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Bradt, D.

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ARO INPUT/OUTPUT CONTROL SYSTEM MAINTENANCE MANUAL

-D. BRADT-

OTTAWA

DECEMBER 1969

ON LOAN
from
National Research Council
Radio & E.E. Division
Document Control Section

ANALYZED

ABSTRACT

This report describes the input/output control system (IOCS) as an integral part of the Algonquin Radio Observatory Data Acquisition and Control System. IOCS runs in a real-time environment and maintains queues for all the standard peripheral devices. This report describes how to modify the programs comprising IOCS in the case of errors or for future expansion of the system.

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*A more detailed description of the IOT format is given in ERB-813 A.R.O. IOCS User's Manual

CHAPTER 1

Introduction

This report is intended for the use of those who wish to modify the existing Input/Output Control System, or to understand more fully the way in which it operates as an integral part of the ARO Data Acquisition and Control System. Users should be familiar with:

ARO Input/Output Control System Users' Manual.

The Physical Environment of the Computer

The ARO Data Acquisition and Control System is located at the Algonquin Radio Observatory, a national facility operated by the National Research Council, Ottawa, Canada. The principal instrument at this site is a 150 foot radio telescope operating at wavelengths as low as 8 millimeters. The size of the telescope, and the wavelength at which it is operated require a positional accuracy of about 15 seconds of arc.

The large radio telescope is a general purpose instrument used by many scientists both from within the National Research Council, and from Canadian and U.S. universities. The telescope itself is a fully steerable paraboloid, 150 feet in diameter, using an alt-azimuth mount. Located at the vertex is a high precision, independently mounted master equatorial unit which is guided from the control building by a remote console. The radio tele-

scope is controlled by the master equatorial unit optically, and acts as a slave to it.

Phase I of the Data Acquisition and Control System involves the acquiring of radiometer data, positional, temporal, and equipment status information; the performing of preliminary calculations on these data; and the writing of all this information on magnetic tape for further processing on a larger computer. Phase I has been implemented and is currently performing satisfactorily. Phase II of the system involves the addition of control software and hardware to allow the computer to control the master equatorial unit, and hence the radio telescope. The implementation of Phase II should involve no software changes to the Input/Output Control System.

The Software Environment of IOCS

The Input/Output Control System (IOCS) of the ARO Data Acquisition and Control System must perform all the Input/Output from/to the standard peripheral units. The software environment in which IOCS operates is described below.

The computer receives timing information and positional information from another computer which is hardwired to drive all the coordinate displays on the control desk. This computer also provides a one millisecond interrupt and seven positional or temporal parameters (Q values). All time dependent processors

(programs) are driven by this millisecond clock and its associated processor. By means of a System Generator program and the Command Language an astronomer constructs tables describing a "scan" or "scan pattern". (A scan pattern is a related group of scans.) Basically a "scan" consists of a start coordinate, a stop coordinate, a sample interval, and a list of quantities to be sampled. Radiometer calibrations may also by inserted at specified points in the scan, and astronomer-written routines may be executed at the taking of each sample and at scan termination.

Any or all of the above programs plus an independent background job make use of IOCS to display messages, or to receive inputs. These messages arrive sporadically during the use of the Data Acquisition and Control System, except at the beginning and end of each "scan" where there tends to be a burst of messages, none of which may be allowed to tie up the system. It was therefore necessary to construct request queues to hold the messages waiting to be output during these peak periods.

Real-Time Considerations

The foremost concern in writing a real-time Input/Output Control System is to maintain the real-time conditions of the system. There must be no halt instructions, no wait loops, and of particular concern here - no I/O waits. All I/O devices must be interrupt driven, with only one I/O operation initiated for each

pass through the I/O handler. All routines controlling I/O devices (handlers) are entered by the interrupt hardware and must save the status of the Central Processing Unit (CPU) upon entrance, and completely restore the CPU status upon exit. This is mandatory for all interrupt driven routines. The status of the CPU consists of:

1) All programmable registers which this interrupt routine will modify.
2) The program counter. (Location counter).
3) The memory protect status.
4) The overflow latch.

In addition, any routine which may be called by processors at different interrupt levels must either be re-entrant, or must be able to suppress the higher interrupt until the lower priority interrupt has finished with the common routine.

Operator/Computer Communication

The command and logging device used for operator/computer communication is an ASR-35 teletypewriter. All operator intentions must be communicated to the computer through keyboard input, and most messages to the operator will be displayed on this printer by the computer. The large volume of this man-machine communication was one of the prime factors influencing the design of IOCS.

It was felt that the operator should not be forced to count characters or columns while keying-in messages with numerical parameters, and that programs using this input should not all have to convert the octal or decimal parameters keyed-in by the operator. On the other hand, programs in the computer requiring the output of status or error messages should not have to individually convert each number to be displayed into a buffer, and then display the buffer as a character string. A requirement for IOCS was therefore that a programmer could output a small array in octal or decimal format with no more coding or effort than that required to output a character string.

This standard I/O conversion available to programs using the teletypes should also be available to the individual I/O handlers for the display of I/O status and error messages. This could be most easily achieved by a complete separation of driver and handler. In this I/O system, the I/O driver NEVER calls any I/O handler. The handler is entered by enabling its unique interrupt. This complete separation allows all I/O handlers to invoke IOCS in the same manner as all other programs.

CHAPTER 2

The Hardware

The computer configuration at the Algonquin Radio Observatory is a SEL 840A Central Processing Unit (CPU) with 12K words of 1.75 μsec core storage. There is an ASR-33 console teletype with two remote ASR-35 teletypes. Each of these teletypes has a separate control unit, and two separate interrupts, which greatly simplifies the software. The system is basically a paper tape system with a 300 char/sec photoelectric paper tape reader, and a 110 char/sec paper tape punch. The high speed paper tape system is used chiefly for program development. There is also a magnetic tape control unit driving two seven-track magnetic tape units. One of these tape units will hold the system tape, and the second tape unit will record the data collected by the system. Data transfer between the computer and magnetic tape is controlled by the Block Transfer Control (BTC). The BTC operates in a cycle stealing mode, and uses one memory cycle for each word transferred.

The analog and discrete inputs and outputs have such a small I/O wait time that it would be inconceivable to use the IOCS driver. These I/O facilities are described in the publication: ARO/DATAC System Maintenance Manual, ERB-815. A complete schematic is given in figure 2-1.

The I/O structure is in the form of a "party-line". All units are connected to the I/O bus and are selected by the unit number present in the I/O instruction. The I/O instructions have

two modes: the wait mode, and the skip mode. In both cases the execution of an I/O instruction causes the unit to be connected to the computer, the unit is tested and the I/O command is executed if the unit is not busy, and then the unit is disconnected from the computer. The entire transfer takes 3 memory cycles. In the wait mode the computer waits for the unit to become free. In the skip mode, the program counter is advanced one location if the I/O command could be executed. It is the latter mode which is used by IOCS.

The creation of system software on the SEL 840A is made much easier by its powerful and versatile interrupt system. The A.R.O. system contains 31 different priority interrupts, each containing three latches. The Enable or E latch is set on by a PIE instruction, and off by a PID instruction. The interrupt will not become active if it is disabled. The Active or A latch is set by the interrupt hardware and indicates which interrupt routine is currently being executed. The Request or R latch is usually set by an external signal. An interrupt becomes active if the R and E latches are both set and there is no higher priority A latch set. When an interrupt becomes active, the instruction at a specified core location (unique for each interrupt) is executed. This core location usually contains a Store Place and Branch (SPB) instruction. In the case of IOCS, an SPB to the I/O handler is stored at this interrupt location.

Any interrupt routine may be interrupted by an interrupt of higher priority. The lower priority routine continues after execution of the higher priority routine. It is therefore necessary that all interrupt routines save the CPU status which they modify and restore the status upon exit.

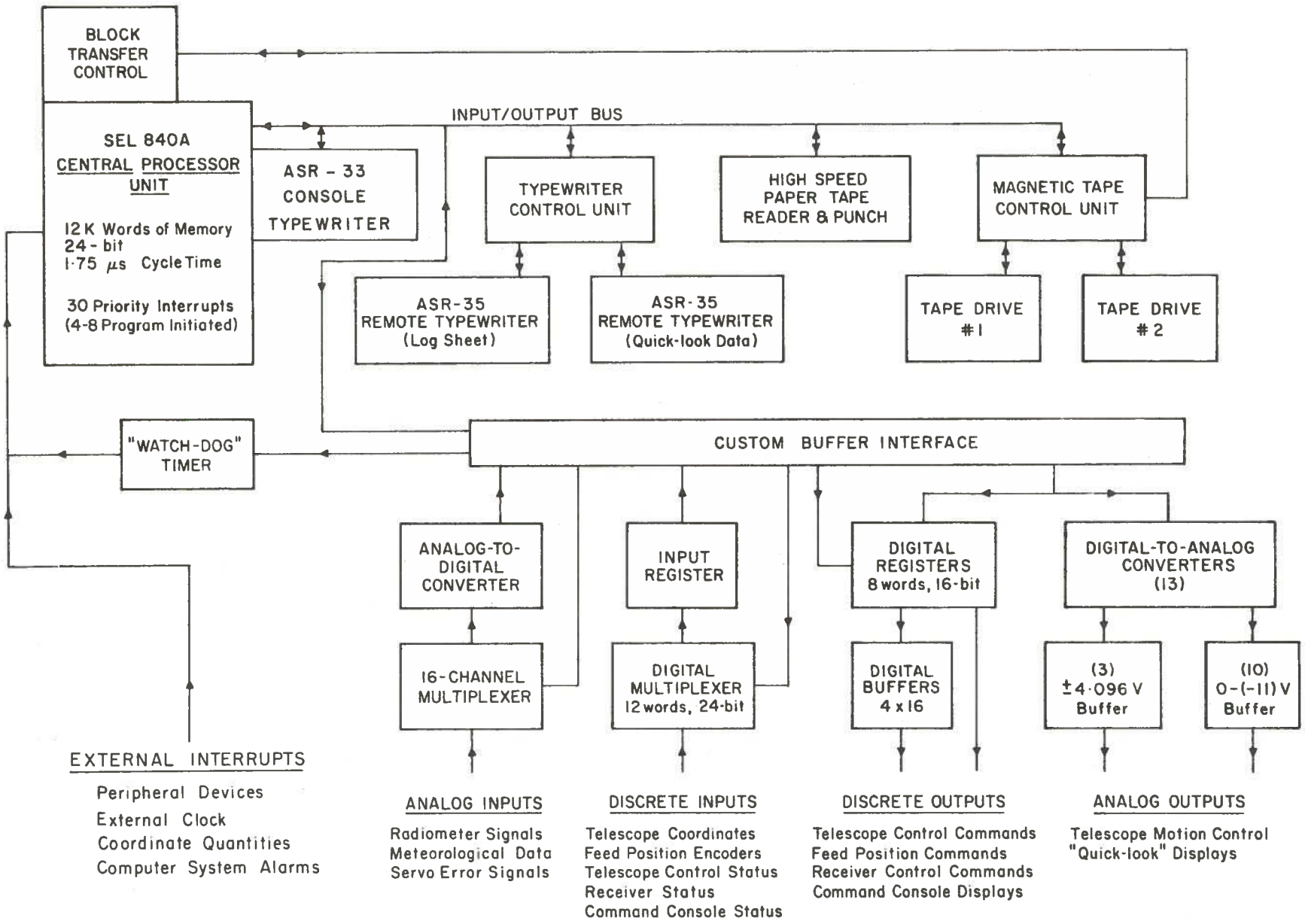


Figure 2-1 Computer system hardware

CHAPTER 3

The I/O Driver and Special Function Routines.

The I/O Driver (IOCS)

The complete separation of driver and handler necessitates the use of tables for internal communication between various parts of IOCS. The user takes part in this table communication by the construction of an I/O Table (IOT) to completely describe his I/O request. (See Appendices B, C and D). The only part of the I/O Table used by the I/O driver is the first word. The format of this word is identical for all types of Input/Output Tables and for all devices.

The logical unit number contained in the first word of the IOT is used as an index to the Logical Device Table (LDT). The LDT is described in Appendix I. The entry in the LDT is the address of the Device Control Table (DCT) corresponding to the specified logical unit number. The format of the individual Device Control Tables is described in Appendices F, G, and H. The DCT contains a description of the physical characteristics of the device, and the I/O request queue for that device. The I/O driver then uses the queue pointers (Appendix E) in the DCT to enter the request (IOT address) in the queue, enables the interrupt specified in the DCT, and, if necessary, performs some action which will set the request latch of the interrupt. This sequence is shown in figure 3.1 and 3.2.

The interrupt hardware completely supervises each handler. As each device is finished its task and is free for another

character, word or record (device dependent), the request latch is set by the hardware. The setting of the request latch will cause the handler to be executed. This sequence will continue until the I/O request queue for the device is empty. Each device has its own individual interrupt priority, and therefore each device is able to operate simultaneously, and at its full rate.

The Background User

The memory protect hardware of the SEL 840A allows one level of memory protection only. Each core location contains a protect bit indicating whether it is protected (foreground) or unprotected (background). The Data Acquisition Monitor is located at the bottom of core, and the background user has any core remaining at the top of memory. An instruction trap interrupt also prevents the background user from changing these protect bits, modifying any interrupt status, or using any I/O instructions directly.

The Monitor is set up such that the background user calls IOCS directly. This action will cause a memory protect interrupt to be raised. The memory protect interrupt routine will then check to determine if the violation was a CALL IOCS. If it was, a check is made to see if the IOT address is in the background, and if so - the CALL IOCS is re-issued. Control is then returned to the background routine. The I/O driver (IOCS) is the only portion of the IOCS which the background is permitted to use.

Special Function Routines

In addition to the standard I/O driver entry point

(IOCS), IOCS has some special function routines. These routines are used to prevent the background program from using certain devices, or to release devices to it. Various initialization routines are also available to set up devices, reset queues, and to describe the Command Language IOTs to be used. These routines are available to foreground users only.

1) Initialization Routine

This routine initializes all the teletype and paper tape devices. All typewriters are set to keyboard mode, and all input interrupts are enabled. This routine is called by IO$PRG, and must be called by the Command Language if a teletype is turned from off-line to on-line. This routine may be invoked any time during the operation of the data acquisition system.

The calling sequence is:

CALL IO$ITL for a resident monitor routine.

or

LIX = -2,3 for a non-resident

SPB $IOCS,3 foreground routine.

A, B and XR1 are modified and not restored by this routine.

2) Assign Routine

This routine is used by foreground routines to re-assign devices. A complete list of available

devices is always present in the Standard Device Table (SDT - see Appendix I). Logical device J in the SDT will replace logical device I in the Logical Device Table (LDT). The calling sequence is:

```
LIX    I,1
LIX    J,2
CALL   IO$ASN for a resident monitor routine.
```

or

```
LIX    I,1
LIX    J,2
LIX    = -4,3
SPB    $IOCS,3 for a non-resident foreground
                routine.
```

A, XR1, and XR2 are modified and not restored by this routine.

3) Inhibit Routine

This routine will inhibit background jobs from using logical device I. I/O requests already in the queue are unaffected. The calling sequence is:

```
LIX    I,1
CALL   IO$NHB for a resident monitor routine.
```

or

```
LIX    I,1
LIX    = -6,3 for a non-resident foreground
SPB    $IOCS,3                    routine.
```

A and XR1 are modified and not restored.

4) Release Routine

This routine will release logical device I to background jobs. The calling sequence is:

```
LIX   I,1
CALL  IO$RLS for a resident monitor routine.
```

or

```
LIX   I,1
LIX   = -8,3
SPB   $IOCS,3 for a non-resident foreground
                routine.
```

A and XR1 are modified and not restored.

5) Purge Routine

This routine is the main IOCS initialization routine and must be invoked at system startup. The Logical Device Table is created as an exact copy of the Standard Device Table (erasing all previous device re-assignments). The last two entries in each Device Control Table (DCT) are set to zero. The queue pointers in each DCT are set to the beginning of the queue. Each IOT address encountered in a queue is removed, after first resetting the queue bits in the first word of the IOT. The LDT is then modified to include the command and logging devices as set by control switches 18-23 on the computer console. The background device setting is in switches 18-20, and the foreground device setting is in

switches 21-23. The following settings are used for both foreground and background:

0 standard setting as specified in the standard device table.

1 Console teletype (ASR - 33).

2 Remote teletype (unit '10).

3 Remote teletype (unit '15).

4 Input from console teletype, Output onto high speed paper tape punch.

5 Input from remote teletype (unit '10), Output onto high speed paper tape punch.

The Purge Routine then invokes the initialization routine (IO$ITL) and returns to the calling program. The only time this routine may be invoked is at system startup. The calling sequence is:

```
    CALL   IO$PRG
or  LIX    = -10,3
    SPB    $IOCS,3
```

A,B,XR1,XR2, and XR3 are modified and not restored.

6) Foreground Command Setup Routine

This routine should be called by the Command Language Initialization Routine. The routine I$FIOT places the special IOT address (FIOT) in the Device Control Table of the foreground command device. All input messages beginning with a slash (/) will be directed to this IOT by the I/O handler regardless of the number of requests already present in the

input queue. The slash itself is discarded and does not enter the input stream converted by the IOT.

The following example of a Foreground Command IOT interprets the input as a four-letter mnemonic followed by up to ten decimal numbers typed in free-form format.

```
α-1     LAA FIOT          }
α       CALL I$FIOT       }     in-line
α+1                       }

                .
                .
                .

FIOT    DAC *+1           }
        DATA '34          }
        ZZZ 1             }
        DAC FBUF          }     out-of-line
        ZZZ* 10,Z         }
        DAC FBUF+1        }
FBUF    BSS 11            }
```

Return is to α+1

XR1 is modified and not restored.

7) Background Command Setup Routine

This routine should be called by the Command Language Initialization Routine if a background job is to be allowed. The routine I$BIOT places the

special IOT address (BIOT) in the Device Control Table of the background Command device.

All input messages beginning with a slash (/) will be directed to this IOT regardless of the number of requests already present in the input queue. The slash character is not retained. The following example of a Background Command IOT interprets the input as a four-letter mnemonic followed by up to ten octal numbers typed in free-form format.

```
α-1     LAA    BIOT      }
α       CALL   I$BIOT    }      in-line
α+1                       }
                .
                .
                .
BIOT    DAC    *+1       }
        DATA   '35       }
        ZZZ    1         }
        DAC    BBUF      }      out-of-line
        ZZZ*   10,1      }
        DAC    BBUF+1    }
BBUF    BSS    11        }
```

Return is to α+1.

XR1 is modified and not restored.

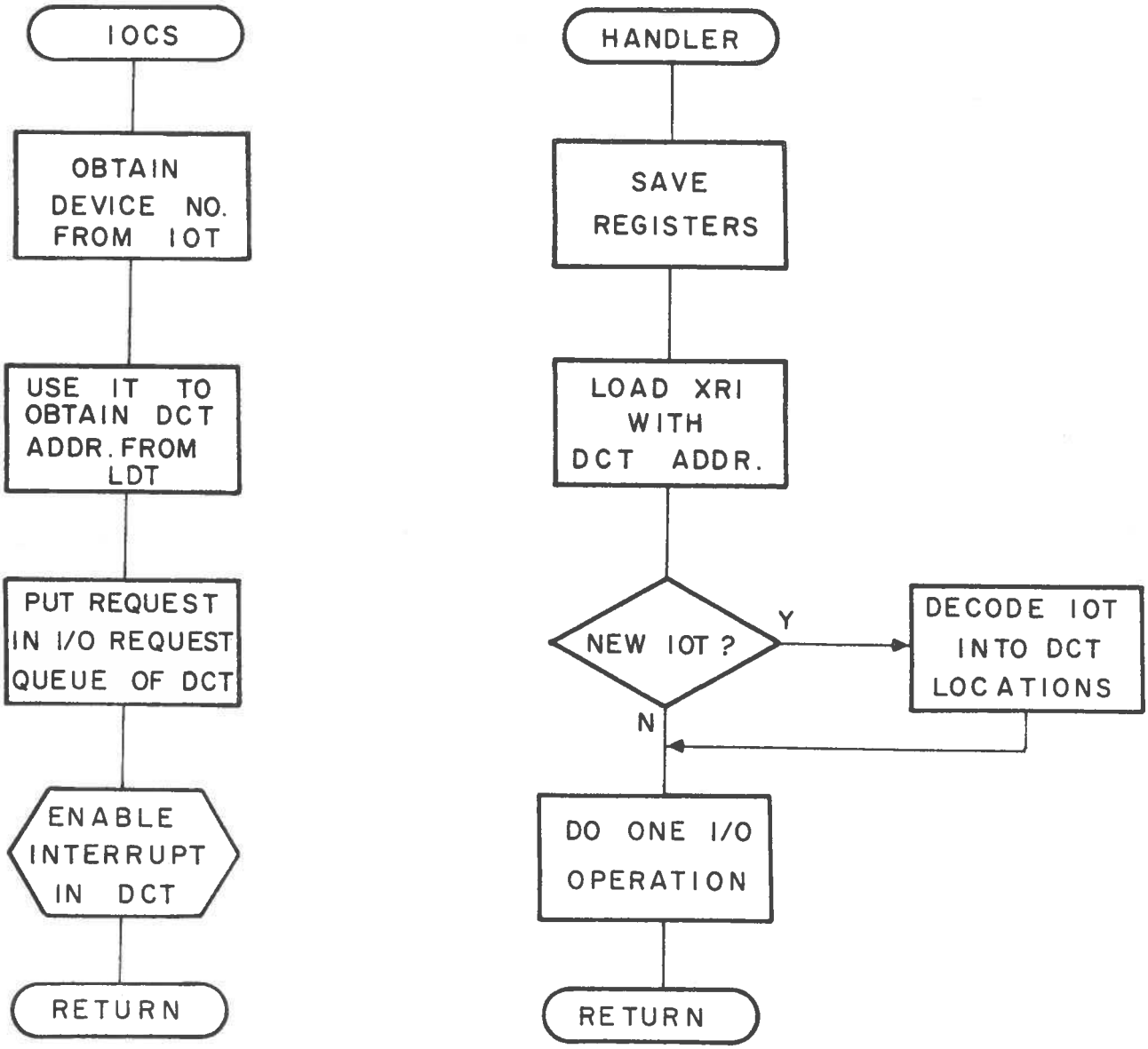


Figure 3-1 Simplified flowchart

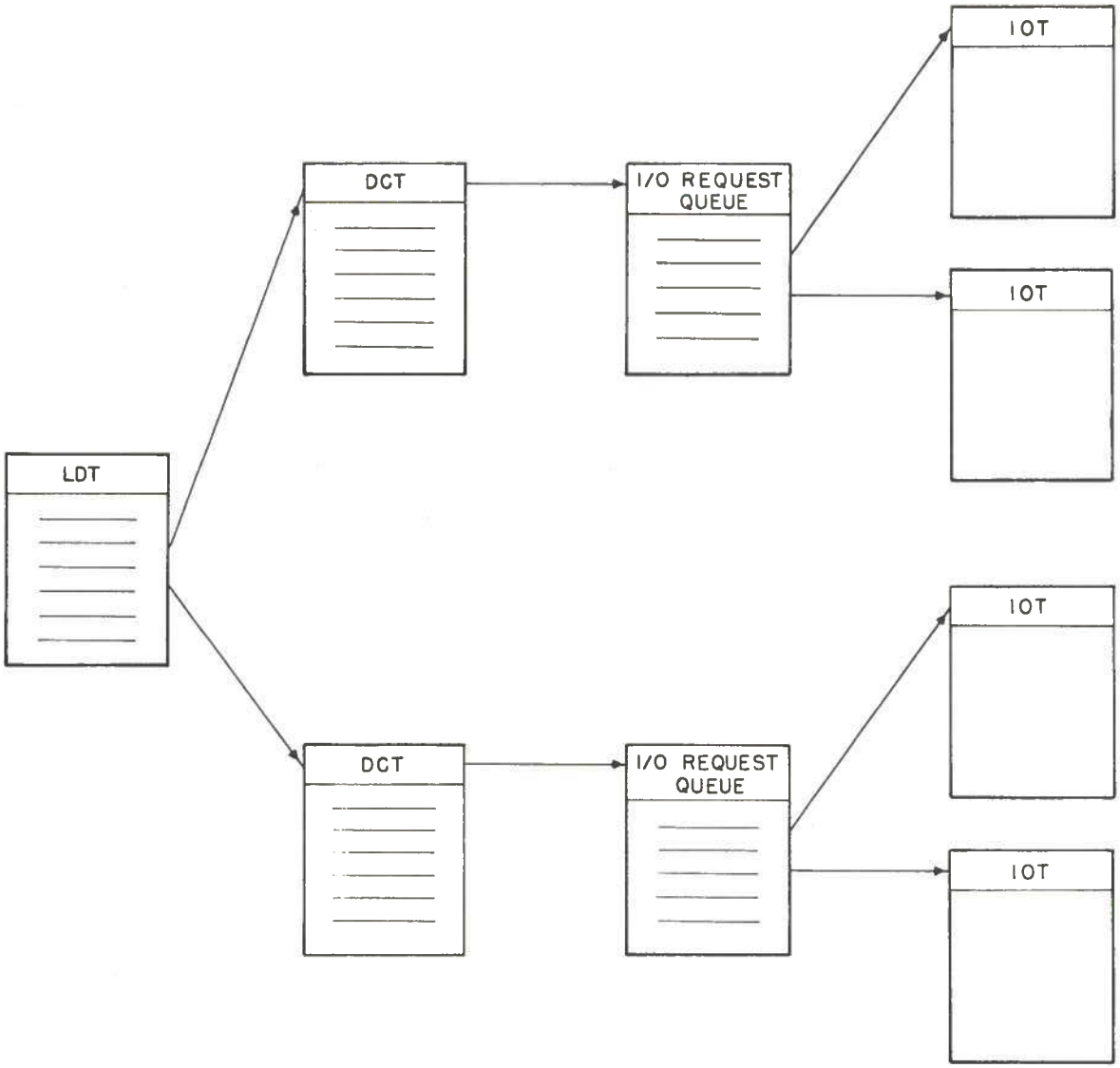


Figure 3-2 IOCS table structure

Chapter 4

The Teletype and Paper Tape Handler.

The Prehandler

The same coding is used for the I/O handler controlling the three teletype units and the high speed paper tape units. In all four cases both the input and the output sections of the unit have their own interrupt levels, and function as independent units. The only dependence between the input and output units (keyboard and printer) of a teletype is that characters input from the keyboard should be output as soon as possible on the corresponding printer.

The input handler has the external name I$TKO1. For all eight units there is a "prehandler", which is the routine to which control is passed by the interrupt hardware. The return address (the program counter before the interrupt) is stored at the entry point of the prehandler by the SPB instruction at the interrupt address. The first two index registers are saved in the Device Control Table (DCT) and the address of the DCT is loaded into index register one. Control is then passed to either I$KYO1 or I$TYO1 where the A and B registers are saved in the DCT. The return address to the prehandler is a permanent entry in the DCT. The I/O handler (I$KYO1 or I$TYO1) then inputs or outputs a character modifying only locations in the DCT, or locations pointed to by the DCT. The handler itself is re-entrant and may be interrupted at any point.

An alternate paper tape prehandler has been written which accepts either five level paper tape or eight level paper tape as input on the high speed paper tape reader. For five level

tape this prehandler inputs the character, masks off the upper three bits and uses the result as an index to a code table. The character from the code table is the eight level Ascii equivalent and is used as the input character by branching to I$KY01 just after the input instruction. The code table used is shown in table 4-1. The routine I$LEV5 or I$LEV8 must be invoked to initially set up the interrupt locations for either the 5 level or 8 level entry point of the prehandler.

Adding Another Teletype or Paper Tape Unit

An additional teletype or paper tape unit may easily be added to the system by writing a prehandler for the device. This prehandler may be copied from the original with only the following changes:

1) The four external names will have to be different.
2) INTL will have to be set for the proper interrupt level (input).
3) ONTL will have to be set for the proper interrupt level (output).
4) INTG will have to be set for the proper interrupt group.
5) DEVN must specify the physical device number.

The rest of the coding may remain the same. Each new device must have a unique interrupt level for both input and output. A device other than a standard ASR-33, ASR-35 or SEL high speed paper tape unit may also be added to the system. This prehandler can have a table lookup and conversion similar to the alternate paper tape prehandler for five level tape. Some entries in the DCT (e.g. AIP,

AOP, CEU) may have to be changed to an SPB to special purpose routines in this case.

The Special Command IOT

The first character of every input is compared to a special character (/). A character is assumed to be the first character of an input if the current IOT address is zero, or if the execution bit of the current IOT is off. The special character used to begin commands may be changed from a slash to any other character by changing the statement "SLSH EQU *+'120" in the literal pool definitions. When a slash is detected, the slash is set to zero so it will be ignored, the special IOT is decoded instead of the IOT pointed to by The Execution Pointer, and the Special IOT bit is set so that the I/O request queue will not be reset at the termination of the input. This special IOT is then decoded and executed similarly to any other IOT. The basic difference between the special IOT and the other IOT is that the special command IOT never passes through the I/O Driver (IOCS) but is a permanently outstanding request. For this reason the "In Queue" bit in the IOT is never set. A special Command IOT must be tested for completion by the setting of the third Q bit (bit 2 in the first word of the IOT).

The Absolute Load/Dump Routine

The teletype and paper tape handler contains an absolute load routine and an absolute dump routine. The use of these routines is checked for as near as possible to the beginning of the handler. All of the 256 different bit combinations are valid characters for these routines and hence control must be passed to them before any character checking is done. The absolute load or absolute dump

routine is invoked by using a special IOT to describe the I/O. (See Appendix B and Appendix C, in particular figures B-2 and C-2).

Since only one character may be input or output during each pass through the handler there is a need for special flags which may be tested, and then a branch to the proper place in the routine. The flags MODE, XR4, and XR5 are used by the absolute load/dump routine and are described with the other entries of the DCT.

The format of the absolute tape is identical to the tape produced by the SEL 840A Absolute Dump Routine. It consists of:

1) about 12 inches of leader;
2) an initial character with all the holes punched ('377).
3) The base address of the absolute load module being dumped. This address is 24 bits in length and occupies three characters on the tape.
4) The negative word count. This is the length in words of the absolute load module being dumped negated (2's complement notation). This value is 24 bits in length and occupies three characters on the tape.
5) The Absolute Load Module in '100 word blocks, each word occupying three characters on tape. Each '100 word block is followed by a checksum word (three characters long) formed by adding together each word in the '100 word block and neglecting overflow.

Step 5 is repeated until the entire module has been output. The user must output his own leader and trailer by using a different IOT and specifying the leader operation.

ADDRESS CHECKING:

Since all input and output by background programs is controlled by IOCS, there must be some check to ensure that background programs do not inadvertantly destroy portions of foreground routines by overwriting them. IOCS itself is entirely foreground resident and is able to direct input to any portion of core storage. Software checking is therefore the only method which will protect the foreground program.

Background I/O requests are trapped by the memory protect routine and passed on to IOCS only if the IOT address is in the background. The routine CHEK is used by the input handler to ensure that the background user's data area is on the same side of the B/G - F/G partition as the IOT address. Since the SEL 840A has address wrap-around it is also necessary to check that his final data address is not in the foreground area. The return code from CHEK is:

A = 0 for no errors

A = -1 for an address violation.

The external name I$XXXX points to the core location containing LAA = -1 to indicate a memory protect violation. This instruction may be changed to CLA for debugging a test system with added background capabilities.

THE LOW PRIORITY QUEUE:

Characters being input from a teletype keyboard must also be output on the printer of that teletype by the I/O handler,

with no interference to the output being directed to that device. In addition, since the keyboard and printer are separate devices, the use of one must not be allowed to interfere with the availability of the other. It was decided that output from the computer would have priority over the output of characters being keyed-in by an operator, but it was imperative that the operator would still be able to key-in a message while the printer was busy. The Input Handler, instead of performing a direct output of characters input, places them in a low priority queue using the routine ELPQ. The associated output handler works on the I/O request queue, until all entries have been exhausted. The low priority queue is then checked for non-zero characters, and any non-zero characters are output. This sequence continues until an entry in the I/O request queue pre-empts the low priority queue, or until the low priority queue is empty.

The action of striking a key on the keyboard or the computer requesting an output will re-enable the interrupt. In most cases, the printer is available, and the character is output with no noticeable delay. The usual input keyed-in while the printer is busy is a command to stop the printer output.

The LPQ is similar to the I/O request queue in structure. There are four queue pointers: execution, entry, start and end, used to maintain the circular queue. Each entry in the queue is a left justified ASCII character, which is zeroed when printed. Each LPQ holds ten characters, any further input is interpreted in the usual manner by the input handler, but is not output.

ERROR MESSAGE GENERATION:

The teletype and paper tape handler, being completely

separate from the I/O driver (IOCS), is able to make use of the full facilities of IOCS for error message generation. The I/O handler contains a number of error message IOTs which are used upon the detection of certain error conditions. These error messages are described in Appendix L. In order to conserve core storage, the error message IOT's are not duplicated prior to output. The I/O handler is re-entrant and there is the possibility that two similar error conditions will arise during the length of time needed to output the error message. If such a condition arises, the second error message will be lost, and the first error message will be modified slightly if the IOT address or data address is being displayed. The probability of this happening is very slight with only two core partitions.

The Teletype and Paper Tape Device Control Table:

All I/O handlers use a Device Control Table (DCT) for storage of intermediate results. The address of the DCT is kept in index register one during all phases of execution of the handler. The following are the DCT entries for teletype and paper tape I/O.

DCT-4	SAVA	The word in which the contents of the A register are saved upon entry to the handler.
DCT-3	SAVB	The word in which the contents of the B register are saved upon entry to the handler.
DCT-2	SXR1	The word in which the contents of index register one are saved upon entry to the prehandler.
DCT-1	SXR2	The word in which the contents of index register two are saved upon entry to the prehandler.
DCT+0	XPTR	The execution pointer in the I/O request queue. See Appendix E.

DCT+1	NPTR	The pointer for the next available entry in the I/O request queue.
DCT+2	ASTQ	The address of the start of the I/O request queue.
DCT+3	AEDQ	The address of the end of the I/O request queue.
DCT+4	NOP	This is an instruction which will set the request latch for this interrupt level. It is an NOP for teletype output, and an SPB to TONR for teletype input. (TONR switches the teletype to reader mode if the device specified is paper tape). An SPB to TPN1 for the high speed paper tape reader to enable the reader.
DCT+5	PIE	This is an instruction to enable the interrupt associated with the device. It is also used to create a PID instruction by the output handler to turn itself off when the contents of the I/O request queue have been exhausted.
DCT+6	LPQ	The address of the low priority queue or character queue. This queue contains the characters that have been keyed-in and are to be output. A zero entry indicates that there is no LPQ, and characters input are not to be typed or punched.
DCT+7	FRMT	This word contains the conversion format for both input and output. The values are: -1 Tascii 0 Octal +1 Decimal. FRMT is set by the routine DDDW within the I/O handler.

DCT+8 FCC — The Full Character Count. This word contains the negative field width of an output word or the negative maximum permitted field width for input. The values are:

-4 Tascii

-8 Octal

-8 Decimal

DCT+9 CCC — The Current Character Count. This field is incremented for each valid character input or output. Its initial value is equal to FCC. When CCC = 0, the next word for output is placed in the CCB or for input the CCB is stored at the data address.

DCT+10 FWC — The Full Word Count. This word contains the number of words to be output or the maximum number of words to be input for this DDW. It is set by the subroutine DDDW (Decode DDW).

DCT+11 CWC — The Current Word Count field is incremented from 0 to a maximum value of FWC. When CWC = FWC the next DDW is decoded. If this is the last DDW, the input or output is terminated. An Input is terminated by changing the current character to a carriage return and branching to the beginning of the handler.

DCT+12 DADR — The Data Address. This field is set initially by the routine DDDW and is incremented each time CWC is incremented. It points to the word being

output, or the address at which the word now being input is to be stored.

DCT+13	CCB	The Current Character Buffer. This word contains the partially converted word for both output and input. For output it is loaded initially by DDDW, and reloaded each time CCC = 0. For input it is zeroed initially, and stored at the address pointed to by DADR each time CCC = 0.
DCT+14	DDWP	The Data Double Word Pointer is initially set to the address of the first DDW of the current IOT. It is incremented each time DDDW is entered.
DCT+15	TEMP or RETN	This word is used for temporary storage by various parts of the handler. It is used to hold the return address for re-entrant subroutines within the handler and to hold computer-built instructions which are then executed by an EXU instruction.
DCT+16	SIOT	This word contains the special IOT address for Command Language for an input DCT. This word is set by the routine I$FIOT or I$BIOT and is not used by the output handler.
DCT+17	RTAD	The Return Address to the Prehandler. This location is never modified.
DCT+18	AIP AOP	This location contains the I/O instruction to be used by the handler for input or output.
DCT+19	CEU	This location contains the CEU instruction to be used by the handler.
DCT+20	CHAR or OUTC	This location contains the character just input (left justified) or the character to be output.

DCT+21 IOTA The Address of the IOT now being executed.

DCT+22 STAT A status word for both the input and output handlers. It contains various single bit flags:

0 = Off

1 = On

bit 0 Absolute Load Flag - branch to the resident absolute loader upon entry to I$KY01.

bit 1 Special IOT flag - the IOT now being executed is the special command language IOT. The queue should not be updated at the termination of this input.

bit 2 Reader Mode Flag - the current input is using the paper tape reader of a teletype unit.

bit 3 Minus sign Flag - A minus sign has been typed for the decimal number now being input.

bit 4 Last DDW flag - The DDW currently being executed is the last DDW in this IOT.

bit 5 Immediate Data Flag - this output DDW specified immediate data.

bit 6 Binary Output Flag - the IOT currently being executed specifies binary output.

bit 8 This output message should not be terminated by a carriage return, line feed.

bit 9 The operation specified is a punch power off command for the high speed paper tape unit.

bit 10 Absolute Dump Flag - control should be passed to the resident absolute dump routine.

bit 11 Leader Flag - this operation specifies leader. The IOT is executed normally except that the output character is changed to leader just prior to output.

bit 15 Output a carriage return immediately.

bit 16 Output a line feed immediately and terminate the I/O request.

Some of the DCT entries have alternate uses when the absolute load/dump routine is being used. These uses are:

DCT+7 MODE The type of I/O being performed by the resident load/dump routine.

Absolute Loader:

MODE=-2 while reading leader. Set to -1 when '377 detected.

=-1 while reading start address. Set to 0 after three characters.

= 0 while reading negative word count. Set to 1 after three characters.

= 1 while reading a '100 word block. Set to 2 after '100 words.

= 2 while reading checksum. Set to 1 after three characters.

Absolute Dump Routine:

MODE=-2 Initially and while punching '377. Set to -1 after '377 is punched.

=-1 while punching data address. Set to 0 after three characters.

= 0 while punching negative word count. Set to one after three characters.

= 1 while punching a '100 word block. Set to 2 after '100 words.

= 2 while punching checksum. Set to 1 after three characters.

DCT+8	XR4	A character counter varying from -3 to 0. The absolute load/dump format packs three characters into a word.
DCT+9	XR5	A word counter varying from -'100 to 0.
DCT+10	NWDC	The Negative Word Count. Read from the tape by the absolute load routine, or obtained from the IOT by the absolute dump routine.
DCT+11	CKSM	The CHECKSUM is formed by adding together each word in the '100 word block and neglecting overflow.

TABLE 4-1

ASCII EQUIVALENTS OF 5-LEVEL CODE

Code	Letter Mode	Ascii	Figure Mode	Ascii	
00	leader	000	leader	000	
01	T	324	5	265	
02	C/R	215	C/R	215	
03	O(letter)	317	9	271	
04	space	240	space	240	
05	H	310		336	(↑)
06	N	316	,	254	
07	M	315	.	256	
10	L/F	212	L/F	212	
11	L	314	)	251	
12	R	322	4	264	
13	G	307		252	(*)
14	I	311	8	270	
15	P	320	0(number)	260	
16	C	303	:	272	
17	V	326	=	275	
20	E	305	3	263	
21	Z	332	&	253	
22	D	304	$	244	($)
23	B	302	?	277	
24	S	323	'	247	
25	Y	331	6	266	
26	F	306		244	($)
27	X	330	/	257	
30	A	301	-	255	
31	W	327	2	262	
32	J	312	bell	207	
33	figure	377	figure	377	
34	U	325	7	267	
35	Q	321	1	261	
36	K	313	(	250	
37	letter	377	letter	377	

CHAPTER 5

MAGNETIC TAPE I/O HANDLER

The magnetic tape I/O handler contrcls and supervises all magnetic tape operations from the Monitor and Data Acquisition Routines. The routine is not re-entrant since a control unit may supervise only one tape drive at any one time, and there is only one tape control unit in the configuration. The handler is written in the form of many small general purpose subroutines which are used for all the tape operations. This method of coding produces a very straightforward, easy-to-modify program, but at a slight cost of core storage.

The basic magnetic tape handler has two priorities of tape units, and can control up to eight units. The dual priority is accomplished by having two Device Control Tables (DCTs) and by always checking the highest priority DCT first. By assigning the data tape the highest priority, data output may be interleaved with more complex system tape operations.

The magnetic tape units are not available to background programs and hence no address checking is performed. A hardware design fault causes the computer to revert to an I/O wait condition if a tape drive is addressed which is not in remote mode, or if there is no tape drive set to the selected unit number. Even the stall alarm will not pull the CPU out of this wait condition, and therefore the background user is not given this opportunity to tie up the system.

Adding Macro-Operations

Because of the modular nature of the magnetic tape handler,

and the fact that each routine incorporates an I/O wait, macro-operations may be constructed within the handler. These macro-operations are given an operation code, and an entry in the operation branch table. The macro-operation will usually consist of a branch to one or more existing routines. An example of a macro-operation is Operation 03 - Rewind File.

Subroutines Driven by the Operation Table

The operation field and unit field of the IOT are decoded into the DCT. The drive selected is connected to the control unit if possible, and the operation is used as an index to the operation table. One of the following subroutines is invoked.

OPERATION 01 - Read a block and attempt error correction.

This subroutine reads the next sequential record from magnetic tape via the basic input routine READ. A parity error will cause up to five error correction attempts. The test routines are invoked to check for status or error conditions, and then the number of words input is obtained from the BTC. If the error correction attempts were unsuccessful, an error message is generated. The error correction consists of a backspace record followed by a read attempt.

OPERATION 02 - Write a block and attempt error correction.

This subroutine outputs a block onto magnetic tape using the basic output routine WRIT. A parity error will cause up to five error correction attempts, each attempt consisting of a backspace record, erase gap, and a write record. If the error correction is unsuccessful an error message is generated, and the parity error bit set on in the error word. The presence of a

write ring is checked (RNGT) prior to the output, and the end-of-tape test (EOTT) routine is invoked after the output.

OPERATION 03 - Rewind File.

This subroutine will backspace the tape one file, if the tape is not at the load point, and then advance over the file mark if the tape is not at the load point after the backspace file operation. The routine is re-entrant because of the possibility of being interrupted between the two operations.

OPERATION 04 - Rewind the tape.

This subroutine will rewind the tape to the load point. The backspace inhibit test routine is invoked to ensure that this is not the data tape. If the tape is positioned at the load point, a no - operation results. The rewind operation requires the presence of the unit number, which is obtained from the set mode (STMD) subroutine. The rewinding bit is set in the status word if it is necessary to perform the rewind.

OPERATION 05 - Backspace file.

This routine backspaces the tape one file if the backspace inhibit latch is not turned on, or if the tape is not positioned at the load point.

OPERATION 06 - Advance file.

This subroutine will advance the tape just past the next end-of-file mark.

OPERATION 07 - Write end-of-file.

This subroutine will write an end-of-file mark on the drive connected to the control unit. The absence of a write ring will terminate the operation.

OPERATION 10 - Backspace Record and Test.

This subroutine will backspace the selected tape one record if the tape is not positioned at the load point. If the record was an end-of-file mark, the tape is forward spaced over it. The basic backspace record routine (BSPR) is used.

OPERATION 11 - Advance Record and Test.

This subroutine will advance the tape one record. If the record was an end-of-file mark, the tape is backspaced over it. Operation 10 and 11 always leave the tape in the same file.

OPERATION 12 - Erase Gap.

This subroutine will erase four inches of tape. This operation is usually used during output error correction to space over a bad section of tape. The absence of a write ring will terminate this operation.

OPERATION 14 - Set Mode (SETM).

This subroutine replaces the entry in the mode table specified by the unit field by the contents of the second word of the IOT. The tape control unit is not addressed, and this routine should not be confused with the routine STMD which connects the tape drive to the control unit. SETM specifies the way in which a unit should be set up if it is ever used in the future.

Operations 13, 15, 16 and 17 are illegal using the basic magnetic tape handler and generate an error message if used.

READ - Basic Read Routine.

This subroutine sets up the BTC locations ('60 and '61) using the routine DDDW (Decode DDW) and initializes the block transfer. The BTC interrupt routine (BTCR) keeps resetting the

interrupt locations for as many DDWs as are present in the IOT.

WRIT - Basic Write Routine.

This subroutine is the output equivalent of READ. The absence of a write ring will terminate the operation. The BTC locations are set up by the routine DDDW and an output block transfer is initialized.

DDDW - Decode Data Double Word.

This subroutine is used by the READ, WRIT, and BTCR routines to set up the two BTC locations. The DDW pointer (DDWP) points to the last word of the previous DDW or to the IOT address (IOTA) upon entrance. This routine decodes a DDW into locations '60 and '61 and also into the DCT. At exit the DDW pointer is pointing at the last word of the decoded DDW.

The last DDW is recognized by the sign bit in the first word of the DDW. This is also the bit used by the BTC hardware to terminate the block transfer.

CHKQ - Check I/O Request Queue.

This subroutine checks the status of the DCT whose address is in index register one, and returns only if there is nothing to do. A unit whose rewind bit is set in the status word is connected and tested for completion of the rewind. Control is returned to the calling point if the unit is still busy. The wait word (WATF) in the DCT is checked. If this word is non-zero it contains the address of the waiting routine, and control is returned to this routine, and the wait flag set to zero. If there was no I/O wait, the I/O request queue is checked for non-zero entries. If the I/O request queue is empty, control is returned to the

calling point. If there is an entry, the first word of the IOT is decoded into the DCT and the proper operation initiated. The priorities of units or DCTs is determined by the order in which DCTs are passed to this routine.

DCW1 - Decode first word of IOT.

This subroutine decodes the first word of an IOT into the DCT and initializes the DCT for the new IOT. The DDW pointer is set equal to the IOT address, and the execution bit of the IOT is turned on. The unit number is put in the location PUNN in the DCT, and the number of error correction attempts set to five. The error word is initialized and control is returned with the operation (masked to four bits) in index register three.

ADVR - Advance Record.

This subroutine advances the tape on the selected unit one record and waits for the completion of the operation. This routine is used by ADVT (operation 11). The tape control unit status must be checked immediately on return.

BSPR - Backspace Record.

This subroutine uses the backspace inhibit logic to determine if this is the first backspace. If more than one consecutive backspace has been attempted, the operation is terminated with an error message and an error return code. If this will be the first backspace, or if the backspace inhibit option is not enabled a backspace operation is performed. This routine is used by the routine BRAT (operation 10).

STMD - Set Mode.

This routine is invoked by CHKQ, and connects the

drive specified by PUNN to the magnetic tape control unit. The drive is set up according to the corresponding entry in the mode table (MDWD).

BTCR - BTC Interrupt Routine.

This routine is branched to by the interrupt hardware when the BTC is ready to accept a new word count and data address in the BTC locations. Following a BTC initialization by READ or WRIT, the next two memory cycles are used by the BTC to obtain the contents of locations '60 and '61. If bit zero is set on in the word count (location '61), the BTC will terminate after the specified block transfer has been completed. If this bit is not set, another base address and word count are obtained from the BTC locations, a BTC interrupt is generated, and this routine is invoked. The sole purpose of this routine is to check whether there is another DDW present, and if so, call DDDW to reset the BTC locations. In this manner, successive DDWs are written as one record by the WRIT routine or one record is spread out among successive DDWs by the INPT routine. The BTC hardware thus allows "gather read" and "scatter write" operations to be performed quite simply. The BTC interrupt routine does not have to be serviced between successive words unless the word count of a DDW is one. The READ and WRIT routines set up the next BTC immediately after initializing the first transfer.

Wait Routines

The Basic Magnetic Tape Handler contains three different wait routines. Each Device Control Table has a priority associated with it, determined by its order in the coding at the

entrance to the magnetic tape handler (MG01). The routine WAIT saves a return address at location WATF in the DCT. Processing for the I/O request queue associated with this DCT is halted until the I/O has been completed, although if the control unit is free, another I/O request queue may become active and processing may continue using another tape drive. The extended magnetic tape handler uses this routine extensively for system tape searching. Higher priority data tape requests are performed between the searching operations on the system tape.

The second type of wait routine (WAST - Wait for Status) halts all tape processing until the I/O has been completed. This wait routine is used whenever the control unit status must be checked at the end of an operation. This wait routine has the highest priority.

Test Routines

The following routines within the magnetic tape handler test for error or status conditions in the control unit. The TEU (Test External Unit) has no unit select bits and tests whichever drive is connected to the control unit. One important point to remember is that a CEU (Command External Unit) will reset some of the status bits, so that all testing following a read or write operation must be done before obtaining the word count from the BTC (Block Transfer Control).

EOFT - End-of-File Test.

The unit already connected is tested for an end-of-file condition. If the condition is true, the end-of-file bit is set on in the error word, and optionally an error message is

generated.

Calling sequence: α SPB EOFT

$\alpha + 1$

$\alpha + 2$

Return is to $\alpha + 1$ if there is no end-of-file condition.

Return is to $\alpha + 2$ if there is an end-of-file condition.

EOTT - End-of-Tape Test.

The unit already connected is tested for an end-of-tape condition. If the condition is true, the end-of-tape bit is set in the error word, and an end-of-tape error message is generated. A number of bell rings is incorporated in this error message to warn the operator that the data tape is full.

OVFT - Overflow Test

The unit already connected is tested for the overflow condition. This condition occurs only during input when the record on tape is longer than the buffer area provided. Data transmission is terminated when the buffer is full, and the tape advances to the next inter-record gap.

RNGT - Write Ring Test

The unit already connected is tested for the presence of a write ring. This test is made prior to write, write end-of-file, and erase gap commands. Control is returned only if there is a write ring present. If there is no ring present, the no-write-ring bit is set in the error word, an error message is generated, and the operation is terminated.

PART - Parity Error Test

The unit already connected is tested for a read or write parity error.

Calling Sequence α SPB PART

$\alpha + 1$

$\alpha + 2$

$\alpha + 3$

Return is to $\alpha + 1$ for no parity error. If a parity error is detected, the error counter is incremented and control returned to $\alpha + 2$ for error correction. If the error counter reaches zero, a terminal error is assumed. In this case the parity bit is set in the error word and control is returned to $\alpha + 3$.

BSPT - Backspace Inhibit Test.

The tape units have been wired with a special option to prevent inadvertent backspaces or rewinds of the data tape. With this option enabled it is physically impossible to execute a rewind or backspace file, and one backspace record is permitted if it is followed by a forward motion operation. This single backspace permits the attempted correction of parity errors. This routine tests the unit selected to determine if the option is enabled. This routine is used only by the rewind, backspace file, and a second pass through the backspace record routine. If the option is not enabled, return is to $\alpha + 1$, otherwise the backspace inhibit bit is set in the error word, and the operation is terminated.

BUST - Busy Test.

The unit selected is tested to determine if it is available to receive commands. The unit busy and unit rewinding

tests are both applied. Return is to $\alpha + 1$ if the unit is not available. Return is to $\alpha + 2$ if the unit is available. If this is the case the rewinding bit is turned off in the status word.

APPENDIX A

THE IOT QUEUE (Q) BITS

The Q bits are present in all Input/Output Tables (IOT's) and reflect the status of the I/O. These bits are bits 0, 1, 2 in the first word. (See Appendices B, C and D).

bit 0 set to 0 by user initially, and by IOCS when the operation has been completed.

set to 1 by IOCS when the request is entered in the queue.

bit 1 set to 0 by user initially, and by IOCS when execution of the request has been completed.

set to 1 by IOCS when execution of the request has begun.

bit 2 set to 0 by IOCS when request is entered in queue.

set to 1 by IOCS when request has been completed.

APPENDIX B

IOT FORMAT - TYPEWRITER AND PAPER TAPE INPUT

Each IOT for typewriter and paper tape consists of one word for the operation and unit number, and a variable number of Data Double Words (DDW's). Each DDW contains a code for the type of conversion to be used, the maximum number of words to expect, and a buffer area into which the converted data may be stored. When the maximum word count specified for one DDW is reached, the next DDW in line is used. The input is terminated when the maximum word count for the last DDW has been reached.

The following is a description of each field in an IOT, as shown on Figure B-1

Q bits: The Q bits are the same for all IOT's and are described in Appendix A. They should be set to zero by the user initially.

OPERATION: 00_8 Read a record from the unit specified in the unit field.

02_8 Direct this IOT to the Resident Paper Tape Absolute Loader (See figure B-2).

40_8 Read a binary record from the unit specified in the unit field. (Up arrow is not a special character in the binary mode).

UNIT: Specified by the user.

The logical unit number of the device to be used. (See Appendix J).

F (flag field) Specified by the user.

F=1 if this is the last or only DDW in the sequence, otherwise F=0. This bit may be set by using the indirect flag (*) in the assembly language instruction.

T (tag field) Specified by the user.

Type of conversion desired.

$T=00_2$ Convert input characters from 8-bit ASCII to 6-bit Truncated ASCII (TASCII). The converted characters are packed 4 characters to a word, the last word being left justified.

$T=01_2$ Convert from octal to binary.

$T=10_2$ Convert from decimal to binary. (2's complement notation).

This field may be set by specifying Index Register 0, 1 or 2 in the assembly language instruction.

WORD COUNT: Specified by the user.

The maximum number of words to be allowed in this input. The input will be terminated if this limit is reached. If TASCII input is used, the buffer area should be one word longer than the specified word count to allow space for the carriage return and line feed which IOCS adds to the input string.

WORDS INPUT: Returned by IOCS.
This field, at the completion of the input will contain the number of words input for octal or decimal format, or the number of words plus one for TASCII format. Using TASCII format the last word is left-justified if the total number of characters is not a multiple of four, and a word consisting of blank, blank, carriage return, line feed ('40407674) is added to the character string.

DATA ADDRESS: Specified by the user.
This field contains the address of the buffer area. The data will be input to this buffer area.

E (error flag) E = 0 no error
E = 1 The address specified falls within the foreground region, and the input request was made by a background user. No input is accepted.

The output DDW fields of "field width", and immediate data are not allowed in an input IOT. The "field width" specification is meaningless under free form input conditions. "Immediate data" cannot be used because the input handler returns the number of words input to the second word of the DDW.

SPECIAL CHARACTERS: In order to achieve flexibility, and to allow operators to key-in messages in a form convenient to them, certain characters have been assigned special purposes.

; (semi colon) If this is the first character of the record, the mode of the typewriter will be changed from keyboard mode to reader mode, and the first record (up to and including the first carriage return) will be input. If the typewriter is already in reader mode or if the high speed paper tape reader is being used, the semi colon will be ignored.

↑ (up arrow): This character when detected causes the current record to be deleted. The next character input will be interpreted as the first character. If the device is a typewriter, typing ↑ causes up arrow, carriage return, line feed to be output, and the typewriter is ready to re-accept the key-in.

* On paper tape there should be no carriage return following the up arrow.

** The buffer area is not cleared by typing ↑. If the corrected key-in is shorter than the previous erroneous key-in, the last part of the first input will still be in the buffer area.

/ (slash) This special character causes the typewriter to direct the input to a special IOT. This special IOT is not present in the input queue, but is forced in upon recognition of a slash as the first character. In the present system these special IOT's are used by command language.

C/R (carriage return): This special character causes the termination of the current input request. (A record is the information between two successive carriage return characters.)

L/F (line feed): Line feeds cause the typewriter to space one line, but are otherwise ignored. They are not inserted in the input string.

Leader (no punch): Leader is ignored by IOCS except within an absolute load block.

(number sign): *The programmer may specify whether octal or decimal conversion is to be used when he constructs the IOT. Regardless of his choice, typing # will cause the following numbers to be interpreted as decimal numbers.

' (quote) *As above, this character overrides the programmer's specification, and causes the following numbers to be interpreted as octal numbers.

*The operator may switch between octal and decimal conversion many times within one line. The # or ' affect all following number until another # or ' is detected.

and ' have no effect in the TASCII input mode and are input like any other character.

FORMAT OF OCTAL AND DECIMAL INPUT

Both octal and decimal integers are input in free-form format. The integers are separated by any non-numeric character or characters (not a special character) i.e., words may be inserted between the integers to make the printout more readable.

Example: Three decimal integers are requested by a program. The following are equivalent methods of typing these numbers.

1) -4, +85, 12345 C/R

2) -00004b +00085b +12345 C/R
3
3) A=-4, B=85, C=12345 C/R

4) CORRECTION FACTOR IS -4 FOR 85 POINTS. Z= 12345 C/R

5) '77777774, 125, #12345 C/R

RESIDENT ABSOLUTE LOADER:

IOCS contains a re-entrant absolute paper tape loader. (See figure B-2) This program accepts the paper tape produced by the resident IOCS paper tape dump program, or the SEL paper tape dump program. The high speed paper tape reader, or the low speed paper tape reader of a typewriter may be selected by the user by specifying the appropriate unit number.

Only one DDW is recognized by the absolute loader, and it is set entirely by IOCS. The first word of the DDW contains only the positive word count and indicates the length of the absolute block in words. The second word of the DDW contains the data address and indicates the low address of the loaded program.

If an error condition is detected, IOCS will set the sign bit in the second word of the DDW, and an error message will be output on the background logging typewriter.

The following error conditions are possible.

1) CHECKSUM ERROR

cause: an incorrectly punched paper tape, or a correctly punched paper tape being read incorrectly by the paper tape reader.

2) MEMORY PROTECT VIOLATION

cause: the data address punched on the absolute tape falls within the protected foreground system. (The foreground program is variable in size and the extent of free core will vary with time).

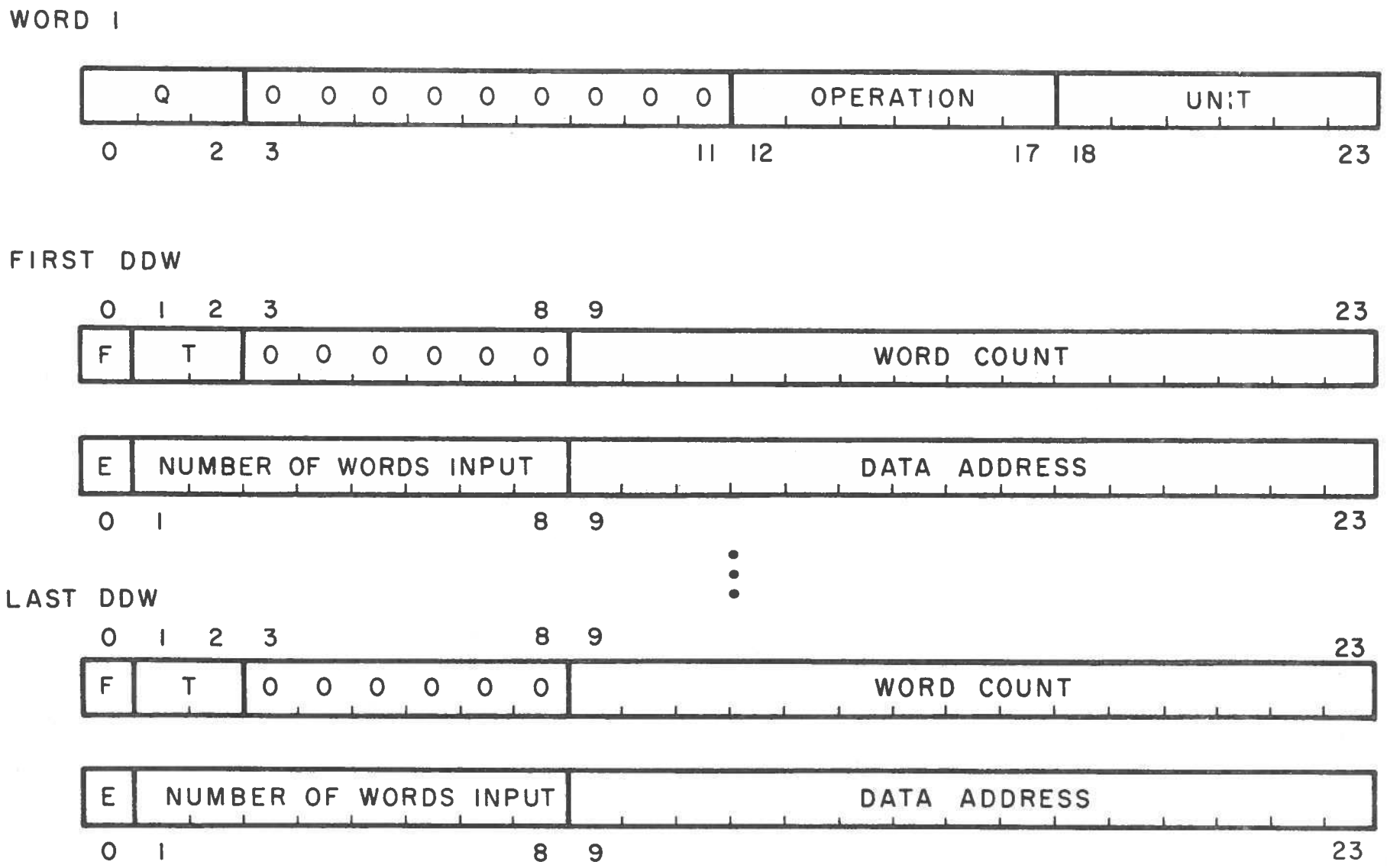


Figure B-1 Input/output table typewriter and paper-tape input

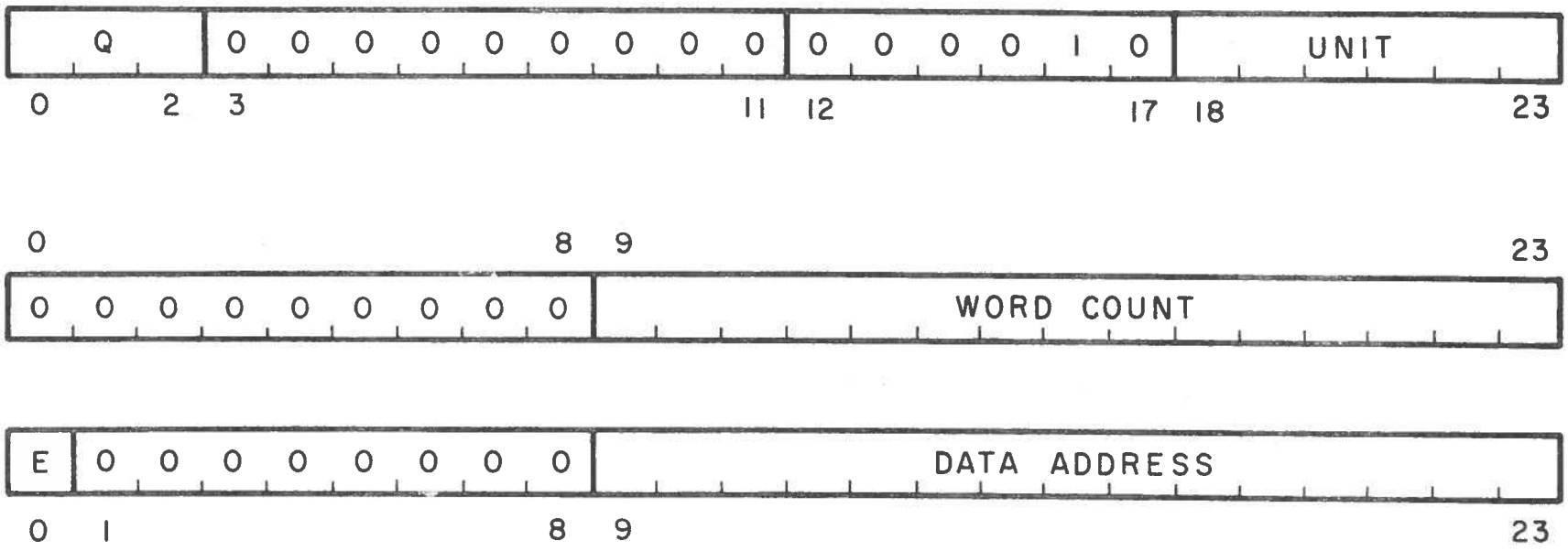


Figure B-2 Input/output table for paper-tape absolute load

APPENDIX C

IOT FORMAT - TYPEWRITER AND PAPER TAPE OUTPUT

Each IOT for typewriter and paper tape output consists of one word for the operation and unit number, and a variable number of Data Double Words (DDW's). Each DDW contains the output conversion desired, the field width, the number of words to be output, and the address of the first data word (See figure C-1).

For output, it is permitted to replace the second word of the DDW by the actual data to be output. If there is more than one word of data, the DDW is extended. The length of the DDW is then n+1 words, where n is the word count specified in the first word of the IOT. These data, which are now included in the body of the IOT, are called "immediate data" and are recognized by the setting of the immediate data flag in word 1 of the DDW.

The following is a description of each field in an IOT, as shown in Figure C-1.

Q bits: The Q bits are the same for all IOT's and are described in Appendix A. They should be set to zero initially by the user.

OPERATION: 00_8 Write a record on specified unit and terminate the output with a carriage return and line feed.

01_8 Punch a leader on paper tape. The length of the leader is determined by the word count. (A word count of 5 produces 2 inches of leader). The data address can be any address.

02_8 Select the Resident Absolute Paper Tape Dump routine (See page C-4).

04_8 Turn punch power off if unit specified is the high speed paper tape punch. This operation causes a typewriter to be reset to the keyboard mode.

10_8 Write a record on the specified unit with no carriage return and line feed.

40_8 Write a binary record on the specified unit terminated by a carriage return and line feed. (>, <, and \ are not interpreted as special characters under the binary output operation.

UNIT NUMBER: See Appendix J for the logical unit number.

F (flag field): F=1 if this is the last or only DDW in the sequence, otherwise F=0.

T (tag field): T=00 Convert the data from TASCII (6 bit characters packed 4/word) to full ASCII (8 bit) and output on the desired unit.

T=01 Convert to octal and output.

T=10 Convert to decimal and output.

WIDTH: The field width for each word to be output. If WIDTH=0, the following widths are assumed:

ASCII	4 characters
OCTAL	8 characters
DECIMAL	8 characters

Each octal and decimal number is preceded by a blank which is not considered to be part of the field width.

If n is the specified width, the following will result.

ASCII	n = 0 or 4	One word in core is output as four characters.
	0 < n < 4	One word in core is output as 1, 2 or 3 character(s), beginning with the leftmost character.
	4 < n < 32	One word in core is output as 5, 6 or 7 etc. characters. The last 1, 2 or 3 etc. characters are blank(s).
OCTAL	n = 0 or 8	One word in core is output as a space followed by 8 octal digits.

	0 < n < 8	One word in core is output as a space followed by n octal digits. The leftmost (8-n) are truncated.
DECIMAL	n = 0 or 8	One word in core is output as a space, a sign, and seven decimal digits.
	0 < n < 8	One word in core is output as a space, a sign, and n-1 decimal digits. (If n=1, only the sign will be output.)

**If the decimal number is too large for the field width, the result will be incorrect, and probably non-numeric.

I (immediate data field)

I = 0	if the following word contains the data address.
I = 1	if the following word(s) contain the actual data.

WORD COUNT: The number of words to be output. This field must be exact and for immediate data specifies the number of words of data following.

DATA ADDRESS: The address of the first data word to be output.

SPECIAL CHARACTERS:

> will cause a carriage return to be typed or punched.

< will cause a line feed to be typed or punched.

\ will cause the typewriter bell to ring, and/or '207 to be punched.

ERROR CONDITIONS

IOCS will prohibit the output specified by any DDW for typewriter/paper-tape with a word count greater than 50 (Absolute Dump excepted). A request containing this error will be replaced by an error message. The "In Q" bit in the IOT is left on to prevent the request from being re-issued.

RESIDENT ABSOLUTE DUMP ROUTINE

IOCS contains a re-entrant absolute paper tape dump routine. This program creates a paper tape compatible with the SEL absolute load/dump routines, and with the IOCS resident absolute loader. Only one DDW is permitted in an absolute dump IOT as shown in figure C-2.

The word count is the length in words of the absolute module to be created. (The sign bits (F=1) must be set). The data address is the base address for the absolute module.

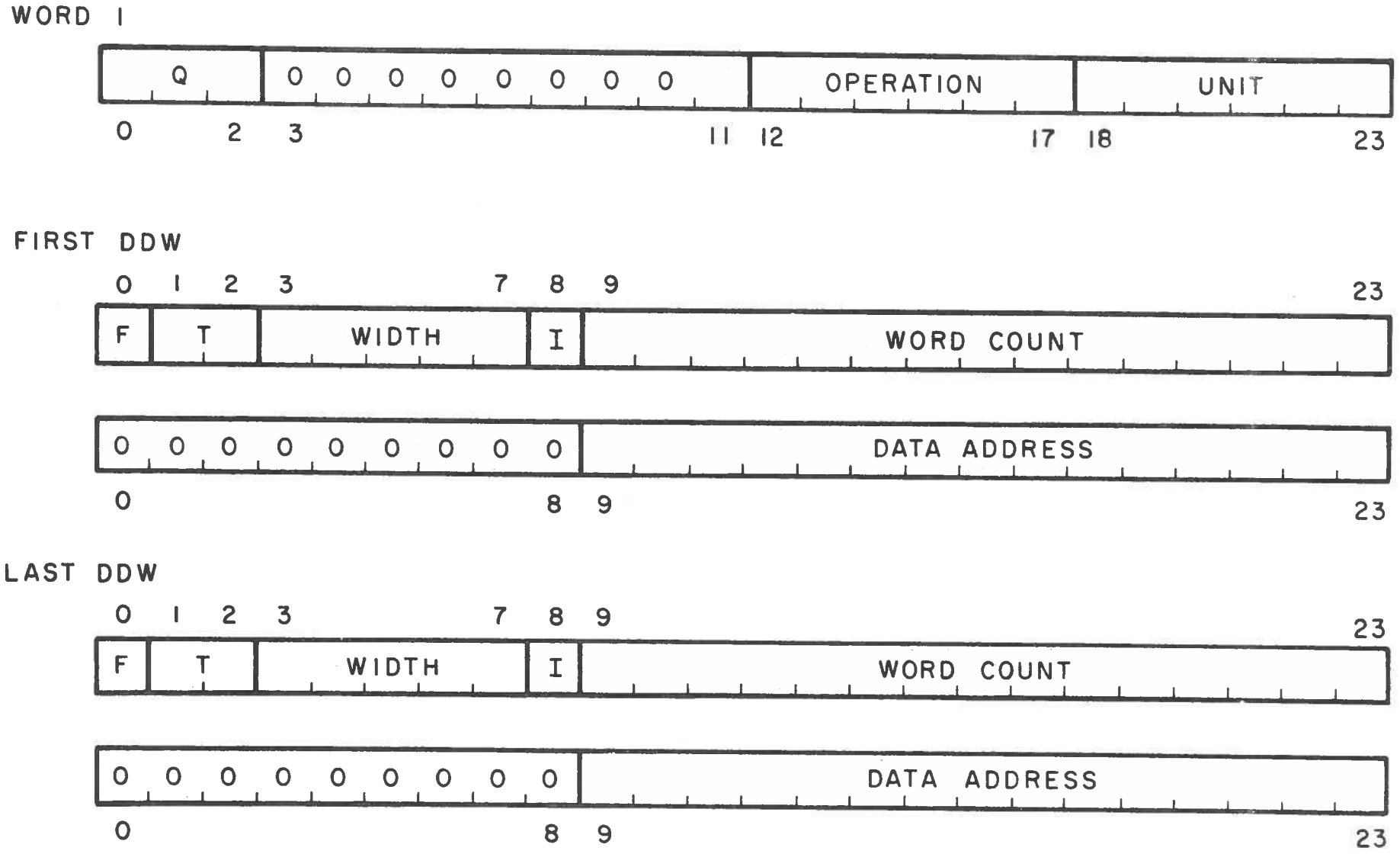


Figure C-1 Input/output table typewriter and paper-tape output

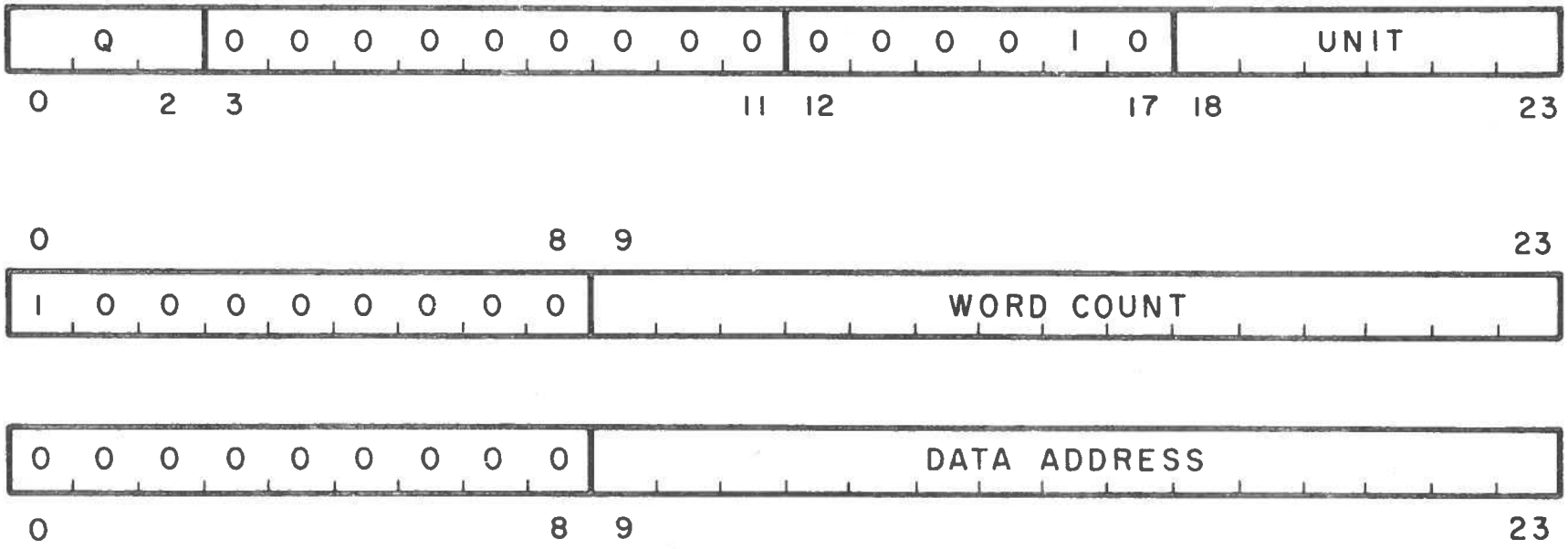


Figure C-2 Input/output table for paper-tape absolute dump

APPENDIX D

IOT FORMAT - MAGNETIC TAPE

All magnetic tape I/O and control must be performed by IOCS. The user's directions are transmitted to IOCS by an I/O Table (IOT). The first word of an IOT is identical for all units. The succeeding words for magnetic tape are dependent upon the operation specified.

Q bits = The Q bits are the same for all IOT's and are described in Appendix A. They should be set to zero initially by the user

OPERATION:	01	Read a block	figure	D-1
	02	Write a block	"	D-1
	03	Rewind file	"	D-2
	04	Rewind	"	D-2
	05	Backspace file	"	D-2
	06	Advance file	"	D-2
	07	Write end-of-file	"	D-2
	10	Backspace record (block)	"	D-2
	11	Advance record (block)	"	D-2
	12	Erase gap (4 inches of tape)	"	D-2
	13	(not used)		
	14	Set Mode	"	D-3
	15	(not used)		
	16	(not used)		
	17	(not used)		

See the designated figures for the IOT fields.

UNIT: See Appendix J for the logical unit number assignment.

READ/WRITE (Operations 01-02)

A read or write IOT consists of a first word, a variable number of Data Double words, and an Error word. There is no provision for immediate data or data conversion in the magnetic tape handler. Input and Output is accomplished on a cycle-stealing basis by the Block Transfer Control (BTC). Data are transferred to and from the computer a word at a time (24 bits), and shifted into characters within the magnetic tape control unit. In the normal mode of operation, one word in core becomes four characters on the seven-track tape and vice versa.

Data chaining or Gather Read/Scatter Write is accomplished by using multiple Data Double Words (DDW's) to describe the I/O. (See figure D-1)

F (flag bit)	= 1 if this is the last or only DDW in the sequence, otherwise F = 0.
WORD COUNT	the number of words to be output onto magnetic tape, or the maximum number of words to be input.
DATA ADDRESS	the address of the first word to be output, or the buffer into which the data will be read.
ERROR BITS	See Appendix K for a more complete description.
bit 0 = 1	if any other bits are on in the error field
bit 1 = 1	parity error
bit 2 = 1	EOF detected

bit 3 = 1 end-of-tape area detected

bit 4 = 1 data overflow

bit 5 = 1 write ring missing

bit 6 = 1 backspace violation

NUMBER OF WORDS INPUT: This field is used only for an input IOT and is returned by IOCS. It contains the number of words input if this IOT contains one DDW only. If there are multiple DDW's, the contents of this field contains the number of words input for the last DDW only.

CONTROL (Operations '03 - '12)

These IOT's are used to position the tape, to erase a portion of a tape, or to write a file mark on the tape. These IOT's consist of a first word and an error word only. The operations are:

'03 Rewind a file. A backspace file is issued if the tape is not at the load point. An advance file is then issued to advance over the file mark if the tape is not at the load point.

'04 The tape is rewound to the load point.

'05 A backspace file command is issued if the tape is not at load point

'06 An advance file command is issued.

'07 Approximately 3-1/2 inches of tape are erased and an end-of-file mark is written.

'10 The tape is moved backwards one physical record (block). If the tape is at load point a no operation results. If the record was an end-of-file mark, the tape is advanced back over it.

'11 The tape is moved forward one physical record (block). If the record was an end-of-file mark, the tape is backspaced over it.

'12 Approximately four inches of tape are erased.

ERROR OR STATUS CONDITIONS

All reverse operations (Rewind, backspace file, and more than one backspace record) cause the backspace inhibit latch to be checked. If the latch is on, the operation is terminated, and bits 0,6 are set on in the error word.

An erase gap or write end-of-file operation cause a test for the write ring to be made. If there is no write ring, the operation is terminated, and bits 0,5 are set on in the error word.

An advance or backspace record over a file mark causes the tape to be restored to its position before the operation and bits 0,2 to be set on in the error word.

SET MODE (Operation '14)

The Set Mode operation does not physically address the tape control unit. The mode word (word 2 of the IOT) replaces the previous contents of the mode table for that unit. IOCS uses this mode word prior to every tape operation to physically connect the tape control unit to the tape unit. The format of this IOT is shown in figure D-3.

The fields of the mode word are:

B (bit 7) = 0 binary (odd parity)

= 1 TASCII (even parity)

D (bits 16-17) = 00 low density (200 bpi)

= 01 medium density (556 bpi)

= 10 high density (800 bpi

C (bits 22-23) = 01 for 1 char/word

= 10 for 2 char/word

= 11 for 3 char/word

= 00 for 4 char/word (normal setting)

If less than four characters per word are specified, the left most characters in each word are selected.

The preset mode of each unit is set in the mode table within the magnetic tape handler. The system tape is preset to odd parity, medium density, and four characters per word. The data tape is preset to odd parity, low density, and four characters per word.

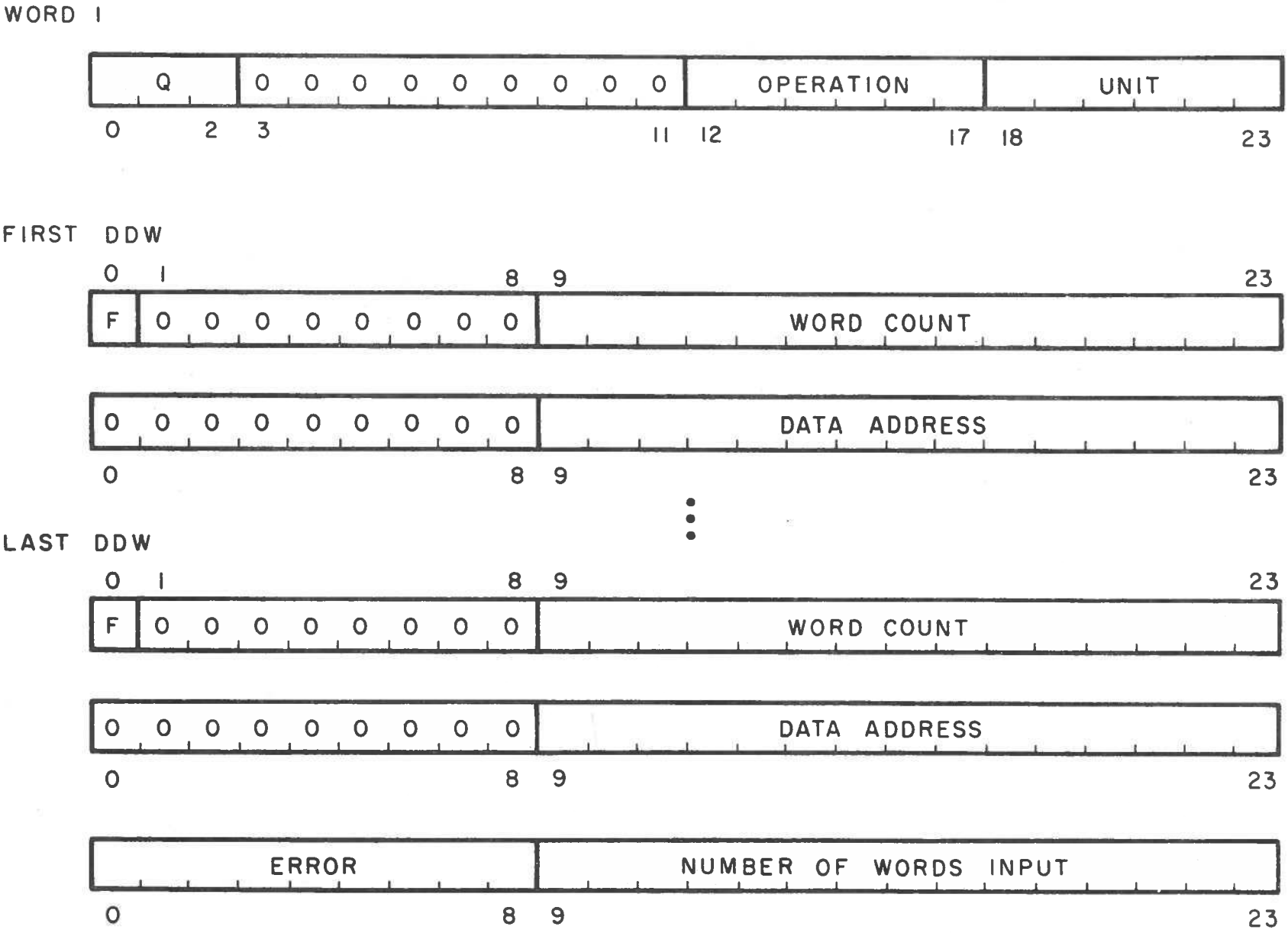


Figure D-1 Input/output table magnetic tape input and output

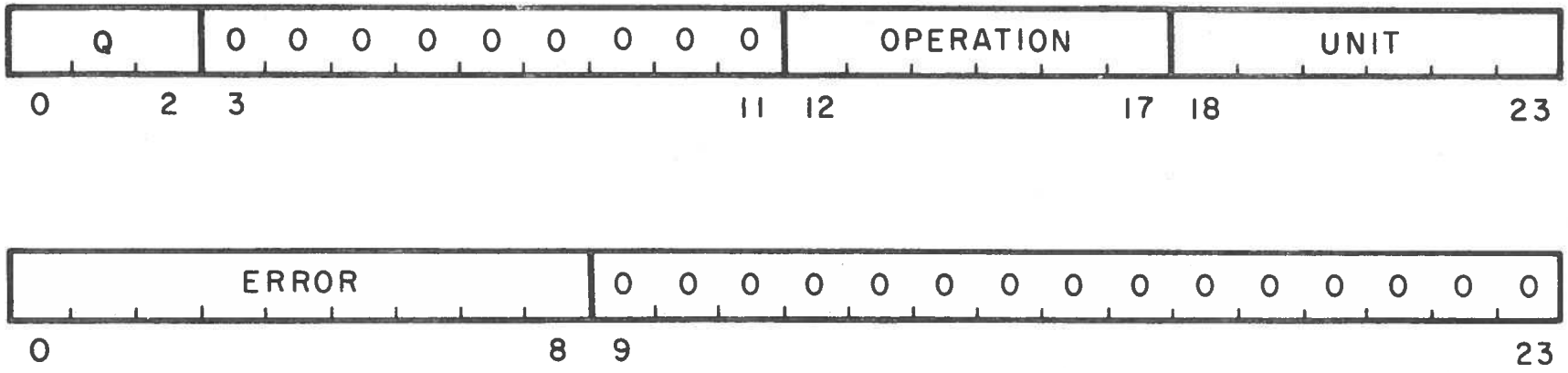


Figure D-2 Input/output table magnetic tape control

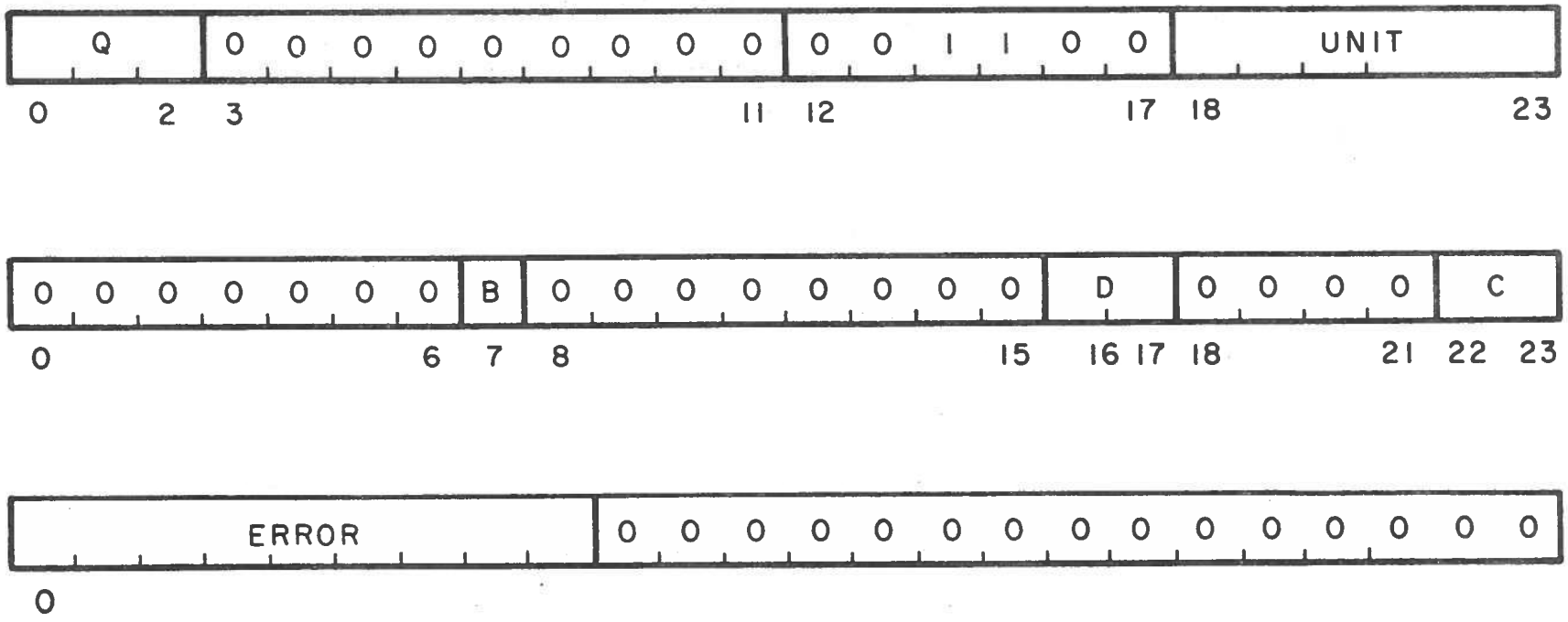


Figure D-3 Input/output table magnetic tape mode set

APPENDIX E

I/O REQUEST QUEUE STRUCTURE

Each I/O device has an I/O request queue associated with it containing the addresses of the IOT waiting for, or undergoing, execution. The queue structure is identical for all devices, although the length may vary according to the real-time requirements of the device. IOCS is therefore able to treat all queues in a similar manner. The queue is a first in - first out circular queue and is defined and maintained by the first four entries in the DCT (Device Control Table) of the associated device.

DCT+0 contains the execution pointer within the queue. This pointer is maintained entirely by the handler, and points to the IOT currently under execution.

DCT+1 contains the entry pointer within the queue. This pointer is maintained by the driver (IOCS), and points to the first empty position in the queue. A non-zero entry (IOT address) in this position indicates that the queue is full.

DCT+2 contains the start address of the queue.

DCT+3 contains the end address of the queue.

The start and end addresses of the queue are used by IOCS and by the handlers to loop the entry and the execution pointers back to the beginning of the queue when the end of the queue has been reached.

The physical position of the queue in the coding is immediately following the DCT. The DCT address is used by IO$PRG to zero the last two entries of the DCT for all handlers.

APPENDIX F

DCT for Typewriter and Paper Tape Input

	DCT entry	Mnemonic
-4	A	SAVE
-3	B	
-2	XR1	
-1	XR2	
0	Execution pointer	XPTR
1	Entry pointer	NPTR
2	Address of start of queue	ASTQ
3	Address of end of queue	AEDQ
4	Instruction to start input	
5	Instruction to enable interrupt	
6	Address of low priority queue	LPQ
7	Conversion format	FRMT/MODE
8	Full character count	FCC/XR4
9	Current character count	CCC/XR5
10	Full word count	FWC/NWDC
11	Current word count	CWC/CKSM
12	Data address	DADR
13	Current character buffer	CCB
14	DDW pointer	DDWP
15	Temporary storage	TEMP/RETN
16	Special (command) IOT address	SIOT
17	Return address	RTAD
18	Input instruction	AIP
19	Control I/O instruction	CEU
20	Character just input	CHAR
21	Current IOT address	IOTA
22	Status word	STAT
23	I/O REQUEST QUEUE	
24	⋮	
25		
26		

Register save area

APPENDIX G

DCT for Typewriter and Paper Tape Output

	DCT entry	Mnemonic
-4	A	SAVE
-3	B	
-2	XR1	
-1	XR2	
0	Execution pointer	XPTR
1	Entry pointer	NPTR
2	Address of start of queue	ASTQ
3	Address of end of queue	AEDQ
4	Instruction to start output	
5	Instruction to enable interrupt	
6	Address of low priority queue	LPQ
7	Conversion format	FRMT/MODE
8	Full character count	FCC/XR4
9	Current character count	CCC/XR5
10	Full word count	FWC/NWDC
11	Current word count	CWC/CKSM
12	Data address	DADR
13	Current character buffer	CCB
14	DDW pointer	DDWP
15	Temporary storage	TEMP/RETN
16	... not used ...	
17	Return address	RTAD
18	Output instruction	AOP
19	Control I/O instruction	CEU
20	Character to be output	OUTC
21	Current IOT address	IOTA
22	Status word	STAT
23	I/O REQUEST QUEUE	
24	⋮	
25		
26		

Register save area

APPENDIX H

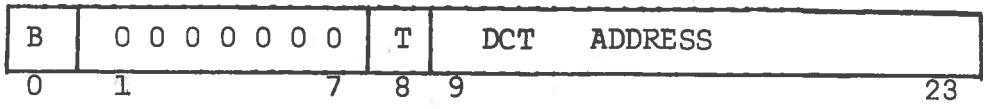
DCT for Magnetic Tape

	DCT entry	Mnemonic
0	Execution pointer	EXPT
1	Entry pointer	
2	Address of start of queue	STQ
3	Address of end of queue	EDQ
4	Instruction to start I/O	
5	Instruction to enable interrupt	
6	Return address for WAIT routine	WATF
7	.... not used	
8	Current IOT address	IOTA
9	DDW pointer	DDWP
10	Physical unit number	PUNN
11	Return address (re-entrant routines)	LEV1
12	Number of error retrys	ETRY
13	Error word	ERWD
14	Data address	DADR
15	Status word	STAT
16	Temporary storage	TEMP
17	.... not used	ERWA
18	I/O REQUEST QUEUE	
19	⋮	
20		
21		

APPENDIX I

LOGICAL AND STANDARD DEVICE TABLES

The Standard Device Table (SDT) is created at monitor generation time. The SDT is referenced by the external name IO$SDT. Each logical unit occupies one word in the SDT. The format of each entry is:



B (background bit)

= 0 if this is a foreground device.

= 1 if this device is available to background jobs.

T (device type)

= 0 if the device is a teletype keyboard or printer.

= 1 if the device is a teletype paper tape reader.

DCT ADDRESS is the address of the Device Control Table pointing to the I/O request queue into which IOCS should put the request.

A zero entry indicates a removed device. The end of the table is a minus zero ('40000000).

The Logical Device Table (LDT) is created from the SDT by the routine IO$PRG at system initialization. The format of the LDT is identical to that of the SDT. The LDT is referenced by the external name IO$LDT.

Re-assignment of devices, and changes to the background bit by IOCS routines involve changes to the LDT only. Restarting the system resets the LDT entries to those of the SDT. Permanent modifications should be made directly to the SDT.

The Logical Unit Numbers are defined by the entries of the LDT and SDT. Logical unit numbers start at '20 to remove any confusion between the A.R.O. data acquisition system and the non real-time EXECUTIVE system supplied by the manufacturer. The constant '20 must therefore be subtracted from the logical unit number before it may be used as an index to the LDT or SDT.

APPENDIX J

LOGICAL UNIT NUMBER ASSIGNMENT

'20	FOREGROUND LOG
21	Console teletype keyboard (ASR-33, unit '01)
22	Remote teletype keyboard (ASR-35, unit '10)
23	Remote teletype keyboard (ASR-35, unit '15)
24	Console teletype keyboard (ASR-33, unit '01)
25	Remote teletype keyboard (ASR-35, unit '10)
26	Console teletype printer (ASR-33, unit '01)
27	Remote teletype printer (ASR-35, unit '10)
30	Remote teletype printer (ASR-35, unit '15)
31	High speed paper tape punch, unit '02
32	High speed paper tape punch, unit '02
33	High speed paper tape reader, unit '02
34	FOREGROUND COMMAND
35	BACKGROUND COMMAND
36	BACKGROUND LOG
37	BACKGROUND LOW SPEED PAPER TAPE
40	SYSTEM (Magnetic tape)
41	BACKGROUND MAGNETIC TAPE
42	unassigned
43	unassigned
44	DATA TAPE #1
45	DATA TAPE #2
46	unassigned
47	unassigned

units '50 to '77 are unassigned

Units '21 to '32 are used to select the foreground and background command/log devices at monitor initialization by the control switch settings 18-23.

The octal numbers '20 to '47 are the Logical Unit Numbers and appear in bits 18-23 of Word 1 of the IOT.

APPENDIX K

INTERRUPT ASSIGNMENTS

Group	Level	Use	Address (Octal)
0	0	Power fail	100
	1	Stall alarm	101
	2	*Block transfer	102
	3	Watch dog timer	103
	4	**Monitor	104
	5	Analog converter	105
	6	Sidereal clock (IMS)	106
	7	Co-ordinate values	107
	8	Memory protect	110
	9	Instruction trap	111
	10	*ASR 33 teletype (output)	112
	11	*ASR 33 teletype (input)	113
	12	Memory parity	114
	13	*Mag. tape free	115
	14	Standard/Spare	116
	15	Standard/Spare	117
1	1	*ASR 35 TTY #10 (output)	121
	2	*ASR 35 TTY #10 (input)	122
	3	*ASR 35 TTY #15 (output)	123
	4	*ASR 35 TTY #15 (input)	124
	5	*High speed punch	125
	6	*High speed reader	126
	7	Discrete sample processor #1	127

Group	Level	Use	Address (Octal)
	8	Analog sample processor #1	130
	9	Discrete sample processor #2	131
	10	Analog sample processor #2	132
	11	Discrete sample processor #3	133
	12	Analog sample processor #3	134
	13	Spare	135
	14	Solar clock (IMS) - LBI	136
	15	Command language	137

*These interrupt levels are used by IOCS only. Each teletype or paper tape device has two interrupt levels assigned to it: one for input and one for output, the output interrupt having the higher priority.

**The MONITOR interrupt may be used by any foreground program. Instead of being re-entrant, a foreground program may enable this interrupt level and block out all lower levels until the completion of the routine. This interrupt is used by the I/O driver (IOCS).

APPENDIX L

ERROR MESSAGES AND CONDITION CODES

ERROR MESSAGES:

All error and status messages from IOCS are in the form:

IO XX explanation.

The IO prefix is a code unique to IOCS. The numerical code (XX) identifies the message for easy reference, and the explanation attempts to explain the message in as few characters as possible.

IO 01 MGTP INPUT — A block has just been read from magnetic tape which contains a parity error. The parity error has persisted for five re-read attempts. This message is displayed on the foreground logging device.

IO 02 MGTP OUTPUT — A block has just been written onto magnetic tape with a permanent parity error. The parity error has persisted after five re-write attempts This message is displayed on the foreground logging device.

IO 04 END-OF-TAPE — The reflective strip marking the end of tape area has just been sensed on magnetic tape. This message is displayed on the foreground logging device.

IO 06 MGTP NO-RING — An erase gap, write, or write end-of-file has been attempted on a protected tape. This message is displayed on the foreground logging device.

IO 07 BKWRD MOTION NHBITED — An attempt has been made to rewind, backspace file, or backspace more than one record on a magnetic tape unit that has the backspace inhibit option enabled. This message is displayed on the foreground logging device.

IO 08 ILEG OPRTN — An IOT for magnetic tape specifies an illegal operation. (Basic magnetic tape handler only). This message is displayed on the foreground logging device.

IO 10 CKSM — A checksum has been detected while using the resident absolute paper tape loader. This message is displayed on the background logging device.

IO 11 DADR XXXXX YYYYY — The data address specified by an input IOT falls within the foreground region. The input is not accepted. This message is displayed on the background logging device.

IO 12 ABSL XXXXX YYYYY — The loading address read from an absolute paper tape is outside the background region. The tape is not loaded. This message is displayed on the background logging device.

IO 14 WRDCNT XXXXX — A paper-tape or teletype IOT has specified a word count greater than 50. This error message replaces the output on the device selected.

IO 15 IMDT XXXXX — A paper-tape or teletype input IOT has the immediate data flag on. Immediate data are illegal for input. This message is displayed on the background logging device.

IO 16 N377 — The first non-zero character detected by the resident absolute loader was not '377. Loading is terminated. This message is displayed on the background logging device.

XXXXX — is the IOT address in error

YYYYY — is the data address in error.

FMAT AAAAA — A Fortran coded program used an incorrect floating point format specification, or the number is too large to be output under an F format. The error occurred in a Fortran OUTPUT statement. AAAAA is the absolute octal address of the portion of the OUTPUT statement causing the error.

CONDITION CODES

IOCS condition codes fall into two groups:

IOCS CONDITION CODES

Condition codes from the IOCS driver. These condition codes are returned to the user before the execution of the I/O has begun, and show only if IOCS was successful in entering the IOT into the proper queue. These codes are returned in the A register.

HANDLER CONDITION CODES

Condition codes from the various handlers. These codes are returned directly to the IOT. In the case of teletype and paper-tape I/O these codes are returned to the E bit (see figures B-1 and B-2). In the case of the magnetic tape handler, the code is returned to the ERROR bits of the last word of the IOT (see figure D-1, D-2 and D-3).

In all cases a condition code of zero indicates no errors.

IOCS CONDITION CODES

The register status upon return from IOCS is:

A register: IOCS CONDITION CODE

B register: IOT address

Index Registers: unchanged.

The condition code is:

0	Normal return, no errors detected.
bit 0 = 1	If any of the following error conditions have been detected.
bit 1 = 1	The queue for the device specified in the unit field was full and no entry could be made.
bit 2 = 1	The device is within the range '20 to '47, but the device has been removed from the system.
bit 3 = 1	The IOT specified is already in the queue. (The first Q bit is on.) This prevents the queue from becoming filled unnecessarily with the same message request.

bit 4 = 1 The unit number specified does not fall within the range '20 to '47.

bit 5 = 1 A background user has attempted to use a "foreground only" device.

In all five cases, no Input or Output is attempted.

HANDLER CONDITION CODES:

a) Teletypewriter and Paper-tape handler.

The single bit error indicator (E) in the teletypewriter and paper tape IOT may be set by the following error conditions:

1) A checksum error detected by the resident paper-tape absolute loader.

2) The address read by the resident paper-tape absolute loader indicates that the load module is all or partially within the foreground region. Loading is terminated.

3) The data address specified in an input IOT falls within the foreground region. Input is not accepted.

b) Magnetic Tape Handler

Error or status conditions detected by the magnetic tape handler are displayed in the upper nine bits of the last word of the IOT. The following conditions are returned.

bit 0 = 1 if any bits are on in the error field.

bit 1 = 1 for a read or write parity error (the error has persisted after 5 attempts to correct it).

bit 2 = 1 if an end-of-file or tapemark has been read.

bit 3 = 1 if the end-of-tape area has been detected.

bit 4 = 1 if there was data overflow. (The buffer length specified in the word count field of the input IOT was not large enough to contain the block. The information returned after the buffer had been filled was lost.)

bit 5 = 1 a write, write end-of-file, or erase gap operation has been attempted on a tape with no write ring.

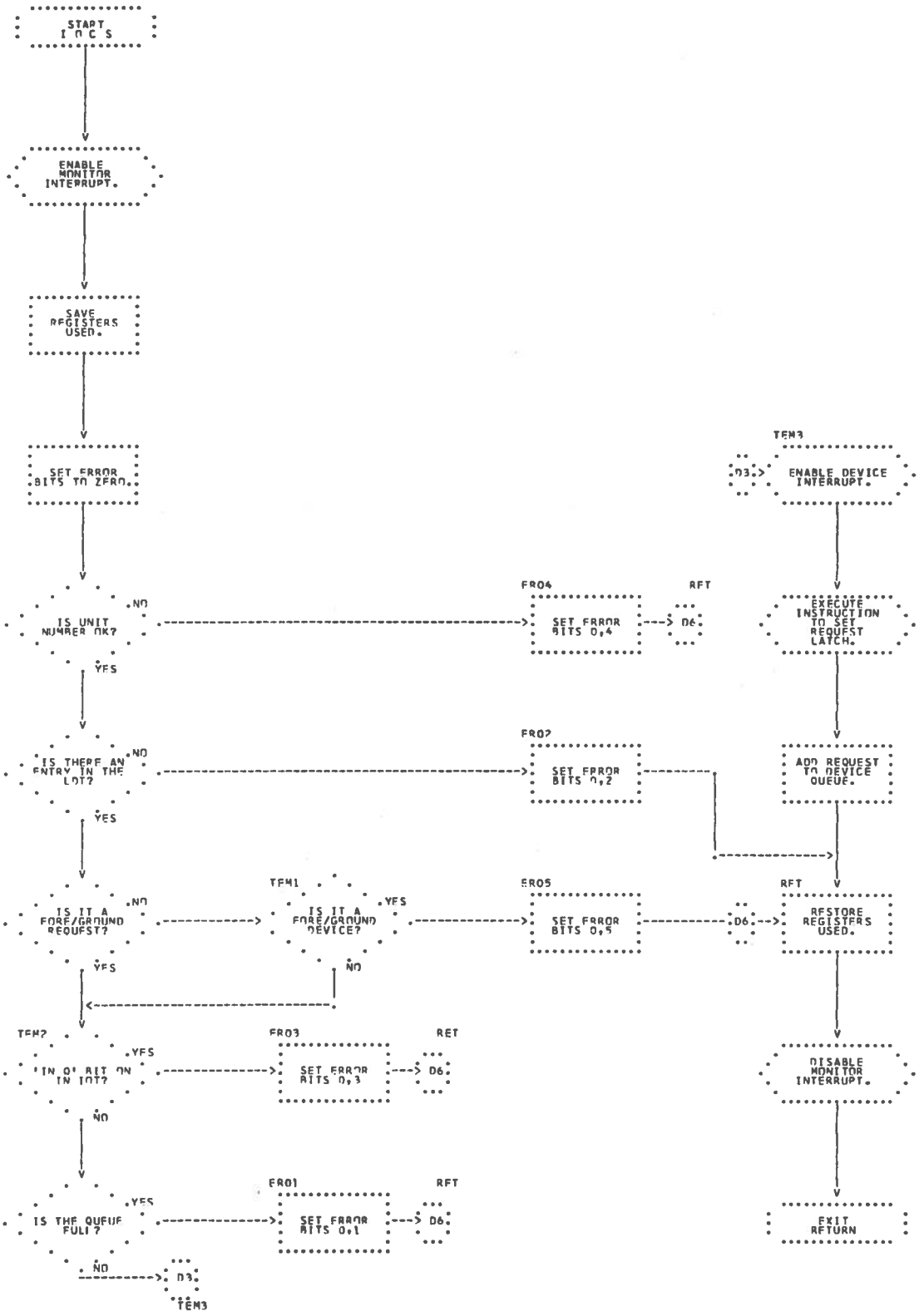
bit 6 = 1 a rewind, backspace file, or more than one backspace record has been attempted on a unit with the backspace inhibit option enabled.

APPENDIX M

IOCS DRIVER FLOWCHARTS AND LISTING

Symbol	Page	Coordinate*
ER01	M-1	B8
ER02	M-1	C5
ER03	M-1	B7
ER04	M-1	C4
ER05	M-1	C6
RET	M-1	D6
TEM1	M-1	B6
TEM2	M-1	A7
TEM3	M-1	D3

*Each flowchart page contains a maximum of forty boxes, arranged in a four-by-ten matrix. The four columns are labeled A, B, C, and D, and the ten rows are numbered from zero to nine.


START I O C S
ENABLE MONITOR INTERRUPT.
SAVE REGISTERS USED.
SET ERROR BITS TO ZERO.
IS UNIT NUMBER OK?
NO
YES
ERR4
SET ERROR BITS 0,4
RET
D6
IS THERE AN ENTRY IN THE LOT?
NO
YES
ERR2
SET ERROR BITS 0,2
IS IT A FORE/GROUND REQUEST?
NO
YES
TEM1
IS IT A FORE/GROUND DEVICE?
YES
NO
ERR5
SET ERROR BITS 0,5
D6
RET
RESTORE REGISTERS USED.
TEM2
'IN 0' BIT ON IN IOT?
YES
NO
ERR3
SET ERROR BITS 0,3
RET
D6
IS THE QUEUE FULL?
YES
NO
ERR1
SET ERROR BITS 0,1
RET
D6
D3
TEM3
TEM3
D3
ENABLE DEVICE INTERRUPT.
EXECUTE INSTRUCTION TO SET REQUEST LATCH.
ADD REQUEST TO DEVICE QUEUE.
DISABLE MONITOR INTERRUPT.
EXIT RETURN

```
0001          00000012    IOCH NAME I$IOCS,IOCS  JULY 23/69
0003                      ************************************************************
0004                      *                                                          *
0005                      *-------------A.R.C.   SYSTEM    SOFTWARE.---------------*
0006                      *                                                          *
0007                      *------REAL-TIME   INPUT/OUTPUT  CONTROL   SYSTEM.-------*
0008                      *                                                          *
0009                      *--------------------SEPTEMBER  1968-----------------DJB*
0010                      *                                                          *
0011                      ************************************************************
0012                      *
0013                      *
0014          00000012          NAME IOCS,IOCS
0015          00000124          NAME IO$LDT,LDT
0016          00000316          NAME IO$SDT,SDT
0017          00000000          NAME IO$PRG,PURG
0018          00000010          NAME IO$ITL,INCS
0019          00000002          NAME IO$RLS,RLSE
0020          00000004          NAME IO$NHB,NHBT
0021          00000006          NAME IO$ASN,ASGN
0022          00000305          NAME I$FIOT,FIOT
0023          00000311          NAME I$BIOT,BIOT
0024                      *
0025                      *
0026                      *----CONSTANTS FOUND IN THE SYSTEM LITERAL POOL.
0027                      *
0028                           ABS
0029          00200            ORG  '200          ABSOLUTE ORIGIN OF LITERAL POOL.
0030                      *
0031          00327      OTWY EQU  *+'127         ='20
0032                      *
0033          00225      OSVT EQU  *+'025         ='17
0034                      *
0035          00222      OTEN EQU  *+'022         ='10
0036                      *
0037          00336      O1HD EQU  *+'136         ='100
0038                      *
0039          00337      O2HD EQU  *+'137         ='200
0040                      *
0041          00307      BIT2 EQU  *+'107         ='10000000
```

```
0042                    *
0043        00326       OMTY EQU  *+'126        =-'20
0044                    *
0045        00224       TWLV EQU  *+'024        ='12
0046                    *
0047        00233       LUNO EQU  *+'033        ='77
0048                    *
0049        00234       NEG  EQU  *+'034        ='40000000
0050                    *
0051        00246       E1   EQU  *+'046        ='60000000
0052                    *
0053        00247       E2   EQU  *+'047        ='50000000
0054                    *
0055        00250       E3   EQU  *+'050        ='44000000
0056                    *
0057        00251       E4   EQU  *+'051        ='42000000
0058                    *
0059        00252       E5   EQU  *+'052        ='41000000
0060                    *
0061        00241       BT2F EQU  *+'041        ='67777777
0062                    *
0063        00213       ONE  EQU  *+'013        =1
0064                    *
0065        00245       BT01 EQU  *+'045        ='17777777
0066                    *
0067        00235       BTZN EQU  *+'035        ='37777777
0068                    *
0069        00212       ZERO EQU  *+'012        =0
0070                    *
0071        00242       AMSK EQU  *+'042        ='77777
0072                    *
0073        00206       MFOR EQU  *+'006        =-4
0074                    *
0075        00234       SDTE EQU  *+'034        ='40000000  LAST ENTRY IN SDT.
0076                    *
0077        00304       LAA  EQU  *+'104
0078                    *
0079        00215       P3   EQU  *+'15         =3
0080                    *
0081                *       REL                 RELOCATABLE MODE.
```

```
0082          00000          ORG  0
0083                       *
0084          00007        PART EQU  7          FOREGROUND/BACKGROUND PARTITION.
0085                       *                 (ENTRY IN DRTY-C).
0086          00020        COMM EQU  16         COMMAND IOT WORD IN TTY HANDLER.
0087                       *
0088          00022        AOP  EQU  18         AOP INSTRUCTION IN DCT.
0089                       *
0090          00023        CEU  EQU  19         CEU INSTRUCTION IN DCT.
0091                       *
0092                       *
0093                       *----ENTRY POINTS.
0094                       *
0095  00000   00000000     PURG ZZZ  **         PURGE ROUTINE ENTRY.
0096  00001   01100172*         BRU  IOE1
0097                       *
0098  00002   00000000     RLSE ZZZ  **         RELEASE ROUTINE ENTRY.
0099  00003   01100300*         BRU  IOE2
0100                       *
0101  00004   00000000     NHBT ZZZ  **         INHIBIT ROUTINE ENTRY.
0102  00005   01100273*         BRU  IOE3
0103                       *
0104  00006   00000000     ASGN ZZZ  **         ASSIGN ROUTINE ENTRY.
0105  00007   01100266*         BRU  IOE4
0106                       *
0107  00010   00000000     INCS ZZZ  **         INITIALIZATION ENTRY.
0108  00011   01100153*         BRU  IOE5
0109                       *
0110  00012   00000000     IOCS ZZZ  **         MAIN I/O ENTRY.
0111                            CALL HYUP       TURN ON MONITOR INTERRUPT IF NOT ALREADY ON.
0112  00014   00300000*         STA  IOTA       ADDRESS OF IOT FOR THIS I/O.
0113  00015   13300121*         STI  SXR1,1     SAVE XR1 AND XR2.
0114  00016   23300122*         STI  SXR2,2
0115  00017   23200000         LIX  $DRTY-C,2  USE XR2 AS POINTER TO C DIRECTORY.
0116  00020   40100000*        LAA* IOTA       GET FIRST WORD OF IOT.
0117  00021   02700233         MAA  LUNO       STRIP TO LOGICAL UNIT NUMBER.
0118  00022   00600327         SMA  OTWY       CONVERT TO RANGE 00-27.
0119  00023   02300113*         BAN  ER04       ILLEGAL DEVICE NUMBER.
0120  00024   10000001         TAI  ,1         USE AS INDEX TO LOGICAL DEVICE TABLE (LDT).
0121  00025   00600225         SMA  OSVT       FOR LATER CHECKING OF DEVICE TYPE.
```

```
0122  00026  00300120*        STA   ERUN
0123  00027  00600222         SMA   OTEN        LARGEST DEVICE MINUS '20.
0124  00030  02400113*        BAP   ER04        ILLEGAL DEVICE NUMBER.
0125  00031  10100124*        LAA   LDT,1       GET ADDRESS OF DCT (DEVICE CONTROL TABLE)
0126  00032  00300123*        STA   DEVQ        FROM LOGICAL DEVICE TABLE.
0127  00033  10000001         TAI   ,1          ADDRESS OF DCT TO XR1  AS POINTER.
0128  00034  02200107*        BAZ   ER02        ZERO ENTRY IN LDT..NON-EXISTENT DEVICE.
0129  00035  20100007         LAA   PART,2      GET F-G/B-G PARTITION FROM DRTY-C.
0130  00036  00600000*        SMA   IOTA        WHERE DID IOT ORIGINATE...
0131  00037  02400042*        BAP   *+3         IOT IN FOREGROUND..OK.
0132  00040  00100123*        LAA   DEVQ        CHECK PERMITTED USAGE.
0133  00041  02400115*        BAP   ER05        FOREGROUND ONLY DEVICE...ERROR.
0134  00042  40100000*        LAA*  IOTA        FIRST WORD OF IOT.
0135  00043  02300111*        BAN   ER03        ''IN Q'' BIT ON..ALREADY IN QUEUE.
0136  00044  11600005         EXU   5,1         ENABLE INTERRUPT FOR THIS DEVICE.
0137  00045  00200123*        LBA   DEVQ        ADDRESS OF DCT IN B REG.
0138  00046  00000003         CLA               ZERO IN A REG.
0139  00047  11600004         EXU   4,1         DO SOMETHING THAT WILL RAISE THE INTERRUPT.
0140  00050  00000222         NOP               IN CASE THE SOMETHING IS AOP INSTR.
0141  00051  50100001         LAA*  1,1         QUEUE ENTRY POINTER FROM DCT.
0142  00052  02200054*        BAZ   *+2         OK TO MAKE ENTRY.
0143  00053  01100076*        BRU   ER01        QUEUE FULL..NO ENTRY POSSIBLE.
0144  00054  00100000*        LAA   IOTA        PUT THE IOT ADDRESS IN THE QUEUE.
0145  00055  50300001         STA*  1,1
0146  00056  11400001         IMS   1,1         INCREMENT THE ENTRY POINTER.
0147  00057  10100003         LAA   3,1         CHECK FOR END OF QUEUE.
0148  00060  10600001         SMA   1,1
0149  00061  02400064*        BAP   *+3         NOT END YET.
0150  00062  10100002         LAA   2,1         HAVE REACHED END OF QUEUE.
0151  00063  10300001         STA   1,1         LOPP BACK TO START.
0152  00064  00100234         LAA   NEG         SET THE ''IN Q'' BIT
0153  00065  43000000*        MUA*  IOTA        IN THE FIRST WORD OF THE IOT.
0154  00066  02700241         MAA   BT2F        TURN OFF BIT 2.
0155  00067  40300000*        STA*  IOTA
0156  00070  00000003         CLA               NORMAL RETURN CODE. (A=0).
0157  00071  13200121*  RET   LIX   SXR1,1      RESTORE XR1.
0158  00072  00200000*        LBA   IOTA        B=IOT ADDR FOR WAIT ROUTINE.
0159  00073  23200122*        LIX   SXR2,2      RESTORE XR2.
0160                          CALL  LOWD        TURN OFF MONITOR INTERRUPT IF IT WAS OFF.
0161  00075  40000012*        DAC*  IOCS        RETURN..(LOWD EXECUTES THE BRANCH).
```

```
0162                        *
0163                        *----ERROR RETURNS.
0164                        *
0165  00076  00200246    ER01 LBA  E1          QUEUE FULL ERROR.
0166  00077  00100337         LAA  02HD        ='200..F/G QUEUE OVERFLOW.
0167  00100  03500123*        SMP  DEVQ
0168  00101  00100336         LAA  01HD        ='100..B/G QUEUE OVERFLOW.
0169  00102  03500120*        SMP  ERUN
0170  00103  01100105*        BRU  *+2
0171  00104  03000307         MOA  BIT2        ='10000000..MGTP Q OVRFLO..A L A R M.
0172                         CALL REPAIR      REPORT ERROR. ROUTINE.
0173  00106  01100116*        BRU  ERRT        ERROR RETURN.
0174  00107  00200247    ER02 LBA  E2
0175  00110  01100116*        BRU  ERRT
0176  00111  00200250    ER03 LBA  E3
0177  00112  01100116*        BRU  ERRT
0178  00113  00200251    ER04 LBA  E4
0179  00114  01100116*        BRU  ERRT
0180  00115  00200252    ER05 LBA  E5
0181  00116  00000004    ERRT TBA
0182  00117  01100071*        BRU  RET         RETURN.
0183                        *
0184                        *
0185                        *----TEMPORARY WORK AREA.
0186                        *
0187        00000     *   IOTA EQU  PURG        USE PURG ENTRY POINT FOR TEMPORARY STORAGE.
0188        00120         ERUN BSS  1
0189        00121         SXR1 BSS  1
0190        00122         SXR2 BSS  1
0191        00123         DEVQ BSS  1
0192        00121     *   INTL EQU  *-3
0193        00122     *   LADR EQU  *-2
0194        00123     *   SADR EQU  *-1
0195                        *
0196                        *
0197                        *
0198                        *======LDT..LOGICAL DEVICE TABLE.
0199                        *------FILLED IN BY IO$PRG.
0200                        *
0201        00124         LDT  BSS  23          LOGICAL DEVICE TABLE.
```

```
0202                        *
0203                        *
0204                        *-----INITIALIZATION ROUTINE.
0205                        *
0206  00153  00000003      IOE5 CLA
0207  00154  01700002           AOP  2
0208  00155  00000022           NOP
0209  00156  23200206           LIX  MFOR,2
0210  00157  20200327*          LBA  OTAB+4,2
0211  00160  10000002           TBI  ,1            DCT ADDR. IN XR1.
0212  00161  11600023           EXU  CEU,1
0213  00162  01000000           DATA '01000000     TTY'S TO KEYBOARD MODE.
0214  00163  00000022           NOP
0215  00164  11600022           EXU  AOP,1         BLANK CHAR TO START INTERRUPTS.
0216  00165  00000022           NOP
0217  00166  23400157*          IIB  *-7,2
0218  00167  14302000           PIE  '2000,0       ENABLE TTY INTERRUPTS.
0219  00170  34300012           PIE  '12,1
0220  00171  41100010*          BRU* INCS          RETURN.
0221                        *
0222                        *
0223                        *-----A ROUTINE TO PURGE THE I/O QUEUES.
0224                        *
0225                        ****************************
0226                        *                          *
0227                        *--------IO$PRG-----------*
0228                        *                          *
0229                        ****************************
0230                        *
0231                        *THIS ROUTINE REMOVES ALL ACTIVE, AND WAITING
0232                        *I/O REQUESTS FROM THE QUEUES.
0233                        *THE ''Q'' BITS OF ALL IOTS FOUND IN THE
0234                        *QUEUES ARE SET TO ZERO.
0235                        *
0236  00172  00100315*      IOE1 LAA  LDTA          ADDRESS OF LDT-1.
0237  00173  00300122*           STA  LADR          POINTER TO LDT FOR ITS CONSTRUCTION.
0238  00174  00100237*           LAA  SDTA
0239  00175  00300123*           STA  SADR          POINTER TO SDT.
0240                        *
0241  00176  04302000           PID  '2000,0       RESET THE REQUEST LATCHES
```

```
0242  00177  24300052          PID  '52,1          OF ALL DEVICES.
0243                        *
0244                        *
0245  00200  01400122*    INC3 IMS  LADR          INCREMENT PNTR TO LOGICAL DEVICE TABLE.
0246  00201  01400123*         IMS  SADR          INCREMENT PNTR TO STANDARD DEVICE TABLE.
0247  00202  40100123*         LAA* SADR          GET ADDRESS OF DCT (DEVICE CONTROL TABLE).
0248  00203  02200200*         BAZ  INC3          ZERO--UNASSIGNED DEVICE NUMBER..TRY AGAIN.
0249  00204  10000001          TAI  ,1            PUT DCT ADDR IN XR1 AS A BASE ADDR.
0250  00205  01500234          CMA  SDTF          CHECK FOR END OF SDT. (LAST ENTRY='40000000).
0251  00206  01100210*         BRU  *+2           NOT END YET.
0252  00207  01100236*         BRU  INC5          END OF SDT..GO TO END OF PURGE ROUTINE.
0253  00210  40300122*         STA* LADR          PUT THIS DCT ADDR IN LDT.
0254  00211  10100002          LAA  2,1           ADDR OF START OF QUEUE FROM DCT.
0255  00212  30000001          TAI  ,3            USE XR3 AS PNTR THRU THE QUEUE.
0256  00213  00200212          LBA  ZERO          SOURCE OF ZEROS.
0257  00214  30477777          STB  '77777,3      ZERO THE TWO WORDS OF THE DCT
0258  00215  30477776          STB  '77776,3      DIRECTLY PRECEDING THE QUEUE ITSELF.
0259  00216  10300000          STA  0,1           RESET EXECUTION POINTER TO START OF QUEUE.
0260  00217  10300001          STA  1,1           RESET ENTRY POINTER TO START OF QUEUE.
0261  00220  20000001          TAI  ,2            USE XR2 AS PNTR THRU THE QUEUE.
0262  00221  10600003          SMA  3,1           SUBT ADDR OF END OF QUEUE TO GET LENGTH.
0263  00222  00600213          SMA  ONE           USE XR3 AS A NEGATIVE UP COUNTER
0264  00223  30000001          TAI  ,3            TO LOOP THRU LENGTH OF QUEUE.
0265  00224  20100000    INC4  LAA  0,2           PICK UP ENTRY FROM QUEUE.
0266  00225  02200233*         BAZ  *+6
0267  00226  10000001          TAI  ,1            FROM QUEUE ENTRY GET FIRST WORD OF
0268  00227  10100000          LAA  0,1           I/O TABLE & ZERO BITS 0,1 AND 2
0269  00230  02700345*         MAA  ='07777777
0270  00231  10300000          STA  0,1
0271  00232  20400000          STB  0,2           ALSO ZERO ENTRY IN QUEUE
0272  00233  23400234*         IIB  *+1,2         INCREMENT TO QUEUE POINTER.
0273  00234  33400224*         IIB  INC4,3        GOTO INC4 FOR ANOTHER QUEUE ENTRY.
0274  00235  01100200*         BRU  INC3          GOTO INC3 FOR ANOTHER DCT.
0275  00236  01200010*    INC5 SPB  INCS          PURGE FINISHED..INVOKE INITIALIZATION ROUTINE.
0276                        *
0277                        *-----A ROUTINE TO SELECT F/G AND B/G COMMAND AND LOGGING DEVICES
0278                        *-----FROM THE CONTROL SWITCHES AT MONITOR STARTUP TIME.
0279                        *
0280                        *-----F/G..SWITCHES 21-23.
0281                        *-----B/G..SWITCHES 18-20.
```

```
0282                          *
0283  00237 E05700315*    SDTA LCS /SDT-1          LCS..ALSO USED AS SDT-1 ADDR.
0284  00240  00003015           RSL  3
0285  00241  02700215           MAA  P3             ONLY DEVICES 1,2&3 ARE LEGAL ON SWITCHES
0286  00242  10000001           TAI  ,1             USE SETTING AS INDEX TO ITAB AND OTAB.
0287  00243  23200274*          LIX  IOE3+1,2       LDT ADDR TO XR2.
0288  00244  02200255*          BAZ  *+9            NO B/G SWITCHES SET...LEAVE AS IS.
0289  00245  10100323*          LAA  OTAB,1
0290  00246  03000234           MOA  NEG            SET B/G BIT.
0291  00247  20300016           STA  '16,2          B/G LOGGING DEVICE.
0292  00250  10100316*          LAA  ITAB,1
0293  00251  03000234           MOA  NEG            SET B/G BIT.
0294  00252  20300017           STA  '17,2          B/G PAPER TAPE DEVICE.
0295  00253  03000304           MOA  LAA
0296  00254  20300015           STA  '15,2          B/G COMMAND DEVICE.
0297  00255  05700000           LCS
0298  00256  02700215           MAA  P3
0299  00257  10000001           TAI  ,1             F/G SWITCH SETTINGS.
0300  00260  02200265*          BAZ  *+5
0301  00261  10100323*          LAA  OTAB,1
0302  00262  20300000           STA  0,2            F/G LOGGING DEVICE.
0303  00263  10100316*          LAA  ITAB,1
0304  00264  20300014           STA  '14,2          F/G COMMAND DEVICE.
0305  00265  41100000*          BRU* PURG           RETURN.
0306                          *
0307                          *
0308                          *
0309                          *
0310                          *
0311                          ****************************
0312                          *                          *
0313                          *--------IO$ASN-----------*
0314                          *                          *
0315                          ****************************
0316                          *
0317                          *ASSIGN I TO J.
0318                          * I IS IN XR1.
0319                          * J IS IN XR2.
0320                          *DEVICE J IN SDT REPLACES DEVICE I IN LDT.
0321                          *
```

```
0322  00266  16100326    IOE4 AMX   OMTY,1        SUBTRACT '20 TO GET DEVICES
0323  00267  26100326         AMX   OMTY,2        IN RANGE 00-'27.
0324  00270  20100000         LAA   $IO$SDT,2     SDT ENTRY.
0325  00271  10300124*        STA   LDT,1         MAKE ENTRY TO LDT.
0326  00272  41100006*        BRU*  ASGN          RETURN.
0327                        *
0328                        *
0329                        *
0330                        ****************************
0331                        *                          *
0332                        *----------IO$NHB---------*
0333                        *                          *
0334                        ****************************
0335                        *
0336                        *INHIBIT BACKGROUND FROM USING DEVICE I IN LDT.
0337                        * I IS IN XR1.
0338                        *
0339  00273  16100326    IOE3 AMX   OMTY,1        CONVERT TO RANGE 00-'27.
0340  00274  10100124*        LAA   LDT,1         A ''FOREGROUND ONLY'' DEVICE HAS SIGN BIT ON
0341  00275  02700235         MAA   BTZN          TURN OFF SIGN BIT TO INHIBIT DEVICE.
0342  00276  10300124*        STA   LDT,1         RETURN ENTRY TO LDT.
0343  00277  41100004*        BRU*  NHBT          RETURN.
0344                        *
0345                        *
0346                        ****************************
0347                        *                          *
0348                        *--------IO$RLS----------*
0349                        *                          *
0350                        ****************************
0351                        *
0352                        *
0353                        *RELEASE DEVICE I TO THE BACKGROUND.
0354                        * I IS IN XR1.
0355                        *
0356  00300  16100326    IOE2 AMX   OMTY,1        CONVERT TO RANGE 00-'27.
0357  00301  10100124*        LAA   LDT,1         TURN ON SIGN BIT OF DCT
0358  00302  03000234         MCA   NEG           IN LOGICAL DEVICE TABLE.
0359  00303  10300124*        STA   LDT,1
0360  00304  41100002*        BRU*  RLSE          RETURN.
0361                        *
```

```
0362                        *
0363                        ****************************
0364                        *                          *
0365                        *--------I$FIOT----------*
0366                        *--------I$BIOT----------*
0367                        *                          *
0368                        ****************************
0369                        *
0370                        *
0371                        *PLACE THE SPECIAL IOT ADDRESS FOR FOREGROUND (FIOT)
0372                        *OR BACKGROUND (BIOT) COMMAND INTO THE CORRESPONDING
0373                        *DEVICE CONTROL TABLES.
0374                        *WORD 16 OF DCT FOR TTY INPUT IS RESERVED FOR THIS IOTA.
0375                        *FOREGROUND COMMAND DEVICE..'14
0376                        *BACKGROUND COMMAND DEVICE..'15          *******+'20.
0377                        *
0378                        * IOT ADDRESS IS A REG.
0379                        *
0380  00305  00000000    FIOT ZZZ  **
0381  00306  13200140*        LIX  LDT+'14,1     DCT ADDRESS.
0382  00307  10300020         STA  COMM,1        STORE IOT ADDRESS IN DCT.
0383  00310  41100305*        BRU* FIOT          RETURN.
0384                        *
0385  00311  00000000    BIOT ZZZ  **
0386  00312  13200141*        LIX  LDT+'15,1
0387  00313  10300020         STA  COMM,1
0388  00314  41100311*        BRU* BIOT
0389                        *
0390                        *
0391                        *
0392  00315  00000123*    LDTA DAC  LDT-1
0393                        *
0394                        *------STANDARD DEVICE TABLE.
0395                        *
0396       00316    *      ITAB EQU  *
0397  00316  00000000       SDT  ZZZ  $I$TYQ3      '20  F/G LOG.
0398  00317  00000000            ZZZ  $I$KEQ1      '21
0399  00320  00000000            ZZZ  $I$KEQ2      '22
0400  00321  00000000            ZZZ  $I$KEQ3      '23
0401  00322  00000000            ZZZ  $I$KEQ1      '24
```

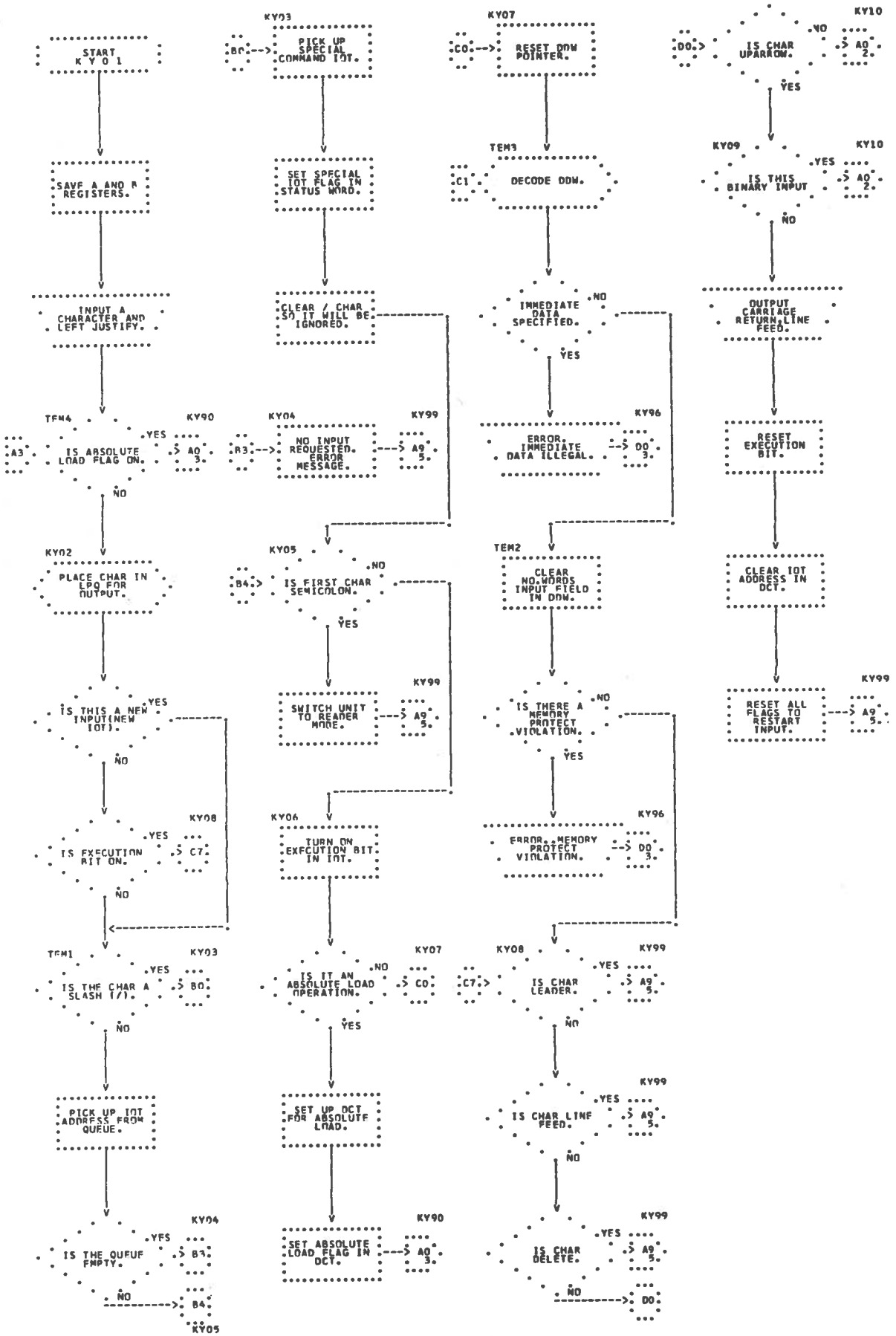
```
0402  00323  00000000   OTAB ZZZ  $I$KEO2      '25
0403  00324  00000000        ZZZ  $I$TYQ1      '26
0404  00325  00000000        ZZZ  $I$TYQ2      '27
0405  00326  00000000        ZZZ  $I$TYQ3      '30
0406  00327  00000000        ZZZ  $I$HTQO      '31
0407  00330  40000000        ZZZ* $I$HTQO      '32  HIGH SPEED PAPER TAPE PUNCH.
0408  00331  40000000        ZZZ* $I$HTQI      '33  HIGH SPEED PAPER TAPE READER.
0409  00332  00000000        ZZZ  $I$KEQ3      '34  F/G COMMAND.
0410  00333  40000000        ZZZ* $I$KEQ1      '35  B/G COMMAND.
0411  00334  40000000        ZZZ* $I$TYQ1      '36  B/G LOG.
0412  00335  40100000        LAA* $I$KEQ1      '37  B/G PAPER TAPE
0413  00336  00000000        ZZZ  $I$SDCT      '40  SYSTEM TAPE.
0414  00337  40000000        ZZZ* $I$SDCT      '41  B/G MAG TAPE.
0415  00340  00000000        ZZZ  0            '42  SPARE..MAG TAPE.
0416  00341  00000000        ZZZ  0            '43  SPARE..MAG TAPE.
0417  00342  00000000        ZZZ  $I$DDCT      '44  DATA TAPE #1.
0418  00343  00000000        ZZZ  $I$DDCT      '45  DATA TAPE #2.
0419  00344  40000000        ZZZ* 0           END OF TABLE.
0420                          END
      00345  07777777
```

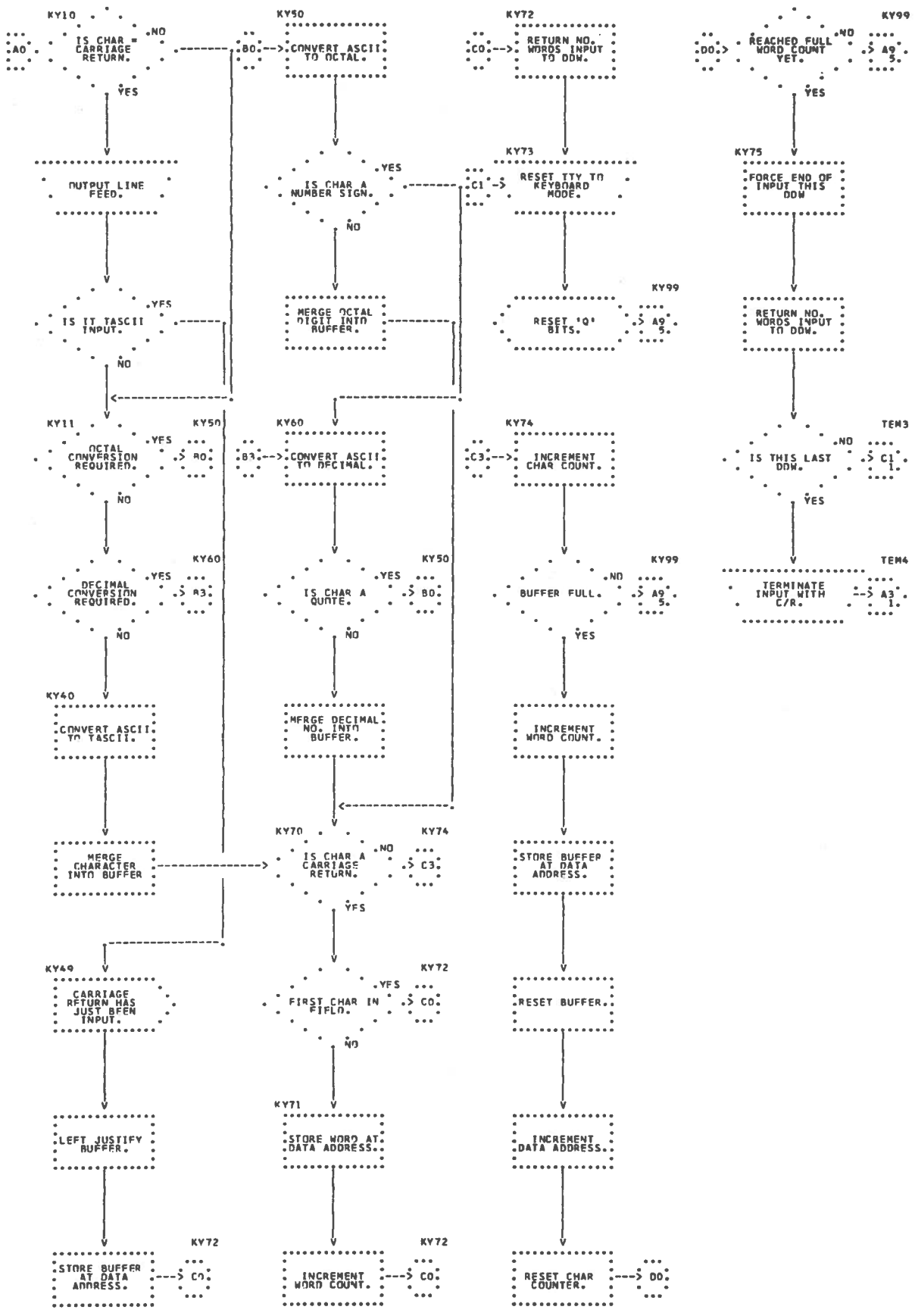
0001 ERRORS

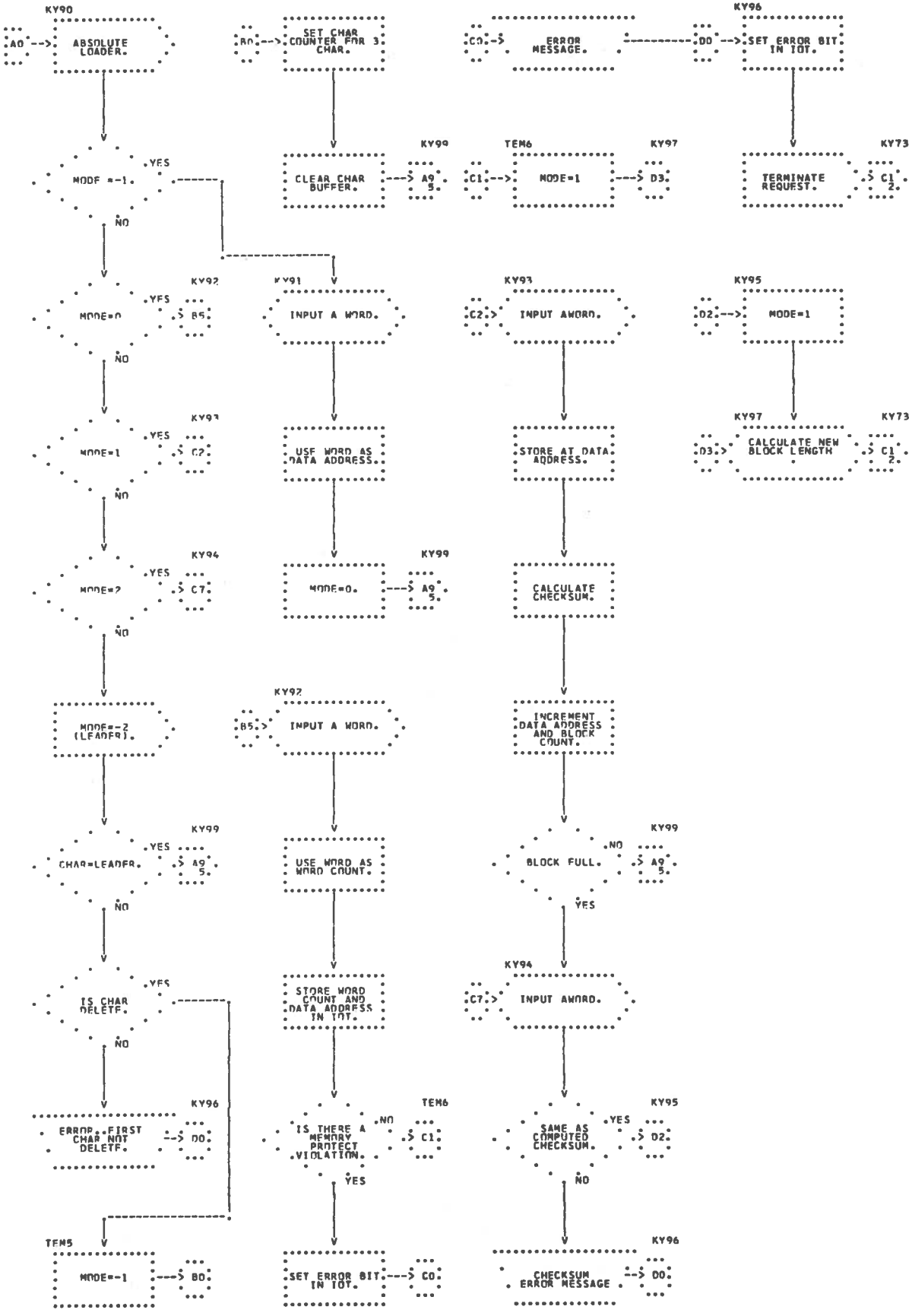
APPENDIX N

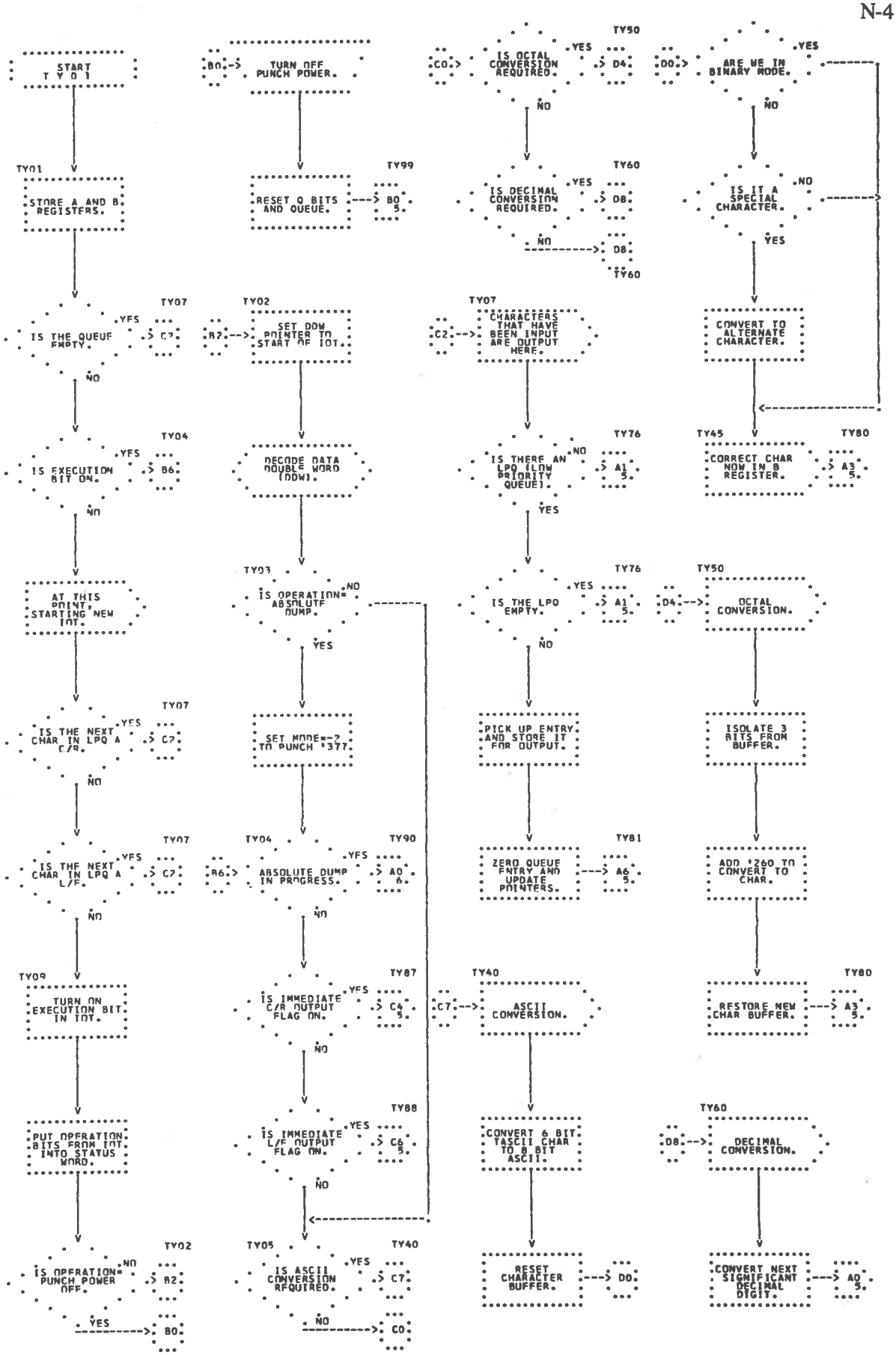
TELETYPE/PAPER TAPE HANDLER FLOWCHART AND LISTING

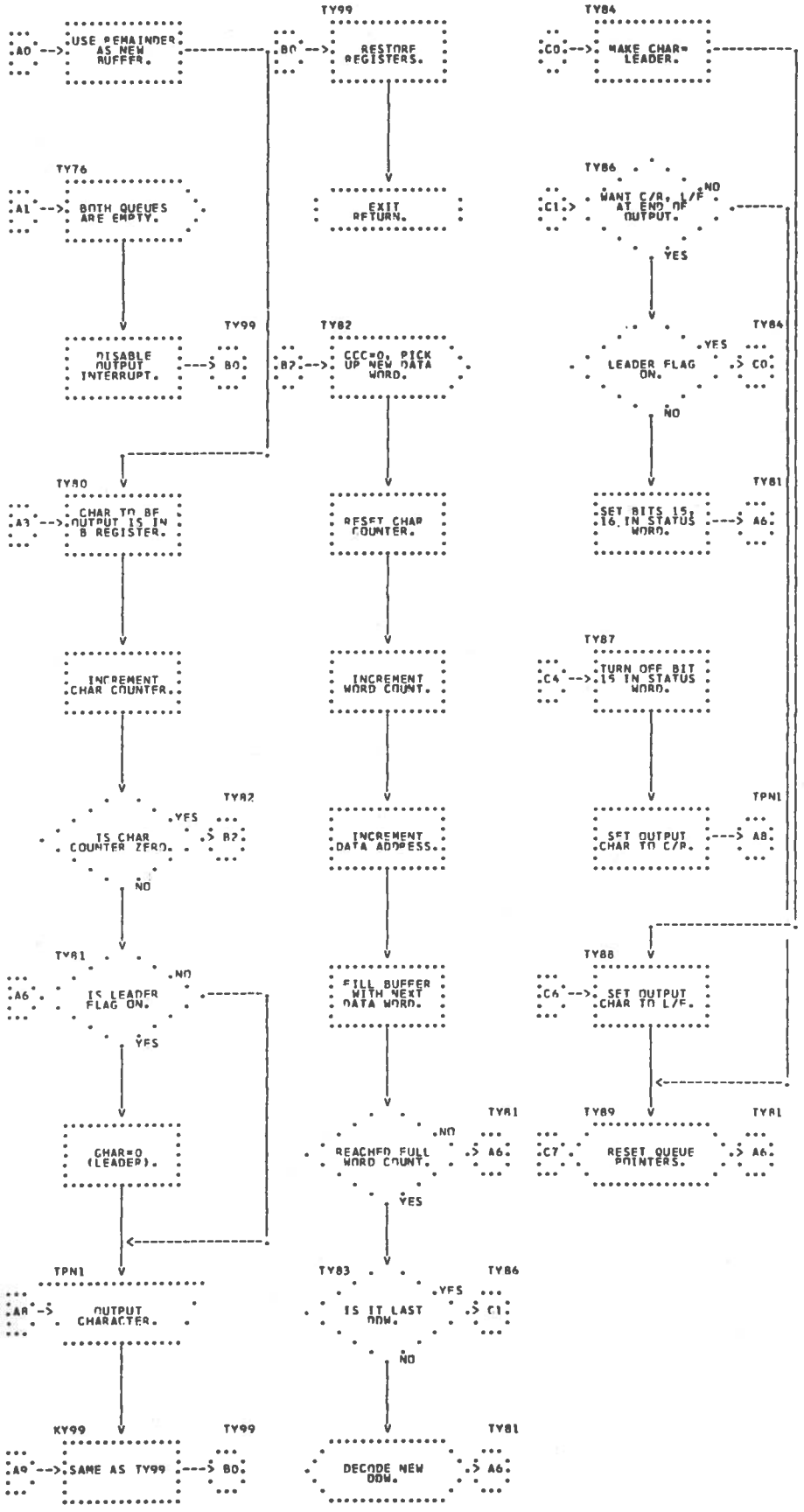
Symbol	Page	Coordinate
KY02	N-1	A4
KY03	N-1	B0
KY04	N-1	B3
KY05	N-1	B4
KY06	N-1	B6
KY07	N-1	C0
KY08	N-1	C7
KY09	N-1	D1
KY10	N-2	A0
KY11	N-2	A3
KY40	N-2	A5
KY49	N-2	A7
KY50	N-2	B0
KY60	N-2	B3
KY70	N-2	B6
KY71	N-2	B8
KY72	N-2	C0
KY73	N-2	C1
KY74	N-2	C3
KY75	N-2	D1
KY90	N-3	A0
KY91	N-3	B2
KY92	N-3	B5
KY93	N-3	C2
KY94	N-3	C7
KY95	N-3	D2
KY96	N-3	D0
KY97	N-3	D3
KY99	N-5	A9
TEM1	N-1	A7
TEM2	N-1	C4
TEM3	N-1	C1
TEM4	N-1	A3
TEM5	N-3	A9
TEM6	N-3	C1
TPN1	N-5	A8
TY01	N-4	A1
TY02	N-4	B2
TY03	N-4	B4
TY04	N-4	B6
TY05	N-4	B9
TY07	N-4	C2
TY09	N-4	A7
TY40	N-4	C7
TY45	N-4	D3
TY50	N-4	D4
TY60	N-4	D8
TY76	N-5	A1
TY80	N-5	A3
TY81	N-5	A6
TY82	N-5	B2
TY83	N-5	B8
TY84	N-5	C0
TY86	N-5	C1
TY87	N-5	C4
TY88	N-5	C6
TY89	N-5	C7
TY90	N-6	A0
TY91	N-6	A9
TY92	N-6	B2
TY93	N-6	B5
TY94	N-6	C2
TY97	N-6	C5
TY99	N-5	B0

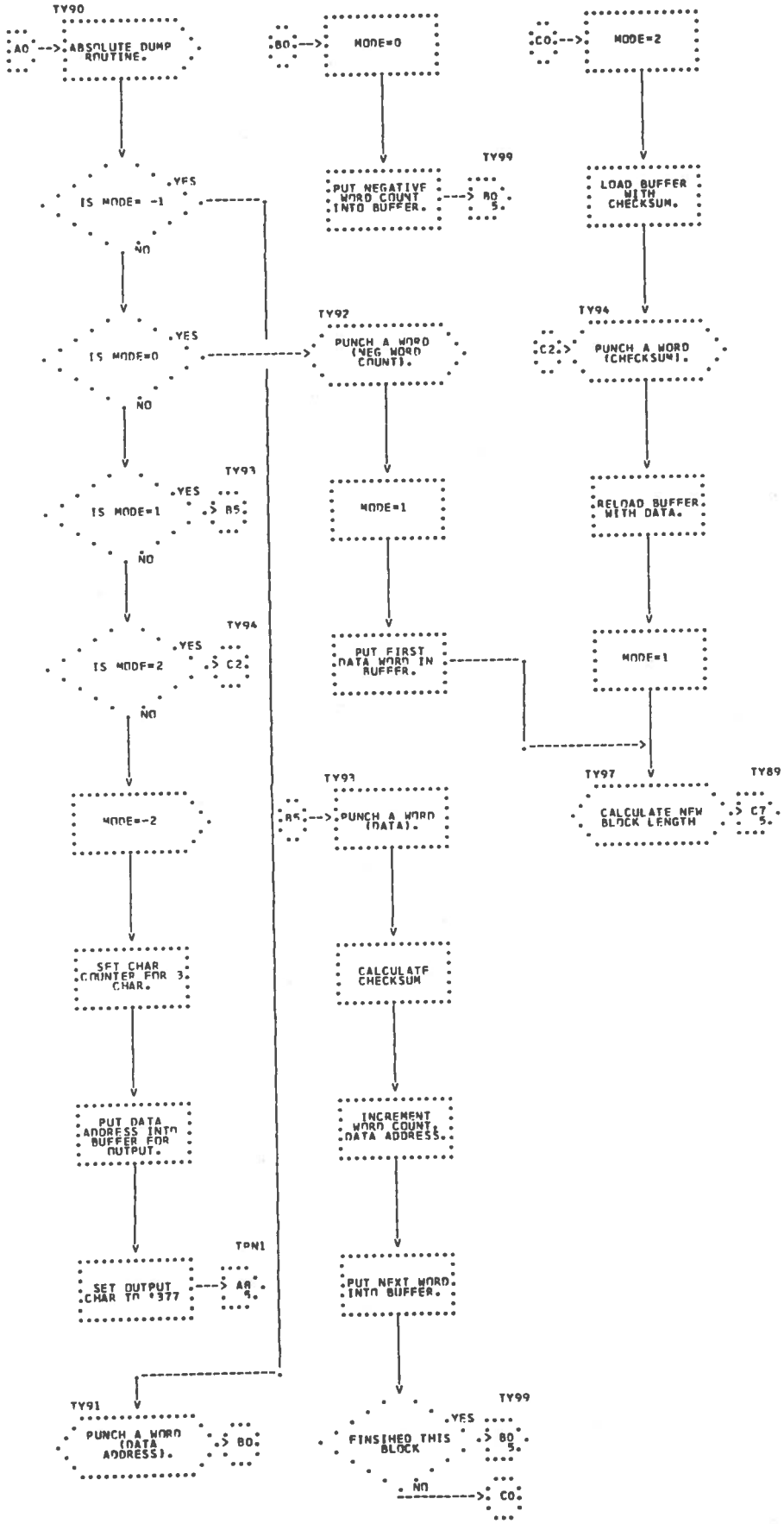

START K Y 0 1
SAVE A AND R REGISTERS.
INPUT A CHARACTER AND LEFT JUSTIFY.
TEM4
IS ABSOLUTE LOAD FLAG ON.
YES
-> A0 3.
NO
KY90
A3
KY02
PLACE CHAR IN LPQ FOR OUTPUT.
IS THIS A NEW INPUT(NEW IOT).
YES
NO
KY08
IS EXECUTION BIT ON.
YES
-> C7
NO
TEM1
IS THE CHAR A SLASH (/).
YES
-> B0
KY03
NO
PICK UP IOT ADDRESS FROM QUEUE.
IS THE QUFUF EMPTY.
YES
-> B4
KY04
NO
B4
KY05
KY03
B0
PICK UP SPECIAL COMMAND IOT.
SET SPECIAL IOT FLAG IN STATUS WRD.
CLEAR / CHAR SO IT WILL BE IGNORED.
KY04
B3
NO INPUT REQUESTED. ERROR MESSAGE.
KY99
-> A9 5.
KY05
IS FIRST CHAR SEMICOLON.
NO
B4
YES
KY99
SWITCH UNIT TO READER MODE.
-> A9 5.
KY06
TURN ON EXECUTION BIT IN IOT.
KY07
IS IT AN ABSOLUTE LOAD OPERATION.
NO
-> C0
YES
SET UP DCT FOR ABSOLUTE LOAD.
KY90
SET ABSOLUTE LOAD FLAG IN DCT.
-> A0 3.
KY07
C0
RESET DDW POINTER.
TEM3
DECODE DDW.
C1
IMMEDIATE DATA SPECIFIED.
NO
YES
KY96
ERROR. IMMEDIATE DATA ILLEGAL.
-> D0 3.
TEM2
CLEAR NO.WORDS INPUT FIELD IN DDW.
IS THERE A MEMORY PROTECT VIOLATION.
NO
YES
KY96
ERROR. MEMORY PROTECT VIOLATION.
-> D0 3.
KY08
C7
KY99
IS CHAR LEADER.
YES
-> A9 5.
NO
KY99
IS CHAR LINE FEED.
YES
-> A9 5.
NO
KY99
IS CHAR DELETE.
YES
-> A9 5.
NO
D0
KY10
D0
IS CHAR UPARROW.
NO
-> A0 2.
YES
KY09
KY10
IS THIS BINARY INPUT
YES
-> A0 2.
NO
OUTPUT CARRIAGE RETURN,LINE FEED.
RESET EXECUTION BIT.
CLEAR IOT ADDRESS IN DCT.
KY99
RESET ALL FLAGS TO RESTART INPUT.
-> A9 5.


KY10
IS CHAR = CARRIAGE RETURN.
NO
YES
A0
OUTPUT LINE FEED.
IS IT TASCII INPUT.
YES
NO
KY11
OCTAL CONVERSION REQUIRED.
YES
KY50
R0
NO
KY60
DECIMAL CONVERSION REQUIRED.
YES
R3
NO
KY40
CONVERT ASCII TO TASCII.
MERGE CHARACTER INTO BUFFER
KY49
CARRIAGE RETURN HAS JUST BEEN INPUT.
LEFT JUSTIFY BUFFER.
STORE BUFFER AT DATA ADDRESS.
KY72
C0
KY50
B0
CONVERT ASCII TO OCTAL.
IS CHAR A NUMBER SIGN.
YES
NO
MERGE OCTAL DIGIT INTO BUFFER.
KY60
B3
CONVERT ASCII TO DECIMAL.
KY50
IS CHAR A QUOTE.
YES
B0
NO
MERGE DECIMAL NO. INTO BUFFER.
KY70
IS CHAR A CARRIAGE RETURN.
NO
KY74
C3
YES
KY72
FIRST CHAR IN FIELD.
YES
C0
NO
KY71
STORE WORD AT DATA ADDRESS.
INCREMENT WORD COUNT.
KY72
C0
KY72
C0
RETURN NO. WORDS INPUT TO DDW.
KY73
C1
RESET TTY TO KEYBOARD MODE.
KY99
RESET 'Q' BITS.
A9
5.
KY74
C3
INCREMENT CHAR COUNT.
KY99
BUFFER FULL.
NO
YES
A9
5.
INCREMENT WORD COUNT.
STORE BUFFER AT DATA ADDRESS.
RESET BUFFER.
INCREMENT DATA ADDRESS.
RESET CHAR COUNTER.
D0
KY99
D0
REACHED FULL WORD COUNT YET.
NO
A9
5.
YES
KY75
FORCE END OF INPUT THIS DDW
RETURN NO. WORDS INPUT TO DDW.
TEM3
IS THIS LAST DDW.
NO
C1
1.
YES
TEM4
TERMINATE INPUT WITH C/R.
A3
1.


KY90
A0
ABSOLUTE LOADER.
MODE =-1.
YES
NO
MODE=0
YES
B5
KY92
MODE=1
YES
C2
KY93
MODE=2
YES
C7
KY94
MODE=-2 (LEADER).
CHAR=LEADER.
YES
A9 5.
KY99
NO
IS CHAR DELETE.
YES
NO
ERROR..FIRST CHAR NOT DELETE.
D0
KY96
TEM5
MODE=-1
B0
B0
SET CHAR COUNTER FOR 3 CHAR.
CLEAR CHAR BUFFER.
KY99
A9 5.
KY91
INPUT A WORD.
USE WORD AS DATA ADDRESS.
MODE=0.
KY99
A9 5.
KY92
B5
INPUT A WORD.
USE WORD AS WORD COUNT.
STORE WORD COUNT AND DATA ADDRESS IN TDT.
IS THERE A MEMORY PROTECT VIOLATION.
NO
C1.
TEM6
YES
SET ERROR BIT IN TDT.
C0
KY93
C2
INPUT A WORD.
STORE AT DATA ADDRESS.
CALCULATE CHECKSUM.
INCREMENT DATA ADDRESS AND BLOCK COUNT.
BLOCK FULL.
NO
A9 5.
KY99
YES
KY94
C7
INPUT A WORD.
SAME AS COMPUTED CHECKSUM.
YES
D2.
KY95
NO
CHECKSUM ERROR MESSAGE
D0
KY96
C0
ERROR MESSAGE.
D0
SET ERROR BIT IN TDT.
KY96
TEM6
C1
MODE=1
D3.
KY97
KY95
D2
MODE=1
KY97
D3
CALCULATE NEW BLOCK LENGTH
C1 2.
KY73
KY73
TERMINATE REQUEST.
C1 2.


START T Y 0 1
TY01
STORE A AND B REGISTERS.
IS THE QUEUE EMPTY.
YES
C7
NO
TY07
IS EXECUTION BIT ON.
YES
B6
NO
TY04
AT THIS POINT, STARTING NEW IOT.
IS THE NEXT CHAR IN LPQ A C/R.
YES
C7
NO
TY07
IS THE NEXT CHAR IN LPQ A L/F.
YES
C7
NO
TY07
TURN ON EXECUTION BIT IN IOT.
TY09
PUT OPERATION BITS FROM IOT INTO STATUS WORD.
IS OPERATION= PUNCH POWER OFF.
NO
YES
B2
B0
TURN OFF PUNCH POWER.
B0
RESET Q BITS AND QUEUE.
TY99
B0
5
SET DDW POINTER TO START OF IOT.
TY02
B2
DECODE DATA DOUBLE WORD (DDW).
IS OPERATION= ABSOLUTE DUMP.
NO
YES
TY03
SET MODE=? TO PUNCH '377.
ABSOLUTE DUMP IN PROGRESS.
YES
R6
A0
6
TY04
TY90
NO
IS IMMEDIATE C/R OUTPUT FLAG ON.
YES
C4
5
TY87
NO
IS IMMEDIATE L/F OUTPUT FLAG ON.
YES
C6
5
TY88
NO
IS ASCII CONVERSION REQUIRED.
YES
C7
TY05
TY40
NO
C0
IS OCTAL CONVERSION REQUIRED.
YES
D4
TY50
NO
IS DECIMAL CONVERSION REQUIRED.
YES
D8
TY60
NO
D8
TY60
C0
C2
CHARACTERS THAT HAVE BEEN INPUT ARE OUTPUT HERE.
TY07
IS THERE AN LPQ (LOW PRIORITY QUEUE).
NO
A1
5
TY76
YES
IS THE LPQ EMPTY.
YES
A1
5
TY76
NO
PICK UP ENTRY AND STORE IT FOR OUTPUT.
ZERO QUEUE ENTRY AND UPDATE POINTERS.
A6
5
TY81
C7
ASCII CONVERSION.
CONVERT 6 BIT TASCII CHAR TO 8 BIT ASCII.
RESET CHARACTER BUFFER.
D0
ARE WE IN BINARY MODE.
YES
NO
IS IT A SPECIAL CHARACTER.
NO
YES
CONVERT TO ALTERNATE CHARACTER.
TY45
CORRECT CHAR NOW IN B REGISTER.
A3
5
TY80
D4
OCTAL CONVERSION.
TY50
ISOLATE 3 BITS FROM BUFFER.
ADD '260 TO CONVERT TO CHAR.
RESTORE NEW CHAR BUFFER.
A3
5
TY80
D8
DECIMAL CONVERSION.
TY60
CONVERT NEXT SIGNIFICANT DECIMAL DIGIT.
A0
5


A0
USE REMAINDER AS NEW BUFFER.
A1
TY76
BOTH QUEUES ARE EMPTY.
DISABLE OUTPUT INTERRUPT.
TY99
B0
A3
TY80
CHAR TO BE OUTPUT IS IN B REGISTER.
INCREMENT CHAR COUNTER.
IS CHAR COUNTER ZERO.
YES
TY82
B2
NO
A6
TY81
IS LEADER FLAG ON.
NO
YES
CHAR=0 (LEADER).
TPN1
AR
OUTPUT CHARACTER.
A9
KY99
SAME AS TY99
B0
TY99
RESTORE REGISTERS.
EXIT RETURN.
B2
TY82
CCC=0, PICK UP NEW DATA WORD.
RESET CHAR COUNTER.
INCREMENT WORD COUNT.
INCREMENT DATA ADDRESS.
FILL BUFFER WITH NEXT DATA WORD.
REACHED FULL WORD COUNT.
TY81
NO
YES
A6
TY83
IS IT LAST DDW.
YES
TY86
C1
NO
DECODE NEW DDW.
TY81
A6
C0
TY84
MAKE CHAR= LEADER.
C1
TY86
WANT C/R, L/F AT END OF OUTPUT.
NO
YES
LEADER FLAG ON.
YES
TY84
C0
NO
SET BITS 15, 16 IN STATUS WORD.
TY81
A6
C4
TY87
TURN OFF BIT 15 IN STATUS WORD.
SET OUTPUT CHAR TO C/R.
TPN1
A8
C6
TY88
SET OUTPUT CHAR TO L/F.
C7
TY89
RESET QUEUE POINTERS.
TY81
A6


TY90
A0
ABSOLUTE DUMP ROUTINE.
IS MODE= -1
YES
NO
IS MODE=0
YES
NO
TY93
IS MODE=1
YES
B5
NO
TY94
IS MODE=2
YES
C2
NO
MODE=-2
SET CHAR COUNTER FOR 3 CHAR.
PUT DATA ADDRESS INTO BUFFER FOR OUTPUT.
TP01
SET OUTPUT CHAR TO 177377
TY91
PUNCH A WORD (DATA ADDRESS).
B0
B0
MODE=0
PUT NEGATIVE WORD COUNT INTO BUFFER.
TY99
A0
5.
TY92
PUNCH A WORD (NEG WORD COUNT).
MODE=1
PUT FIRST DATA WORD IN BUFFER.
TY93
B5
PUNCH A WORD (DATA).
CALCULATE CHECKSUM
INCREMENT WORD COUNT, DATA ADDRESS.
PUT NEXT WORD INTO BUFFER.
TY99
YES
FINSIHED THIS BLOCK
B0
5.
NO
C0
C0
MODE=2
LOAD BUFFER WITH CHECKSUM.
TY94
C2
PUNCH A WORD (CHECKSUM).
RELOAD BUFFER WITH DATA.
MODE=1
TY97
CALCULATE NEW BLOCK LENGTH
TY89
C7
5.

```
1  PAGE 00C1                    TELETYPE/PAPER TAPE PREHANDLER.

0001                           *TT1
0003                           ********************************************
0004                           *                                          *
0005                           *-----A.R.O. SYSTEM SOFTWARE.---------------*
0006                           *                                          *
0007                           *-------TYPEWRITER   I/O   PREHANDLER-------*
0008                           *                                          *
0009                           *-------------SEPTEMBER  1968            DJB*
0010                           *                                          *
0011                           ********************************************
0012          00000000              NAME I$KEY1,KEY1
0013          00000015              NAME I$KEQ1,KEQ1
0014          00000051              NAME I$TYP1,TYP1
0015          00000065              NAME I$TYQ1,TYQ1
0016         02000                  INTL EQU  '02000   INPUT INTERRUPT LEVEL.
0017         01000                  ONTL EQU  '01000   OUTPUT INTERRUPT LEVEL.
0018         00000                  INTG EQU  0        I/O INTERRUPT GROUP.
0019         00001                  DEVN EQU  1        PHYSICAL DEVICE NUMBER.
0020                                ****
0021                                ****
0022  0C000  00000000               KEY1 ZZZ  **       INPUT ENTRY POINT.
0023  00001  13300013*                    STI  KEQ1-2,1 SAVE REGISTERS IN
0024  0C002  23300014*                    STI  KEQ1-1,2 REGISTER SAVEAREA.
0025  0C003  13200005*                    LIX  *+2,1    ADDRESS OF WORD AREA.
0026  0C004  01100000                     BRU  $I$KY01  TTY/PT INPUT HANDLER.
0027  0C005  00000015*                    DAC  KEQ1     ADDRESS OF WORDAREA.
0028                                *
0029                                *---------RETURN FROM INPUT HANDLER.
0030                                *
0031  0C006  14301000               KZR1 PIE  ONTL,INTG  ENABLE OUTPUT INTERRUPT.
0032  0C007  13200013*                    LIX  SAVE+2,1  FROM REGISTER SAVE AREA.
0033  00010  03600000*                    PIR  KEY1     RETURN.
0034                                *
0035                                *----DEVICE CONTROL TABLE  (INPUT).
0036                                *
0037         00011                  SAVE BSS  4
0038  00015  00000044*              KEQ1 DAC  KZCS     EXECUTION POINTER.
0039  00016  00000044*                   DAC  KZCS     ENTRY POINTER.
0040  0C017  00000044*                   DAC  KZCS     ADDRESS OF START OF QUEUE.
0041  0C020  00000050*                   DAC  KZCE     ADDRESS OF END OF QUEUE.
```

```
0042                              CALL TCNR
0043  00022  14302000            PIE  INTL,INTG ENABLE INPUT INTERRUPT.
0044  00023  00000125*           DAC  LPQ1     ADDRESS OF LOW PRIORITY QUEUE.
0045  00024  00000000            HLT            FORMAT...CONVERSION.
0046  00025  00000000            HLT            FCC..FULL CHARACTER COUNT.
0047  00026  00000000            HLT            CCC..CURRENT CHARACTER COUNT.
0048  00027  00000000            HLT            FWC..FULL WORD COUNT.
0049  00030  00000000            HLT            CWC..CURRENT WORD COUNT.
0050  00031  00000000            HLT            DADR.DATA ADDRESS.
0051  00032  00000000            HLT            CCB..CURRENT CHARACTER BUFFER.
0052  00033  00000000            HLT            DDWP.DATA DOUBLE WORD POINTER.
0053  00034  00000000            HLT            TEMP.TEMPORARY STORAGE.
0054  00035  00000000            HLT            SIOT.SPECIAL IOT (COMMAND).
0055  00036  00000006*           DAC  KZR1     RTAD.RETURN ADDRESS.
0056  00037  01720001            AIP  DEVN     AIP..INPUT INSTRUCTION.
0057  00040  01300001            CEU  DEVN     CEU..COMMAND EXTERNAL UNIT INSTR.
0058  00041  00000000            HLT            CHAR.CHARACTER JUST INPUT.
0059  00042  00000000            HLT            ICTA.ADDRESS OF CURRENT IOT.
0060  00043  00000000            HLT            STAT.INPUT STATUS WORD.
0061  00044  00000000    KZQS    HLT            FIRST LOCATION OF QUEUE.
0062  00045  00000000            HLT
0063  00046  00000000            HLT
0064  00047  00000000            HLT
0065  00050  00000000    KZQE    HLT            LAST LOCATION OF QUEUE.
0066                     *
0067                     *
0068                     *---------OUTPUT PREHANDLER.
0069                     *
0070  00051  00000000    TYP1    ZZZ  **       OUTPUT ENTRY POINT.
0071  00052  13300063*           STI  TYQ1-2,1 SAVE REGISTERS IN
0072  00053  23300064*           STI  TYQ1-1,2 REGISTER SAVE AREA.
0073  00054  13200056*           LIX  *+2,1    LOAD XR1 WITH ADDR OF WORKAREA.
0074  00055  01100000            BRU  $I$TY01  TTY/PT OUTPUT HANDLER.
0075  00056  00000065*           DAC  TYQ1     ADDRESS OF WORD AREA.
0076                     *
0077                     *---------RETURN FROM OUTPUT HANDLER.
0078                     *
0079  00057  13200063*    TYR1    LIX  TYQ1-2,1 RESTORE XR1
0080  00060  03600051*           PIR  TYP1     RETURN.
0081                     *
```

```
0082                        *----DEVICE CONTROL TABLE  (OUTPUT).
0083                        *
0084          00061         SAVR BSS  4
0085  00065  00000114*      TYQ1 DAC  TZQS      EXECUTION POINTER.
0086  00066  00000114*           DAC  TZQS      ENTRY POINTER.
0087  00067  00000114*           DAC  TZQS      ADDRESS OF START OF QUEUE.
0088  00070  00000124*           DAC  TZQE      ADDRESS OF END OF QUEUE.
0089  00071  00000022            NOP
0090  00072  14301000            PIE  ONTL,INTG ENABLE INSTR.
0091  00073  00000125*           DAC  LPQ1      ADDRESS OF LCW PRIORITY QUEUE.
0092  00074  00000000            HLT            FRMT...FORMAT.
0093  00075  00000000            HLT            FCC....FULL CHAR COUNT.
0094  00076  00000000            HLT            CCC....CURRENT CHAR COUNT.
0095  00077  00000000            HLT            FWC....FULL WORD COUNT.
0096  00100  00000000            HLT            CWC....CURRENT WORD COUNT.
0097  00101  00000000            HLT            DADR...DATA ADDRESS.
0098  00102  00000000            HLT            CCB....CURRENT CHAR BUFFER.
0099  00103  00000000            HLT            DDWP...DDW POINTER.
0100  00104  00000000            HLT            TEMP...TEMPORARY STORAGE.
0101  00105  00000000            HLT            --------NOT USED--------
0102  00106  00000057*           DAC  TYR1      RTAD...RETURN ADDRESS.
0103  00107  01700001            AOP  DEVN      ACP....OUTPUT INSTRUCTION.
0104  00110  01300001            CEU  DEVN      CEU....CEU INSTRUCTION.
0105  00111  00000000            HLT            OUTC...CHAR TO BE OUTPUT.
0106  00112  00000000            HLT            IOTA...IOT ADDRESS.
0107  00113  00000000            HLT            STAT...OUTPUT STATUS WORD.
0108  00114  00000000      TZQS  HLT            START OF QUEUE.
0109  00115  00000000            HLT
0110  00116  00000000            HLT
0111  00117  00000000            HLT
0112  00120  00000000            HLT
0113  00121  00000000            HLT
0114  00122  00000000            HLT
0115  00123  00000000            HLT
0116  00124  00000000      TZQE  HLT            END OF QUEUE.
0117                        *
0118                        *
0119                        *----------LCW PRIORITY QUEUE.
0120                        *
0121  00125  00000131*      LPQ1 DAC  LPQS
```

```
    0122  00126  00000131*        DAC  LPQS
    0123  00127  00000131*        DAC  LPQS
    0124  00130  00000146*        DAC  LPQE
    0125  00131  00000000   LPQS  HLT
    0126  00132  00000000         HLT
    0127  00133  00000000         HLT
    0128  00134  00000000         HLT
    0129  00135  00000000         HLT
    0130  00136  00000000         HLT
    0131  00137  00000000         HLT
    0132  00140  00000000         HLT
    0133  00141  00000000         HLT
    0134  00142  00000000         HLT
    0135  00143  00000000         HLT
    0136  00144  00000000         HLT
    0137  00145  00000000         HLT
    0138  00146  00000000   LPQE  HLT
    0139                         END
EOJ
```

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1  PAGE 0001                    TELETYPE/PAPER TAPE PREHANDLER.

0001                            *TT2
0003                            ************************************************
0004                            *                                              *
0005                            *-----A.R.C. SYSTEM SOFTWARE.-----------------*
0006                            *                                              *
0007                            *-------TYPEWRITER   I/C   PREHANDLER--------*
0008                            *                                              *
0009                            *-------------SEPTEMBER  1968              DJB*
0010                            *                                              *
0011                            ************************************************
0012          00000000              NAME I$KEY2,KEY1
0013          00000015              NAME I$KEQ2,KEQ1
0014          00000051              NAME I$TYP2,TYP1
0015          00000065              NAME I$TYQ2,TYQ1
0016         00002                  INTL EQU  '00002    INPUT INTERRUPT LEVEL.
0017         00001                  ONTL EQU  '00001    OUTPUT INTERRUPT LEVEL.
0018         00001                  INTG EQU  '1        I/O INTERRUPT GROUP.
0019         00010                  DEVN EQU  '10       PHYSICAL DEVICE NUMBER.
0020                                ****
0021                                ****
0022  00000  00000000                KEY1 ZZZ  **        INPUT ENTRY POINT.
0023  00001  13300013*                    STI  KEQ1-2,1 SAVE REGISTERS IN
0024  00002  23300014*                    STI  KEQ1-1,2 REGISTER SAVEAREA.
0025  00003  13200005*                    LIX  *+2,1    ADDRESS OF WORD AREA.
0026  00004  01100000                    BRU  $I$KY01  TTY/PT INPUT HANDLER.
0027  00005  00000015*                    DAC  KEQ1     ADDRESS OF WORDAREA.
0028                                *
0029                                *---------RETURN FROM INPUT HANDLER.
0030                                *
0031  00006  34300001                KZR1 PIE  ONTL,INTG  ENABLE OUTPUT INTERRUPT.
0032  00007  13200013*                    LIX  SAVE+2,1  FROM REGISTER SAVE AREA.
0033  00010  03600000*                    PIR  KEY1      RETURN.
0034                                *
0035                                *----DEVICE CONTROL TABLE  (INPUT).
0036                                *
0037         00011                  SAVE BSS  4
0038  00015  00000044*              KEQ1 DAC  KZQS      EXECUTION POINTER.
0039  00016  00000044*                   DAC  KZQS      ENTRY POINTER.
0040  00017  00000044*                   DAC  KZQS      ADDRESS OF START OF QUEUE.
0041  00020  00000050*                   DAC  KZQE      ADDRESS OF END OF QUEUE.
```

```
0042                                CALL TONR
0043  00022  34300002              PIE  INTL,INTG ENABLE INPUT INTERRUPT.
0044  00023  00000125*             DAC  LPQ1      ADDRESS OF LOW PRIORITY QUEUE.
0045  00024  00000000              HLT            FORMAT...CONVERSION.
0046  00025  00000000              HLT            FCC..FULL CHARACTER COUNT.
0047  00026  00000000              HLT            CCC..CURRENT CHARACTER COUNT.
0048  00027  00000000              HLT            FWC..FULL WORD COUNT.
0049  00030  00000000              HLT            CWC..CURRENT WORD COUNT.
0050  00031  00000000              HLT            DADR.DATA ADDRESS.
0051  00032  00000000              HLT            CCB..CURRENT CHARACTER BUFFER.
0052  00033  00000000              HLT            DCWP.DATA DOUBLE WORD POINTER.
0053  00034  00000000              HLT            TEMP.TEMPORARY STORAGE.
0054  00035  00000000              HLT            SIOT.SPECIAL IOT (COMMAND).
0055  00036  00000006*             DAC  KZR1      RTAD.RETURN ADDRESS.
0056  00037  01720010              AIP  DEVN      AIP..INPUT INSTRUCTION.
0057  00040  01300010              CEU  DEVN      CEU..COMMAND EXTERNAL UNIT INSTR.
0058  00041  00000000              HLT            CHAR.CHARACTER JUST INPUT.
0059  00042  00000000              HLT            ICTA.ADDRESS OF CURRENT IOT.
0060  00043  00000000              HLT            STAT.INPUT STATUS WORD.
0061  00044  00000000    KZQS HLT                 FIRST LOCATION OF QUEUE.
0062  00045  00000000         HLT
0063  00046  00000000         HLT
0064  00047  00000000         HLT
0065  00050  00000000    KZQE HLT                 LAST LOCATION OF QUEUE.
0066                     *
0067                     *
0068                     *---------OUTPUT PREHANDLER.
0069                     *
0070  00051  00000000    TYP1 ZZZ  **             OUTPUT ENTRY POINT.
0071  00052  13300063*         STI  TYQ1-2,1  SAVE REGISTERS IN
0072  00053  23300064*         STI  TYQ1-1,2  REGISTER SAVE AREA.
0073  00054  13200056*         LIX  *+2,1     LOAD XR1 WITH ADDR OF WORKAREA.
0074  00055  01100000         BRU  $I$TY01 TTY/PT OUTPUT HANDLER.
0075  00056  00000065*         DAC  TYQ1      ADDRESS OF WORD AREA.
0076                     *
0077                     *---------RETURN FROM OUTPUT HANDLER.
0078                     *
0079  00057  13200063*    TYR1 LIX  TYQ1-2,1 RESTORE XR1
0080  00060  03600051*         PIR  TYP1      RETURN.
0081                     *
```

TELETYPE/PAPER TAPE PREHANDLER.

```
0082                                *----DEVICE CONTROL TABLE  (OUTPUT).
0083                                *
0084          00061                 SAVR BSS  4
0085  00065  00000114*               TYQ1 DAC  TZQS      EXECUTION POINTER.
0086  00066  00000114*                    DAC  TZQS      ENTRY POINTER.
0087  00067  00000114*                    DAC  TZQS      ADDRESS OF START OF QUEUE.
0088  00070  00000124*                    DAC  TZQE      ADDRESS OF END OF QUEUE.
0089  00071  00000022                     NOP
0090  00072  34300001                     PIE  ONTL,INTG ENABLE INSTR.
0091  00073  00000125*                    DAC  LPQ1      ADDRESS OF LOW PRIORITY QUEUE.
0092  00074  00000000                     HLT            FRMT...FORMAT.
0093  00075  00000000                     HLT            FCC....FULL CHAR COUNT.
0094  00076  00000000                     HLT            CCC....CURRENT CHAR COUNT.
0095  00077  00000000                     HLT            FWC....FULL WORD COUNT.
0096  00100  00000000                     HLT            CWC....CURRENT WORD COUNT.
0097  00101  00000000                     HLT            DADR...DATA ADDRESS.
0098  00102  00000000                     HLT            CCB....CURRENT CHAR BUFFER.
0099  00103  00000000                     HLT            DDWP...DDW POINTER.
0100  00104  00000000                     HLT            TEMP...TEMPORARY STORAGE.
0101  00105  00000000                     HLT            --------NOT USED--------
0102  00106  00000057*                    DAC  TYR1      RTAD...RETURN ADDRESS.
0103  00107  01700010                     AOP  DEVN      ACP....OUTPUT INSTRUCTION.
0104  00110  01300010                     CEU  DEVN      CEU....CEU INSTRUCTION.
0105  00111  00000000                     HLT            OUTC...CHAR TO BE OUTPUT.
0106  00112  00000000                     HLT            IOTA...IOT ADDRESS.
0107  00113  00000000                     HLT            STAT...OUTPUT STATUS WORD.
0108  00114  00000000               TZQS HLT            START OF QUEUE.
0109  00115  00000000                     HLT
0110  00116  00000000                     HLT
0111  00117  00000000                     HLT
0112  00120  00000000                     HLT
0113  00121  00000000                     HLT
0114  00122  00000000                     HLT
0115  00123  00000000                     HLT
0116  00124  00000000               TZQE HLT            END OF QUEUE.
0117                                *
0118                                *
0119                                *----------LOW PRIORITY QUEUE.
0120                                *
0121  00125  00000131*               LPQ1 DAC  LPQS
```

```
    0122  0C126  00000131*          DAC  LPQS
    0123  0C127  00000131*          DAC  LPQS
    0124  0C130  00000146*          DAC  LPQE
    0125  0C131  0C000000    LPQS   HLT
    0126  0C132  00000000           HLT
    0127  0C133  00000000           HLT
    0128  0C134  00000000           HLT
    0129  0C135  0C000000           HLT
    0130  0C136  00000000           HLT
    C131  0C137  00000000           HLT
    0132  0C14C  00000000           HLT
    0133  00141  00000000           HLT
    0134  0C142  00000000           HLT
    0135  0C143  00000000           HLT
    0136  0C144  00000000           HLT
    0137  0C145  00000000           HLT
    0138  0C146  00000000    LPQE   HLT
    0139                            END
EOJ
```

TELETYPE/PAPER TAPE PREHANDLER.

```
0001                        *TT3
0003                        ***********************************************
0004                        *                                             *
0005                        *-----A.R.O. SYSTEM SOFTWARE.----------------*
0006                        *                                             *
0007                        *-------TYPEWRITER   I/C   PREHANDLER--------*
0008                        *                                             *
0009                        *-------------SEPTEMBER  1968              DJR*
0010                        *                                             *
0011                        ***********************************************
0012          00000000           NAME I$KEY3,KEY1
0013          00000015           NAME I$KEQ3,KEQ1
0014          00000051           NAME I$TYP3,TYP1
0015          00000065           NAME I$TYQ3,TYQ1
0016         00010               INTL EQU  '00010   INPUT INTERRUPT LEVEL.
0017         00004               ONTL EQU  '00004   OUTPUT INTERRUPT LEVEL.
0018         00001               INTG EQU  1        I/O INTERRUPT GROUP.
0019         00015               DEVN EQU  '15      PHYSICAL DEVICE NUMBER.
0020                             ****
0021                             ****
0022  00000  00000000             KEY1 ZZZ  **       INPUT ENTRY POINT.
0023  00001  13300013*                  STI  KEQ1-2,1 SAVE REGISTERS IN
0024  00002  23300014*                  STI  KEQ1-1,2 REGISTER SAVEAREA.
0025  00003  13200005*                  LIX  *+2,1    ADDRESS OF WORD AREA.
0026  00004  01100000                   BRU  $I$KY01  TTY/PT INPUT HANDLER.
0027  00005  00000015*                  DAC  KEQ1     ADDRESS OF WCRDAREA.
0028                             *
0029                             *---------RETURN FROM INPUT HANDLER.
0030                             *
0031  00006  34300004             KZR1 PIE  ONTL,INTG  ENABLE OUTPUT INTERRUPT.
0032  00007  13200013*                  LIX  SAVE+2,1  FROM REGISTER SAVE AREA.
0033  00010  03600000*                  PIR  KEY1      RETURN.
0034                             *
0035                             *----DEVICE CONTROL TABLE  (INPUT).
0036                             *
0037         00011               SAVE BSS  4
0038  00015  00000044*           KEQ1 DAC  KZQS     EXECUTION POINTER.
0039  00016  00000044*                DAC  KZQS     ENTRY POINTER.
0040  00017  00000044*                DAC  KZQS     ADDRESS OF START OF QUEUE.
0041  00020  00000050*                DAC  KZQE     ADDRESS OF END OF QUEUE.
```

```
0042                                CALL TCNR
0043  0CC22  34300010              PIE  INTL,INTG ENABLE INPUT INTERRUPT.
0044  00023  00000125*             DAC  LPQ1     ADDRESS OF LOW PRIORITY QUEUE.
0045  0C024  00000000              HLT            FORMAT...CONVERSION.
0046  0C025  00000000              HLT            FCC..FULL CHARACTER COUNT.
0047  0C026  00000000              HLT            CCC..CURRENT CHARACTER COUNT.
0048  0C027  0C000000              HLT            FWC..FULL WORD COUNT.
0049  0C030  00000000              HLT            CWC..CURRENT WORD COUNT.
0050  00031  00000000              HLT            DADR.DATA ADDRESS.
0051  00032  00000000              HLT            CCB..CURRENT CHARACTER BUFFER.
0052  0C033  00000C00              HLT            DDWP.DATA DOUBLE WORD POINTER.
0053  00034  00000000              HLT            TEMP.TEMPORARY STORAGE.
0054  00035  00000000              HLT            SIOT.SPECIAL IOT (COMMAND).
0055  0C036  00000006*             DAC  KZR1     RTAD.RETURN ADDRESS.
0056  00037  01720015              AIP  DEVN     AIP..INPUT INSTRUCTION.
0057  0C040  01300015              CEU  DEVN     CEU..COMMAND EXTERNAL UNIT INSTR.
0058  00041  00000000              HLT            CHAR.CHARACTER JUST INPUT.
0059  00042  00000000              HLT            ICTA.ADDRESS OF CURRENT IOT.
0060  0C043  00000000              HLT            STAT.INPUT STATUS WORD.
0061  00044  00000000    KZQS HLT                 FIRST LOCATION OF QUEUE.
0062  0C045  0C000000         HLT
0063  0C046  00000000         HLT
0064  00047  00000000         HLT
0065  0C050  0C000000    KZQE HLT                 LAST LOCATION OF QUEUE.
0066                     *
0067                     *
0068                     *---------OUTPUT PREHANDLER.
0069                     *
0070  00051  00000000    TYP1 ZZZ  **             OUTPUT ENTRY POINT.
0071  00052  13300063*         STI  TYQ1-2,1 SAVE REGISTERS IN
0072  0C053  23300064*         STI  TYQ1-1,2 REGISTER SAVE AREA.
0073  0C054  13200056*         LIX  *+2,1    LOAD XR1 WITH ADDR OF WORKAREA.
0074  00055  01100000          BRU  $I$TY01  TTY/PT OUTPUT HANDLER.
0075  0C056  00000065*         DAC  TYQ1     ADDRESS OF WORD AREA.
0076                     *
0077                     *---------RETURN FROM OUTPUT HANDLER.
0078                     *
0079  0C057  13200063*    TYR1 LIX  TYQ1-2,1 RESTORE XR1
0080  0C060  03600051*         PIR  TYP1     RETURN.
0081                     *
```

```
0082                          *----DEVICE CONTROL TABLE  (OUTPUT).
0083                          *
0084          00061           SAVR BSS  4
0085  00065  00000114*        TYQ1 DAC  TZQS      EXECUTION POINTER.
0086  00066  00000114*             DAC  TZQS      ENTRY POINTER.
0087  00067  00000114*             DAC  TZQS      ADDRESS OF START OF QUEUE.
0088  00070  00000124*             DAC  TZQE      ADDRESS OF END OF QUEUE.
0089  00071  00000022              NOP
0090  00072  34300004              PIE  ONTL,INTG ENABLE INSTR.
0091  00073  00000125*             DAC  LPQ1      ADDRESS OF LOW PRIORITY QUEUE.
0092  00074  00000000              HLT            FRMT...FORMAT.
0093  00075  00000000              HLT            FCC....FULL CHAR COUNT.
0094  00076  00000000              HLT            CCC....CURRENT CHAR COUNT.
0095  00077  00000000              HLT            FWC....FULL WORD COUNT.
0096  00100  00000000              HLT            CWC....CURRENT WORD COUNT.
0097  00101  00000000              HLT            DADR...DATA ADDRESS.
0098  00102  00000000              HLT            CCB....CURRENT CHAR BUFFER.
0099  00103  00000000              HLT            DDWP...DDW POINTER.
0100  00104  00000000              HLT            TEMP...TEMPORARY STORAGE.
0101  00105  00000000              HLT            --------NOT USED--------
0102  00106  00000057*             DAC  TYR1      RTAD...RETURN ADDRESS.
0103  00107  01700015              AOP  DEVN      AOP....OUTPUT INSTRUCTION.
0104  00110  01300015              CEU  DEVN      CEU....CEU INSTRUCTION.
0105  00111  00000000              HLT            OUTC...CHAR TO BE OUTPUT.
0106  00112  00000000              HLT            IOTA...IOT ADDRESS.
0107  00113  00000000              HLT            STAT...OUTPUT STATUS WORD.
0108  00114  00000000        TZQS  HLT            START OF QUEUE.
0109  00115  00000000              HLT
0110  00116  00000000              HLT
0111  00117  00000000              HLT
0112  00120  00000000              HLT
0113  00121  00000000              HLT
0114  00122  00000000              HLT
0115  00123  00000000              HLT
0116  00124  00000000        TZQE  HLT            END OF QUEUE.
0117                          *
0118                          *
0119                          *------------LOW PRIORITY QUEUE.
0120                          *
0121  00125  00000131*        LPQ1 DAC  LPQS
```

```
   0122  00126  00000131*        DAC  LPQS
   0123  0C127  00000131*        DAC  LPQS
   0124  0C130  00000146*        DAC  LPQE
   0125  0C131  00000000    LPQS HLT
   0126  00132  00000000         HLT
   0127  0C133  00000000         HLT
   0128  0C134  00000000         HLT
   0129  00135  00000000         HLT
   0130  0C136  00000000         HLT
   0131  0C137  00000000         HLT
   0132  0C140  00000000         HLT
   0133  0C141  00000000         HLT
   0134  00142  00000000         HLT
   0135  0C143  00000000         HLT
   0136  00144  00000000         HLT
   0137  0C145  00000000         HLT
   0138  00146  00000000    LPQE HLT
   0139                        END
EOJ
```

```
0001                          *PT1
0003                          ***********************************************
0004                          *                                             *
0005                          *-----A.R.O. SYSTEM SOFTWARE.----------------*
0006                          *                                             *
0007                          *----PAPER-TAPE   I/O  PREHANDLER.-----------*
0008                          *                                             *
0009                          *-------------SEPTEMBER  1968              DJB*
0010                          *                                             *
0011                          ***********************************************
0012          00000000             NAME I$HSTI,KEY1
0013          00000027             NAME I$HTQI,KEQ1
0014          00000066             NAME I$HSTO,TYP1
0015          00000102             NAME I$HTQO,TYQ1
0016          00040        INTL EQU  '00040    INPUT INTERRUPT LEVEL.
0017          00020        ONTL EQU  '00020    OUTPUT INTERRUPT LEVEL.
0018          00001        INTG EQU  1         I/O INTERRUPT GROUP.
0019          00002        DEVN EQU  2         PHYSICAL DEVICE NUMBER.
0020          00026        STAT EQU  22       I/O STATUS WORD.
0021                          ****
0022                          ****
0023  00000   00000000     KEY1 ZZZ  **         INPUT ENTRY POINT.
0024  00001   13300025*         STI  KEQ1-2,1 SAVE REGISTERS IN
0025  00002   23300026*         STI  KEQ1-1,2 REGISTER SAVEAREA.
0026  00003   13200005*         LIX  *+2,1    ADDRESS OF WORD AREA.
0027  00004   01100000          BRU  $I$KY01  TTY/PT INPUT HANDLER.
0028  00005   00000027*         DAC  KEQ1     ADDRESS OF WORDAREA.
0029                          *
0030                          *---------RETURN FROM INPUT HANDLER.
0031                          *
0032  00006   00100043*     KZR1 LAA  KEQ1+12  KY01 MAKES DATA ADDR NEG.
0033  00007   02400013*          BAP  *+4       WHEN FINISHED INPUT.
0034  00010   01300002          CEU  DEVN      DISABLE READER.
0035  00011   00200000          DATA '00200000
0036  00012   00000022          NOP
0037  00013   00100023*          LAA  SAVE       RESTORE REGISTERS
0038  00014   13200025*          LIX  SAVE+2,1   FROM REGISTER SAVE AREA.
0039  00015   03600000*          PIR  KEY1      RETURN.
0040  00016   00000000     TPN1 ZZZ  **
0041  00017   01300002          CEU  DEVN      ENABLE READER.
```

```
0042  00020  00400000          DATA *00400000
0043  00021  00000022          NOP
0044  00022  41100016*         BRU* TPN1
0045                      *
0046                      *----DEVICE CONTROL TABLE  (INPUT).
0047                      *
0048         00023        SAVE BSS  4
0049  00027  00000056*   KEQ1 DAC  KZQS      EXECUTION POINTER.
0050  00030  00000056*        DAC  KZQS      ENTRY POINTER.
0051  00031  00000056*        DAC  KZQS      ADDRESS OF START OF QUEUE.
0052  00032  00000062*        DAC  KZQE      ADDRESS OF END OF QUEUE.
0053  00033  01200016*        SPB  TPN1
0054  00034  34300040         PIE  INTL,INTG ENABLE INPUT INTERRUPT.
0055  00035  00000000         HLT            NO LPQ FOR PAPER-TAPE.
0056  00036  00000000         HLT            FORMAT...CONVERSION.
0057  00037  00000000         HLT            FCC..FULL CHARACTER COUNT.
0058  00040  00000000         HLT            CCC..CURRENT CHARACTER COUNT.
0059  00041  00000000         HLT            FWC..FULL WORD COUNT.
0060  00042  00000000         HLT            CWC..CURRENT WORD COUNT.
0061  00043  00000000         HLT            DADR.DATA ADDRESS.
0062  00044  00000000         HLT            CCB..CURRENT CHARACTER BUFFER.
0063  00045  00000000         HLT            DDWP.DATA DOUBLE WORD POINTER.
0064  00046  00000000         HLT            TEMP.TEMPORARY STORAGE.
0065  00047  00000000         HLT            SIOT.SPECIAL IOT (COMMAND).
0066  00050  00000006*        DAC  KZR1      RTAD.RETURN ADDRESS.
0067  00051  01720002         AIP  DEVN      AIP..INPUT INSTRUCTION.
0068  00052  01200063*        SPB  JUMP
0069  00053  00000000         HLT            CHAR.CHARACTER JUST INPUT.
0070  00054  00000000         HLT            IOTA.ADDRESS OF CURRENT IOT.
0071  00055  00000000         HLT            STAT.INPUT STATUS WORD.
0072  00056  00000000    KZQS HLT            FIRST LOCATION OF QUEUE.
0073  00057  00000000         HLT
0074  00060  00000000         HLT
0075  00061  00000000         HLT
0076  00062  00000000    KZQE HLT            LAST LOCATION OF QUEUE.
0077  00063  00000000    JUMP ZZZ  **
0078  00064  01400063*        IMS  JUMP
0079  00065  41100063*        BRU* JUMP
0080                      *
0081                      *
```

```
0082                          *---------OUTPUT PREHANDLER.
0083                          *
0084  00066  00000000    TYP1 ZZZ  **        OUTPUT ENTRY POINT.
0085  00067  13300100*         STI  TYQ1-2,1 SAVE REGISTERS IN
0086  00070  23300101*         STI  TYQ1-1,2 REGISTER SAVE AREA.
0087  00071  13200073*         LIX  *+2,1    LOAD XR1 WITH ADDR OF WORKAREA.
0088  00072  01100000          BRU  $I$TY01  TTY/PT OUTPUT HANDLER.
0089  00073  00000102*         DAC  TYQ1     ADDRESS OF WORD AREA.
0090                          *
0091                          *---------RETURN FROM OUTPUT HANDLER.
0092                          *
0093  00074  13200100*    TYR1 LIX  TYQ1-2,1 RESTORE XR1
0094  00075  03600066*         PIR  TYP1     RETURN.
0095                          *
0096                          *----DEVICE CONTROL TABLE  (OUTPUT).
0097         00076          SAVR BSS  4
0098  00102  00000131*    TYQ1 DAC  TZQS     EXECUTION POINTER.
0099  00103  00000131*         DAC  TZQS     ENTRY POINTER.
0100  00104  00000131*         DAC  TZQS     ADDRESS OF START OF QUEUE.
0101  00105  00000141*         DAC  TZQE     ADDRESS OF END OF QUEUE.
0102  00106  01200142*         SPB  OUT
0103  00107  34300020          PIE  ONTL,INTG ENABLE INSTR.
0104  00110  00000000          HLT            NO LPQ FOR PAPER-TAPE.
0105  00111  00000000          HLT            FRMT...FORMAT.
0106  00112  00000000          HLT            FCC....FULL CHAR COUNT.
0107  00113  00000000          HLT            CCC....CURRENT CHAR COUNT.
0108  00114  00000000          HLT            FWC....FULL WORD COUNT.
0109  00115  00000000          HLT            CWC....CURRENT WORD COUNT.
0110  00116  00000000          HLT            DADR...DATA ADDRESS.
0111  00117  00000000          HLT            CCB....CURRENT CHAR BUFFER.
0112  00120  00000000          HLT            DDWP...DDW POINTER.
0113  00121  00000000          HLT            TEMP...TEMPORARY STORAGE.
0114  00122  00000000          HLT            --------NOT USED--------
0115  00123  00000074*         DAC  TYR1     RTAD...RETURN ADDRESS.
0116  00124  01700002          AOP  DEVN     AOP....OUTPUT INSTRUCTION.
0117  00125  01300002          CEU  DEVN     CEU....CEU INSTRUCTION.
0118  00126  00000000          HLT            OUTC...CHAR TO BE OUTPUT.
0119  00127  00000000          HLT            IOTA...IOT ADDRESS.
0120  00130  00000000          HLT            STAT...OUTPUT STATUS WORD.
0121  00131  00000000    TZQS HLT            START OF QUEUE.
```

```
   0122  0C132  00000000          HLT
   0123  00133  00000000          HLT
   0124  0C134  00000000          HLT
   0125  0C135  00000000          HLT
   0126  00136  00000000          HLT
   0127  0C137  00000000          HLT
   0128  0C140  00000000          HLT
   0129  00141  00000000    TZQE  HLT             END OF QUEUE.
   0130  0C142  00000000    OUT   ZZZ   **
   0131  00143  10100026          LAA   STAT,1
   0132  0C144  02200146*         BAZ   *+2
   0133  00145  41100142*         BRU*  OUT
   0134  00146  01300002          CEU   DEVN      PUNCH POWER ON.
   0135  00147  02000000          DATA  '02000000
   0136  00150  00000022          NOP
   0137  00151  41100142*         BRU*  OUT
   0138                           END
EOJ
```

```
0001                        *PT4
0003                        ********************************************
0004                        *                                          *
0005                        *-----A.R.O. SYSTEM SOFTWARE.---------------*
0006                        *                                          *
0007                        *----PAPER-TAPE   I/O  PREHANDLER.----------*
0008                        *                                          *
0009                        *-------------SEPTEMBER  1969              DJB*
0010                        *                                          *
0011                        ********************************************
0012          00000000            NAME I$HSTI,KEY1
0013          00000027            NAME I$HTQI,KEQ1
0014          00000100            NAME I$HSTQ,TYP1
0015          00000114            NAME I$HTQQ,TYQ1
0016          00000163            NAME I$HSTA,HSTA
0017          00000072            NAME I$LEV8,LEV8
0018          00000066            NAME I$LEV5,LEV5
0019          00040       INTL  EQU  '00040    INPUT INTERRUPT LEVEL.
0020          00020       ONTL  EQU  '00020    OUTPUT INTERRUPT LEVEL.
0021          00001       INTG  EQU  1         I/O INTERRUPT GROUP.
0022          00002       DEVN  EQU  2         PHYSICAL DEVICE NUMBER.
0023          00022       AIP   EQU  18
0024          00026       STAT  EQU  22       I/O STATUS WORD.
0025          00216       EQUR  EQU  '216
0026          00126       ILOC  EQU  '126      INTERRUPT LOCATION.
0027                      ****
0028                      ****
0029  00000  00000000     KEY1  ZZZ  **        INPUT ENTRY POINT.
0030  00001  13300025*          STI  KEQ1-2,1 SAVE REGISTERS IN
0031  00002  23300026*          STI  KEQ1-1,2 REGISTER SAVEAREA.
0032  00003  13200005*          LIX  *+2,1    ADDRESS OF WORD AREA.
0033  00004  01100000           BRU  $I$KY01  TTY/PT INPUT HANDLER.
0034  00005  00000027*          DAC  KEQ1     ADDRESS OF WORDAREA.
0035                      *
0036                      *---------RETURN FROM INPUT HANDLER.
0037                      *
0038  00006  00100043*    KZP1  LAA  KEQ1+12  KY01 MAKES DATA ADDR NEG.
0039  00007  02400013*          BAD  *+4      WHEN FINISHED INPUT.
0040  00010  01300002           CEU  DEVN     DISABLE READER.
0041  00011  00200000           DATA '00200002
```

```
0042  00012  00000022          NOP
0043  00013  00100023*         LAA  SAVE       RESTORE REGISTERS
0044  00014  13200025*         LIX  SAVE+2,1   FROM REGISTER SAVE AREA.
0045  00015  03600000*         PIR  KEY1       RETURN.
0046  00016  00000000    TPN1  ZZZ  **
0047  00017  01300002          CEU  DEVN       ENABLE READER.
0048  00020  00400000          DATA '00400000
0049  00021  00000022          NOP
0050  00022  41100016*         BRU* TPN1
0051         00023        SAVE  BSS  4
0052  00027  00000056*    KEQ1  DAC  KZQS       EXECUTION POINTER.
0053  00030  00000056*          DAC  KZQS       ENTRY POINTER.
0054  00031  00000056*          DAC  KZQS       ADDRESS OF START OF QUEUE.
0055  00032  00000062*          DAC  KZQE       ADDRESS OF END OF QUEUE.
0056  00033  01200016*          SPB  TPN1
0057  00034  34300040          PIE  INTL,INTG ENABLE INPUT INTERRUPT.
0058  00035  00000000          HLT              NO LPQ FOR PAPER-TAPE.
0059  00036  00000000          HLT              FORMAT...CONVERSION.
0060  00037  00000000          HLT              FCC..FULL CHARACTER COUNT.
0061  00040  00000000          HLT              CCC..CURRENT CHARACTER COUNT.
0062  00041  00000000          HLT              FWC..FULL WORD COUNT.
0063  00042  00000000          HLT              CWC..CURRENT WORD COUNT.
0064  00043  00000000          HLT              DADR.DATA ADDRESS.
0065  00044  00000000          HLT              CCB..CURRENT CHARACTER BUFFER.
0066  00045  00000000          HLT              DDWP.DATA DOUBLE WORD POINTER.
0067  00046  00000000          HLT              TEMP.TEMPORARY STORAGE.
0068  00047  00000000          HLT              SIOT.SPECIAL IOT (COMMAND).
0069  00050  00000006*          DAC  KZR1       RTAD.RETURN ADDRESS.
0070  00051  01720002          AIP  DEVN       AIP..INPUT INSTRUCTION.
0071  00052  01200063*          SPB  JUMP
0072  00053  00000000          HLT              CHAR.CHARACTER JUST INPUT.
0073  00054  00000000          HLT              IOTA.ADDRESS OF CURRENT IOT.
0074  00055  00000000          HLT              STAT.INPUT STATUS WORD.
0075  00056  00000000    KZQS  HLT              FIRST LOCATION OF QUEUE.
0076  00057  00000000          HLT
0077  00060  00000000          HLT
0078  00061  00000000          HLT
0079  00062  00000000    KZQE  HLT              LAST LOCATION OF QUEUE.
0080  00063  00000000    JUMP  ZZZ  **
0081  00064  01400063*          IMS  JUMP
```

```
0082  00065  41100063*        BRU* JUMP
0083                      *
0084                      *
0085  00066  00000000    LEV5 ZZZ  **        SET UP INTERRUPT LOCATION FOR
0086  00067  00100076*        LAA  LEV       EIGHT LEVEL PAPER TAPE INPUT.
0087  00070  00300126        STA  ILOC
0088  00071  41100066*        BRU* LEV5
0089                      *
0090                      *
0091  00072  00000000    LEV8 ZZZ  **        SET UP INTERRUPT LOCATION FOR
0092  00073  00100077*        LAA  LEV+1     EIGHT LEVEL PAPER TAPE INPUT.
0093  00074  00300126        STA  ILOC
0094  00075  41100072*        BRU* LEV8
0095                      *
0096  00076  01200163*    LEV  SPB  HSTA
0097  00077  01200000*        SPB  KEY1
0098                      *
0099                      *
0100                      *---------OUTPUT PREHANDLER.
0101                      *
0102  00100  00000000    TYP1 ZZZ  **        OUTPUT ENTRY POINT.
0103  00101  13300112*        STI  TYQ1-2,1  SAVE REGISTERS IN
0104  00102  23300113*        STI  TYQ1-1,2  REGISTER SAVE AREA.
0105  00103  13200105*        LIX  *+2,1     LOAD XR1 WITH ADDR OF WORKAREA.
0106  00104  01100000        BRU  $I$TYQ1     GO TO OUTPUT HANDLER.
0107  00105  00000114*        DAC  TYQ1      ADDRESS OF WORD AREA.
0108                      *
0109                      *---------RETURN FROM OUTPUT HANDLER.
0110                      *
0111  00106  13200112*    TYR1 LIX  TYQ1-2,1 RESTORE XR1
0112  00107  03600100*        BIR  TYP1      RETURN.
0113         00110        SAVE BSS  4
0114  00114  00000143*    TYQ1 DAC  TZQS      EXECUTION POINTER.
0115  00115  00000143*         DAC  TZQS      ENTRY POINTER.
0116  00116  02000143*         DAC  TZQS      ADDRESS OF START OF QUEUE.
0117  00117  00000153*         DAC  TZQE      ADDRESS OF END OF QUEUE.
0118  00120  01200154*         SPB  QUT
0119  00121  34300020         BIF  ONTL,INTG ENABLE INSTR.
0120  00122  00000000         HIT            NO LPO FOR PAPER-TAPE.
0121  00123  00000000         HIT            FRMT...FORMAT.
```

```
0122  00124  00000000          HLT             ECC....FULL CHAR COUNT.
0123  00125  00000000          HLT             CCC....CURRENT CHAR COUNT.
0124  00126  00000000          HLT             FWC....FULL WORD COUNT.
0125  00127  00000000          HLT             CWC....CURRENT WORD COUNT.
0126  00130  00000000          HLT             DADR...DATA ADDRESS.
0127  00131  00000000          HLT             CCB....CURRENT CHAR BUFFER.
0128  00132  00000000          HLT             DDWP...DDW POINTER.
0129  00133  00000000          HLT             TEMP...TEMPORARY STORAGE.
0130  00134  00000000          HLT             --------NOT USED--------
0131  00135  00000106*         DAC   TYP1      RTAD...RETURN ADDRESS.
0132  00136  01700002          AOP   DEVN      AOP....OUTPUT INSTRUCTION.
0133  00137  01300002          CFU   DEVN      CFU....CFU INSTRUCTION.
0134  00140  00000000          HLT             OUTC...CHAR TO BE OUTPUT.
0135  00141  00000000          HLT             IOTA...IOT ADDRESS.
0136  00142  00000000          HLT             STAT...OUTPUT STATUS WORD.
0137  00143  00000000    TZQS  HLT             START OF QUEUE.
0138  00144  00000000          HLT
0139  00145  00000000          HLT
0140  00146  00000000          HLT
0141  00147  00000000          HLT
0142  00150  00000000          HLT
0143  00151  00000000          HLT
0144  00152  00000000          HLT
0145  00153  00000000    TZQE  HLT             END OF QUEUE.
0146  00154  00000000    OUT   ZZZ   **
0147  00155  10100026          LAA   STAT,1
0148  00156  02200160*         BAZ   *+2
0149  00157  41100154*         BRU*  OUT
0150  00160  01300002          CFU   DEVN      PUNCH POWER ON.
0151  00161  02000000          DATA  '02000000
0152  00162  00000022          NOP
0153  00163  00000000    HSTA  ZZZ   **
0154  00164  00300023*         STA   KEQ1-4          SAVE REGISTERS USED.
0155  00165  00400024*         STB   KEQ1-3
0156  00166  13300025*         STI   KEQ1-2,1
0157  00167  23300026*         STI   KEQ1-1,2
0159  00170  13200005*         LIX   KEY1+5,1        DCT ADDRESS.
0159  00171  11600022          EXU   AIP,1           INPUT A CHARACTER.
0160  00172  00000022          NOP
0161  00173  02700321*         MAA   ='37            CHOP TO 5 BITS.
```

```
0162  00174  20020001          TAI   ,2
0163  00175  00200216*         LBA   PRCD          PREVIOUS CODE TABLE USED.
0164  00176  01500215*         CMA   LTER          CHANGE TO LETTER CODE...
0165  00177  01100201*         BRU   *+2
0166  00200  00200217*         LBA   LTCD          YES..USED LETTER CODE TABLE.
0167  00201  01500214*         CMA   FGUR          FIGURE CODE..
0168  00202  01100204*         BRU   *+2
0169  00203  00200260*         LBA   FGCD          YES..USE FIGURE CODE TABLE.
0170  00204  00400216*         STB   PRCD
0171  00205  00100163*         LAA   HSTA          RESET ENTRY-POINT.
0172  00206  00300000*         STA   KEY1
0173  00207  26100216*         AMX   PRCD,2        GET EQUIVALENT ASCII FROM TABLE.
0174  00210  20100000          LAA   0,2
0175  00211  23200216          LIX   FOUR,2        BRANCH TO HANDLER WITH CHAR INA.
0176  00212  21100000          BRU   $KY01,2       (JUST BEYOND INPUT(.
0177  00213  21100000          BRU   $I$KY01,2   (JUST BEHOND INPUT INSTR,)
0178                    *
0179  00214  00000033    FGUR  DATA  '33
0180  00215  00000037    LTER  DATA  '37
0181                    *
0182                    *
0183  00216  00000220*   PRCD  DAC   *+2
0184  00217  00000220*   LTCD  DAC   *+1
0185  00220  00000000          DATA  '000      LEADER.
0186  00221  00000324          DATA  '324      T
0187  00222  00000215          DATA  '215      C/R
0188  00223  00000317          DATA  '317    O  (LETTER).
0189  00224  00000240          DATA  '240    SPACE.
0190  00225  00000310          DATA  '310    H
0191  00226  00000316          DATA  '316    N
0192  00227  00000315          DATA  '315    M
0193  00230  00000212          DATA  '212    L/F
0194  00231  00000314          DATA  '314    L
0195  00232  00000322          DATA  '322    R
0196  00233  00000307          DATA  '307    G
0197  00234  00000311          DATA  '311    I
0198  00235  00000320          DATA  '320    P
0199  00236  00000303          DATA  '303    C
0200  00237  00000326          DATA  '326    V
0201  00240  00000305          DATA  '305    E
```

```
0202  00241  00000332          DATA '332     Z
0203  00242  00000304          DATA '304     D
0204  00243  00000302          DATA '302     B
0205  00244  00000323          DATA '323     S
0206  00245  00000331          DATA '331     Y
0207  00246  00000306          DATA '306     F
0208  00247  00000330          DATA '330     X
0209  00250  00000301          DATA '301     A
0210  00251  00000327          DATA '327     W
0211  00252  00000312          DATA '312     J
0212  00253  00000377          DATA '377     DELETE..FIGURE CODE.
0213  00254  00000325          DATA '325     U
0214  00255  00000321          DATA '321     Q
0215  00256  00000313          DATA '313     K
0216  00257  00000377          DATA '377     DELETE..LETTER CODE.
0217                      *
0218                      *
0219  00260  00000261*    EGCD  DAC  *+1
0220  00261  00000000          DATA '000     LEADER.
0221  00262  00000265          DATA '265     5
0222  00263  00000215          DATA '215     C/R
0223  00264  00000271          DATA '271     9
0224  00265  00000240          DATA '240     SPACE.
0225  00266  00000336          DATA '336     DIAGONAL BOX..MAKE IT UP ARROW.
0226  00267  00000254          DATA '254     ,
0227  00270  00000256          DATA '256     .
0228  00271  00000212          DATA '212     L/F
0229  00272  00000251          DATA '251     )
0230  00273  00000264          DATA '264     4
0231  00274  00000252          DATA '252     HORIZ SQ...MAKE IT *
0232  00275  00000270          DATA '270     8
0233  00276  00000260          DATA '260     0 (NUMBER)
0234  00277  00000272          DATA '272     :
0235  00300  00000275          DATA '275     =
0236  00301  00000263          DATA '263     3
0237  00302  00000253          DATA '253     +
0238  00303  00000244          DATA '244     ..............
0239  00304  00000277          DATA '277     ?
0240  00305  00000247          DATA '247     ' (QUOTE)
0241  00306  00000266          DATA '266     6
```

```
    0242  00307  00000244          DATA '244     BOX..MAKE IT $.
    0243  00310  00000257          DATA '257     /
    0244  00311  00000255          DATA '255     -
    0245  00312  00000262          DATA '262     2
    0246  00313  00000207          DATA '207     BELL.
    0247  00314  00000377          DATA '377     FIGURE CODE.
    0248  00315  00000267          DATA '267     7
    0249  00316  00000261          DATA '261     1
    0250  00317  00000250          DATA '250     (
    0251  00320  00000377          DATA '377     LETTER CODE
    0252                          END
          00321  00000037
EOJ
```

```
0001          00000000    TKYB NAME I$KY01,KY01
0002          00000766         NAME I$TY01,TY01
0003          00000542         NAME I$XXXX,ERTN
0005                      ********************************************
0006                      *                                          *
0007                      *---------A.R.C.  SYSTEM  SOFTWARE.---------*
0008                      *                                          *
0009                      *-----------TYPEWRITER AND PAPER-TAPE-------*
0010                      *----------INPUT/OUTPUT HANDLER-------------*
0011                      *                                          *
0012                      *-----------------AUGUST  1968-----------DJB*
0013                      *                                          *
0014                      ********************************************
0015                      *
0016                      *
0017                      *
0018          00000       XPTR EQU  0          EXECUTION POINTER.
0019                      ****
0020          00001       NPTR EQU  1          ENTRY POINTER.
0021                      ****
0022          00002       ASTQ EQU  2          ADDRESS OF START OF QUEUE.
0023                      ****
0024          00003       AEDQ EQU  3          ADDRESS OF END OF QUEUE.
0025                      ****
0026          00006       LPQ  EQU  6          ADDRESS OF LOW PRIORITY QUEUE.
0027                      ****                 (AN OUTPUT QUEUE CONSISTING ONLY OF
0028                      ****                 CHARACTERS TYPED WAITING TO BE OUTPUT).
0029                      ****
0030          00007       FRMT EQU  7          CONVERSION FORMAT.
0031                      ****                 =-1 FOR TASCII INPUT.
0032                      ****                 = 0 FOR OCTAL INPUT.
0033                      ****                 =+1 FOR DECIMAL INPUT.
0034                      ****
0035          00010       FCC  EQU  8          FULL CHARACTER COUNT.
0036                      ****                 =-4 FOR TASCII INPUT.
0037                      ****                 =-8 FOR OCTAL AND DECIMAL INPUT.
0038                      ****
0039          00011       CCC  EQU  9          CURRENT CHARACTER COUNT.
0040                      ****
0041          00012       FWC  EQU  10         FULL WORD COUNT. (FROM DDW.)
```

```
0042                    ****
0043        00013       CWC  EQU  11        CURRENT WORD COUNT.
0044                    ****                (A RUNNING COUNT OF NO. OF WORDS INPUT.)
0045                    ****
0046        00014       DADR EQU  12        THE ADDRESS AT WHICH THE CURRENT DATA
0047                    ****                WORD WILL BE STORED.
0048                    ****
0049        00015       CCB  EQU  13        CURRENT CHARACTER BUFFER.
0050                    ****                CONTAINS THE PARTIALLY CONVERTED
0051                    ****                WORD FOR ALL INPUT FORMATS.
0052                    ****
0053        00016       DCWP EQU  14        DDW POINTER.  (POINTS TO THE SECOND
0054                    ****                WORD OF THE DDW.)
0055                    ****                DDW=DATA DOUBLE WORD.
0056                    ****
0057        00017       TEMP EQU  15        ONE WORD OF TEMPORARY STORAGE.
0058        00017       RETN EQU  15        SAME LOCATION AS ABOVE..(THIS LOCATION
0059                    ****                IS USED TO STORE THE RETURN ADDRESS
0060                    ****                FOR RE-ENTRANT ROUTINES INTERNAL TO IOCS.)
0061                    ****
0062        00020       SIOT EQU  16        SPECIAL IOT ADDRESS.  (THE IOT ADDRESS OF THE
0063                    ****                IOT(INPUT/OUTPUT TABLE) USED BY COMMAND
0064                    ****                LANGUAGE).  ENTERED IN WORK AREA BY IOCS
0065                    ****                ROUTINES I$FIOT AND I$BIOT.
0066                    ****
0067        00021       RTAD EQU  17        RETURN ADDRESS  (TO PREHANDLERS).
0068                    ****
0069        00022       AIP  EQU  18        INPUT INSTRUCTION FOR THE DEVICE  (AIP).
0070        00022       AOP  EQU  18        OUTPUT INSTRUCTION FOR THE DEVICE.
0071                    ****
0072        00023       CEU  EQU  19        COMMAND EXTERNAL UNIT FOR THIS DEVICE.
0073                    ****
0074        00024       CHAR EQU  20        CHARACTER JUST INPUT.
0075                    ****                STORED IN UPPER 8 BITS OF THIS WORD.
0076                    ****
0077        00024       OUTC EQU  20        CHARACTER TO BE OUTPUT.
0078                    ****                STORED IN UPPER 8 BITS.
0079                    ****
0080        00025       ICTA EQU  21        IOT ADDRESS OF CURRENT INPUT.
0081                    ****
```

```
                        TYPEWRITER AND PAPER TAPE INPUT/OUTPUT HANDLER.

0082        00026       STAT EQU  22        STATUS WORD FOR THIS INPUT.
0083                    ****                BIT  0  ABSOLUTE LOAD FLAG.
0084                    ****                BIT  1  SPECIAL IOT FLAG.
0085                    ****                BIT  2  READER MODE FLAG
0086                    ****                BIT  3  MINUS SIGN FLAG.
0087                    ****                BIT  4  LAST DDW FLAG.
0088                    ****                BIT  5  IMMEDIATE DATA FLAG.
0089                    ****                BIT  6  BINARY OUTPUT FLAG.
0090                    ****                BIT  8  NO CR/LF THIS OUTPUT.
0091                    ****                BIT  9  PUNCH POWER OFF FLAG.
0092                    ****                BIT 10  ABSOLUTE DUMP FLAG.
0093                    ****                BIT 11  LEADER FLAG.
0094                    ****                BIT 15  OUTPUT CR IMMEDIATELY.
0095                    ****                BIT 16  OUTPUT LF IMMEDIATELY AND TERMINATE.
0096                    ****
0097                    ****
0098        00007       PART EQU  7         FORE-GROUND/BACK-GROUND PARTITION.
0099                    ****                (ENTRY IN DRTY-C).
0100                    ****
0101                    ****
0102                    ****
0103                    ****----------------ALTERNATE ARRANGEMENT OF SAVEAREA FOR
0104                    ****----------------THE RESIDENT PAPER TAPE ABSOLUTE LOADER.
0105                    ****
0106                    ****
0107        00007       MODE EQU  7         MODE OF ABSOLUTE LOADER.
0108                    ****                =-2 WHILE READING LEADER.
0109                    ****                =-1 WHILE READING START ADDRESS.
0110                    ****                = 0 WHILE READING NEGATIVE WORD COUNT.
0111                    ****                =+1 WHILE READING '100 LENGTH BLOCK.
0112                    ****                =+2 WHILE READING CHECKSUM.
0113                    ****
0114                    ****
0115        00010       XR4  EQU  8         INDEX REGISTER 4.  (CHARACTER COUNTER)  -3 TO 0.
0116                    ****                ABSOLUTE LOADER PACKS 3 CHAR TO A WORD.
0117                    ****
0118        00011       XR5  EQU  9         INDEX REGISTER 5.  -'100 TO 0.
0119                    ****                BLOCK WORD COUNT.
0120                    ****
0121        00012       NWDC EQU  10        NEGATIVE WORD COUNT.
```

```
0122                    ****                    READ FROM TAPE.
0123                    ****
0124        00013       CKSM EQU  11            CHECKSUM-FORMED BY ADDING EACH WORD IN
0125                    ****                    BLOCK AND NEGLECTING OVERFLOW.
0126                    ****
0127                    ****
0128                    ***
0129                    **
0130                    *---------THE FOLLOWING CONSTANTS ARE FOUND
0131                    *---------IN THE LITERAL POOL.
0132                    *
0133                    *
0134                         ABS
0135        00200            ORG  '200   ORIGIN OF LITERAL POOL.
0136                    *
0137        00201       MNIN EQU  *+'001    -9
0138                    *
0139        00202       MATE EQU  *+'002    -8
0140                    *
0141        00206       MFOR EQU  *+'006    -4
0142                    *
0143        00207       MTRE EQU  *+'007    -3
0144                    *
0145        00210       MTWO EQU  *+'010    -2
0146                    *
0147        00211       MONE EQU  *+'011    -1
0148                    *
0149        00212       ZERO EQU  *+'012    0
0150                    *
0151        00213       ONE  EQU  *+'013    +1
0152                    *
0153        00214       TWO  EQU  *+'014    +2
0154                    *
0155        00215       TREE EQU  *+'015    +3
0156                    *
0157        00216       FOUR EQU  *+'016    +4
0158                    *
0159        00220       SIX  EQU  *+'020   +6
0160                    *
0161        00225       FLLI EQU  *+'025    FLL  0   ('17).
```

```
0162                    *
0163                    *
0164        00234       BITO EQU  *+'034     '40000000
0165                    *
0166        00236       BIT1 EQU  *+'036     '20000000
0167                    *
0168        00314       BIT5 EQU  *+'114     '01000000
0169                    *
0170        00337       BT16 EQU  *+'137     '00000200
0171                    *
0172        00336       BT17 EQU  *+'136     '00000100
0173                    *
0174        00237       BTF1 EQU  *+'037     '57777777
0175                    *
0176                    *
0177        00242       AMSK EQU  *+'042     '00077777
0178                    *
0179        00233       DMSK EQU  *+'033     '00000077
0180                    *
0181        00300       CVC  EQU  *+'100     '00000260
0182                    *
0183        00245       FINI EQU  *+'045     '17777777
0184                    *
0185        00240       FINB EQU  *+'040     '10000000
0186                    *
0187                    *
0188        00320       SLSH EQU  *+'120     SLASH (/)
0189                    *
0190        00321       QEST EQU  *+'121     QUESTION MARK (?)
0191                    *
0192        00262       TYCR EQU  *+'062     CARRIAGE RETURN
0193                    *
0194        00263       TYLF EQU  *+'063     LINE FEED
0195                    *
0196        00316       SEMI EQU  *+'116     SEMI-COLON (;)
0197                    *
0198        00272       DELT EQU  *+'072     DELETE
0199                    *
0200        00273       UPAR EQU  *+'073     UP-ARROW
0201                    *
```

```
0202          00276     DSIN EQU  *+'076    NUMBER SIGN (#)
0203                    *
0204          00275     QUOT EQU  *+'075    QUOTE (')
0205                    *
0206          00271     MSIN EQU  *+'071    MINUS SIGN
0207                    *
0208          00270     PSIN EQU  *+'070    BLANK (PLUS SIGN)
0209                    *
0210          00265     TZCR EQU  *+'065   DUMMY CARRIAGE RETURN (>).
0211                    *
0212          00266     TZLF EQU  *+'066   DUMMY LINE FEED (<).
0213                    *
0214          00267     TZBL EQU  *+'067   DUMMY BELL RING (|).
0215                    *
0216          00264     TYBL EQU  *+'064    REAL BELL RING.
0217                    *
0218          00247     BLAN EQU  *+'047    ASCII BLANK.
0219                    *
0220          00246     TZAT EQU  *+'046   AT SIGN  ().
0221                    *
0222                    *
0223          00277     BLNK EQU  *+'077    '40404040
0224                    *
0225          00315     CRLF EQU  *+'115    '40407674
0226                    *
0227          00301     TRNF EQU  *+'101    '76000000
0228                    *
0229          00302     OCDG EQU  *+'102    '54000000
0230                    *
0231          00303     BGDI EQU  *+'103    '56200000
0232                    *
0233          00322     M100 EQU  *+'122    '77777700  (-'100)
0234                    *
0235          00234     SNON EQU  *+'034    '40000000
0236                    *
0237          00231     MSK2 EQU  *+'031   'C0770000
0238                    *
0239          00261     TY65 EQU  *+'061   MULTIPLE OF TEN TABLE.
0240                    *
0241          00241     PIDI EQU  *+'041   ='67777777
```

```
0242                        *
0243                        *
0244                        *
0245                    *       REL
0246          00000             ORG  0
0247                        *
0248                        *
0249  00000  10377774    KY01  STA  -4,1      SAVE A REGISTER IN SAVEAREA.
0250  00001  10477775          STB  -3,1      SAVE B REGISTER IN SAVEAREA.
0251  00002  11600022          EXU  AIP,1     INPUT A CHARACTER.
0252  00003  00000022          NOP
0253  00004  00020016          LSL  16        SHIFT CHAR TO UPPER 8 BITS.
0254  00005  10300024          STA  CHAR,1    STORE 8-BIT CHAR.
0255  00006  13500026          SMP  STAT,1    TEST ABSOLUTE LOADER FLAG.
0256  00007  01100571*         BRU  KY90      ON..GO TO RESIDENT ABS LOADER.
0257                        *
0258  00010  01200546*    KY02  SPB  ELPQ      PLACE CHAR IN LPQ FOR OUTPUT.
0259  00011  10100025          LAA  IOTA,1    CHECK IOT ADDRESS.
0260  00012  02200016*         BAZ  *+4       NONO PRESENT..BEGINNING NEW INPUT.
0261  00013  50100025          LAA* IOTA,1    GET FIRST WORD OF IOT.
0262  00014  00001016          LSL  1         CHECK IF EXECUTION BIT IS ON.
0263  00015  02300130*         BAN  KY08      YES..ALREACY WORKING ON IOT.
0264  00016  10100024          LAA  CHAR,1    IOTA=0,I.E. FIRST CHAR OF INPUT.
0265  00017  01500320          CMA  SLSH      CHECK IF FIRST CHAR IS SLSH.
0266  00020  01100022*         BRU  *+2       NO.
0267  00021  01100026*         BRU  KY03      YES.
0268  00022  50100000          LAA* XPTR,1    PICK UP IOT ADDRESS FROM QUEUE.
0269  00023  02200035*         BAZ  KY04      QUEUE EMPTY...ERROR.
0270  00024  10300025          STA  IOTA,1
0271  00025  01100046*         BRU  KY05
0272                        *
0273                        *
0274                        *---------EACH INPUT DEVICE HAS A SPECIAL IOT ASSOCIATED
0275                        *---------WITH IT.   THESE IOT'S WILL USUALLY BE USED FOR
0276                        *---------THE COMMAND LANGUAGE, AND ARE NOT REQUESTED.
0277                        *---------THESE REQUESTS DO NOT GO THROUGH THE IOCS DRIVER,
0278                        *---------BUT ARE USED AUTOMATICALLY WHEN A / IS TH FIRST
0279                        *---------CHARACTER.
0280                        *
0281  00026  10100020    KY03  LAA  SIOT,1     PICK UP SPECIAL IOT ADDR
```

```
0282  00C27  10300025          STA  IOTA,1     AND USE IT FOR CURRENT INPUT.
0283  00030  00100236          LAA  BIT1       (='20000000).
0284  00C31  10300026          STA  STAT,1     RESET STATUS WORD, AND SET
0285  00C32  00000003          CLA             CLEAR CHAR (/) TO ZERO
0286  00033  10300024          STA  CHAR,1     SO IT WILL BE IGNORED.
0287  00C34  01100046*         BRU  KY05       SPECIAL IOT FLAG.
0288                       *
0289                       *
0290                       *---------A KEY-IN HAS BEEN ATTEMPTED, NOT PRECEDED
0291                       *---------BY A SLASH (/), AND THERE WAS NO INPUT REQUEST
0292                       *---------IN THE QUEUE.
0293                       *---------ERROR MESSAGE   /0 CR/LF.
0294                       *
0295  00C35  00100320     KY04 LAA  SLSH
0296  00036  01200546*          SPB  ELPQ
0297  00C37  00100321          LAA  QEST
0298  00C40  01200546*          SPB  ELPQ
0299  00C41  00100262          LAA  TYCR
0300  00C42  01200546*          SPB  ELPQ
0301  00C43  00100263          LAA  TYLF
0302  00C44  01200546*          SPB  ELPQ
0303  00C45  01101217*          BRU  KY99       RETURN.
0304                       *
0305                       *
0306                       *---------IF FIRST CHAR IS A SEMICOLON,SWITCH MODE
0307                       *---------OF TYPEWRITER TO READER MODE, BUT STILL
0308                       *---------DIRECT INPUT TO LPQ.  (I.E. PRINT IT OUT).
0309                       *
0310  00C46  10100024     KY05 LAA  CHAR,1     IS FIRST CHAR
0311  00C47  00600316          SMA  SEMI       SEMI-COLON.
0312  00C50  02200052*         BAZ  *+2        YES.
0313  00C51  01100056*         BRU  KY06       NO.
0314  00052  11600023          EXU  CEU,1      SWITCH TO READER MODE.
0315  00C53  02000000          DATA '02000000  IGNORE SEMI-COLON.
0316  00C54  01100052*         BRU  *-2
0317  00C55  01101217*         BRU  KY99       RETURN.
0318                       *
0319                       *---------SET EXECUTION BIT IN IOT.
0320                       *
0321  00C56  50100025     KY06 LAA* IOTA,1
```

```
0322  0C057  03000236          MCA  BIT1       (='20000000)
0323  0C060  50300025          STA* IOTA,1
0324                      *
0325                      *---------CHECK OPERATION BITS.
0326                      *
0327  0C061  02700337          MAA  BT16       CHECK FOR ABSOLUTE LOAD OPERATION.
0328  0C062  02200077*         BAZ  KY07       NO.
0329  0C063  00100234          LAA  BIT0       RESET STATUS WORD AND
0330  0C064  10300026          STA  STAT,1     SET ABSOLUTE LOAD FLAG.
0331  0C065  00100210          LAA  MTW0       SET MODE=-2 TO READIN LEADER
0332  0C066  10300007          STA  MODE,1     AS INITIAL ABSOLUTE LOADER FUNCTION.
0333  0C067  00100207          LAA  MTRE
0334  0C070  10300010          STA  XR4,1      SET CHAR-COUNT TO -3.
0335  0C071  10100025          LAA  IOTA,1     SET DDWP TO FIRST
0336  0C072  00500213          AMA  ONE        WORD OF DDW.
0337  0C073  10300016          STA  DDWP,1
0338  0C074  00000003          CLA
0339  0C075  10300014          STA  DADR,1   RESET DATA ADDRESS FLAG.(FOR HSPT).
0340  0C076  01100571*         BRU  KY90       GO TO ABSOLUTE LOADER.
0341                      *
0342                      *---------DECODE THE DATA DOUBLE WORD.  (DDW).
0343                      *
0344  0C077  10100025     KY07 LAA  IOTA,1     INITIALIZE
0345  0C100  10300016          STA  DDWP,1     DDW POINTER.
0346  0C101  01200440*         SPB  DDDW       DECODE DDW ROUTINE.
0347  0C102  10100026          LAA  STAT,1   IMMEDIATE DATA NOT
0348  0C103  00005016          LSL  5        ALLOWED FOR INPUT.
0349  0C104  02400112*         BAP  *+6      OK.
0350  0C105  10100025          LAA  IOTA,1   PUT IOT ADDR IN
0351  0C106  00301457*         STA  IRR2     ERROR MESSAGE IOT.
0352  0C107  00101450*         LAA  IAT9     OUTPUT ERROR MESSAGE.
0353                           CALL IOCS
0354  0C111  01100662*         BRU  KY96     SET ERROR BIT AND TERMINATE REQUEST.
0355  0C112  50100016          LAA* DDWP,1   CLEAR BITS 0-9 IN WORD 2 OF
0356  0C113  02700242          MAA  AMSK     DDW FOR NUMBER OF WORDS INPUT.
0357  0C114  50300016          STA* DDWP,1
0358                      *
0359                      *---------CHECK ADDRESS FROM DDW FOR
0360                      *---------POSSIBLE MEMORY PROTECT VIOLATION.
0361                      *
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0362  0C115  10100014          LAA  DADR,1    DATA ADDRESS IN A ACCUMULATOR.
0363  0C116  10200025          LBA  IOTA,1    IOT ADDRESS IN B ACCUMULATOR.
0364  0C117  01200520*         SPB  CHEK      CHECK DATA ADDRESS.
0365  0C120  02400130*         BAP  KY08      OK..LET IT PASS.
0366  0C121  10100025          LAA  IOTA,1   PUT IOT ADDR IN
0367  0C122  00300707*         STA  DA11     ERROR MESSAGE IOT.
0368  0C123  10100014          LAA  DADR,1   PUT DATA ADDR IN
0369  0C124  00300710*         STA  DA12    ERROR MESSAGE IOT.
0370  0C125  00100700*         LAA  IAT2      MEMORY PROTECT ERROR..DATA ADDRESS
0371                           CALL IOCS      IN IOT IS IN A PROTECTED LOCATION.
0372  0C127  01100662*         BRU  KY96      OUTPUT ERROR MESSAGE, AND SET BIT IN DDW.
0373                     *
0374                     *---------CHECK IF CHAR JUST INPUT IS
0375                     *---------A SPECIAL CHARACTER.
0376                     *
0377  0C130  10100024    KY08 LAA  CHAR,1
0378  0C131  02201217*         BAZ  KY99      IGNORE LEADER.
0379  0C132  01500263          CMA  TYLF
0380  0C133  01100135*         BRU  *+2
0381  0C134  01101217*         BRU  KY99      IGNORE LINE FEED.
0382  0C135  01500272          CMA  DELT
0383  0C136  01100140*         BRU  *+2
0384  0C137  01101217*         BRU  KY99      IGNORE DELETE.
0385  0C140  01500273          CMA  UPAR      UP ARROW..
0386  0C141  01100162*         BRU  KY10      NO.
0387  0C142  01100144*         BRU  *+2       YES.
0388  0C143  01100162*         BRU  KY10      NO.
0389                     *
0390                     *
0391                     *---------HAVE JUST INPUT UP-ARROW, IF BINARY MODE FLAG IS
0392                     *---------ON, LET IT PAST, OTHERWISE DELETE ENTIRE INPUT.
0393                     *
0394  0C144  50100025    KY09 LAA* IOTA,1    GET FIRST WORD OF IOT.
0395  0C145  00014016          LSL  12        IS BINARY OPERATION SPECIFIED..
0396  0C146  02300162*         BAN  KY10      YES..LET IS PAST.
0397  0C147  00100262          LAA  TYCR      OUTPUT CARRIAGE RETURN.
0398  0C150  01200546*         SPB  ELPQ
0399  0C151  00100263          LAA  TYLF      OUTPUT LINE FEED.
0400  0C152  01200546*         SPB  ELPQ
0401  0C153  50100025          LAA* IOTA,1    RESET EXECUTION BIT
```

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0402  0C154  02700237          MAA  BTF1       IN IOT.  THIS RESETS IOT AND
0403  0C155  50300025          STA* IOTA,1     ALLOWS INPUT TO BE RESTARTED.
0404  0C156  00000003          CLA
0405  0C157  10300025          STA  IOTA,1     SET IOT ADDRESS TO 0.
0406  0C160  10300026          STA  STAT,1     RESET ALL FLAGS.
0407  0C161  01101217*         BRU  KY99       RETURN.
0408                       *
0409                       *---------CHECK FOR CARRIAGE RETURN.
0410                       *
0411  0C162  10100024       KY10 LAA  CHAR,1
0412  0C163  00600262          SMA  TYCR
0413  0C164  02200166*         BAZ  *+2
0414  0C165  01100172*         BRU  KY11       NOT C/R.
0415  0C166  00100263          LAA  TYLF       C/R.  OUTPUT LINE FEED.
0416  0C167  01200546*         SPB  ELPQ
0417  0C170  10100007          LAA  FRMT,1     IF TASCII INPUT
0418  0C171  02300204*         BAN  KY49       LEFT JUSTIFY CHARACTER BUFFER.
0419                       *
0420                       *---------CHECK FORMAT AND BRANCH TO SPECIFIED
0421                       *---------          CONVERSION ROUTINE.
0422                       *
0423  0C172  10100007       KY11 LAA  FRMT,1
0424  0C173  02300176*         BAN  KY40       ----------TASCII.
0425  0C174  02200231*         BAZ  KY50                 OCTAL
0426  0C175  01100264*         BRU  KY60                 DECIMAL.
0427                       *
0428                       *
0429                       *---------ASCII TO TASCII CONVERSION.
0430                       *
0431  0C176  10200024       KY40 LBA  CHAR,1     STRIP OFF UPPER TWO BITS.
0432  0C177  00002017          FLL  2
0433  0C200  10100015          LAA  CCB,1       MERGE WITH PREVIOUS CHARACTERS.
0434  0C201  00006017          FLL  6
0435  0C202  10300015          STA  CCB,1
0436  0C203  01100363*         BRU  KY70
0437                       *
0438                       *---------CARRIAGE RETURN HAS BEEN DETECTED.
0439                       *
0440  0C204  10100011       KY49 LAA  CCC,1      CONVERT CURRENT CHAR COUNT
0441  0C205  05600000          NEG               INTO SHIFT INSTRUCTION TO
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```
0442  CC206  00000005          TAB
0443  00207  00700220          MPY  SIX       CONVERT FROM CHAR TO BITS.
0444  CC210  00000004          TBA
0445  0C211  00011016          LSL  9          LEFT JUSTIFY THE LAST WORD.
0446  0C212  00500225          AMA  FLLI       (FLL  0)
0447  0C213  10300017          STA  TEMP,1     PUT SHIFT INSTR IN TEMPORARY STORAGE.
0448  0C214  10100015          LAA  CCB,1      LOAD BUFFER IN A REGISTER.
0449  0C215  00200277          LBA  BLNK       LOAD BLANKS I B REGISTER.
0450  0C216  11600017          EXU  TEMP,1     SHIFT  (LEFT JUSTIFY).
0451  CC217  50300014          STA* DADR,1     STORE WORD IN DATA ADDRESS.
0452  CC220  11400013          IMS  CWC,1      INCREMENT WORD COUNT.
0453  CC221  10100011          LAA  CCC,1      CHECK IF INPUT WAS
0454  00222  00500216          AMA  FOUR       MULTIPLE OF FOUR.
0455  0C223  02200226*         BAZ  *+3        YES.
0456  0C224  11400014          IMS  DADR,1     INCR. DATA ADDR. AND WORD COUNT.
0457  0C225  11400013          IMS  CWC,1      (IF WAS MULT. OF 4 CHAR---CRLF IIS
0458                      *                    STORED OVER TOP OF WORD STORED ABOVE).
0459  0C226  00100315          LAA  CRLF       ADD A WORD CONSISTING OF '40407674
0460  0C227  50300014          STA* DADR,1     TO THE INPUT STRING.
0461  CC230  01100375*         BRU  KY72
0462                      *
0463                      *
0464                      *---------OCTAL CONVERSION.
0465                      *
0466  00231  10100024    KY50  LAA  CHAR,1     CHECK IF CHAR IS #.
0467  0C232  00600276          SMA  DSIN
0468  0C233  02200235*         BAZ  *+2        YES.
0469  0C234  01100237*         BRU  *+3        NO.
0470  0C235  11400007          IMS  FRMT,1     YES..CHANGE TO DECIMAL FORMAT.
0471  0C236  01101217*         BRU  KY99       RETURN.
0472  0C237  1C100011          LAA  CCC,1      CHECK IF FIRST CHAR.
0473  00240  10600010          SMA  FCC,1      IN THIS FIELD.
0474  0C241  02200251*         BAZ  KY51       YES.
0475  0C242  10100024          LAA  CHAR,1     NO...CHECK IF LAST CHAR IN THIS FIELD.
0476  0C243  02700301          MAA  TRNF       ('76000000)  I.E. ILLEGAL OCTAL DIGIT.
0477  0C244  00600302          SMA  OCDG
0478  0C245  02200256*         BAZ  KY53       NO.....IT'S OK.
0479  0C246  00100211    KY52  LAA  MONE       ILLEGAL DIGIT..SET CHAR COUNTER
0480  00247  1C300011          STA  CCC,1      TO LAST CHARACTER.
0481  0C250  01100363*         BRU  KY70
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0482  00251  10100024   KY51 LAA  CHAR,1     FIRST CHAR IN THE FIELD.
0483  00252  02700301        MAA  TRNF       CHECK IF VALID
0484  00253  00600302        SMA  OCDG       OCTAL DIGIT.
0485  00254  02200256*       BAZ  KY53       YES..
0486  00255  01100307*       BRU  KY63       NO..DON'T START CONVERSION YET.
0487  00256  10200024   KY53 LBA  CHAR,1     STRIP OFF UPPER
0488  00257  00005017        FLL  5               5 BITS.
0489  00260  10100015        LAA  CCB,1      MERGE INTO CHAR BUFFER.
0490  00261  00003017        FLL  3
0491  00262  10300015        STA  CCB,1
0492  00263  01100363*       BRU  KY70
0493                        *
0494                        *
0495                        *---------DECIMAL CONVERSION.
0496                        *
0497  00264  10100024   KY60 LAA  CHAR,1     CHECK INPUT CHAR FOR QUOTE (').
0498  00265  00600275        SMA  QUCT       IF SO, RESET
0499  00266  02200270*       BAZ  *+2        CONVERSION FORMAT TO OCTAL.
0500  00267  01100273*       BRU  KY61
0501  00270  00000003        CLA
0502  00271  10300007        STA  FRMT,1
0503  00272  01101217*       BRU  KY99       RETURN.
0504  00273  10100011   KY61 LAA  CCC,1      FIRST CHAR IN FIELD.....
0505  00274  10600010        SMA  FCC,1
0506  00275  02200277*       BAZ  *+2        YES..
0507  00276  01100325*       BRU  KY65       NO.
0508  00277  10100024        LAA  CHAR,1     IF FIRST CHAR, CHECK FOR
0509  00300  01500271        CMA  MSIN       MINUS SIGN.
0510  00301  01100313*       BRU  KY62       NO.
0511  00302  011003C4*       BRU  *+2        YES.
0512  00303  01100313*       BRU  KY62       NO.
0513  00304  10100026        LAA  STAT,1     SET MINUS SIGN FLAG.
0514  00305  03001464*       MOA  ='C4COCOCO  IN STATUS WORD.
0515  00306  10300026        STA  STAT,1
0516  00307  10100010   KY63 LAA  FCC,1      RESET CHARACTER COUNTER.
0517  00310  00600213        SMA  ONE
0518  00311  10300011        STA  CCC,1
0519  00312  01100363*       BRU  KY70
0520  00313  01500270   KY62 CMA  PSIN       FIRST CHAR IN FIELD.
0521  00314  01100316*       BRU  *+2        CHECK FOR PLUS SIGN.
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0522  0C315  01100307*        BRU  KY63       YES..LEAVE MINUS SIGN FLAG OFF.
0523  0C316  01500302         CMA  0CDG       CHECK FOR VALID DECIMAL DIGIT
0524  0C317  01100307*        BRU  KY63       NO.
0525  0C320  00000022         NOP             MAYBE.
0526  00321  01500303         CMA  BGDI
0527  0C322  01100352*        BRU  KY68       YES..BEGIN CONVERSION.
0528  0C323  01100352*        BRU  KY68       YES.
0529  0C324  01100307*        BRU  KY63        NO.
0530  0C325  1C100024   KY65  LAA  CHAR,1
0531  00326  01500302         CMA  0CDG       CHECK CHAR FOR VALID DECIMAL DIGIT.
0532  0C327  01100334*        BRU  KY66       NO..TERMINATE CONVERSION.
0533  0C330  00000022         NOP             MAYBE.
0534  0C331  01500303         CMA  BGDI
0535  0C332  01100352*        BRU  KY68       OK.
0536  0C333  01100352*        BRU  KY68       OK.
0537  0C334  00100211   KY66  LAA  MONE        NOT A VALID DIGIT.
0538  0C335  1C300011         STA  CCC,1      SET CHAR COUNTER TO LAST CHAR.
0539  00336  10100026         LAA  STAT,1     CHECK SIGN FLAG.
0540  0C337  00003016         LSL  3
0541  0C340  02400363*        BAP  KY70       PLUS SIGN..
0542  00341  1C100015         LAA  CCB,1      MINUS SIGN
0543  0C342  05600000         NEG             TAKE 2'S COMPLEMENT.
0544  0C343  02300345*        BAN  KY67       NEG..OK.
0545  00344  00000020         ASC             STILL PCS AFTER NEG COMMAND.
0546  0C345  1C300015   KY67  STA  CCB,1      THEREFORE NO. WAS MINUS ZERO.
0547  0C346  10100026         LAA  STAT,1     RESET SIGN FLAG IN STATUS WORD
0548  0C347  02701463*        MAA  ='73777777   FOR NEXT WORD.
0549  0C350  1C300026         STA  STAT,1
0550  CC351  01100363*        BRU  KY70
0551  00352  10100024   KY68  LAA  CHAR,1     CONVERT CHAR FROM DECIMAL
0552  0C353  00020015         RSL  16         AND MERGE INTO BUFFER.
0553  0C354  00600300         SMA  CVC        STANDARD DECIMAL DIGIT
0554  CC355  14400015         IAM  CCB,1      TO BINARY CONVERSION
0555  CC356  00001016         LSL  1                ROUTINE.
0556  0C357  13100015         AAM  CCB,1
0557  CC360  00002016         LSL  2
0558  0C361  13100015         AAM  CCB,1
0559  0C362  01100363*        BRU  KY70
0560                     *
0561                     *---------CHECK INPUT CHAR FOR CARRIAGE RETURN.
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```
0562                          *
0563  0C363  10100024    KY70 LAA  CHAR,1
0564  0C364  00600262         SMA  TYCR       CARRIAGE RETURN....
0565  0C365  02200367*        BAZ  *+2        YES.
0566  0C366  01100410*        BRU  KY74       NO.
0567  00367  10100010         LAA  FCC,1      CHECK IF IT WAS FIRST CHAR IN FIELD.
0568  0C370  10600011         SMA  CCC,1
0569  0C371  02400375*        BAP  KY72       YES..BY-PASS STORING DATA.
0570  00372  10100015    KY71 LAA  CCB,1      STORE CHARACTER BUFFER IN DATA ADDRESS.
0571  0C373  50300014         STA* DADR,1
0572  0C374  11400013         IMS  CWC,1      INCR. WORD COUNT.
0573                          *
0574                          *---------RETURN NUMBER OF WORDS INPUT TO DDW.
0575                          *
0576  0C375  10100013    KY72 LAA  CWC,1
0577  0C376  00017016         LSL  15         SHIFT WORD COUNT TO UPPER NINE BITS.
0578  00377  53000016         MOA* DDWP,1     MERGE INTO DATA DOUBLE WORD.
0579  00400  50300016         STA* DDWP,1                      (DDW)
0580                          *
0581                          *---------SET FINISHED BITS IN ICT.
0582                          *
0583  0C401  11600023    KY73 EXU  CEU,1      SET TTY TO KEYBOARD MODE.
0584  0C402  01000000         DATA '01000000
0585  0C403  00000022         NOP
0586  0C404  01201320*        SPB  RSTQ       REST QUEUE BITS AND UPDATE QUEUE.
0587  0C405  00100211         LAA  MONE       FINISHED FLAG FOR
0588  0C406  10300014         STA  DADR,1     HIGH SPEED READER.
0589  0C407  01101217*        BRU  KY99       RETURN.
0590                          *
0591                          *---------CHECK FOR END OF FIELD, AND IF SO CHECK
0592                          *---------WORD COUNT.  TERMINATE OR GET NEW DDW.
0593                          *
0594  0C410  11400011    KY74 IMS  CCC,1      INCREMENT CHAR, COUNTER.
0595  0C411  01101217*        BRU  KY99       RETURN..NOT FULL FIELD YET.
0596  0C412  11400013         IMS  CWC,1      CCC=0, INCREMENT WORD COUNT.
0597  0C413  10100015         LAA  CCB,1
0598  0C414  50300014         STA* DADR,1     STORE BUFFER IN DATA ADDRESS.
0599  0C415  0C000003         CLA
0600  0C416  10300015         STA  CCB,1      RESET CHARACTER BUFFER.
0601  00417  11400014         IMS  DADR,1     INCREMENT DATA ADDRESS.
```

```
0602  00420  10100010          LAA  FCC,1      RESET CURRENT CHAR COUNT
0603  00421  10300011          STA  CCC,1      TO FULL CHAR COUNT.
0604  00422  10100013          LAA  CWC,1      CHECK TO SEE IF REACHED
0605  00423  10600012          SMA  FWC,1      FULL WORD COUNT YET...
0606  00424  02301217*         BAN  KY99       NO..RETURN.
0607                        *
0608                        *---------FULL WORD COUNT REACHED
0609                        *
0610  00425  10100013    KY75 LAA  CWC,1      YES..RETURN WORD
0611  00426  00017016          LSL  15         COUNT TO DDW.
0612  00427  53000016          MOA* DDWP,1
0613  00430  50300016          STA* DDWP,1
0614  00431  00000003          CLA
0615  00432  10300024          STA  CHAR,1     ZERO CHAR SO NEW DDW WON'T USE IT.
0616  00433  10100026          LAA  STAT,1      CHECK STATUS WORD FOR
0617  00434  00004016          LSL  4          LAST DDW FLAG.
0618  00435  02400101*         BAP  KY07+2     FLAG OFF.. MORE DDW'S.
0619  00436  00100262          LAA  TYCR       ON..SIMULATE CARRIAGE RETURN
0620  00437  01100005*         BRU  KY01+5     TO TERMINATE INPUT.
0621                        *
0622                        *
0623                        *
0624                        *
0625                        *
0626                        *---------A RE-ENTRANT ROUTINE TO DECODE DDW'S.
0627                        *
0628                        *          (FOR OUTPUT FIELD WIDTH IS RETURNED IN CCB.
0629                        *
0630  00440  00000440*    DDDW ZZZ **          ENTRY POINT.
0631  00441  00100440*         LAA  DDDW       SAVE POINT FOR RETURN ADDRESS.
0632  00442  10300017          STA  RETN,1      PUT IT IN TEMPORARY STORAGE.
0633  00443  11400016          IMS  DDWP,1
0634  00444  00000003          CLA
0635  00445  50200016          LBA* DDWP,1
0636  00446  00001017          FLL  1
0637  00447  00023016          LSL  19
0638  00450  13000026          MQA  STAT,1
0639  00451  10300026          STA  STAT,1     ENTER F BIT IN STATSUS WORD.
0640  00452  00000003          CLA
0641  00453  10300013          STA  CWC,1      ZERO CURRENT WORD COUNT.
```

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0642  0C454  00002017          FLL  2
0643  0C455  0C600213          SMA  CNF
0644  0C456  10300007          STA  FRMT,1   CONVERT FORMAT TO RANGE -1 TO +1.
0645  0C457  02300462*         BAN  *+3       CALCULATE FULL CHAR COUNT.
0646  0C460  00100202          LAA  MATE      =-8.
0647  0C461  01100463*         BRU  *+2
0648  0C462  00100206          LAA  MFCR      =-4.
0649  0C463  10300010          STA  FCC,1
0650  0C464  10300011          STA  CCC,1     SET CURRENT CHAR COUNT=CALCULATED FCC.
0651  0C465  00000003          CLA
0652  0C466  00005017          FLL  5
0653  0C467  10300015          STA  CCB,1
0654  0C470  10100026          LAA  STAT,1
0655  0C471  02701462*         MAA  ='76777777 TURN OFF IMMEDIATE DATA FLAG.
0656  0C472  10300026          STA  STAT,1
0657  0C473  00000003          CLA
0658  0C474  00001017          FLL  1
0659  0C475  00022016          LSL  18
0660  0C476  13000026          MOA  STAT,1
0661  0C477  10300026          STA  STAT,1
0662  0C500  00000003          CLA
0663  0C501  00017017          FLL  15
0664  0C502  10300012          STA  FWC,1
0665  0C503  11400016          IMS  DDWP,1
0666  0C504  50100016          LAA* DDWP,1
0667  0C505  02700242          MAA  AMSK      SET UPPER 9 BITS IN DATA WORD TO 0.
0668  0C506  10300014          STA  DADR,1
0669  0C507  10100026          LAA  STAT,1
0670  0C510  00005016          LSL  5
0671  0C511  02400517*         BAP  *+6
0672  0C512  10100016          LAA  DDWP,1
0673  0C513  10300014          STA  DADR,1
0674  0C514  10500012          AMA  FWC,1
0675  0C515  00500211          AMA  MONE
0676  0C516  10300016          STA  DDWP,1
0677  0C517  51100017          BRU* RETN,1
0678                       *
0679                       *
0680                       *
0681                       *
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0682                          *-----A ROUTINE TO CHECK THE VALIDITY
0683                          *-----OF ALL DATA ADRESSES ASSOCIATED WITH
0684                          *-----INPUT, AND TO INHIBIT THE BACKGROUND
0685                          *-----USER FROM INPUTTING IN THE FOREGROUND
0686                          *-----REGION.
0687                          *
0688                          *EXIT WITH A= 0 FOR ADDRESS OK.
0689                          *EXIT WITH A=-1 FOR MEMORY PROTECT VIOLATION.
0690                          *
0691                          *----(ROUTINE IS RE-ENTRANT.)
0692                          *
0693  00520  00000000    CHEK ZZZ  **         ENTRY POINT OF ROUTINE.
0694  00521  00200520*         LBA  CHEK      SAVE RETURN ADDRESS TO MAKE
0695  00522  10400017         STB  TEMP,1    THE ROUTINE RE-ENTRANT.
0696  00523  23200000         LIX  $DRTY-C,2 FG/BG PARTITION IS IN DRTY-C+7.
0697  00524  00000003         CLA
0698  00525  10200014         LBA  DADR,1   KEEP ADDR IN LOWER 16K BECAUSE
0699  00526  00012017         FLL  10       OF MEMORY WRAP AROUND.
0700  00527  02200531*        BAZ  *+2      OK.
0701  00530  01100542*        BRU  ERTN    ADDRESS .GT. 16K.
0702  00531  00016017         FLL  14      DATA ADDRESS TO A.
0703  00532  21500007         CMA  PART,2  COMPARE DATA ADDR WITH PARTITION.
0704  00533  01100536*        BRU  *+3    F/G DATA ADDRESS.  CHECK FURTHER.
0705  00534  01100536*        BRU  *+2     DITTO.
0706  00535  01100544*        BRU  RTRN    B/G DATA ADDRESS..OK.
0707  00536  10100025         LAA  IOTA,1   IF F/G ADDR. MAKE SURE IOT IS ALSO
0708  00537  21500007         CMA  PART,2   IN FOREGROUND.  (F/G INPUT).
0709  00540  01100544*        BRU  RTRN     F/G IOT   OK.
0710  00541  01100544*        BRU  RTRN      DITTO.
0711  00542  00100211    ERTN LAA  MONE      ERROR...SOCK-IT-TO-IM.
0712  00543  51100017         BRU* TEMP,1   RETURN.
0713  00544  00000003    RTRN CLA            NORMAL RETURN.
0714  00545  51100017         BRU* TEMP,1
0715                          *
0716                          *
0717                          * MAKE AN ENTRY TI THE LOW
0718                          *PRICRITY QUEUE.
0719                          *
0720  00546  00000000    ELPQ ZZZ  **
0721  00547  00200546*         LBA  ELPQ  RE-ENTRANT ROUTINE..RETURN ADDR.
```

```
0722  0C550  10400017          STB  TEMP,1  PUT RETN ADDR IN TEMPORARY STORAGE.
0723  0C551  10200006          LBA  LPQ,1   PUT ADDR OF LPQ
0724  0C552  20000002          TBI  ,2       INTO XR2.
0725  0C553  00000006          IAB
0726  0C554  42200546*         BAZ* ELPQ     NO LOW PRIORITY QUEUE.
0727  0C555  10100026          LAA  STAT,1
0728  0C556  00002016          LSL  2         NO ENTRY
0729  0C557  02300570*         BAN  ELP1 FOR READER MODE.
0730  0C560  00000006          IAB
0731  00561  60300001          STA* NPTR,2
0732  0C562  21400001          IMS  NPTR,2
0733  0C563  20100003          LAA  AEDQ,2
0734  0C564  20600001          SMA  NPTR,2
0735  0C565  02400570*         BAP  *+3
0736  00566  20100002          LAA  ASTQ,2
0737  0C567  20300001          STA  NPTR,2
0738  0C570  51100017    ELP1  BRU* TEMP,1  RETURN.
0739                      *
0740                      *ABSOLUTE PAPER-TAPE LOADER..RE-ENTRANT.
0741                      *
0742                      *MODE=-2 WHILE READING LEADER (KY90).
0743                      *        SET TO -1 WHEN '377 DETECTED.
0744                      *
0745                      *    =-1 WHILE READING START ADDRESS. (KY91).
0746                      *        SET TO ZERO AFTER THREE CHARACTERS.
0747                      *
0748                      *    = 0 WHILE READING NEGATIVE WORD COUNT (KY92)
0749                      *        SET TO ONE AFTER THREE CHARACTERS.
0750                      *
0751                      *    = 1 WHILE READING '100 LENGTH BLOCK (KY93).
0752                      *        SET TO TWO AFTER READING '100 CHAR.
0753                      *
0754                      *    = 2 WHILE READING CHECKSUM (KY94).
0755                      *         SET TO ONE AFTER THREE CHAR.
0756                      *
0757  0C571  10100007    KY90  LAA  MODE,1
0758  0C572  00500213          AMA  ONE
0759  0C573  02200611*         BAZ  KY91 IF MODE=-1
0760  0C574  02400616*         BAP  KY92 IF MODE = 0,1 OR 2.
0761  0C575  10100024          LAA  CHAR,1 MODE=-2
```

```
0762  0C576  02201217*          BAZ  KY99      IGNORE LEADER.
0763  0C577  02600272           MEA  DELT      TEST IF FIRST NON-ZERO CHAR
0764  0C600  02200603*          BAZ  *+3       IS A DELETE.
0765  0C601  00100722*          LAA  IT10      NO...ERROR.
0766  0C602  01100661*          BRU  KY96-1    OUTPUT ERROR MESSAGE.
0767  0C603  11400007           IMS  MODE,1 MODE=-1
0768  0C604  00100207           LAA  MTPE  CORE INDEX REG.
0769  0C605  10300010           STA  XR4,1 FOR COUNTING CHAR.
0770  0C606  00000003           CLA     ZERO THE WORD
0771  0C607  10300015           STA  CCB,1  BUFFER.
0772  0C610  01101217*          BRU  KY99     RETURN.
0773  0C611  01200730*  KY91 SPB  MRGE INPUT A WORD.
0774  0C612  10300014           STA  DADR,1  USE AS DATA ADDRES.
0775  0C613  00000003           CLA
0776  0C614  10300007           STA  MODE,1  MODE=0
0777  0C615  01101217*          BRU  KY99     RETURN.
0778  0C616  10100007  KY92 LAA  MODE,1
0779  0C617  00600213           SMA  ONE
0780  0C620  02200645*          BAZ  KY93 IF MODE=1
0781  0C621  02400655*          BAP  KY94 IF MODE=2
0782  00622  01200730*          SPB  MRGE MODE IS 0.
0783  0C623  10300012           STA  NWDC,1 GET NEG. WORD COUNT.
0784  00624  05600000           NEG    STORE POS. WORD COUNT.
0785  0C625  50300016           STA* DDWP,1 IN COUNT FIELD OF IOT.
0786  00626  11400016           IMS  DDWP,1
0787  0C627  10100014           LAA  DADR,1 STORE INITIAL DATA ADDR.
0788  00630  50300016           STA* DDWP,1  IN ADDR FIELD OF IOT.
0789  0C631  10200025           LBA  IOTA,1
0790  0C632  01200520*          SPB  CHEK
0791  00633  02400643*          BAP  *+8
0792  0C634  10100025           LAA  IOTA,1   PUT IOT ADDR AND
0793  00635  00300720*          STA  DA13     DATA ADDR IN
0794  0C636  10100014           LAA  DADR,1   ERROR MESSAGE IOT.
0795  0C637  00300721*          STA  DA14
0796  CC640  00100711*          LAA  IAT3
0797                            CALL IOCS
0798  0C642  01100662*          BRU  KY96
0799  0C643  11400007           IMS  MODE,1 SET MODE=1
0800  0C644  01100670*          BRU  KY97     SET UP BLOCK LENGTH.
0801  0C645  01200730*  KY93 SPB  MRGE  GET A WORD.
```

```
0802  0C646  50300014          STA* DADR,1  STORE IN DATA ADDR.
0803  0C647  13100013          AAM  CKSM,1 ACCUMULATE CHECKSUM.
0804  00650  11400014          IMS  DADR,1
0805  0C651  11400011          IMS  XR5,1 INCR BLOCK COUNT.
0806  0C652  01101217*         BRU  KY99    RETURN.
0807  0C653  11400007          IMS  MODE,1 MODE=2(COMPLETED BLOCK)
0808  0C654  01101217*         BRU  KY99  RETURN.
0809  0C655  01200730*  KY94 SPB  MRGE  GET A WORD.
0810  0C656  12600013          MEA  CKSM,1 COMPARE WITH COMPUTED CKSM.
0811  0C657  02200666*         BAZ  KY95 OK.. CONTINUE.
0812  0C660  00100672*         LAA  IAT1 CKSM ERROR.
0813                           CALL ICCS OUTPUT ERROR MESSAGE.
0814  0C662  50100016    KY96 LAA* DDWP,1  ERROR.
0815  0C663  03000234          MCA  SNCN  ='40000000
0816  0C664  50300016          STA* DDWP,1 INITIATE ABNORMAL
0817  0C665  01100401*         BRU  KY73  TERMINATION OF REQUEST.
0818  0C666  00100213    KY95 LAA  ONE CKSM OK.
0819  00667  10300007          STA  MODE,1 SET MODE=1
0820  0C670  01200746*  KY97 SPB  CNBL     GET NEW BLOCK LENGTH
0821  00671  01100401*         BRU  KY73     IF RETURNS..FINISHED.
0822  0C672  00000673*  IAT1 DAC  IOT1
0823  0C673  00000036    IOT1 DATA '36
0824  00674  40100003          LAA* 3
0825  0C675  76741117          DATA ''><IO 10 CKSM''
      0C676  40616040
      0C677  03132315
0826  0C700  00000701*  IAT2 DAC  IOT2
0827  0C701  00000036    IOT2 DATA '36
0828  0C702  00100003          LAA  3
0829  0C703  76741117          DATA ''><IO 11 DADR''
      0C704  40616140
      0C705  04010422
0830  0C706  51300002          DATA '51300002
0831  0C707  00000000    DA11 ZZZ  **
0832  0C710  00000000    DA12 ZZZ  **
0833  0C711  00000712*  IAT3 DAC  IOT3
0834  0C712  00000036    IOT3 DATA '36
0835  0C713  00100003          LAA  3
0836  0C714  76741117          DATA ''><IO 12 ABSL''
      0C715  40616240
```

```
       0C716  01022314
0837   0C717  51300002          DATA '51300002
0838   0C720  00000000    DA13 ZZZ  **
0839   0C721  00000000    DA14 ZZZ  **
0840                       *
0841   0C722  00000723*    IT1C DAC  *+1
0842   0C723  00000036          DATA '36
0843   0C724  40100003          LAA* 3
0844   0C725  76741117          DATA ''><IO 16 N377''
       0C726  40616640
       0C727  16636767
0845                       *
0846                       *
0847                       *A ROUTINE TO MERGE THREE
0848                       *CONSECUTIVE CHARACTERS INTO
0849                       *ONE WORD FOR ABSOLUTE LOADER.
0850                       *------RE-ENTRANT-----------*
0851                       *
0852   0C730  00000000    MRGE ZZZ  **
0853   0C731  00100730*         LAA  MRGE STORE RETURN
0854   0C732  10300017          STA  RETN,1 ADDRESS.
0855   0C733  10200024          LBA  CHAR,1 CHAR JUST INPUT.
0856   0C734  10100015          LAA  CCB,1 CHAR BUFFER.
0857   0C735  0C010017          FLL  8 CHAR SHIFTED INTO BUFFER.
0858   0C736  10300015          STA  CCB,1 RESTORE BUFFER.
0859   0C737  11400010          IMS  XR4,1 INCR CHAR COUNT.
0860   0C740  01101217*         BRU  KYS9    RETURN..NOT 3 CHAR YET.
0861   0C741  00200207          LBA  MTRE  3 CHAR INPUT..RESTORE
0862   0C742  1C40001C          STB  XR4,1  INDEX CHAR COUNTER.
0863   0C743  00200212          LBA  ZERO  ZERO THE
0864   0C744  10400015          STB  CCB,1  BUFFER.
0865   0C745  51100017          BRU* RETN,1 RETURN TO THE CALLING
0866                       *                 PROGRAM WITH A FULL WORD
0867                       *                 IN THE A ACC.
0868                       *
0869                       *
0870                       *A ROUTINE TO CALCULATE A NEW
0871                       *BLOCK LENGTH FOR THE ABSOLUTE LOADER.
0872                       *
0873   0C746  00000000    CNBL ZZZ  **        ENTRY POINT.
```

```
0874  00747  23200746*        LIX  *-1,2      SAVE RETURN ADDR. IN XR2.
0875  00750  00000003         CLA             SET CHECKSUM=0
0876  00751  10300013         STA  CKSM,1
0877  00752  10100012         LAA  NWDC,1
0878  00753  62400000         BAP* 0,2   FINISHED..RETURN TO CALLING POINT.
0879  00754  00500336         AMA  BT17  (='100)
0880  00755  00000005         TAB
0881  00756  02300762*        BAN  DXR5 NOT LAST BLOCK YET.
0882  00757  10100012         LAA  NWDC,1 LAST BLOCK &.LT. '100
0883  00760  10300011         STA  XR5,1
0884  00761  01100764*        BRU  EXR5
0885  00762  00100322    DXR5 LAA  M100  (=-'100) STANDARD BLOCK
0886  00763  10300011         STA  XR5,1     LENGTH.
0887  00764  10400012    EXR5 STB  NWDC,1
0888  00765  01101217*        BRU  KY99       RETURN.
0889                       *
0890                       *--------TYPEWRITER/PAPER-TAPE OUTPUT HANDLER.
0891                       *--------ENTRY POINT.
0892                       *
0893  00766  10377774    TY01 STA  -4,1      STORE A AND B REGISTERS
0894  00767  10477775         STB  -3,1      IN THE SAVEAREA.
0895  00770  50100000         LAA* XPTR,1    PICK UP IOT ADDRESS FROM QUEUE.
0896  00771  02201051*        BAZ  TY07      QUEUE EMPTY...CHECK LPQ.
0897  00772  10300025         STA  IOTA,1    THERE IS A ENTRY IN THE QUEUE.
0898  00773  50100025         LAA* IOTA,1    GET FIRST WORD OF IOT.
0899  00774  00001016         LSL  1         CHECK EXECUTION BIT...
0900  00775  02301035*        BAN  TY04      EXECUTION BIT ON..OLD IOT..ALREADY DECODED.
0901                       *
0902                       *--------BEGINNING TO DECODE NEW IOT.
0903                       *--------CHECK LOW PRIORITY QUEUE FOR CR/LF.
0904                       *--------OUTPUT THESE CHARACTERS FIRST.
0905                       *
0906  00776  10100006         LAA  LPQ,1     LOAD LOW PRIORITY QUEUE ADDRESS.
0907  00777  20000001         TAI  ,2        INTO INDEX REGISTER 2.
0908  01000  02201010*        BAZ  TY09      NO LPQ.
0909  01001  60100000         LAA* XPTR,2    IS NEXT CHAR IN LPQ::
0910  01002  01500262         CMA  TYCR      A CARRIAGE RETURN....
0911  01003  01101005*        BRU  *+2       NO.
0912  01004  01101051*        BRU  TY07      YES..OUTPUT IT IMMEDIATELY.
0913  01005  01500263         CMA  TYLF      A LINE FEED....
```

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0914  01006  01101010*        BRU  *+2       NO.
0915  01007  01101051*        BRU  TY07      YES..OUTPUT IT IMMEDIATELY.
0916                         *
0917                         *--------SET EXECUTION BIT IN IOT.
0918                         *
0919  01010  50100025         TY09 LAA* IOTA,1
0920  01011  03000236              MOA  BIT1      BIT 1..FIRST WORD IOT.
0921  01012  50300025              STA* IOTA,1
0922                         *
0923                         *--------PUT OPERATION BITS FROM IOT
0924                         *--------INTO OUTPUT STATUS WORD.
0925                         *
0926  01013  00006016              LSL  6
0927  01014  02700231              MAA  MSK2      ='00770000
0928  01015  10300026              STA  STAT,1
0929  01016  00011016              LSL  9         CHECK FOR PUNCH POWER OFF OPERATION.
0930  01017  02401025*             BAP  TY02      NO.
0931                         *
0932                         *--------TURN PUNCH POWER OFF ON FSPT.
0933                         *--------(IF A TTY  GETS SET TO KEYBOARD MODE).
0934                         *
0935  01020  11600023              EXU  CEU,1
0936  01021  01000000              DATA '01000000
0937  01022  00000022              NOP
0938  01023  01201320*             SPB  RSTQ      RESET QUEUE AND Q BITS.
0939  01024  01101217*             BRU  TY99      RETURN.
0940                         *
0941                         *--------DECODE FIRST DATA DOUBLE WORD. (DDW).
0942                         *
0943  01025  10100025         TY02 LAA  IOTA,1    SET DDW POINTER
0944  01026  10300016              STA  DDWP,1    TO FIRST WORD OF IOT INITIALLY.
0945  01027  01201264*             SPB  DCDW      DECODE DDW.
0946                         *
0947                         *--------CHECK FOR ABSOLUTE DUMP OPERATIONS.
0948                         *
0949  01030  10100026         TY03 LAA  STAT,1    CHECK ABSOLUTE DUMP FLAG
0950  01031  00012016              LSL  10        IN OUTPUT STATUS WORD.
0951  01032  02401044*             BAP  TY05      OFF.
0952  01033  00100210              LAA  MTWO      SET ABSD MODE TO ''LOOK FOR
0953  01034  10300007              STA  MODE,1    '377.''
```

```
0954                          *
0955                          *--------CHECK IF ABSOLUTE DUMP IN PROGRESS.
0956                          *
0957  01035  10100026    TY04 LAA  STAT,1    CHECK ABSOLUTE DUMP FLAG
0958  01036  00012016         LSL  10        IN OUTPUT STATUS WORD.
0959  01037  02301344*        BAN  TY90      ON..GO TO ABSD ROUTINE.
0960  01040  00005016         LSL  5
0961  01041  02301254*        BAN  TY87      OUTPUT C/R IMMEDIATELY.
0962  01042  00001016         LSL  1         OUTPUT L/F IMMEDIATELY
0963  01043  02301260*        BAN  TY88      AND TERMINATE OUTPUT.
0964                          *
0965                          *--------CHECK FORMAT AND BRANCH
0966                          *--------TO CONVERSION ROUTINE.
0967                          *
0968  01044  10200015    TY05 LBA  CCB,1     CHARACTER BUFFER (CCB) IN B.
0969  01045  10100007         LAA  FRMT,1
0970  01046  02301072*        BAN  TY40      ASCII CONVERSION.
0971  01047  02201124*        BAZ  TY50      OCTAL CONVERSION.
0972  01050  01101147*        BRU  TY60      DECIMAL CONVERSION.
0973                          *
0974                          *--------LOW PRIORITY QUEUE ENTRANCE.
0975                          *
0976  01051  10100006    TY07 LAA  LPQ,1     ADDRESS OF LOW PRIORITY QUEUE.
0977  01052  02201176*        BAZ  TY76      NO LPQ..RETURN..NO OUTPUT.
0978  01053  20000001         TAI  ,2        PUT LPQ ADDRESS IN XR2.
0979  01054  20100000         LAA  XPTR,2    CHECK IF ANY
0980  01055  20600001         SMA  NPTR,2    ENTRIES IN LPQ.
0981  01056  02201176*        BAZ  TY76      NO..DISABLE AND RETURN.
0982  01057  60100000         LAA* XPTR,2    YES..PICK UP ENTRY
0983  01060  10300024         STA  OUTC,1    AND STORE FOR OUTPUT.
0984  01061  00000003         CLA
0985  01062  60300000         STA* XPTR,2    ZERO ENTRY IN QUEUE.
0986  01063  21400000         IMS  XPTR,2    INCREMENT EXECUTION POINTER.
0987  01064  20100003         LAA  AEDQ,2    CHECK FOR END OF QUEUE.
0988  01065  20600000         SMA  XPTR,2
0989  01066  02401071*        BAP  *+3       NOT END YET.
0990  01067  20100002         LAA  ASTQ,2    RESET TO BEGINNING
0991  01070  20300000         STA  XPTR,2    OF QUEUE..(CIRCULAR QUEUE).
0992  01071  01101207*        BRU  TY81      RETURN..CHAR TO BE OUTPUT IN OUTC.
0993                          *
```

```
0994                          *--------ASCII OUTPUT CONVERSION.
0995                          *
0996  01072  00000004    TY40  TBA             CONVERT LEFTMOST
0997  01073  02301076*        BAN   *+3        6 BITS OF BUFFER (CCB).
0998  01074  00100215        LAA   TREE       TO ONE 8-BIT ASCII CHARACTER.
0999  01075  01101077*        BRU   *+2
1000  01076  00100214        LAA   TWO
1001  01077  00006017        FLL   6
1002  01100  00020016        LSL   16         SHIFT TO UPPER A FOR OUTPUT.
1003  01101  10400015        STB   CCB,1      RESTORE BUFFER.
1004  01102  00000005        TAB              OUTPUT CHAR IN B.
1005  01103  10100026        LAA   STAT,1     CHECK FOR BINARY MODE.
1006  01104  00006016        LSL   6
1007  01105  02301123*        BAN   TY45       YESS...NO SPECIAL CHARACTERS.
1008  01106  00000004        TBA
1009  01107  01500265        CMA   TZCR       IS CHAR DUMMY CARRIAGE RETURN..
1010  01110  01101112*        BRU   *+2        NO.
1011  01111  00200262        LBA   TYCR       YES...USE REAL CARRIAGE RETURN.
1012  01112  01500266        CMA   TZLF       IS CHAR DUMMY LINE FEED...
1013  01113  01101115*        BRU   *+2        NO.
1014  01114  00200263        LBA   TYLF       YES..USE REAL LINE FEED.
1015  01115  01500267        CMA   TZBL       IS CHAR DUMMY BELL RING.
1016  01116  0110112C*        BRU   *+2        NO.
1017  01117  00200264        LBA   TYBL       YES..USE REAL BELL RING.
1018  01120  01500246        CMA   TZAT       IS CHAT AT-SIGN..
1019  01121  01101123*        BRU   *+2        NO.
1020  01122  00200247        LBA   BLAN       YES..USE A BLANK.
1021  01123  01101203*    TY45  BRU   TY80
1022                          *
1023                          *--------OCTAL OUTPUT CONVERSION.
1024                          *
1025  01124  10100010    TY50  LAA   FCC,1     CHECK IF FIRST CHAR..
1026  01125  1C600C11        SMA   CCC,1
1027  01126  0230114C*        BAN   TY52       NO.
1028  01127  00100201        LAA   MNIN       YES..IS IT FULL FIELD..(-9).
1029  01130  10600010        SMA   FCC,1
1030  01131  02201136*        BAZ   *+5        YES.
1031  01132  20000001        TAI   ,2         NO..NOT FULL FIELD
1032  01133  00003C17        FLL   3          SHIFT CCB INTO POSITION.
1033  01134  23401133*        TIB   *-1,2
```

```
1034  01135  1C400015          STB  CCB,1
1035  01136  00200247    TY51  LBA  BLAN      OUTPUT A BLANK.
1036  01137  01101203*         BRU  TY80      FOR THE FIRST CHARACTER.
1037  01140  00000003    TY52  CLA            CONVERT ONE OCTAL DIGIT.
1038  01141  00003017          FLL  3         (CCB STILL IN B REG.).
1039  01142  00500300          AMA  CVC       CONVERT TO CHAR.  ('260).
1040  01143  10400015          STB  CCB,1     RESTORE BUFFER.
1041  01144  0C020016          LSL  16        SHIFT TO UPPER A.
1042  01145  0C000005          TAB
1043  01146  01101203*         BRU  TY80
1044                      *
1045                      *--------DECIMAL OUTPUT CONVERSION.
1046                      *
1047  01147  1C100011    TY60  LAA  CCC,1     CHECK IF FIRST CHARACTER.
1048  01150  1C60001C          SMA  FCC,1
1049  01151  00600213          SMA  ONE
1050  C1152  02401154*         BAP  TY61      NO.
1051  01153  01101136*         BRU  TY51      YES..OUTPUT BLANK FOR FIRST CHAR.
1052  C1154  02201166*    TY61  BAZ  TY62      IF SECOND CHARACTER (SIGN).
1053  01155  1C100011          LAA  CCC,1     BEGIN CONVERSION FOR .GT. SECOND CHAR.
1054  01156  20000001          TAI  ,2        USE CHAR COUNT TO PICK UP DIVISOR.
1055  01157  0C000003          CLA
1056  C1160  21000262          DIV  TY65+1,2  DIVIDE BY CORRESPONDING MULTIPLE OF 10.
1057  01161  00500300          AMA  CVC       CONVERT QUOTIENT TO CHAR.
1058  C1162  00020016          LSL  16        SHIFT TO UPPER A FOR OUTPUT.
1059  C1163  10400015          STB  CCB,1     STORE REMAINDER FOR NEXT DIVISION.
1060  01164  00000005          TAB            OUTPUT CHAR IN B.
1061  01165  01101203*         BRU  TY80
1062  01166  1C100015    TY62  LAA  CCB,1     CHECK NUMBER FOR SIGN.
1063  01167  02401136*         BAP  TY51      POSITIVE..OUTPUT PLUS SIGN  (BLANK).
1064  C1170  05600000          NEG            TAKE 2'S COMLEMENT OF NEG NUMBER.
1065  01171  02401173*         BAP  *+2       MINUS ZERO ('40000000) IS STILL NEG
1066  01172  00000020          ASC            AFTER NEG COMMAND.  FORCE IT POS WITH ASC.
1067  C1173  10300015          STA  CCB,1     BUFFER IS NOW POSITIVE.
1068  01174  00200271          LBA  MSIN      OUTPUT A MINUS SIGN.
1069  01175  01101203*         BRU  TY80
1070                      *
1071                      *
1072                      *---------BOTH QUEUES EMPTY.
1073                      *---------DISABLE INTERRUPT AND RETURN.
```

```
1074                          *
1075  01176  10100005    TY76 LAA  PIE,1   CONSTRUCT A PIC INSTRUCTION
1076  01177  02700241         MAA  PIDI     FROM PIE INSTRUCTION IN DCT.
1077  01200  10300017         STA  TEMP,1   STORE INSTRUCTION IN TEMPORARY STORAGE.
1078  01201  11600017         EXU  TEMP,1   EXECUTE PID INDIRECTLY.
1079  01202  01101217*        BRU  TY99     RETURN.
1080        00005         PIE  EQU  5        PIE IN DCT.
1081                          *
1082                          *
1083                          *--------INCREMENT CHARACTER COUNTER.
1084                          *--------RETURN IF NON-ZERO.
1085                          *--------RESET WORD COUNT, DATA ADDR. ETC. IF ZERO.
1086                          *
1087  01203  10400024    TY80 STB  OUTC,1   CHARACTER TO BE OUTPUT.
1088  01204  11400011         IMS  CCC,1    INCREMENT CURRENT CHAR COUNT.
1089  01205  01101207*       BRU  *+2      IF NOT ZERO.
1090  01206  01101224*       BRU  TY82     IF ZERO.
1091                          *
1092                          *--------OUTPUT ONE CHARACTER.  (IN OUTC).
1093                          *
1094  01207  10100026    TY81 LAA  STAT,1   CHECK LEADER FLAG IN STATUS WORD.
1095  01210  00013016         LSL  11
1096  01211  02401214*       BAP  *+3      OFF.
1097  01212  00100212         LAA  ZERO     ON..OUTPUT ZERO CHAR..(LEADER).
1098  01213  01101215*       BRU  *+2
1099  01214  10100024         LAA  OUTC,1   PICK UP CHAR TO BE OUTPUT IF NOT LEADER.
1100  01215  11600022         EXU  AOP,1    OUTPUT THE CHAR.
1101  01216  00000022         NOP
1102                          *
1103                          *---------TY99---RESTORE A,B,XR2----RETURN.
1104                          *
1105        01217    *    KY99 EQU  *        USE SAME RETURN FOR KY01.
1106  01217  10177774    TY99 LAA  -4,1     RESTORE A.
1107  01220  10277777         LBA  -1,1
1108  01221  20000002         TBI  ,2       RESTORE XR2 FROM REG SAVE AREA.
1109  01222  10277775         LBA  -3,1     RESTORE B.
1110  01223  51100021         BRU* RTAD,1   RETURN.
1111                          *
1112                          *
1113                          *--------CHAR COUNT=0..PICK UP NEXT DATA WORD.
```

```
1114                        *
1115  01224  10100010    TY82 LAA  FCC,1     RESET CHARACTER COUNT
1116  01225  10300011         STA  CCC,1     TO FULL CHARACTER COUNT.
1117  01226  11400013         IMS  CWC,1     INCREMENT WORD COUNT
1118  01227  11400014         IMS  DADR,1    INCREMENT DATA ADDRESS.
1119  01230  50100014         LAA* DADR,1    PICK UP NEXT WORD OF DATA.
1120  01231  10300015         STA  CCB,1     PUT IT IN BUFFER.
1121  01232  10100013         LAA  CWC,1     CHECK IF REACHED  FULL
1122  01233  10600012         SMA  FWC,1     WORD COUNT YET..
1123  01234  02301207*        BAN  TY81      NO.
1124                        *
1125                        *--------HAVE REACHED FULL WORD COUNT.
1126                        *--------DECODE NEW DDW IF PRESENT.
1127                        *--------TERMINATE IF NO DDW.
1128                        *
1129  01235  10100026    TY83 LAA  STAT,1    CHECK IF LAST DDW..
1130  01236  00004016         LSL  4
1131  01237  02301244*       BAN  TY86      YES.
1132  01240  01201264*       SPB  DCDW      NO.
1133  01241  01101207*       BRU  TY81      OUTPUT CHAR.
1134                        *
1135                        *---------SET OUTC=0 IF LAST CHAR IS LEDER.
1136                        *
1137  01242  00000003    TY84 CLA
1138  01243  01101261*       BRU  TY88+1
1139                        *
1140                        *--------CHECK IF WANT CR/LF AT END OF OUTPUT.
1141                        *
1142  01244  10100026    TY86 LAA  STAT,1    CHECK IF WANT
1143  01245  00010016         LSL  8         CARRIAGE RETURN/LINE FEED.
1144  01246  02301262*       BAN  TY89      OPERATION='10..NO.
1145  01247  00003016         LSL  3
1146  01250  02301242*       BAN  TY84      LEADER OP..YES NO C/R.
1147  01251  00101461*       LAA  ='C0000600 YES..SET BITS 15,16.
1148  01252  10300026         STA  STAT,1
1149  01253  01101207*       BRU  TY81      OUTPUT CHAR..((OUTC).
1150                        *
1151                        *--------OUTPUT C/R AND TURN OFF STATUS BIT 15.
1152                        *
1153  01254  00100337    TY87 LAA  BT16      ='20C
```

```
1154  01255  10300026          STA  STAT,1
1155  01256  00100262          LAA  TYCR      OUTPUT CARRIAGE RETURN.
1156  01257  01101215*         BRU  TY81+6
1157                        *
1158                        *--------OUTPUT LINE FEED, RESET QUEUE AND Q BITS.
1159                        *
1160  01260  00100263      TY88 LAA  TYLF
1161  01261  10300024          STA  OUTC,1
1162                        *
1163  01262  01201320*     TY89 SPB  RSTQ      RESET Q AND G BITS.
1164  01263  01101207*          BRU  TY81
1165                        *
1166                        *
1167                        *--------A RE-ENTRANT ROUTINE TO DECODE TTY/PT OUTPUT DDW.
1168                        *--------NOTE THAT THIS ROUTINE CALLS ANOTHER RE-ENTRANT
1169                        *--------ROUTINE..DDDW.
1170                        *
1171  01264  00000000      DCDW ZZZ  **        ENTRY POINT.
1172  01265  23201264*          LIX  *-1,2    SAVE RETURN ADDRESS IN XR2.
1173  01266  01200440*          SPB  DDDW     GENERAL DECODE ROUTINE INPUT AND OUTPUT.
1174  01267  10100015          LAA  CCB,1    CHECK FIELD WIDTH
1175  01270  02201273*          BAZ  *+3      IF NOT SPECIFIED.
1176  01271  05600000          NEG           CONVERT SPECIFIED FIELD
1177  01272  01101274*          BRU  *+2      WIDTH TO CHAR COUNT.
1178  01273  10100010          LAA  FCC,1    NOT SPECIFIED.
1179  01274  13500007          SMP  FRMT,1   CHANGE CHAR COUNT TO -9
1180  01275  01101277*          BRU  *+2      FOR OCTAL AND DECIMAL.
1181  01276  00500211          AMA  MONE     RESET
1182  01277  10300010          STA  FCC,1    FULL CHARACTER COUNT, AND
1183  01300  10300011          STA  CCC,1    CURRENT CHARACTER COUNT.
1184  01301  50100014          LAA* DADR,1   LOAD BUFFER WITH
1185  01302  10300015          STA  CCB,1    FIRST DATA WORD.
1186  01303  10100012          LAA  FWC,1    CHECK DDW FOR UNREASONABLE
1187  01304  00601460*          SMA  =50      WORD COUNT.
1188  01305  22300000          BAN  0,2      WORD COUNT O.K.--RETURN.
1189  01306  10100026          LAA  STAT,1   IF ABSOLUTE DUMP..LONG
1190  01307  00012016          LSL  10       WORD COUNT IS OK.
1191  01310  22300000          BAN  0,2      ABSD..NO ERROR.
1192  01311  00101437*          LAA  IATB     TOO LONG..REPLACE
1193  01312  54400000          IAM* XPTR,1   OUTPUT WITH ERROR MESSAGE.
```

```
1194  01313  00301447*        STA  IERR
1195  01314  50100025         LAA* IOTA,1   PICK UP DEVICE NO.
1196  01315  02700233         MAA  DMSK     OF ERRONEOUS IOT.
1197  01316  00301440*        STA  IOT8
1198  01317  01100770*        BRU  TY01+2
1199                        *
1200                        *
1201                        *--------A ROUTINE TO RESET Q BITS IN IOT TO OPERATION COMPLETE.
1202                        *--------AND TO UPDATE TO QUEUE.
1203                        *
1204  01320  00000000    RSTQ ZZZ  **       ENTRY POINT.
1205  01321  23201320*        LIX  *-1,2    SAVE RETURN ADDRESS IN XR2.
1206  01322  5C100025         LAA* IOTA,1   TURN OFF ''IN Q'' AND ''EXECUTION''
1207  01323  0270C245         MAA  FINI     BITS IN IOT.
1208  01324  03000240         MOA  FINB     TURN ON FINISHED BIT IN IOT.
1209  01325  5C300025         STA* IOTA,1
1210  01326  10100026         LAA  STAT,1   CHECK IF USING SPECIAL IOT
1211  01327  00001016         LSL  1        FOR COMMAND INPUT.
1212  01330  02301341*        BAN  RST1     YES..DON'T RESET QUEUE.
1213  01331  0C000003         CLA
1214  01332  50300000         STA* XPTR,1   ZERO QUEUE ENTRY.
1215  01333  11400000         IMS  XPTR,1   INCREMENT EXECUTION POINTER.
1216  01334  10100003         LAA  AEDQ,1   CHECK FOR
1217  01335  1C600C0C         SMA  XPTR,1   END OF QUEUE.
1218  01336  02401341*        BAP  *+3      NOT YET.
1219  01337  1C100002         LAA  ASTQ,1   END..RESET QUEUE
1220  01340  10300000         STA  XPTR,1   TO BEGINNING.
1221  01341  00000003    RST1 CLA
1222  01342  1C300026         STA  STAT,1   RESET STATUS WORD.
1223  01343  21100000         BRU  0,2      RETURN.
1224                        *
1225                        ****************************************
1226                        *                                      *
1227                        *--------ABSCLUTE DUMP ROUTINE-------*
1228                        *                                      *
1229                        ****************************************
1230                        *
1231                        *
1232                        *
1233                        *MODE=-2 INITIALLY AND WHILE PUNCHING '377.
```

```
1234                          *         SET TC -1 AFTER '377 PUNCHED.
1235                          *
1236                          *      -1 WHILE PUNCHING DATA ADDRESS (TY91).
1237                          *         SET TC ZERO AFTER 3 CHAR.
1238                          *
1239                          *       0 WHILE PUNCHING NEGATIVE WORD COUNT.
1240                          *         SET TC 1 AFTER THREE CHARACTERS.
1241                          *
1242                          *       1 WHILE PUNCHING DATA BLOCK.
1243                          *         SET TC 2 AFTER '100 WORDS.
1244                          *
1245                          *       2 WHILE PUNCHING CHECKSUM.
1246                          *         SET TC 1 AFTER 3 CHAR.
1247                          *
1248                          *
1249  01344  1C100007    TY90 LAA  MODE,1
1250  01345  00500213         AMA  ONE
1251  01346  02201356*        BAZ  TY91      IF MODE=-1
1252  01347  02401366*        BAP  TY92      IF MODE=0,1 OR 2
1253  01350  11400007         IMS  MODE,1     SET MODE=-1.
1254  01351  00200207         LBA  MTRE    SET XR4 FOR 3
1255  01352  1C400010         STB  XR4,1  CHAR DATA ADDRESS.
1256  01353  10200014         LBA  DADR,1   LOAD DATA ADDR
1257  01354  1C400015         STB  CCB,1    INTO BUFFER.
1258  01355  01101215*        BRU  TY81+6
1259  01356  01201422*    TY91 SPB  PAW        PUNCH DATA ADDR.
1260  01357  00000003         CLA
1261  01360  1C300007         STA  MODE,1   MODE=0
1262  01361  1C100012         LAA  FWC,1    LOAD NEGATIVE
1263  01362  05600000         NEG           WORD COUNT
1264  01363  10300012         STA  NWDC,1
1265  01364  1C300015         STA  CCB,1        INTO BUFFER.
1266  01365  01101217*        BRU  TY99     RETURN.
1267  01366  10100007    TY92 LAA  MODE,1
1268  01367  00600213         SMA  ONE
1269  01370  02201377*        BAZ  TY93    IF MODE=1
1270  01371  02401413*        BAP  TY94    IF MODE=2
1271  01372  01201422*        SPB  PAW     OUTPUT NEG WORD COUNT.
1272  01373  11400007         IMS  MODE,1   INCR MODE (1)
1273  01374  50100014         LAA* DADR,1     SET UP FIRST DATA
```

```
1274  01375  1C300015          STA  CCB,1       WORD IN BUFFER.
1275  01376  01101420*         BRU  TY97     GET NEW BLOCK COUNT.
1276  01377  01201422*    TY93 SPB  PAW
1277  01400  50100014          LAA* DADR,1  ADD WORD
1278  01401  13100013          AAM  CKSM,1  TO CHECKSUM.
1279  01402  11400014          IMS  DADR,1  INCR DATA ADDR.
1280  01403  50100014          LAA* DADR,1  GET NEXT WORD.
1281  01404  10300015          STA  CCB,1  PUT IT IN BUFFER.
1282  01405  11400011          IMS  XR5,1 INCR BLOCK COUNTER.
1283  01406  01101217*         BRU  TY99      RETURN..NOT FINISHED.
1284  01407  11400007          IMS  MODE,1 FINISHED BLOCK..SET MODE=2
1285  01410  10100013          LAA  CKSM,1  LOAD CHECKSUM
1286  01411  10300015          STA  CCB,1 INTO BUFFER.
1287  01412  01101217*         BRU  TY99      RETURN.
1288  01413  01201422*    TY94 SPB  PAW  PUNCH CHECKSUM
1289  01414  50100014          LAA* DADR,1  RELOAD DATA WORD.
1290  01415  1C300015          STA  CCB,1
1291  01416  00100213          LAA  ONE
1292  01417  1C300007          STA  MODE,1  SET MODE=1
1293  01420  01200746*    TY97 SPB  CNBL     GET NEW BLOCK COUNT.
1294  01421  01101262*         BRU  TY89      FINISHED..IF RETURNS TO HERE.
1295                        *
1296                        *
1297                        *A ROUTINE TO PUNCH A WORD (3 CHAR).
1298                        *
1299  01422  00000000    PAW  ZZZ  **
1300  01423  00101422*         LAA  PAW SAVE RETURN ADDRESS
1301  01424  10300017          STA  RETN,1 TO MAKE ROUTINE RE-ENTRANT.
1302  01425  1C100015          LAA  CCB,1  LOAD BUFFER INTO A.
1303  01426  11600022          EXU  AOP,1  OUTPUT ONE CHAR, AND
1304  01427  00000022          NOP      SHIFT NEXT CHAR
1305  01430  0C010016          LSL  8    INTO POSITION.
1306  01431  1C300015          STA  CCB,1  RESTORE BUFFER.
1307  01432  1140C01C          IMS  XR4,1  INCR CHAR COUNTER.
1308  01433  01101217*         BRU  TY99      RETURN..NOT 3 CHAR YET.
1309  01434  00100207          LAA  MTRE    3 CHAR..RESTORE
1310  01435  1C30001C          STA  XR4,1  COUNTER AND RETURN
1311  01436  51100017          BRU* RETN,1 TO CALLING POINT.
1312                        *
1313  01437  0C001440*    IAT8 DAC  *+1
```

```
1314  01440  00000020    IOT8 DAC  '2C
1315  01441  00100004         LAA  4
1316  01442  76741117         DATA ''><IO 14 WRDCNT''
      01443  40616440
      01444  27220403
      01445  16244040
1317  01446  51300001         DATA '51300001
1318  01447  00000000    IERR DAC  0
1319                     *
1320  01450  00001451*   IATS DAC  *+1
1321  01451  00000036         DAC  '36
1322  01452  00100003         LAA  3
1323  01453  76741117         DATA ''><IO 15 IMDT''
      01454  40616540
      01455  11150424
1324  01456  51300001         DATA '51300001
1325  01457  00000000    IRR2 DAC  0
1326                     *
1327                          END
      01460  00000062
      01461  00000600
      01462  76777777
      01463  73777777
      01464  04000000
EOJ
```

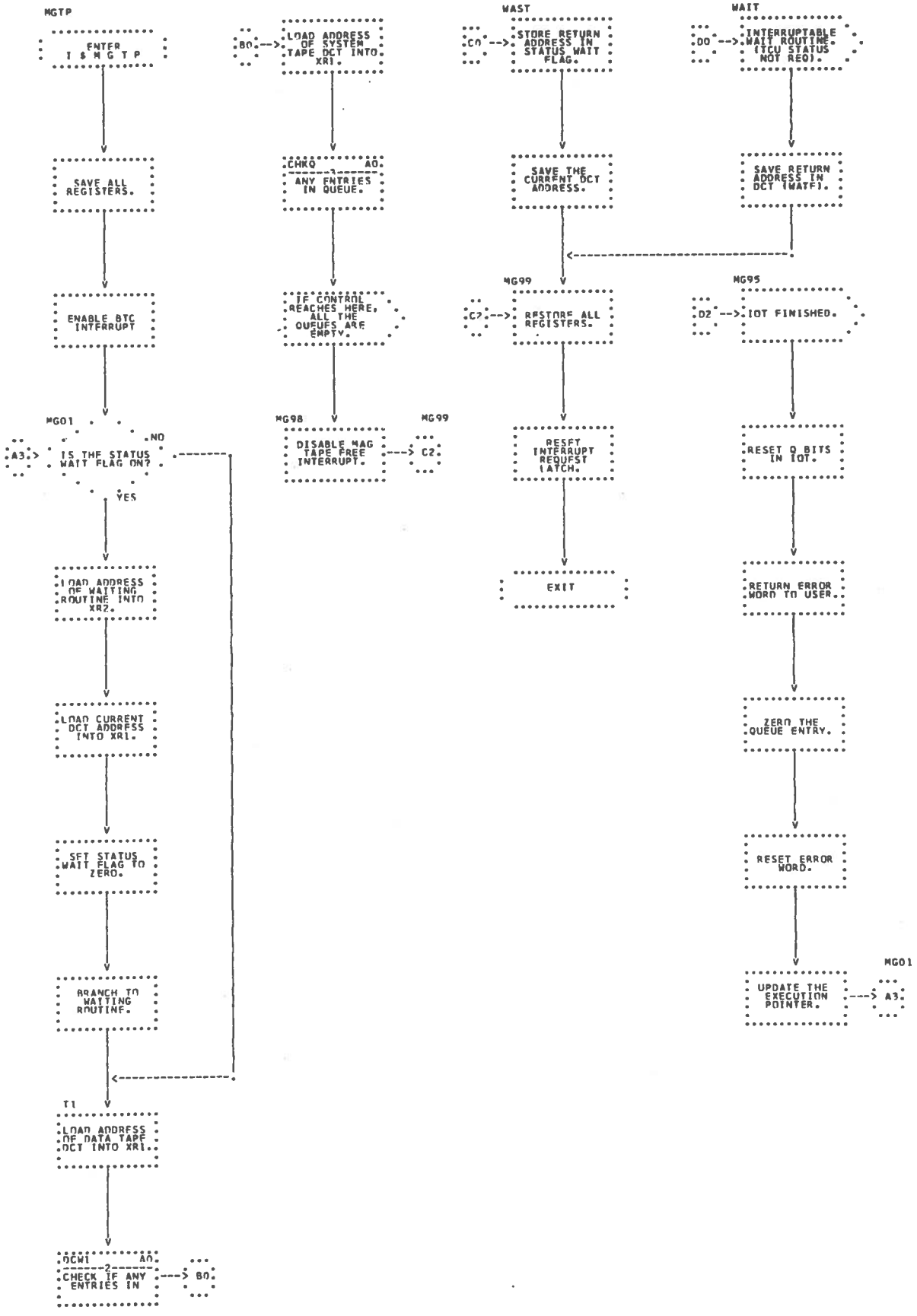
```
1  PAGE  0001

0001           0C000000     TNRA NAME TONR,TCNR
0002           00000000          NAME I$TONR,TONP
0003                        *
0004                        *----A RCUTINE TO TEST:
0005                        * 1) IF DEVICE IS TTY-PAPER-TAPE.
0006                        * 2) IF DEVICE IS BUSY.
0007                        *---IFSO..SWITCH TO READER MODE.
0008                        *
0009           00023        CEU  EQU  19
0010           00240        BIT2 EQU  '240
0011           00026        STAT EQU  22
0012           00001        NTRY EQU  1
0013                        *
0014    00000  00000000     TONR ZZZ  **
0015    00001  50100001          LAA* NTRY,1
0016    00002  02200004*         BAZ  *+2
0017    00003  41100000*         BRU* TONR
0018    00004  00000004          TBA
0019    00005  02700016*         MAA  ='00100000
0020    00006  42200000*         BAZ* TONR
0021    00007  11600023          EXU  CEU,1
0022    00010  02000000          DATA '02000000
0023    00011  00000022          NOP
0024    00012  10100026          LAA  STAT,1
0025    00013  03000240          MOA  BIT2
0026    00014  10300026          STA  STAT,1
0027    00015  41100000*         BRU* TONR
0028                             END
        00016  00100000
```

APPENDIX O

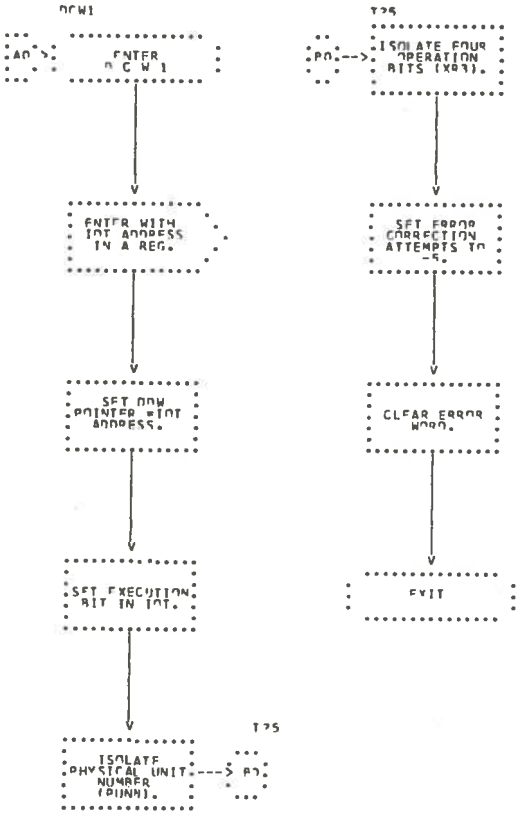
MAGNETIC TAPE HANDLER FLOWCHART AND LISTING

Symbol	Page	Coordinate
ADVF	O-7	B0
ADVR	O-8	C0
ADVT	O-8	A0
BRAT	O-7	D0
BSPE	O-13	A4
BSPF	O-7	A0
BSPR	O-8	D0
BSPT	O-13	A0
BTCR	O-10	A0
BUST	O-13	B0
CHKQ	O-3	A0
DCW1	O-2	A0
DDDW	O-9	A0
EOFT	O-11	A0
EOTT	O-11	B0
ERGP	O-8	B0
GWDC	O-4	B4
INPT	O-4	A0
INP1	O-4	A2
MGTP	O-1	A0
MG01	O-1	A3
MG95	O-1	D2
MG98	O-1	B3
MG99	O-1	C2
OUTP	O-5	A0
OUT1	O-5	A2
OVFT	O-11	C0
PART	O-12	A0
READ	O-6	A0
REWF	O-6	C0
RNGT	O-11	D0
RWND	O-6	D0
SETM	O-9	B0
STMD	O-9	C0
TSTS	O-5	C0
T1	O-1	A8
T10	O-6	A7
T11	O-6	B7
T12	O-6	C6
T13	O-6	D5
T14	O-7	D6
T15	O-8	A5
T16	O-10	B1
T17	O-11	A4
T18	O-11	B4
T19	O-11	C4
T2	O-3	A6
T20	O-11	D4
T21	O-12	A4
T22	O-12	B3
T23	O-13	B5
T24	O-13	B7
T25	O-2	B0
T26	O-3	B0
T27	O-4	B0
T28	O-4	C0
T29	O-5	B0
T30	O-10	B0
T31	O-12	B0
T32	O-13	C0
T4	O-3	C0
T5	O-3	C3
T7	O-4	B3
T8	O-5	B4
WAIT	O-1	D0
WAST	O-1	C0
WEOF	O-7	C0
WRIT	O-6	B0

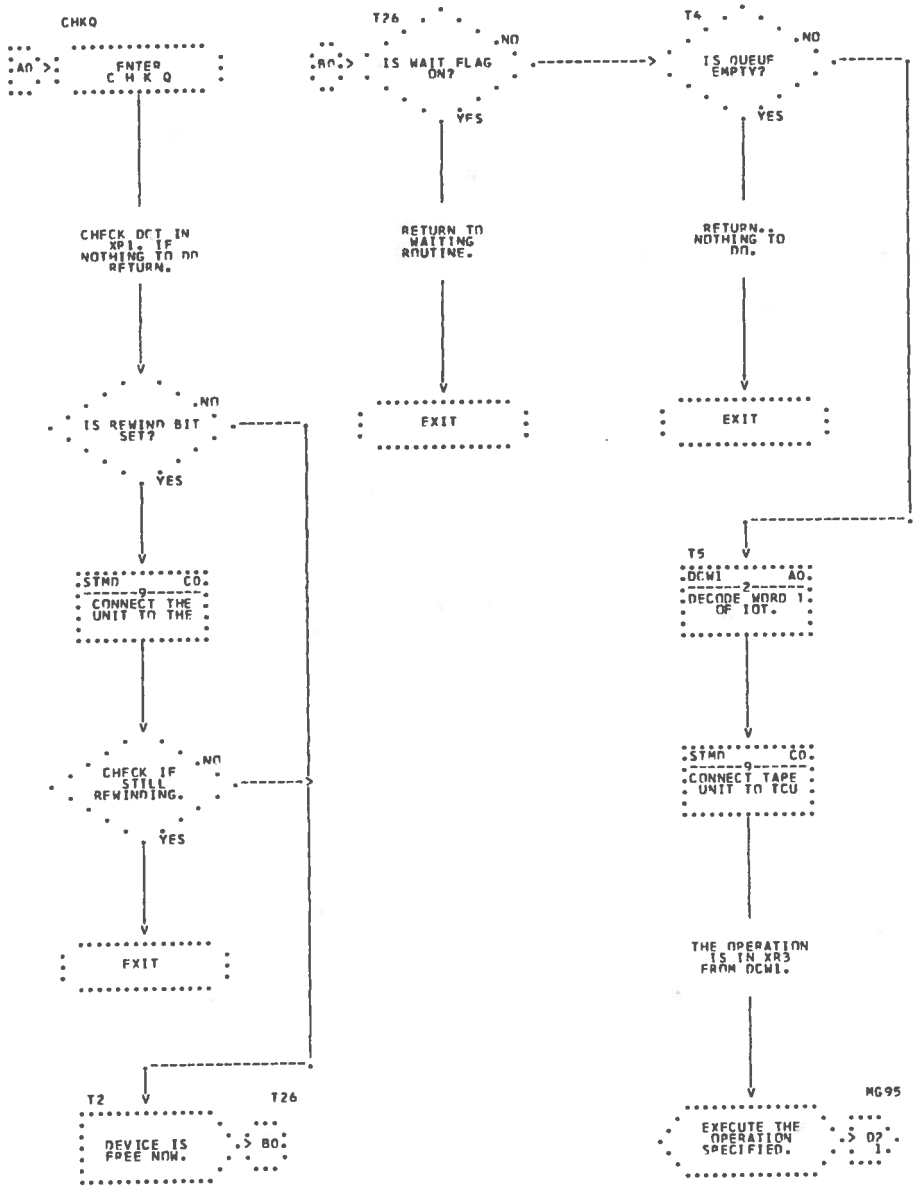
BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



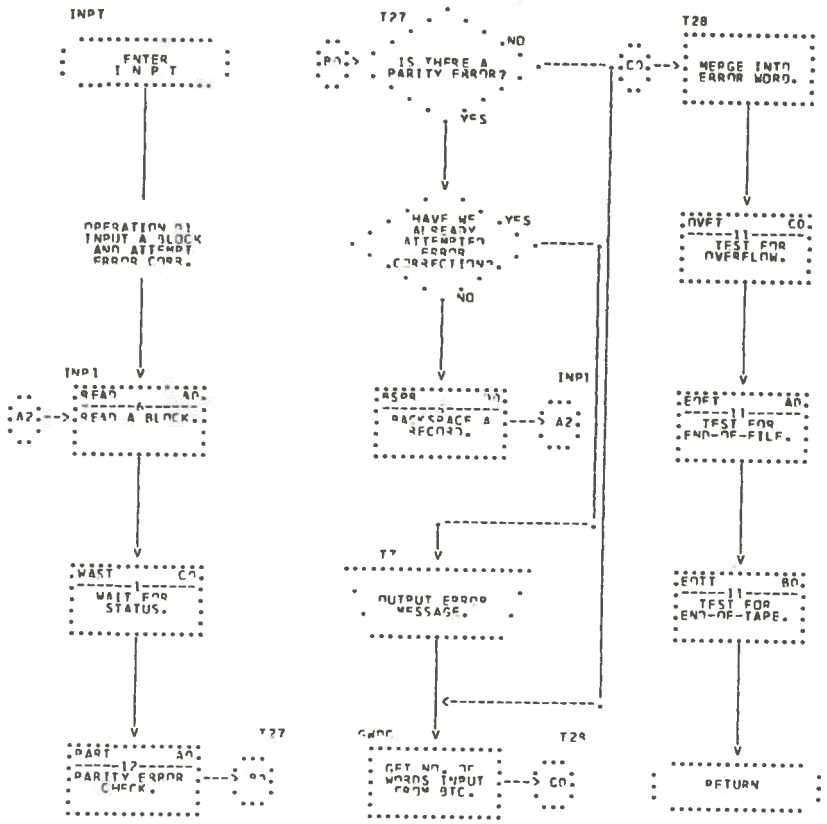
BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



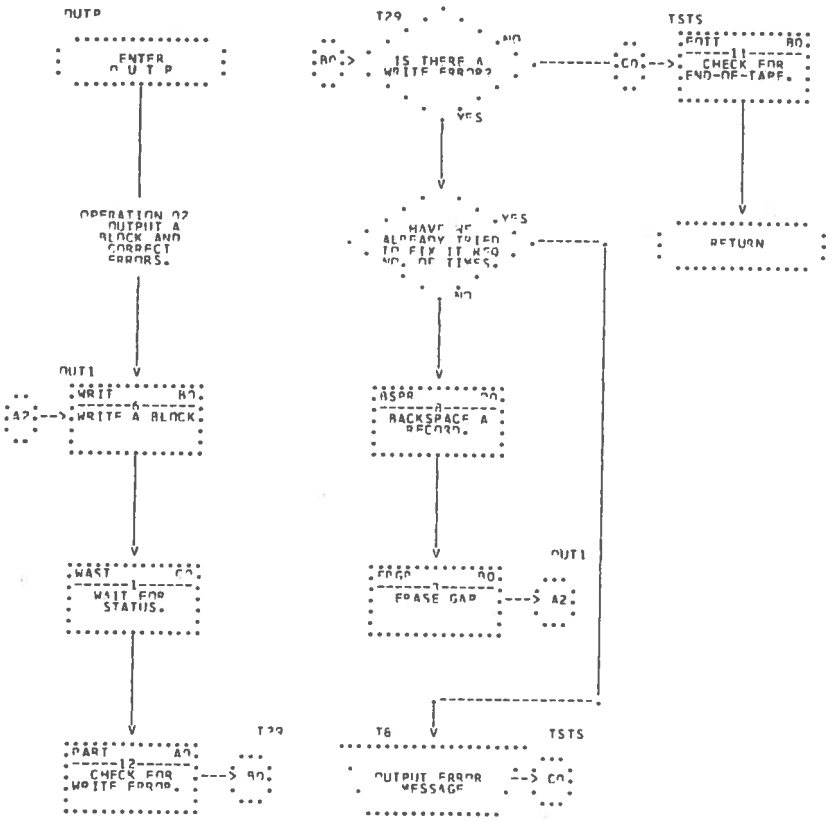
BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



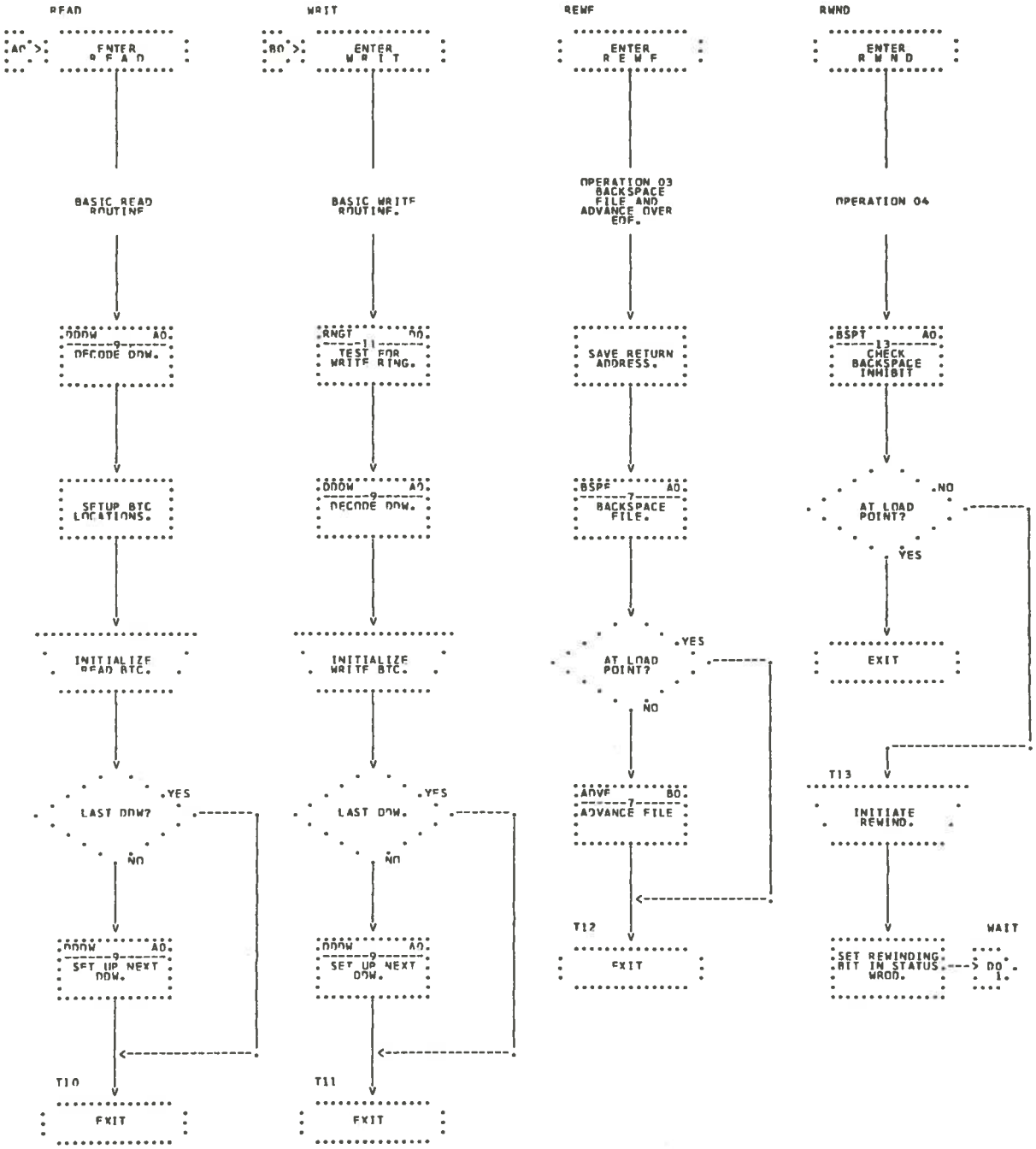
BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



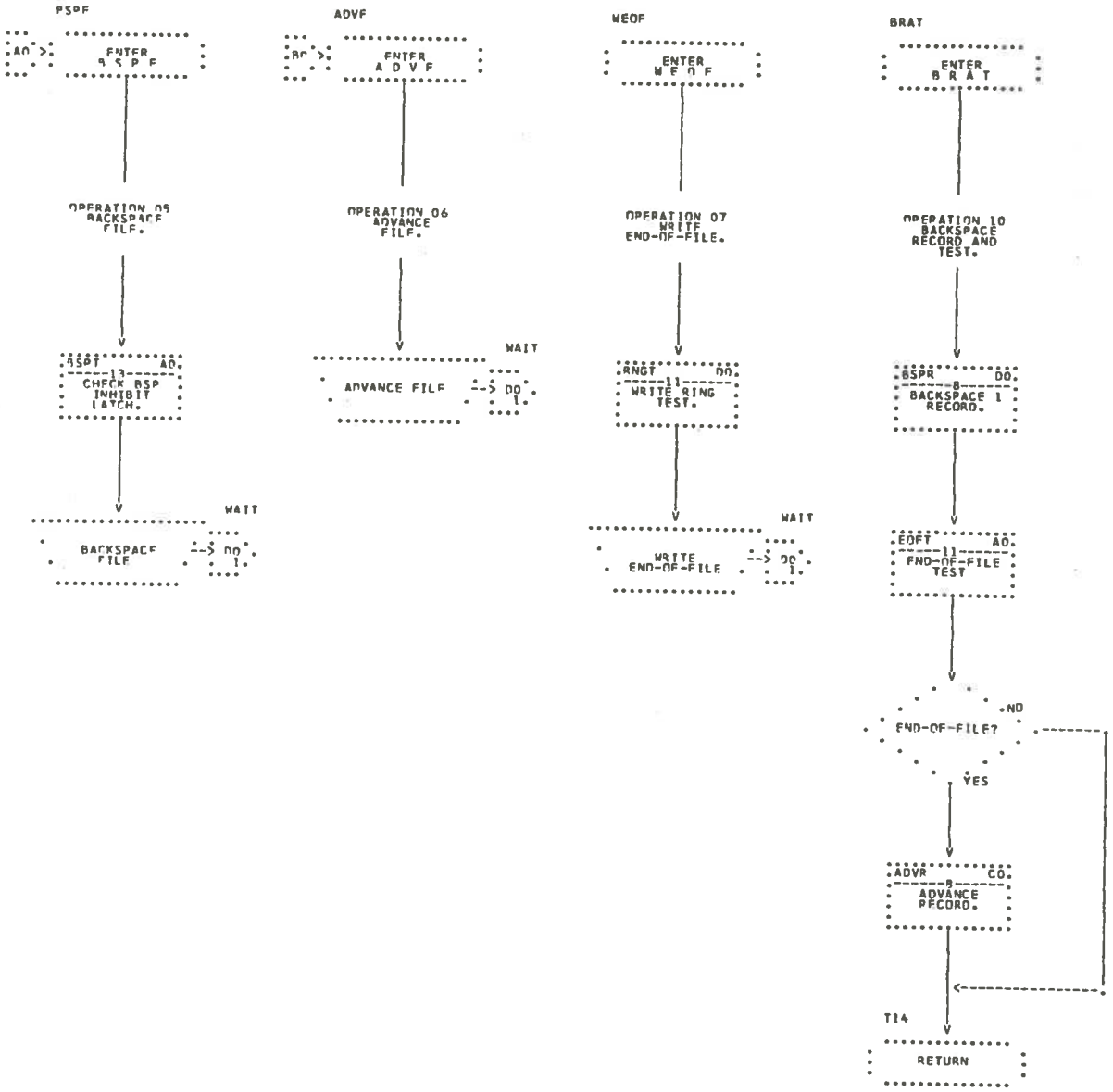
BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



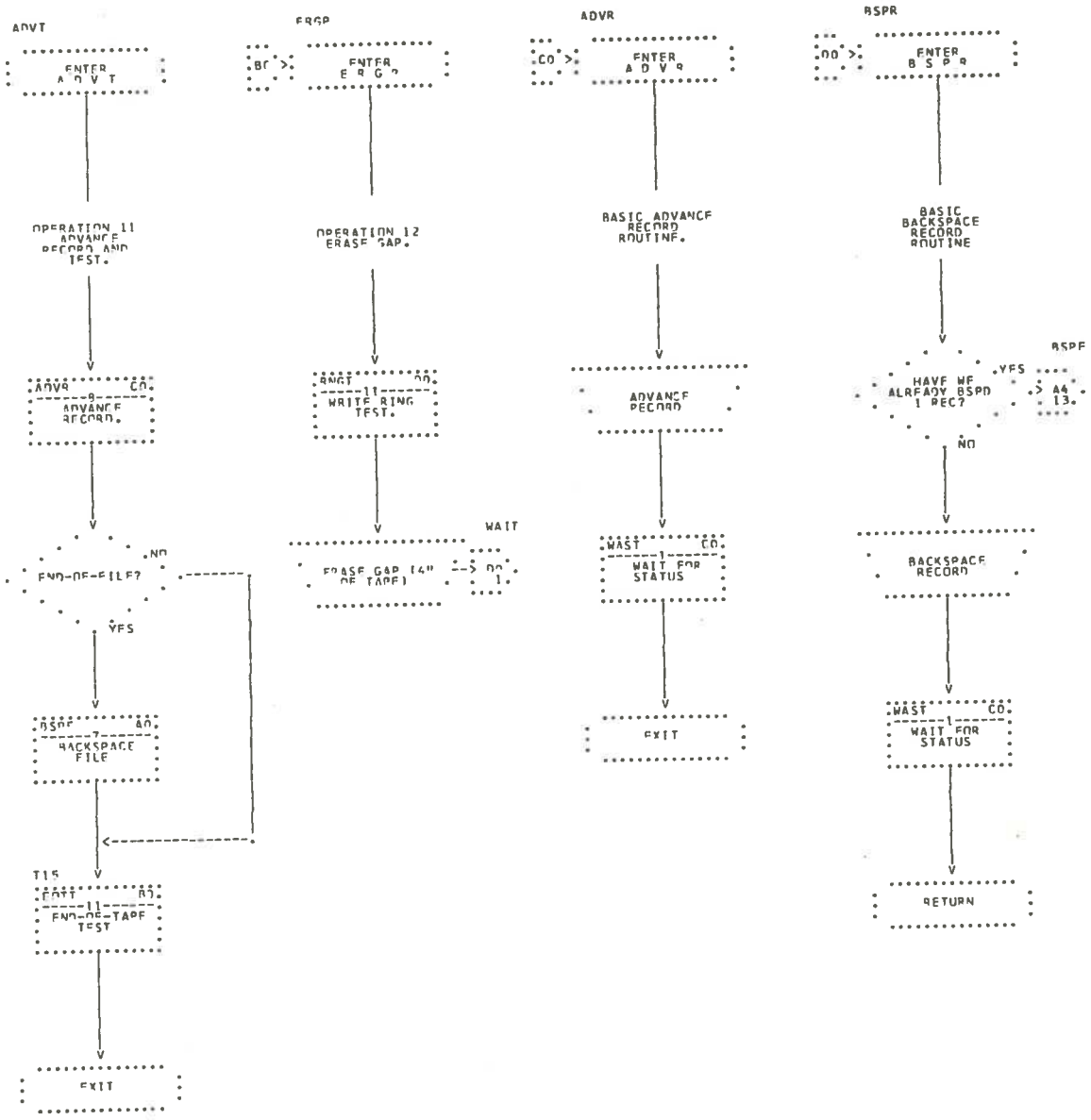
BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



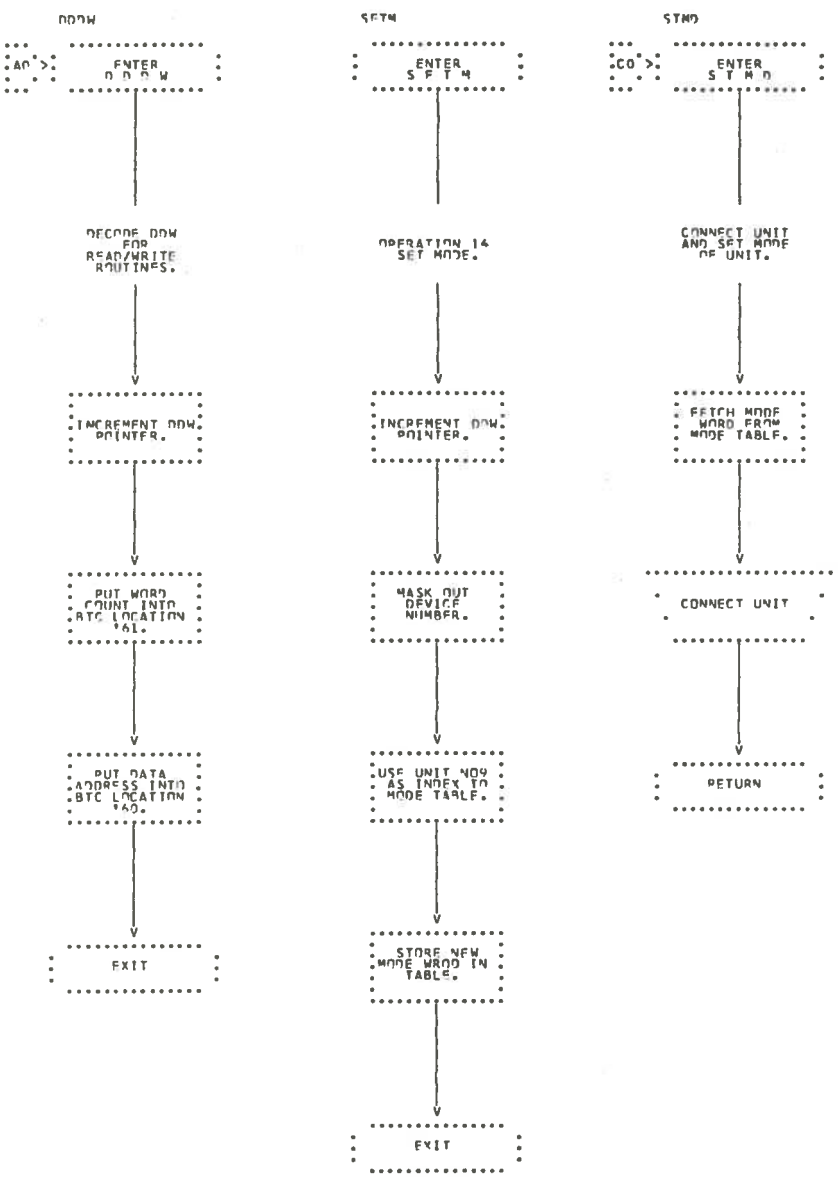
BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



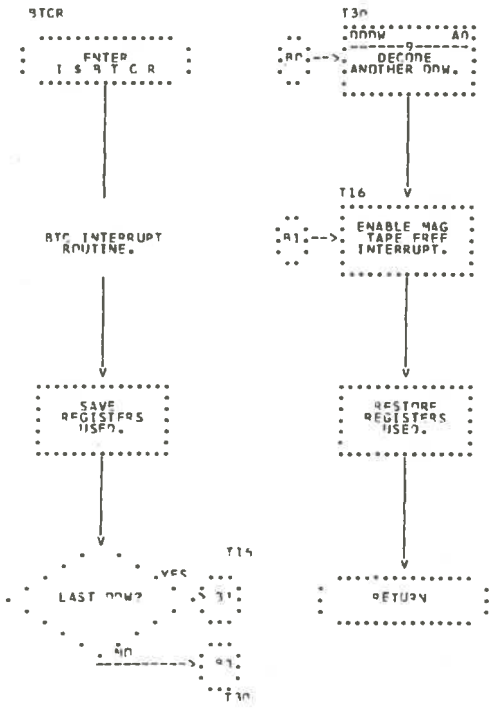
BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



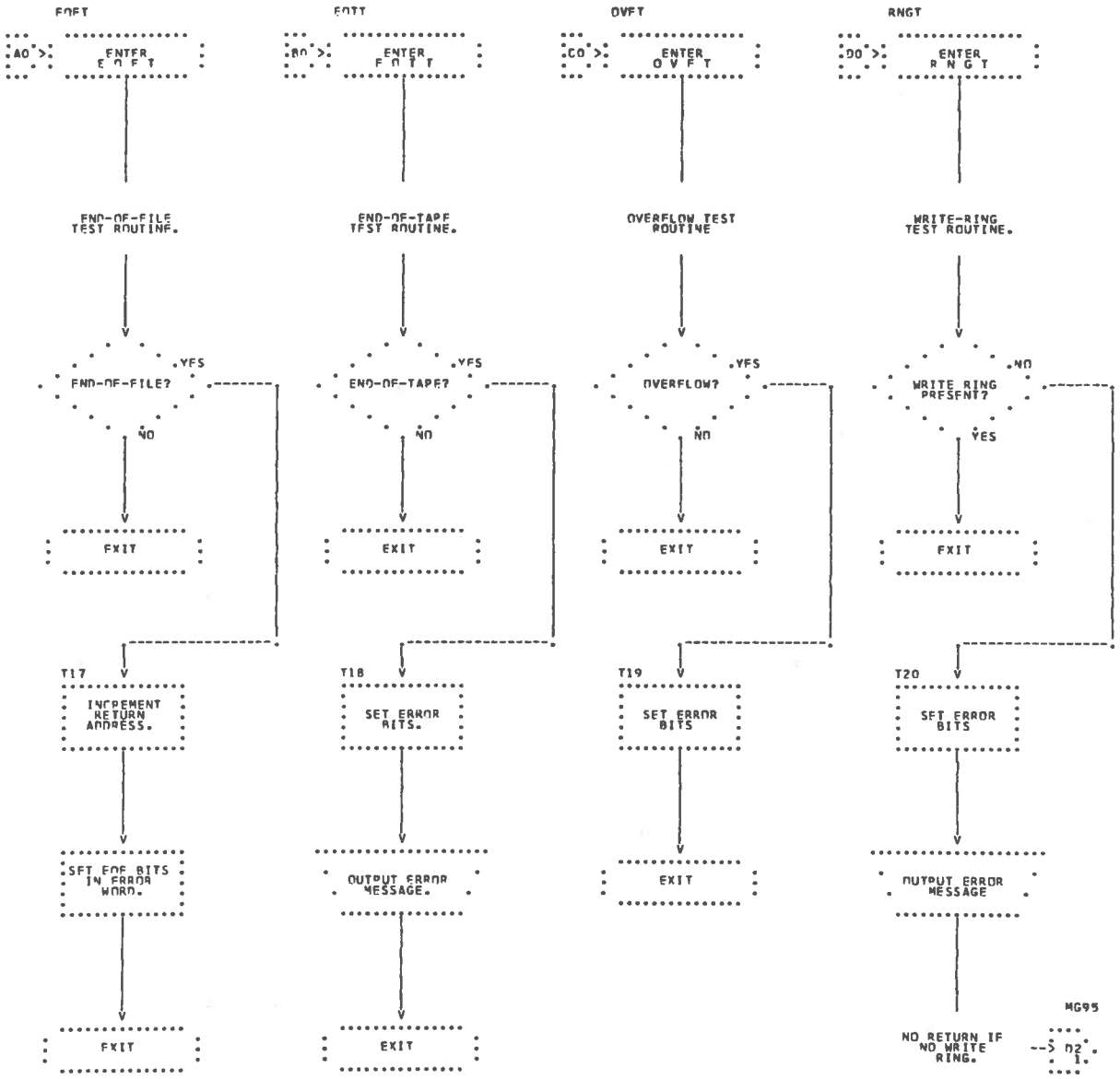
BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



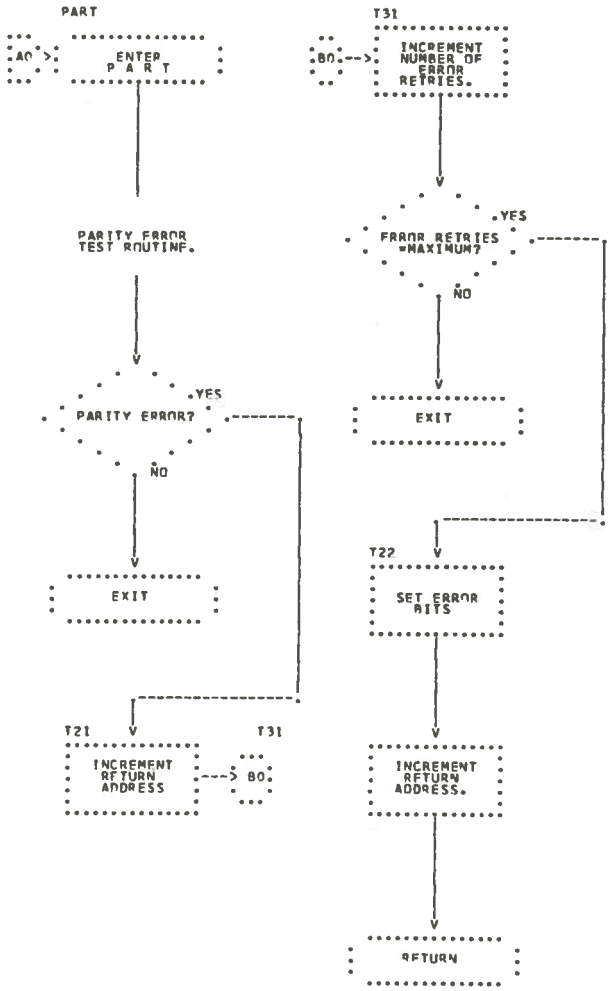
BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



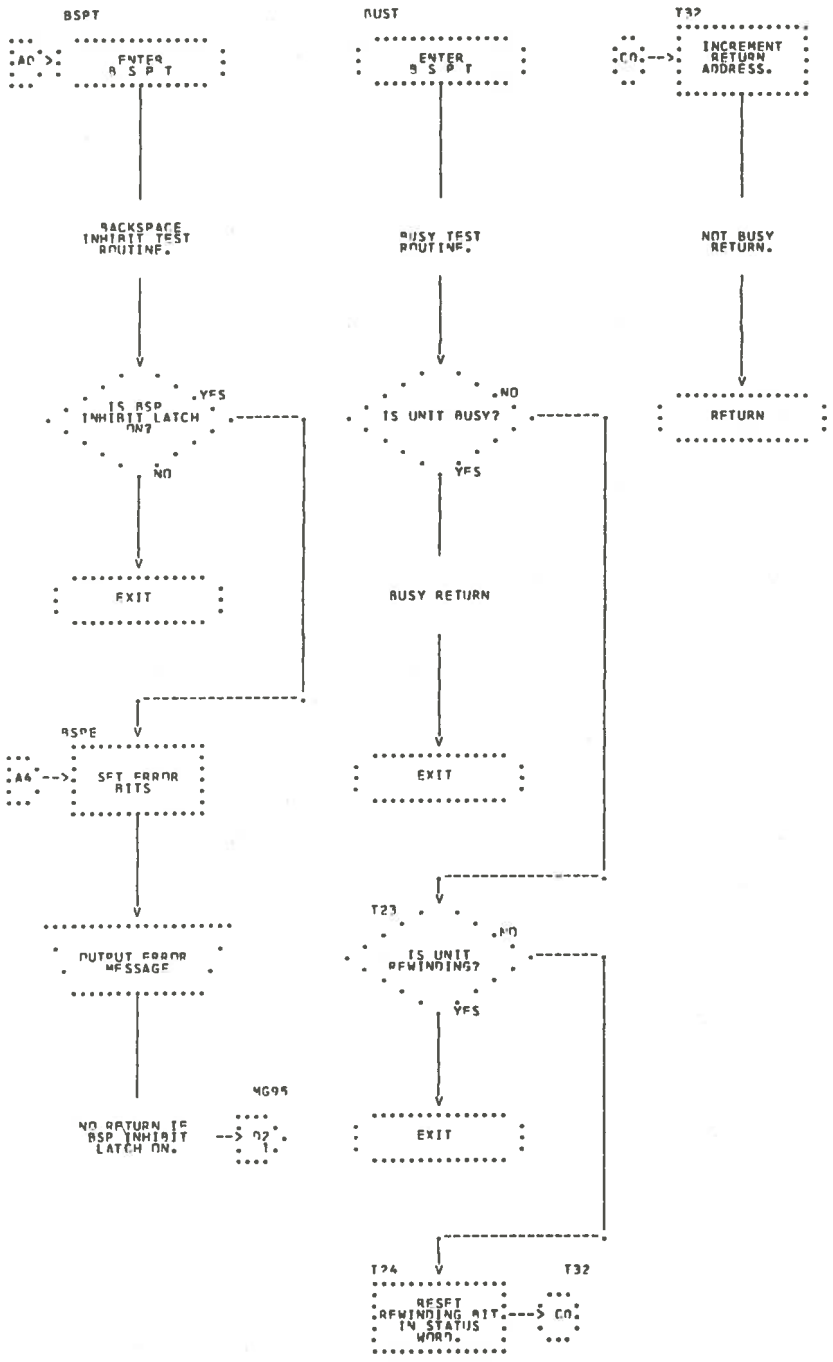
BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



BASIC MAGNETIC TAPE INPUT/OUTPUT HANDLER.



```
0001                    *MT7       AUG 7/69  NOP'S IN SKIP MODES REMOVED JW
0002                    *MT6       MAY 6/69    ABSL/ABSD  REMOVED.
0004                    ********************************************
0005                    *                                          *
0006                    *-------MAGNETIC TAPE I/O HANDLER.----------*
0007                    *                                          *
0008                    *------------NOVEMBER  1968-------------DJB*
0009                    *                                          *
0010                    ********************************************
0011                    *
0012          00000000        NAME I$MGTP,MGTP  MAG TAPE FREE INTERRUPT ENTRY POINT.
0013          00000437        NAME I$BTCR,BTCR  BTC INTERRUPT ROUTINE ENTRY POINT.
0014          00000452        NAME I$DDCT,DDCT  DATA TAPE DEVICE CONTROL TABLE.
0015          00000504        NAME I$SDCT,SDCT  SYSTEM TAPE DEVICE CONTROL TABLE.
0016                    *
0017                    *
0018                    *----POINTERS WITHIN DEVICE CONTROL TABLES.
0019                    *
0020                    *
0021          00000     EXPT EQU  0           EXECUTION POINTER.
0022                    *
0023          00002     STQ  EQU  2           START OF QUEUE.
0024                    *
0025          00003     EDQ  EQU  3           END OF QUEUE.
0026                    *
0027          00006     WATF EQU  6           INTERRUPTABLE WAIT ROUTINE.
0028                    *
0029          00010     IOTA EQU  8           IOT ADDRESS.
0030                    *
0031          00011     DDWP EQU  9           DDW POINTER.
0032                    *
0033          00012     PUNN EQU  10          PHYSICAL UNIT NUMBER.
0034                    *
0035          00013     LEV1 EQU  11          RETURN ADDRESS FOR RE-ENTRANT ROUTINES.
0036                    *
```

```
0037        00014       ETRY EQU  12          NO. ERROR CORRECTION ATTEMPTS.
0038                    *
0039        00015       ERWD EQU  13          ERROR WORD.
0040                    *
0041        00016       DADR EQU  14          DATA ADDRESS..INPUT ONLY.
0042                    *
0043        00017       STAT EQU  15          STATUS
0044                    *
0045        00020       TEMP EQU  16          TEMPORARY STORAGE.
0046                    *
0047        00021       ERWA EQU  17          TEMPORARY STORAGE FOR DDWP.
0048                    *
0049                    *
0050                    *
0051                    *----REFERENCES TO LITERAL POOL.
0052                    *
0053                         ABS
0054        00200            ORG  '200
0055                    *
0056        00205       MFIV EQU  *+'005       '77777773  (-5)
0057                    *
0058        00212       ZERO EQU  *+'012       '00000000
0059                    *
0060        00213       ONE  EQU  *+'013       '00000001
0061                    *
0062        00216       FOUR EQU  *+'016       '00000004
0063                    *
0064        00221       SEVN EQU  *+'021       '00000007
0065                    *
0066        00225       FLLC EQU  *+'025       '00000017
0067                    *
0068        00234       SBIT EQU  *+'034       '40000000
0069                    *
0070        00236       BIT1 EQU  *+'036       '20000000
0071                    *
```

```
0072          00240          B2ON EQU  *+'040        '10000000
0073                         *
0074          00242          AMSK EQU  *+'042        '00077777
0075                         *
0076          00245          QBOF EQU  *+'045        '17777777
0077                         *
0078          00246          E1   EQU  *+'046        '60000000
0079                         *
0080          00247          E2   EQU  *+'047        '50000000
0081                         *
0082          00250          E3   EQU  *+'050        '44000000
0083                         *
0084          00251          E4   EQU  *+'051        '42000000
0085                         *
0086          00252          E5   EQU  *+'052        '41000000
0087                         *
0088          00352          E6   EQU  *+'152        '40400000
0089                         *
0090          00314          BIT5 EQU  *+'114        '01000000
0091                         *
0092          00317          SMSK EQU  *+'117        '40077777
0093                         *
0094          00353          BIT6 EQU  *+'153        '00400000
0095                         *
0096          00323          PMSK EQU  *+'123        '77777707
0097                         *
0098                         *----END OF LITERAL DEFINITIONS.
0099                         *
0100                   *          REL
0101          00000              ORG  0
0102                         *
0103  00000   00000000     MGTP ZZZ  **
0104  00001   00300726*          STA  SAVE           SAVE REGISTERS USED.
0105  00002   00400727*          STB  SAVE+1
0106  00003   13300730*          STI  SAVE+2,1
```

```
0107  00004  23300731*        STI   SAVE+3,2
0108  00005  33300732*        STI   SAVE+4,3
0109  00006  14300002         PIE   BTCL,BTCG     ENABLE BTC INTERRUPT.
0110                    *
0111  00007  00100025*  MG01  LAA   WAST          CHECK STATUS WAIT ROUTINE.
0112  00010  02200015*        BAZ   *+5           NO STATUS WAIT.
0113  00011  23200025*        LIX   WAST,2        RETURN ADDRESS TO XR2.
0114  00012  13200735*        LIX   CDCT,1        CURRENT DCT ADDRESS TO XR1.
0115  00013  03300025*        STI   WAST,0        SET WAIT FLAG TO ZERO.
0116  00014  21100000         BRU   0,2           RETURN TO ROUTINE THAT IS WAITING.
0117  00015  13200023*        LIX   ADDC,1        DATA TAPE DCT ADDRESS.
0118  00016  01200037*        SPB   CHKQ          CHECK IF ANYTHING FOR DATA TAPE FIRST.
0119  00017  13200024*        LIX   ASDC,1        DCT ADDRESS OF SYSTEM TAPE.
0120  00020  01200037*        SPB   CHKQ          IF RETURNS HERE..NOTHING TO DO.
0121  00021  04310000   MG98  PID   MTFL,MTFG     IF GETS THIS FAR..NOTHING TO DO.
0122  00022  01100027*        BRU   MG99          RETURN.
0123                    *
0124  00023  00000452*  ADDC  DAC   DDCT          ADDRESS OF DATA TAPE DCT.
0125  00024  00000504*  ASDC  DAC   SDCT          ADDRESS OF SYSTEM TAPE DCT.
0126                    *
0127                    *
0128                    *----WAIT FOR STATUS.
0129                    *
0130                    *----THIS ROUTINE IS USED TO SAVE THE PROGRAM COUNTER
0131                    *----IN THE MAGNETIC HANDLER WHEN THE STATUS OF THE UNIT
0132                    *----CONNECTED MUST BE TESTED BEFORE ANY OTHER I/O IS
0133                    *----ATTEMPTED.
0134                    *
0135  00025  00000000   WAST  ZZZ   **            SAVE PROGRAM COUNTER.
0136  00026  13300735*        STI   CDCT,1        SAVE CURRENT DCT ADDRESS.
0137  00027  00100726*  MG99  LAA   SAVE          RESTORE REGISTERS.
0138  00030  00200727*        LBA   SAVE+1
0139  00031  13200730*        LIX   SAVE+2,1
0140  00032  23200731*        LIX   SAVE+3,2
0141  00033  33200732*        LIX   SAVE+4,3
```

```
0142  00034  03600000*        PIR  MGTP          RETURN.
0143                        *
0144                        *
0145                        *----INTERRUPTABLE WAIT ROUTINE.
0146                        *
0147                        *----THIS ROUTINE IS USED TO WAIT WITHIN A LONGER SEQUENCE OF MAG
0148                        *----TAPE COMMANDS WHEN THE STATUS OF THE CONTROL UNIT IS NOT
0149                        *----IMPORTANT.  HIGHER PRIORITY DRIVES MAY BE SERVICED AT
0150                        *----THIS BREAK-POINT.
0151                        *
0152  00035  10300006     WAIT STA  WATF,1        SAVE PROGRAM COUNTER IN DCT.
0153  00036  01100027*         BRU  MG99          RESTORE REGISTERS AND RETURN.
0154                        *
0155                        *
0156                        *----A ROUTINE TO CHECK THE DCT OF A DEVICE, CONNECT IT IF
0157                        *----NECESSARY, AND INITIATE THE OPERATION.  RETURNS TO
0158                        *----WAITING POINT IF WAIT STATUS FLAG ON.
0159                        *----THIS ROUTINE RETURNS TO CALLING POINT ONLY IF THERE IS
0160                        *----NOTHING TO DO FOR THIS DEVICE.
0161                        *
0162  00037  00000000     CHKQ ZZZ  **
0163  00040  10100017          LAA  STAT,1        CHECK IF DEVICE IS REWINDING.
0164  00041  02400045*         BAP  *+4           NO.
0165  00042  01200426*         SPB  STMD          YES..SET UP UNIT.
0166  00043  01200635*         SPB  BUST          CHECK IF STILL BUSY.
0167  00044  41100037*         BRU* CHKQ          STILL BUSY...RETURN.
0168  00045  10100006          LAA  WATF,1        FREE.
0169  00046  02200053*         BAZ  *+5           WAIT FLAG OFF..
0170  00047  00000003          CLA                SET WAIT FLAG OFF  (=0).
0171  00050  14400006          IAM  WATF,1        GO TO WAITING ROUTINE.
0172  00051  20000001          TAI  ,2
0173  00052  21100000          BRU  0,2
0174  00053  50100000          LAA* EXPT,1        CHECK IF ANYTING IN QUEUE.
0175  00054  42200037*         BAZ* CHKQ          =0 IF QUEUE EMPTY.
0176  00055  01200103*         SPB  DCW1          ENTRY IN Q, DECODE WORD 1 IOT.
```

```
0177  00056  01200426*        SPB  STMD          SET UP TAPE UNIT.
0178  00057  31600124*        EXU  BRTB,3        BEGIN OPERATION SPECIFIED.
0179  00060  00000027         NOP                IN CASE OF ERROR RETURN.
0180  00061  01100062*        BRU  MG95          RESET DCT AND QUEUE.
0181                      *
0182                      *----RETURN ERROR WORD,  RESET Q BITS,  UPDATE QUEUE,
0183                      *----AND GO BACK TO FIRST TO SEE IF ANYTHING ELSE TO DO.
0184                      *
0185                      *
0186  00062  50100010    MG95 LAA* IOTA,1        RESET 'IN Q' AND 'EXECUTION' BITS
0187  00063  02700245         MAA  QBOF          IN WORD 1 OF IOT.
0188  00064  03000240         MOA  B2ON          TURN ON FINISHED BIT.
0189  00065  50300010         STA* IOTA,1
0190  00066  11400011         IMS  DDWP,1        SET DDW POINTER TO ERROR WORD ADDRESS.
0191  00067  10100015         LAA  ERWD,1        RETURN ERROR WROD TO USER.
0192  00070  50300011         STA* DDWP,1
0193  00071  00000003         CLA
0194  00072  50300000         STA* EXPT,1        ZERO QUEUE ENTRY
0195  00073  10300015         STA  ERWD,1        ZERO ERROR WORD.
0196  00074  11400000         IMS  EXPT,1        UPDATE EXECUTION POINTER.
0197  00075  10100003         LAA  FDQ,1         CHECK FOR END OF QUEUE.
0198  00076  10600000         SMA  EXPT,1
0199  00077  02400102*        BAP  *+3
0200  00100  10100002         LAA  STQ,1         HAVE HIT END OF QUEUE.
0201  00101  10300000         STA  EXPT,1        LOOP BACK TO START.
0202  00102  01100007*        BRU  MG01          CHECK FOR SOMETHING ELSE TO DO.
0203                      *
0204                      *
0205                      *----A ROUTINE TO DECODE WORD 1 OF A MAG TAPE IOT.
0206                      *
0207  00103  00000000    DCW1 ZZZ  **
0208  00104  10300010         STA  IOTA,1        ENTER WITH IOT ADDRESS IN A.
0209  00105  10300011         STA  DDWP,1        SET DDW PNTR TO IOTA INITIALLY.
0210  00106  50100010         LAA* IOTA,1        GET THE FIRST WORD OF THE IOT.
0211  00107  03000236         MOA  BIT1          SET THE 'IN EXECUTION' BIT.
```

```
0212  00110  50300010          STA* IOTA,1
0213  00111  02700221          MAA  SEVN          ISOLATE PHYSICAL UNIT NUMBER.
0214  00112  10300012          STA  PUNN,1        STORE IN DCT.
0215  00113  50100010          LAA* IOTA,1
0216  00114  00006015          RSL  6
0217  00115  02700225          MAA  FLLC          ISOLATE FOUR OPERATION BITS.
0218  00116  30000001          TAI  ,3            LEAVE OPERATION BITS IN XR3.
0219  00117  00100205          LAA  MFIV          SET NUMBER OF ERROR CORRECTION
0220  00120  10300014          STA  ETRY,1        ATTEMPTS TO 5
0221  00121  00000003          CLA
0222  00122  10300015          STA  ERWD,1        SET ERWD=0.
0223  00123  41100103*         BRU* DCW1          RETURN..WITH OPERATION IN XR3.
0224                       *
0225                       *
0226                       *----BRANCH TABLE OF OPERATIONS.
0227                       *
0228  00124  01200144*    BRTB SPB  INPT          00 READ A BLOCK
0229  00125  01200144*         SPB  INPT          01 READ A BLOCK
0230  00126  01200200*         SPB  OUTP          02 WRITE A BLOCK
0231  00127  01200243*         SPB  REWF          03 BACKSPACE FILE AND ADVANCE OVER FILEMARK.
0232  00130  01200255*         SPB  RWND          04 REWIND
0233  00131  01200276*         SPB  BSPF          05 BACKSPACE FILE
0234  00132  01200305*         SPB  ADVF          06 ADVANCE FILE
0235  00133  01200313*         SPB  WEOF          07 WRITE EOF
0236  00134  01200322*         SPB  BRAT          10 BACKSPACE RECORD AND TEST
0237  00135  01200330*         SPB  ADVT          11 ADVANCE RECORD AND TEST
0238  00136  01200337*         SPB  ERGP          12 ERASE GAP
0239  00137  01200736*         SPB  ILEG
0240  00140  01200403*         SPB  SETM          14 SET MODE
0241  00141  01200736*         SPB  ILEG          ILLEXAL OPERATION.
0242  00142  01200736*         SPB  ILEG
0243  00143  01200736*         SPB  ILEG
0244                       *
0245                       *
0246                       *----OPERATION 01 INPUT A BLOCK AND ATTEMPT ERROR CORRECTION.
```

```
0247                        *
0248  00144  00000000    INPT ZZZ  **
0249  00145  01200220*   INP1 SPB  READ          READ A BLOCK
0250  00146  01200025*        SPB  WAST          WAIT FOR STATUS.
0251  00147  01200605*        SPB  PART          PARITY ERROR CHECK
0252  00150  01100161*        BRU  GWDC          PARITY OK..GET WORD COUNT.
0253  00151  01100153*        BRU  *+2           PARITY ERROR..TRY AGAIN.
0254  00152  01100157*        BRU  GWDC-2        CAN'T FIX IT..GIVE UP.
0255  00153  10100010         LAA  IOTA,1        RESET DDW POINTER FOR ERROR RECOVERY
0256  00154  10300011         STA  DDWP,1        ATTEMPTS.
0257  00155  01200357*        SPB  BSPR          BACKSPACE RECORD.
0258  00156  01100145*        BRU  INP1          GO BACK AND TRY AGAIN.
0259  00157  00100652*        LAA  RERR          OUTPUT ERROR MESSAGE
0260                          CALL IOCS
0261  00161  01200561*   GWDC SPB  OVFT          OVERFLOW TEST.
0262  00162  01200534*        SPB  EOFT          END-OF-FILE TEST.
0263  00163  00000022         NOP                IN CASE IT IS TRUE.
0264  00164  01200546*        SPB  EOTT          END OF TAPE TEST.
0265  00165  00100434*        LAA  MCEU          SET UP CEU FOR CURRENT WORD ADDRESS IN (BTC).
0266  00166  03000216         MOA  FOUR          SET BIT 21.
0267  00167  00300171*        STA  *+2
0268  00170  01300006         CEU  DEVN          GET CURRENT ADDRESS
0269  00171  00000000         HLT
0270  00172  01100170*        BRU  *-2
0271  00173  00100060         LAA  '60           CURRENT WORD ADDRESS.
0272  00174  10600016         SMA  DADR,1        INITIAL WORD ADDRESS.
0273  00175  13000015         MOA  ERWD,1        SET WORD COUNT INTO ERROR WORD.
0274  00176  10300015         STA  ERWD,1        WORD COUNT ONLY TRUE IF 1 DDW.
0275  00177  41100144*        BRU* INPT          RETURN.
0276                        *
0277                        *
0278                        *----OPERATION 02 OUTPUT A BLOCK AND ATTEMPT ERROR CORRECTION.
0279                        *
0280  00200  00000000    OUTP ZZZ  **            ENTRY POINT.
0281  00201  01200231*   OUT1 SPB  WRIT          WRITE A BLOCK
```

```
0282  00202  01200025*        SPB  WAST          WAIT FOR STATUS.
0283  00203  01200605*        SPB  PART          PARITY ERROR CHECK
0284  00204  01100216*        BRU  TSTS          NO ERROR.
0285  00205  01100207*        BRU  *+2           PARITY ERROR..TRY AGAIN.
0286  00206  01100214*        BRU  TSTS-2        CAN'T FIX IT..GIVE UP.
0287  00207  10100010         LAA  IOTA,1        RESET DDW POINTER FOR ERROR
0288  00210  10300011         STA  DDWP,1        RECOVERY ATTEMPS.
0289  00211  01200357*        SPB  BSPR          BACKSPACE A RECORD.
0290  00212  01200337*        SPB  ERGP          ERASE GAPE
0291  00213  01100201*        BRU  OUT1          GO BACK AND TRY AGAIN.
0292  00214  00100662*        LAA  WERR
0293                          CALL IOCS          ERROR MESSAGE TO SYSTEM LOG.
0294  00216  01200546*  TSTS  SPB  EOTT          END OF TAPE TEST.
0295  00217  41100200*        BRU* OUTP          RETURN.
0296                    *
0297                    *
0298                    *----BASIC READ ROUTINE.
0299                    *
0300  00220  00000000  READ  ZZZ  **
0301  00221  01200370*        SPB  DDDW          DECODE DDW AND SETUP BTC LOCATIONS.
0302  00222  01300006         CEU  DEVN          INITIALIZE READ BTC.
0303  00223  42200000         DATA '42200000
0304  00224  01100222*        BRU  *-2
0305  00225  00100061         LAA  '61           LAST DDW....
0306  00226  02300230*        BAN  *+2           YES.
0307  00227  01200370*        SPB  DDDW          NO.  RESET BTC LOCATIONS.
0308  00230  41100220*        BRU* READ          RETURN.
0309                    *
0310                    *
0311                    *----BASIC WRITE ROUTINE.
0312                    *
0313  00231  00000000  WRIT  ZZZ  **
0314  00232  01200572*        SPB  RNGT          TEST FOR WRITE RING.
0315  00233  01200370*        SPB  DDDW          DECODE DDW AND SETUP BTC LOCATIONS.
0316  00234  01300006         CEU  DEVN          INITIATE WRITE BTC.
```

```
0317  00235  43000000          DATA '43000000
0318  00236  01100234*         BRU  *-2
0319  00237  00100061          LAA  '61          LAST DDW....
0320  00240  02300242*         BAN  *+2          YES.
0321  00241  01200370*         SPB  DDDW         NO..SET UP NEXT DDW.
0322  00242  41100231*         BRU* WRIT         RETURN.
0323                      *
0324                      *
0325                      *----OPERATION 03  BACKSPACE FILE AND ADVANCE OVER EOF.
0326                      *
0327  00243  00000000    REWF ZZZ  **
0328  00244  00100243*        LAA  *-1          SAVE PROGRAM COUNTER.
0329  00245  10300013          STA  LEV1,1
0330  00246  01200276*         SPB  BSPF         BACKSPACE FILE AND WAIT.
0331  00247  01320006          TEU  DEVN         LOAD POINT TEST.
0332  00250  04000000          DATA '04000000
0333  00251  01100253*         BRU  *+2
0334  00252  51100013          BRU* LEV1,1       AT LOAD POINT RETURN.
0335  00253  01200305*         SPB  ADVF         ADVANCE OVER FILEMARK.
0336  00254  51100013          BRU* LEV1,1       RETURN.
0337                      *
0338                      *
0339                      *----OPERATION 04 REWIND
0340                      *
0341  00255  00000000    RWND ZZZ  **
0342  00256  01200622*        SPB  BSPT         CHECK BACKSPACE INHIBIT KEY.
0343  00257  01320006          TEU  DEVN         NOT ON..CHECK FOR LOAD POINT.
0344  00260  04000000          DATA '04000000
0345  00261  01100263*         BRU  *+2
0346  00262  41100255*         BRU* RWND         RETURN..ALREADY AT LOAD POINT.
0347  00263  00100434*         LAA  MCEU         SET REWIND BIT IN UNIT SELECTED.
0348  00264  03000314          MOA  BIT5
0349  00265  00300267*         STA  *+2
0350  00266  01300006          CEU  DEVN         INITIATE REWIND.
0351  00267  01000000          DATA '01000000
```

```
0352  00270  01100266*        BRU  *-2
0353  00271  10100017         LAA  STAT,1        SET REWINDING BIT IN STATUS WORD.
0354  00272  03000234         MOA  SBIT
0355  00273  10300017         STA  STAT,1
0356  00274  00100255*        LAA  RWND          WAIT FOR COMPLETION OF REWIND FOR THIS DCT.
0357  00275  01100035*        BRU  WAIT
0358                       *
0359                       *
0360                       *----OPERATION 05 BACKSPACE FILE.
0361                       *
0362  00276  00000000     BSPF ZZZ  **
0363  00277  01200622*        SPB  BSPT          BACKSPACE INHIBIT TFS.
0364  00300  01300006         CEU  DEVN
0365  00301  02000020         DATA '02000020
0366  00302  01100300*        BRU  *-2
0367  00303  00100276*        LAA  BSPF
0368  00304  01100035*        BRU  WAIT          WAIT FOR BACKSPACE.
0369                       *
0370                       *
0371                       *----OPERATION 06 ADVANCE FILE.
0372                       *
0373  00305  00000000     ADVF ZZZ  **
0374  00306  01300006         CEU  DEVN          ADVANCE FILE
0375  00307  02000100         DATA '02000100     ON UNIT ALREADY SELECTED.
0376  00310  01100306*        BRU  *-2
0377  00311  00100305*        LAA  ADVF          WAIT AND RETURN VIA THE
0378  00312  01100035*        BRU  WAIT          ROUTINE.
0379                       *
0380                       *
0381                       *----OPERATION 07 WRITE END-OF-FILE.
0382                       *
0383  00313  00000000     WEOF ZZZ  **
0384  00314  01200572*        SPB  RNGT          CHECK FOR WRITE RING.
0385  00315  01300006         CEU  DEVN
0386  00316  02400000         DATA '02400000
```

```
0387  00317  01100315*        BRU  *-2
0388  00320  00100313*        LAA  WEOF
0389  00321  01100035*        BRU  WAIT          INTERRUPTABLE WAIT ROUTINE.
0390                      *
0391                      *
0392                      *----OPERATION 10 BACKSPACE RECORD AND TEST.
0393                      *
0394  00322  00000000    BRAT ZZZ  **
0395  00323  01200357*        SPB  BSPR          BACKSPACE ONE RECORD.
0396  00324  01200534*        SPB  EOFT          EOF..
0397  00325  41100322*        BRU* BRAT          NO..RETURN.
0398  00326  01200351*        SPB  ADVR          YES..ADVANCE BACK OVER FILEMARK.
0399  00327  41100322*        BRU* BRAT          RETURN.
0400                      *
0401                      *
0402                      *----OPERATION 11 ADVANCE RECORD AND TEST.
0403                      *
0404  00330  00000000    ADVT ZZZ  **
0405  00331  01200351*        SPB  ADVR          ADVANCE RECORD.
0406  00332  01200534*        SPB  EOFT          EOF TEST.
0407  00333  01100335*        BRU  *+2           NO EOF.
0408  00334  01200276*        SPB  BSPF          BACKSPACE OVER FILEMARK.
0409  00335  01200546*        SPB  EOTT          END-OF-TAPE TEST.
0410  00336  41100330*        BRU* ADVT
0411                      *
0412                      *
0413                      *----OPERATION 12 ERASE GAP.
0414                      *
0415  00337  00000000    ERGP ZZZ  **
0416  00340  01200572*        SPB  RNGT          WRITE RING TEST.
0417  00341  00100434*        LAA  MCEU
0418  00342  03000353        MOA  BIT6          PUT IN ERG COMMAND
0419  00343  00300345*        STA  *+2
0420  00344  01300006         CEU  DEVN
0421  00345  00000000         DATA 0
```

```
0422  00346  01100344*        BRU  *-2
0423  00347  00100337*        LAA  ERGP
0424  00350  01100035*        BRU  WAIT          WAIT FOR I/O.
0425                      *
0426                      *----BASIC ADVANCE RECORD ROUTINE.
0427                      *
0428  00351  00000000    ADVR ZZZ  **
0429  00352  01300006        CEU  DEVN
0430  00353  02000200        DATA '02000200
0431  00354  01100352*       BRU  *-2
0432  00355  01200025*       SPB  WAST          WAIT FOR STATUS.
0433  00356  41100351*       BRU* ADVR          RETURN.
0434                      *
0435                      *----BASIC BACKSPACE RECORD ROUTINE.
0436                      *
0437  00357  00000000    BSPR ZZ7  **
0438  00360  01320006        TEU  DEVN          CHECK IF HAVE ALREADY BACKSPACED
0439  00361  00000040        DATA '40           ONE RECORD.
0440  00362  01100627*       BRU  BSPE          YES..ERROR.
0441  00363  01300006        CEU  DEVN
0442  00364  02000040        DATA '02000040
0443  00365  01100363*       BRU  *-2
0444  00366  01200025*       SPB  WAST          WAIT FOR STATUS.
0445  00367  41100357*       BRU* BSPR          RETURN.
0446                      *
0447                      *
0448                      *-----DECODE DDW FOR READ/WRITE.
0449                      *
0450  00370  00000000    DDDW ZZZ  **
0451  00371  11400011        IMS  DDWP,1        INCREMENT DDW POINTER.
0452  00372  50100011        LAA* DDWP,1        WORD COUNT.
0453  00373  02700317        MAA  SMSK
0454  00374  00300061        STA  '61           STORE WC IN BTC LOCATION.
0455  00375  11400011        IMS  DDWP,1
0456  00376  50100011        LAA* DDWP,1        DATA ADDRESS.
```

```
0457  00377  02700242          MAA   AMSK
0458  00400  10300016          STA   DADR,1
0459  00401  00300060          STA   '60           CWA BTC LOCATION.
0460  00402  41100370*         BRU*  DODW          RETURN.
0461                       *
0462                       *
0463                       *----OPERATION 14 SET MODE.
0464                       *
0465                       *----THIS ROUTINE CHANGES THE MODE TABLE IN CORE ONLY AND
0466                       *----DOES NOT SELECT A DRIVE.  THE DRIVE IS SET UP BEFORE
0467                       *----EVERY MOTION COMMAND WITH THE ENTRY FROM THIS TABLE.
0468                       *
0469  00403  00000000     SETM  ZZZ   **
0470  00404  11400011          IMS   DDWP,1
0471  00405  50100011          LAA*  DDWP,1
0472  00406  02700323          MAA   PMSK
0473  00407  10300020          STA   TEMP,1        TAKE OUT ANY DEVICE NO SPECIFIED.
0474  00410  10100012          LAA   PUNN,1        PHYSICAL DEIVCE NO.
0475  00411  20000001          TAI   ,2            FOR MODE TABLE INDEX
0476  00412  00003016          LSL   3
0477  00413  13000020          MDA   TEMP,1        PUT IN UNIT NUMBER.
0478  00414  20300416*         STA   MDWD,2        PUT BACK IN TABLE.
0479  00415  41100403*         BRU*  SETM          RETURN.
0480                       *
0481                       *
0482                       *---MODE TABLE    UNIT  DENSITY  CPW   MODE
0483                       *
0484  00416  00000100     MDWD  DATA  '100          0       1      4    BINARY   SYSTEM
0485  00417  00000110           DATA  '110          1       1      4    BINARY
0486  00420  00000120           DATA  '120          2       1      4    BINARY
0487  00421  00000130           DATA  '130          3       1      4    BINARY
0488  00422  00000040           DATA  '040          4       0      4    BINARY   DATA
0489  00423  00000050           DATA  '050          5       0      4    BINARY
0490  00424  00000060           DATA  '060          6       0      4    BINARY
0491  00425  00000170           DATA  '170          7       1      4    BINARY
```

```
0492                        *
0493                        *
0494                        *----SET MODE ROUTINE.
0495                        *----MUST PRECEDE ALL OPERATIONS TO CONNECT
0496                        *----DESIRED DRIVE TO CONTOL UNIT.
0497                        *
0498  00426  00000000    STMD ZZZ  **
0499  00427  10100012         LAA  PUNN,1        USE PHYSICAL UNIT NUMBER
0500  00430  20000001         TAI  ,2            AS AN INDEX TO MODE TABLE.
0501  00431  20100416*        LAA  MDWD,2        GET MODE WORD FROM ABOVE TABLE.
0502  00432  00300434*        STA  MCEU
0503  00433  01300006         CEU  DEVN          SELECT AND CONNECT DRIVE.
0504  00434  00000000    MCEU HLT
0505  00435  01100433*        BRU  *-2
0506  00436  41100426*        BRU* STMD
0507                        *
0508                        *
0509                        *----BTC INTERRUPT ROUTINE.
0510                        *
0511  00437  00000000    BTCR ZZZ  **
0512  00440  00300733*        STA  SAV2          SAVE A REG.
0513  00441  13300734*        STI  SXR1,1        SAVE XR1
0514  00442  13200735*        LIX  CDCT,1        CURRENT DCT ADDRESS.
0515  00443  00100061         LAA  '61           CHECK WC ADDRESS.
0516  00444  02300446*        BAN  *+2           IF LAST BLOCK BEING OUTPUT
0517  00445  01200370*        SPB  DDDW          DECODE ANOTHER DDW..STILL MORE DATA.
0518  00446  14310000         PIE  MTFL,MTFG     ENABLE MAG TAPE FREE INTERRUPT.
0519  00447  00100733*        LAA  SAV2          RESTORE REGISTERS.
0520  00450  13200734*        LIX  SXR1,1
0521  00451  03600437*        PIR  BTCR          RETURN.
0522                        *
0523                        *
0524                        *
0525                        *----D E V I C E  C O N T R O L  T A B L E S.
0526                        *
```

```
0527                        *----DCT FOR DATA TAPE...HIGHEST PRIORITY.
0528                        *
0529  00452  00000474*   DDCT DAC  DSRT          EXPT
0530  00453  00000474*        DAC  DSRT          NPTR
0531  00454  00000474*        DAC  DSRT          STQ
0532  00455  00000503*        DAC  DEND          EDQ
0533  00456  00000022         NOP
0534  00457  14310000         PIE  MTFL,MTFG
0535  00460  00000000         ZZZ  **            WATF
0536  00461  01100027*        BRU  MG99
0537  00462  00000000         HLT                IOTA
0538  00463  00000000         HLT                DDWP
0539  00464  00000000         HLT                PUNN
0540  00465  00000000         HLT                LEV1
0541  00466  00000000         HLT                ETRY
0542  00467  00000000         HLT                ERWD
0543  00470  00000000         HLT                DADR
0544  00471  00000000         HLT                STAT
0545  00472  00000000         HLT                TEMP
0546  00473  00000000         HLT                ERWA
0547  00474  00000000   DSRT  HLT                START OF QUEUE.
0548  00475  00000000         HLT
0549  00476  00000000         HLT
0550  00477  00000000         HLT
0551  00500  00000000         HLT
0552  00501  00000000         HLT
0553  00502  00000000         HLT
0554  00503  00000000   DEND  HLT
0555                        *
0556                        *
0557                        *----DCT FOR SYSTEM TAPE..
0558                        *
0559  00504  00000526*   SDCT DAC  SSRT
0560  00505  00000526*        DAC  SSRT
0561  00506  00000526*        DAC  SSRT
```

```
0562  00507  00000533*          DAC   SEND
0563  00510  00000022          NOP
0564  00511  14310000          PIE   MTFL,MTFG
0565  00512  00000000          ZZZ   **
0566  00513  01100027*         BRU   MG99
0567  00514  00000000          HLT
0568  00515  00000000          HLT
0569  00516  00000000          HLT
0570  00517  00000000          HLT
0571  00520  00000000          HLT
0572  00521  00000000          HLT
0573  00522  00000000          HLT
0574  00523  00000000          HLT
0575  00524  00000000          HLT
0576  00525  00000000          HLT
0577  00526  00000000     SSRT HLT
0578  00527  00000000          HLT
0579  00530  00000000          HLT
0580  00531  00000000          HLT
0581  00532  00000000          HLT
0582  00533  00000000     SEND HLT
0583                      *
0584                      *
0585                      *
0586                      *----END OF FILE TEST ROUTINE.     SPB  EOFT
0587                      *                                  NO EOF RETURN
0588                      *                                  EOF RETURN
0589                      *
0590  00534  00000000     EOFT ZZZ  **
0591  00535  01320006          TEU  DEVN          TEST UNIT SELECTED.
0592  00536  20000000          DATA '20000000
0593  00537  01100541*         BRU  *+2
0594  00540  41100534*         BRU* EOFT          NO EOF..RETURN.
0595  00541  01400534*         IMS  EOFT          INCREMENT RETURN ADDRESS.
0596  00542  10100015          LAA  ERWD,1
```

```
0597  00543  03000247          MOA  E2            SET EOF BITS IN ERWD.
0598  00544  10300015          STA  ERWD,1
0599  00545  41100534*         BRU* EOFT          EOF RETURN.
0600                      *
0601                      *
0602                      *
0603                      *----END-OF-TAPE TEST ROUTINE.   SPB  EOTT
0604                      *                                NO EOT RETURN
0605                      *                               NO RETURN IF EOT.
0606                      *
0607  00546  00000000    EOTT ZZZ  **
0608  00547  01320006          TEU  DEVN
0609  00550  00200000          DATA '00200000
0610  00551  01100553*         BRU  *+2
0611  00552  41100546*         BRU* EOTT          NO EOT DETECTED..RETURN.
0612  00553  10100015          LAA  ERWD,1
0613  00554  03000250          MOA  E3            ERROR BITS FOR EOT.
0614  00555  10300015          STA  ERWD,1
0615  00556  00100672*         LAA  EOTA          ERROR MESSAGE
0616                           CALL IOCS
0617  00560  41100546*         BRU* EOTT          RETURN.
0618                      *
0619                      *
0620                      *----OVERFLOW TEST ROUTINE.
0621                      *
0622  00561  00000000    OVFT ZZZ  **
0623  00562  01320006          TEU  DEVN
0624  00563  10000000          DATA '10000000
0625  00564  01100566*         BRU  *+2
0626  00565  41100561*         BRU* OVFT          NO OVERFLO..RETURN.
0627  00566  10100015          LAA  ERWD,1
0628  00567  03000251          MOA  E4
0629  00570  10300015          STA  ERWD,1
0630  00571  41100561*         BRU* OVFT          RETURN.
0631                      *
```

```
0632                        *
0633                        *----WRITE RING TEST ROUTINE.
0634                        *
0635                        *----NO RETURN IF RING NO PRESENT.
0636                        *
0637  00572  00000000      RNGT ZZZ  **
0638  00573  01320006           TEU  DEVN
0639  00574  00400000           DATA '00400000
0640  00575  01100577*          BRU  *+2
0641  00576  41100572*          BRU* RNGT          RETURN..RING IS THERE.
0642  00577  10100015           LAA  ERWD,1
0643  00600  03000252           MOA  E5
0644  00601  10300015           STA  ERWD,1
0645  00602  00100703*          LAA  RNGA          ERROR MESSAGE
0646                           CALL IOCS
0647  00604  01100062*          BRU  MG95          TERMINATE OPERATION.
0648                        *
0649                        *
0650                        *----PARITY ERROR TEST ROUTINE.
0651                        *
0652  00605  00000000      PART ZZZ  **
0653  00606  01320006           TEU  DEVN
0654  00607  01000000           DATA '01000000
0655  00610  01100612*          BRU  *+2
0656  00611  41100605*          BRU* PART          NO ERROR RETURN.
0657  00612  01400605*          IMS  PART          PARITY ERROR  RETURN+1
0658  00613  11400014           IMS  ETRY,1        INCREMENT ERROR RE-TRYS.
0659  00614  41100605*          BRU* PART          NOT FINISHED ERROR CORRECTION YET.
0660  00615  10100015           LAA  ERWD,1        CAN'T CORRECT IT.
0661  00616  03000246           MOA  E1
0662  00617  10300015           STA  ERWD,1
0663  00620  01400605*          IMS  PART          RETURN+2 FOR TERMINAL ERROR.
0664  00621  41100605*          BRU* PART          RETURN.
0665                        *
0666                        *
```

```
0667                        *----BACKSPACE INHIBIT TEST ROUTINE.
0668                        *
0669                        *----NO RETURN IF CANNOT BACKSPACE.
0670                        *
0671  00622  00000000    BSPT ZZZ  **
0672  00623  01320006         TEU  DEVN
0673  00624  00000020         DATA '00000020
0674  00625  01100627*        BRU  *+2
0675  00626  41100622*        BRU* BSPT          O.K.  KEY OFF.
0676  00627  10100015    BSPE LAA  ERWD,1
0677  00630  03000352         MDA  E6
0678  00631  10300015         STA  ERWD,1
0679  00632  00100714*        LAA  BSPA          ERROR MESSAGE
0680                         CALL IOCS
0681  00634  01100062*        BRU  MG95
0682                        *
0683                        *
0684                        *----BUSY TEST ROUTINE...SPB  BUST
0685                        *                       BUSY RETURN
0686                        *                       NOT BUSY RETURN.
0687                        *
0688  00635  00000000    BUST ZZZ  **
0689  00636  01320006         TEU  DEVN
0690  00637  40000000         DATA '40000000
0691  00640  41100635*        BRU* BUST
0692  00641  01320006         TEU  DEVN
0693  00642  00000200         DATA '00000200     REWINDING..
0694  00643  01100645*        BRU  *+2
0695  00644  41100635*        BRU* BUST          YES.
0696  00645  10100017         LAA  STAT,1        NOT BUSY.
0697  00646  02700752*        MAA  ='37777777
0698  00647  10300017         STA  STAT,1
0699  00650  01400635*        IMS  BUST
0700  00651  41100635*        BRU* BUST
0701                        *
```

```
0702                        *
0703                        *
0704                        *----ERROR MESSAGES.
0705                        *
0706  00652  00000653*     RERR DAC  *+1
0707  00653  00000020           DATA '20
0708  00654  40100005           LAA* 5
0709  00655  76741117           DATA ''><IO 01 MGTP INPUT''
      00656  40606140
      00657  15072420
      00660  40111620
      00661  25244040
0710                        *
0711  00662  00000663*     WERR DAC  *+1
0712  00663  00000020           DATA '20
0713  00664  40100005           LAA* 5
0714  00665  76741117           DATA ''><IO 02 MGTP OUTPUT''
      00666  40606240
      00667  15072420
      00670  40172524
      00671  20252440
0715                        *
0716                        *
0717  00672  00000673*     EOTA DAC  *+1
0718  00673  00000020           DATA '20
0719  00674  40100006           LAA* 6
0720  00675  34347674           DATA ''||><IO 04 END-OF-TAPE''
      00676  11174060
      00677  64400516
      00700  04551706
      00701  55240120
      00702  05404040
0721                        *
0722  00703  00000704*     RNGA DAC  *+1
0723  00704  00000020           DATA '20
```

```
0724  00705  40100006          LAA* 6
0725  00706  34347674          DATA ''||><IO 06 MGTP NO-RING''
      00707  11174060
      00710  66401507
      00711  24204016
      00712  17552211
      00713  16074040
0726                     *
0727  00714  00000715*   BSPA DAC  **+1
0728  00715  00000020          DATA '20
0729  00716  40100007          LAA* 7
0730  00717  76741117          DATA ''><IO 07 BKWRD MOTION NHBITED''
      00720  40606740
      00721  02132722
      00722  04401517
      00723  24111716
      00724  40161002
      00725  11240504
0731                     *
0732                     *
0733                     *
0734                     ************************************************
0735                     *
0736        00726        SAVE BSS  5            REGISTER SAVE AREA.
0737        00733        SAV2 BSS  1            BTC SAVE AREA.
0738        00734        SXR1 BSS  1
0739        00735        CDCT BSS  1
0740                     *
0741  00736  00000000    ILEG ZZZ  **
0742  00737  00100742*         LAA  OPER
0743                           CALL IOCS
0744  00741  41100736*         BRU* ILEG
0745                     *
0746  00742  00000743*   OPER DAC  **+1
0747  00743  00000020          DATA '20
```

```
   0748  00744  40100005          LAA* 5
   0749  00745  76741117          DATA ''><IO 08 ILEG OPRTN.''
         00746  40607040
         00747  11140507
         00750  40172022
         00751  24165640
   0750                     *
   0751                     *
   0752         00000       BTCG EQU  0
   0753         00002       BTCL EQU  2
   0754         10000       MTFL EQU  '10000
   0755         00000       MTFG EQU  0
   0756         00006       DEVN EQU  6
   0757                     *
   0758                          END
         00752  37777777
```

0000 ERRORS

APPENDIX P

CHARACTER	TRUNCATED ASCII	ASCII	CHARACTER	TRUNCATED ASCII	ASCII
@	00	300	Space	40	240
A	01	301	!	41	241
B	02	302	"	42	242
C	03	303	#	43	243
D	04	304	$	44	244
E	05	305	%	45	245
F	06	306	&	46	246
G	07	307	'	47	247
H	10	310	(	50	250
I	11	311	)	51	251
J	12	312	*	52	252
K	13	313	+	53	253
L	14	314	,	54	254
M	15	315	-	55	255
N	16	316	.	56	256
O	17	317	/	57	257
P	20	320	0	60	260
Q	21	321	1	61	261
R	22	322	2	62	262
S	23	323	3	63	263
T	24	324	4	64	264
U	25	325	5	65	265
V	26	326	6	66	266
W	27	327	7	67	267
X	30	330	8	70	270
Y	31	331	9	71	271
Z	32	332	:	72	272
[	33	333	;	73	273
\	34	334	<	74	274
]	35	335	=	75	275
↑	36	336	>	76	276
←	37	337	?	77	277
C/R		215	Bell		207
L/F		212	Delete		377