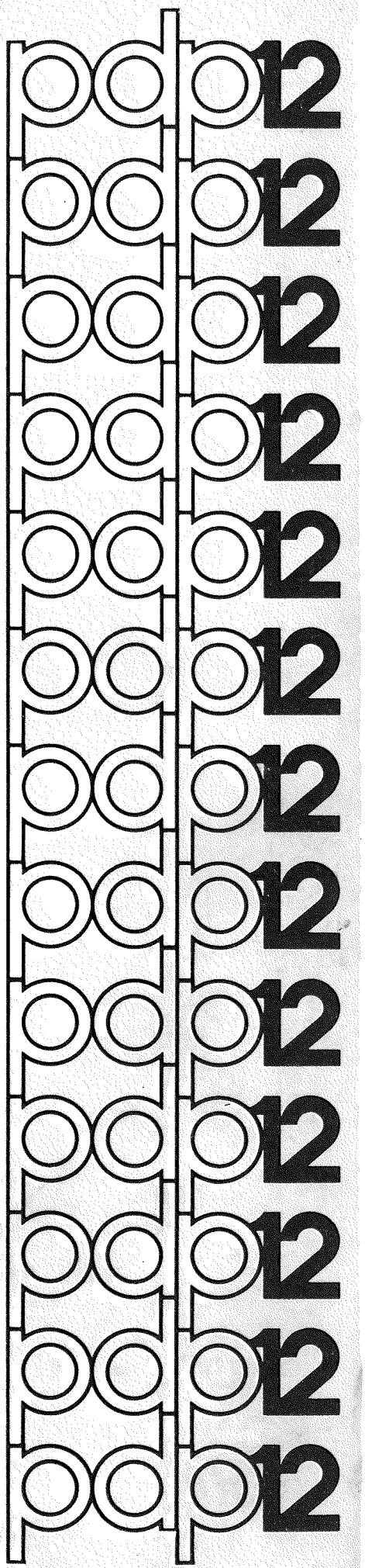
digital

TISA



DEC-12-UW3A-D
June, 1970

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TABLE OF CONTENTS

1.0 INTRODUCTION

TISA, the Time Independent Spectrum Acquisition program, acquires asynchronous data from interfaced instruments, displays that data on the scope and stores it on LINCtape. TISA is compatible with any instrument that transmits X-Y data at rates that do not exceed 2 milliseconds/point and is capable of acquiring data simultaneously from five instruments. The number of data points that TISA can accept depends on the core size of the PDP-12A being used; the maximum number is 512 points for a 4K machine, 46Ø8 for an 8K machine, and 29,184 for a 32K machine.

The external asynchronous instrument must be interfaced to the PDP-12 by either two potentiometers or one shaft encoder and one potentiometer, such that one input transmits X-axis data (independent variable), and the other transmits Y-axis data (dependent variable). For a given instrument TISA will generate the function Y=f(X). Thus, a typical application for TISA is generating a series of absorption spectra from infra-red spectrophotometers.

Concepts and terminology peculiar to this manual are defined in the glossary (refer to section 11).

2.0 MINIMUM REQUIREMENTS

a. PDP-12A with 4K of core[1] and KW12A clock.
b. LAP6-DIAL[2] (version 2) tape with the TISA program.

3.0 OPERATING PROCEDURE

3.1 Loading TISA

TISA is a "load and go" program and is called from tape by the DIAL command

→LO TISA, unit↵

where unit is the tape unit with the TISA tape. The initial starting address is 4ØØ1; the restart address is 4Ø2Ø.

To obtain correct results, the X-Y inputs for an interfaced instrument must be connected as described in section 8.0, PIN ASSIGNMENTS.

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[1] For a data buffer of reasonable length, 8K of core is suggested.

[2] LAP6-DIAL is hereafter referred to as DIAL.

3.2 Operating Modes

TISA has three modes of operation:

a. Setup mode - experiment parameters are defined
b. A/D mode - data is being acquired
c. Pause mode - no data is being acquired

When setup mode is terminated, TISA automatically enters pause mode and the data buffer display is activated. Any of the available commands may be issued at this time (refer to section 5.0).

3.3 Sense Switch Ø Options

Sense Switch Ø (SSWØ) is used in all three operating modes.

In the setup mode, its settings and effects are:

Value	Effect
Ø	none
1	erase all previous parameter input and initialize setup mode

Note that SSWØ is active during all of setup mode and that all user input is ignored when SSWØ=1. The only function of SSWØ during setup mode is to allow the user to restart parameter input from the beginning if he discovers an input error from which he cannot recover. During setup mode, raising and lowering SSWØ performs the same function as the following restart procedure, which may also be used:

1. Raise and lower the STOP switch
2. Set the mode switch to LINC
3. Depress the I/O PRESET switch
4. Depress the START 2Ø switch

During pause and A/D modes, the SSWØ settings and effects are

Value	Effect
Ø	display data buffer
1	display HELP frame

Raising SSWØ during A/D mode has no effect on data acquisition.

3.4 Knob Options

Knobs Ø and 4 provide flexibility for user control of the data buffer display.

Knob Movement	Effect
KNOB Ø	
Clockwise from center position	Move window forward; the farther away from center position, the faster the motion.
Counterclockwise from center position	Move window backward; the farther away from center position, the faster the motion.
Center position	Freeze window.
KNOB 4	
Clockwise	Move cursor toward the right side of the scope.
Counterclockwise	Move cursor toward the left side of the scope.

4.0 SETUP MODE

4.1 Using Setup Mode

Setup mode allows the user to define his particular experimental parameters, such as number of instruments, sampling frequency, etc., by displaying a series of scope messages. The user responds by typing the appropriate characters on the keyboard.

In setup mode, all scope messages are presented using the QANDA subroutine; the user must be familiar with the operating procedures of QANDA. Refer to DEC-12-FISA-D for a detailed explanation of QANDA. The following explanation deals only with those conventions that are peculiar to TISA.

Setup mode is initialized by any of the following:

1. Loading TISA from DIAL (refer to section 3.1)
2. Raising SSWØ during setup mode (refer to section 3.3)
3. Typing "S" during pause mode (refer to section 5.7)
4. Restarting at 4Ø2Ø (refer to section 3.3)

When responding to any of the following messages, an unfilled blank is interpreted as a zero; leading zeros are ignored. Thus, a response of 1 _ _

is identical to a response of ØØ1,_ _ _ _ is ØØØØ. Note that all messages must be answered and terminated according to QANDA conventions except where noted. TISA does not interrogate any user reply until a terminator is typed.

4.2 Message 1

Initializing setup mode clears the data buffers (fills them with zeros) and displays the following message:

```
    PARAMETER INPUT
    DO'_
1   LINCTAPE
2   KEYBOARD
```

Be usre that SSWØ=Ø now or all further keyboard input will be ignored. TISA alerts the user that SSWØ=1 by causing message 1 to flicker.

Type 1 to select option 1, LINCtape, or type 2 to select option 2, keyboard. A response other than 1 or 2 and a terminator will redisplay the message.

Option 1 allows the user to recall from LINCtape a parameter list for a given experiment that was previously saved using the WRITE command in the HELP frame (refer to section 5.8). If option 1 is chosen, the following message is displayed:

```
READ TBLK'_ _ _
UNIT _
```

Type the tape block and unit numbers that contain the desired parameter list, followed by a terminator. Only octal values are legal; nonoctal input will redisplay the read message. The user must know where his parameter list is stored; TISA has no file handling capabilities. After the tape block and unit have been specified, TISA tries to read in that parameter list. If the requested tape block contains a previously defined parameter list, setup mode is terminated and pause mode is entered. If the read message is redisplayed after TISA has read in the requested tape block, an illegal TBLK, i.e., one that does not contain a parameter list, has been specified. It is possible to request an illegal tape block that will not be caught. Because TISA cannot check for all possible errors, running TISA under such conditions could produce weird results. The user is cautioned to know the location of a stored parameter list.

Option 2 requires parameter input from the keyboard and will advance to message 2 for definition of each instrument.

4.3 Message 2

Message 2 requests information defining the parameters for a particular instrument. The message has the following format:

```
INSTRUMENT K IS!_
(1 = analog, 2 = encoded)

STARTING POINT=_ _ _ _ _
TOTAL POINTS=_ _ _ _ _
SAMPLING FREQUENCY=_ _
```

TISA will support up to five instruments, each of which must be defined in message 2. In the above display, K is the number of the instrument currently being defined and is always in the range Ø-4. For example, the first instrument defined in message 2 would be displayed as:

```
INSTRUMENT Ø IS!_
```

Four error conditions described below may be detected and noted by TISA when the values for message 2 are supplied.

All input to message 2 must be decimal; non-decimal input for any of the four responses will redisplay message 2. If TISA first detects any of the error conditions described below, the appropriate error message is displayed. An error in defining an instrument has no effect on the parameter input for a previously defined instrument; thus, if instruments Ø and 1 have been defined successfully but an error, such as non-decimal input, occurs in defining instrument 2, message 2 is redisplayed for instrument 2 and the parameter definitions for instruments Ø and 1 remain unchanged. Note that if an error in the definition of instrument 1 is detected by the user while defining instrument 2, it can be corrected only by raising SSWØ and starting with message 1 again.

The only legal values for the first response in message 2 are 1 for an analog instrument or 2 for an encoded instrument. Any other response will redisplay message 2.

TISA will support a maximum of three encoded instruments. If an attempt is made to define more than three instruments, the message

```
ERR ENC
```

is displayed and message 2 is redisplayed for the offending instrument when the error message is terminated.

The response for STARTING POINT can be any decimal number up to five digits long, i.e. Ø-99999, and is the value of the initial X coordinate in the data buffer display routines (see DATA BUFFER DISPLAY, section 9.0).

TOTAL POINTS is the number of points that TISA will acquire and store in its data buffers, as distinguished from a detected point as described in SAMPLING FREQUENCY below.

The response for TOTAL POINTS for any instrument must be a number greater than Ø and less than or equal to the number of points left in the data buffer, which is the maximum number of points available minus the number that has been allotted to previously defined instruments. The maximum number of points available depends upon the amount of core in the system configuration, according to the following scheme:

AMOUNT OF PDP-12 CORE	MAXIMUM NUMBER OF DATA POINTS AVAILABLE
4K	512
8K	46Ø8
12K	87Ø4
16K	128ØØ
2ØK	16896
24K	2Ø992
28K	25Ø88
32K	29184

Thus, if instruments Ø and 1 are defined as having 6Ø8 and 1ØØØ points, respectively, for an 8K machine, the maximum number of points available for instrument 2 is 46Ø8 minus 6Ø8 for instrument Ø and 1ØØØ for instrument 1, or 3ØØØ points for instrument 2.

If the user requests no points, the error message

ERR Ø PTS

is displayed.

If more points are requested than there are left, i.e. the capacity of the data buffer is exceeded, the error message

ERR BUF FULL

is displayed.

Terminating either error message reinitializes message 2 for the offending instrument.

The SAMPLING FREQUENCY determines the density or resolution of the spectrum. The X axis input is considered as a pulse. For an analog device a pulse is a one bit increment of an analog channel; for an encoded device a pulse is an interrupt on one of the KW12A clock channels. A point is said to be detected on the Y axis whenever TISA receives a pulse on the X axis. The ratio of detected points to acquired points is defined as the SAMPLING FREQUENCY. If the user defines TOTAL POINTS to be 1ØØØ and the SAMPLING FREQUENCY to be 5, TISA will detect 5ØØØ points and every fifth detected point will be an acquired point. SAMPLING FREQUENCIES of Ø or 1 mean acquire every detected point, a SAMPLING FREQUENCY of 2 means acquire every second detected point, etc.

The SAMPLING FREQUENCY must be a number from Ø to 1Ø. Requested sampling frequencies outside of this range display the error message

ERR FREQ

Terminate this error message; message 2 is reinitialized.

4.4 Message 3

When an instrument's parameter definition has been successfully completed in message 2, TISA displays the following message:

```
    DO'_
1   MORE INSTRUMENTS
2   START
```

Type 1 to redisplay message 2 to define more instruments. TISA will redisplay message 2 with the instrument identifier (the K of message 2) incremented by one. Each instrument is defined in turn in this manner until option 2 of message 3 is selected. Type 2 if all the instruments in this experiment have been defined. Pause mode is entered immediately after typing 2. Terminating message 3 with a response other than 1 or 2 is illegal and redisplays message 3.

If option 1 is selected, there are two possible error messages that may be displayed. If the user attempts to define more than five instruments, the error message

ERR INST

is displayed. If the user attempts to define additional instruments when all the data storage has been allotted to previously defined instruments, the following error message is displayed:

```
ERR  BUF  FULL
```

Terminate either error message display; message 3 is then redisplayed.

5.0 HELP FRAME AND KEYBOARD COMMANDS

When the user is in either pause or A/D mode and SSWØ=1, a HELP frame is displayed that briefly summarizes all keyboard commands available to the user in either of these modes. The HELP frame display is:

```
D              DIAL
      A/D    MODE
          CTRL/H     HALT ALL INSTRUMENTS
          HN         HALT INSTRUMENT N
          P          POLARITY
          F          FREEZE
      PAUSE MODE
          GN         GO INSTRUMENT N
          S          SETUP
          W          WRITE TAPE
          C          CATACAL
          M          MAGSPY
          L          LOADER
          P          POLARITY
          F          FREEZE
```

All commands are issued by typing the letter(s) and then their action is implemented immediately.

5.1 DIAL

The D command is active in either mode and is used to restart DIAL. Refer to the LAP6-DIAL Programmer's Reference Manual, DEC-12-SE2B-D.

5.2 Halt All Instruments

Typing CTRL/H[1] when in A/D mode directs TISA to halt all instruments; data acquisition is terminated on all instruments and TISA enters pause mode. Whenever TISA enters pause mode, the message:

```
PAUSE MODE
```

is printed on the Teletype.

---

[1] CTRL/H is typed by pressing down the CTRL (control) key and simultaneously typing H, in the same manner as using the SHIFT key.

5.3 Halt Instrument n

HN is a two character command that allows the user to halt a given instrument (put it into pause mode) without affecting the mode status of the other defined instruments. The first character of the command is H (for halt); the second character, n, is a number in the range Ø-4 and defines the number assigned to the instrument in message 2. Thus, the command H2 means halt instrument 2. Any number of intervening characters may be typed between H and N, the numeric argument, without interfering with the execution of the command HN, except for the character G. Thus, the command HAAA777BBB2 is identical to the command H2 because the nine intervening characters are illegal and ignored by TISA. The command H666PPP????2 directs TISA to halt instrument 2, but it is not identical to the command H2 because it executes the polarity command P (refer to section 5.4) three times before instrument 2 is halted. An HN command is acknowledged by the following message printed on the Teletype:

HALT INSTRUMENT N

where N is the user supplied value Ø-4. If the HN command is typed for an instrument that has not been defined by the user or for an instrument that is in pause mode, it is ignored.

5.4 Polarize Display

Typing P polarizes or inverts the entire data buffer display. For example:

BEFORE P COMMAND

AFTER P COMMAND

The P command does not destroy the integrity of the data in the data buffer but merely inverts it before it is displayed on the scope. If the data buffer is polarized when one P command has already been issued, the display is restored to its normal form. If the P command causes the display to be inverted, TISA responds with the Teletype message:

INVERTED

If the P command causes the display to be normalized, TISA outputs the message:

NORMAL

The P command can be issued as often and whenever the user chooses.

5.5 Freeze

The F command directs TISA to freeze the moving window display (see DATA BUFFER DISPLAY, section 9.0), thereby isolating the display on a given portion of the data buffer. Typing F when the window is frozen directs TISA to restart window motion. TISA acknowledges the F command and indicates the action taken by typing FREEZE or MOTION, whichever is appropriate. The user may issue the F command as often as he likes.

The P and F commands are active in both pause and A/D modes.

5.6 Go Instrument n

GN is a two character command issued in the same manner as HN (refer to section 5.3), but performs the opposite function; GN puts an instrument in A/D mode. Remember that arguments H and G cannot be intermixed in a command. For example, typing H followed by G erases the first half of an HN command and directs TISA to wait for the second argument of a GN command. Thus, the commands HG2, HHHHHG2, and G2 are all identical. If instrument N is in A/D mode, TISA will ignore the command GN.

When TISA initiates A/D mode for a given instrument, the message

GO INSTRUMENT N

is printed on the Teletype, where N is the instrument number Ø-4. Whenever TISA enters A/D mode it outputs the following message on the Teletype:

A/D MODE

5.7 Setup Mode

Typing the key S causes TISA to enter setup mode so a new parameter list can be input. The contents of the data buffer are not preserved.

5.8 Write

The W command outputs the data buffers to LINCtape. TISA acknowledges this command by displaying the following message:

E X P E R I M E N T N A M E

_ _ _ _ _ _ _ _

The user can name his experiment with any combination of up to eight characters; input acceptable to QANDA is legitimate here.

The Write command will generate 2+K TBLKs of output where K is the smallest number of tape blocks needed to store the portion of the data defined by the experiment. If the user had defined 1ØØØ points of the data buffer area, then K is equal to four. The first two blocks contain the experiment name and the parameter list for the experiment just completed; they contain no data but enable the user to exercise the LINCtape input option during setup mode (refer to section 4.2). The experiment name will appear in the beginning of the first block of output exactly as it is typed in the name message above. For example, if the first block of output is assigned the name

```
ABCD_ _ _ _
```

then this block when viewed via MAGSPY[1] will appear as follows:

```
A B C D _ _ _ _
$%ASJWBE*996%RYSSI&456%&J
```

After the name message, TISA displays the following Write message:

```
WRITE XYZ (OCT) TBLKS
FIRST TBLK= _ _ _
UNIT _
```

where XYZ is the number of octal tape blocks that will be output and is the number 2+K described above. The user specifies in octal the starting TBLK and unit number; a non-octal response redisplays the name message. If the response to the Write message is legitimate, TISA commences to write the data buffer plus the two header blocks. While writing, the display is maintained; however, all commands are ignored until this operation is finished. When the interrupt (ION) light comes on, the operation is finished. If this parameter list just output is ever to be recalled, remember the first TBLK specified in the Write message because it is this block that option 1 of message 1 (refer to section 4.2) requires. (This block number may also be determined using the MAGSPY program.) Note that TISA considers TBLK 777 to be contiguous to TBLK ØØØ. For example, if a request is made to write 2Ø TBLKs starting at TBLK 77Ø, the first 1Ø TBLKs are written on 77Ø-777 and the last 1Ø TBLKs on Ø-7. Data should not be output in this manner, however, because of difficulties created for related software, such as MAGSPY[1].

[1]MAGSPY is a program used to examine data stored on LINCtape. Refer to DEC-12-UZSA-D and section 5.10.

5.9 CATACAL

Typing C exits TISA and loads the program CATACAL which is very useful for data manipulation. Refer to DEC-12-UW1A-D for a description of CATACAL.

5.10 MAGSPY

Typing M exits TISA and loads the program MAGSPY.

The CATACAL and MAGSPY commands both assume that a DIAL-V2 tape (not DIAL-MS) with the binary files CATACAL and MAGSPY are on unit Ø. If the binary files are not present, the user will find himself in DIAL with the NO message on the scope. If a DIAL-V2 tape is not on unit Ø, the results are unpredictable.

5.11 Load

TISA can load an arbitrary program by issuing the command L. A DIAL V2 tape must be on unit Ø. The following load message is displayed:

```
LOAD'_ _ _ _ _ _ _ _
UNIT _
```

Type at least one character for the program name in acceptable QANDA characters and then type the unit where this program is located. No error checking is done for the unit argument; thus, if the user requests unit A, he gets unit 1,etc. If the requested binary is a file on the requested unit, TISA will load it. If the file does not exist, the user will find himself in DIAL with the NO message on the scope.

5.12 Polarize

The P command in pause mode is identical to the P command, Polarize, in A/D mode (refer to section 5.4).

5.13 Freeze

The F command in pause mode is identical to the F command, Freeze, in A/D mode (refer to section 5.5).

6.0 TELETYPE USAGE

TISA outputs messages to the Teletype to make the user aware of the present action. The following set of messages are in TISA's repertoire:

```
HALT INSTRUMENT N     (N=Ø-4)
GO INSTRUMENT N       (N=Ø-4)
MOTION
FREEZE
NORMAL
INVERTED
PAUSE MODE
A/D MODE
HANDS OFF
```

A backlog of several messages may occur because the Teletype is a relatively slow device for TISA's environment. TISA services legal keyboard commands immediately; the message(s) appropriate to the command(s), however, is typed afterward. If a command is issued while a message is being typed, the command is executed immediately and the message(s) appropriate to the command is put on TISA's backlog. TISA will never overload the Teletype but the user may do so by leaning on the P key. In this case, the integrity of the messages printed on the Teletype may be destroyed, but execution of the keyboard commands is maintained. If the Teletype becomes too overloaded with commands, the message HANDS OFF is printed.

7.0 DATA ACQUISITION

TISA has the ability to acquire data simultaneously from five instruments. A given device must not transmit X axis data at rates that are faster than 2 milliseconds/point or data will be lost. If all instruments (maximum of 3) are defined as encoded, the optimum rate obeys the following scheme:

NO. OF ENCODED INSTRUMENT	OPTIMUM RATE
1	500 μs
2	1000 μs
3	1500 μs

For analog devices, a one bit increment in the X axis potentiometer indicates to TISA that a point has been detected on the Y axis. For encoded devices, an interrupt on a KW12A clock channel (X axis input) indicates a detected point. The data that TISA acquires comes from the Y axis input. Each data point represents a 1Ø bit A/D conversion on one of the Y axis analog inputs, and is stored as a 1Ø bit single precision word. Each defined instrument is assigned a sector of contiguous core locations in the data buffer area, beginning at location 7ØØØ of PDP-8 field Ø and continuing to the last location of the last PDP-8 field. The data sectors for each instrument are adjacent to one another; there are no data gaps between instrument data sectors. The data sector for instrument Ø always begins at the initial PDP-8 data buffer location (Ø7ØØØ). For example, if the user defined TOTAL POINTS for

instruments Ø, 1, and 2 to be 512, 2ØØØ, and 3 (1ØØØ,372Ø, 3 octal), respectively, then the allocation in the data area for an 8K of core configuration is:

INSTRUMENT	DATA BUFFER ALLOCATION FROM		TO	
Ø	Ø	7ØØØ	Ø	7777
1	1	ØØØØ	1	3717
2	1	372Ø	1	3722

(1 3723 to 1 7777 is unused)

TISA starts acquiring data from an instrument upon receiving a Go command (refer to section 5.6). No action is taken on an instrument until the first pulse is received from the X axis. TISA does not require the data to be input in a periodic or time dependent fashion; pulses can be days or milliseconds apart.

TISA will acquire data from an instrument until any one of the following conditions occurs:

1. the requested number (TOTAL POINTS) of points has been acquired
2. the user halts the instrument from the keyboard
3. the X axis potentiometer (analog instruments only) decreases 2Ø bits from its last value read

Conditions 1 and 3 represent internal instrument halts. If a halt message is printed on the Teletype and the halt was not requested by the user from the keyboard, then the instrument halt was internal. All three conditions cease data acquisition for the given instrument and an appropriate message is printed on the Teletype.

8.0 PIN ASSIGNMENTS

There is only one correct way to connect the X-Y inputs from an instrument to the PDP-12, regardless of the particular system configuration. Let instrument K be the Kth instrument defined during setup mode for K=Ø,1,2,3,4 and let N_K be the number of analog instruments that were defined previous to instrument K. The X-Y inputs must then obey the following rules:

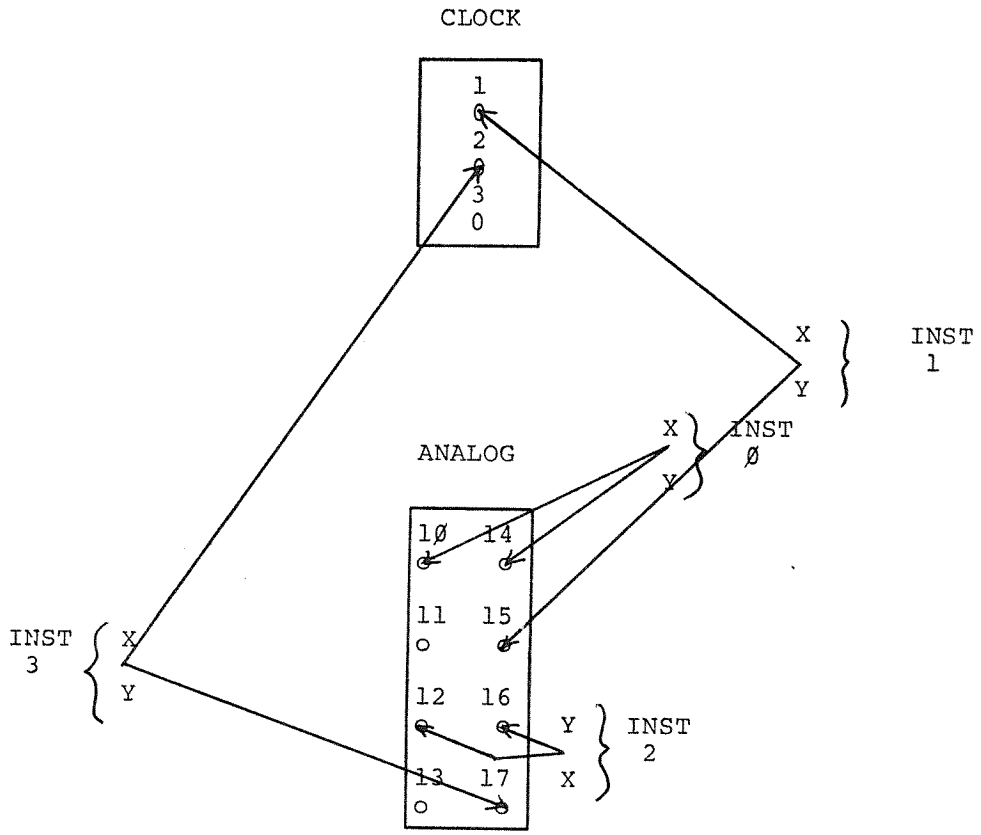
1. If instrument K is analog, its X axis input is connected to analog channel 1Ø+K for K<4. If K=4, the input is connected to analog channel 2Ø.[1]

[1]The fifth channel requires the analog extension (channels 2Ø-27) which is not standard PDP-12 hardware.

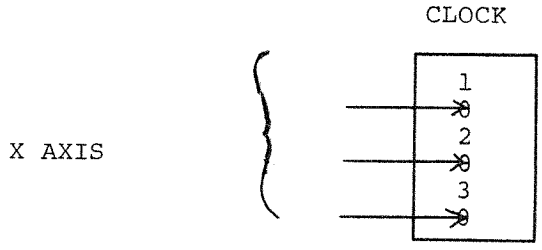
2. If instrument K is encoded, its X axis input is connected to clock channel $1+K-N_K$.

3. The Y axis input for instrument K is analog channel 14+K for $K<4$.[1] For K=4, the input is connected to analog channel 24.

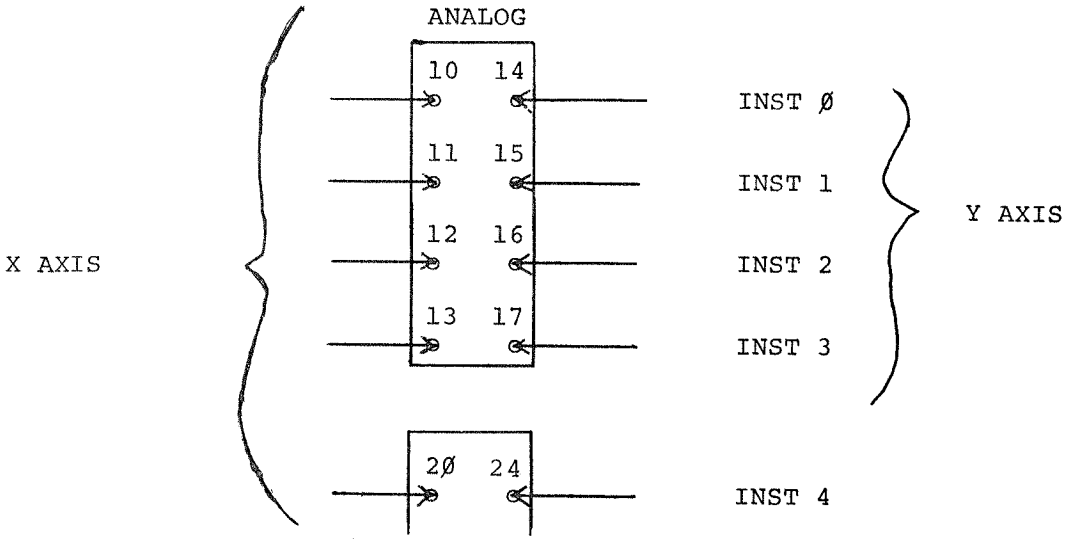
Consider, for example, the following configuration:



GENERAL CONFIGURATION



[1]The fifth channel requires the analog extension (channels 2Ø-27) which is not standard PDP-12 hardware.



INST	INST TYPE	N_K	X AXIS	Y AXIS
Ø	ANALOG	Ø	ANCH 1Ø	ANCH 14
1	ENCODED	1	CLOCK 1	ANCH 15
2	ANALOG	1	ANCH 12	ANCH 16
3	ENCODED	2	CLOCK 2	ANCH 17

9.0 DATA BUFFER DISPLAY

The data buffer display has the three following features:

1. A moving window display controlled by A/D Knob Ø and the keyboard
2. A cursor superimposed on the data buffer display and controlled by A/D Knob 4
3. X-Y decimal coordinate display of cursor position

The 1Ø bit values in the data buffer are scaled to 9 bits prior to display to prevent scope "wrap-around."

9.1 Moving Window

Because the scope can display a maximum of 512 points at any one time and the data buffer has a maximum capacity of 29,184 points, the moving window display is used to view any 512 contiguous points of the data buffer, starting at any given point, simply by rotating A/D Knob Ø. The moving window is very similar to that used in MAGSPY. Consider the data buffer as a ring

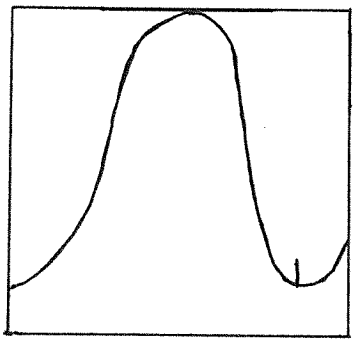
located behind the VR12 scope, with the initial and terminal data points being contiguous, that can be turned by a wheel, namely, A/D knob Ø; the scope is the window. (The phrase moving window is actually a misnomer because it is the data buffer that moves.) When knob Ø is in its center position, the display is stationary.

When A/D knob Ø is moved clockwise from the center position, the data buffer (the ring) appears to move from right to left across the scope. The velocity of the moving window increases with the clockwise movement of A/D knob Ø from the center position. The exact opposite occurs for counterclockwise movement of A/D knob Ø. The data buffer appears to be moving from left to right across the scope. When the display is frozen under the keyboard command F, knob Ø has no effect. When TISA enters pause mode for the first time (after being loaded from LINCtape), the display is frozen and the leftmost scope point is the first point for instrument Ø.

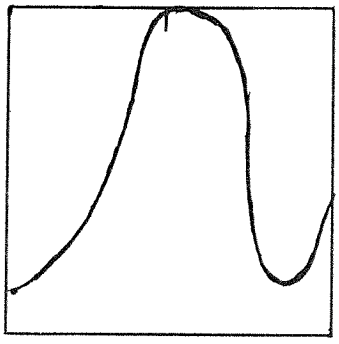
9.2 Cursor Display

A cursor is superimposed upon the data buffer display and can be positioned over any of the 512 points in the display by rotating A/D knob 4 If knob 4 is moved to its furthermost counterclockwise (leftmost) position, the cursor will be imposed on the leftmost point of the scope display. Similarly, if knob 4 is positioned to its furthermost clockwise (rightmost) position, the cursor will be imposed upon the rightmost scope data point. Intervening knob positions will yield intervening cursor positions. The cursor appears on the scope as a vertical line (|) and normally "sits" on top of the display point. However, for those cursor points that do not allow enough room at the top of the scope for the cursor to sit comfortably, the cursor is displayed beneath the cursor point as the following example shows.

CURSOR ABOVE



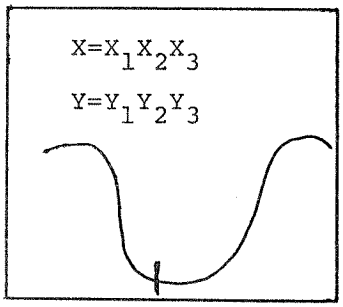
CURSOR BELOW



It should be noted that knob Ø has no control over the position of the cursor relative to the scope. If the window is frozen and the cursor is I inches from the left side of the scope, the cursor will remain fixed at I inches from the left of the scope if the window movement is started. The relationship of the cursor to the data buffer, however, changes because the data buffer is moving across the scope.

9.3 X-Y Coordinates

If the cursor is sitting on a defined portion of the data buffer, its X-Y coordinate position is displayed on the scope in the following manner:



Both X and Y are non-negative decimal integers; the range for X is Ø-391829; the range for Y is Ø-511. Leading zeros and the point ØØØØØ are not displayed. If both the X and Y coordinates are Ø, the coordinates are displayed as:

X=
Y=

If the cursor is positioned over an undefined portion of the data buffer, the X-Y coordinates are not displayed at all. The Y coordinate reads the amplitude (height) of the cursor; the value Ø is the bottom of the scope and the value 511 is the top of the scope.

The value of the X-coordinate depends upon the cursor's absolute position within the data buffer and the starting points and sampling frequencies assigned by the user during setup mode. Each instrument was assigned a sector of the data buffer after replying to TOTAL POINTS in message 2 (refer to section 4.3). When the STARTING POINT value was input, an initial X coordinate to the first data point of the data sector for that instrument was assigned.

Consider the case where the sampling frequency is 1, the STARTING POINT is 9ØØØ for instrument K, and the cursor is positioned over the initial data point of the data sector for the instrument K. If the cursor is moved

from left to right with the window frozen and the cursor at the far left of the scope, the X coordinate will read successively:

9ØØØ, 9ØØ1, ..., 9ØØ9, 9Ø1Ø, ..., 951Ø, 9511

assuming TOTAL POINTS is greater than 511. Because the STARTING POINT (initial X coordinate) is arbitrary and data sectors are adjacent to one another in the data buffer, it is not unusual for the X coordinate to jump as the cursor crosses data sectors. Suppose the user defined TOTAL POINTS=1 for instruments Ø, 1, and 2 and STARTING POINTS=9ØØØ, 5, and 4731l, respectively. If the cursor is positioned over the first (and last) data point for instrument Ø and moved from left to right, the X coordinate will read respectively (and discontinuously):

9ØØØ,5,47311

As long as the cursor stays within a data sector and moves forward across it via A/D Knob Ø or 4 or both, the X coordinate will increase in value. The difference between any two X coordinates within a data sector for a given instrument is the SAMPLING FREQUENCY of that instrument. In the same case, if the SAMPLING FREQUENCY is three, then the successive X coordinate readings are:

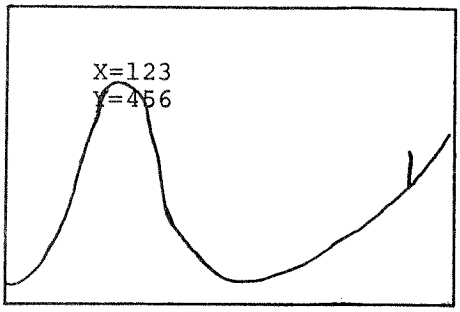
9ØØØ, 9ØØ3, ..., 9Ø27, 9Ø3Ø, ..., 1Ø53Ø, 1Ø533

For a SAMPLING FREQUENCY of 1Ø, the readings are:

9ØØØ, 9Ø1Ø, ..., 9Ø9Ø, 91ØØ, ..., 141ØØ, 1411Ø

With a SAMPLING FREQUENCY of 1Ø, the data acquisition routines acquire 1 point for every 1Ø detected and they are stored as successive data points in the data buffer. This difference, therefore, is reflected in the X coordinate display. There is no X-Y display over undefined areas of the data buffer because there are no arguments (STARTING POINT, etc.) for the X-Y display routines to use. The X-Y coordinates are displayed on hardware channel 1, and the data buffer is displayed on hardware channel 2. To see both displays the channel select knob should be set to the position 1 & 2. In the event that the data buffer display and X-Y readout overlap, they can be viewed separately by selecting the appropriate hardware scope channel.

OVERLAP CONDITION



10.0 INSTRUMENT INTERFACE

TISA plots the incoming data from each of up to five instruments as a dependent variable versus an independent variable. The dependent variable, for example the intensity at a given frequency for an infra-red spectrophotometer, must be an analog signal within the range of the analog-to-digital converter contained in the particular PDP-12. The standard voltage range is -1 volt to +1 volt.

The independent variable may be a monotonically increasing voltage as shown in figure 1 or a pulse train as shown in figure 2. Note that the fastest sampling rate on any and all instruments is 2 milliseconds per point. The maximum slope of an analog dependent variable can be found by the following formula:

$$\text{maximum slope} \leq \frac{X \text{ volts}}{10^3 \text{ samples}} \cdot \frac{1}{2 \text{ msec}}$$

where X = voltage range of particular analog-to-digital converter system

For the encoded or pulsed dependent variable the input waveform need only pass through the desired threshold whenever an analog sample is required. The desired trigger level is set by the threshold knob on the KW12A input panel. The threshold knob is not calibrated but the limits are approximately $\pm$ 6 volts and the potentiometer controlled by the threshold knob is approximately linear. The slope control defined as shown in figure 2 is also on the KW12A input panel.

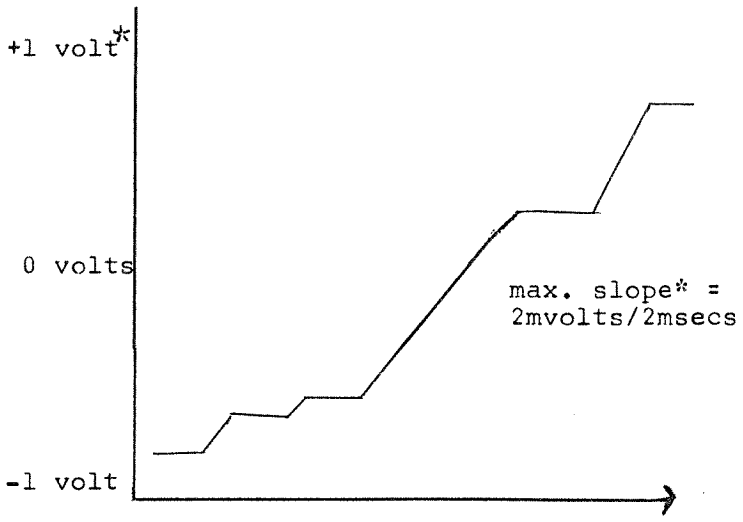
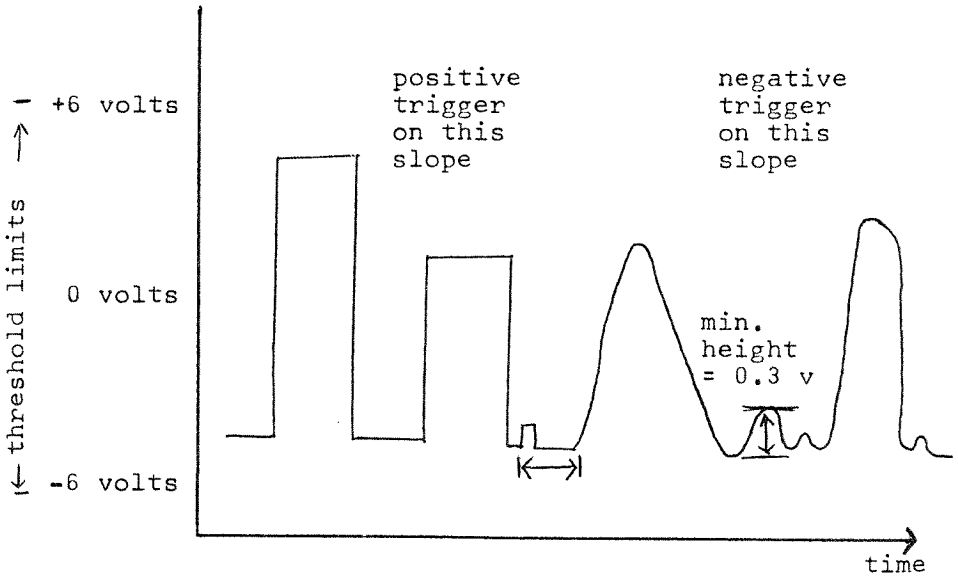


Figure 1 Monotonically Increasing Voltage

*voltage range for standard analog to digital converter



minimum time between
triggering points = 2 msecs

Figure 2 Pulse Train

The setup procedure for instrument N, where N = 0, 1, 2, 3, 4, is described in section 8.0. The setup procedure details which input channels are to be used.

Typical analog independent variable sources are retransmitting pots or ramp generators while pulsed sources are typically shaft encoders or oscillators.

Several examples of typical interfaces were tried in the PDP-12 engineering laboratory. A Perkin Elmer model 621 infrared spectrophotometer was interfaced by placing a retransmitting pot on the pen drive gear and either a retransmitting pot or an incremental shaft encoder on the main chart drive gear. In the case of the Perkin Elmer instrument, the pickup devices were attached via extra chart drive gears supplied with the instrument. The potentiometers were Bourns 3400S series devices. The incremental shaft encoder was a Data Technology model #C25-100-40 with two one-hundred cycle/turn pulse outputs 90° out of phase.[1] The two outputs can be used to detect the direction of rotation and/or produce a 400 cycle/turn output. However, for this application, either of the outputs alone was sufficient.

[1]The specification of these part numbers in this manual does not constitute DIGITAL EQUIPMENT CORP. sanction or guarantee, but is intended as an aid for the user.

11.0 GLOSSARY

ACQUIRED POINT — an acquired point is one that has been retrieved from the Y axis of a defined instrument and stored in TISA's data buffers (see also SAMPLING FREQUENCY and DETECTED POINTS).

A/D MODE

INSTRUMENT — an instrument is said to be in A/D mode (running) when TISA is accepting information from its X axis.

TISA — TISA is said to be in A/D mode when at least one of its defined instruments is in A/D mode.

ANALOG INSTRUMENT — one of two types of instruments that may be interfaced to TISA. An instrument is defined as analog if its X axis input runs from a potentiometer to a PDP-12A analog channel.

CURSOR — a vertical line (|) superimposed upon the data buffer display and controlled by A/D knob 4.

CURSOR POINT — that point in the data buffer display upon which the cursor is sitting.

DATA BUFFER — the amount of core available on the PDP-12 that has been reserved for acquiring points. The data buffer is a function of core size and ranges from 512 to 29,184 words.

DATA POINT — a signed 10 bit single precision A/D conversion or word.

DATA SECTOR — a contiguous set of core locations in the data buffer that has been assigned to a defined instrument. A data sector can be anywhere in length from 1 to 29,184 core locations.

DEFINED DATA AREA — the portion of the data buffer that contains the data sectors of all defined instruments.

DEFINED INSTRUMENT — an instrument is defined if it has been assigned a set of parameters during setup mode.

DETECTED POINT — for a given instrument, a point on the Y axis is detected if TISA has received a pulse from the corresponding X axis.

ENCODED INSTRUMENT — one of two types of instruments that may be interfaced to TISA. An instrument is defined as encoded if its X axis input runs from a shaft encoder to a KW12A clock channel.

HELP FRAME — a message that can be displayed on the scope when TISA is in either pause of A/D mode which briefly summarizes the keyboard commands that are available to the user.

INSTRUMENT — interfaced to TISA for data acquisition. Instruments are either analog or encoded, depending upon the manner in which they are interfaced.

INSTRUMENT K — the Kth instrument defined during setup mode; K = Ø,1,2,3,4.

INTERNAL HALT — an instrument in A/D mode that is halted by a means other than by an HN or CTRL/H keyboard command is said to have been internally halted.

MODE
INSTRUMENT — the state of an instrument at any point in time or the relationship that it bears to TISA is called its mode. An instrument is either in A/D mode or pause mode. Undefined instruments are in pause mode by default.

TISA — the state of TISA's operation or its relationship to the user at any given point in time is called the mode. TISA has three modes: A/D, pause, and setup.

PARAMETER — a numeric value that is used to define an instrument, e.g. TOTAL POINTS.

PARAMETER LIST — the set of all parameters for all defined instruments.

PAUSE MODE
INSTRUMENT — an instrument is in pause mode whenever TISA is not accepting information from its X axis.

TISA — TISA is in pause mode whenever all of its defined instruments are in pause mode.

PULSE — X axis information transmitted by a defined instrument. For an analog instrument, a pulse is a one bit increment on the X axis potentiometer. For an encoded instrument, it is an interrupt on one of the KW12A clock channels.

QANDA — a PDP-12 subroutine that facilitates question and answer type of dialogue via the scope and keyboard. (Refer to DEC-12-FISA-D.)

SAMPLING FREQUENCY — an instrument parameter that is the ratio of DETECTED POINTS to ACQUIRED POINTS. SAMPLING FREQUENCY determines an acquired spectrum's resolution.

SETUP MODE — TISA is said to be in setup mode when the user is defining his instruments (messages 1-3).

SPECTRUM — the sum total of an instrument's acquired points is called the spectrum of that instrument.

SSWØ — Sense Switch Ø.

STARTING POINT	an instrument parameter that defines the initial X coordinate for the data buffer display of the first data point of the instrument's data sector.
TBLK	an abbreviation for LINCtape block.
TOTAL POINTS	an instrument parameter which equals the total number of points that TISA will attempt to acquire when the instrument is in A/D mode. The length of an instrument's data sector is equal to its TOTAL POINTS.
X AXIS	one of two of an instrument's inputs to TISA that are required to generate the instrument's spectrum. The X axis input is the independent variable.
Y AXIS	one of two of an instrument's inputs to TISA that are required to generate the instrument's spectrum. The Y axis input is the dependent variable.

Appendix A
Internal Description

This appendix assumes that the reader is familiar with TISA's external characteristics as described in sections 1 through 11 of this manual.

A.1 INTERRUPT ROUTINES

The interrupt routines handle interrupts in both modes. In either mode, only the following central processor registers are preserved: AC, LINK, PC, IF, and DF. The entry and exit routines for P-mode and L-mode interrupts are different but the interrupt dispatching is common to both. Interrupts remain off until the routines exit. I.e., the interrupt routines can not be interrupted. An L-mode interrupt goes to a routine INTL which saves the AC and LINK, sets up a LINKmode jump at RTNJMP, an LDF instruction at RTNLDF and an LIF instruction at RTNLIF, and sets the interrupt mode switch (INTMOD) to 0. A P-mode interrupt saves the AC, link and sets the interrupt mode switch to 7777, before going to interrupt dispatch.

The interrupt dispatch routines always check three devices in the following order: clock, keyboard, and Teletype. If the clock flag is set, the routine dispatches a call to the routine TISA for data acquisition. If the keyboard flag is up, a character is read in and stored in location KBDBUF. If the Teletype flag is up, it is cleared, then location ADMESS is checked to see if a character needs to be typed (C(ADMESS)NE to 0 means type C(ADMESS)). If a character needs to be typed, it is; the location ADMESS is advanced by one; and the location TTYFLG is set to C(ADMESS) - non zero - to indicate that the Teletype is busy. If no characters need to be typed, then TTYFLG is set to 0 to indicate that the Teletype is not busy. When all devices have been either check or serviced, the AC and link are restored and the INTMOD switch is ISZed to implement one of the two following exits:

P-MODE

```
RMF
ION
JMP  I 0
```

L-MODE

```
        LINC
        DJR
RTNLIF, 0
RTNLDF, 0
        IOB
        ION

RTNJMP, 0
```

A.2 DATA ACQUISITION

When the data acquisition routines are called they check all five devices (even if some devices are not defined or not selected) because it takes only 14.4 microseconds to determine that a device is not selected. The first task of the data acquisition routines is to preserve the clock bits by executing:

```
CLSA
DCA STATUS
```

An analog device must be checked whenever there is a clock overflow, not because the device is ready but because it might be ready. The only way to determine a 1 bit increase of an X-axis analog channel is to read it periodically. The clock is set to overflow and causes an interrupt on overflow once every two milliseconds. Analog devices, therefore, are checked once every 2 milliseconds (optimum speed for analog devices under the worst circumstances). An encoded device is checked whenever its clock channel causes an interrupt indicating it is ready. Note that encoded devices can run at speeds much faster than 2 milliseconds. For instance, TISA could handle one encoded device and no others without loss of any data, if the rate of interrupt was faster than 1/2 millisecond/point. Because the optimum speed varies among all possible user defined configurations, the upper limit in the user's manual is a worst possible case restriction. There are only 4 bits in the clock status register that are of interest to the data acquisition routines:

1. Clock overflow, bit 0
2. Interrupt on channel 1, bit 6
3. Interrupt on channel 2, bit 8
4. Interrupt on channel 3, bit 10

Each device has a select word associated to it whose function is to mask out all status bits except the one that determines if the device is ready to be checked. For example, the select word for an analog device is 4000. The coding that determines if a device needs to be checked is identical for all devices. For device K, the coding is:

```
TAD     STATUS
AND     SELDVK
SNA
JMP(I)  NXTDV
DCA     DVTYP
JMS I     KINPUT
```

Devices are deselected by clearing their select words. The select word for an undefined device is always 0. Every device has a set of parameters associated to it that are required for checking and servicing the device. If a device needs to be checked, the subroutine INPUT is called; the parameters for the device are directly beneath the call:

```
        JMS    I     KINPUT
           100     XAXDVK
           100     YAXDVK
                   .
                   .
                   .
EHIDVK,            0                        /END OF LIST
               JMP (I)  NXTDV               /CONTINUE RTN
                   .                        /HLT RTN
                   .
                   .
NXTDV,         TAD   STATUS
                   .
                   .
                   .
```

The INPUT routine retrieves the parameter list, checks the devices, and returns. If the device is to be halted, input returns to the halt return; otherwise it returns to the continue return. Each device is checked in an identical manner; the last device checked returns to the interrupt dispatch routines so that the keyboard and Teletype may also be checked.

After retrieving the parameter list, INPUT checks the high order bit of DVTYP to determine if the device is analog or encoded. DVTYP = 4000 for analog and 0XXX for encoded devices. If the device is analog, the routine ANALOG is called to check for a 1 bit increment of the X axis. ANALOG samples the X axis (NEWSAM) and compares the value read with OLDSAM, which holds the X axis A/D value for the last detected point. If NEWSAM is greater than OLDSAM, a point has been detected. At this juncture, NEWSAM replaces OLDSAM and ANALOG returns in line (ANARTN) for further checking of the device. If ANALOG finds no increase, NEWSAM is checked for a 20 bit decrease. If the X axis has dropped 20 bits, ANALOG exits to the halt return; otherwise, it exits to the continue to next device return. For encoded devices or analog devices that make it to ANARTN, INPUT advances and checks the detected point counter. When this counter goes to zero, a point is ready to be acquired; otherwise, INPUT exits to the continue return:

```
ISZ   I   FREQ
JMP   I   INPUT
      .
      .
      .
```

If the device is ready, INPUT resets the detected point counter, sets up a 15 bit buffer address (CDF INST and 12 bit address), SAMs the Y axis, stores away the value, and resets the field to 0 (CDF0). INPUT then compares the

current device address to the terminal device address to determine if all points have been acquired and, if so, exits to the halt return. If the device is not finished, INPUT increments the current address by 1 and exits to the continue return. Returning to the halt return affects the values of 2 parameters 0 is put into SELDVK to deselect and the device number (0-4) is put into HSWITK for subsequent use by the routine CHKSWI.

A.3 TELETYPE ROUTINES

The Teletype routines work in conjunction with a que stack capable of holding the addresses (of the first character of each message) of twenty messages. Messages go on the que via the pointer QUEIN, and come off via the pointer QUEOUT; QUECNT always holds the number of untyped messages on the que. The que stack is ringed so that the address of message 20 is adjacent to the address of message 1. Each message consists of a string of 8 bit ASCII characters followed by the message terminator 0000. The subroutine MESCHK takes messages off the que, and the subroutine QUPUT puts them on the que.

A.3.1 MESCHK

MESCHK first looks at QUECNT to see if it is zero. When QUECNT is zero, there are no more messages waiting to be typed so MESCHK exits in this case. Location ADMESS is the pointer to the current message being typed; once ADMESS is initialized by MESCHK, it is controlled by the interrupt routines (see above). If QUECNT is non-zero (message waiting), MESCHK looks at ADMESS (TAD I ADMESS). If the AC is non-zero, a message is in progress and MESCHK exits. If the AC is zero, MESCHK must verify that the last character of the message has been typed; this is done by checking the location TTYFLG. If TTYFLG is non-zero, the TTY is busy and MESCHK exits. If the TTYFLG is zero, MESCHK takes the next message off the que:

```
TAD  I  QUEOUT
DCA     ADMESS
```

QUEOUT is advanced to the next message; if it is at the end of the que, it is reset to the start of the que. The QUECNT is decreased by 1 and the first character of the message is typed to initiate the Teletype interrupt routines that will finish the message. MESCHK then exits.

A.3.2 QUPUT

When QUPUT is called, the address of the message is in the AC. QUPUT saves the message in QSAVE and checks QUECNT to see if the que has room for only one more message and, if so, the message in QSAVE is ignored and the busy message (HANDS OFF) is put on the que instead. If QUPUT makes it by the busy message, it checks to see if the que is full and, if so, QUPUT exits. If the que is not

full, the message is put on the que via QUEIN; QUEIN is advanced to the next location and QUECNT is incremented by 1; QUPUT then exits.

A.4 KEYBOARD ROUTINES

All incoming characters are dispositioned by the subroutine KEYBRD. When KEYBRD is called it immediately checks location KBDBUF to see if the interrupt routines have retrieved a character. If KBDBUF is zero, no character is waiting and KEYBRD exits. If KBDBUF is non zero, a character is waiting. The waiting character is put into location CHAR which is part of the character look up table, and KBDBUF is cleared (set to zero) so that the waiting character will be dispositioned only once. KEYBRD next searches the character table. Each defined character is assigned a consecutive pair of core locations. The first location in the pair is the 8 bit ASCII code of the defined character, the second location is JMP to a routine appropriate to the character. The last pair in the table is:

```
CHAR, 0
      JMP  I  KEYBRD
```

The reason for this pair is to ensure that all keyboard characters will generate a match in the table search routine. All undefined characters cause KEYBRD to exit. Starting at the top of the table, KEYBRD compares each defined character with the waiting character in location CHAR. The search routine ISZ's by the jump instructions in the table location. JMP X is never compared with CHAR. When a match is found at location A, KEYBRD executes the jump instruction at location A+1 via:

```
TAD     (LOC A+1)
DCA    .+1
  0                          /JMP INST
```

The following is an explanation of the various routines that are called from the character table.

A.4.1 D Routine

This routine restarts DIAL with IOF and XOB clear by jumping to the following bootstrap:

```
4015     LDF 3
4016     RCG I
4017     7300
```

A.4.2 CTRLH Routine

The function of this routine is to put TISA into Pause mode. Location MODE determines whether TISA is in pause or A/D mode; 0 = pause, 7777 = A/D.

CTRLH first checks MODE; if it is zero, CTRLH exits (JMP I KEYBRD). If TISA is in A/D mode, CTRLH sets MODE to 0, sends 0 to CLEN to disable all clock interrupts, sets the select words for all devices to 0, puts the address of the pause mode message in the AC, calls QUPUT, and then exits.

A.4.3 H Routine

The character H is the first in a two character command of the form HN(N=0,4). The function of the H routine is to enable the N half of the command. H does this by setting the word HSWIT to 7777. H also clears the go switch GSWIT (sets it to 0) because there is another two character command GN. HSWIT and GSWIT cannot be simultaneously enabled, i.e., TISA waits for either the N half of G or the N half of H, but not both. After setting HSWIT and GSWIT, H exits.

A.4.4 G Routine

G has the opposite effect of H; i.e., GSWIT is set to 7777 and HSWIT is set to 0.

A.4.5 P Routine

The function of the P routine is to complement the polarity word POLAR. Depending upon the value of POLAR, the display routines do or do not complement a data word before it is displayed. The logic employed is:

```
        TAD     (DATA WORD)
        SRO I
POLAR,                          /7777 COMPLEMENTS
        COM
```

After the polarity word is complemented, the P routine checks its value and sends either the normal or inverted message to QUPUT, then exits.

A.4.6 F Routine

Window motion depends upon the value of one word, FREEZE. The logic in the display routines is as follows:

```
        SRO  I
FREEZE,
        JMP  (FREEZE)
        JMP  (MOTION)
```

The F routine dispositions the "F" command and the freeze word in a manner exactly analogous to the P routine.

The function of the S routine is to initialize setup mode. If TISA is in A/D mode, S exits; if not, then the interrupts are turned off and S jumps to the setup routines at location SETUP.

A.4.8 W Routine

If TISA is in A/D mode, W exits. If TISA is in Pause mode, W calls the LINCtape write routines (see LINCtape Routines, section A.5.3).

A.4.9 L Routine

If TISA is in A/D mode, the L routine exits; otherwise, L jumps to a routine that displays the following QANDA message:

```
LOAD _ _ _ _ _ _ _ _
UNIT _ _
```

which allows the user to specify program name and unit. When the user terminates the load message, the first character of the answer buffer is checked for 00; 00 means the user input no program name to QANDA and will redisplay the load message. When the message is terminated, the routine KLOAD is called, whose function is to transfer the QANDA answer buffer to DIAL's monitor parameter table (for a full discussion of the table see DIAL EDITOR V2 internal description DEC-12-ZW7A-D) at locations E6+2 (2373) - E6+6 (2377). The program name is first transferred, one half word at a time, to an intermediate table (LODPTR). Eight characters must be transferred for the program name to meet the requirements of the E6 table. Unused portions of a QANDA answer buffer contain 00. Unused portions of the E6 table must contain 77. If the user requested the program name ABCD, the two answer buffers would look as follows:

```
        QANDA
        BUFFER

ANSWER,74 01 /74A
       02 03 /B C
       04 00 /D -
       00 00 /- -
       00 74 /-74
       XX    /UNIT
```

```
        KLOAD
        BUFFER

LODPTR, 01 02   /AB
        03 04   /CD
        77 77
        77 77
        YYYY    /UNIT
```

The KLOAD routine skips over the first QANDA 74 and terminates name transfer when it uncovers the second 74. The response for unit in the QANDA answer buffer is stripped to 3 bits and stored in the LODPTR table after the name. 60 (0) is unit 0 and 01 (A) is unit 1, etc. When the LODPTR table has been set up, KLOAD puts LODPTR-1 into the AC and calls the routine LOADER.

The function of the routine LOADER is to transfer the table whose address-1 is in the AC to the E6 table and call the DIAL loader. All program calls in TISA to DIAL binary files realize that setting up the E6 table and calling the DIAL LOADER is sufficient work to accomplish the task. LOADER turns off the interrupts, clears the XOB and special functions, registers and reads the Editor's grid table into LDF1 in case the DIAL LOADER decides to display "NO". The AC table is transferred to the E6 table and then the DIAL LOADER is read in and started. The logic is highly similar to executing an LO command in the DIAL EDITOR.

A.4.10 C and M Routines

The function of the C and M routines is to call the programs CATACAL and MAGSPY, respectively. Both routines will execute a JMP I KEYBRD if TISA is in A/D MODE. Otherwise, the address, CATPTR-1 or MAGPTR-1, is loaded into the AC and the LOADER routine is called.

```
CATPTR, 0301  /CA                MAGPTR, 1501  /MA
        2401  /TA                        0723  /GS
        0301  /CA                        2031  /PY
        1477  /L                         7777
         0    /UNIT                       0    /UNIT
```

C and M both require the programs to be on unit 0. C, M, and L all require a DIAL V2 tape to be on unit 0. DIAL MS will not work because the MS LOADER is logically different from the V2 LOADER.

A.4.11 NUM Routine

The function of the NUM routines is to interpret numeric characters. NUM first strips the ASCII and stores the number in TEMP. NUM compares TEMP with DEVNUM, the number of defined devices, to check for an undefined number, exiting in such a case. If the number in TEMP is a defined device number, NUM checks HSWIT for 7777. If HSWIT is set, NUM clears it and calls the HALT routine. If HSWIT is not set, NUM checks GSWIT. If GSWIT is set, NUM clears it and calls the GO routine; otherwise NUM exits.

A.4.12 HALT Routine

The HALT routine checks the device select word to see if the device is in Pause mode and, if so, HALT exits. If the device is in A/D mode, HALT sets the select word to 0 to deselect the device, calls the routine HLTMS to put the Halt message on the Teletype que, and then exits.

A.4.13 GO Routine

The GO routine first checks the device select word to determine if the device is in A/D mode and, if so, GO exits. If the device is in Pause mode, GO

calls GOMS to put the go message on the que. With the aid of 4 tables and relative to the device number in TEMP, the GO routine next initiates the device.

Device K has 2 tables associated to it: TIADK and TISTRK. TISTRK holds the parameters that define the device, and TIADK holds the addresses within the data acquisition routines of these parameters. To initiate a device, six parameters must be set up within the acquisition routines: starting address (2 words), select word, sampling frequency (variable), sampling frequency (fixed), and initial X axis SAM. There are two other tables that are shared by all devices VALTAB and ADRTAB:

```
VALTAB, TISTR0          ADRTAB, TIAD0
        TISTR1                  TIAD1
        TISTR2                  TIAD2
        TISTR3                  TIAD3
        TISTR4                  TIAD4
```

Note that for device K - whose value is in TEMP - VALTAB+K, ADRTAB+K point to TISTRK, TIADK respectively. The GO routine employs the above logic in selecting the tables appropriate to device K. GO further sets up a SAM instruction because analog devices require an initial X-axis SAM at location OSDVK. GO then sets HSWITK to 7777 for the routine CHKSWI, turns the interrupts off, and transfers the device parameters to the data acquisition routines. The interrupts must be off during parameter transfer because it is possible to get an interrupt from device J when device K is only partially initialized. Such a circumstance could produce adverse results for device K. The interrupts are off for 200 microseconds, which presents no problem for the data acquisition routines. Once the device is initialized all clock interrupts are enabled and MODE is checked. If TISA is in Pause mode, the A/D mode message is sent to the que. GO then sets MODE to 7777,turns the interrupts back on, and exits.

A.5 LINCTAPE ROUTINES

There are six LINCtape routines that enable the user to either read a parameter list from LINCtape or write his data buffers onto LINCtape.

A.5.1 READ Routine

If the user selects the LINCtape option during setup mode, TISA calls the READ routine, which displays the QANDA message:

```
READ    TBLK _ _ _
UNIT _
```

When the message is terminated, READ sets a pointer to the QANDA answer buffer

and calls DORDC.

A.5.2 DORDC Routine

DORDC calls the routine TPARGS whose function is to translate a QANDA message which holds LINCtape arguments. If TPARGS returns to P+1, the QANDA input was illegal and DORDC implements the error exit, which is simply a recall to the READ routine. If TPARGS returns to P+2, then location TBLK holds the requested tape block; UNIT holds the low order unit bit i.e., UNIT=10 or 0; and the XOB holds the high order unit bits. Using the arguments from TPARGS, DORDC reads the requested TBLK into locations 7000-7377 (start of the data buffer), executes an I/O preset to clear all flags and the extended unit bits, resets no pause, and transfers the parameter list at 7000-7377 to the setup initialization table at 6000-6144. If the user requests a TBLK that does not contain a legitimate paramater list, DORDC checks the only value in the table that could be fatal to TISA and the user, to wit, the number of defined devices. The function of setup mode is to fill the initialization table with the user's parameters. As the user defines more instruments, more information is input to this table. When setup mode is terminated, TISA takes the information from the initialization table and distributes it to appropriate locations within the program. The number of user defined devices is in the table and determines the length of the table transfer. If the number of defined devices is greater than the maximum number allowed, TISA will extend beyond the initialization table and transfer arbitrary values to arbitrary locations; such a situation is quite obviously fatal. If the number of defined devices is too large, DORDC executes the error exit; otherwise, DORDC goes to the last leg of the setup routines (QADUN+3), just as if input was from the keyboard.

A.5.3 WRIT Routine

WRIT first shuts off the interrupts so that the user cannot inhibit the write sequence via the keyboard. WRIT then retrieves the number of blocks to write from the initialization table (loc. BLKCNT), translates it into DIAL codes, and puts it into the text field of the QANDA write message. The following message is then displayed:

```
WRITE     XYZ  (OCT)  TBLKS
FIRST  TBLK = _ _ _
UNIT _
```

where XYY is the number described above. When the user terminates the message, WRIT sets a pointer to the QANDA answer field and calls DOWRC.

A.5.4 DOWRC

Like DORDC, DOWRC calls TPARGS; at the error return (P+1) is a recall to the routine WRIT. If there is no QANDA input error, DOWRC sets up the following arguments for DOMTP: WRI I (U) to ARGHI, MBLK\TBLK to ARGLO; then calls DOMTP. When DOMTP returns to DOWRC, the operation is finished and DOWRC turns the interrupts on and hangs up in the idle loop.

A.5.5 TPARGS

The function of TPARGS is to retrieve the TBLK and UNIT arguments from a QANDA answer field and to return to P+1 for input error and P+2 for no error. To achieve this end, TPARGS enlists the aid of the more general QANDA numeric decoder DIGCHK, a routine that is heavily exercised during setup mode. DIGCHK has 3 returns:

```
JMS I KDIG                  /CALL
                            /NON DECIMAL CHAR RTN
                            /QANDA END OF QUES. FIELD RTN
                            /NORMAL RTN OCTAL NUM IN AC
```

TPARGS changes location UPLIM of DIGCHK to minus 10 (1's complement) so that non-octal input will be illegal. TPARGS then calls DIGCHK, retrieving in this manner one numeric argument at a time. If DIGCHK returns TPARGS to P+1, then TPARGS returns to the calling program at P+1 (the TPARGS error return). The arguments for TBLK are rolled and packed into location TBLK. DIGCHK is called until it executes the end of field return at which point TPARGS calls DIGCHK one more time for the UNIT argument. The low order unit bit is put into bit 8 of location UNIT and the two high order unit bits go to bits 10 and 11 of the XOB. After the tape arguments have been set up, TPARGS restores UPLIM to its regular value and returns to P+2. TPARGS always restores UPLIM before exiting, error or no error.

A.5.6 DOMTP

The function of DOMTP is to execute a series of tape transfers as indicated by a list of arguments. Currently, only DOWRC calls DOMTP, but DOMTP is general enough in nature to read data as well as write it. The arguments for DOMTP are:

```
BLKCNT =   - (the number to do)
ARGHI  =   a LINCtape instruction
ARGLO  =   initial MBLK\TBLK
LDFSTR =   initial LDF
```

DOMTP first retrieves and sets up its arguments, then issues a tape instruction and calls TPWAIT, which is simply a routine to hang in the idle loop until the

tape operation is complete. When the tape is finished, DOMTP adds 1 to the TBLK and 1 to the MBLK, then checks the MBLK to see if it advanced from 7 to 0. When the MBLK goes to 0, DOMTP resets it to 4 and adds 1 to the LDF instruction at TPLDF. All tape transfers are done via the data field. DOMTP then iterates the tape process, counting each step. When the operation is finished, DOMTP stops the tape, clears the extended unit bits, and exits.

A.6 DISPLAY ROUTINES

The Display Routines present the user with one of two displays, depending upon SSW0: Help Frame, or Data Buffer Display.

A.6.1 DSCHLP Routine

The DSCHLP Routine (help frame) is driven by 4 tables: (1) HLPTAB, which contains the DIAL codes for all the characters displayed in the help frame plus a number of control characters that are not displayed; (2) VCTAB, which is a table of scope vertical coordinates and determines the vertical alignment of the help frame; (3) HCTAB, which is a table of scope horizontal coordinates and determines the horizontal alignment of the help frame; and (4) GRDTAB, which is the QANDA table of grid patterns. The following codes in HLPTAB are the control characters that direct DSCHLP to take certain actions:

Symbol	Value	Meaning
FUL1	0600	Switch to full size characters
CR1	4300	End of a line; go to next line
ENDWD1	7700	End of help frame; exit
CHGHC	3600	Reset horizontal coordinate

The LINC data field is set to 2, where the GRID table is located.

DSCHLP first sets up pointers to the tables and falls through to LNNXT. LNNXT puts the next vertical coordiaate in VCOORD, the next horizontal coordinate in BETA1, and then checks the first character of the line to determine full or half size characters. The link bit is set to 0 for half size characters and to 1 for full size characters. After setting character size, LNNXT goes to CHRNXT. CHRNXT loads a character from HLPTAB and checks for the control characters, CR1, ENDWD1, and CHGHC. CR1 causes a jump to LNNXT, ENDWD1 effects an exit, and CHGHC causes the next value in HCTAB to be placed in BETA1. If CHRNXT finds no control characters, it calls DSCCHR routine to DSC the character whose DIAL code is in the AC.

A.6.2 DSCCHR Routine

DSCCHR finds an address in GRDTAB relative to the contents of the AC and stores the address in GRDPTR (BETA14). VCOORD is loaded into the AC and the character is displayed. To make a horizontal gap between characters so they won't look pressed together on the scope, 2 or 4 is added to BETA1. DSCCHR checks the link bit which indicates character size. A gap of 2 is for half size and 4 is for full size

A.6.3 Data Buffer Display

The Data Buffer Display is controlled by two knobs, 0 and 4. The high order 9 bits of knob 4 determines cursor position; 9 bits will cover 512 points. The A/D value 7400 is converted to -1, and the value 377 is converted to -1000. The converted value is called the cursor count and is stored in location CURCNT. Every time a point is displayed, CURCNT is ISZed. When CURCNT goes to zero, the cursor is displayed. The high order 6 bits of knob 0 is added to the initial scope address to find the address of the first point (leftmost scope point) to be displayed. Suppose the knob value is 10 and the initial scope address is 2000. The display routines display the data from 2010 to 3010 the first time they are called; the second time the display is called, locations 2020 to 3020 are displayed, and so on. Varying the initial scope address in the manner described above lends the appearance of motion to the display routines. Positive knob values move the display from right to left; negative values, from left to right.

When the Data Buffer Display is called, knob 4 is put into CURCNT, XCORD (loc 2017) is set -1000, and knob 0 is put into the AC. Next the FREEZE location is checked. If the display is frozen, the display routine (GODIS) is called immediately. If the display is not frozen, the routine SETMOT is called to determine the initial scope address relative to knob 0.

A.6.3.1 SETMOT - The locations BUFHI,BUFLO hold the initial 15 bit scope address that was used for the last call to the Data Buffer Display. The function of SETMOT is to update this address for each call. The routine further must be capable of making the initial and terminal points of the buffer contiguous. Suppose knob 0 has a value of 20 and BUFHI,BUFLO = 0001,7770 (8K of core). Adding 20 to this address extends 10 locations beyond the size of the data buffer, i.e., 0002,0010. There is no field 2 on an 8K PDP-12. This effect is called high end wrap around. For this case, SETMOT sets the initial address to 10 locations past the initial data buffer address, i.e., 0001,7010. Low end wrap around is handled in analogous fashion. When SETMOT exits, the proper address is in BUFHI,BUFLO. Note that all routines which must handle 15 bit

addresses treat the high order half as a PDP-8 field. An address at HI,LO is referenced in the following manner:

```
TAD   HI
CLL  RTL
 RAL
TAD  CDF0
DCA  .+1
  0                          /CORRECT CDF INST
TAD I LO                     /CORRECT ADDR
```

A.6.3.2 GODIS Routine - GODIS displays 512 consecutive data points, beginning with the address BUFHI,BUFLO. BUFHI goes to CURCDF, BUFLO goes to BUFPTR. The routine SETCDF sets the data field relative to CURCDF. The BETA register for display is XCORD (2017) and runs from 7000 to 7777. Note that hardware channel 1 is selected. When CURCNT goes to zero CURDIS is called to display the cursor. If BUFPTR goes to zero, a PDP-8 field boundary has been reached and FWDCDF is called to set the next data field. FWDCDF also checks for high end wraparound. BCNTR is set to -1000 when this location goes to zero, GODIS is finished, XYGET is called to display the X,Y coordinates.

A.6.3.3 CURDIS - When CURDIS is called, the cursor Y coordinate is in the AC and it is stored at location YCUR, not only for use by CURDIS but also for subsequent use by the X,Y coordinate routines.

The contents of the data field are put into XCURHI and BUFPTR is put into XCURLO. These two locations are the X coordinate and will be subsequently accessed by the routine XYGET. YCUR is compared to MAXCUR; if YCUR is greater than MAXCUR, -1 is put into TEMPHI and the cursor is displayed below the spectrum. Minus the length or the height of the cursor is in location CURLEN. The cursor is displayed by putting YCUR into the AC, displaying it CURLEN times via a DIS XCORD; prior to each DIS, TEMPHI is added to the AC.

A.6.3.4 XYGET Routines - The routines that determine the X,Y decimal coordinates use a table called LIMVL whose format is:

```
LIMVL0,     0              /-starting address device 0 (LO ORD)
            0              /-starting address device 0 (HI ORD)
            0               -sampling frequency device 0
          BCD0             /address of initial X-coordinate device 0
            .
            .
            .
LIMVLK,     0              /-S.A. device K (LO ORD)
            0              /-S.A. device K (HI ORD)
            0              /-sam.freq. device K
          BCDK             /addr of X-COORD device K
            0              /-first unused   core
            0              /location
```

The first task of XYGET is to find the data sector that contains the address XCURHI, XCURLO. This is done by adding the X coordinate to the starting addresses in the LIMVL table, always saving the sum for step k-1. If the sum for step k becomes minus, then the X coordinate lies in between the starting addresses used for steps k-1 and step k; and the sum for step k-1 is the address of the X coordinate, relative to the data sector that contains the X coordinate. Suppose that the data sector for device 0 is 1000_8 points and the X coordinate is 07500. The starting address for device 0 is 0 7000; for device 1 it is 1 0000. The X coordinate is the 500th point in the data sector for device 0. Subtracting the starting address for device 0 yields a sum of +500 which is saved. Because the result is positive, the process continues for device 1, yielding 07500-10000 = -300, which is negative. The negative result means that the previous sum, step k-1, i.e., 500, is the desired address. If the entire table is scanned without a negative result, the X coordinate is in undefined data area and the XYGET routines exit. The relative address is then multiplied by the sampling frequency; this result is converted to a six digit BCD number. A routine to deflate by decimal radii is used for the conversion. The BCD number is stored, one digit to a word, at locations BCDVAL-BCDVAL+5. If the sampling frequency is 3, the value to convert to BCD is 1700. The decimal value for 1700 is 960, which is stored as:

```
BCDVAL, 0
        0
        0
       11      /9
        6      /6
        0      /0
```

960 is a relative decimal value and must be added to the initial X coordinate which is stored from low to high, starting at location BCDK:

```
BCDK,           /UNITS
                /TENS
                /HUNDREDS
                /THOUSANDS
                / 10 THOUSANDS
```

The number at BCDVAL is added as a BCD number to the number at BCDK. To obtain the DIAL code for each digit, add 60 to the sum for each digit. The DIAL codes are stored in the table DCODEX:

```
DCODEX, 3075  /X=
        4300  /CR 100K
        0000  /10K 1K
        0000  /100 10
        0043  /UNITS CR
```

These values will subsequently be displayed by the routine DSCXY.

After the table DCODEX has been set up for the X coordinate, the table DCODEY must be set up for the Y coordinate. First, 400 is added to YCUR to put it in the range 0-511(0-777); YCUR is then converted to a BCD value and then to DIAL codes, one digit at a time, and stored in the table DCODEY.

A.6.3.5 DSCXY Routine - DSCXY sets the LDF to 2 to access the grid table; sets half size characters, and sets the X,Y display coordinate for the top left of the scope (0,400). The routine always displays X=, Y= but never displays leading zeroes or the value 0000. The non-numeric characters are separated from the numeric characters by the carriage return code (43). Display of numeric characters is inhibited until the first non-zero digit (DIAL code $\neq$ 60) is encountered. The characters are displayed by loading their codes into the AC and calling the routine DSCCHR. When DSCXY is finished, the entire scope display is complete. DSCXY exits to SCPRTN.

A.7 SETUP ROUTINES

The function of the Setup Routines is to decode QANDA responses and put them into the initialization table which runs from location INISTR to LAST, or to fill the table from a specified block of LINCtape. QANDA and calls to QANDA are in segment 2. The Setup Routines start at location SETUP. For each QANDA setup message, the refresh return contains the instruction JMP CHKSNS:

```
CHKSNS,     SNS 0
            JMP QARFSH
SETUP,       PDP
```

thus activating SSW0 for all of Setup mode. The Setup Routines first call the routine FRSTR (fresh start), which clears the data buffer and sets all pointers to their initial values. Message 1 is then displayed. After message 1 comes either the READ message (see above) or message 2.

A.7.1 MESS2 Routine

MESS2 first calls the routine RESTR (restart a device), whose function is to reset all pointers to their initial values for defining device K. The initial values for device K are preserved throughout the entire definition of device K so that if an error is made in input the routine RESTR will be able to reset them.

All values go into the table via the index pointer INIPTR. When message 2 is terminated, the QANDA answer buffer is decoded and put into the initialization table. The first value is the device type. If the device is analog, the value

ANAVAL (4000) is put in the table; if the device is encoded, a value from the table ENCVAL is put into the initialization table. The next 3 values are the STARTING POINT, TOTAL POINTS, and SAMPLING FREQUENCY. The routine DIGCHK is used to convert the DIAL codes to digits. The routine DIGCHK expects that BETA14 (ANSPTR) is pointing to a QANDA answer field. When DIGCHK is called, it retrieves one QANDA character. If the QANDA character is 00 (a blank) it is ignored and another character is retrieved. If the QANDA character is QANDA end of question field (74,<) or QANDA end of answer buffer (34,\), DIGCHK exits to P+2. If the character is decimal (codes 60-71), DIGCHK exits to P+3 with the numeric value (0-11) in the AC. If the character is not decimal and not either 74 or 34, DIGCHK exits to the error return P+1. All DIGCHK error returns initialize the routine MESS2.

To setup the starting point, the routines DIGCHK and DSCL4 are alternately called until the end of question field return. DSCL4 takes the contents of the AC and rolls and packs them 4 bits each call into the double precision accumulator (DAC). After the starting point has been put into the DAC, the routine UPACK is called to take the BCD values out of the DAC and put them into the initialization table.

After STARTING POINT has been set up, TOTAL POINTS is set up. For TOTAL POINTS, the routines DIGCHK and MUL10 are alternately called until end of question field. MUL10 does a decimal to octal conversion with the DAC and AC. When TOTAL POINTS is in the DAC, the arguments appropriate to TOTAL POINTS are put into the table, e.g., starting address device K, 2's complement of the starting address, etc. The error conditions "no points" and "buffer full" are checked for at this time.

Like TOTAL POINTS, SAMPLING FREQUENCY is retrieved by alternately calling DIGCHK and MUL10. After the sampling frequency is in the DAC, the error condition greater than 10 is checked for. If the sampling frequency is zero, it is set to 1 before being input to the table. Sampling frequency terminates definition of the device and message 3 is displayed.

A.7.2 MESS3 Routine

If the user requests more devices, the error conditions "no more devices and "buffer full" are checked first, then the routine NXSTR (start next device) is called, whose function is to set up all pointers for the definition of the next device; MESS2 is then recalled. If the user requests to start, an I/O preset is executed and the routine GBLK is called, whose function is to translate the defined data area into (-) the number of TBLKS and store it at location BLKCNT. After GBLK, the routine QADUN is called, whose function is to initialize TISA.

Associated to the initialization table is the table of addresses INIAD, which tells where all the initial values are to go. Using INIAD, QADUN distributes the initial values throughout TISA. The buffer preset and clock control registers are set at this time. The TTYQUE is initialized; pause mode is entered by setting the mode to A/D and putting the control H character into KBDBUF. The interrupts are turned on and the IDLE routine is called.

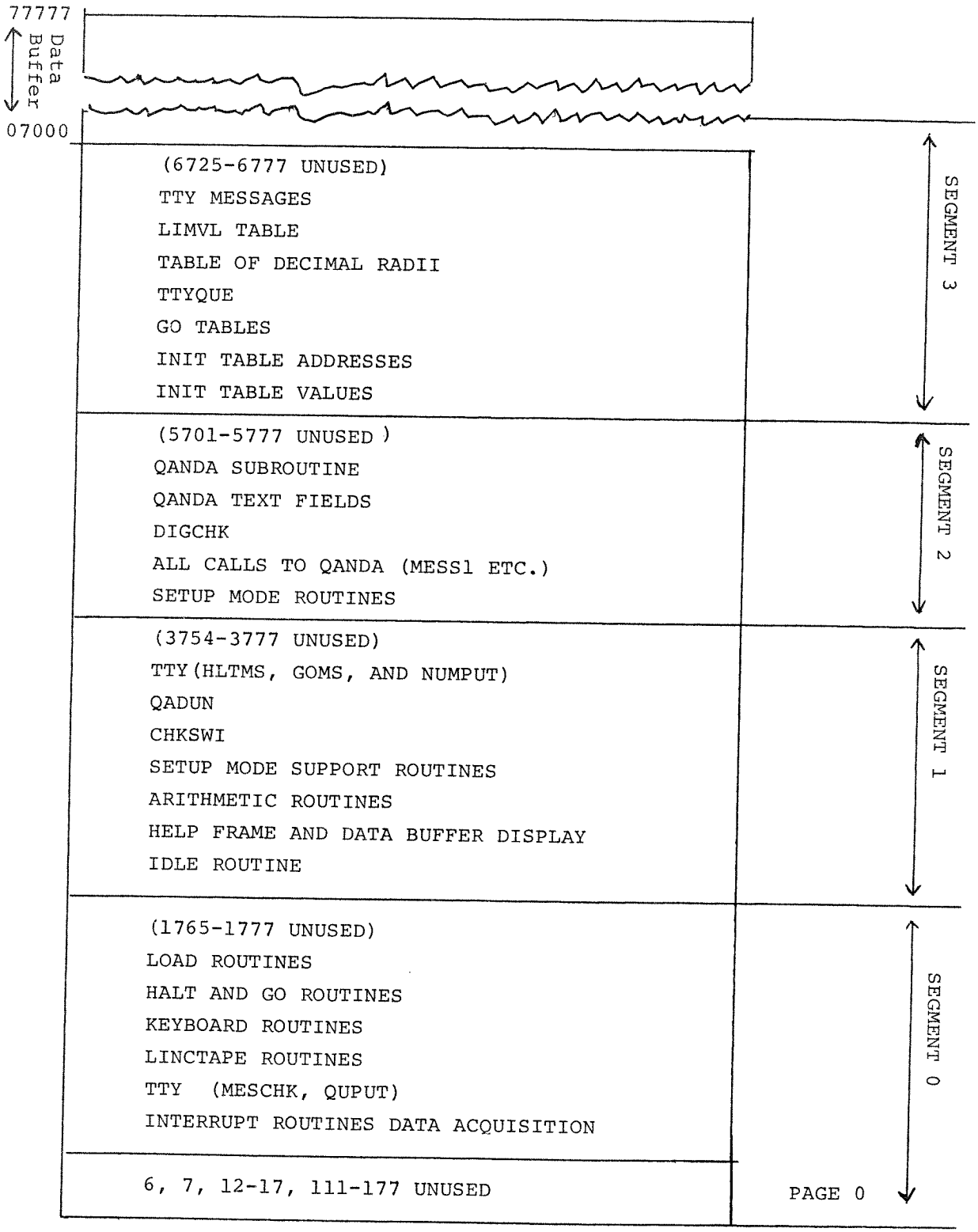
The function of the IDLE routine is to keep TISA busy, when it is not acquiring data, by calling four routines and exiting. The routines and the order in which they are called are

1. SCOPE DISPLAY
2. KEYBRD
3. CHKSWI
4. MESCHK

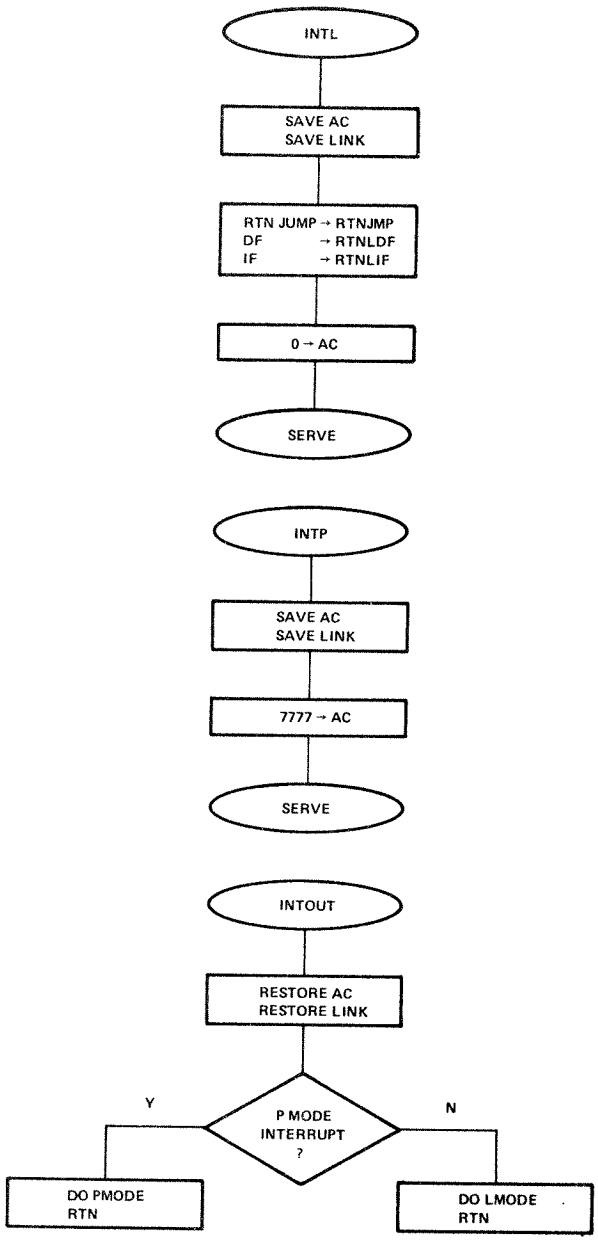
A.8 MEMORY CHECK ROUTINE

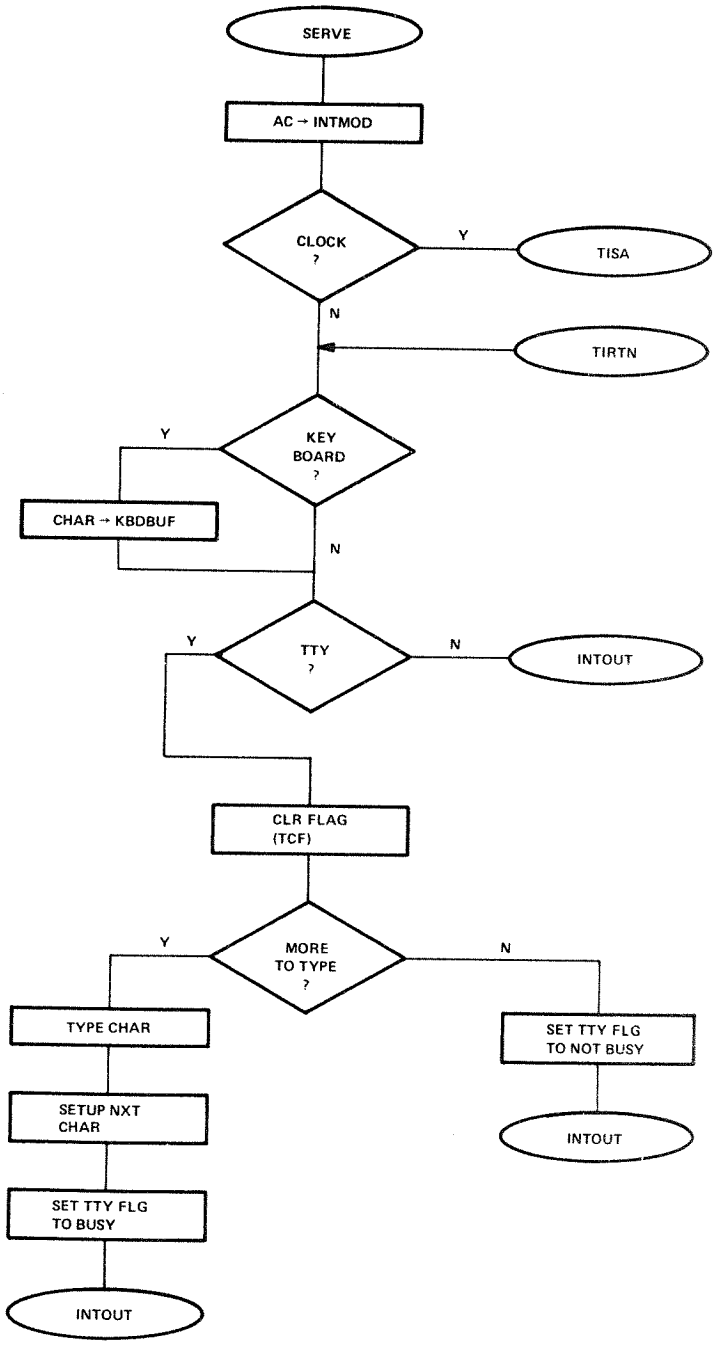
The routine MEMCHK lies in the data area and is called once only (when TISA is loaded from LINCtape). Its function is to determine the core limits of the PDP-12 on which TISA is running. MEMCHK puts the largest PDP-8 field in location MAXCDF and exits. This routine must be called for TISA to function properly and is the primary reason why the starting address for TISA is 4001 and the restart address is 4020.

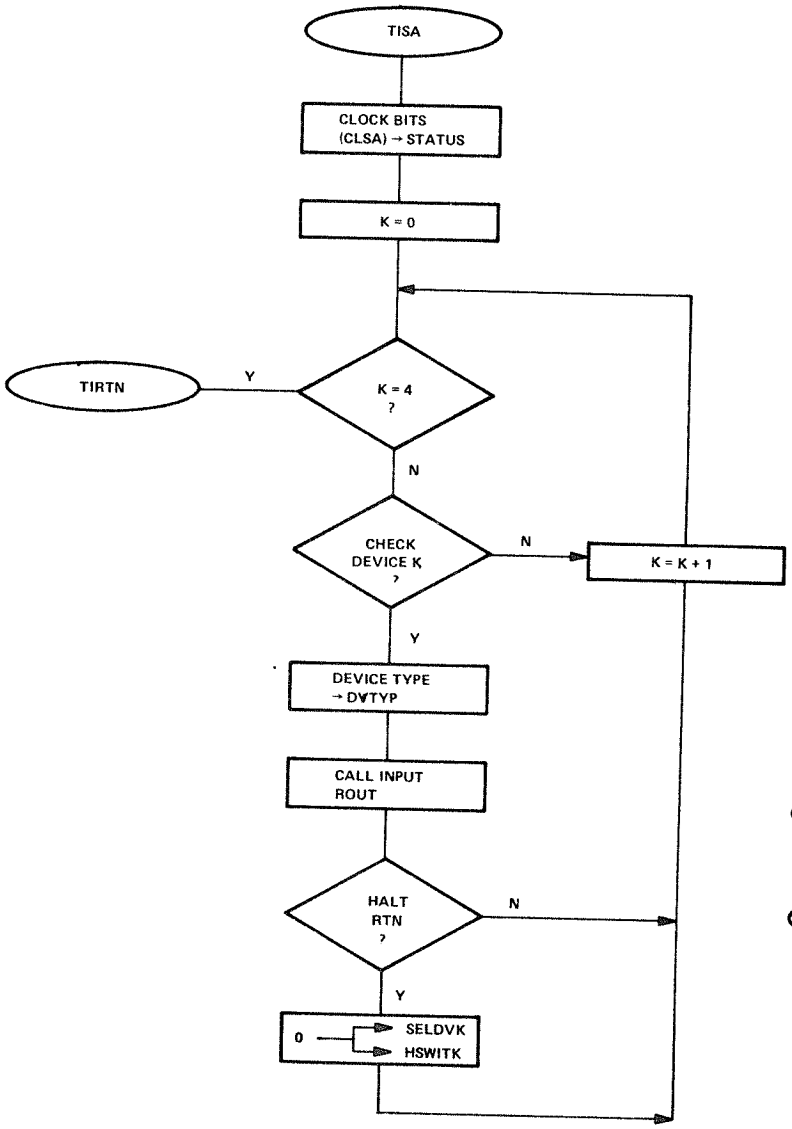
A.10 CORE ALLOCATION

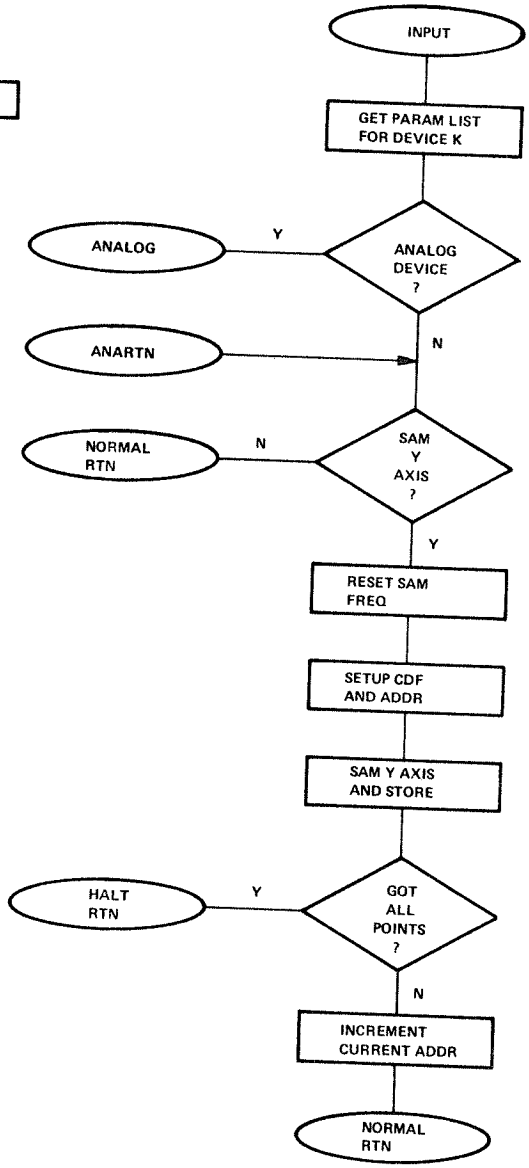


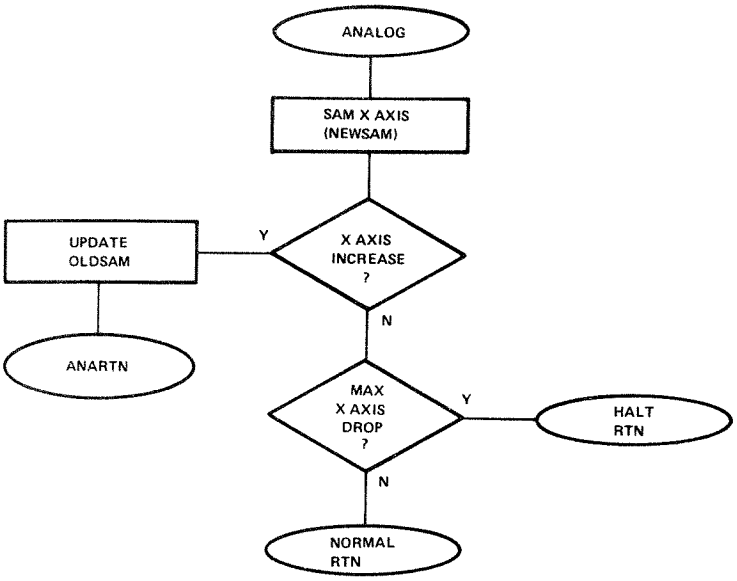
Appendix B
Flowcharts

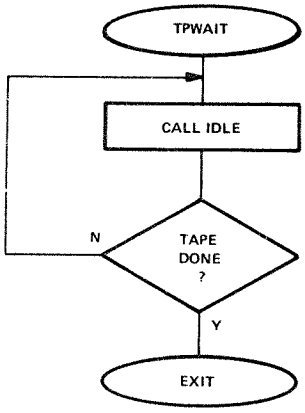


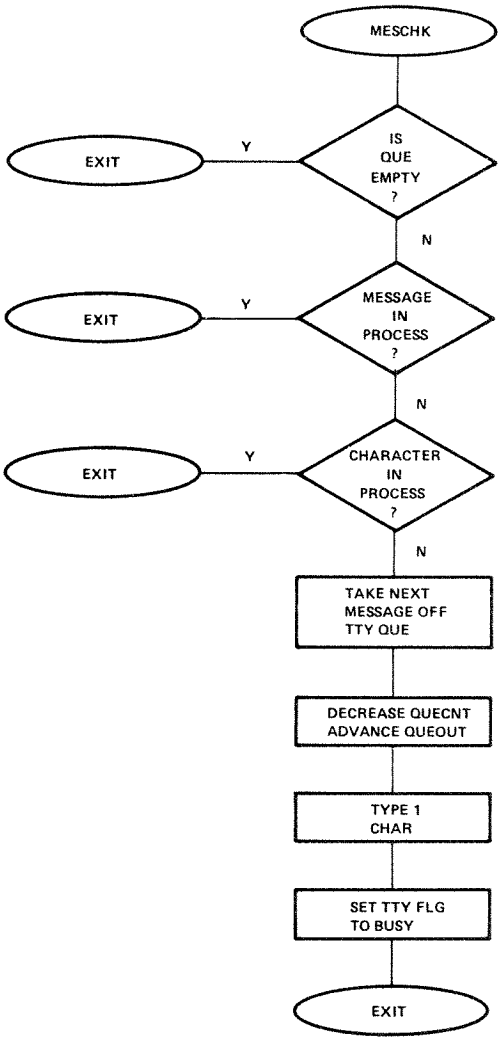


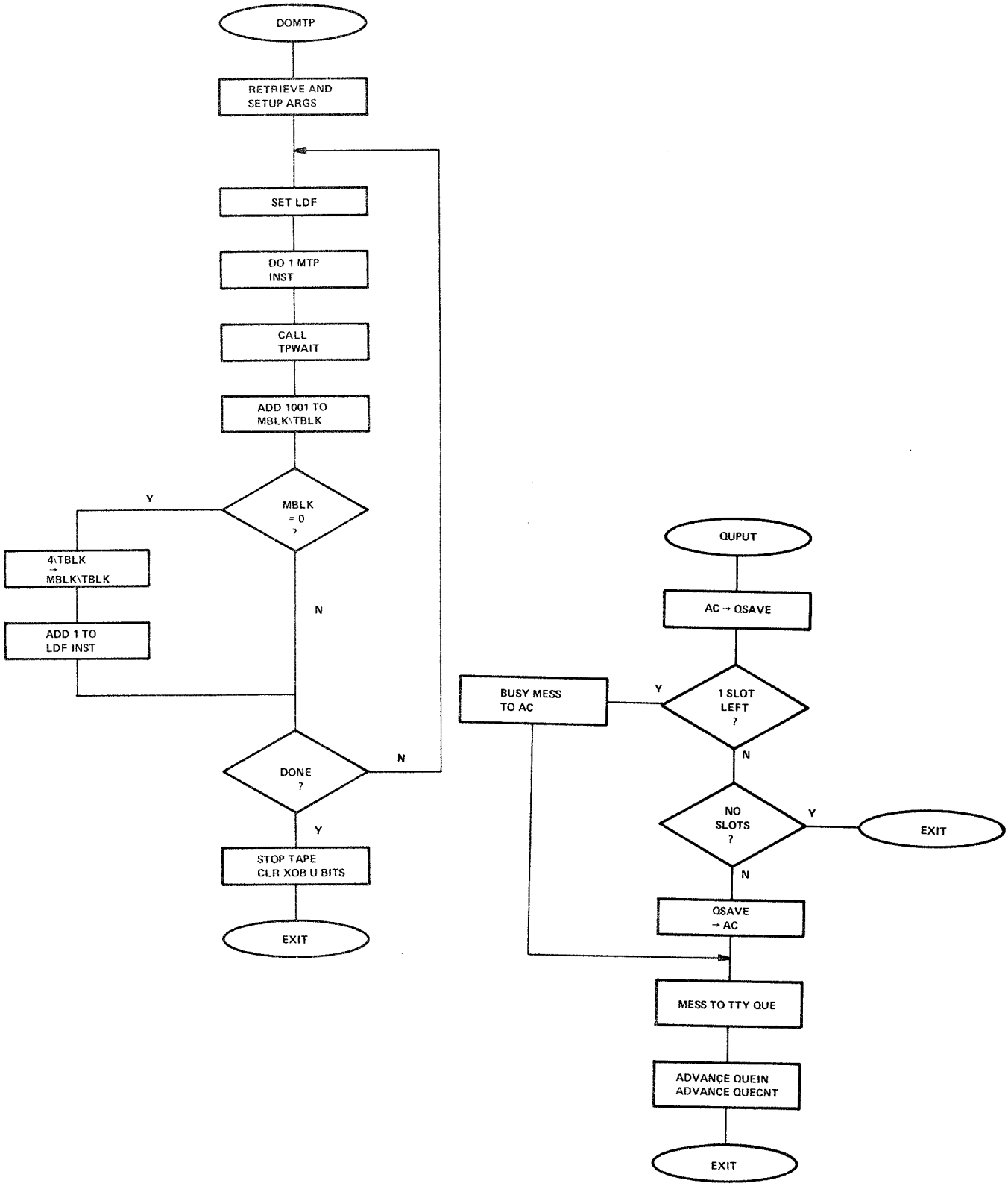

TISA
CLOCK BITS (CLSA) → STATUS
K = 0
TIRTN
Y
K = 4 ?
N
CHECK DEVICE K ?
N
K = K + 1
Y
DEVICE TYPE → DVTYP
CALL INPUT ROUT
HALT RTN ?
N
Y
0
SELDVK
HSWITK

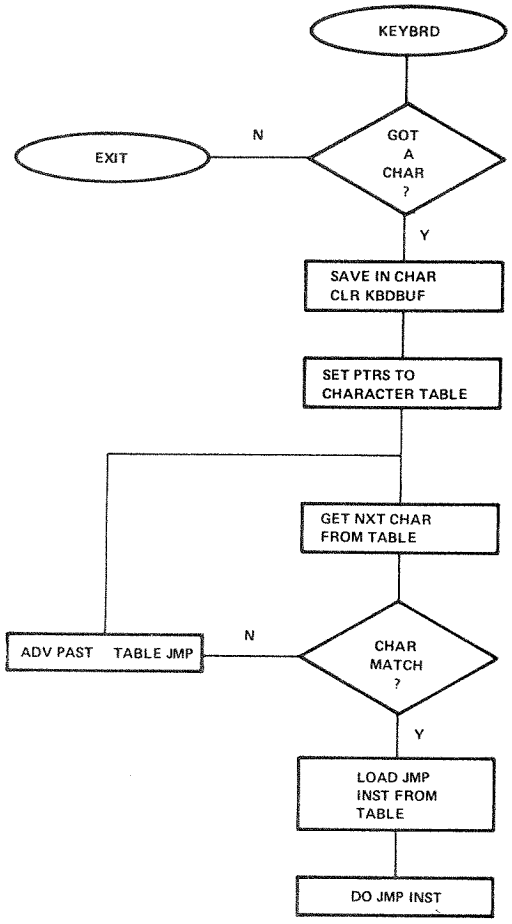

INPUT
GET PARAM LIST FOR DEVICE K
ANALOG
Y
ANALOG DEVICE ?
ANARTN
N
NORMAL RTN
N
SAM Y AXIS ?
Y
RESET SAM FREQ
SETUP CDF AND ADDR
SAM Y AXIS AND STORE
HALT RTN
Y
GOT ALL POINTS ?
N
INCREMENT CURRENT ADDR
NORMAL RTN

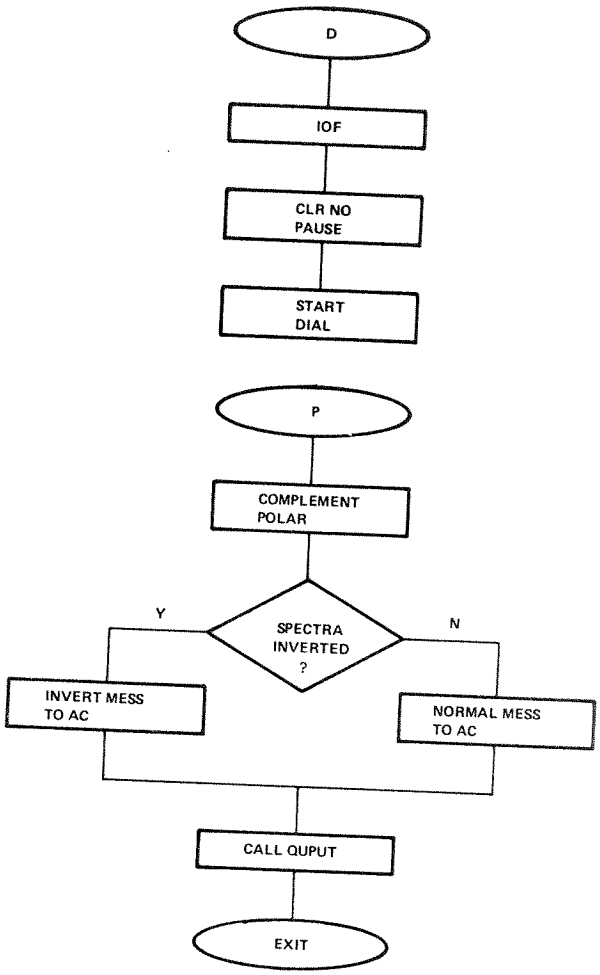

ANALOG
SAM X AXIS (NEWSAM)
X AXIS INCREASE ?
Y
UPDATE OLDSAM
ANARTN
N
MAX X AXIS DROP ?
Y
HALT RTN
N
NORMAL RTN

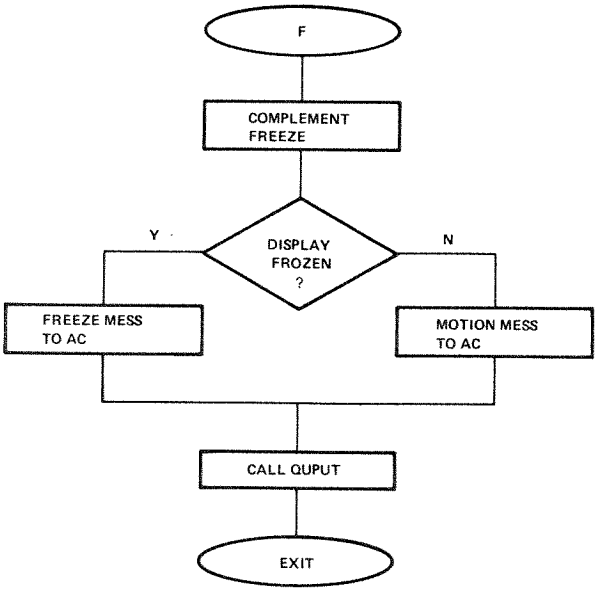

TPWAIT
CALL IDLE
TAPE DONE ?
N
Y
EXIT

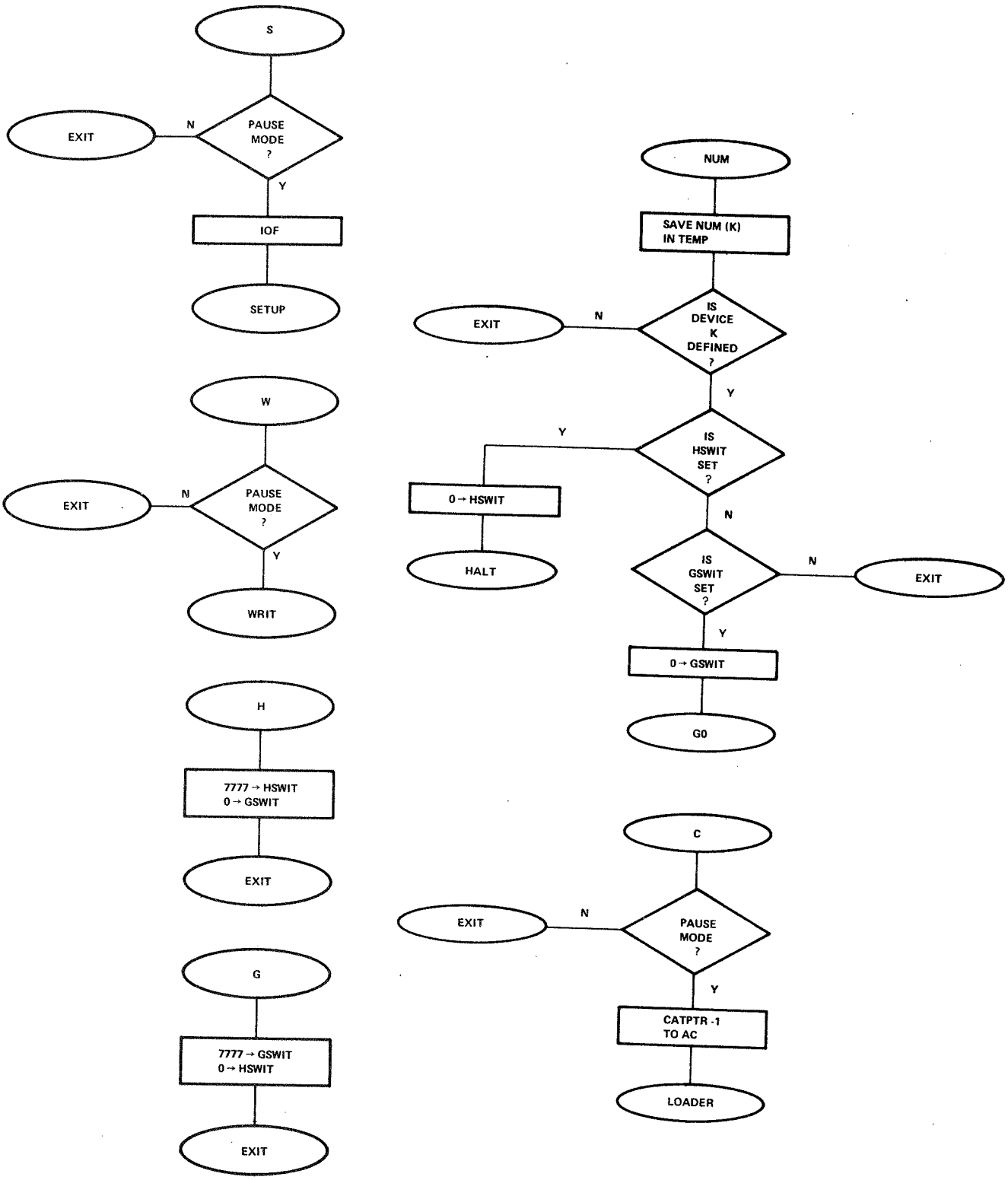

MESCHK
IS QUE EMPTY ?
Y
EXIT
N
MESSAGE IN PROCESS ?
Y
EXIT
N
CHARACTER IN PROCESS ?
Y
EXIT
N
TAKE NEXT MESSAGE OFF TTY QUE
DECREASE QUECNT ADVANCE QUEOUT
TYPE 1 CHAR
SET TTY FLG TO BUSY
EXIT

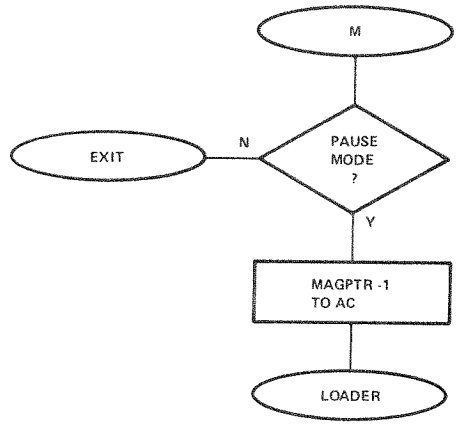

DOMTP
RETRIEVE AND SETUP ARGS
SET LDF
DO 1 MTP INST
CALL TPWAIT
ADD 1001 TO MBLK\TBLK
MBLK = 0 ?
Y
4\TBLK → MBLK\TBLK
ADD 1 TO LDF INST
N
DONE ?
N
Y
STOP TAPE CLR XOB U BITS
EXIT
QUPUT
AC → QSAVE
BUSY MESS TO AC
Y
1 SLOT LEFT ?
N
NO SLOTS ?
Y
EXIT
N
QSAVE → AC
MESS TO TTY QUE
ADVANCE QUEIN ADVANCE QUECNT
EXIT

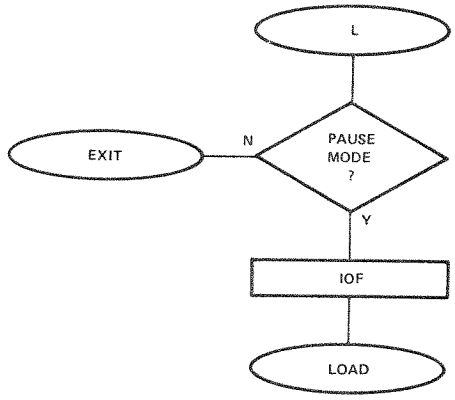

KEYBRD
GOT A CHAR ?
N
EXIT
Y
SAVE IN CHAR
CLR KBDBUF
SET PTRS TO CHARACTER TABLE
GET NXT CHAR FROM TABLE
CHAR MATCH ?
N
ADV PAST TABLE JMP
Y
LOAD JMP INST FROM TABLE
DO JMP INST

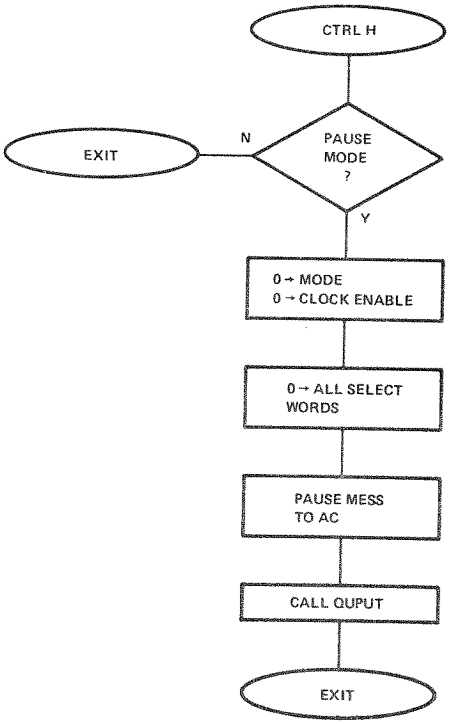

D
IOF
CLR NO PAUSE
START DIAL
P
COMPLEMENT POLAR
SPECTRA INVERTED ?
Y
N
INVERT MESS TO AC
NORMAL MESS TO AC
CALL QUPUT
EXIT

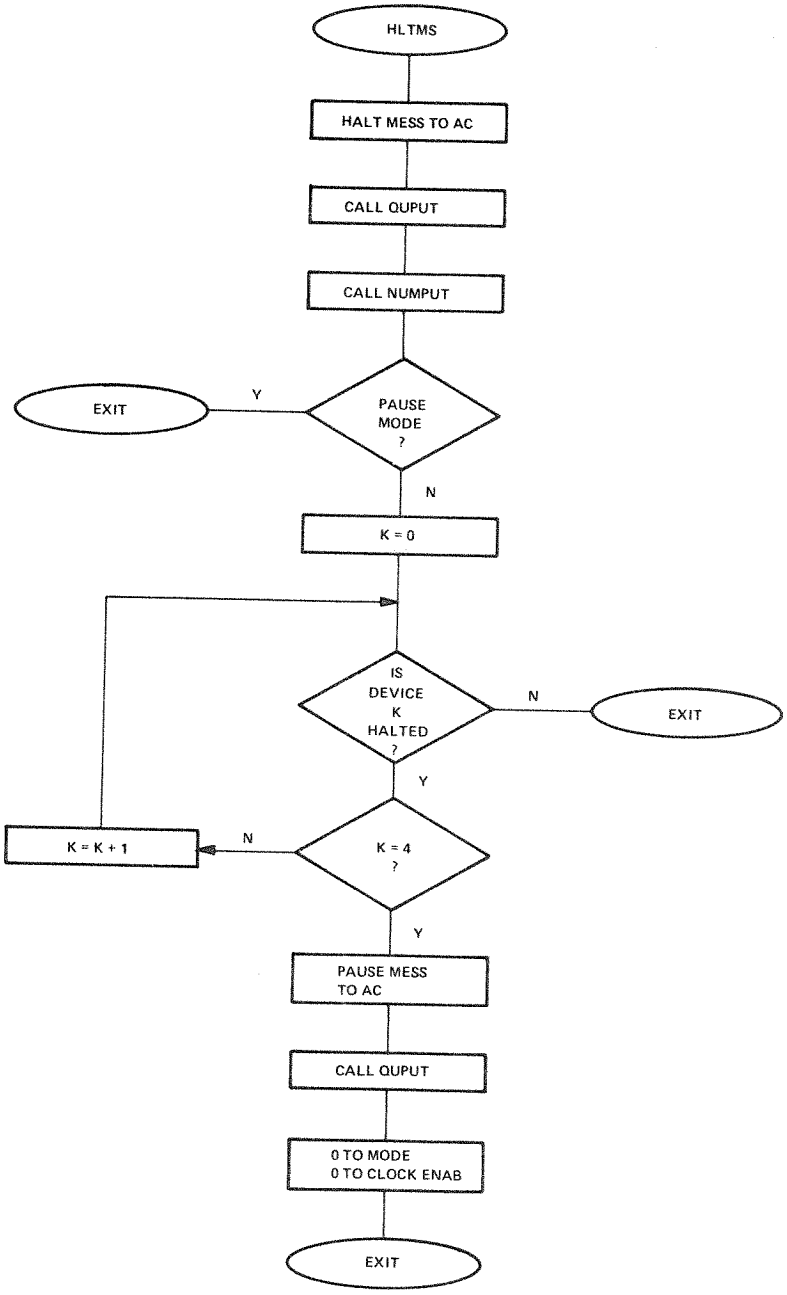

F
COMPLEMENT FREEZE
DISPLAY FROZEN ?
Y
N
FREEZE MESS TO AC
MOTION MESS TO AC
CALL QUPUT
EXIT

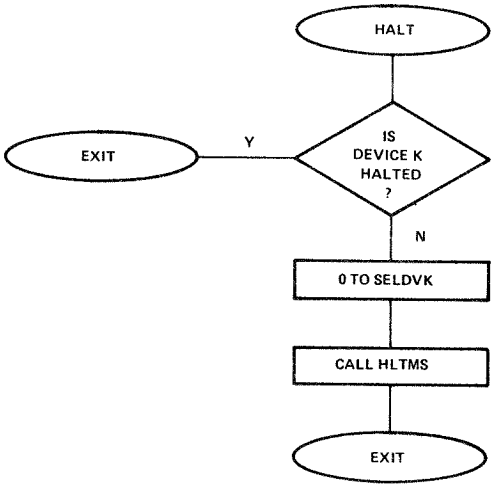

S
EXIT
N
PAUSE MODE ?
Y
IOF
SETUP
W
EXIT
N
PAUSE MODE ?
Y
WRIT
H
7777 → HSWIT
0 → GSWIT
EXIT
G
7777 → GSWIT
0 → HSWIT
EXIT
NUM
SAVE NUM (K) IN TEMP
EXIT
N
IS DEVICE K DEFINED ?
Y
Y
IS HSWIT SET ?
0 → HSWIT
HALT
N
IS GSWIT SET ?
N
EXIT
Y
0 → GSWIT
GO
C
EXIT
N
PAUSE MODE ?
Y
CATPTR -1 TO AC
LOADER

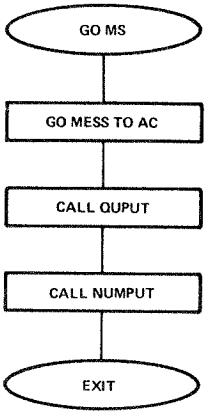

M
EXIT
N
PAUSE MODE ?
Y
MAGPTR -1 TO AC
LOADER

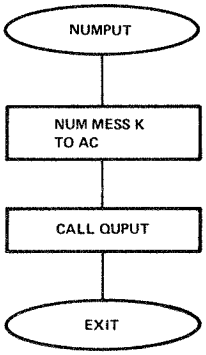

L
EXIT
N
PAUSE MODE ?
Y
IOF
LOAD

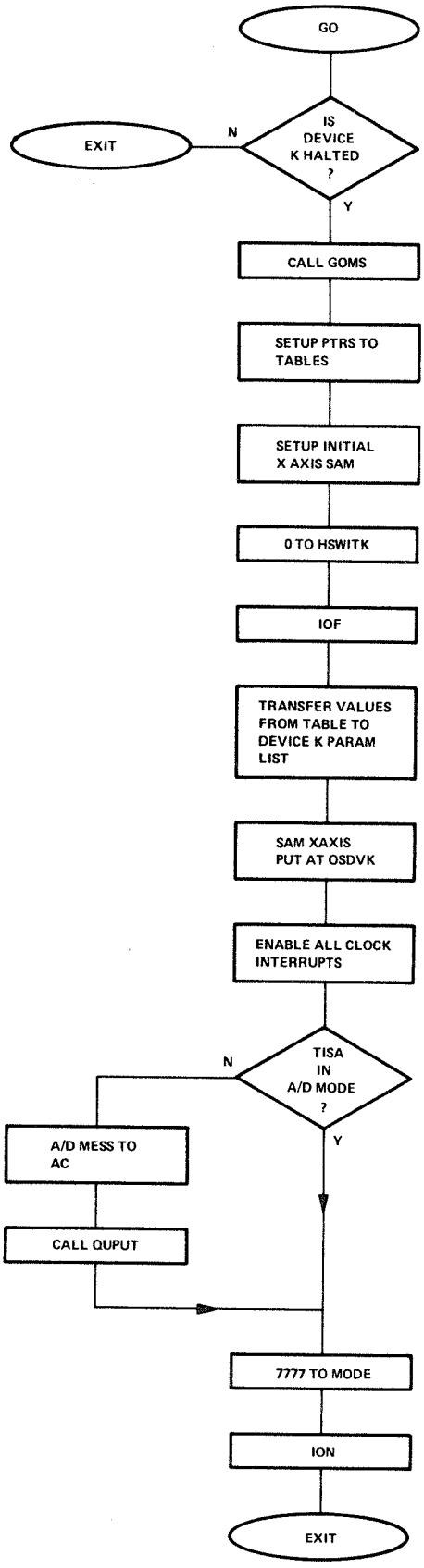

CTRL H
EXIT
N
PAUSE MODE ?
Y
0 → MODE
0 → CLOCK ENABLE
0 → ALL SELECT WORDS
PAUSE MESS TO AC
CALL QUPUT
EXIT

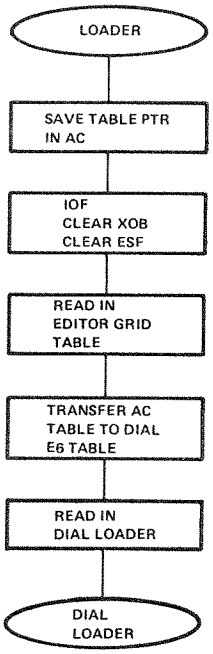

HLTMS
HALT MESS TO AC
CALL QUPUT
CALL NUMPUT
EXIT
Y
PAUSE MODE ?
N
K = 0
IS DEVICE K HALTED ?
N
EXIT
Y
K = K + 1
N
K = 4 ?
Y
PAUSE MESS TO AC
CALL QUPUT
0 TO MODE
0 TO CLOCK ENAB
EXIT

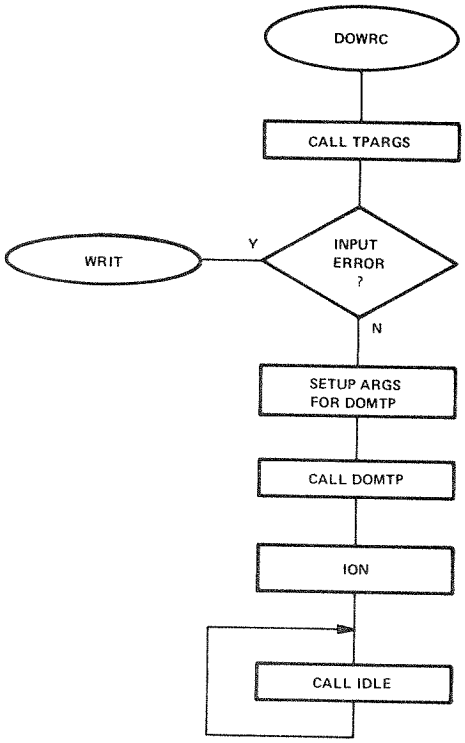

HALT
IS DEVICE K HALTED ?
Y
EXIT
N
0 TO SELDVK
CALL HLTMS
EXIT

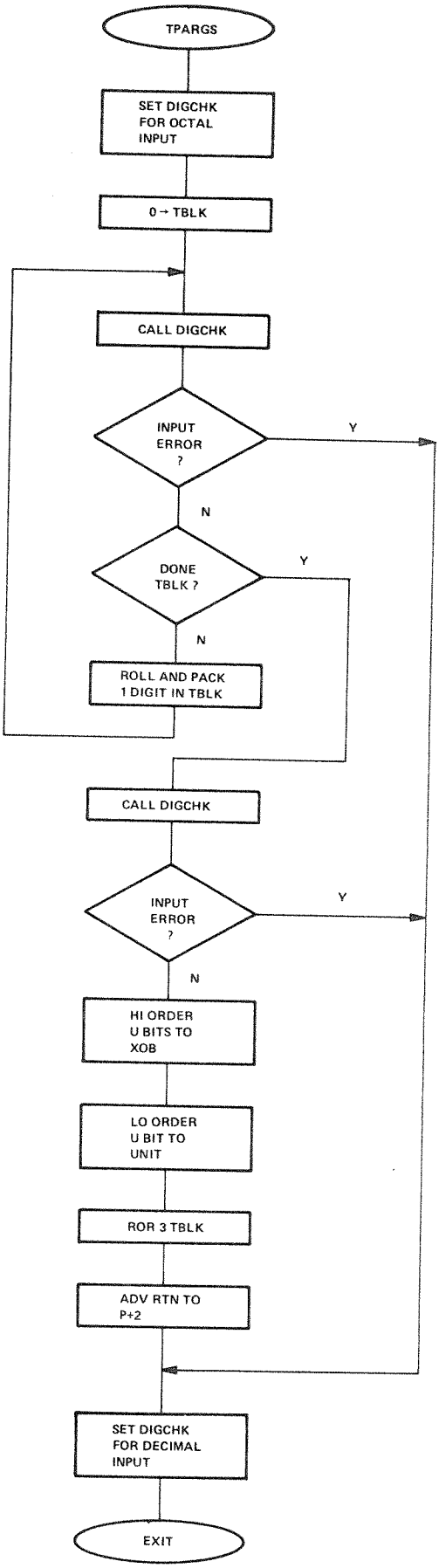

GO MS
GO MESS TO AC
CALL QUPUT
CALL NUMPUT
EXIT

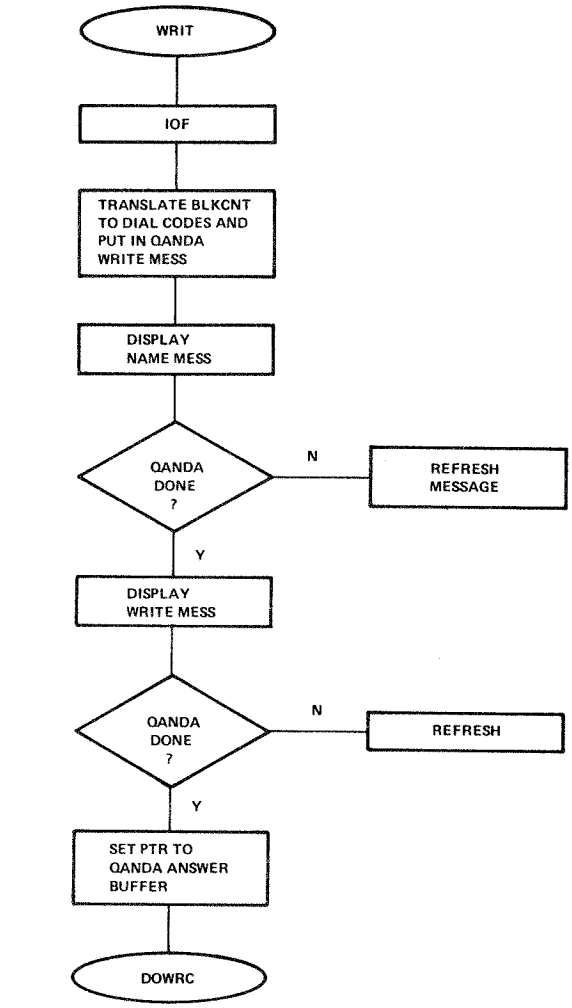

NUMPUT
NUM MESS K TO AC
CALL QUPUT
EXIT

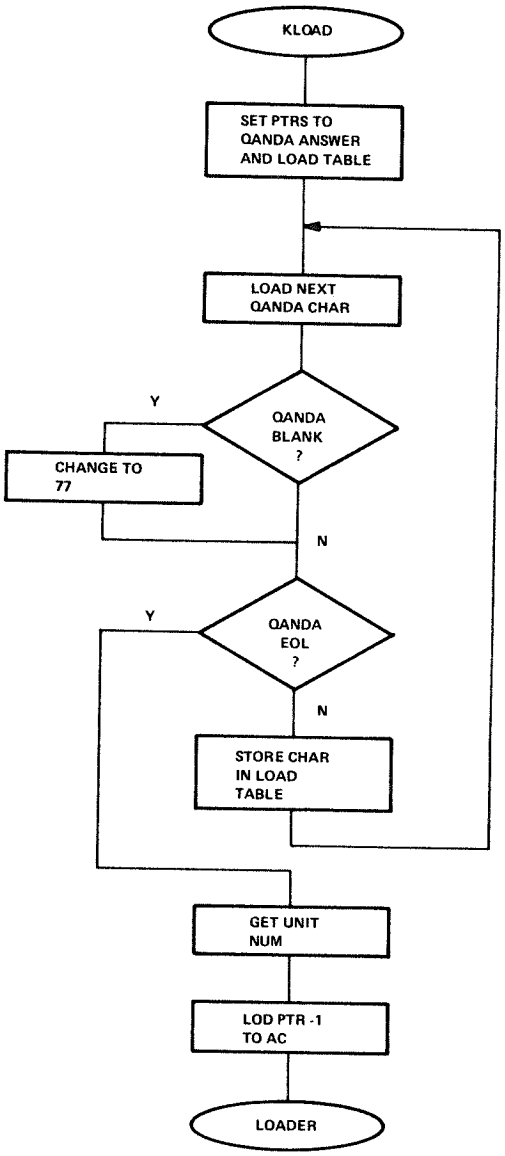

GO
IS DEVICE K HALTED ?
N
EXIT
Y
CALL GOMS
SETUP PTRS TO TABLES
SETUP INITIAL X AXIS SAM
0 TO HSWITK
IOF
TRANSFER VALUES FROM TABLE TO DEVICE K PARAM LIST
SAM XAXIS PUT AT OSDVK
ENABLE ALL CLOCK INTERRUPTS
TISA IN A/D MODE ?
N
Y
A/D MESS TO AC
CALL QUPUT
7777 TO MODE
ION
EXIT

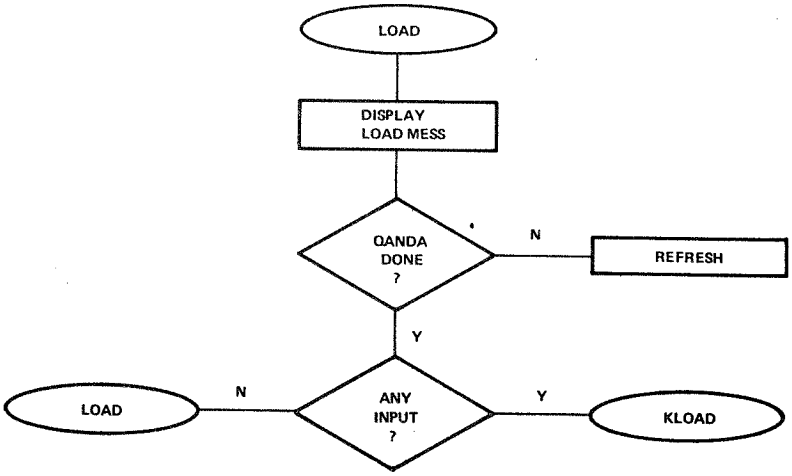

LOADER
SAVE TABLE PTR IN AC
IOF
CLEAR XOB
CLEAR ESF
READ IN EDITOR GRID TABLE
TRANSFER AC TABLE TO DIAL E6 TABLE
READ IN DIAL LOADER
DIAL LOADER

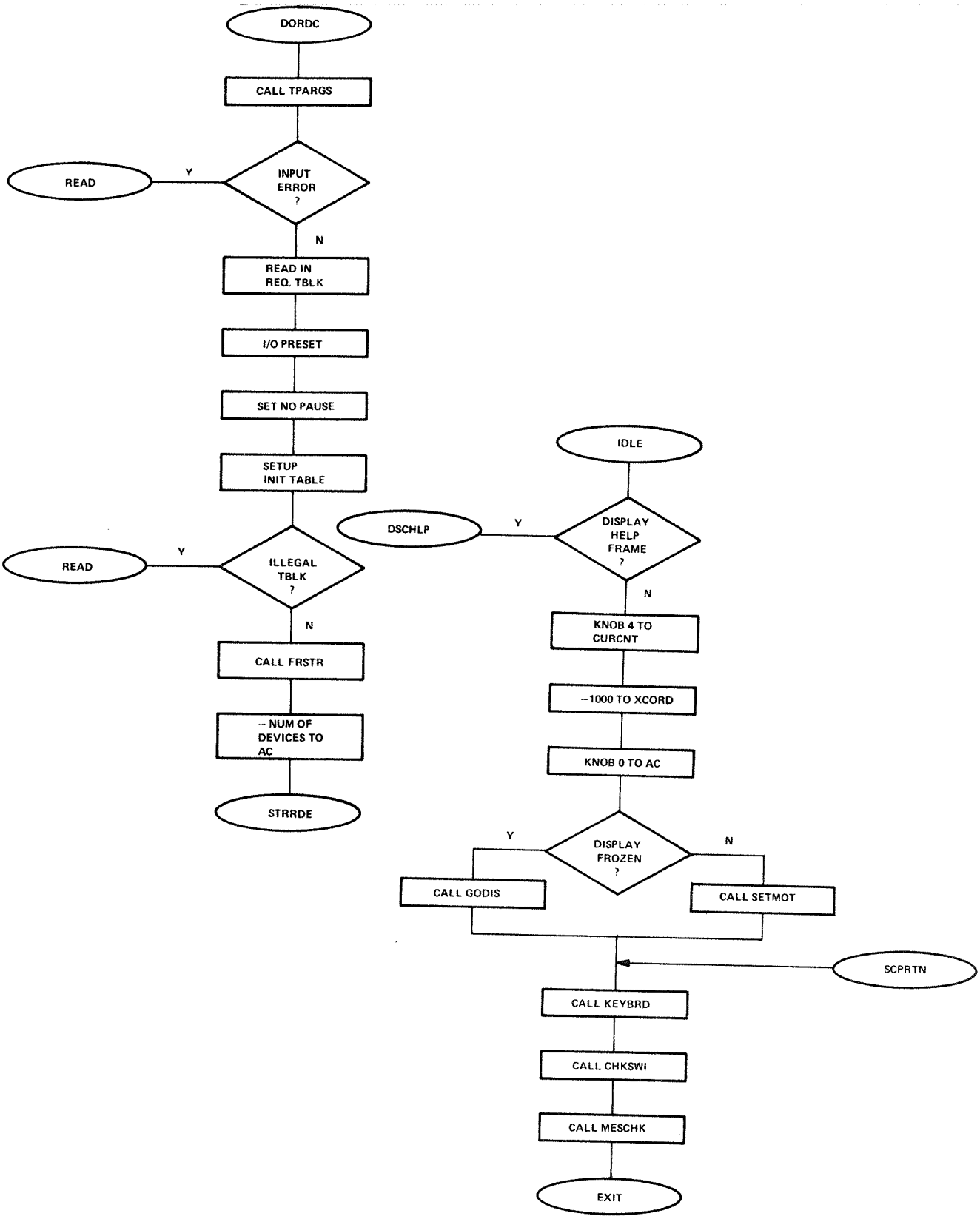

DOWRC
CALL TPARGS
WRIT
Y
INPUT ERROR ?
N
SETUP ARGS FOR DOMTP
CALL DOMTP
ION
CALL IDLE

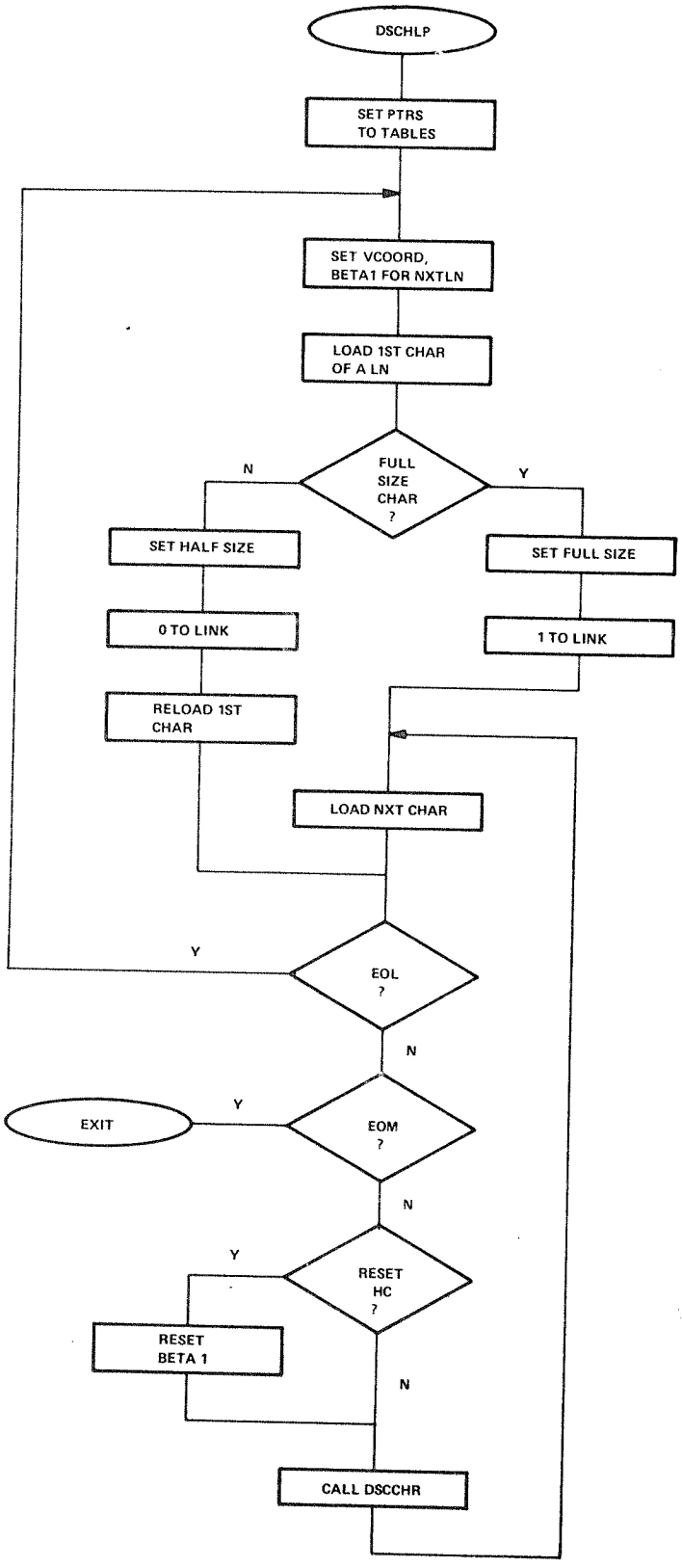

TPARGS
SET DIGCHK FOR OCTAL INPUT
0 → TBLK
CALL DIGCHK
INPUT ERROR ?
Y
N
DONE TBLK ?
Y
N
ROLL AND PACK 1 DIGIT IN TBLK
CALL DIGCHK
INPUT ERROR ?
Y
N
HI ORDER U BITS TO XOB
LO ORDER U BIT TO UNIT
ROR 3 TBLK
ADV RTN TO P+2
SET DIGCHK FOR DECIMAL INPUT
EXIT

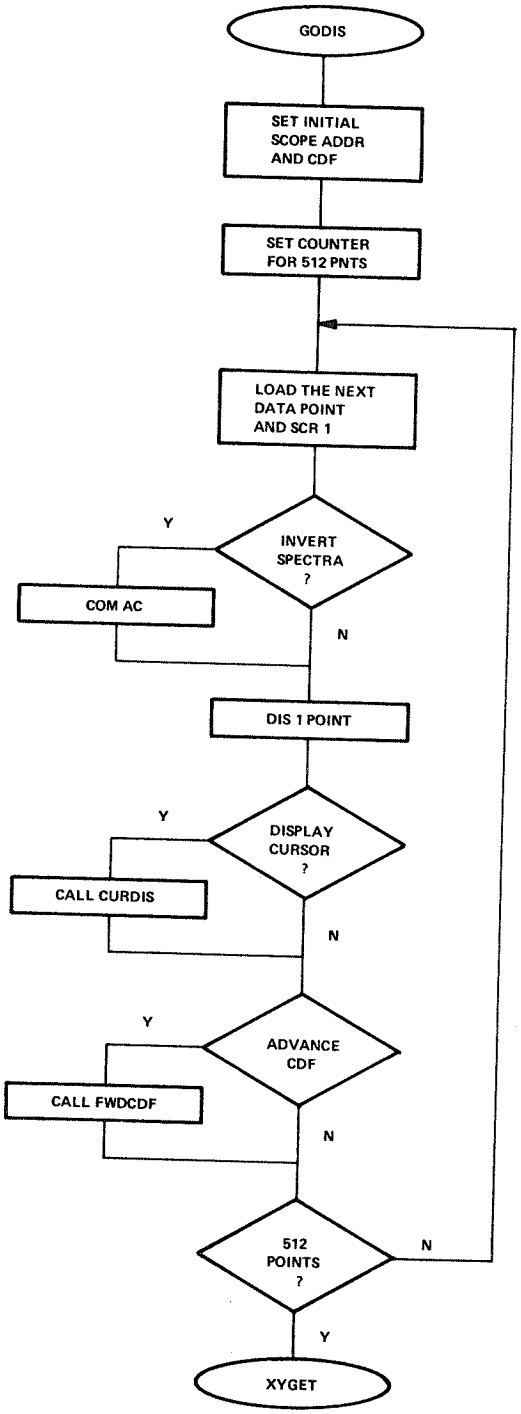

WRIT
IOF
TRANSLATE BLKCNT TO DIAL CODES AND PUT IN QANDA WRITE MESS
DISPLAY NAME MESS
QANDA DONE ?
N
REFRESH MESSAGE
Y
DISPLAY WRITE MESS
QANDA DONE ?
N
REFRESH
Y
SET PTR TO QANDA ANSWER BUFFER
DOWRC

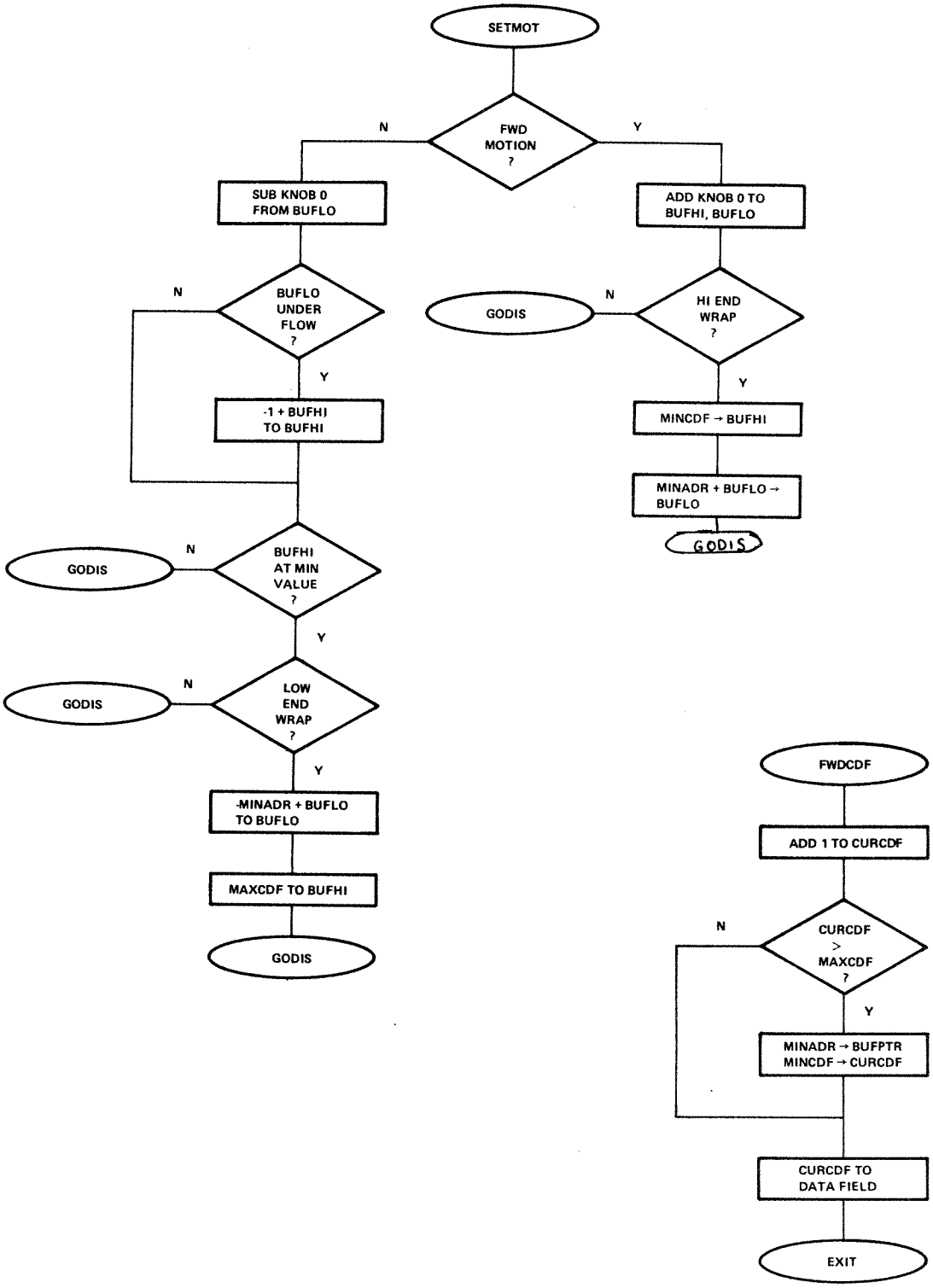

KLOAD
SET PTRS TO QANDA ANSWER AND LOAD TABLE
LOAD NEXT QANDA CHAR
Y
QANDA BLANK ?
CHANGE TO 77
N
Y
QANDA EOL ?
N
STORE CHAR IN LOAD TABLE
GET UNIT NUM
LOD PTR -1 TO AC
LOADER

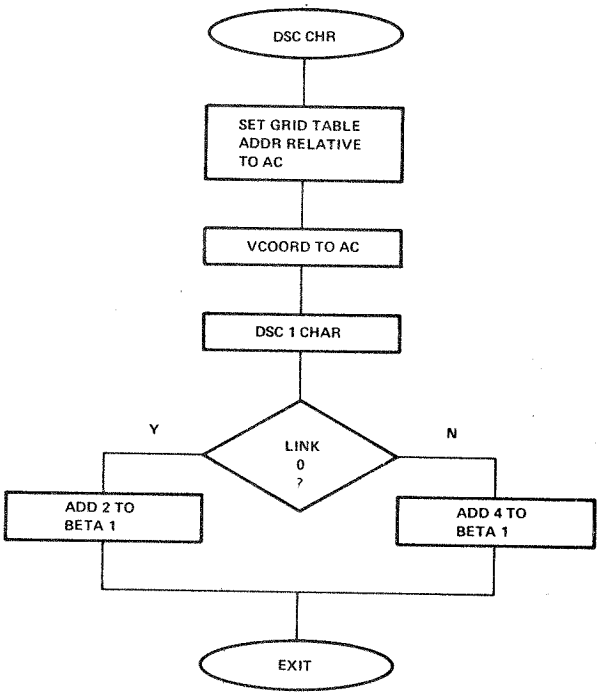

LOAD
DISPLAY LOAD MESS
QANDA DONE ?
N
REFRESH
Y
LOAD
N
ANY INPUT ?
Y
KLOAD

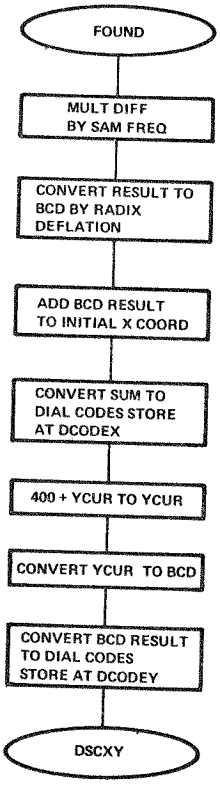

DORDC
CALL TPARGS
READ
Y
INPUT ERROR ?
N
READ IN REQ. TBLK
I/O PRESET
SET NO PAUSE
SETUP INIT TABLE
READ
Y
ILLEGAL TBLK ?
N
CALL FRSTR
– NUM OF DEVICES TO AC
STRRDE
IDLE
DSCHLP
Y
DISPLAY HELP FRAME ?
N
KNOB 4 TO CURCNT
–1000 TO XCORD
KNOB 0 TO AC
Y
DISPLAY FROZEN ?
N
CALL GODIS
CALL SETMOT
SCPRTN
CALL KEYBRD
CALL CHKSWI
CALL MESCHK
EXIT

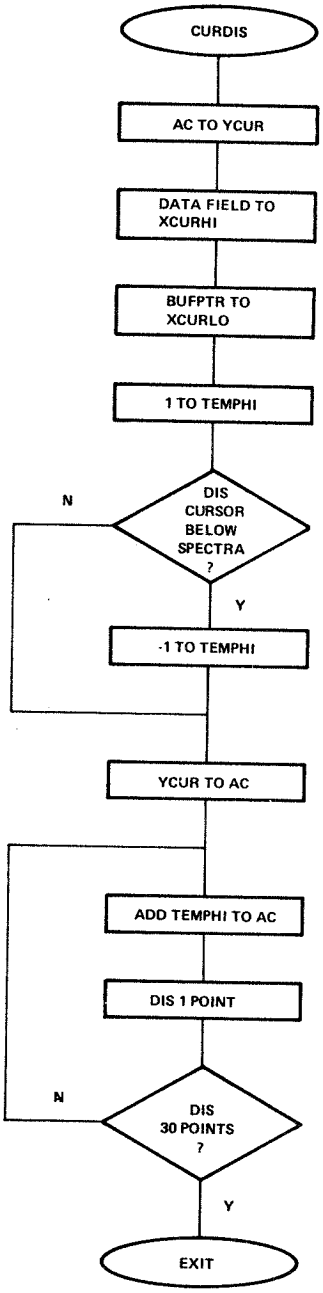

DSCHLP
SET PTRS TO TABLES
SET VCOORD, BETA1 FOR NXTLN
LOAD 1ST CHAR OF A LN
FULL SIZE CHAR ?
N
Y
SET HALF SIZE
SET FULL SIZE
0 TO LINK
1 TO LINK
RELOAD 1ST CHAR
LOAD NXT CHAR
EOL ?
Y
N
EXIT
EOM ?
Y
N
RESET HC ?
Y
N
RESET BETA 1
CALL DSCCHR

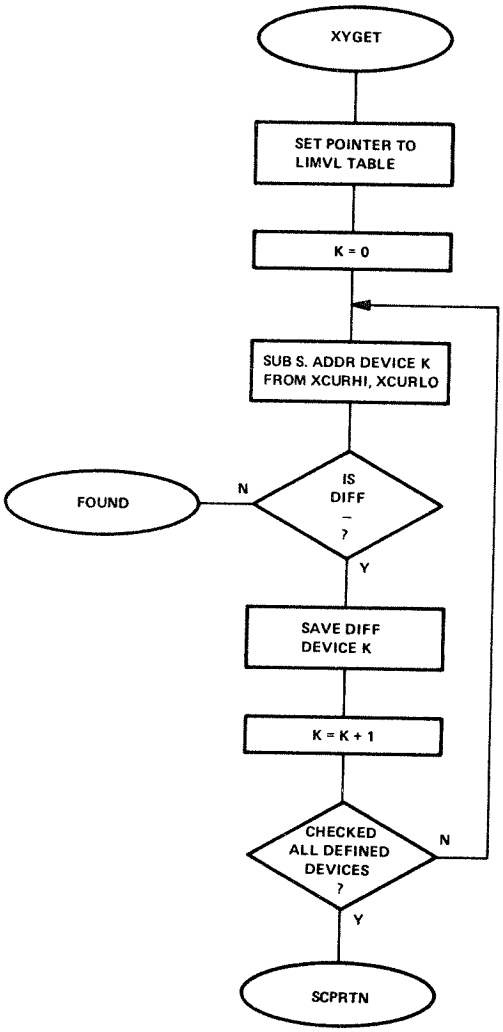

GODIS
SET INITIAL SCOPE ADDR AND CDF
SET COUNTER FOR 512 PNTS
LOAD THE NEXT DATA POINT AND SCR 1
INVERT SPECTRA ?
Y
COM AC
N
DIS 1 POINT
DISPLAY CURSOR ?
Y
CALL CURDIS
N
ADVANCE CDF
Y
CALL FWDCDF
N
512 POINTS ?
N
Y
XYGET

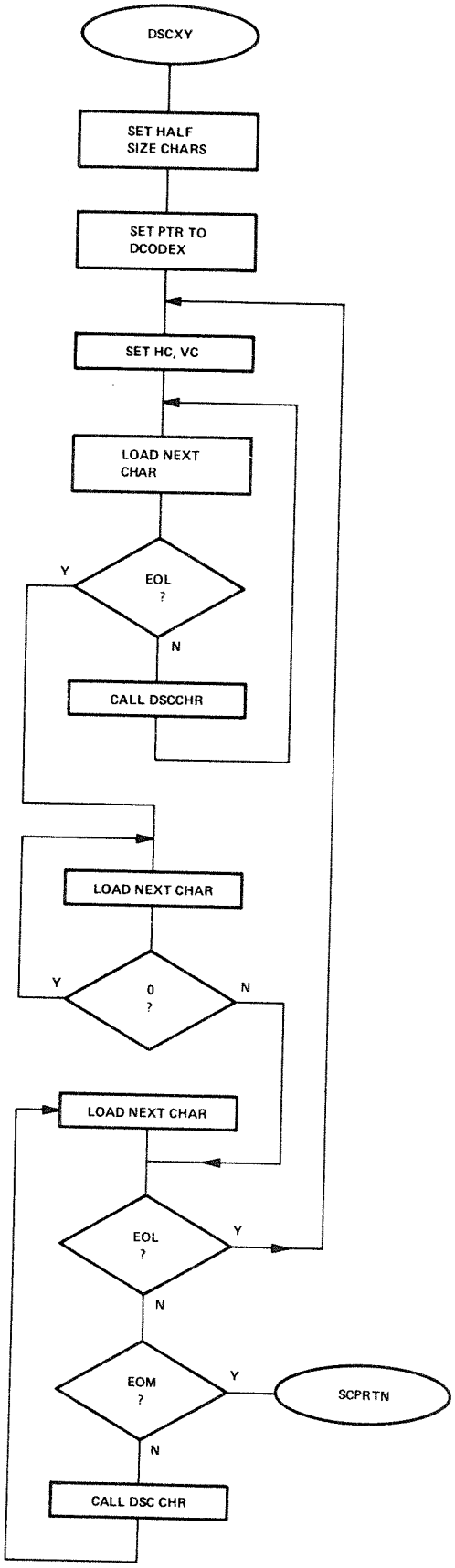

SETMOT
FWD MOTION ?
N
Y
SUB KNOB 0 FROM BUFLO
ADD KNOB 0 TO BUFHI, BUFLO
BUFLO UNDER FLOW ?
N
Y
-1 + BUFHI TO BUFHI
GODIS
HI END WRAP ?
N
Y
MINCDF → BUFHI
MINADR + BUFLO → BUFLO
GODIS
BUFHI AT MIN VALUE ?
N
Y
GODIS
LOW END WRAP ?
N
Y
GODIS
-MINADR + BUFLO TO BUFLO
MAXCDF TO BUFHI
GODIS
FWDCDF
ADD 1 TO CURCDF
CURCDF > MAXCDF ?
N
Y
MINADR → BUFPTR
MINCDF → CURCDF
CURCDF TO DATA FIELD
EXIT

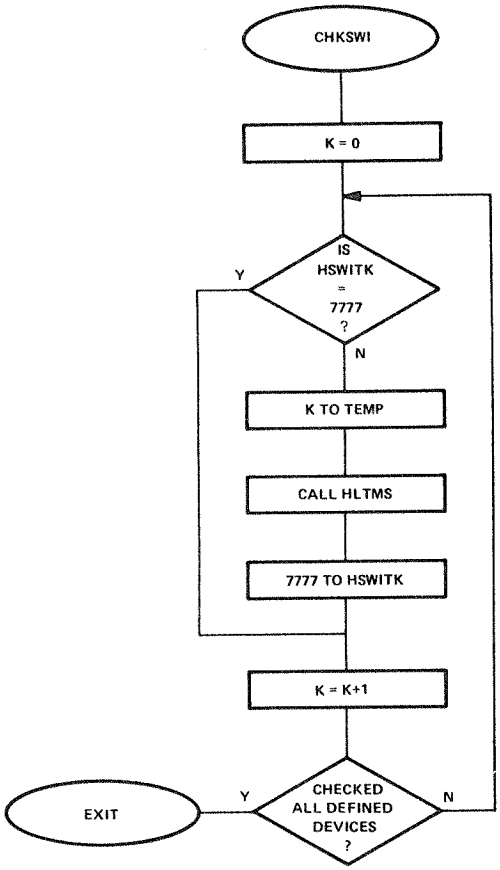

DSC CHR
SET GRID TABLE ADDR RELATIVE TO AC
VCOORD TO AC
DSC 1 CHAR
LINK 0 ?
Y
N
ADD 2 TO BETA 1
ADD 4 TO BETA 1
EXIT

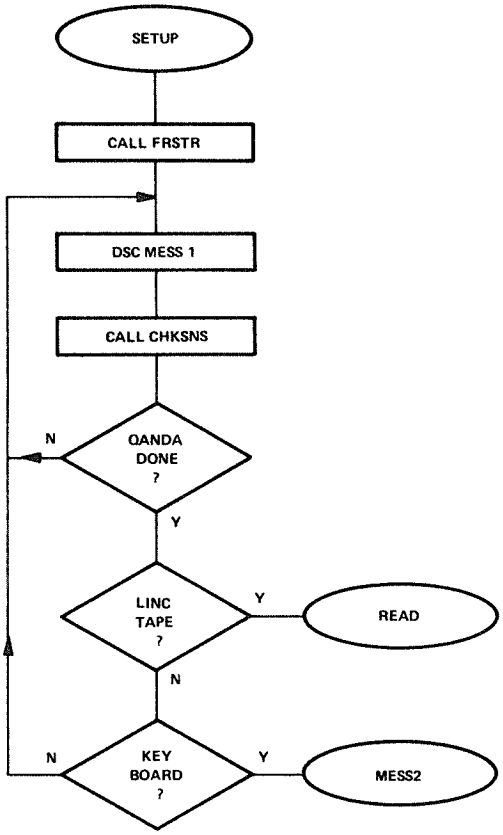

FOUND
MULT DIFF BY SAM FREQ
CONVERT RESULT TO BCD BY RADIX DEFLATION
ADD BCD RESULT TO INITIAL X COORD
CONVERT SUM TO DIAL CODES STORE AT DCODEX
400 + YCUR TO YCUR
CONVERT YCUR TO BCD
CONVERT BCD RESULT TO DIAL CODES STORE AT DCODEY
DSCXY

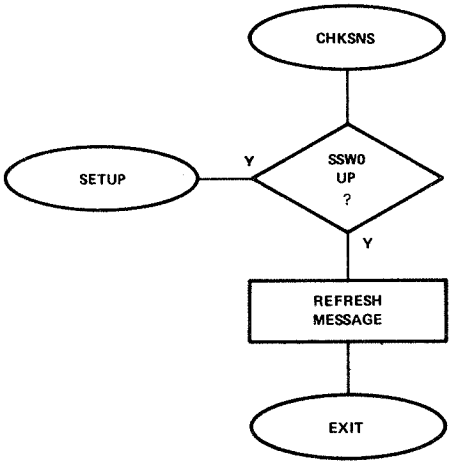

CURDIS
AC TO YCUR
DATA FIELD TO XCURHI
BUFPTR TO XCURLO
1 TO TEMPHI
DIS CURSOR BELOW SPECTRA ?
N
Y
-1 TO TEMPHI
YCUR TO AC
ADD TEMPHI TO AC
DIS 1 POINT
DIS 30 POINTS ?
N
Y
EXIT

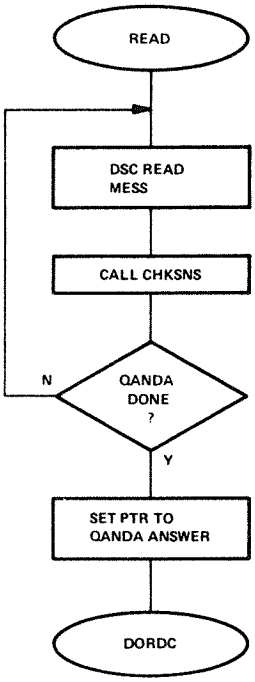

XYGET
SET POINTER TO LIMVL TABLE
K = 0
SUB S. ADDR DEVICE K FROM XCURHI, XCURLO
IS DIFF = ?
N
FOUND
Y
SAVE DIFF DEVICE K
K = K + 1
CHECKED ALL DEFINED DEVICES ?
N
Y
SCPRTN

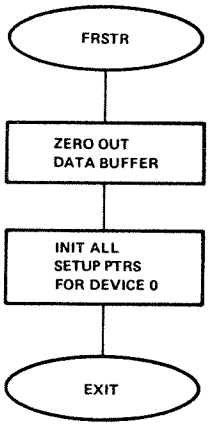

DSCXY
SET HALF SIZE CHARS
SET PTR TO DCODEX
SET HC, VC
LOAD NEXT CHAR
EOL ?
Y
N
CALL DSCCHR
LOAD NEXT CHAR
0 ?
Y
N
LOAD NEXT CHAR
EOL ?
Y
N
EOM ?
Y
SCPRTN
N
CALL DSC CHR

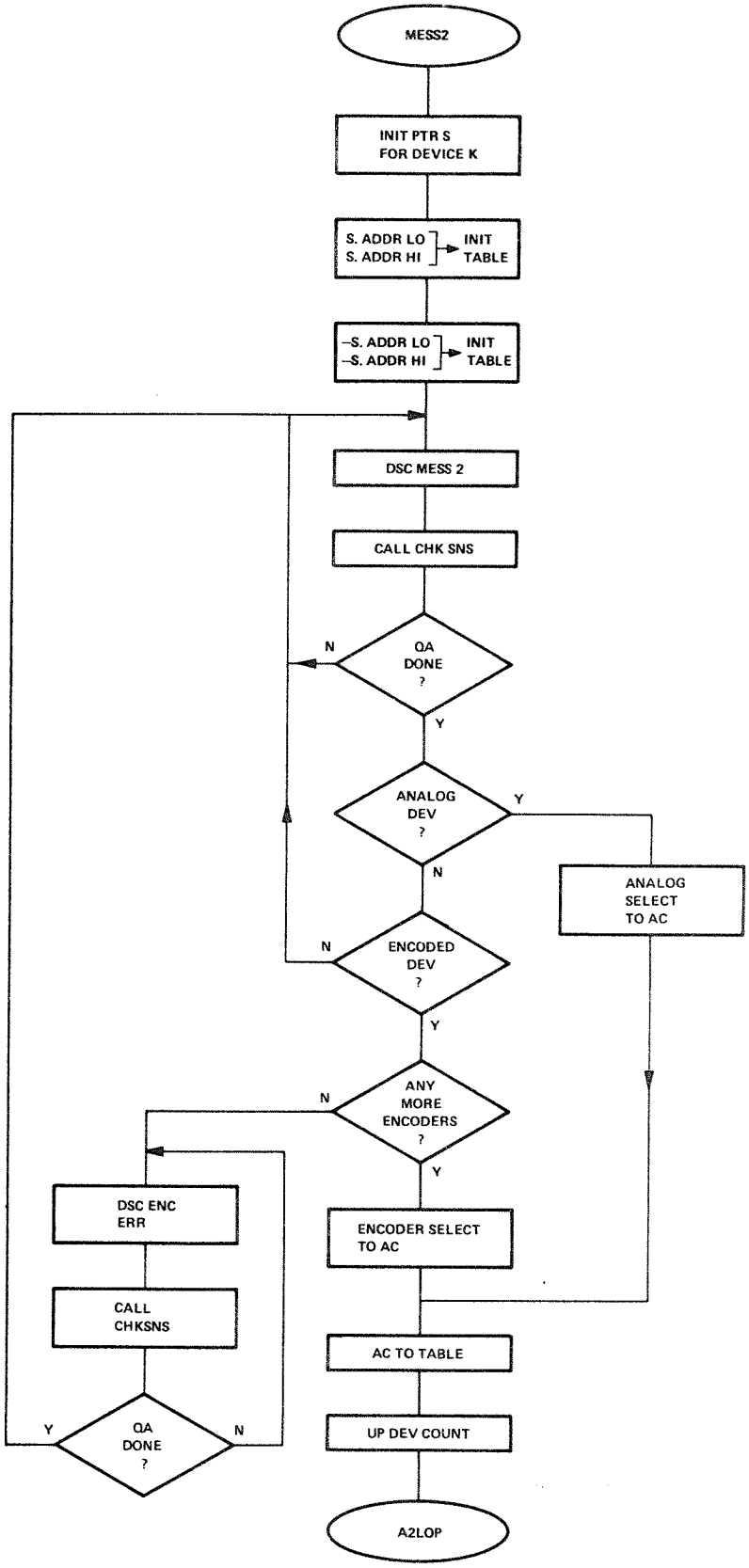

CHKSWI
K = 0
IS HSWITK = 7777 ?
Y
N
K TO TEMP
CALL HLTMS
7777 TO HSWITK
K = K+1
CHECKED ALL DEFINED DEVICES ?
Y
N
EXIT

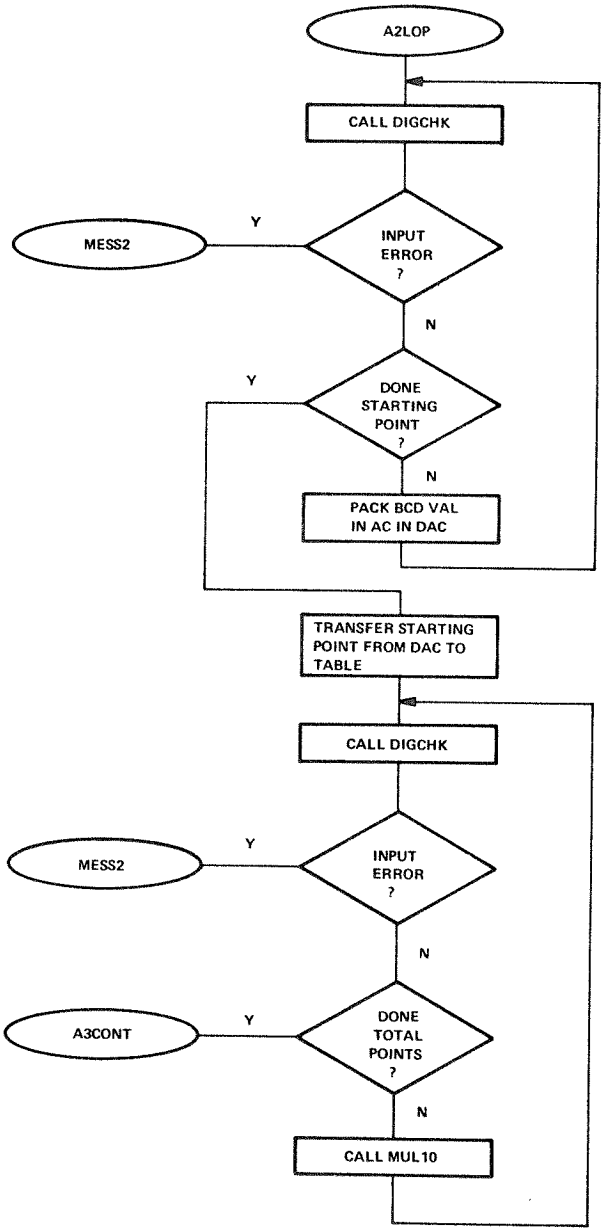

SETUP
CALL FRSTR
DSC MESS 1
CALL CHKSNS
QANDA DONE ?
N
Y
LINC TAPE ?
Y
READ
N
KEY BOARD ?
N
Y
MESS2

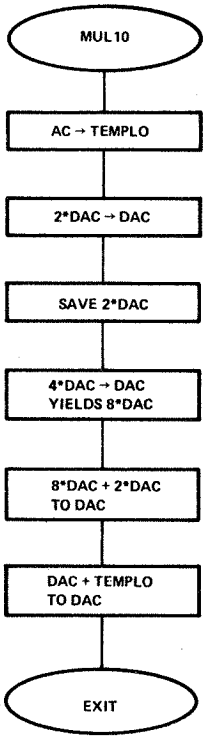

CHKSNS
SSW0 UP ?
Y
SETUP
Y
REFRESH MESSAGE
EXIT

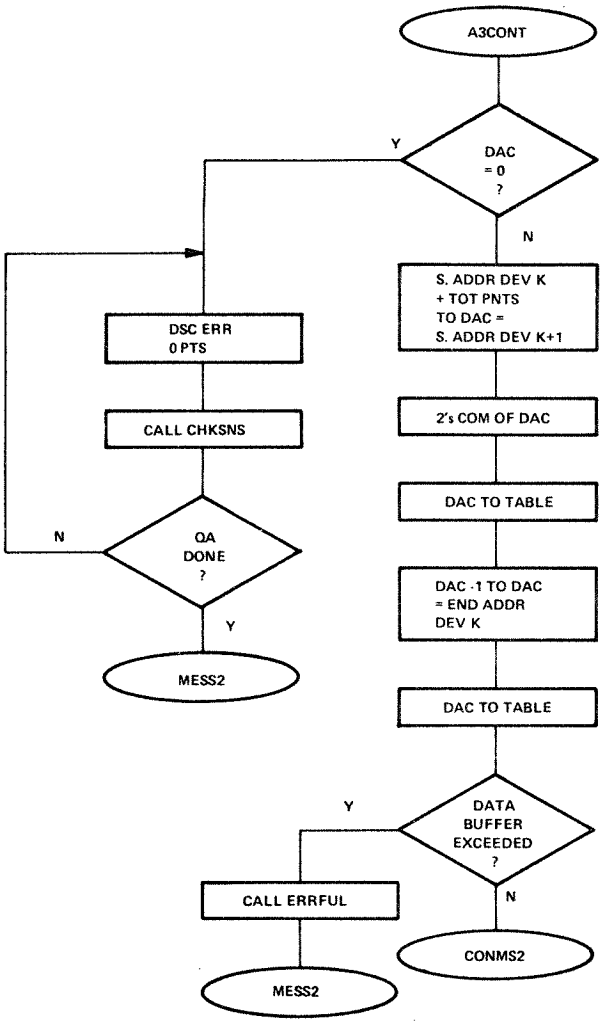

READ
DSC READ MESS
CALL CHKSNS
QANDA DONE ?
N
Y
SET PTR TO QANDA ANSWER
DORDC

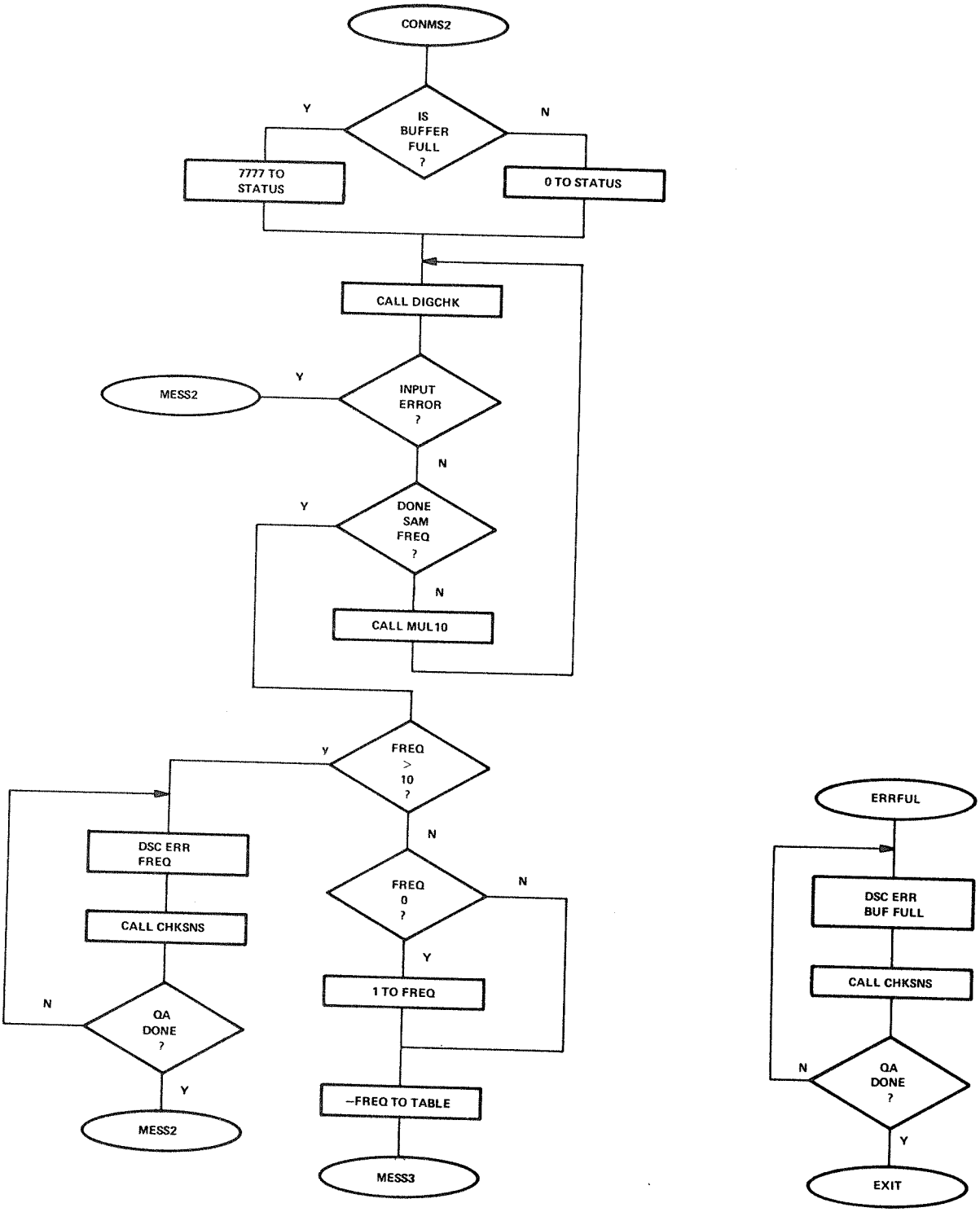

FRSTR
ZERO OUT DATA BUFFER
INIT ALL SETUP PTRS FOR DEVICE 0
EXIT

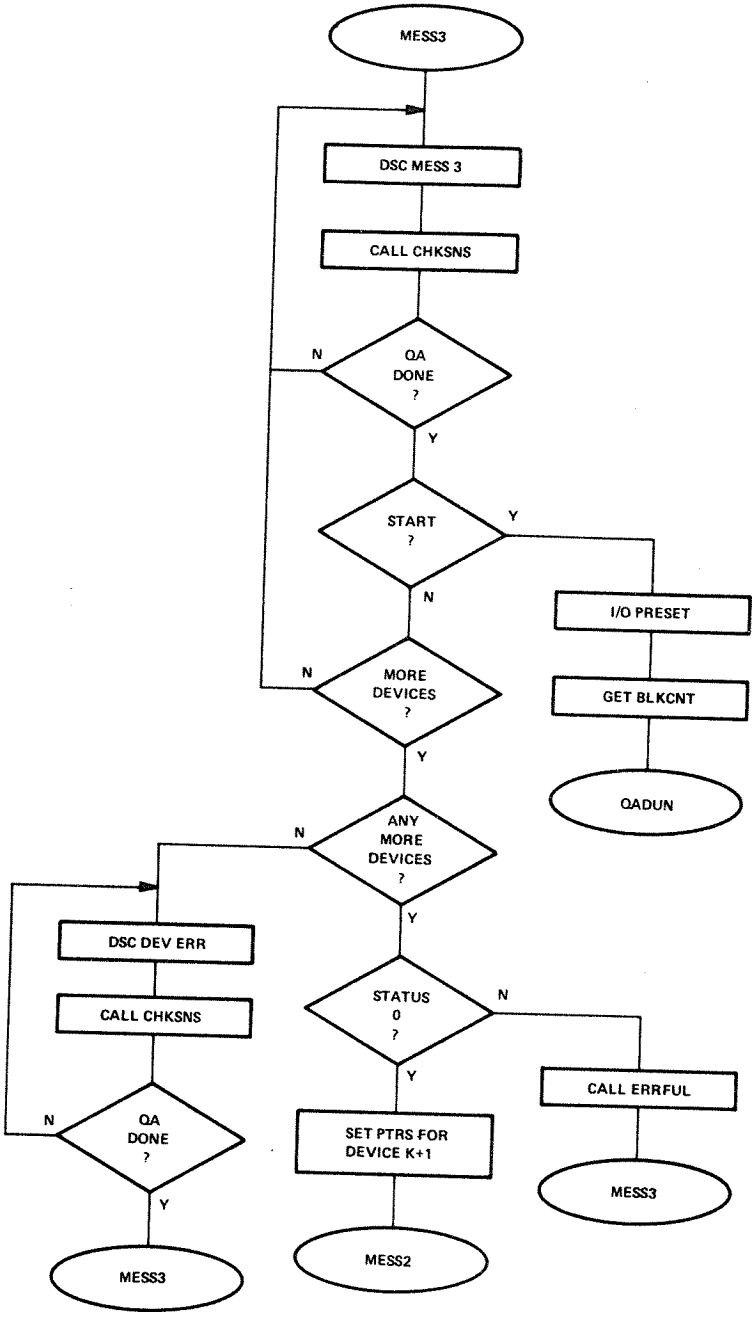

MESS2
INIT PTR S FOR DEVICE K
S. ADDR LO
S. ADDR HI
INIT TABLE
-S. ADDR LO
-S. ADDR HI
INIT TABLE
DSC MESS 2
CALL CHK SNS
QA DONE ?
N
Y
ANALOG DEV ?
Y
N
ANALOG SELECT TO AC
ENCODED DEV ?
N
Y
ANY MORE ENCODERS ?
N
Y
DSC ENC ERR
CALL CHKSNS
QA DONE ?
Y
N
ENCODER SELECT TO AC
AC TO TABLE
UP DEV COUNT
A2LOP

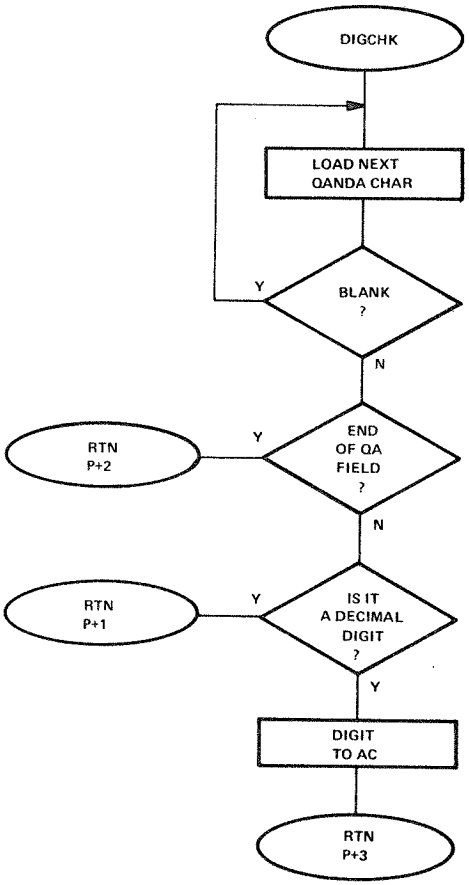

A2LOP
CALL DIGCHK
INPUT ERROR ?
Y
MESS2
N
DONE STARTING POINT ?
Y
N
PACK BCD VAL IN AC IN DAC
TRANSFER STARTING POINT FROM DAC TO TABLE
CALL DIGCHK
INPUT ERROR ?
Y
MESS2
N
DONE TOTAL POINTS ?
Y
A3CONT
N
CALL MUL10

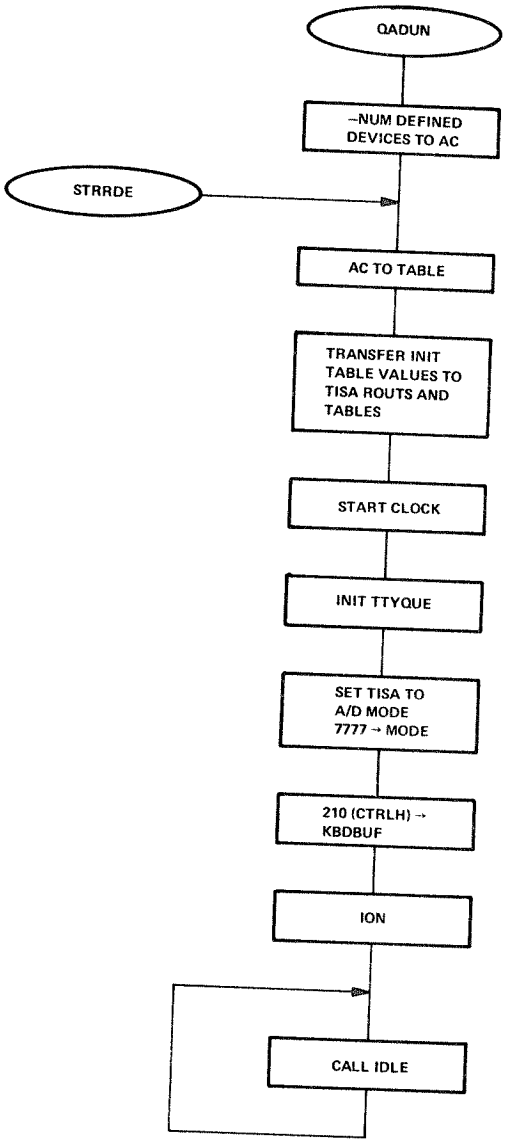

MUL10
AC → TEMPLO
2*DAC → DAC
SAVE 2*DAC
4*DAC → DAC YIELDS 8*DAC
8*DAC + 2*DAC TO DAC
DAC + TEMPLO TO DAC
EXIT


A3CONT
DAC = 0 ?
Y
N
S. ADDR DEV K + TOT PNTS TO DAC = S. ADDR DEV K+1
2's COM OF DAC
DAC TO TABLE
DAC -1 TO DAC = END ADDR DEV K
DAC TO TABLE
DATA BUFFER EXCEEDED ?
Y
N
CALL ERRFUL
MESS2
CONMS2
DSC ERR 0 PTS
CALL CHKSNS
QA DONE ?
N
Y
MESS2


CONMS2
IS BUFFER FULL ?
Y
N
7777 TO STATUS
0 TO STATUS
CALL DIGCHK
INPUT ERROR ?
Y
MESS2
N
DONE SAM FREQ ?
Y
N
CALL MUL10
FREQ > 10 ?
Y
N
DSC ERR FREQ
CALL CHKSNS
QA DONE ?
N
Y
MESS2
FREQ 0 ?
N
Y
1 TO FREQ
-FREQ TO TABLE
MESS3
ERRFUL
DSC ERR BUF FULL
CALL CHKSNS
QA DONE ?
N
Y
EXIT


MESS3
DSC MESS 3
CALL CHKSNS
QA DONE ?
N
Y
START ?
Y
N
I/O PRESET
GET BLKCNT
QADUN
MORE DEVICES ?
N
Y
ANY MORE DEVICES ?
N
Y
DSC DEV ERR
CALL CHKSNS
QA DONE ?
N
Y
MESS3
STATUS 0 ?
N
Y
CALL ERRFUL
MESS3
SET PTRS FOR DEVICE K+1
MESS2


DIGCHK
LOAD NEXT
QANDA CHAR
BLANK
?
Y
N
RTN
P+2
Y
END
OF QA
FIELD
?
N
RTN
P+1
Y
IS IT
A DECIMAL
DIGIT
?
Y
DIGIT
TO AC
RTN
P+3


QADUN
–NUM DEFINED
DEVICES TO AC
STRRDE
AC TO TABLE
TRANSFER INIT
TABLE VALUES TO
TISA ROUTS AND
TABLES
START CLOCK
INIT TTYQUE
SET TISA TO
A/D MODE
7777 → MODE
210 (CTRLH) →
KBDBUF
ION
CALL IDLE

```
0000                    *20
0001                    /TISA (TIME INDEPENDENT
0002                    /SPECTRUM ACQUISITION)
0003                    /MULTIPLE DEVICES INTERRUPT DRIVEN
0004                    /MOVING WINDOW DISPLAY
0005                    /CURSOR AND X-Y DECIMAL READ OUT
0006                    /USES QANDA FOR SET UP MODE
0007                    /SUPPØRTS UP TO 32K OF CORE
0010                            PMODE           /INTERRUPT
0011                            *1              /DISPATCH
0012        0001  5402          JMP I ,+1       /P MODE
0013        0002  0230          INTP
0014        0003  0000  BETA1,  Ø               /BETAS FOR LOAD
0015        0004  0000  BETA2,  Ø               /ROUTS
0016        0005  0000  BETA3,  Ø
0017                            *10
0020        0010  0000  INIPTR, Ø               /PTRS FOR TABLE
0021        0011  0000  ADPTR,  Ø               /SETUP
0022                                            /OF INITIAL VAL
0023                            *20
0024        0020  0000  ADMESS, Ø               /MESSAGE PTR
0025                                            /FOR TYPE OUT
0026                                            /ROUTINES
0027        0021  0000  KBDBUF, Ø               /HOLDS LAST
0030                                            /KEYBOARD CHAR
0031        0022  0000  TTYFLG, Ø               /HOLDS LAST
0032                                            /TTY CHAR
0033                                            /=Ø IF NONE
0034        0023  0000  QUEIN,  Ø               /PTR TO TTY QUE
0035                                            /FOR IN COMING
0036                                            /MESSAGES
0037        0024  0000  QUEOUT, Ø               /PTR FOR OUT
0040                                            /GOING MESS
0041        0025  0000  QUECNT, Ø               /HOLDS NUMBER
0042                                            /OF UNTYPED
0043                                            /MESSAGES IN
0044                                            /TTY QUE
0045        0026  0000  STATUS, Ø               /HOLDS CLOCK
0046                                            /BITS FROM CLSA
0047        0027  0000  DVTYP,  Ø               /TELLS WHETHER
0050                                            /A DEVICE IS
0051                                            /ANALOG OR
0052                                            /ENCODED
0053                                            /4000=ANALOG
0054                                            /ØXXX=ENCODED
0055        0030  0600  KINPUT, INPUT           /PTR TO INPUT
0056                                            /ROUT
0057        0031  6201  CDFØ,   CDF Ø
0060        0032  0000  MAXCDF, Ø
0061        0033  0000  MINCDF, CDFMIN
0062        0034  7000  MINADR, ADRMIN          /BUFFER BOUNDS
0063        0035  0000  YCUR,   Ø               /Y COORD
0064                                            /OF CURSOR
0065        0036  0000  DEVNUM, Ø               /-NUM OF DV
0066                                            /AT RUN TIME
0067        0037  2330  KDADD,  DADD            /CALL TO DBL
0070                                            /PREC ADD
0071                            *41             /L MODE
0072        0041  0002          2               /INTERRUPT
0073        0042  5443          JMP I ,+1       /DISPATCH
0074        0043  0200          INTL
0075        0044  0000  DBLLO,  Ø               /DBL PREC
=
```

```
0076    0045  0000  DBLHI,  Ø          /AC
0077    0046  0000  ARGLO,  Ø          /DBL PREC
0100    0047  0000  ARGHI,  Ø          /ARG
0101                                   /ALSO =
0102                                   /XCURLO,XCURHI
0103                                   /CURSOR X COORD
0104    0050  0000  TEMPLO, Ø
0105    0051  0000  TEMPHI, Ø
0106    0052  0000  CNTR,   Ø
0107    0053  0000  BCNTR,  Ø
0110    0054  0000  BUFPTR, Ø          /FOR MOVING
0111                                   /WINDOW DISP
0112    0055  0000  LIMPTR, Ø          /PTR TO ARGS
0113                                   /FOR SR XYGET
0114    0056  0000  BCDPTR, Ø          /PTR TO BCD VAL
0115                                   /FOR SR XYGET
0116    0057  0000  RADPTR, Ø          /PTR TO PWRS OF
0117                                   /10 FOR OCTAL
0120                                   /TO DECIMAL SR
0121    0060  0000  CURCDF, Ø
0122    0061  7773  MAXDVN, DVNMAX     /= -NUM OF DEV
0123                                   /TISA WILL
0124                                   /SUPPORT
0125    0062  0377  KCLEN,  Ø377        /GOES TO CLEN
0126                                   /INT ON OVF
0127                                   /CHAN 1,2,3
0130    0063  4466  KDIG,   DIGCHK     /CALL TO SR TO
0131                                   /CHK QANDA ANS
0132                                   /BUFER FOR
0133                                   /NUMERIC INPUT
0134    0064  3000  KMUL10, MUL10      /CALL TO DECMAL
0135                                   /TO OCT CVERT
0136    0065  2020  KIDLE,  IDLE       /CALL TO IDLE
0137                                   /LOOP
0140    0066  0000  SELDV0, Ø          /DEVICE SELECT
0141    0067  0000  SELDV1, Ø          /WORDS
0142    0070  0000  SELDV2, Ø
0143    0071  0000  SELDV3, Ø
0144    0072  0000  SELDV4, Ø
0145    0073  7777  HSWIT0, 7777
0146    0074  7777  HSWIT1, 7777
0147    0075  7777  HSWIT2, 7777
0150    0076  7777  HSWIT3, 7777
0151    0077  7777  HSWIT4, 7777
0152    0100  0066  SELPTR, SELDV0
0153    0101  3461  KHLTMS, HLTMS     /CAL SR TO PUT
0154                                   /HALT MESS IN
0155                                   /TTY QUE
0156    0102  3507  KGOMS,  GOMS      /CALL GO MESS
0157    0103  0000  MODE,   Ø          /MODE WORD Ø=
0160                                   /PAUSE 7777=A\D
0161    0104  0000  TEMP,   Ø
0162    0105  1033  KQUPUT, QUPUT     /CALL SR TO PUT
0163                                   /A MESS IN QUE
0164    0106  6015  KINI,   INISTR-1   /TOP INIT TABLE
0165    0107  6143  KBLKCT, BLKCNT     /PTR TO -NUM OF
0166                                   /TBLKS IN BUF
0167    0110  6144  KLAST,  LAST       /ENTRY OF INIT
0170                                   /TABLE
0171    0111  0000  AAAP0,  Ø          /1ST UNUSED PG
0172                                   /Ø CORE LOC
0173                       *200        /L MODE INTRUPT
0174    0200  3352  INTL,   DCA ASAVE
```

```
0175    0201  7010          RAR
0176    0202  3351          DCA LSAVE
0177    0203  1040          TAD 40          /MAKE LINC JMP
0200    0204  0355          AND P1777
0201    0205  1354          TAD P6000
0202    0206  3274          DCA RTNJMP
0203    0207  6141          LINC            /SET UP LDF LIF
0204                        LMODE           /FOR INTERRUPT
0205    0210  0500          IOB             /RTN
0206    0211  6234          6234            /RIB
0207    0212  1060          STA I           /SAVE IB
0210    0213  0000          0
0211    0214  0242          ROL 2           /POSITION LDF
0212                                        /BITS
0213    0215  0002          PDP
0214                        PMODE
0215    0216  0350          AND P37
0216    0217  1347          TAD ANLDF
0217    0220  3271          DCA RTNLDF
0220    0221  1213          TAD .-6
0221    0222  7012          RTR             /POSITION LIF
0222    0223  7010          RAR             /BITS
0223    0224  0350          AND P37
0224    0225  1346          TAD ANLIF
0225    0226  3270          DCA RTNLIF
0226    0227  5234          JMP SERVE       /SERVICE INTRUP
0227    0230  3352  INTP,   DCA ASAVE       /P MODE INTRUP
0230    0231  7010          RAR
0231    0232  3351          DCA LSAVE
0232    0233  7040          CMA             /7777 FOR PMODE
0233                                        /0000 FOR LMODE
0234    0234  3345  SERVE,  DCA INTMOD      /INTERRUPT
0235    0235  6131          CLSK            /CLOCK ?
0236    0236  7410          SKP
0237    0237  5275          JMP TISA        /YES SERVICE
0240                                        /DEVICES
0241    0240  7300  TIRTN,  CLA CLL
0242    0241  6031          KSF             /KEYBOARD ?
0243    0242  5245          JMP CHKTTY
0244    0243  6036          KRB             /YES GET CHAR
0245    0244  3021          DCA KBDBUF
0246    0245  6041  CHKTTY, TSF             /TTY ?
0247    0246  5256          JMP INTOUT      /NO EXIT
0250    0247  6042          TCF             /CLR FLAG
0251    0250  1420          TAD I ADMESS    /NXT CHAR
0252    0251  7450          SNA             /MORE TO TYPE ?
0253    0252  5255          JMP .+3         /NO
0254    0253  6046          TLS
0255    0254  2020          ISZ ADMESS      /SET PTR FOR
0256                                        /NEXT CHAR
0257    0255  3022          DCA TTYFLG      /SET TTY FLAG
0260                                        /0 MEANS TTY
0261                                        /NOT BUSY
0262    0256  1351  INTOUT, TAD LSAVE       /RTN FROM
0263    0257  7004          RAL             /INTERRUPT
0264    0260  1352          TAD ASAVE
0265    0261  2345          ISZ INTMOD      /P OR L MODE ?
0266    0262  5266          JMP OUTL        /L MODE
0267    0263  6244          RMF
0270    0264  6001          ION
0271    0265  5400          JMP I 0
0272    0266  6141  OUTL,   LINC
0273    0267  0006          6               /DJR
-
```

```
0274    0270  0000  RTNLIF, 0
0275    0271  0000  RTNLDF, 0
0276    0272  0500        500             /IOB
0277    0273  6001        ION
0300    0274  0000  RTNJMP, 0
0301                                      /DATA
0302                                      /ACQUISITION
0303                                      /SERVICE
0304                                      /DEVICES
0305    0275  6135  TISA,   CLSA          /SAVE
0306    0276  3026        DCA STATUS      /CLOCK BITS
0307    0277  1026        TAD STATUS      /CHK DV0
0310    0300  0066        AND SELDV0      /SELECT WD DV0
0311    0301  7450        SNA             /READY ?
0312    0302  5321        JMP DV1         /NO GO TO DV1
0313    0303  3027        DCA DVTYP       /SAVE TYPE
0314    0304  4430        JMS I KINPUT    /CALL INPUT
0315                                      /PARAM LIST
0316                                      /DEVICE 0
0317    0305  0110        100 XAXDV0      /X AXIS SAM
0320    0306  0114        100 YAXDV0      /Y AXIS SAM
0321    0307  0000  SFDV0,  0             /SAM
0322                                      /FREQ (VAR)
0323    0310  0000  KSFDV0, 0             /SAM
0324                                      /FREQ (FIXED)
0325    0311  0000  HIDV0,  0             /15 BIT BUFFER
0326                                      /ADDR B9-B11
0327                                      /OF HI ORD
0330                                      /IS DATA FLD
0331    0312  0000  LODV0,  0             /12 BIT ADDR
0332                                      /WITHIN DATA
0333                                      /FIELD
0334    0313  0000  OSDV0,  0             /OLD
0335                                      /X AXIS SAM
0336    0314  0000  ELODV0, 0             /LAST
0337    0315  0000  EHIDV0, 0             /DATA ADDR
0340    0316  5321        JMP DV1         /HERE TO
0341                                      /CALL DV1
0342                                      /HERE TO HLT
0343                                      /DEVICE 0
0344    0317  3066  HLTDV0, DCA SELDV0    /0 DESELECTS
0345                                      /A DEVICE
0346    0320  3073        DCA HSWIT0      /SET HALT SWIT
0347    0321  1026  DV1,    TAD STATUS
0350    0322  0067        AND SELDV1      /SELECT WD DV1
0351    0323  7450        SNA             /READY ?
0352    0324  5753        JMP  I KDV2     /NO GO TO DV2
0353    0325  3027        DCA DVTYP       /SAVE TYPE
0354    0326  4430        JMS I KINPUT    /CALL INPUT
0355                                      /PARAM LIST
0356                                      /DEVICE 1
0357    0327  0111        100 XAXDV1      /X AXIS SAM
0360    0330  0115        100 YAXDV1      /Y AXIS SAM
0361    0331  0000  SFDV1,  0             /SAM
0362                                      /FREQ (VAR)
0363    0332  0000  KSFDV1, 0             /SAM
0364                                      /FREQ (FIXED)
0365    0333  0000  HIDV1,  0             /15 BIT BUFFER
0366                                      /ADDR B9-B11
0367                                      /OF HI ORD
0370                                      /IS DATA FLD
0371    0334  0000  LODV1,  0             /12 BIT ADDR
0372                                      /WITHIN DATA
-
```

```
0373                                        /FIELD
0374    0335  0000  OSDV1,  0               /OLD
0375                                        /X AXIS SAM
0376    0336  0000  ELODV1, 0               /LAST
0377    0337  0000  EHIDV1, 0               /DATA ADDR
0400    0340  5753          JMP  I KDV2     /HERE TO
0401                                        /CALL DV2
0402                                        /HERE TO HLT
0403                                        /DEVICE 1
0404    0341  3067  HLTDV1, DCA SELDV1      /0 DESELECTS
0405                                        /A DEVICE
0406    0342  7001          IAC             /SET HALT SWIT
0407    0343  3074          DCA HSWIT1
0410    0344  5753          JMP I KDV2      /NXT DEVICE
0411    0345  0000  INTMOD, 0
0412    0346  0600  ANLIF,  600
0413    0347  0640  ANLDF,  640
0414    0350  0037  P37,    37
0415    0351  0000  LSAVE,  0
0416    0352  0000  ASAVE,  0
0417    0353  0400  KDV2,   DV2
0420    0354  6000  P6000,  6000
0421    0355  1777  P1777,  1777
0422                        *400
0423    0400  1026  DV2,    TAD STATUS      /CHK DV2
0424    0401  0070          AND SELDV2      /SELECT WD DV2
0425    0402  7450          SNA             /READY ?
0426    0403  5223          JMP DV3         /NO GO TO DV3
0427    0404  3027          DCA DVTYP       /SAVE TYPE
0430    0405  4430          JMS I KINPUT    /CALL INPUT
0431                                        /PARAM LIST
0432                                        /DEVICE 2
0433    0406  0112          100 XAXDV2      /X AXIS SAM
0434    0407  0116          100 YAXDV2      /Y AXIS SAM
0435    0410  0000  SFDV2,   0               /SAM
0436                                        /FREQ (VAR)
0437    0411  0000  KSFDV2,  0               /SAM
0440                                        /FREQ (FIXED)
0441    0412  0000  HIDV2,   0               /15 BIT BUFFER
0442                                        /ADDR B9-B11
0443                                        /OF HI ORD
0444                                        /IS DATA FLD
0445    0413  0000  LODV2,   0               /12 BIT ADDR
0446                                        /WITHIN DATA
0447                                        /FIELD
0450    0414  0000  OSDV2,   0               /OLD
0451                                        /X AXIS SAM
0452    0415  0000  ELODV2,  0               /LAST
0453    0416  0000  EHIDV2,  0               /DATA ADDR
0454    0417  5223          JMP DV3         /HERE TO
0455                                        /CALL DV3
0456                                        /HERE TO HLT
0457                                        /DEVICE 2
0460    0420  3070  HLTDV2, DCA SELDV2      /0 DESELECTS
0461                                        /A DEVICE
0462    0421  7105          CLL IAC RAL     /SET HALT SWIT
0463    0422  3075          DCA HSWIT2
0464    0423  1026  DV3,    TAD STATUS
0465    0424  0071          AND SELDV3      /SELECT WD DV3
0466    0425  7450          SNA             /READY ?
0467    0426  5246          JMP DV4         /NO GO TO DEV4
0470    0427  3027          DCA DVTYP       /SAVE TYPE
0471    0430  4430          JMS I KINPUT    /CALL INPUT
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0472                                        /PARAM LIST
0473                                        /DEVICE 3
0474    0431  0113          100 XAXDV3      /X AXIS SAM
0475    0432  0117          100 YAXDV3      /Y AXIS SAM
0476    0433  0000  SFDV3,   0              /SAM
0477                                        /FREQ (VAR)
0500    0434  0000  KSFDV3,  0              /SAM
0501                                        /FREQ (FIXED)
0502    0435  0000  HIDV3,   0              /15 BIT BUFFER
0503                                        /ADDR B9-B11
0504                                        /OF HI ORD
0505                                        /IS DATA FLD
0506    0436  0000  LODV3,   0              /12 BIT ADDR
0507                                        /WITHIN DATA
0510                                        /FIELD
0511    0437  0000  OSDV3,   0              /OLD
0512                                        /X AXIS SAM
0513    0440  0000  ELODV3,  0              /LAST
0514    0441  0000  EHIDV3,  0              /DATA ADDR
0515    0442  5246          JMP DV4         /HERE TO
0516                                        /CALL DV4
0517                                        /HERE TO HLT
0520                                        /DEVICE 3
0521    0443  3071  HLTDV3,  DCA SELDV3     /0 DESELECTS
0522                                        /A DEVICE
0523    0444  7125          STL IAC RAL     /SET HALT SWIT
0524    0445  3076          DCA HSWIT3
0525    0446  1026  DV4,    TAD STATUS
0526    0447  0072          AND SELDV4      /SELECT WD DV4
0527    0450  7450          SNA             /READY ?
0530    0451  5672          JMP I EXIT      /NO EXIT
0531    0452  3027          DCA DVTYP       /SAVE TYPE
0532    0453  4430          JMS I KINPUT    /CALL INPUT
0533                                        /PARAM LIST
0534                                        /DEVICE 4
0535    0454  0120          100 XAXDV4      /X AXIS SAM
0536    0455  0124          100 YAXDV4      /Y AXIS SAM
0537    0456  0000  SFDV4,   0              /SAM
0540                                        /FREQ (VAR)
0541    0457  0000  KSFDV4,  0              /SAM
0542                                        /FREQ (FIXED)
0543    0460  0000  HIDV4,   0              /15 BIT BUFFER
0544                                        /ADDR B9-B11
0545                                        /OF HI ORD
0546                                        /IS DATA FLD
0547    0461  0000  LODV4,   0              /12 BIT ADDR
0550                                        /WITHIN DATA
0551                                        /FIELD
0552    0462  0000  OSDV4,   0              /OLD
0553                                        /X AXIS SAM
0554    0463  0000  ELODV4,  0              /LAST
0555    0464  0000  EHIDV4,  0              /DATA ADDR
0556    0465  5672          JMP  I EXIT     /HERE TO
0557                                        /EXIT
0560                                        /HERE TO HLT
0561                                        /DEVICE 4
0562    0466  3072  HLTDV4,  DCA SELDV4     /0 DESELECTS
0563                                        /A DEVICE
0564    0467  7107          CLL IAC RTL     /SET HALT SWIT
0565    0470  3077          DCA HSWIT4
0566    0471  5672          JMP I EXIT
0567    0472  0240  EXIT,    TIRTN
0570    0473  6002  D,       IOF             /D KEY
```

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0571    0474  6141          LINC              /START DIAL
0572                        LMODE
0573    0475  0001          AXO
0574    0476  0602          LIF 2
0575    0477  6015          JMP DIAL
0576                        PMODE             /P KEY
0577    0500  1740  P,       TAD I KPOLAR      /POLARITY WD
0600    0501  7040          CMA               /FLIP SPECTRUM
0601    0502  3740          DCA I KPOLAR
0602    0503  1740          TAD I KPOLAR      /IS SPECTRUM
0603    0504  7640          SZA CLA           /INVERTED ?
0604    0505  5310          JMP .+3
0605    0506  1343          TAD NORMS         /NO NORM MESS
0606    0507  7410          SKP               /TO QUE
0607    0510  1344          TAD INVMS         /YES INVERT
0610                                          /MESS TO QUE
0611    0511  4505  KEYRTN,  JMS I KQUPUT
0612    0512  5713  ZXIT,    JMP I .+1         /CROSS PAGE
0613    0513  1203          OPKRTN            /RTN
0614    0514  1737  F,       TAD I KFREQ       /F KEY
0615    0515  7040          CMA               /COM FREEZE WD
0616    0516  3737          DCA I KFREQ
0617    0517  1737          TAD I KFREQ       /IS SPECTRUM
0620    0520  7640          SZA CLA           /FROZEN ?
0621    0521  5324          JMP .+3
0622    0522  1341          TAD MOTMS         /NO MOTION
0623    0523  7410          SKP               /MESS TO QUE
0624    0524  1342          TAD FRMS          /YES FREEZE
0625    0525  5311          JMP KEYRTN        /MESS TO QUE
0626    0526  1103  S,       TAD MODE          /S KEY
0627    0527  7640          SZA CLA           /PAUSE MODE ?
0630    0530  5312          JMP ZXIT          /NO IGNORE S
0631    0531  6002          IOF               /YES CALL QA
0632    0532  5745          JMP I KSETUP      /SETUP ROUTS
0633    0533  1103  W,       TAD MODE          /W KEY
0634    0534  7640          SZA CLA           /PAUSE MODE ?
0635    0535  5312          JMP ZXIT          /NO IGNORE W
0636    0536  5746          JMP I KWRIT       /YES CALL
0637                                          /WRITE ROUTS
0640    0537  2040  KFREQ,   FREEZE
0641    0540  2266  KPOLAR,  POLAR
0642    0541  6613  MOTMS,   MSMOT
0643    0542  6624  FRMS,    MSFR
0644    0543  6635  NORMS,   MSNOR
0645    0544  6646  INVMS,   MSINV
0646    0545  4023  KSETUP,  SETUP
0647    0546  4400  KWRIT,   WRIT
0650                        *600              /GET INPUT FROM
0651    0600  0000  INPUT,   0                 /DEVICE K
0652                                          /GET PARAMETER
0653                                          /LIST FROM CALL
0654    0601  1600          TAD I INPUT
0655    0602  3303          DCA SAMX          /X AXIS SAM
0656    0603  2200          ISZ INPUT
0657    0604  1600          TAD I INPUT
0660    0605  3254          DCA SAMY
0661    0606  2200          ISZ INPUT
0662    0607  1200          TAD INPUT         /PTR TO
0663    0610  3335          DCA FREQ          /SAMPLING FREQ
0664                                          /LAST COUNT
0665                                          /(VAR)
0666    0611  2200          ISZ INPUT
0667    0612  1200          TAD INPUT         /PTR TO
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0670    0613  3334          DCA KFREQ       /SAM FREQ
0671                                        /(FIXED)
0672    0614  2200          ISZ INPUT       /PTR TO
0673    0615  1200          TAD INPUT       /BUFFER
0674    0616  3331          DCA CDFVAL      /CDF BITS
0675    0617  2200          ISZ INPUT       /PTR TO
0676    0620  1200          TAD INPUT       /BUFFER
0677    0621  3330          DCA ADDR        /ADDR
0700    0622  2200          ISZ INPUT
0701    0623  1200          TAD INPUT
0702    0624  3327          DCA OLDSAM      /PTR TO OLDSAM
0703    0625  2200          ISZ INPUT
0704    0626  1600          TAD I INPUT     /PTR TO LAST
0705    0627  3332          DCA ENDLO       /DATA ADDR
0706    0630  2200          ISZ INPUT
0707    0631  1600          TAD I INPUT
0710    0632  3333          DCA ENDHI
0711    0633  2200          ISZ INPUT       /FIRST RTN IS
0712                                        /JMP TO DV K+1
0713                                        /2ND IS HLT DVK
0714    0634  1027          TAD DVTYP       /ANALOG
0715    0635  7710          SPA CLA         /OR ENCODED ?
0716    0636  5302          JMP ANALOG
0717    0637  2735  ANARTN, ISZ  I FREQ     /READY TO SAM
0720                                        /Y AXIS ?
0721    0640  5600          JMP I INPUT     /NO GO TO
0722                                        /DV K+1
0723    0641  1734          TAD I KFREQ     /RESET FREQ
0724    0642  3735          DCA I FREQ      /FOR NXT PASS
0725    0643  1730          TAD I ADDR
0726    0644  3336          DCA HOLD        /BUFFER ADDR
0727    0645  1731          TAD I CDFVAL    /SETUP CDF
0730    0646  7104          CLL RAL
0731    0647  7006          RTL
0732    0650  1031          TAD CDF0
0733    0651  3252          DCA .+1
0734    0652  0000          0               /CDF N
0735    0653  6141          LINC
0736    0654  0000  SAMY,    0              /SAM Y AXIS
0737    0655  0002          2               /PDP
0740    0656  3736          DCA I HOLD      /PUT IN DATA
0741                                        /BUFFER
0742    0657  6201          CDF 0           /RESTORE FLD 0
0743    0660  1332          TAD ENDLO       /DVK IS FINI
0744                                        /WHEN CURRENT
0745    0661  1730          TAD I ADDR      /ADDR
0746    0662  7640          SZA CLA         /(CDFVAL,ADDR)
0747    0663  5273          JMP NFDVK
0750    0664  7004          RAL
0751    0665  1333          TAD ENDHI       /=TERMINAL ADDR
0752                                        /(ENDHI,
0753    0666  1731          TAD I CDFVAL    /ENDLO)
0754    0667  7640          SZA CLA
0755    0670  5273          JMP NFDVK
0756    0671  2200          ISZ INPUT       /FINI DV K
0757    0672  5600          JMP I INPUT
0760    0673  7101  NFDVK,  CLL IAC         /ADV CURRENT
0761    0674  1730          TAD I ADDR      /ADDR
0762    0675  3730          DCA I ADDR
0763    0676  7004          RAL
0764    0677  1731          TAD I CDFVAL
0765    0700  3731          DCA I CDFVAL
0766    0701  5600          JMP I INPUT     /NORMAL RTN
-
```

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0767    0702  6141  ANALOG, LINC
0770    0703  0000  SAMX,   0                 /SAM X AXIS
0771    0704  0002          2                 /PDP
0772    0705  1326          TAD P1000         /MAKE POS
0773    0706  3325          DCA NEWSAM
0774    0707  1727          TAD I OLDSAM      /CHK FOR 1 BIT
0775    0710  7041          CIA               /INCREASE
0776    0711  1325          TAD NEWSAM
0777    0712  7540          SMA SZA           /X AXIS READY ?
1000    0713  5320          JMP CHGSAM        /YES
1001    0714  1324          TAD MAXDRP        /CHK FOR
1002    0715  7710          SPA CLA           /TOO FAR ?
1003    0716  2200          ISZ INPUT         /YES ADV TO
1004                                          /HALT RTN
1005    0717  5600          JMP I INPUT       /NO GO TO DVK+1
1006    0720  7200  CHGSAM, CLA               /UPDATE
1007    0721  1325          TAD NEWSAM        /OLDSAM
1010    0722  3727          DCA I OLDSAM
1011    0723  5237          JMP ANARTN        /NOW CHK Y
1012                                          /AXIS
1013    0724  0020  MAXDRP, DRPMAX           /MAX X AX DROP
1014    0725  0000  NEWSAM, 0
1015    0726  1000  P1000,  1000
1016    0727  0000  OLDSAM, 0
1017    0730  0000  ADDR,   0
1020    0731  0000  CDFVAL, 0
1021    0732  0000  ENDLO,  0
1022    0733  0000  ENDHI,  0
1023    0734  0000  KFREQ,  0
1024    0735  0000  FREQ,   0
1025    0736  0000  HOLD,   0
1026                *1000
1027    1000  0000  MESCHK, 0               /TTY CHK
1030    1001  1025          TAD QUECNT        /IS QUE EMPTY ?
1031    1002  7650          SNA CLA
1032    1003  5600          JMP I MESCHK      /YES XIT
1033    1004  1420          TAD I ADMESS      /NO IS A MESS
1034    1005  7640          SZA CLA           /IN PROCESS ?
1035    1006  5600          JMP I MESCHK      /YES XIT
1036    1007  1022          TAD TTYFLG        /NO IS  A CHAR
1037    1010  7640          SZA CLA           /IN PROCESS ?
1040    1011  5600          JMP I MESCHK      /YES XIT
1041    1012  1424          TAD I QUEOUT      /NO NEXT MESS
1042    1013  3020          DCA ADMESS        /TO BATTERS
1043                                          /BOX
1044    1014  1024          TAD QUEOUT        /ADV QUEOUT TO
1045    1015  2024          ISZ QUEOUT        /NEXT MESS
1046    1016  1265          TAD ENQUE         /IF AT END OF
1047    1017  7640          SZA CLA           /QUE ADV TO GO
1050    1020  5223          JMP .+3           /DO NOT COLLECT
1051                                          /$200
1052    1021  1264          TAD STQUE
1053    1022  3024          DCA QUEOUT
1054    1023  7240          STA               /BACK UP COUNT
1055    1024  1025          TAD QUECNT
1056    1025  3025          DCA QUECNT
1057    1026  1420          TAD I ADMESS      /KICK OFF 1ST
1060    1027  2020          ISZ ADMESS        /CHAR
1061    1030  6046          TLS               /INTERRUPTS
1062                                          /WILL CARRY THE
1063                                          /BALL FROM HERE
1064    1031  3022          DCA TTYFLG        /SET FLAG TTY
1065                                          /IS BUSY
```

```
1066      1032  5600          JMP I MESCHK
1067                                      /INPUT MESS
1070      1033  0000  QUPUT,  0           /TO QUE
1071      1034  3266          DCA QSAVE     /SAVE ADDR
1072      1035  1025          TAD QUECNT    /CHK FOR QUE
1073      1036  1262          TAD QUEMAX    /FULL
1074      1037  7450          SNA           /1 SLOT LEFT ?
1075      1040  5257          JMP TBUSY     /YES INPUT BUSY
1076                                      /MESS
1077      1041  7700          SMA CLA       /FULL ?
1100      1042  5633          JMP I QUPUT   /YES INHIBIT MS
1101      1043  1266          TAD QSAVE     /NO INPUT MESS
1102      1044  3423  INMESS, DCA I QUEIN   /TO QUE
1103      1045  1023          TAD QUEIN     /IS QUEIN AT
1104      1046  1265          TAD ENQUE     /GO ?
1105      1047  7640          SZA CLA
1106      1050  5254          JMP .+4
1107      1051  1264          TAD STQUE     /YES COLLECT
1110      1052  3023          DCA QUEIN     /$200
1111      1053  7410          SKP
1112      1054  2023          ISZ QUEIN     /ADV PTR
1113      1055  2025          ISZ QUECNT    /ADV COUNT
1114      1056  5633          JMP I QUPUT
1115      1057  7200  TBUSY,  CLA           /PUT BUSY
1116      1060  1263          TAD BUSYMS    /MESS IN QUE
1117      1061  5244          JMP INMESS
1120      1062  7755  QUEMAX, STRQUE-ENDQUE /-MAX NUM OF
1121                                      /MESS+1
1122      1063  6676  BUSYMS, MSBUSY        /ADDR OF BUSY
1123                                      /MESS
1124      1064  6373  STQUE,  STRQUE
1125      1065  1362  ENQUE,  -ENDQUE
1126      1066  0000  QSAVE,  0
1127      1067  0000  DOMTP,  0           /WRITE TAPE
1130      1070  1507          TAD I KBLKCT  /-NUM TO DO
1131      1071  3266          DCA QSAVE
1132      1072  1047          TAD ARGHI
1133      1073  3302          DCA TPINST
1134      1074  1046          TAD ARGLO
1135      1075  3303          DCA TPWORD
1136      1076  1372          TAD LDFSTR
1137      1077  3301          DCA TPLDF
1140      1100  6141  MTPLOP, LINC
1141                          LMODE
1142      1101  0000  TPLDF,  0           /LDF N
1143      1102  0000  TPINST, 0           /MTP INST
1144      1103  0000  TPWORD, 0           /MBLK\TBLK
1145      1104  7163          JMP TPWAIT
1146      1105  0011          CLR         /LINK BIT
1147      1106  1020          LDA I       /ADV TBLK, MBLK
1150      1107  1001          1001
1151      1110  1200          LAM
1152      1111  1103          TPWORD
1153      1112  1560          BCL I
1154      1113  7000  P7K,    7000
1155      1114  0450          AZE         /TBLK WRAP ?
1156      1115  7124          JMP GOODY   /NO
1157      1116  0011          CLR         /LINK
1160      1117  3113          ADD P7K     /BU MBLK
1161      1120  1200          LAM
1162      1121  1103          TPWORD
1163      1122  0450          AZE         /END OF DF ?
1164      1123  7137          JMP BYMBLK  /NO
=
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1165    1124  0472  GOODY,  LZE I           /MBLK WRAP
1166                                        /AROUND ?
1167    1125  7137          JMP BYMBLK      /NO
1170    1126  1000          LDA             /YES RESET
1171    1127  1103          TPWORD          /MBLK
1172    1130  1620          BSE I
1173    1131  4000          4000
1174    1132  5103          STC TPWORD
1175    1133  3101          ADD TPLDF       /ADV LDF
1176    1134  1120          ADA I
1177    1135  0001          1
1200    1136  5101          STC TPLDF
1201    1137  0002  BYMBLK,  PDP
1202                        PMODE
1203    1140  2266          ISZ QSAVE       /DONE ?
1204    1141  5300          JMP MTPLOP      /NO
1205    1142  6141          LINC
1206                        LMODE
1207    1143  1000          LDA
1210    1144  1102          TPINST
1211    1145  1560          BCL I
1212    1146  7767          7767            /U BIT
1213    1147  1120          ADA I
1214    1150  0707          CHK
1215    1151  5152          STC .+1
1216    1152  0000          0               /STOP TAPE
1217    1153  0270          270
1220    1154  7163          JMP TPWAIT
1221    1155  0004          ESF
1222    1156  1020          LDA I           /AND CLR XOB
1223    1157  0010          EXTMTP          /U BITS
1224    1160  0001          AXO
1225    1161  0002          PDP
1226                        PMODE
1227    1162  5667          JMP I DOMTP
1230                        LMODE
1231    1163  0002  TPWAIT,  PDP
1232                        PMODE
1233    1164  4465          JMS I KIDLE
1234    1165  6141          LINC
1235                        LMODE
1236    1166  0006          DJR
1237    1167  0416          STD
1240    1170  7163          JMP TPWAIT
1241    1171  6000          JMP 0
1242                        PMODE
1243    1172  0643  LDFSTR,  FIRLDF
1244                        PAGE
1245    1200  0000  KEYBRD,  0               /KEYBOARD SR
1246    1201  1021          TAD KBDBUF      /GOT A CHAR ?
1247    1202  7450          SNA
1250    1203  5600  OPKRTN,  JMP I KEYBRD    /NO XIT
1251    1204  3265          DCA CHAR        /SAVE
1252    1205  3021          DCA KBDBUF      /CLR BUF
1253    1206  1223          TAD CHRTAB      /START OF TABLE
1254    1207  3224          DCA CHRPTR
1255    1210  1624  CHRLOP,  TAD I CHRPTR    /SEARCH FOR
1256    1211  7041          CIA             /MATCH
1257    1212  1265          TAD CHAR
1260    1213  2224          ISZ CHRPTR      /ADV PAST JMP
1261    1214  7650          SNA CLA
1262    1215  5220          JMP MATCH
1263    1216  2224          ISZ CHRPTR      /ADV TO NXT CHR
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1264    1217  5210          JMP CHRLOP
1265    1220  1624  MATCH,  TAD I CHRPTR     /LOAD A JMP
1266    1221  3222          DCA .+1           /SERVE VIA
1267    1222  0000          0                 /JMP INST
1270    1223  1225  CHRTAB, KBDTAB
1271    1224  0000  CHRPTR, 0
1272                /KEYBOARD LOOKUP TABLE FORMAT IS:
1273                /LOCA,   ASCII CODE OF DEFINED CHAR
1274                /LOCA+1, JMP TO ROUT FOR CHAR
1275                /THE LOC CHAR IS IN TABLE SO IF NONE
1276                /MATCH THE DEFAULT CASE IS JMP I KEYBRD
1277    1225  0304  KBDTAB, 304               /D
1300    1226  5671          JMP I KD          /START DIAL
1301    1227  0210          210               /CNTRL\H
1302    1230  5274          JMP CTRLH         /HLT ALL DVS
1303    1231  0310          310               /H
1304    1232  5311          JMP H             /HALT
1305    1233  0320          320               /P
1306    1234  5667          JMP I KP          /POLARITY
1307    1235  0306          306               /F
1310    1236  5670          JMP I KF          /FREEZE
1311    1237  0307          307               /G
1312    1240  5315          JMP G             /GO
1313    1241  0323          323               /S
1314    1242  5672          JMP I KS          /SETUP
1315    1243  0327          327               /W
1316    1244  5673          JMP I KW          /WRITE TAPE
1317    1245  0303          303               /C
1320    1246  5342          JMP C             /CALL CATACAL
1321    1247  0315          315               /M
1322    1250  5347          JMP M             /CALL MAGSPY
1323    1251  0314          314               /L
1324    1252  5354          JMP L             /CALL LOADER
1325                                          /NUMERIC ARGS
1326                                          /FOR H AND G
1327    1253  0260          260               /0
1330    1254  5321          JMP NUM
1331    1255  0261          261               /1
1332    1256  5321          JMP NUM
1333    1257  0262          262
1334    1260  5321          JMP NUM
1335    1261  0263          263
1336    1262  5321          JMP NUM
1337    1263  0264          264
1340    1264  5321          JMP NUM
1341    1265  0000  CHAR,   0                 /DEFAULT CASE
1342    1266  5600          JMP I KEYBRD
1343    1267  0500  KP,     P
1344    1270  0514  KF,     F
1345    1271  0473  KD,     D
1346    1272  0526  KS,     S
1347    1273  0533  KW,     W
1350                                          /CTRLH KEY
1351    1274  1103  CTRLH,  TAD MODE         /=0 FOR PAUSE
1352                                          /=7777 FOR A\D
1353    1275  7650          SNA CLA           /PAUSE MODE ?
1354    1276  5600          JMP I KEYBRD      /YES IGNORE
1355                                          /CTRLH
1356    1277  3103          DCA MODE          /SET MODE TO
1357                                          /PAUSE
1360    1300  6134          CLEN              /DISABLE ALL
1361                                          /CLOCK
1362                                          /INTERRUPTS
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1363    1301  3066          DCA SELDV0
1364    1302  3067          DCA SELDV1      /DESELECT
1365    1303  3070          DCA SELDV2      /ALL DEVICES
1366    1304  3071          DCA SELDV3
1367    1305  3072          DCA SELDV4
1370    1306  1363          TAD HLTALL      /PUT MESS
1371    1307  4505          JMS I KQUPUT    /IN QUE
1372    1310  5600          JMP I KEYBRD
1373                                        /H AND G SET A
1374                                        /SWITCH TO WAIT
1375                                        /FOR A 2ND CHAR
1376    1311  7040  H,      CMA             /SET FOR 2ND
1377    1312  3364          DCA HSWIT       /H AND G CANNOT
1400    1313  3365          DCA GSWIT       /BOTH BE SET
1401    1314  5600          JMP I KEYBRD
1402    1315  7040  G,      CMA             /SET FOR 2ND
1403    1316  3365          DCA GSWIT
1404    1317  3364          DCA HSWIT
1405    1320  5600          JMP I KEYBRD
1406    1321  1265  NUM,    TAD CHAR        /NUM KEY
1407    1322  0367          AND PP17        /STRIP ASCII
1410    1323  3104          DCA TEMP
1411    1324  1104          TAD TEMP        /CHK FOR
1412    1325  1036          TAD DEVNUM      /UNDEFINED
1413    1326  7700          SMA CLA         /DEV NUM
1414    1327  5600          JMP I KEYBRD    /ILLEGAL XIT
1415    1330  1364          TAD HSWIT       /IS 2ND ARG
1416    1331  7650          SNA CLA         /FOR H ?
1417    1332  5335          JMP .+3         /NO CHK G
1420    1333  3364          DCA HSWIT       /YES CLR SWIT
1421    1334  5766          JMP I KHALT     /GO TO HALT SR
1422    1335  1365          TAD GSWIT       /IS IT G ?
1423    1336  7650          SNA CLA
1424    1337  5600          JMP I KEYBRD    /NO XIT
1425    1340  3365          DCA GSWIT       /YES CLR SWIT
1426    1341  5770          JMP I KGO       /GO TO GO SR
1427    1342  1103  C,      TAD MODE        /C KEY
1430    1343  7640          SZA CLA         /PAUSE MODE ?
1431    1344  5600          JMP I KEYBRD    /NO IGNORE C
1432    1345  6141          LINC            /YES LOAD
1433    1346  7517          6000+CATA       /CATACAL
1434    1347  1103  M,      TAD MODE        /M KEY
1435    1350  7640          SZA CLA         /PAUSE MODE ?
1436    1351  5600          JMP I KEYBRD    /NO IGNORE M
1437    1352  6141          LINC            /YES LOAD
1440    1353  7522          6000+MAG        /MAGSPY
1441    1354  1103  L,      TAD MODE        /L KEY
1442    1355  7640          SZA CLA         /PAUSE MODE ?
1443    1356  5600          JMP I KEYBRD    /NO XIT
1444    1357  6002          IOF             /YES GET PROG
1445    1360  6141          LINC            /NAME TO BE
1446                        LMODE           /LOADED
1447    1361  0602          LIF 2
1450    1362  6454          JMP LOAD
1451                        PMODE
1452    1363  6661  HLTALL, ALLHLT
1453    1364  0000  HSWIT,  0
1454    1365  0000  GSWIT,  0
1455    1366  1400  KHALT,  HALT
1456    1367  0017  PP17,   17
1457    1370  1411  KGO,    GO
1460                                        /HERE TO HALT
1461                                        /A DEVICE
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1462                                PAGE
1463    1400  1104  HALT,   TAD TEMP        /HOLDS DV NUM
1464                                        /TO BE HALTED
1465    1401  1100          TAD SELPTR      /PTR TO 1ST
1466                                        /SELECT WORD
1467                                        /THEY OCCUR
1470                                        /SEQUENTIALLY
1471    1402  3306          DCA ATEMP
1472    1403  1706          TAD I ATEMP     /IS DEVICE
1473    1404  7650          SNA CLA         /HALTED ?
1474    1405  5705          JMP I KEYXIT    /YES IGNORE
1475                                        /HALT COMMAND
1476    1406  3706          DCA I ATEMP     /Ø TØ SELECT
1477                                        /WORD
1500                                        /PUT HALT
1501    1407  4501          JMS I KHLTMS    /MESS IN QUE
1502    1410  5705          JMP I KEYXIT
1503    1411  1104  GO,     TAD TEMP        /START A DEVICE
1504    1412  1100          TAD SELPTR      /GET ADDR OF
1505    1413  3306          DCA ATEMP       /SELECT WORD
1506    1414  1706          TAD I ATEMP     /IS THE DV IN
1507    1415  7640          SZA CLA         /A\D MODE ?
1510    1416  5705          JMP I KEYXIT    /YES IGNORE
1511                                        /GO COMMAND
1512                                        /PUT GO MESS
1513    1417  4502          JMS I KGOMS     /IN QUE
1514    1420  1104          TAD TEMP        /GET ADDR OF
1515    1421  1307          TAD TIVAL       /DV GO VALUES
1516    1422  3310          DCA FROM
1517    1423  1710          TAD I FROM
1520    1424  3310          DCA FROM
1521    1425  1104          TAD TEMP        /GET PTR TO
1522    1426  1312          TAD TIADR       /WHERE THEY
1523    1427  3311          DCA TO          /GO
1524    1430  1711          TAD I TO
1525    1431  3311          DCA TO
1526    1432  7146          CLL CMA RTL     /-3
1527    1433  1104          TAD TEMP        /RELATIVE TO
1530    1434  7740          SMA SZA CLA     /SAM 10 ?
1531    1435  7107          CLL IAC RTL     /(4) NO SAM 20
1532    1436  1313          TAD ASAM        /AC=SAM 10 OR
1533                                        /SAM 14
1534    1437  1104          TAD TEMP        /SETUP 1ST SAM
1535    1440  3264          DCA INISAM
1536    1441  1104          TAD TEMP        /CLR HLT SWIT
1537    1442  1316          TAD HLTPTR
1540    1443  3104          DCA TEMP
1541    1444  7040          CMA
1542    1445  3504          DCA I TEMP
1543    1446  1314          TAD M5          /TRANSFER 5
1544    1447  3104          DCA TEMP        /VALUES FROM
1545                                        /TABLE
1546    1450  6002          IOF             /INTERUPTS OFF
1547                                        /UNTIL DV IS
1550                                        /SELECTED
1551    1451  1711  GOLOP,  TAD I TO        /GET AN ADDR
1552    1452  3306          DCA ATEMP       /SAVE
1553    1453  1710          TAD I FROM      /GET A VALUE
1554    1454  3706          DCA I ATEMP     /STORE
1555    1455  2310          ISZ FROM        /ADV PTRS
1556    1456  2311          ISZ TO
1557    1457  2104          ISZ TEMP        /DONE 5 ?
1560    1460  5251          JMP GOLOP
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1561    1461  1711          TAD I TO        /GET ADDR OF
1562    1462  3306          DCA ATEMP       /OLDSAM
1563    1463  6141          LINC
1564    1464  0000  INISAM,  0              /SAM X AXIS
1565    1465  0002          2               /PDP
1566    1466  1315          TAD PL1000      /MAK +
1567    1467  3706          DCA I ATEMP     /STORE INITIAL
1570                                        /SAM
1571    1470  1062          TAD KCLEN       /ENABLE ALL
1572    1471  6134          CLEN            /CLOCK
1573                                        /INTERUPTS
1574    1472  7200          CLA
1575    1473  1103          TAD MODE
1576    1474  7710          SPA CLA
1577    1475  5300          JMP .+3
1600    1476  1304          TAD ADMS
1601    1477  4505          JMS I KQUPUT
1602    1500  7240          STA             /SET A\D MODE
1603    1501  3103          DCA MODE
1604    1502  6001          ION             /DV IS READY
1605    1503  5705          JMP I KEYXIT
1606    1504  6712  ADMS,   MSAD
1607    1505  1203  KEYXIT, OPKRTN
1610    1506  0000  ATEMP,  0
1611    1507  6361  TIVAL,  VALTAB
1612    1510  0000  FROM,   0
1613    1511  0000  TO,     0
1614    1512  6366  TIADR,  ADRTAB
1615    1513  0110  ASAM,   0110          /SAM 10
1616    1514  7773  M5,     -5
1617    1515  1000  PL1000, 1000
1620    1516  0073  HLTPTR, HSWIT0
1621                LMODE
1622    1517  1020  CATA,   LDA I          /LOAD CATACAL
1623    1520  1575          CATPTR-1
1624    1521  7550          JMP LOADER
1625    1522  1020  MAG,    LDA I          /LOAD MAGSPY
1626    1523  1602          MAGPTR-1
1627    1524  7550          JMP LOADER
1630    1525  0642  KLOAD,  LDF 2          /LOAD PRGM X
1631    1526  0063          SET I BETA1     /GET NAME FROM
1632    1527  5607          LODPTR-HBIT     /QANDA ANS BUF
1633    1530  0064          SET I BETA2
1634    1531  2524          ANSWER+2000
1635    1532  1324  LODLOP, LDH I BETA2     /FROM QA
1636    1533  0470          AZE I
1637    1534  0017          COM             /SET 0 TO 77
1640    1535  1420          SHD I
1641    1536  7400          QAEOL1          /END OF NAME
1642    1537  7542          JMP GETU        /YES GET UNIT
1643    1540  1363          STH I BETA1     /TO LOD TABLE
1644    1541  7532          JMP LODLOP
1645    1542  1324  GETU,   LDH I BETA2     /UNIT WD
1646    1543  1560          BCL I
1647    1544  7770          7770
1650    1545  1063          STA I BETA1
1651    1546  1020          LDA I
1652    1547  1607          LODPTR-1
1653    1550  4004  LOADER, STC BETA2       /PUT PROG AND
1654    1551  0500          IOB             /UNIT IN E6
1655                                        /TABLE FOR
1656                                        /LOADER
1657                                        /ARG IS IN AC
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1660    1552  6002          6002              /IOF
1661    1553  0001          AXO               /CLR XOB
1662    1554  0004          ESF
1663    1555  0641          LDF 1
1664    1556  0720          RDC I             /DIAL GRD TAB
1665    1557  4314          4\314
1666    1560  0063          SET I BETA1       /E6 TABLE FOR
1667    1561  2372          2372              /LOADER
1670    1562  0065          SET I BETA3       /NAME AND UNIT
1671    1563  7772          -5                /TAKE 5 WORDS
1672    1564  1024          LDA I BETA2
1673    1565  1063          STA I BETA1
1674    1566  0225          XSK I BETA3       /DONE ?
1675    1567  7564          JMP .-3           /NO
1676    1570  0642          LDF 2
1677    1571  0720          RDC I             /GET DIAL
1700    1572  4354          4\354             /LOADER
1701    1573  0641          LDF 1
1702    1574  0602          LIF 2
1703    1575  6020          JMP 20            /GO LOADER
1704    1576  0301  CATPTR,  0301             /CA
1705    1577  2401          2401              /TA
1706    1600  0301          0301              /CA
1707    1601  1477          1477              /L 77
1710    1602  0000          0                 /UNIT
1711    1603  1501  MAGPTR,  1501             /MA
1712    1604  0723          0723              /GS
1713    1605  2031          2031              /PY
1714    1606  7777          7777
1715    1607  0000          0                 /UNIT
1716    1610  0000  LODPTR,  0                 /N
1717    1611  0000          0                 /A
1720    1612  0000          0                 /M
1721    1613  0000          0                 /E
1722    1614  0000          0                 /UNIT
1723                        PMODE             /HERE TO SETUP
1724                                          /READ WRITE SR
1725    1615  0000  TPARGS,  0                 /GET MTP ARGS
1726    1616  7200          CLA               /FROM QANDA
1727    1617  1260          TAD M10           /SET DIGCHK
1730    1620  3661          DCA I KUPLIM      /TO ACCEPT
1731                                          /OCTAL INPUT
1732                                          /ONLY
1733    1621  3262          DCA TBLK          /CLR TBLK
1734    1622  4463  TPLOP,   JMS I KDIG       /GET 1 DIGIT
1735    1623  5253          JMP ANONO         /INPUT ERROR
1736    1624  5232          JMP DUNBLK        /FINI TBLK
1737    1625  1262          TAD TBLK          /UPDATE
1740    1626  7106          RTL CLL           /TBLK
1741    1627  7004          RAL
1742    1630  3262          DCA TBLK
1743    1631  5222          JMP TPLOP
1744    1632  4463  DUNBLK,  JMS I KDIG       /GET UNIT
1745    1633  5253          JMP ANONO         /INPUT ERROR
1746    1634  7200          CLA               /ONLY 1 ARG
1747    1635  7110          CLL RAR           /SET U BITS
1750    1636  6141          LINC
1751                        LMODE
1752    1637  1120          ADA I
1753    1640  0010          EXTMTP            /EXT U BITS
1754    1641  0001          AXO               /TO XOB
1755    1642  0002          PDP               /NOW PUT LOW
1756                        PMODE             /ORD U BIT
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1757    1643  7206          CLA RTL         /IN BIT 8
1760    1644  7006          RTL             /OF UNIT WORD
1761    1645  3263          DCA UNIT
1762    1646  1262          TAD TBLK
1763    1647  7112          RTR CLL
1764    1650  7010          RAR             /POS TO 9 BITS
1765    1651  3262          DCA TBLK
1766    1652  2215          ISZ TPARGS      /ADV PAST
1767    1653  7200  ANONO,  CLA             /ERROR RTN
1770    1654  1257          TAD MM12        /FIX UP
1771    1655  3661          DCA I KUPLIM    /DIGCHK
1772    1656  5615          JMP I TPARGS
1773    1657  7765  MM12,   -13            /-12 1S COM
1774    1660  7767  M10,    -11            /-10 1S COM
1775    1661  4506  KUPLIM, UPLIM
1776    1662  0000  TBLK,   0
1777    1663  0000  UNIT,   0
2000                                        /HERE TO READ
2001                                        /PARAM INPUT
2002    1664  4215  DORDC,  JMS TPARGS      /GET TBLK, UNIT
2003    1665  5737          JMP I KRDERR    /INPUT ERROR
2004    1666  1262          TAD TBLK
2005    1667  1344          TAD RMBLK
2006    1670  3277          DCA RDCWD
2007    1671  1263          TAD UNIT
2010    1672  1341          TAD ANRDC
2011    1673  3276          DCA TPRDC
2012    1674  6141          LINC
2013                        LMODE
2014    1675  0643          LDF 3
2015    1676  0000  TPRDC,  0               /RDC (U)
2016    1677  0000  RDCWD,  0               /MBLK\TBLK
2017    1700  0416          STD
2020    1701  7700          JMP .-1
2021    1702  1020          LDA I
2022    1703  0020          20
2023    1704  0004          ESF             /I/O PRESET
2024    1705  1020          LDA I
2025    1706  0010          EXTMTP          /SET
2026    1707  0001          AXO             /NO PAUSE
2027    1710  0002          PDP
2030                        PMODE
2031    1711  7200          CLA
2032    1712  1342          TAD RDLEN       /LENGTH OF INIT
2033    1713  3052          DCA CNTR        /TABLE
2034    1714  1340          TAD KFIRST      /START OF TABLE
2035    1715  3010          DCA INIPTR
2036    1716  1034          TAD MINADR      /INPUT STARTS
2037    1717  3011          DCA ADPTR       /BEG OF BUFFER
2040    1720  1411          TAD I ADPTR
2041    1721  3410          DCA I INIPTR
2042    1722  2052          ISZ CNTR        /DONE ?
2043    1723  5320          JMP .-3
2044    1724  1510          TAD I KLAST     /CHK FOR FATAL
2045    1725  7500          SMA
2046    1726  5737          JMP I KRDERR
2047    1727  7041          CIA             /ERROR WRONG
2050    1730  1061          TAD MAXDVN      /TBLK AND TOO
2051    1731  7740          SMA SZA CLA     /MANY DEVS
2052    1732  5737          JMP I KRDERR    /ILLEGAL TBLK
2053    1733  4745          JMS I KFRESH    /CLR BUFFER
2054    1734  1510          TAD I KLAST     /-NUM OF DEVS
2055    1735  5736          JMP I .+1       /GO TO QADUN
=
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2056    1736  3315          STRRDE          /ROUT
2057    1737  4343  KRDERR, READ-1
2060    1740  6000  KFIRST, FIRST=1
2061    1741  0700  ANRDC,  700
2062    1742  7634  RDLEN,  FIRST=LAST-1
2063    1743  4000  WMBLK,  WRMBLK
2064    1744  6000  RMBLK,  RDMBLK
2065    1745  3200  KFRESH, FRSTR
2066    1746  4215  DOWRC,  JMS TPARGS      /GET TBLK, UNIT
2067    1747  5764          JMP I KWRERR    /INPUT ERROR
2070    1750  1262          TAD TBLK
2071    1751  1343          TAD WMBLK
2072    1752  3046          DCA ARGLO       /ARG1 FOR
2073                                        /SR DOMTP
2074    1753  1263          TAD UNIT
2075    1754  1362          TAD AWRI        /ARG2 FOR
2076    1755  3047          DCA ARGHI       /DOMTP
2077    1756  4763          JMS I KDOMTP    /WRITE N BLKS
2100    1757  6001          ION
2101    1760  4465          JMS I KIDLE
2102    1761  5360          JMP .=1
2103    1762  0726  AWRI,   726             /WRI I
2104    1763  1067  KDOMTP, DOMTP
2105    1764  4400  KWRERR, WRIT
2106    1765  0000  AAAS0,  0
2107                /DISPLAY ROUTINES
2110                /MOVING WINDOW, CURSOR
2111                /X-Y DECIMAL READ OUT
2112                /HELP FRAME
2113                      SCPFLD=2000
2114                      LMODE
2115                      SEGMNT 1          /=SCPFLD/2000
2116                      *17
2117    0017  0000  XCORD,  0               /DIS REGISTER
2120    0020  0000  IDLE,   0               /IDLE LOOP
2121                                        /SCOPE, KEYBRD
2122                                        /TTY
2123    0021  6141          6141            /LINC
2124    0022  0460          SNS I 0         /1 OF 2 DISPS
2125    0023  6052          JMP DSCHLP      /HELP FRAME
2126                                        /DATA BUFFER
2127    0024  0104          SAM 4           /CURSOR KNOB
2130    0025  0341          SCR 1           /9 BITS COVERS
2131                                        /ALL X VALUES
2132    0026  0002          PDP             /MAKE +
2133                        PMODE           /WHEN CURCNT
2134    2027  1366          TAD P401        /GOES TO 0
2135    2030  7041          CIA             /DIS CURSOR
2136    2031  6141          LINC
2137                        LMODE
2140    0032  4351          STC CURCNT=SCPFLD
2141    0033  0077          SET I XCORD
2142    0034  6777          =1000           /INIT X COORD
2143                                        /=1
2144    0035  0100          SAM 0           /WINDOW KNOB
2145    0036  0344          SCR 4           /HI ORD 6 BITS
2146                                        /DET MOTION +
2147                                        /IS FWD =IS BWD
2150                                        /APPEARANCE OF
2151                                        /MOTION IS
2152                                        /GIVEN BY
2153                                        /VARYING THE
2154                                        /INITIAL ADDR
```

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2155    0037  1520          SRO I
2156    0040  7777  FREEZE, 7777              /7777 MEANS
2157                                          /FREEZE WINDOW
2160    0041  6250          JMP GODIS-SCPFLD-1
2161    0042  6200          JMP SETMOT-SCPFLD
2162                        PMODE             /HERE WHEN
2163                                          /SCOPE FINI
2164    2043  4647  SCPRTN, JMS I KKEY        /KEYBOARD
2165    2044  4651          JMS I KSWI        /INTERNAL HLT
2166    2045  4650          JMS I KMES        /TTY
2167    2046  5620          JMP I IDLE
2170    2047  1200  KKEY,   KEYBRD
2171    2050  1000  KMES,   MESCHK
2172    2051  3107  KSWI,   CHKSWI
2173                        LMODE             /DSC HELP
2174                                          /SEE HLPTAB
2175                                          /FOR FORMAT
2176    0052  0642  DSCHLP, LDF 2             /GRID TABLE
2177                                          /IN LDF 2
2200    0053  0077          SET I MSPTR       /TO DIAL
2201    0054  5614          HLPTAB-HBIT       /ENCODED MESS
2202    0055  0076          SET I VCPTR       /TABLE OF
2203    0056  1537          VCTAB-1           /VERT COORDS
2204    0057  0075          SET I HCPTR       /TABLE OF
2205    0060  1556          HCTAB-1           /HORIZ COORDS
2206    0061  1036  LNNXT,  LDA I VCPTR
2207    0062  4737          STC VCOORD
2210    0063  1035          LDA I HCPTR
2211    0064  4001          STC 1
2212    0065  1337          LDH I MSPTR       /1ST CHAR OF LN
2213    0066  1420          SHD I             /IS LN FULL
2214    0067  0600          FUL1              /SIZE CHARS ?
2215    0070  6114          JMP SETFUL        /YES
2216    0071  0011          CLR               /L=0 FOR HAF
2217    0072  0004          ESF               /SET HAF SIZE
2220    0073  1317          LDH MSPTR         /RESTORE CHAR
2221    0074  0467          SKP
2222    0075  1337  CHRNXT, LDH I MSPTR
2223    0076  1420          SHD I
2224    0077  4300          CR1               /END OF LN ?
2225    0100  6061          JMP LNNXT         /YES
2226    0101  1420          SHD I             /END OF
2227    0102  7700          ENDWD1            /MESSAGE ?
2230    0103  6163          JMP SCPXIT        /YES
2231    0104  1420          SHD I             /RESET
2232    0105  3600          CHGHC             /HORIZ COORD ?
2233    0106  6111          JMP SETHC         /YES
2234    0107  6732          JMP DSCCHR
2235    0110  6075          JMP CHRNXT
2236    0111  1035  SETHC,  LDA I HCPTR
2237    0112  4001          STC 1
2240    0113  6075          JMP CHRNXT
2241    0114  1020  SETFUL, LDA I
2242    0115  0200          200
2243    0116  0004          ESF               /SET FULL SIZE
2244    0117  0017          COM
2245    0120  0261          ROL I 1           /L=1 FOR FULL
2246    0121  6075          JMP CHRNXT
2247    0122  0642  DSCXY,  LDF 2             /DSC: X=------
2250    0123  0011          CLR               /     Y=---
2251    0124  0004          ESF               /HALF SIZE
2252    0125  2166          ADD P401-SCPFLD
2253    0126  4737          STC VCOORD
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2254    0127  0077          SET I MSPTR     /DIAL ENCODED
2255    0130  5526          DCODEX-HBIT     /MESS
2256    0131  1020  NXTLN,  LDA I
2257    0132  7757          -20
2260    0133  1140          ADM
2261    0134  0737          VCOORD
2262    0135  0061          SET I 1
2263    0136  0000          XYHC
2264    0137  1337  INICHR, LDH I MSPTR     /INIT CHARS
2265    0140  1420          SHD I
2266    0141  4300          CR1             /EOL ?
2267    0142  6145          JMP .+3         /YES
2270    0143  6732          JMP DSCCHR
2271    0144  6137          JMP INICHR
2272    0145  1337          LDH I MSPTR
2273    0146  1420          SHD I           /DO NOT DSC
2274    0147  6000          6000            /LEADING 0S
2275    0150  6145          JMP .-3
2276    0151  0467          SKP
2277    0152  1337  NXTCHR, LDH I MSPTR
2300    0153  1420          SHD I
2301    0154  4300          CR1             /EOL ?
2302    0155  6131          JMP NXTLN       /YES
2303    0156  1420          SHD I
2304    0157  7700          ENDWD1          /END OF MESS ?
2305    0160  6163          JMP SCPXIT      /YES
2306    0161  6732          JMP DSCCHR
2307    0162  6152          JMP NXTCHR
2310    0163  0002  SCPXIT, PDP             /RTN
2311                        PMODE
2312    2164  7300          CLA CLL
2313    2165  5243          JMP SCPRTN
2314    2166  0401  P401,   401
2315                        *SCPFLD+200     /GET INIT BUF
2316                                        /ADDR FOR DISP
2317                                        /DELTA X IN AC
2320    2200  0002  SETMOT, 2               /PDP
2321    2201  7100          CLL
2322    2202  7510          SPA             /FWD OR BWD ?
2323    2203  5224          JMP BWDMOT
2324    2204  1346          TAD BUFLO       /UPDATE 15 BIT
2325    2205  3346          DCA BUFLO       /ADDR
2326    2206  7004          RAL
2327    2207  1347          TAD BUFHI
2330    2210  3347          DCA BUFHI
2331    2211  1347          TAD BUFHI       /CHK FOR HI
2332    2212  7041          CIA             /END WRAP
2333    2213  1032          TAD MAXCDF      /AROUND
2334    2214  7700          SMA CLA         /OK ?
2335    2215  5251          JMP GODIS       /YES
2336    2216  1033          TAD MINCDF      /RESET LO END
2337    2217  3347          DCA BUFHI
2340    2220  1034          TAD MINADR      /NEW ADDR IS
2341    2221  1346          TAD BUFLO       /REL TO MINADR
2342    2222  3346          DCA BUFLO
2343    2223  5251          JMP GODIS
2344    2224  1346  BWDMOT, TAD BUFLO       /BU ADDR
2345    2225  3346          DCA BUFLO
2346    2226  7430          SZL             /UNDER FLOW ?
2347    2227  5233          JMP CHKADR      /NO
2350    2230  7240          STA             /YES BU CDF
2351    2231  1347          TAD BUFHI       /BITS
2352    2232  3347          DCA BUFHI
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2353    2233  1033  CHKADR, TAD MINCDF
2354    2234  7041        CIA
2355    2235  1347        TAD BUFHI
2356    2236  7740        SMA SZA CLA     /CDF BITS AT
2357                                      /LOW END ?
2360    2237  5251        JMP GODIS       /NO
2361    2240  1034        TAD MINADR
2362    2241  7041        CIA
2363    2242  1346        TAD BUFLO       /ADDR BITS
2364    2243  7500        SMA             /OK ?
2365    2244  5251        JMP GODIS       /YES
2366    2245  3346        DCA BUFLO       /CORRECT ADDR
2367                                      /IS IN AC
2370    2246  1032        TAD MAXCDF      /SET CDF BITS
2371    2247  3347        DCA BUFHI       /BWD WRAP
2372    2250  0002        2               /SOMETIMES HERE
2373                                      /IN LMODE (PDP)
2374    2251  7300  GODIS, CLA CLL
2375    2252  1346        TAD BUFLO       /SET BUFPTR
2376    2253  3054        DCA BUFPTR      /TO INIT ADDR
2377    2254  1347        TAD BUFHI       /SET CDF BITS
2400    2255  3060        DCA CURCDF
2401    2256  4320        JMS SETCDF      /SET DATA FLD
2402    2257  1350        TAD M1000       /SET FOR
2403    2260  3053        DCA BCNTR       /512 POINTS
2404    2261  7200  NXTPNT, CLA
2405    2262  1454        TAD I BUFPTR
2406    2263  6141        LINC
2407                      LMODE
2410    0264  0341        SCR 1           /SCP MAX IS 9
2411                                      /BITS
2412    0265  1520        SRO I           /7777 INVERTS
2413    0266  0000  POLAR, 0              /SPECTRUM
2414    0267  0017        COM
2415    0270  0177        DIS I XCORD
2416    0271  0002        PDP
2417                      PMODE
2420    2272  2351        ISZ CURCNT      /READY TO DIS
2421                                      /CURSOR
2422    2273  7410        SKP             /NO
2423    2274  5752        JMP I KCUR
2424    2275  2054  CURRTN, ISZ BUFPTR    /CHNG FLDS ?
2425    2276  7410        SKP             /NO
2426    2277  5303        JMP FWDCDF
2427    2300  2053  FWDRTN, ISZ BCNTR     /512 PNTS ?
2430    2301  5261        JMP NXTPNT      /NO
2431    2302  5753        JMP I KXYGET    /YES GET
2432                                      /X-Y COORDS
2433    2303  7200  FWDCDF, CLA           /ADV CDF
2434    2304  2060        ISZ CURCDF
2435    2305  1060        TAD CURCDF
2436    2306  7041        CIA
2437    2307  1032        TAD MAXCDF
2440    2310  7700        SMA CLA         /WRAP AROUND ?
2441    2311  5316        JMP BYWRAP      /NO
2442    2312  1034        TAD MINADR
2443    2313  3054        DCA BUFPTR
2444    2314  1033        TAD MINCDF
2445    2315  3060        DCA CURCDF
2446    2316  4320  BYWRAP, JMS SETCDF
2447    2317  5300        JMP FWDRTN
2450    2320  0000  SETCDF, 0             /SET CDF REL
2451                                      /TO CURCDF
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2452    2321  1060          TAD CURCDF
2453    2322  7104          RAL CLL
2454    2323  7006          RTL
2455    2324  1031          TAD CDF0
2456    2325  3326          DCA .+1
2457    2326  0000          0
2460    2327  5720          JMP I SETCDF
2461                                      /DBL PREC ADD
2462                                      /OF
2463                                      /(DBLHI,DBLLO)
2464                                      /(ARGHI,ARGLO)
2465                                      /ANSWER IN
2466                                      /(DBLHI,DBLLO)
2467                                      /L=0 IF +
2470                                      /L=1 IF -
2471    2330  0000  DADD,   0
2472    2331  7300          CLA CLL
2473    2332  1044          TAD DBLLO
2474    2333  1046          TAD ARGLO     /=XCURLO
2475    2334  3044          DCA DBLLO
2476    2335  7004          RAL
2477    2336  1045          TAD DBLHI
2500    2337  1047          TAD ARGHI     /=XCURHI
2501    2340  3045          DCA DBLHI
2502    2341  7100          CLL
2503    2342  1045          TAD DBLHI
2504    2343  7710          SPA CLA
2505    2344  7020          CML
2506    2345  5730          JMP I DADD
2507    2346  7000  BUFLO,  ADRMIN
2510    2347  0000  BUFHI,  CDFMIN
2511    2350  7000  M1000,  -1000
2512    2351  0000  CURCNT, 0
2513    2352  2700  KCUR,   CURDIS
2514    2353  2400  KXYGET, XYGET
2515                        *SCPFLD+400   /FIND REL DEV
2516                                      /ADDR IN BUFFER
2517    2400  6201  XYGET,  CDF 0         /RESTORE FIELD
2520    2401  7200          CLA           /HOLDS ADDR OF
2521    2402  1325          TAD KLIM      /TABLE DEV INFO
2522    2403  3055          DCA LIMPTR
2523    2404  7240          STA
2524    2405  1036          TAD DEVNUM    /-NUM DV
2525    2406  3052          DCA CNTR
2526    2407  1455  LIMLOP, TAD I LIMPTR  /-ST ADDR
2527    2410  3044          DCA DBLLO     /FOR DV K
2530    2411  2055          ISZ LIMPTR    /ADDR TO DBLLO
2531    2412  1455          TAD I LIMPTR  /CDF BITS
2532    2413  3045          DCA DBLHI     /TO DBLHI
2533                                      /XCOORD IS IN
2534                                      /(ARGHI,ARGLO)
2535    2414  4437          JMS I KDADD   /IS XCOORD GE
2536    2415  7430          SZL           /ST ADDR DV K ?
2537    2416  5232          JMP FOUND     /NO ADDR LIMITS
2540                                      /HAVE BEEN DET
2541    2417  1044          TAD DBLLO     /SAVE DIFF FOR
2542    2420  3050          DCA TEMPLO    /DV K IT IS REL
2543    2421  1045          TAD DBLHI     /ADDR FOR DV K+1
2544    2422  3051          DCA TEMPHI
2545    2423  2055          ISZ LIMPTR    /ADV PTR TO
2546    2424  2055          ISZ LIMPTR    /NEXT ST
2547    2425  2055          ISZ LIMPTR    /ADDR
2550    2426  2052          ISZ CNTR      /SCANNED ALL
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2551                                            /DEVICES ?
2552    2427  5207          JMP LIMLOP          /NO
2553    2430  5631          JMP I .+1           /YES CURSOR IS
2554    2431  2043          SCPRTN              /IN VOID AREA
2555                                            /DO NOT DSC X=Y
2556    2432  3044  FOUND,  DCA DBLLO           /ANSWER IS IN
2557    2433  3045          DCA DBLHI           /TEMPLO,TEMPHI
2560                                            /CLR DBL AC
2561    2434  7346          STA CLL RTL         /BU PTR (=3)
2562    2435  1055          TAD LIMPTR          /TO DEVICE
2563    2436  3055          DCA LIMPTR          /SAM FREQ
2564    2437  1455          TAD I LIMPTR        /MULT ANSWER
2565    2440  3052          DCA CNTR            /BY SAM FREQ
2566    2441  1051          TAD TEMPHI
2567    2442  3047          DCA ARGHI
2570    2443  1050          TAD TEMPLO
2571    2444  3046          DCA ARGLO
2572    2445  4437          JMS I KDADD
2573    2446  2052          ISZ CNTR            /DONE ?
2574    2447  5245          JMP .=2             /NO
2575                                            /YES REL OCTAL
2576                                            /ADDR NOW IN
2577                                            /DBL AC CVERT
2600                                            /TO BCD
2601    2450  2055          ISZ LIMPTR          /ADV TO BCD
2602    2451  1455          TAD I LIMPTR        /ADDR FOR DV K
2603    2452  3055          DCA LIMPTR          /(LO TO HI)
2604                                            /5 DIGITS
2605    2453  1326          TAD KBCD            /ADDR OF BCD
2606    2454  3056          DCA BCDPTR          /ANSWER
2607    2455  1327          TAD KRAD            /PTR TO
2610    2456  3057          DCA RADPTR          /DECIMAL RADII
2611    2457  1330          TAD NEG5
2612    2460  3052          DCA CNTR
2613    2461  1457  DBLLOP, TAD I RADPTR        /=100K,-10, HI
2614    2462  3047          DCA ARGHI
2615    2463  2057          ISZ RADPTR
2616    2464  1457          TAD I RADPTR        /=100K,-10, LO
2617    2465  3046          DCA ARGLO
2620    2466  2057          ISZ RADPTR
2621    2467  3053          DCA BCNTR           /COUNTS MULTS
2622                                            /OF PWRS OF 10
2623    2470  1044  DBLDEF, TAD DBLLO           /SAVE LAST
2624    2471  3050          DCA TEMPLO          /DEFLATE
2625    2472  1045          TAD DBLHI
2626    2473  3051          DCA TEMPHI
2627    2474  4437          JMS I KDADD         /DEFLATE 1 TIME
2630    2475  2053          ISZ BCNTR
2631    2476  7420          SNL                 /MINUS YET ?
2632    2477  5270          JMP DBLDEF                  /NO CONT
2633    2500  7240          STA                 /CORRECT FOR
2634    2501  1053          TAD BCNTR           /OFF BY 1
2635    2502  3456          DCA I BCDPTR        /SAVE
2636    2503  2056          ISZ BCDPTR
2637    2504  1050          TAD TEMPLO          /RESET TO
2640    2505  3044          DCA DBLLO           /LAST VAL
2641    2506  1051          TAD TEMPHI
2642    2507  3045          DCA DBLHI
2643    2510  2052          ISZ CNTR            /DONE BOTH ?
2644    2511  5261          JMP DBLLOP          /NO
2645    2512  1044          TAD DBLLO           /UNITS
2646    2513  3456          DCA I BCDPTR
2647    2514  6141          LINC
=
```

```
2650                                LMODE
2651      0515  0077                SET I XCORD       /SET PTR TO
2652      0516  1533                DCODEX+4          /X-Y TABLE
2653      0517  0002                PDP
2654                                PMODE
2655      2520  1330                TAD NEG5          /SET FOR 5
2656      2521  3052                DCA CNTR          /BCD ADDS
2657      2522  3053                DCA BCNTR         /HOLDS BCD
2660                                                  /CARRYS
2661      2523  5724                JMP I,+1
2662      2524  2600                BCDLOP            /CONT NXT PAGE
2663      2525  6443  KLIM,         LIMVL0
2664      2526  6435  KBCD,         BCDVAL
2665      2527  6417  KRAD,         RADVAL
2666      2530  7773  NEG5,         -5
2667                                                  /ADD ABSOLUTE
2670                                                  /DECIMAL VIA
2671                                                  /LIMPTR TO
2672                                                  /DECIMAL XCOORD
2673                                                  /VIA BCDPTR AND
2674                                                  /STORE FINAL
2675                                                  /RESULT IN
2676                                                  /X-Y TABLE
2677                                *SCPFLD+600
2700      2600  7300  BCDLOP,      CLA CLL
2701      2601  1053                TAD BCNTR         /CARRY=0,1
2702      2602  1455                TAD I LIMPTR      /0-11
2703      2603  1456                TAD I BCDPTR      /0-11
2704      2604  3050                DCA TEMPLO        /0-23
2705      2605  1050                TAD TEMPLO        /CHK CARRY
2706      2606  1353                TAD M12
2707      2607  7500                SMA               /CARRY ?
2710      2610  3050                DCA TEMPLO        /YES CORRECT
2711                                                  /ANSER IS IN AC
2712      2611  7204                RAL CLA           /L=1 ON CARRY
2713      2612  3053                DCA BCNTR         /SET CARRY FOR
2714                                                  /NEXT BCD ADD
2715      2613  7040                CMA               /RESET PTRS
2716      2614  1056                TAD BCDPTR
2717      2615  3056                DCA BCDPTR
2720      2616  2055                ISZ LIMPTR
2721      2617  1050                TAD TEMPLO        /ANSWER+60
2722      2620  1354                TAD P60           /=DIAL CODE
2723      2621  6141                LINC
2724                                LMODE             /STORE IN
2725      0622  1357                STH XCORD         /X-Y TABLE
2726      0623  1020                LDA I             /BU XCORD
2727      0624  3777                -HBIT
2730      0625  2017                ADD XCORD
2731      0626  4017                STC XCORD
2732      0627  0002                PDP
2733                                PMODE
2734      2630  2052                ISZ CNTR          /DONE ?
2735      2631  5200                JMP BCDLOP        /NO
2736      2632  1456                TAD I BCDPTR      /YES GET 100K
2737      2633  1053                TAD BCNTR         /DIGIT+CARRY
2740      2634  1354                TAD P60
2741      2635  6141                LINC
2742                                LMODE
2743      0636  1357                STH XCORD
2744      0637  0077                SET I XCORD       /NOW SET FOR
2745      0640  1535                DCODEY+1          /Y VALUE
2746      0641  0002                PDP
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2747                                PMODE
2750      2642  7344                CLL STA RAL       /DO 100S, 10S
2751      2643  3052                DCA CNTR          /Y BCD CVERT
2752      2644  1355                TAD PP400         /MAKE Y +
2753      2645  1035                TAD YCUR
2754      2646  3035                DCA YCUR
2755                                                  /Y IS 0-777
2756      2647  1457  YLOP,         TAD I RADPTR      /-100, -10
2757      2650  3046                DCA ARGLO
2760      2651  3053                DCA BCNTR
2761      2652  2057                ISZ RADPTR
2762      2653  1035                TAD YCUR
2763      2654  1046                TAD ARGLO         /1 DEFLATE
2764      2655  2053                ISZ BCNTR         /BCD VALUE
2765      2656  7500                SMA               /DONE ?
2766      2657  5254                JMP .-3           /NO
2767      2660  1457                TAD I RADPTR      /+100, +10
2770      2661  3035                DCA YCUR          /RESET VALUE
2771      2662  2057                ISZ RADPTR
2772      2663  1053                TAD BCNTR         /OFF BY 1
2773      2664  1357                TAD P57           /60-1
2774      2665  6141                LINC
2775                                LMODE             /DIAL CODE
2776      0666  1377                STH I XCORD       /TO X-Y TABLE
2777      0667  0002                PDP
3000                                PMODE
3001      2670  7200                CLA
3002      2671  2052                ISZ CNTR          /DONE ?
3003      2672  5247                JMP YLOP          /NO
3004      2673  1035                TAD YCUR          /UNITS
3005      2674  1354                TAD P60
3006      2675  6141                LINC              /STORE
3007                                LMODE             /THE TABLE
3010      0676  1377                STH I XCORD       /IS FINALLY
3011      0677  6122                JMP DSCXY         /READY
3012                                                  /HERE TO
3013                                PMODE             /DIS CURSOR
3014      2700  3035  CURDIS,       DCA YCUR          /Y COORD
3015      2701  6214                RDF
3016      2702  7110                CLL RAR
3017      2703  7012                RTR
3020      2704  3047                DCA XCURHI        /X COORD HI
3021      2705  1054                TAD BUFPTR
3022      2706  3046                DCA XCURLO        /X COORD LO
3023      2707  7001                IAC
3024      2710  3051                DCA TEMPHI        /DELTA V +,-1
3025      2711  1351                TAD CURLEN        /CURSOR IS VERT
3026      2712  3052                DCA CNTR          /LN OF LENGTH
3027                                                  /=C(CURLEN)
3030      2713  1352                TAD MAXCUR        /IF Y COORD
3031      2714  1035                TAD YCUR          /TOO HI CURSOR
3032      2715  7750                SPA SNA CLA       /IS DIS BELOW
3033                                                  /SPECTRUM
3034      2716  5321                JMP CURLOP-1
3035      2717  7040                CMA               /TOO HI SET
3036      2720  3051                DCA TEMPHI        /DELTA V TO -1
3037      2721  1035                TAD YCUR
3040      2722  1051  CURLOP,       TAD TEMPHI
3041      2723  6141                LINC
3042                                LMODE
3043      0724  0157                DIS XCORD
3044      0725  0002                PDP
3045                                PMODE
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3046    2726  2052          ISZ CNTR
3047    2727  5322          JMP CURLOP
3050    2730  5731          JMP I .+1
3051    2731  2275          CURRTN
3052                        LMODE
3053    0732  0241  DSCCHR, ROL 1              /MULT BY 2
3054    0733  1120          ADA I               /ADDR IS REL
3055    0734  7330          GRDTAB-1+2000       /TO GRDTAB
3056    0735  4014          STC GRDPTR
3057    0736  1120          ADA I
3060    0737  0000  VCOORD, 0
3061    0740  1774          DSC I GRDPTR
3062    0741  1774          DSC I GRDPTR
3063    0742  1020          LDA I               /MAKE HORIZ
3064    0743  0002  P2,     2                   /GAP BET CHARS
3065    0744  0452          LZE                 /2 FOR HALF
3066    0745  2743          ADD P2              /4 FOR FULL
3067    0746  1140          ADM
3070    0747  0001          1
3071    0750  6000          JMP 0
3072                        PMODE
3073    2751  7750  CURLEN, KURLEN             /=-LENGTH OF
3074                                            /CURSOR
3075    2752  7431  MAXCUR, -377-KURLEN        /MAX Y COORD
3076                                            /FOR CURSOR
3077                                            /ABOVE SPECTRUM
3100    2753  7766  M12,    -12
3101    2754  0060  P60,    60
3102    2755  0400  PP400,  400
3103    2756  7774  MM4,    -4
3104    2757  0057  P57,    57
3105                        PAGE
3106    3000  0000  MUL10,  0                   /DAC*10+AC
3107    3001  3050          DCA TEMPLO          /TO DAC
3110    3002  4217          JMS DSCL            /DAC*2
3111    3003  1044          TAD DBLLO
3112    3004  3046          DCA ARGLO           /SAVE
3113    3005  1045          TAD DBLHI
3114    3006  3047          DCA ARGHI
3115    3007  4217          JMS DSCL            /YIELDS
3116    3010  4217          JMS DSCL            /DAC*8
3117    3011  4437          JMS I KDADD         /+DAC*2=DAC*10
3120    3012  3047          DCA ARGHI           /NOW ADD NEW
3121    3013  1050          TAD TEMPLO          /VAL
3122    3014  3046          DCA ARGLO
3123    3015  4437          JMS I KDADD         /=DAC*10+AC
3124    3016  5600          JMP I MUL10
3125    3017  0000  DSCL,   0                   /RAL DAC =DAC*2
3126    3020  7300          CLA CLL
3127    3021  1044          TAD DBLLO
3130    3022  7004          RAL
3131    3023  3044          DCA DBLLO
3132    3024  1045          TAD DBLHI
3133    3025  7004          RAL
3134    3026  3045          DCA DBLHI
3135    3027  5617          JMP I DSCL
3136    3030  0000  DCIA,   0                   /2S COMP OF DAC
3137    3031  7200          CLA
3140    3032  1045          TAD DBLHI
3141    3033  7040          CMA
3142    3034  3045          DCA DBLHI
3143    3035  1044          TAD DBLLO
3144    3036  7041          CIA
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3145      3037  7450          SNA
3146      3040  2045          ISZ DBLHI
3147      3041  3044          DCA DBLLO
3150      3042  5630          JMP I DCIA
3151      3043  0000  DSCL4,  0               /PACK BCD IN
3152      3044  3050          DCA TEMPLO      /DAC =ROL 4 +AC
3153      3045  4217          JMS DSCL        /MOVE 4 LEFT
3154      3046  4217          JMS DSCL
3155      3047  4217          JMS DSCL
3156      3050  4217          JMS DSCL
3157      3051  1044          TAD DBLLO
3160      3052  1050          TAD TEMPLO
3161      3053  3044          DCA DBLLO
3162      3054  5643          JMP I DSCL4
3163      3055  0000  UPACK,  0               /UNPACK DAC
3164      3056  7346          STA CLL RTL     /PUT IN INITAB
3165      3057  3050          DCA TEMPLO      /5 VALS 3 IN
3166      3060  5264          JMP .+4         /DBLLO
3167                                          /2 IN DBLHI
3170      3061  7012  PCKLOP, RTR             /NXT VAL
3171      3062  7012          RTR             /TO LOW 4 BITS
3172      3063  3044          DCA DBLLO       /UPDATE
3173      3064  1044          TAD DBLLO
3174      3065  0306          AND P17
3175      3066  3410          DCA I INIPTR    /1 VAL TO TABLE
3176      3067  1044          TAD DBLLO
3177      3070  2050          ISZ TEMPLO      /DONE ?
3200      3071  5261          JMP PCKLOP      /NO
3201      3072  7200          CLA
3202      3073  1045          TAD DBLHI       /LAST VALS
3203      3074  0306          AND P17
3204      3075  3410          DCA I INIPTR
3205      3076  1045          TAD DBLHI
3206      3077  7012          RTR
3207      3100  7012          RTR
3210      3101  0306          AND P17
3211      3102  3410          DCA I INIPTR
3212      3103  3044          DCA DBLLO       /CLR DAC
3213      3104  3045          DCA DBLHI
3214      3105  5655          JMP I UPACK
3215      3106  0017  P17,     17
3216      3107  0000  CHKSWI, 0               /SEE IF TISA
3217      3110  1330          TAD HSWPTR      /HAS HALTED
3220      3111  3004          DCA BETA2       /ANY DEVS
3221      3112  1036          TAD DEVNUM      /=NUM DEFINED
3222      3113  3052          DCA CNTR
3223      3114  1404  CHKLOP, TAD I BETA2
3224      3115  7510          SPA             /TISA HALT ?
3225      3116  5323          JMP BYHLT       /NO
3226      3117  3104          DCA TEMP        /HLT MESS
3227      3120  4501          JMS I KHLTMS    /TO QUE
3230      3121  7040          CMA             /CLR SWIT
3231      3122  3404          DCA I BETA2
3232      3123  7200  BYHLT,  CLA
3233      3124  2004          ISZ BETA2
3234      3125  2052          ISZ CNTR
3235      3126  5314          JMP CHKLOP
3236      3127  5707          JMP I CHKSWI
3237      3130  0073  HSWPTR, HSWITØ
3240                          PAGE
3241                                          /FRESH START
3242                                          /CLR BUFFER
3243                                          /INIT ALL ARGS
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3244      3200  0000  FRSTR,  0
3245      3201  7200          CLA             /PUT ØS FROM
3246      3202  1034          TAD MINADR      /MINCDF,MINADR
3247      3203  3046          DCA ARGLO       /TO MAXCDF,7777
3250      3204  1033          TAD MINCDF
3251      3205  3060          DCA CURCDF
3252      3206  4672  CLRLOP, JMS I KSET      /SET CDF
3253      3207  3446          DCA I ARGLO     /A Ø TO BUFER
3254      3210  2046          ISZ ARGLO       /DONE FIELD ?
3255      3211  5207          JMP .-2         /NO
3256      3212  2060          ISZ CURCDF      /ADV FLD
3257      3213  1060          TAD CURCDF
3260      3214  7041          CIA
3261      3215  1032          TAD MAXCDF
3262      3216  7700          SMA CLA         /FINI ?
3263      3217  5206          JMP CLRLOP      /NO
3264      3220  6201          CDF Ø           /RESET FLD
3265      3221  3053          DCA BCNTR       /DEV COUNT
3266      3222  1034          TAD MINADR      /1ST AVAIL
3267      3223  3274          DCA LSSALO      /BUF ADDR
3270      3224  1033          TAD MINCDF
3271      3225  3275          DCA LSSAHI      /=SA DV Ø
3272      3226  1106          TAD KINI
3273      3227  3276          DCA LSINI
3274      3230  1277          TAD KENC        /SA ENC TABLE
3275      3231  3300          DCA LSENC
3276      3232  5600          JMP I FRSTR
3277                                          /INIT ARGS FOR
3300                                          /CURRENT DEVICE
3301      3233  0000  RESTR,  0
3302      3234  7200          CLA
3303      3235  1053          TAD BCNTR       /=NUM OF
3304                                          /DEFINED DVS
3305      3236  3052          DCA CNTR
3306      3237  1274          TAD LSSALO      /SA CURN DV
3307      3240  3021          DCA CURNLO
3310      3241  1275          TAD LSSAHI
3311      3242  3020          DCA CURNHI
3312      3243  1276          TAD LSINI       /PTR TO INITAB
3313      3244  3010          DCA INIPTR      /CURN DV
3314      3245  1300          TAD LSENC
3315      3246  3022          DCA ENCPTR
3316      3247  3044          DCA DBLLO
3317      3250  3045          DCA DBLHI
3320      3251  1301          TAD P4060       /CURN DV NUM
3321      3252  1052          TAD CNTR        /TO QA TXT FLD
3322      3253  3702          DCA I KTXT26
3323      3254  5633          JMP I RESTR
3324                                          /INIT ARGS NXT
3325                                          /DV REVERSE OF
3326                                          /RESTR
3327      3255  0000  NXSTR,  0
3330      3256  7200          CLA
3331      3257  1052          TAD CNTR
3332      3260  3053          DCA BCNTR
3333      3261  1021          TAD CURNLO
3334      3262  3274          DCA LSSALO
3335      3263  1020          TAD CURNHI
3336      3264  3275          DCA LSSAHI
3337      3265  1010          TAD INIPTR
3340      3266  3276          DCA LSINI
3341      3267  1022          TAD ENCPTR
3342      3270  3300          DCA LSENC
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3343    3271  5655          JMP I NXSTR
3344    3272  2320  KSET,   SETCDF
3345    3273  7757  INILEN, INISTR-INIEND-1
3346    3274  0000  LSSALO, 0
3347    3275  0000  LSSAHI, 0
3350    3276  0000  LSINI,  0
3351    3277  3306  KENC,   ENCVAL
3352    3300  0000  LSENC,  0
3353    3301  4060  P4060,  4060
3354    3302  4573  KTXT26, TXT2+6
3355    3303  6144  KADR,   INIAD-1
3356    3304  7776  CLKCNT, -2
3357    3305  4100  CLKMOD, 4100
3360    3306  0040  ENCVAL, 0040            /ENABLE CHAN 1
3361    3307  0010          0010            /"          " 2
3362    3310  0002          0002            /"          " 3
3363    3311  0000          0               /MUST HAVE 0
3364                                        /HERE
3365    3312  7200  QADUN,  CLA             /DONE SETUP
3366    3313  1052          TAD CNTR        /NUM OF DEV
3367    3314  7041          CIA
3370    3315  3036  STRRDE, DCA DEVNUM
3371    3316  1036          TAD DEVNUM
3372    3317  3510          DCA I KLAST     /VERY LAST
3373                                        /ENTRY IN
3374                                        /TABLE
3375    3320  1036          TAD DEVNUM
3376    3321  3052          DCA CNTR        /TRANSFER ALL
3377    3322  1106          TAD KINI        /INITIAL VALS
3400    3323  3010          DCA INIPTR
3401    3324  1303          TAD KADR
3402    3325  3011          DCA ADPTR
3403    3326  1273  LOP1,   TAD INILEN
3404    3327  3053          DCA BCNTR
3405    3330  1411  LOP2,   TAD I ADPTR     /1 ADDR
3406    3331  3104          DCA TEMP        /SAVE
3407    3332  1410          TAD I INIPTR    /1 VAL
3410    3333  3504          DCA I TEMP      /STORE
3411    3334  2053          ISZ BCNTR       /DONE A DEV ?
3412    3335  5330          JMP LOP2        /NO
3413    3336  2052          ISZ CNTR        /DONE ALL ?
3414    3337  5326          JMP LOP1
3415    3340  1304          TAD CLKCNT      /SET CLOCK FOR
3416    3341  6133          CLAB            /2 MS COUNT
3417    3342  7200          CLA             /SET 1MS TICK
3420    3343  1305          TAD CLKMOD      /AND INTERRUPT
3421    3344  6132          CLLR            /ON OVERFLOW
3422    3345  7200          CLA
3423    3346  3025          DCA QUECNT      /SET TTY QUE
3424    3347  1367          TAD KSTRQ       /PTRS AND CNT
3425    3350  3023          DCA QUEIN
3426    3351  1367          TAD KSTRQ
3427    3352  3024          DCA QUEOUT
3430    3353  7040          CMA
3431    3354  3103          DCA MODE        /SET A/D MODE
3432    3355  1366          TAD K210        /PUT CNTRL H
3433    3356  3021          DCA KBDBUF      /IN KEYBRD BUF
3434    3357  3022          DCA TTYFLG      /SET TTY FOR
3435    3360  1365          TAD KTTY        /NOT BUSY
3436    3361  3020          DCA ADMESS      /NO MESSAGES
3437    3362  6001          ION             /HANG IN IDLE
3440    3363  4465          JMS I KIDLE     /LOOP TISA WILL
3441    3364  5363          JMP .-1         /IMMEDIATELY
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3442    3365  0022  KTTY,   TTYFLG          /SWITCH INTO
3443    3366  0210  K210,   210             /PAUSE MODE
3444    3367  6373  KSTRQ,  STRQUE
3445                        PAGE
3446    3400  0000  P1DAC,   0               /ADD 1 TO DAC
3447    3401  7201          CLA IAC
3450    3402  3046          DCA ARGLO
3451    3403  3047          DCA ARGHI
3452    3404  4437          JMS I KDADD
3453    3405  5600          JMP I P1DAC
3454    3406  0000  LOHI,   0               /SA LO HI
3455    3407  1021          TAD CURNLO      /TO TABLE
3456    3410  3410          DCA I INIPTR
3457    3411  1020          TAD CURNHI
3460    3412  3410          DCA I INIPTR
3461    3413  1021          TAD CURNLO
3462    3414  3044          DCA DBLLO
3463    3415  1020          TAD CURNHI
3464    3416  3045          DCA DBLHI
3465    3417  4627          JMS I KKDCIA    /DBL PREC CIA
3466    3420  1044          TAD DBLLO       /=SA LO HI
3467    3421  3410          DCA I INIPTR    /TO TABLE
3470    3422  1045          TAD DBLHI
3471    3423  3410          DCA I INIPTR
3472    3424  3044          DCA DBLLO
3473    3425  3045          DCA DBLHI
3474    3426  5606          JMP I LOHI
3475    3427  3030  KKDCIA, DCIA
3476    3430  0000  GBLK,   0               /DETERMINE
3477                                        /BUFER LEN
3500                                        /AS A FCN OF
3501                                        /TBLKS FOR
3502                                        /TAPE ROUTS
3503    3431  7200          CLA
3504    3432  1023          TAD QUEIN       /=LAST USED
3505    3433  3044          DCA DBLLO       /CORE LOC
3506    3434  1024          TAD QUEOUT
3507    3435  3045          DCA DBLHI
3510    3436  1034          TAD MINADR
3511    3437  3046          DCA ARGLO
3512    3440  1033          TAD MINCDF
3513    3441  3047          DCA ARGHI
3514    3442  4437          JMS I KDADD     /DAC NOW=0
3515                                        /TOT CORE
3516                                        /LOCS USED
3517    3443  1260          TAD PL400
3520    3444  3046          DCA ARGLO
3521    3445  3047          DCA ARGHI
3522    3446  3053          DCA BCNTR
3523    3447  4437          JMS I KDADD     /ADD 400
3524    3450  2053          ISZ BCNTR       /COUNT TBLKS
3525    3451  7430          SZL             /DONE ?
3526    3452  5247          JMP .-3         /NO
3527    3453  7005          IAC RAL         /2 BLKS OF HDR
3530    3454  1053          TAD BCNTR
3531    3455  7041          CIA
3532    3456  3507          DCA I KBLKCT
3533    3457  5630          JMP I GBLK
3534    3460  0400  PL400,  400
3535    3461  0000  HLTMS,   0               /PUT HLT MESS
3536    3462  1314          TAD AHLTMS      /ADDR OF MESS
3537    3463  4505          JMS I KQUPUT    /INPUT MESS
3540    3464  4317          JMS NUMPUT      /DEV NUM TO QUE
```

```
3541    3465  1103          TAD MODE
3542    3466  7700          SMA CLA           /PAUSE MODE ?
3543    3467  5661          JMP I HLTMS       /YES
3544    3470  1036          TAD DEVNUM        /CHK FOR PAUSE
3545    3471  3053          DCA BCNTR         /ALL SELECT
3546    3472  7040          CMA               /WORDS MUST
3547    3473  1100          TAD SELPTR        /BE Ø
3550    3474  3011          DCA ADPTR
3551    3475  1411  HLTLOP, TAD I ADPTR
3552    3476  7640          SZA CLA           /DEV K HALTED ?
3553    3477  5661          JMP I HLTMS       /NO EXIT
3554    3500  2053          ISZ BCNTR         /CHKED ALL ?
3555    3501  5275          JMP HLTLOP        /NO
3556    3502  1316          TAD HALTAL        /PAUSE MODE
3557    3503  4505          JMS I KQUPUT      /INPUT MESS
3560    3504  3103          DCA MODE          /Ø=PAUSE
3561    3505  6134          CLEN              /CLR CLOCK
3562    3506  5661          JMP I HLTMS
3563    3507  0000  GOMS,    Ø                 /PUT GO MESS
3564    3510  1315          TAD AGOMS
3565    3511  4505          JMS I KQUPUT      /INPUT MESS
3566    3512  4317          JMS NUMPUT
3567    3513  5707          JMP I GOMS
3570    3514  6527  AHLTMS, MSHLT             /ADDR OF HLT MS
3571    3515  6550  AGOMS,  MSGO              /ADDR OF GO MS
3572    3516  6661  HALTAL, ALLHLT            /ADDR OF PAUSE
3573                                          /MODE MESS
3574    3517  0000  NUMPUT, Ø
3575    3520  1104          TAD TEMP
3576    3521  1326          TAD KNUM
3577    3522  3003          DCA BETA1
3600    3523  1403          TAD I BETA1
3601    3524  4505          JMS I KQUPUT
3602    3525  5717          JMP I NUMPUT
3603    3526  6522  KNUM,   NUMØ
3604                                          /X-Y TABLE
3605                                          /FOR DSC OF
3606                                          /X=----
3607                                          /Y=---
3610                        LMODE
3611    1527  3075  DCODEX, 3075              /X, =
3612    1530  4300          CR1 ØØ            /EOL, 100K
3613    1531  0000          0000              /10K, 1K
3614    1532  0000          0000              /100, 10
3615    1533  0043          ØØ CR             /UNITS, EOL
3616    1534  3175  DCODEY, 3175              /Y, =
3617    1535  4300          CR1 ØØ            /EOL, 100
3620    1536  0000          0000              /10, UNITS
3621    1537  7700          ENDWD1            /EOM
3622                                          /TABLE OF VERT
3623                                          /COORDS FOR
3624                                          /HELP FRAME
3625                                          /DISPLAY
3626    1540  0340  VCTAB,  340               /D DIAL
3627    1541  0240          240               /A/D MODE
3630    1542  0200          200               /CTRL/H
3631    1543  0160          160               /HN
3632    1544  0140          140               /P
3633    1545  0120          120               /F
3634    1546  0020          20                /PAUSE MODE
3635    1547  7757          -20               /GN
3636    1550  7737          -40               /S
3637    1551  7717          -60               /W
```

```
3640      1552  7677          -100            /C
3641      1553  7657          -120            /M
3642      1554  7637          -140            /L
3643      1555  7617          -160            /P
3644      1556  7577          -200            /F
3645                                          /TABLE OF HORIZ
3646                                          /COORDS
3647      1557  0020  HCTAB,   20              /D
3650      1560  0260          260             /DIAL
3651      1561  0164          164             /A/D
3652      1562  0354          354             /MODE
3653      1563  0310          310             /CTRL/H
3654      1564  0454          454             /HALT ALL
3655      1565  0310          310             /HN
3656      1566  0454          454             /HLT INST
3657      1567  0310          310             /P
3660      1570  0454          454             /POLARITY
3661      1571  0276          276             /F
3662      1572  0454          454             /FREEZE
3663      1573  0164          164             /PAUSE
3664      1574  0354          354             /MODE
3665      1575  0310          310             /GN
3666      1576  0454          454             /GO
3667      1577  0310          310             /S
3670      1600  0454          454             /SETUP
3671      1601  0310          310             /W
3672      1602  0454          454             /WRITE
3673      1603  0310          310             /C
3674      1604  0454          454             /CATACAL
3675      1605  0310          310             /M
3676      1606  0454          454             /MAGSPY
3677      1607  0310          310             /L
3700      1610  0454          454             /LOADER
3701      1611  0310          310             /P
3702      1612  0454          454             /POLARITY
3703      1613  0276          276             /F
3704      1614  0454          454             /FREEZE
3705                  /DIAL ENCODED MESSAGE
3706                  /FORMAT IS:
3707                  /D          DIAL
3710                  /
3711                  /
3712                  /   A/D    MODE
3713                  /
3714                  /        CTRL/H   HALT ALL INSTRUMENTS
3715                  /        HN       HALT INSTRUMENT N
3716                  /        P        POLARITY
3717                  /        F        FREEZE
3720                  /
3721                  /   PAUSE  MODE
3722                  /        GN       GO INSTRUMENT N
3723                  /        S        SETUP
3724                  /        W        WRITE TAPE
3725                  /        C        CATACAL
3726                  /        M        MAGSPY
3727                  /        L        LOADER
3730                  /        P        POLARITY
3731                  /        F        FREEZE
3732      1615  0604
3732      1616  3604
3732      1617  1101
3732                  HLPTAB, TEXT 9FD↑DIAL
3733      1620  1443
```

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3733      1621  0601
3733      1622  5704
3733      1623  3615
3733      1624  1704
3733                  FA/D↑MODE
3734      1625  0543
3734      1626  0324
3734      1627  2214
3734      1630  5710
3734      1631  3610
3734      1632  0114
3734      1633  2440
3734      1634  0114
3734      1635  1440
3734      1636  1116
3734      1637  2324
3734      1640  2225
3734      1641  1505
3734      1642  1624
3734                  CTRL/H↑HALT ALL INSTRUMENTS
3735      1643  2343
3735      1644  1016
3735      1645  3610
3735      1646  0114
3735      1647  2440
3735      1650  1116
3735      1651  2324
3735      1652  2225
3735      1653  1505
3735      1654  1624
3735                  HN↑HALT INSTRUMENT N
3736      1655  4016
3736      1656  4320
3736      1657  3620
3736      1660  1714
3736      1661  0122
3736      1662  1124
3736                  P↑POLARITY
3737      1663  3143
3737      1664  4006
3737      1665  3606
3737      1666  2205
3737      1667  0532
3737                   F↑FREEZE
3740      1670  0543
3740      1671  0620
3740      1672  0125
3740      1673  2305
3740      1674  3615
3740      1675  1704
3740                  FPAUSE↑MODE
3741      1676  0543
3741      1677  0716
3741      1700  3607
3741      1701  1740
3741      1702  1116
3741      1703  2324
3741      1704  2225
3741      1705  1505
3741      1706  1624
3741                  GN↑GO INSTRUMENT N
3742      1707  4016
3742      1710  4323
```

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3742      1711  3623
3742      1712  0524
3742                  S↑SETUP
3743      1713  2520
3743      1714  4327
3743      1715  3627
3743      1716  2211
3743      1717  2405
3743      1720  4024
3743      1721  0120
3743                  W↑WRITE TAPE
3744      1722  0543
3744      1723  0336
3744      1724  0301
3744      1725  2401
3744      1726  0301
3744                  C↑CATACAL
3745      1727  1443
3745      1730  1536
3745      1731  1501
3745      1732  0723
3745                  M↑MAGSPY
3746      1733  2031
3746      1734  4314
3746      1735  3614
3746      1736  1701
3746      1737  0405
3746                  L↑LOADER
3747      1740  2243
3747      1741  2036
3747      1742  2017
3747      1743  1401
3747      1744  2211
3747                  P↑POLARITY
3750      1745  2431
3750      1746  4340
3750      1747  0636
3750      1750  0622
3750      1751  0505
3750                   F↑FREEZE
3751      1752  3205
3751      1753  4377
3751                  ?9
3752      1754  0000  AAAS1,  Ø
3753                  /QANDA AND SETUP ROUTINES
3754                          SEGMNT 2
3755                          QAFLD=4000
3756                          *1                /ONCE ONLY
3757      0001  1020          LDA I
3760      0002  0010          EXTMTP            /NO PAUSE
3761      0003  0001          AXO
3762      0004  0707          CHK
3763      0005  0270          270
3764      0006  0603          LIF 3             /DETERMINE
3765      0007  7001          JMP MEMCHK        /CORE SIZE
3766                                            /RTN TO SETUP
3767                          *15
3770      0015  0643  DIAL,   LDF 3             /RESTART
3771      0016  0721          RCG I             /DIAL
3772      0017  7300          7300
3773      0020  6023  START,  JMP SETUP
3774      0021  0440  CHKSNS, SNS Ø             /INIT SETUP
3775      0022  7066          JMP QARFSH        /ON SSWØ=1
```

```
3776      0023  0002  SETUP,  PDP
3777                          PMODE
4000      4024  4763          JMS I KFRSTR      /INIT ALL
4001      4025  6141          LINC              /DSC
4002                          LMODE             /PARAM INPUT
4003      0026  7013  MESS1,   JMP QAINIT       /DO -
4004      0027  0535          TXT1              /1 LINC TAPE
4005      0030  0524          ANSWER            /2 KEYBOARD
4006      0031  6021          JMP CHKSNS
4007      0032  1300          LDH
4010      0033  4524          ANSWER+HBIT
4011      0034  1420          SHD I
4012      0035  6100          6100              /READ ?
4013      0036  6344          JMP READ          /YES
4014      0037  1460          SAE I
4015      0040  0062          62                /KEYBRD ?
4016      0041  6026          JMP MESS1         /NO ERROR
4017      0042  0002          PDP
4020                          PMODE             /INIT ARGS FOR
4021      4043  4764  MESS2,  JMS I KRESTR      /DEV K
4022      4044  4773          JMS I KLOHI
4023      4045  6141          LINC              /DSC
4024                          LMODE             /INST K IS -
4025      0046  7013  REMS2,  JMP QAINIT       /(1=ANA, 2=ENC)
4026      0047  0565          TXT2              /ST PNT =====
4027      0050  0524          ANSWER            /TOT PT =====
4030      0051  6021          JMP CHKSNS        /SAM FREQ =-
4031      0052  0074          SET I ANSPTR
4032      0053  0525          ANSWER+1
4033      0054  1300          LDH               /CHK ANA OR
4034      0055  4524          ANSWER+HBIT       /ENC
4035      0056  1420          SHD I
4036      0057  6100          6100              /ANALOG ?
4037      0060  6073          JMP SETANA        /YES
4040      0061  1460          SAE I
4041      0062  0062          62                /ENCODED ?
4042      0063  6046          JMP REMS2         /NO ERROR
4043      0064  0002          PDP
4044                          PMODE
4045      4065  7200          CLA
4046      4066  1422          TAD I ENCPTR      /ANY MORE
4047      4067  7450          SNA               /ENCODERS ?
4050      4070  5765          JMP I KERENC      /NO ENC ERROR
4051      4071  2022          ISZ ENCPTR        /SET FOR NXT
4052      4072  5276          JMP A1CONT
4053                          LMODE
4054      0073  1020  SETANA, LDA I
4055      0074  4000          ANAVAL
4056      0075  0002          PDP
4057                          PMODE
4060      4076  3410  A1CONT, DCA I INIPTR      /SELECT WD TO
4061                                            /INIT TABLE
4062      4077  2052          ISZ CNTR          /UP DV CNT
4063                                            /X COORD DV K
4064      4100  4463  A2LOP,  JMS I KDIG        /GET 1 DIGIT
4065                                            /FROM QA FLD
4066      4101  5243          JMP MESS2         /INPUT ERROR
4067      4102  5305          JMP A2CONT        /DONE QA FLD
4070      4103  4766          JMS I KDSCL4      /1 BCD VAL IS
4071                                            /AC SCALE AND
4072                                            /PACK IN DAC
4073      4104  5300          JMP A2LOP
4074      4105  4767  A2CONT, JMS I KUPACK      /UNPACK AND PUT
=
```

```
4075                                                    /IN TABLE
4076                                                    /TOTAL POINTS
4077        4106    4463    A3LOP,  JMS I KDIG          /GET 1 DIGIT
4100        4107    5243            JMP MESS2           /INPUT ERROR
4101        4110    5313            JMP A3CONT          /DONE QA FLD
4102        4111    4464            JMS I KMUL10        /DECIMAL TO
4103                                                    /OCTAL CVERT
4104                                                    /ANSWER IN DAC
4105        4112    5306            JMP A3LOP
4106        4113    7200    A3CONT, CLA                 /CHK FOR
4107        4114    1044            TAD DBLLO           /NO POINTS
4110        4115    7640            SZA CLA
4111        4116    5322            JMP NOT0
4112        4117    1045            TAD DBLHI
4113        4120    7650            SNA CLA
4114        4121    5770            JMP I KER0PT        /ERR 0 PTS
4115        4122    1021    NOT0,   TAD CURNLO          /GET ST ADDR
4116        4123    3046            DCA ARGLO           /NXT DV
4117        4124    1020            TAD CURNHI          /=TOT PTS+
4120        4125    3047            DCA ARGHI           /ST ADDR DV K
4121        4126    4437            JMS I KDADD
4122        4127    1044            TAD DBLLO           /SAVE NXT SA
4123        4130    3021            DCA CURNLO
4124        4131    1045            TAD DBLHI
4125        4132    3020            DCA CURNHI
4126        4133    4771            JMS I KDCIA         /2S COM DAC
4127        4134    1044            TAD DBLLO
4130        4135    3410            DCA I INIPTR        /=SA ADDR
4131        4136    1045            TAD DBLHI           /NEXT DEV
4132        4137    3410            DCA I INIPTR
4133        4140    1044            TAD DBLLO           /SAVE FOR
4134        4141    3023            DCA QUEIN           /GBLK SR
4135        4142    1045            TAD DBLHI
4136        4143    3024            DCA QUEOUT
4137        4144    4774            JMS I KP1DAC
4140        4145    1044            TAD DBLLO           /=END ADDR
4141        4146    3410            DCA I INIPTR        /DEV K
4142        4147    1045            TAD DBLHI
4143        4150    3410            DCA I INIPTR
4144                                                    /CHK FOR
4145        4151    1032            TAD MAXCDF          /BUFFER FULL
4146        4152    3047            DCA ARGHI
4147        4153    7040            CMA
4150        4154    3046            DCA ARGLO
4151        4155    4437            JMS I KDADD         /IF -END ADR IS
4152                                                    /GT BUF LEN
4153                                                    /BUF IS EXCEDED
4154        4156    7420            SNL                 /IS DAC = ?
4155        4157    5762            JMP I KCONMS
4156        4160    4772            JMS I KERFUL        /YES BUF ERROR
4157        4161    5243            JMP MESS2
4160        4162    4200    KCONMS, CONMS2
4161        4163    3200    KFRSTR, FRSTR
4162        4164    3233    KRESTR, RESTR
4163        4165    4303    KERENC, ERRENC
4164        4166    3043    KDSCL4, DSCL4
4165        4167    3055    KUPACK, UPACK
4166        4170    4311    KER0PT, ERR0PT
4167        4171    3030    KDCIA,  DCIA
4170        4172    4317    KERFUL, ERRFUL
4171        4173    3406    KLOHI,  LOHI
4172        4174    3400    KP1DAC, P1DAC
4173                        *QAFLD+200
=
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4174    4200  1044  CONMS2, TAD DBLLO
4175    4201  7640          SZA CLA          /SET BUFF FULL
4176    4202  5207          JMP OK2
4177    4203  1045          TAD DBLHI        /SWITCH
4200    4204  7640          SZA CLA          /7777=FULL
4201    4205  5207          JMP OK2
4202    4206  7040          CMA              /ITS FULL
4203    4207  3026  OK2,    DCA STATUS
4204    4210  3044          DCA DBLLO        /SAM FREQ
4205    4211  4463  A4,     JMS I KDIG       /1 DIGIT
4206    4212  5700          JMP I KMESS2     /INPUT ERROR
4207    4213  5216          JMP A4CONT       /DONE QA FLD
4210    4214  4464          JMS I KMUL10     /DEC TO OCT
4211    4215  5211          JMP A4
4212    4216  7200  A4CONT, CLA
4213    4217  1044          TAD DBLLO        /CHK GT 10
4214    4220  1301          TAD NEG12
4215    4221  7740          SMA SZA CLA
4216    4222  5327          JMP ERFREQ       /ERROR FREQ
4217    4223  1044          TAD DBLLO        /SET 0=1
4220    4224  7450          SNA
4221    4225  7001          IAC
4222    4226  7041          CIA              /- FREQ TO TAB
4223    4227  3050          DCA TEMPLO
4224    4230  1050          TAD TEMPLO
4225    4231  3410          DCA I INIPTR
4226    4232  1050          TAD TEMPLO
4227    4233  3410          DCA I INIPTR
4230    4234  1050          TAD TEMPLO
4231    4235  3410          DCA I INIPTR
4232    4236  6141          LINC             /DSC
4233                        LMODE            /DO -
4234    0237  7013  MESS3,  JMP QAINIT       /1 MORE INSTS
4235    0240  0650          TXT3             /2 START
4236    0241  0524          ANSWER
4237    0242  6021          JMP CHKSNS
4240    0243  1300          LDH
4241    0244  4524          ANSWER+HBIT
4242    0245  1420          SHD I
4243    0246  6200          6200             /START ?
4244    0247  6270          JMP ALLDUN       /YES
4245    0250  1460          SAE I
4246    0251  0061          61               /MORE DVS ?
4247    0252  6237          JMP MESS3        /NO ERROR
4250    0253  0002          PDP
4251                        PMODE            /CHK FOR NO
4252    4254  7200          CLA              /MORE DEVICES
4253    4255  1052          TAD CNTR         /=NUM DEFINED
4254    4256  1061          TAD MAXDVN       /=-NUM ALLOWED
4255    4257  7650          SNA CLA
4256    4260  5335          JMP ERRDEV       /ERROR NO MORE
4257                                         /DEVICES
4260    4261  1026          TAD STATUS       /CHK FOR NO
4261    4262  7700          SMA CLA          /MORE PTS
4262    4263  5266          JMP OK1
4263    4264  4317          JMS ERRFUL       /NONE LEFT FOR
4264    4265  5236          JMP MESS3-1      /NEXT DEV
4265    4266  4677  OK1,    JMS I KNXSTR     /SET ARGS FOR
4266                                         /DEVICE K+1
4267    4267  5700          JMP I KMESS2     /DO IT ALL
4270                                         /OVER AGAIN
4271                        LMODE
4272    0270  1020  ALLDUN, LDA I
*
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4273    0271  0020          20              /I\O PRESET
4274    0272  0004          ESF
4275    0273  0002          PDP
4276                        PMODE
4277    4274  4702          JMS I KGBLK     /GET BLK CNT
4300    4275  5676          JMP I .+1
4301    4276  3312          QADUN
4302    4277  3255  KNXSTR, NXSTR
4303    4300  4043  KMESS2, MESS2
4304    4301  7766  NEG12,  -12
4305    4302  3430  KGBLK,  GBLK
4306    4303  6141  ERRENC, LINC
4307                        LMODE           /DSC
4310    0304  7013          JMP QAINIT      /ERR ENC
4311    0305  1006          TXT14
4312    0306  0000          0
4313    0307  6021          JMP CHKSNS
4314    0310  6046          JMP REMS2
4315    0311  6141  ERRØPT, 6141            /LINC
4316    0312  7013          JMP QAINIT      /DSC
4317    0313  0757          TXT10           /ERR Ø PTS
4320    0314  0000          0
4321    0315  6021          JMP CHKSNS
4322    0316  6042          JMP MESS2-1
4323    0317  0000  ERRFUL, 0
4324    0320  6141          6141            /LINC
4325    0321  7013          JMP QAINIT      /DSC
4326    0322  0765          TXT11           /ERR BUF FULL
4327    0323  0000          0
4330    0324  6021          JMP CHKSNS
4331    0325  0002          PDP
4332                        PMODE
4333    4326  5717          JMP I ERRFUL
4334                        LMODE
4335    0327  6141  ERFREQ, 6141            /DSC
4336    0330  7013          JMP QAINIT      /ERR FREQ
4337    0331  0774          TXT12
4340    0332  0000  FREE,   0
4341    0333  6021          JMP CHKSNS
4342    0334  6042          JMP MESS2-1
4343    0335  6141  ERRDEV, 6141            /DSC
4344    0336  7013          JMP QAINIT      /ERR DEV
4345    0337  1001          TXT13
4346    0340  0000          0
4347    0341  6021          JMP CHKSNS
4350    0342  6237          JMP MESS3
4351    0343  6141          6141            /LINC
4352    0344  7013  READ,   JMP QAINIT      /DSC
4353    0345  0705          TXT5            /READ TBLK ---
4354    0346  0524          ANSWER          /UNIT -
4355    0347  6021          JMP CHKSNS
4356    0350  0074          SET I ANSPTR
4357    0351  0524          ANSWER
4360    0352  0002          PDP
4361                        PMODE
4362    4353  5754          JMP I .+1
4363    4354  1664          DORDC
4364                        PAGE
4365    4400  6002  WRIT,   IOF             /IGNORE KBRD
4366                                        /DURING WRITE
4367    4401  1507          TAD I KBLKCT    /-NUM TO DO
4370    4402  7041          CIA
4371    4403  6141          LINC
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4372                                LMODE
4373      0404  4332                STC FREE
4374      0405  0074                SET I ANSPTR      /PUT TBLK
4375      0406  0723                TXT6+3            /NUM (3 DIGITS)
4376      0407  2332                ADD FREE          /IN QANDA TEXT
4377      0410  0306                ROR 6             /AT TXT6+3,
4400      0411  1560                BCL I             /TXT6+4,
4401      0412  7770                7770              /AND TXT6+5
4402      0413  2513                ADD PL60
4403      0414  1374                STH I ANSPTR
4404      0415  1000                LDA
4405      0416  0332                FREE
4406      0417  0303                ROR 3
4407      0420  1560                BCL I
4410      0421  7770                7770
4411      0422  2513                ADD PL60
4412      0423  1374                STH I ANSPTR
4413      0424  1000                LDA
4414      0425  0332                FREE
4415      0426  1560                BCL I
4416      0427  7770                7770
4417      0430  2513                ADD PL60
4420      0431  1374                STH I ANSPTR
4421      0432  0643                LDF 3             /EXP NAME
4422      0433  7013                JMP QAINIT        /--------
4423      0434  0672                TXT4
4424      0435  2005                ANS4+2000
4425      0436  7066                JMP QARFSH
4426      0437  1020                LDA I             /PATCH SPACE
4427      0440  0040                40                /AROUND NAME
4430      0441  1340                STH               /FOR MAGSPY
4431      0442  2005                ANS4+2000
4432      0443  7013                JMP QAINIT        /DSC
4433      0444  0720                TXT6              /WRITE ---
4434      0445  0524                ANSWER            /TBLKS
4435      0446  7066                JMP QARFSH        /1ST TBLK ---
4436      0447  0074                SET I ANSPTR      /UNIT -
4437      0450  0524                ANSWER
4440      0451  0002                PDP
4441                                PMODE
4442      4452  5653                JMP I .+1
4443      4453  1746                DOWRC
4444                                LMODE
4445      0454  7013  LOAD,         JMP QAINIT        /DSC
4446      0455  0747                TXT7              /LOAD --------
4447      0456  0524                ANSWER            /UNIT -
4450      0457  7066                JMP QARFSH
4451      0460  1300                LDH
4452      0461  4524                ANSWER+HBIT
4453      0462  0470                AZE I
4454      0463  6454                JMP LOAD
4455      0464  0600                LIF 0
4456      0465  7525                JMP KLOAD
4457      0466  0000  DIGCHK,       0                 /CHK NUMERIC
4460      0467  6141                6141              /INPUT
4461      0470  1334  DLOOP,        LDH I ANSPTR      /FROM QA FLD
4462      0471  1420                SHD I
4463      0472  7400                QAEOL1
4464      0473  6517                JMP EOLXIT-QAFLD
4465      0474  0470                AZE I             /BLANK INPUT ?
4466      0475  6470                JMP DLOOP         /YES IGNORE
4467      0476  1420                SHD I
4470      0477  3400                QAEOM1
-
```

```
4471    0500  6517          JMP EOLXIT-QAFLD
4472    0501  1120          ADA I
4473    0502  7720          -57
4474    0503  0451          APO               /DIGIT ?
4475    0504  6522          JMP ERRXIT-QAFLD/NO ILLEGAL
4476                                          /INPUT
4477    0505  1120          ADA I
4500    0506  7765  UPLIM,  -12               /-10 OR -12
4501    0507  0471          APO I             /DIGIT ?
4502    0510  6522          JMP ERRXIT-QAFLD
4503    0511  1314          LDH ANSPTR
4504    0512  1560          BCL I             /PUT DIGIT
4505    0513  0060  PL60,   60                /IN AC
4506    0514  0002          PDP
4507                        PMODE
4510    4515  2266          ISZ DIGCHK        /P+3 IS NORMAL
4511    4516  7410          SKP
4512    4517  0002  EOLXIT, 2                 /PDP
4513    4520  2266          ISZ DIGCHK        /P+2 IS EOL
4514    4521  7410          SKP
4515    4522  0002  ERRXIT, 2                 /P+1 IS ERR
4516    4523  5666          JMP I DIGCHK      /RTN
4517                        LMODE
4520    0524  0000  ANSWER, 0
4521    0525  0000          0
4522    0526  0000          0
4523    0527  0000          0
4524    0530  0000          0
4525    0531  0000          0
4526    0532  0000          0
4527    0533  0000          0
4530    0534  0000          0
4531    0535  0620
4532    0536  0122
4533    0537  0115
4534    0540  0124
4535    0541  0122
4536    0542  4011
4537    0543  1620
4540                  TXT1,   TEXT ?FPARAMETER INPUT
4541    0544  2524
4542    0545  4506
4543    0546  0417
4544                  FDO<1
4545    0547  7401
4546    0550  4506
4547    0551  0140
4550    0552  1411
4551    0553  1003
4552    0554  4024
4553    0555  0120
4554                  F1 LINC TAPE
4555    0556  0043
4556    0557  0002
4557    0560  4013
4560    0561  0531
4561    0562  0217
4562    0563  0122
4563    0564  0434
4564                  F2 KEYBOARD\?
4565    0565  0911
4566    0566  1623
4567    0567  2422
```

```
4535        0570   2215
4535        0571   0210
4535        0572   2440
4535        0573   5051
4535        0574   4011
4535        0575   2374
4535                      TXT2,   TEXT ?FINSTRUMENT XY IS<1
4536        0576   0143
4536
4537        0577   4043
4537        0600   4040
4537        0601   4040
4537        0602   5061
4537        0603   7501
4537        0604   1601
4537        0605   1417
4537        0606   0754
4537        0607   4062
4537        0610   7505
4537        0611   1605
4537        0612   1704
4537        0613   0504
4537                      (1=ANALOG, 2=ENCODED)
4540        0614   5143
4540        0615   0025
4540        0616   2401
4540        0617   2224
4540        0620   1116
4540        0621   0740
4540        0622   2017
4540        0623   1116
4540        0624   2475
4540                      FSTARTING POINT=<5
4541        0625   7465
4541        0626   4006
4541        0627   2417
4541        0630   2401
4541        0631   1440
4541        0632   2017
4541        0633   1116
4541        0634   2423
4541        0635   7574
4541                      FTOTAL POINTS=<5
4542        0636   6543
4542        0637   0623
4542        0640   0115
4542        0641   2014
4542        0642   1116
4542        0643   0740
4542        0644   0622
4542        0645   0521
4542        0646   7574
4542        0647   6234
4542                      FSAMPLING FREQ=<2\?
4543        0650   0604
4543        0651   1774
4543                      TXT3,   TEXT ?FDO<1
4544        0652   6143
4544        0653   0561
4544        0654   4015
4544        0655   1722
4544        0656   0540
4544        0657   1116
```

```
4544      0660  2324
4544      0661  2225
4544      0662  1505
4544      0663  1024
4544                  F1 MORE INSTRUMENTS
4545      0664  2343
4545      0665  0662
4545      0666  4023
4545      0667  2401
4545      0670  2224
4545      0671  3400
4545                  F2 START\?
4546      0672  0605
4546      0673  3020
4546      0674  0522
4546      0675  1115
4546      0676  0516
4546      0677  2440
4546      0700  1601
4546                  TXT4,   TEXT ?FEXPERIMENT NAME
4547      0701  1505
4547      0702  4306
4547      0703  7470
4547      0704  3400
4547                  F<8\?
4550      0705  0622
4550      0706  0501
4550      0707  0440
4550      0710  2402
4550      0711  1413
4550                  TXT5,   TEXT ?FREAD TBLK<3
4551      0712  7463
4551      0713  4306
4551      0714  2516
4551      0715  1124
4551      0716  7461
4551      0717  3400
4551                  FUNIT<1\?
4552      0720  0627
4552      0721  2211
4552      0722  2405
4552      0723  4030
4552      0724  3132
4552      0725  4050
4552      0726  1703
4552      0727  2451
4552      0730  4024
4552      0731  0214
4552                  TXT6,   TEXT ?FWRITE XYZ (OCT) TBLKS
4553      0732  1323
4553      0733  4306
4553      0734  0611
4553      0735  2223
4553      0736  2440
4553      0737  2402
4553      0740  1413
4553      0741  7574
4553                  FFIRST TBLK#<3
4554      0742  6343
4554      0743  0625
4554      0744  1611
4554      0745  2474
4554      0746  6134
```

```
4554                        FUNIT<1\?
4555        0747    0614
4555        0750    1701
4555        0751    0474
4555                        TXT7,   TEXT ?FLOAD<8
4556        0752    7043
4556        0753    0625
4556        0754    1611
4556        0755    2474
4556        0756    6134
4556                        FUNIT<1\?
4557        0757    0605
4557        0760    2222
4557        0761    4060
4557        0762    4020
4557        0763    2423
4557        0764    3400
4557                        TXT10,  TEXT ?FERR Ø PTS\?
4560        0765    0605
4560        0766    2222
4560        0767    4002
4560        0770    2506
4560        0771    4006
4560        0772    2514
4560        0773    1434
4560                        TXT11,  TEXT ?FERR BUF FULL\?
4561        0774    0605
4561        0775    2222
4561        0776    4006
4561        0777    2205
4561        1000    2134
4561                        TXT12,  TEXT ?FERR FREQ\?
4562        1001    0605
4562        1002    2222
4562        1003    4011
4562        1004    1623
4562        1005    2434
4562                        TXT13,  TEXT ?FERR INST\?
4563        1006    0605
4563        1007    2222
4563        1010    4005
4563        1011    1603
4563        1012    3400
4563                        TXT14,  TEXT ?FERR ENC\?
4564                        NOLIST
5530        1701    0000    AAAS2,  Ø
5531                        SEGMNT 3
5532                        *1
5533        0001    4040    FIRST,  4040            /SPACE FMT
5534        0002    4040            4040            /AROUND NAME
5535        0003    4040            4040            /FOR MAGSPY
5536        0004    4040            4040
5537        0005    0000    ANS4,   Ø               /EXPERIMENT
5540        0006    0000            Ø               /NAME
5541        0007    0000            Ø
5542        0010    0000            Ø
5543        0011    0000            Ø
5544        0012    4040            4040
5545        0013    4040            4040
5546        0014    4040            4040
5547        0015    4040            4040
5550                                PMODE
5551                    /INITIALIZATION TABLE FILLED BY
```

```
5552                    /SETUP AND READ ROUTS
5553                    /17 VALUES PER DEVICE 4 DEVICES
5554      6016  0001    INISTR, 1               /SA LO
5555      6017  0002            2               /SA HI
5556      6020  0003            3               /-SA LO
5557      6021  0004            4               /-SA HI
5560      6022  0005            5               /SELECT WORD
5561      6023  0006            6               /X COORD 1S
5562      6024  0007            7               /10S
5563      6025  0010            8               /100S
5564      6026  0011            9               /1000S
5565      6027  0010            10              /10000S
5566      6030  0011            11              /-SA LO NXT DV
5567      6031  0012            12              /-SA HI NXT DV
5570      6032  0013            13              /-(EA LO,EA HI)
5571      6033  0014            14              /
5572      6034  0015            15              /-SAM FREQ
5573      6035  0016            16              /-SAM FREQ
5574      6036  0017    INIEND, 17              /-SAM FREQ
5575      6037  0001            1               /DEVICE 1
5576      6040  0002            2
5577      6041  0003            3
5600      6042  0004            4
5601      6043  0005            5
5602      6044  0006            6
5603      6045  0007            7
5604      6046  0010            8
5605      6047  0011            9
5606      6050  0010            10
5607      6051  0011            11
5610      6052  0012            12
5611      6053  0013            13
5612      6054  0014            14
5613      6055  0015            15
5614      6056  0016            16
5615      6057  0017            17
5616      6060  0001            1               /DEVICE 2
5617      6061  0002            2
5620      6062  0003            3
5621      6063  0004            4
5622      6064  0005            5
5623      6065  0006            6
5624      6066  0007            7
5625      6067  0010            8
5626      6070  0011            9
5627      6071  0010            10
5630      6072  0011            11
5631      6073  0012            12
5632      6074  0013            13
5633      6075  0014            14
5634      6076  0015            15
5635      6077  0016            16
5636      6100  0017            17
5637      6101  0001            1               /DEVICE 3
5640      6102  0002            2
5641      6103  0003            3
5642      6104  0004            4
5643      6105  0005            5
5644      6106  0006            6
5645      6107  0007            7
5646      6110  0010            8
5647      6111  0011            9
5650      6112  0010            10
```

```
5651    6113  0011          11
5652    6114  0012          12
5653    6115  0013          13
5654    6116  0014          14
5655    6117  0015          15
5656    6120  0016          16
5657    6121  0017          17
5660    6122  0001          1                 /DEVICE 4
5661    6123  0002          2
5662    6124  0003          3
5663    6125  0004          4
5664    6126  0005          5
5665    6127  0006          6
5666    6130  0007          7
5667    6131  0010          8
5670    6132  0011          9
5671    6133  0010          10
5672    6134  0011          11
5673    6135  0012          12
5674    6136  0013          13
5675    6137  0014          14
5676    6140  0015          15
5677    6141  0016          16
5700    6142  0017          17
5701    6143  0000  BLKCNT, 0
5702    6144  0000  LAST,   0
5703                /TABLE OF ADDR THAT TELL WHERE
5704                /INIT VALS GO
5705    6145  6272  INIAD,  TISTR0            /DEVICE 0
5706    6146  6273          TISTR0+1
5707    6147  6443          LIMVL0
5710    6150  6444          LIMVL0+1
5711    6151  6274          TISTR0+2
5712    6152  6471          BCD0
5713    6153  6472          BCD0+1
5714    6154  6473          BCD0+2
5715    6155  6474          BCD0+3
5716    6156  6475          BCD0+4
5717    6157  6447          LIMVL1
5720    6160  6450          LIMVL1+1
5721    6161  0314          ELODV0
5722    6162  0315          EHIDV0
5723    6163  6275          TISTR0+3
5724    6164  6276          TISTR0+4
5725    6165  6445          LIMVL0+2
5726    6166  6277          TISTR1            /DEVICE 1
5727    6167  6300          TISTR1+1
5730    6170  6447          LIMVL1
5731    6171  6450          LIMVL1+1
5732    6172  6301          TISTR1+2
5733    6173  6476          BCD1
5734    6174  6477          BCD1+1
5735    6175  6500          BCD1+2
5736    6176  6501          BCD1+3
5737    6177  6502          BCD1+4
5740    6200  6453          LIMVL2
5741    6201  6454          LIMVL2+1
5742    6202  0336          ELODV1
5743    6203  0337          EHIDV1
5744    6204  6302          TISTR1+3
5745    6205  6303          TISTR1+4
5746    6206  6451          LIMVL1+2
5747    6207  6304          TISTR2            /DEVICE 2
```

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5750    6210  6305          TISTR2+1
5751    6211  6453          LIMVL2
5752    6212  6454          LIMVL2+1
5753    6213  6306          TISTR2+2
5754    6214  6503          BCD2
5755    6215  6504          BCD2+1
5756    6216  6505          BCD2+2
5757    6217  6506          BCD2+3
5760    6220  6507          BCD2+4
5761    6221  6457          LIMVL3
5762    6222  6460          LIMVL3+1
5763    6223  0415          ELODV2
5764    6224  0416          EHIDV2
5765    6225  6307          TISTR2+3
5766    6226  6310          TISTR2+4
5767    6227  6455          LIMVL2+2
5770    6230  6311          TISTR3          /DEVICE 3
5771    6231  6312          TISTR3+1
5772    6232  6457          LIMVL3
5773    6233  6460          LIMVL3+1
5774    6234  6313          TISTR3+2
5775    6235  6510          BCD3
5776    6236  6511          BCD3+1
5777    6237  6512          BCD3+2
6000    6240  6513          BCD3+3
6001    6241  6514          BCD3+4
6002    6242  6463          LIMVL4
6003    6243  6464          LIMVL4+1
6004    6244  0440          ELODV3
6005    6245  0441          EHIDV3
6006    6246  6314          TISTR3+3
6007    6247  6315          TISTR3+4
6010    6250  6461          LIMVL3+2
6011    6251  6316          TISTR4          /DEVICE 4
6012    6252  6317          TISTR4+1
6013    6253  6463          LIMVL4
6014    6254  6464          LIMVL4+1
6015    6255  6320          TISTR4+2
6016    6256  6515          BCD4
6017    6257  6516          BCD4+1
6020    6260  6517          BCD4+2
6021    6261  6520          BCD4+3
6022    6262  6521          BCD4+4
6023    6263  6467          LIMVL5
6024    6264  6470          LIMVL5+1
6025    6265  0463          ELODV4
6026    6266  0464          EHIDV4
6027    6267  6321          TISTR4+3
6030    6270  6322          TISTR4+4
6031    6271  6465          LIMVL4+2
6032                /TABLE OF VALUES FOR GO ROUTS
6033                /5 PER DEVICE
6034    6272  0001  TISTR0, 1             /SALO
6035    6273  0002          2             /SAHI
6036    6274  0003          3             /SELECT WD
6037    6275  0004          4             /+SAM FREQ
6040    6276  0005          5             /-SAM FREQ
6041    6277  0001  TISTR1, 1             /DV1
6042    6300  0002          2
6043    6301  0003          3
6044    6302  0004          4
6045    6303  0005          5
6046    6304  0001  TISTR2, 1             /DV2
```

```
6047    6305  0002          2
6050    6306  0003          3
6051    6307  0004          4
6052    6310  0005          5
6053    6311  0001  TISTR3,  1                /DV3
6054    6312  0002          2
6055    6313  0003          3
6056    6314  0004          4
6057    6315  0005          5
6060    6316  0001  TISTR4,  1
6061    6317  0002          2
6062    6320  0003          3
6063    6321  0004          4
6064    6322  0005          5
6065                /TABLE OF ADDR FOR GO VALUES
6066                /6 PER DEVICE
6067    6323  0312  TIAD0,   LODV0
6070    6324  0311           HIDV0
6071    6325  0066           SELDV0
6072    6326  0307           SFDV0
6073    6327  0310           KSFDV0
6074    6330  0313           OSDV0
6075    6331  0334  TIAD1,   LODV1
6076    6332  0333           HIDV1
6077    6333  0067           SELDV1
6100    6334  0331           SFDV1
6101    6335  0332           KSFDV1
6102    6336  0335           OSDV1
6103    6337  0413  TIAD2,   LODV2
6104    6340  0412           HIDV2
6105    6341  0070           SELDV2
6106    6342  0410           SFDV2
6107    6343  0411           KSFDV2
6110    6344  0414           OSDV2
6111    6345  0436  TIAD3,   LODV3
6112    6346  0435           HIDV3
6113    6347  0071           SELDV3
6114    6350  0433           SFDV3
6115    6351  0434           KSFDV3
6116    6352  0437           OSDV3
6117    6353  0461  TIAD4,   LODV4
6120    6354  0460           HIDV4
6121    6355  0072           SELDV4
6122    6356  0456           SFDV4
6123    6357  0457           KSFDV4
6124    6360  0462           OSDV4
6125                /ADDR OF START OF EACH TABLE
6126                /FOR GO ROUTS
6127    6361  6272  VALTAB,  TISTR0
6130    6362  6277           TISTR1
6131    6363  6304           TISTR2
6132    6364  6311           TISTR3
6133    6365  6316           TISTR4
6134    6366  6323  ADRTAB,  TIAD0
6135    6367  6331           TIAD1
6136    6370  6337           TIAD2
6137    6371  6345           TIAD3
6140    6372  6353           TIAD4
6141                /TTY QUE HOLDS 20 MESS ADDRS MAX
6142    6373  0001  STRQUE,  1
6143    6374  0002           2
6144    6375  0003           3
6145    6376  0004           4
```

```
6146        6377   0005            5
6147        6400   0006            6
6150        6401   0007            7
6151        6402   0010            8
6152        6403   0011            9
6153        6404   0010            10
6154        6405   0011            11
6155        6406   0012            12
6156        6407   0013            13
6157        6410   0014            14
6160        6411   0015            15
6161        6412   0016            16
6162        6413   0017            17
6163        6414   0020            18
6164        6415   0021            19
6165        6416   0020  ENDQUE,   20
6166                     /TABLES FOR SCOPE ROUTINES
6167                                          /POWERS OF TEN
6170                                          /FOR OCTAL TO
6171                                          /DECIMAL
6172                                          /CONVERSION
6173        6417   7747  RADVAL,   7747        /-100,000
6174        6420   4540            4540
6175        6421   7775            7775        /-10,000
6176        6422   4360            4360
6177        6423   7777            7777        /-1,000
6200        6424   6030            6030
6201        6425   7777            7777        /-100
6202        6426   7634            -144
6203        6427   7777            7777        /-10
6204        6430   7766            -12
6205        6431   7634            -144        /-100
6206        6432   0144            +144        /+100
6207        6433   7766            -12         /-10
6210        6434   0012            +12         /+10
6211                                          /HOLDS BCD VAL
6212                                          /OF X COORD
6213        6435   0000  BCDVAL,   0           /100K
6214        6436   0000            0           /10K
6215        6437   0000            0           /1K
6216        6440   0000            0           /100S
6217        6441   0000            0           /10S
6220        6442   0000            0           /UNITS
6221                                          /DEVICE INFO
6222                                          /TABLE FOR
6223                                          /XYGET SETUP
6224                                          /AT QANDA STAGE
6225        6443   0000  LIMVL0,   0           /-ST ADDR DV0
6226        6444   0000            0           /LO, HI
6227        6445   0000            0           /- SAM FREQ DV0
6230        6446   6471            BCD0        /ADDR OF BCD
6231                                          /VAL FOR DEV 0
6232        6447   0000  LIMVL1,   0           /DV1 ARGS
6233        6450   0000            0
6234        6451   0000            0
6235        6452   6476            BCD1
6236        6453   0000  LIMVL2,   0           /DV2 ARGS
6237        6454   0000            0
6240        6455   0000            0
6241        6456   6503            BCD2
6242        6457   0000  LIMVL3,   0           /DV3 ARGS
6243        6460   0000            0
6244        6461   0000            0
```

```
6245    6462  6510          BCD3
6246    6463  0000  LIMVL4, 0             /DV4 ARGS
6247    6464  0000          0
6250    6465  0000          0
6251    6466  6515          BCD4
6252    6467  0000  LIMVL5, 0             /1ST UNUSED
6253    6470  0000          0             /BUFFER CORE
6254                                      /LOC COMES
6255                                      /RIGHT AFT LAST
6256                                      /USER DEFINED
6257                                      /DEVICE
6260    6471  0000  BCD0,   0             /HOLDS USER
6261    6472  0000          0             /DEFINED INIT
6262    6473  0000          0             /X VALUE
6263    6474  0000          0             /5 DIGITS
6264    6475  0000          0             /1 EACH DV
6265    6476  0000  BCD1,   0             /UNITS
6266    6477  0000          0             /TENS
6267    6500  0000          0             /HUNDREDS
6270    6501  0000          0             /THOUSANDS
6271    6502  0000          0             /10 THOUS
6272    6503  0000  BCD2,   0
6273    6504  0000          0
6274    6505  0000          0
6275    6506  0000          0
6276    6507  0000          0
6277    6510  0000  BCD3,   0
6300    6511  0000          0
6301    6512  0000          0
6302    6513  0000          0
6303    6514  0000          0
6304    6515  0000  BCD4,   0
6305    6516  0000          0
6306    6517  0000          0
6307    6520  0000          0
6310    6521  0000          0
6311    6522  6567  NUM0,   MS0           /NUM TAGS
6312    6523  6573  NUM1,   MS1           /MUST BE
6313    6524  6577  NUM2,   MS2           /CONTIGUOUS
6314    6525  6603  NUM3,   MS3
6315    6526  6607  NUM4,   MS4
6316                /TISA MESSAGES
6317    6527  0310  MSHLT,  310           /H
6320    6530  0301          301           /A
6321    6531  0314          314           /L
6322    6532  0324          324           /T
6323    6533  0240          240           /SPACE
6324    6534  0311          311           /I
6325    6535  0316          316           /N
6326    6536  0323          323           /S
6327    6537  0324          324           /T
6330    6540  0322          322           /R
6331    6541  0325          325           /U
6332    6542  0315          315           /M
6333    6543  0305          305           /E
6334    6544  0316          316           /N
6335    6545  0324          324           /T
6336    6546  0240          240           /SPACE
6337    6547  0000          0             /EOM
6340    6550  0307  MSGO,   307           /G
6341    6551  0317          317           /O
6342    6552  0240          240           /SPACE
6343    6553  0311          311           /I
```

```
6344    6554  0316          316             /N
6345    6555  0323          323             /S
6346    6556  0324          324             /T
6347    6557  0322          322             /R
6350    6560  0325          325             /U
6351    6561  0315          315             /M
6352    6562  0305          305             /E
6353    6563  0316          316             /N
6354    6564  0324          324             /T
6355    6565  0240          240             /SPACE
6356    6566  0000          0               /EOM
6357    6567  0260  MS0,     260
6360    6570  0215          215
6361    6571  0212          212
6362    6572  0000          0
6363    6573  0261  MS1,     261
6364    6574  0215          215
6365    6575  0212          212
6366    6576  0000          0
6367    6577  0262  MS2,     262
6370    6600  0215          215
6371    6601  0212          212
6372    6602  0000          0
6373    6603  0263  MS3,     263
6374    6604  0215          215
6375    6605  0212          212
6376    6606  0000          0
6377    6607  0264  MS4,     264
6400    6610  0215          215
6401    6611  0212          212
6402    6612  0000          0
6403    6613  0315  MSMOT,   315             /M
6404    6614  0317          317             /O
6405    6615  0324          324             /T
6406    6616  0311          311             /I
6407    6617  0317          317             /O
6410    6620  0316          316             /N
6411    6621  0215          215             /CR
6412    6622  0212          212             /LF
6413    6623  0000          0               /EOM
6414    6624  0306  MSFR,    306             /F
6415    6625  0322          322             /R
6416    6626  0305          305             /E
6417    6627  0305          305             /E
6420    6630  0332          332             /Z
6421    6631  0305          305             /E
6422    6632  0215          215
6423    6633  0212          212
6424    6634  0000          0
6425    6635  0316  MSNOR,   316             /N
6426    6636  0317          317             /O
6427    6637  0322          322             /R
6430    6640  0315          315             /M
6431    6641  0301          301             /A
6432    6642  0314          314             /L
6433    6643  0215          215
6434    6644  0212          212
6435    6645  0000          0
6436    6646  0311  MSINV,   311             /I
6437    6647  0316          316             /N
6440    6650  0326          326             /V
6441    6651  0305          305             /E
6442    6652  0322          322             /R
```

```
6443    6653  0324          324             /T
6444    6654  0305          305             /E
6445    6655  0304          304             /D
6446    6656  0215          215
6447    6657  0212          212
6450    6660  0000          0
6451    6661  0320  ALLHLT,  320             /P
6452    6662  0301          301             /A
6453    6663  0325          325             /U
6454    6664  0323          323             /S
6455    6665  0305          305             /E
6456    6666  0240          240             /SP
6457    6667  0315          315             /M
6460    6670  0317          317             /O
6461    6671  0304          304             /D
6462    6672  0305          305             /E
6463    6673  0215          215
6464    6674  0212          212
6465    6675  0000          0
6466    6676  0310  MSBUSY,  310             /H
6467    6677  0301          301             /A
6470    6700  0316          316             /N
6471    6701  0304          304             /D
6472    6702  0323          323             /S
6473    6703  0240          240
6474    6704  0317          317             /O
6475    6705  0306          306             /F
6476    6706  0306          306             /F
6477    6707  0215          215
6500    6710  0212          212
6501    6711  0000          0
6502    6712  0301  MSAD,    301             /A
6503    6713  0257          257             //
6504    6714  0304          304             /D
6505    6715  0240          240
6506    6716  0315          315             /M
6507    6717  0317          317             /O
6510    6720  0304          304             /D
6511    6721  0305          305             /E
6512    6722  0215          215
6513    6723  0212          212
6514    6724  0000          0
6515    6725  0000  AAAS3,   0
6516                        LMODE
6517                        *1000
6520    1000  0004  P4,      4
6521                                        /FIND OUT HOW
6522                                        /MUCH EXT MEM
6523    1001  0640  MEMCHK,  LDF 0           /PUT ANYTHING
6524    1002  1020          LDA I           /EXCEPT LDF K
6525    1003  0640          LDF 0           /IN LDF 0
6526    1004  1040          STA
6527    1005  2000          2000
6530    1006  1040          STA             /SET LDF
6531    1007  1013          NLDF            /INST
6532    1010  3000  LOOP,    ADD P4          /PUT LDF K
6533    1011  1040          STA             /K=4,10,,,,,34
6534    1012  1013          NLDF            /IN LOC NLDF
6535    1013  0000  NLDF,    0
6536    1014  1040          STA             /PUT LDF K
6537    1015  2000          2000            /IN LDF K
6540    1016  1000          LDA             /GET IT
6541    1017  2000          2000            /BACK
```

```
6542    1020  1440          SAE               /DID WE
6543    1021  1013          NLDF              /MAKE IT ?
6544    1022  7035          JMP DUN           /NO
6545    1023  0640          LDF Ø             /CHK FOR
6546    1024  1440          SAE               /CONTROL LOGIC
6547    1025  2000          2000              /ONLY
6550    1026  0467          SKP               /STILL OK
6551    1027  7035          JMP DUN           /4K ONLY
6552    1030  1460          SAE I             /CHK FOR
6553    1031  0674          LDF 34            /MAX CORE
6554    1032  7010          JMP LOOP          /DO SOME MORE
6555    1033  3000          ADD P4            /WE HAVE 32K
6556    1034  5013          STC NLDF
6557    1035  1000  DUN,     LDA               /PUT FIRST NON
6560    1036  1013          NLDF              /EXISTANT LDF
6561                                          /IN AC
6562    1037  1120          ADA I
6563    1040  7137          -640
6564    1041  0302          ROR 2             /=1ST NON CDF
6565    1042  1120          ADA I
6566    1043  7776          -1
6567    1044  0470          AŻE I
6570    1045  0011          CLR
6571    1046  0002          PDP
6572                        PMODE
6573    7047  6201          CDF Ø
6574    7050  3032          DCA MAXCDF
6575    7051  1255          TAD P4040
6576    7052  3656          DCA I K6K         /FIXUP 6000
6577    7053  5654          JMP I ,+1
6600    7054  4023          SETUP
6601    7055  4040  P4040,  4040
6602    7056  6000  K6K,     6000
6603                /DEFINITIONS FOR INPUT ROUTINES
6604                        ADRMIN=7000       /1ST BUF ADDR
6605                        CDFMIN=Ø
6606                        DRPMAX=2Ø         /MAX X AX DROP
6607                        WRMBLK=4000       /1ST MBLK FOR
6610                                          /WRITE
6611                        FIRLDF=643        /1ST BUF LDF
6612                        RDMBLK=6000       /1ST MBLK FOR
6613                                          /READ
6614                /ANALOG ASSIGNMENTS FOR DEVICES
6615                        /X AXIS
6616                        XAXDV0=1Ø
6617                        XAXDV1=XAXDV0+1
6620                        XAXDV2=XAXDV1+1
6621                        XAXDV3=XAXDV2+1
6622                        XAXDV4=2Ø
6623                        /Y AXIS
6624                        YAXDV0=14
6625                        YAXDV1=YAXDV0+1
6626                        YAXDV2=YAXDV1+1
6627                        YAXDV3=YAXDV2+1
6630                        YAXDV4=24
6631                /DEFINITIONS FOR SCOPE ROUTINES
6632                        CHGHC=3600        /CHANGE HORIŻ
6633                                          /COORD
6634                        CR=0043           /EOL RH
6635                        CR1=4300          /EOL LH
6636                        ENDWD=0077        /END OF MESS
6637                        ENDWD1=7700       /END OF MESS
6640                        FUL=0006          /FULL SIŻ CHARS
```

```
6641                    FUL1=0600
6642                    GRDPTR=14       /PTR TO GRID
6643                                    /TABLE
6644                    GRDTAB=QAV      /ADDR OF GRID
6645                                    /TABLE
6646                    HBIT=4000
6647                    HCPTR=15        /PTR TO TABLE
6650                                    /HORIZ COORDS
6651                    KURLEN=-30      /- LENGTH OF
6652                                    /CURSOR
6653                    MSPTR=17        /=XCORD
6654                                    /PTR TO DIAL
6655                                    /ENCODED MESS
6656                    VCPTR=16        /PTR TO TABLE
6657                                    /VERT COORDS
6660                    XCURHI=ARGHI    /PAGE 0
6661                    XCURLO=ARGLO    /PAGE 0
6662                    XYHC=0          /INIT HORIZ
6663                                    /COORD FOR
6664                                    /X-Y DISP
6665            /DEFINITIONS FOR QANDA SETUP ROUTINES
6666                    ANAVAL=4000     /ANALOG SELECT
6667                    ANSPTR=14
6670                    CURNHI=ADMESS   /PAGE 0
6671                    CURNLO=KBDBUF   /PAGE 0
6672                    DVNMAX=-5
6673                    ENCPTR=TTYFLG   /PAGE 0
6674                    EXTMTP=10       /XOB CONSTANT
6675                    QAEOL1=7400
6676                    QAEOM1=3400
6677            /TISA 15 APR 70
```

0000 ERRORS

```
AAAPØ  Ø111
AAASØ  1765
AAAS1  3754
AAAS2  5701
AAAS3  6725
ADDR   Ø73Ø
ADMESS ØØ2Ø
ADMS   1504
ADPTR  ØØ11
ADRMIN 7ØØØ
ADRTAB 6366
AGOMS  3515
AHLTMS 3514
ALLDUN 427Ø
ALLHLT 6661
ANALOG Ø7Ø2
ANARTN Ø637
ANAVAL 4ØØØ
ANLDF  Ø347
ANLIF  Ø346
ANONO  1653
ANPROC 1741
ANSPTR ØØ14
ANSWER 4524
ANS4   6ØØ5
ARGHI  ØØ47
ARGLO  ØØ46
ASAM   1513
ASAVE  Ø352
```

```
ATEMP   1506
AWRI    1762
A1CONT  4076
A2CONT  4105
A2LOP   4100
A3CONT  4113
A3LOP   4106
A4      4211
A4CONT  4216
BCDLOP  2600
BCDPTR  0056
BCDVAL  6435
BCD0    6471
BCD1    6476
BCD2    6503
BCD3    6510
BCD4    6515
BCNTR   0053
BETA1   0003
BETA2   0004
BETA3   0005
BLKCNT  6143
BUFHI   2347
BUFLO   2346
BUFPTR  0054
BUSYMS  1063
BWDMOT  2224
BYHLT   3123
BYMBLK  1137
BYWRAP  2316
C       1342
CATA    1517
CATPTR  1576
CDFMIN  0000
CDFVAL  0731
CDF0    0031
CHAR    1265
CHGHC   3600
CHGSAM  0720
CHKADR  2233
CHKLOP  3114
CHKSNS  4021
CHKSWI  3107
CHKTTY  0245
CHRLOP  1210
CHRNXT  2075
CHRPTR  1224
CHRTAB  1223
CLKCNT  3304
CLKMOD  3305
CLRLOP  3206
CNTR    0052
CONMS2  4200
CR      0043
CR1     4300
CTRLH   1274
CURCDF  0060
CURCNT  2351
CURDIS  2700
CURLEN  2751
CURLOP  2722
CURNHI  0020
CURNLO  0021
```

```
CURRTN 2275
D      0473
DADD   2330
DBLDEF 2470
DBLHI  0045
DBLLO  0044
DBLLOP 2461
DCIA   3030
DCODEX 3527
DCODEY 3534
DEVNUM 0036
DIAL   4015
DIGCHK 4466
DLOOP  4470
DOMTP  1067
DORDC  1664
DOWRC  1746
DRPMAX 0020
DSCCHR 2732
DSCHLP 2052
DSCL   3017
DSCL4  3043
DSCXY  2122
DUN    7035
DUNBLK 1632
DVNMAX 7773
DVTYP  0027
DV1    0321
DV2    0400
DV3    0423
DV4    0446
EHIDV0 0315
EHIDV1 0337
EHIDV2 0416
EHIDV3 0441
EHIDV4 0464
ELODV0 0314
ELODV1 0336
ELODV2 0415
ELODV3 0440
ELODV4 0463
ENCPTR 0022
ENCVAL 3306
ENDHI  0733
ENDLO  0732
ENDQUE 6416
ENDWD  0077
ENDWD1 7700
ENQUE  1065
EOLXIT 4517
ERFREQ 4327
ERRDEV 4335
ERRENC 4303
ERRFUL 4317
ERRXIT 4522
ERR0PT 4311
EXIT   0472
EXTMTP 0010
F      0514
FIRLDF 0643
FIRST  6001
FOUND  2432
FREE   4332
```

```
FREEZE 2040
FREQ   0735
FRMS   0542
FROM   1510
FRSTR  3200
FUL    0006
FUL1   0600
FWOCDF 2303
FWDRTN 2300
G      1315
GBLK   3430
GETKBD 5534
GETU   1542
GO     1411
GODIS  2251
GOLOP  1451
GOMS   3507
GOODY  1124
GRDPTR 0014
GRDTAB 5331
GSWIT  1365
H      1311
HALT   1400
HALTAL 3516
HBIT   4000
HCPTR  0015
HCTAB  3557
HIDV0  0311
HIDV1  0333
HIDV2  0412
HIDV3  0435
HIDV4  0460
HLPTAB 3615
HLTALL 1363
HLTDV0 0317
HLTDV1 0341
HLTDV2 0420
HLTDV3 0443
HLTDV4 0466
HLTLOP 3475
HLTMS  3461
HLTPTR 1516
HOLD   0736
HSWIT  1364
HSWIT0 0073
HSWIT1 0074
HSWIT2 0075
HSWIT3 0076
HSWIT4 0077
HSWPTR 3130
IDLE   2020
INIAD  6145
INICHR 2137
INIEND 6036
INILEN 3273
INIPTR 0010
INISAM 1464
INISTR 6016
INMESS 1044
INPUT  0600
INTL   0200
INTMOD 0345
INTOUT 0256
```

```
INTP    0230
INVMS   0544
KADR    3303
KBCD    2526
KBDBUF  0021
KBDTAB  1225
KBLKCT  0107
KCLEN   0062
KCONMS  4162
KCUR    2352
KD      1271
KDADD   0037
KDCIA   4171
KDIG    0063
KDOMTP  1763
KDSCL4  4166
KDV2    0353
KENC    3277
KERENC  4165
KERFUL  4172
KERØPT  4170
KEYBRD  1200
KEYRTN  0511
KEYXIT  1505
KF      1270
KFIRST  1740
KFREQ   0537
KFREQ   0734
KFRESH  1745
KFRSTR  4163
KGBLK   4302
KGO     1370
KGOMS   0102
KHALT   1366
KHLTMS  0101
KIDLE   0065
KINI    0106
KINPUT  0030
KKDCIA  3427
KKEY    2047
KLAST   0110
KLIM    2525
KLOAD   1525
KLOHI   4173
KMES    2050
KMESS2  4300
KMUL10  0064
KNUM    3526
KPXSTR  4277
KP      1267
KPOLAR  0540
KP1DAC  4174
KQUPUT  0105
KRAD    2527
KRDERR  1737
KRESTR  4164
KS      1272
KSET    1272
KSETUP  0545
KSFDV0  0310
KSFDV1  0352
KSFDV2  0411
KSFDV3  0434
```

```
KSFDV4 0457
KSTRQ  3367
KSWI   2051
KTTY   3365
KTXT26 3302
KUPACK 4167
KUPLIM 1661
KURLEN 7750
KW     1273
KWRERR 1764
KWRIT  0546
KXYGET 2353
K210   3366
K6K    7056
L      1354
LAST   6144
LDFSTR 1172
LIMLOP 2407
LIMPTR 0055
LIMVL0 6443
LIMVL1 6447
LIMVL2 6453
LIMVL3 6457
LIMVL4 6463
LIMVL5 6467
LNNXT  2061
LOAD   4454
LOADER 1550
LODLOP 1532
LODPTR 1610
LODV0  0312
LODV1  0334
LODV2  0413
LODV3  0436
LODV4  0461
LOHI   3406
LOOP   7010
LOP1   3326
LOP2   3330
LSAVE  0351
LSENC  3300
LSINI  3276
LSSAHI 3275
LSSALO 3274
M      1347
MAG    1522
MAGPTR 1603
MATCH  1220
MAXCDF 0032
MAXCUR 2752
MAXDRP 0724
MAXDVN 0061
MEMCHK 7001
MESCHK 1000
MESS1  4026
MESS2  4043
MESS3  4237
MINADR 0034
MINCDF 0033
MM12   1657
MM4    2756
MODE   0103
MOTMS  0541
-
```

```
MSAD    6712
MSBUSY  6676
MSFR    6624
MSGO    6550
MSHLT   6527
MSINV   6646
MSMOT   6613
MSNOR   6635
MSPTR   0017
MS0     6567
MS1     6573
MS2     6577
MS3     6603
MS4     6607
MTPLOP  1100
MUL10   3000
M10     1660
M1000   2350
M12     2753
M5      1514
NEG12   4301
NEG5    2530
NEWSAM  0725
NFDVK   0673
NLOF    7013
NORMS   0543
NOT0    4122
NUM     1321
NUMPUT  3517
NUM0    6522
NUM1    6523
NUM2    6524
NUM3    6525
NUM4    6526
NXSTR   3255
NXTCHR  2152
NXTLN   2131
NXTPNT  2261
OK1     4266
OK2     4207
OLDSAM  0727
OPKRTN  1203
OSDV0   0313
OSDV1   0335
OSDV2   0414
OSDV3   0437
OSDV4   0462
OUTL    0266
P       0500
PCKLOP  3061
PL1000  1515
PL400   3460
PL60    4513
POLAR   2266
PP17    1367
PP400   2755
P1DAC   3400
P1000   0726
P17     3106
P1777   0355
P2      2743
P37     0350
P4      7000
=
```

```
P401    2166
P4040   7055
P4060   3301
P57     2757
P60     2754
P6000   0354
P7K     1113
QAB     5017
QACA    5030
QACHAR 5670
QACKLF 5634
QACNTR 5617
QAD     5041
QADUN   3312
QAE     5063
QAEOL1 7400
QAEOM1 3400
QAEXIT 5650
QAF     5531
QAFLD   4000
QAG     5075
QAH     5127
QAI     5144
QAINIT 5013
QAJ     5151
QAK     5320
QAKRB   6036
QAL     5210
QALEGL 5610
QAM     5114
QAN     5236
QAO     5244
QAP     5255
QAQ     5276
QARFSH 5066
QAT     5303
QATLS   6046
QATPE   5657
QATSF   6041
QATY    5551
QAU     5521
QAV     5331
QAW     5525
QAX     5437
QAY     5425
QAZ     5314
QSAVE   1066
QUECNT 0025
QUEIN   0023
QUEMAX 1062
QUEOUT 0024
QUPUT   1033
RADPTR 0057
RADVAL 6417
RDCWD   1677
RDLEN   1742
RDMBLK 6000
READ    4344
REMS2   4046
RESTR   3233
RMBLK   1744
RTNJMP 0274
RTNLDF 0271
-
```

```
RTNLIF  0270
S       0526
SAMX    0703
SAMY    0654
SCPFLD  2000
SCPRTN  2043
SCPXIT  2163
SELDV0  0066
SELDV1  0067
SELDV2  0070
SELDV3  0071
SELDV4  0072
SELPTR  0100
SERVE   0234
SETANA  4073
SETCDF  2320
SETFUL  2114
SETHC   2111
SETMOT  2200
SETUP   4023
SFDV0   0307
SFDV1   0331
SFDV2   0410
SFDV3   0433
SFDV4   0456
START   4020
STATUS  0026
STQUE   1064
STRQUE  6373
STRRDE  3315
TBLK    1662
TBUSY   1057
TEMP    0104
TEMPHI  0051
TEMPLO  0050
TIADR   1512
TIAD0   6323
TIAD1   6331
TIAD2   6337
TIAD3   6345
TIAD4   6353
TIRTN   0240
TISA    0275
TISTR0  6272
TISTR1  6277
TISTR2  6304
TISTR3  6311
TISTR4  6316
TIVAL   1507
TO      1511
TPARGS  1615
TPINST  1102
TPLDF   1101
TPLOP   1622
TPRDC   1676
TPWAIT  1163
TPWORD  1103
TTYFLG  0022
TXT1    4535
TXT10   4757
TXT11   4765
TXT12   4774
TXT13   5001
```

```
TXT14   5006
TXT2    4565
TXT3    4650
TXT4    4672
TXT5    4705
TXT6    4720
TXT7    4747
UNIT    1663
UPACK   3055
UPLIM   4506
VALTAB  6361
VCOORD  2737
VCPTR   0016
VCTAB   3540
W       0533
WMBLK   1743
WRIT    4400
WRMBLK  4000
XAXDV0  0010
XAXDV1  0011
XAXDV2  0012
XAXDV3  0013
XAXDV4  0020
XCORD   2017
XCURHI  0047
XCURLO  0046
XYGET   2400
XYHC    0000
YAXDV0  0014
YAXDV1  0015
YAXDV2  0016
YAXDV3  0017
YAXDV4  0024
YCUR    0035
YLOP    2647
ZXIT    0512
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