ESD-TDR-64-353

Group Report

1964-38

Computer Programs for Haystack Servo Testing

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21 July 1964

Prepared under Electronic Systems Division Contract AF 19(628)-500 by

Lincoln Laboratory
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Lexington, Massachusetts

The work reported in this document was performed at Lincoln Laboratory, a center for research operated by Massachusetts Institute of Technology, with the support of the U.S. Air Force under Contract AF 19(628)-500.

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LINCOLN LABORATORY

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ABSTRACT

The facilities available for testing the performance of the Haystack servo system using the Univac 490 digital computer are described. Sine, step, impulse, and polynomial inputs may be applied to the system. Operating instructions and examples of inputs and outputs from the various programs are given. A fairly detailed description of the program logic is provided and complete listings are included for all non-library programs.

Accepted for the Air Force
Franklin C. Hudson, Deputy Chief
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COMPUTER PROGRAMS FOR HAYSTACK SERVO TESTING

I. INTRODUCTION

It is intended that the Haystack antenna be primarily directed by the 490 digital computer. When the digital control system is first connected to the antenna and actual motion is attempted, it will be important to study the response characteristics of the antenna servo system. It will also be desirable to periodically check this response over the useful life of the facility. Although the system response can be checked by analog techniques, and although the normal "Pointing" program also provides some checking, it was felt that a special effort was justified. Specifically, it appeared desirable to permit digital generation of special test functions and a detailed digital analysis of the resulting response. For this purpose, a computer program has been written for the Univac 490 which can drive the antenna and which will provide on-line printouts in real time of the input to the servo and the response of the servo. For more detailed checking, the program provides magnetic tape outputs which can be further processed and plotted using the Laboratory IBM 7094 in Lexington.

Probably the most informative viewpoint to take in attempting to comprehend all the ramifications of this system of programs is to consider it as a completely flexible and automatic data-gathering system. It is not the function of the system to provide analyses of complex aspects of antenna steering kinematics. The function of the system is to provide a perfectly general, systematic, and uniform procedure for automatically obtaining static or dynamic data about antenna behavior under a variety of conditions. The data obtained is in printed, magnetically recorded (digital), or graphed form and is, therefore, suitable for immediate analysis by manual or mechanical computation procedures. In particular, the magneitc tape records are acceptable to the IBM 7094 computer for further computation.

This testing is performed by entering through the on-line console specifications for independent motions to be executed by the azimuth and elevation drive systems. One is free to specify dynamic tests with sinusoidal oscillations, step and impulse functions, and up to fifth order polynomial trajectories. A static positioning test is also available. The antenna servo response to these signals is automatically recorded on magnetic tape and simultaneously printed on the on-line printer. The magnetic tape can be further processed by the IBM 7094 system to produce graphs of the response (via the Calcomp plotter) and BCD tapes suitable for printing or input to FORTRAN programs.

The remainder of this report discusses the testing package in increasingly greater detail. First, typical examples of the data generated are exhibited. Detailed instructions for system usage follow, terminating in a detailed documentation of the mechanical logic of the computer programs. Examples and discussions tend to be in terms of the particular aspect of the problem with which our group is associated; however, this aspect is extremely general itself.

II. SYSTEM DESCRIPTION

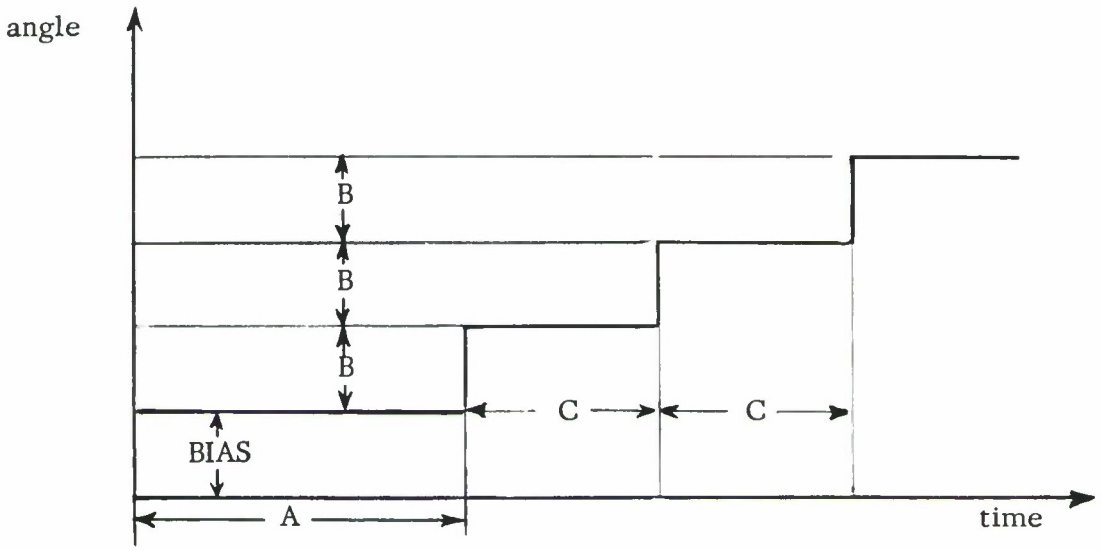
In using the system, one first performs certain routine operations which bring the program into the Univac 490 computer. When the program is started, it makes a few basic inquiries and then leaves the operator free to specify his requirements. The specifications of a run permit complete freedom in selecting starting positions (biases) on both axes. Nominally, the experiment begins at a specified time and lasts for a specified duration, with motions commencing when the antenna has stabilized at the specified starting point. One always has full and independent control over the amount of data recorded on magnetic tape and on the on-line printer. The mathematical functions which define the drive functions (see below) can be independently specified on both axes. An experiment can be interrupted at any time without losing any data previously obtained.

Five driving functions are available on each axis. AZNOT and ELNOT simply hold the antenna fixed at a specified azimuth or elevation bias. AZSINE and ELSINE produce a sinusoidal oscillation about the bias angle with independently specified amplitude (in degrees), and frequency (in cycles per second). AZPOLY and ELPOLY cause the antenna to track any trajectory that can be specified parametrically in time by an equation of the fifth order, or less.

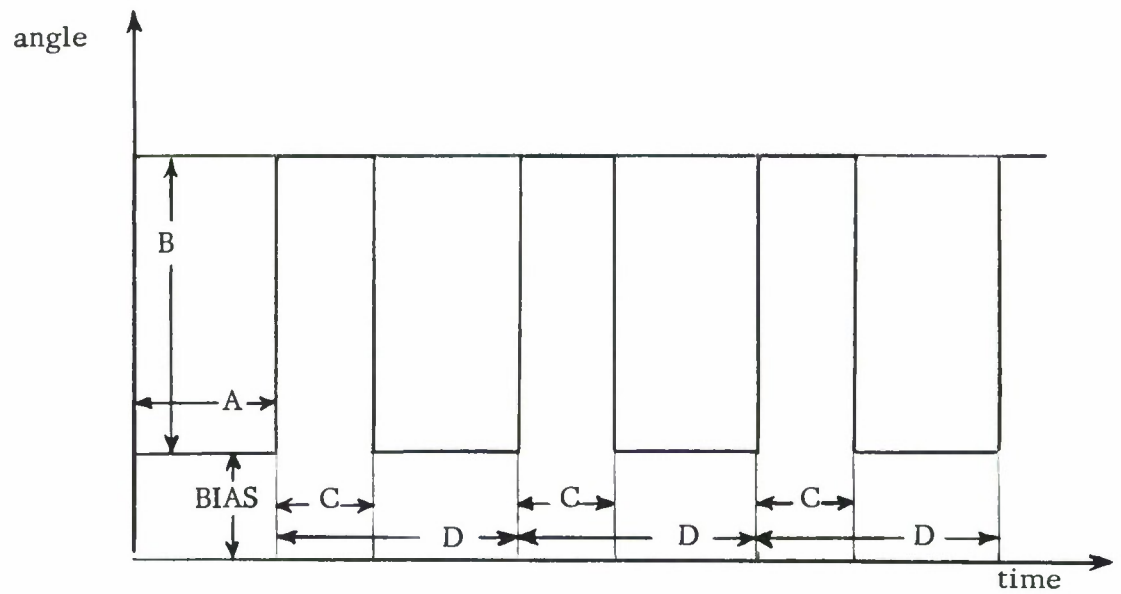
$$\text{AZIMUTH} = a_0 + a_1 t + a_2 t^2 + a_3 t^3 + a_4 t^4 + a_5 t^5 + \text{BIAS}$$

Positive or negative values may be entered for the coefficients.

To test transient response, two types of functions are available. AZSTEP and ELSTEP provide a positive or negative-going staircase function of time, starting at the specified bias = STEP(A, B, C) + BIAS:



The parameter B may be negative, thus providing the negative-going function. The other test available is provided by AZIMPULSE and ELIMPULSE which produce a positive or negative directed series of impulse, also beginning at the specified bias: IMPULSE (A, B, C, D) + BIAS:



Again, the parameter B may be positive or negative.

Once an experiment has been specified by the operator, the Univac 490 computer program generates instructions for the antenna servo system at the standard rate of 250 times per second. The data is transferred to the servo system in exactly the same fashion as the data is handled in the standard "Pointing" program.

In real time, two forms of output are produced; hard copy on the on-line, high-speed printer and IBM format magnetic tapes for further processing at the 7094. It is anticipated that the line printer output will be used for more simple testing, but that the detailed analysis may be useful for trouble analyses or for graphical presentation of results. Due to the speed limitations on the on-line printer, it is not possible to obtain by that method the full rate of 250-point-per-second data; the maximum output rate of the line printer in this program is 10 lines per second (or a sampling of the servo input and output at 1/25 of the actual data transfer rate). The magnetic tape recordings, of course, provide complete data on every point in the full rate.

The magnetic tapes generated by these tests contain a record of the signal applied to the servos and the position of the axes when the signal was applied, along with the time of application. A special program on the 7094 will convert these tapes to a BCD format suitable for printing or input to another 7094 program. Another 7094 program produces graphs of selected material directly from these tapes with completely labeled and calibrated axes. These graphs are drawn by the Calcomp plotter via the IBM 1401.

III. OPERATING INSTRUCTIONS FOR HAYSTACK TESTING PACKAGE

The testing facility for the Haystack antenna servo system consists of three programs:

Program I to run on the Univac 490 computer which supplies commands to the servos and records their responses.

Program II to run on the IBM 7094 to convert and print the output of Program I.

Program III to run on the IBM 7094 to plot the output of Program I on the Calcomp plotter.

A. Program I - Univac 490 Testing Program

The following is an exact explanation of one way in which the antenna testing program (ANTENATEST) may be operated so as to take full advantage of all its features. This does not represent the full generality of the system since particular operations are here prespecified when a number of different but effectively equivalent alternatives exist. Accordingly, this should prove particularly useful to those persons who are relatively unacquainted with the testing system and/or the Univac 490.

1. Mount the following magnetic tapes on drives as indicated:

    a. (Logical 0) SPURT III system tape

b. (Logical 1) Any blank tape

c. (Logical 2) The ANTENATEST 321 tape

2. Press the "CHANNEL CLEAR" buttons on the tape adapter cabinet and on the printer control cabinet.

3. On the maintenance panel of the computer, depress the toggle switches marked "OPERATION," "MASTER CLEAR," and "BOOTSTRAP" in that order.

4. The console printer will type "READY." You type:

LD␣S2␣321␣10000 (s)

The character "␣" is marked "SPEC" on the keyboard.

5. Next, the console printer will again type "READY." You type:

PS␣10000 (s) .

6. The console printer types:

THIS IS THE ANTENNA TESTING PROGRAM.

DO YOU WISH TO HAVE OUTPUT ON THE ON-LINE PRINTER.

IF SO, HOW OFTEN.

You may reply:

NO (s)

if you wish to have no on-line printing, or

YES␣XXX (s)

where "XXX" is a decimal integer of exactly three digits in the range 999 to 025. If you type in a number N, exactly 1/Nth of the data generated in positioning the antenna will be printed on the on-line printer. The output may be obtained in octal or decimal form. The decimal listing contains seven columns. See Fig. 2. From left to right, the first column is time, in seconds, from the beginning of the test. The second is the azimuth position generated by the computer. The third is the current azimuth position of the antenna. The fourth is the difference between these figures. The fifth, sixth, and seventh repeat these functions for the elevation coordinate. All angles are printed in degrees, truncated to four decimal places. In octal mode, 9 columns are printed. See Fig. 3. The first, second, and fifth are identical to those in decimal mode. The third column is the azimuth command to the antenna in octal. The fourth column is the azimuth position of the antenna in octal. The sixth and seventh repeat the third and fourth for elevation. The eighth and ninth are the octal differences in azimuth and elevation between the command and the position. Printing mode may be selected in mid-run or changed by typing the characters "O" for octal mode and "D" for decimal

mode. Printing may be stopped and restored in mid-run by typing the characters "S" for stop and "P" for print. None of these characters will be printed at the console.

7. The console printer types

TYPE TEST IDENTIFICATION

You may type a label up to 30 characters in length and terminated by a (S) .

8. Next, the console printer types

TYPE TEST PARAMETERS

You have two options. You may type ".. (S) " (option a), or you may type a parameter line (option b).

9 a. If you typed ".. (S) ," the console will ask two questions. First, it asks:

DO YOU WISH TO CONTINUE

This should be answered YES (S) or NO (S) . Next it will say

DO YOU WISH TO REWIND OUTPUT TAPE

Again, answer YES (S) or NO (S) . If you answered YES to the second question, the tape on B will be rewound with interlock and must be changed. If you answered YES to the first question, you will be back at step 6. If you typed NO, you will be back at step 5.

9 b. If you elect to enter data for a new run, it must be in the form described at the end of this discussion. As soon as you type (S) at the end of the line, the actual test begins. If you enter an inadmissible line, an appropriate remark will be typed and you will be returned to step 8.

10. After a 15-second delay for aiming, the computer will generate the specified function and supply it to the antenna. After specified delays, data will be printed on-line and written on magnetic tape.

11. If you decide, in mid-run, to enter a new set of parameters before the full run is complete, type (S) . You will be returned to step 7. All data recorded on tape to this point will be usable. If you let the run continue for its specified duration, you will still end up at step 7.

Note: It is important to plan your runs to take maximum advantage of identical constants in printing rate, since the only way to change the rate is by the jump from step 9 a. to step 6, a fairly time consuming operation.

Format for a Line of Parameters

1. Type the azimuth bias in degrees as a signed or unsigned decimal number (fractional places allowed).

2. Type a comma.

3. Repeat 1 and 2 for elevation bias.

4. Type the number of seconds delay desired before recording output as a positive decimal integer. Zero is not acceptable. Type a comma.

5. Repeat 4 for the duration of run desired.

6. Type the number of 4 ms intervals between successive tape recorded data points as a positive decimal integer. (5 intervals = 20 ms between recorded measurements)

7. Type the name desired for azimuth drive function. It must be AZNOT, AZPOLY, AZSINE, AZSTEP, or AZIMPULSE. Type a comma.

8. Repeat 7 for elevation. The names are ELNOT, etc.

9. Type the arguments, separated by commas, for the azimuth function.

10. Repeat 9 for the elevation function. At this point, every field in the line should end with a comma, including the last field.

11. Type a (s) . The computer should now be running.

If a field is simply entered as a comma with no prefixed number, or function name, the value from the preceeding test will be used. In the case of the first test, do not trust this value to be zero.

Function Arguments

NOT:

1. Selecting this function causes the antenna to remain stationary at the given bias angle. No input parameter is used, but a single comma must be typed in the parameter field (see Fig. 1).

POLY:

1. The nth field in the argument list for a polynomial function is the coefficient a_{n-1} in:

$$\Delta \measuredangle = a_o + \frac{a_1 t}{10} + \frac{a_2 t^2}{100} + \frac{a_3 t^3}{1000} + \frac{a_4 t^4}{10000} + \frac{a_5 t^5}{100000}$$

where t is given as elapsed time in seconds and the Δ angle is in degrees.

SINE:

1. Frequency of oscillation in cycles/sec. (f).
2. Amplitude of oscillation in degrees (A).

$$\Delta \theta = A \sin (2\pi ft)$$

STEP:

1. Time for first step (seconds).
2. Height of steps (degrees).
3. Repetition time (seconds).

IMPULSE:

1. Time for first impulse leading edge (seconds).
2. Height of impulses (degrees).
3. Duration of impulse in seconds.
4. Repetition time, leading edge to next leading edge (seconds).

B. Program II - IBM 7094 Print Program

This program reads the files of data from the 490 output tape and prepares a BCD tape (for printing on the 1401). For each file on the 490 tape, a print file is generated on the BCD tape. Each file contains an identifying label, in addition to the edited data obtained from the 490 and converted to decimal numbers of degrees.

Figure 4 shows a listing of a control deck that was used for printing the output tape produced by the console communications of Fig. 1. The first card gives the number of files to be listed in columns 9 and 10. The seven remaining cards (one for each file) give the editing factor for the corresponding files. If this number is n, every nth point on tape will be printed.

Figure 5 shows a page of the output produced by the specification of Fig. 4 and the tape from the 490.

The first line is simply the run label that was typed in on the 490. The columns are (from the left):

1. Time elapsed in seconds from first application of drive function to servos.
2. Azimuth (in degrees) output to servos.
3. Elevation output to servos.
4. Azimuth input from encoders.
5. Elevation input from encoders.
6. Difference of columns 2 and 4.
7. Difference of columns 3 and 5.

For brevity, only a single page of output is reproduced here; however, this would normally be quite copious.

This IBM 7094 program is a relocatable column binary deck that must be run under FMS control. The deck is labeled "Haystack Test Print." The 490 output is mounted on A7. The print tape is A6. The control data deck is placed behind the binary deck for the run.

Control Deck:

1st Card: Col. 1 = *, Cols. 7-10 = DATA

2nd Card: Number of files to process in Cols. 1-10 as a right justified integer.

Rest of Deck: One card per file to process, giving, in Cols. 1-10, the frequency of selecting points for printing as a right justified decimal integer (1 = every point, 2 = every 2nd point, etc.).

C. Program III - IBM 7094 Plot Program

This program reads files of data from the 490 tape as they are addressed by their file labels. It prepares, as output, a BCD tape for driving the Calcomp plotter (via the 1401). The format of the graphs produced is quite flexible.

Figure 6 shows a listing of a control deck that was used to plot some of the information from the output tape produced by the console communications of Fig. 1. The first card gives the number of plots to be made in Cols. 9 and 10. Each plot is specified by a pair of cards. The first card of each pair contains, in Cols. 1-30, the label of the file from which the plot is to be made. The second card of each pair contains six variables, in fields ending in Cols. 10, 20, 30, 40, 50 and 60, respectively. The first of these provides selection of the coordinate to be plotted (0 means plot azimuth; 1, plot elevation). The second field specifies the time, in seconds, between plotted points, while the third and fourth fields state, respectively, the lower and upper limits of the time axis in seconds. The fifth field gives the physical length of the graph in inches (measured along time axis). The sixth field specifies what data is to be plotted for the given file and coordinate. This appears as a one-digit code. For more detailed discussion, see p. 10.

Figures 7 through 14 are some graphs produced by the data cards in Fig. 6. Note that the file label is neatly plotted above the graph and that the fixed length of the vertical (angle) axis (5 inches) makes the graph suitable for full-size reproduction on

standard 8-1/2" x 11" paper. All parameters of the graphs can be seen to conform to the relevant specifications of Fig. 6. Since the antenna was not connected to the computer at the time these tests were made, Figs. 8, 10, and 14 show errors due to delays in the in-out system, but do not show true servo errors.

This IBM 7094 program exists as a relocatable column binary deck that must be run under FMS control. The deck is labeled "Haystack Test Plot." The 490 output is mounted on A7. The plot tape on A6. The control deck is placed behind the binary deck for the run.

Control Deck:

1st Card: Col. 1 = *, Cols. 7-10 = DATA

2nd Card: Cols. 1-10, right justified decimal integer, number of graphs to be plotted, same as number of pairs of cards which follow.

Rest of deck consists of a pair of cards for each graph to be drawn. Of each pair:

2n + 1st Card: Cols. 1-30, left justified, the exact label given to the file to be plotted when that file was generated on the Univac 490.

2n + 2nd Card: Col. 10 = 0, plot azimuth; 1, plot elevation.

Cols. 11-20 = time interval between data points to be plotted, in seconds, as any decimal number, right justified.

Cols. 21-30 = lower time limit of plot, in seconds, as any decimal number, right justified.

Cols. 31-40 = upper time limit of plot, in seconds, same format.

Cols. 41-50 = length of time axis on graph, in inches, same format.

Cols. 60 = specifies what combinations of data to plot, with following interpretation:

0, nothing plotted

1, only input

2, only output

3, input and output

4, only error

5, input and error

6, output and error

7, input, output, and error

IV. INTERNAL DETAILS OF THE UNIVAC 490 ANTENNA SERVO TESTING PROGRAM

The three programs will again be discussed separately. This material should be read with reference to the program listings in the Appendices.

A. Program I - Univac 490 Testing Program

This program supplies azimuth and elevation coordinates to the antenna servo every 4 ms in accordance with input specifications. The time-dependent variation of the coordinates from a constant bias is calculated through a subroutine for the function used. The manner of linking subroutines to the program will be described.

Execution of the program begins at ANTENTRY. An initial remark is typed. By use of the subroutine SINEFUNCS a table of the sine function containing 2048 values is calculated and stored at location SINTBL. This corresponds to a density of 512 points per quadrant. The table is subsequently used by AZSINE and ELSINE for driving the antenna.

Next an interrogative remark is typed out requesting the parameters of on-line printer output. The first character typed in is examined to determine if it is a "Y" or an "N". If it is an N, the program jumps to INTCLKTEST after clearing ZXNLINEIND. If it is a Y, the 5th, 6th and 7th characters are entered as a decimal number, converted to octal, and stored in the lower half of ZXNLINEIND.

The entry at PROGRAM is used to write an end-of-file mark on tape #1 on completion of an operation. INPUTBUF is cleared to receive the run label which is accepted from the console. The label is converted to BCD from fieldata by FDTOBCD and is written on tape #1. The program now accepts the running parameters.

The line of data is first tested for a double period code ".." which indicates termination and causes a jump to NOMORE. If this is not present, the line is scanned from left to right and separated at the commas. The fields are stored successively in the areas designated by the low-order halves of TABLE. The operation is terminated by sensing a stop " (S) ," and control passes to VIRGULE. The program calls DECON to convert the first 5 variables listed in TABLE to octal with binary points indicated by the upper halves of the corresponding words in TABLE. If a variable is indicated only by a comma, the number in the register is left unchanged; otherwise, the converted number is placed in the appropriate location in CONTBL. When this is complete, control passes to FUNIDLOOP.

FUNIDLOOP compares the bit patterns stored in FAZI and FELE (addressed through TABLE) with the various possible names in FUNCTBL. If the function is

successfully identified, its address and argument count is transferrred from the appropriate location in FUNADDTBL to FUNLOC or FUNLOC+1. If the function name cannot be identified, an appropriate error remark is typed out and control is returned to CONINETC.

If no difficulties are encountered, the function arguments are converted by scanning the tables appended to the beginning of each subroutine. The upper half of each word contains the location of the binary point and the lower half the address for storage of the converted variable. If the total field count at the end of this operation does not match the argument counts obtained from the upper halves of FUNLOC and FUNLOC+1, an appropriate remark is typed and control passes to CONINETC. Otherwise, the real time section of the program is initiated at ZKFLDCNT.

AZST and ELST are set equal to the biases of azimuth and elevation in degrees, and these biases are converted to revolutions with a binary point at 19. The time periods specified in the input line are converted to a count of servo I-O cycles (4 ms each). They go into NWAIT, NRUN, and FREQOUT, respectively. A loop on B1 for 3750 cycles (15 seconds) moves the servos to the initial position specified by the input string.

The drive loop is initialized with two index registers (B1 and B4) being used in tandem to count running times longer than 77777_8 cycles. POINTGEN begins the drive loop. It ends roughly at PRINTRET+5. In this loop, the elapsed time in seconds is calculated and stored in THYME; the appropriate azimuth and elevation functions are called and the results (in degrees) stored in CONTBL. These quantities are converted to revolutions and stored in AZIMUTH and ELEVATION. Finally, the computed point is transferred to the servos via DRIVEREAL and index registers are tested to determine appropriate action. Register B5 delays output until the servos can start to track the applied function; i.e., until the servo response has reached a steady-state condition. Register B2 causes a line of output to be added to the output buffer (through WRITEBUF), with the period determined by FREQOUT loaded into B2. B3 performs a similar function for the on-line printer (transferring control to PRINTER). As mentioned before, B1 and B4 are used together to control the total number of cycles of the loop.

When the loop is finished, whatever remains in a tape output buffer is written out along with a terminal end-of-file mark. The biases in CONTBL and CONTBL+1 are reset to their initial value before the run.

Control is transferred to WRITEBUF if an entry is to be made in a tape output buffer. The output values are obtained from the encoders via ENCODEREAL and the five variables TIME, AZIMUTH, AZOUT, ELEVATION, and ELOUT are assembled into six words so that a blank block of six bits will appear between each word written on tape (this extra byte makes direct reading of the tape on the 7094 possible). The data is assembled into BUFB or BUFA depending on the status of the indicator FIRST. When B6 indicates that 100 lines have been entered, TAPEWRITE is called to initiate the output buffer.

At the end of a tape when a double period has been typed in as an input line, control passes to NOMORE which asks if continuation is desired. A YES or a NO (or a Y or N) may be typed in. The program also asks if the output tape should be rewound or left positioned. Again, YES or NO will be accepted. The indicated operation is performed (rewind with interlock) and control is returned either to MAIN or TOPS (137).

Subroutine TAPEWRITE sets up the channel 13 interrupt location (external) and activates the appropriate buffer to write output in binary high density mode on servo #1.

Subroutine DEGCON divides the contents of the A and the Q separately by 360_{10} to convert degrees to revolutions at a binary point of 19.

Subroutines DRIVE and ENCODE are dummy routines that function through jumps to DRIVEREAL and ENCODEREAL.

TABLE is a list of the addresses of the areas for storing the various input fields separated from the input line. FUNCTBL is a list of the names of allowed drive functions, while FUNADDTBL contains the addresses of the functions and the length of the argument storage list associated with each one.

ELPOLY and AZPOLY are the polynomial generating subroutines. They are each prefixed with a list of the addresses of the six coefficients of the polynomials:

$$\Theta - \Theta_o = \sum_{n=0}^{5} a_n \zeta^n \; ; \; \varphi - \varphi_o = \sum_{n=0}^{5} a_{6+n} \zeta^n$$

where ζ = (THYME/10), Θ = azimuth in degrees, and φ = elevation in degrees. The variable ζ is stored in THYMEX. Θ_o and φ_o are the initial biases stored in AZST and ELST.

Subroutine DECON converts a 12-character decimal numeric field stored in NUMBER to binary according to the placement of the binary point specified in BINPNT. The result is left in ACCUM. Acceptable forms are:

3.1415926,	3,	3.,
+3.1415926,	+3,	+3.,
-3.1415926,	-3,	-3.,

No more than nine numbers may be used in the input field and it must be terminated by a comma. BINPNT may be greater than 31 or negative, if desired; however, it is usually positive and less than 31. This is a general utility subroutine and is transparent to all external and active registers.

FIXTC is the error recovery program for magnetic tape interrupts.

FDTOBCD converts a word in the Q-register from fieldata to BCD by use of the table BCDTBL. One character at a time is entered into B2 and the appropriate code obtained from the table and appended to ANZ.

SINEFUNCS computes the sine of an angle specified in revolutions, with sign corrected in all quadrants. The sines are actually computed in the first quadrant by the Hastings approximation subroutine SINEFUN. SINEFUN obtains the sine of the fractional revolution stored in the Q-register at B21. The result is left in the Q at B21.

Subroutines AZSTEP and ELSTEP compute the step functions. This is accomplished by finding the remainder when THYME-AZ(EL) TIME is divided by AZ(EL)PERIOD. If this is less than 777_8, CONTBL(+1) is incremented by AZ(EL)HEIGHT.

Subroutines AZIMPULSE and ELIMPULSE operate similarly; however, both THYME-AZ(EL)TIME and THYME-AZ(EL)TIME - AZ(EL)DURAT are computed and divided by AZ(EL)PERIOD. If the former remainder is sufficiently small, CONTBL(+1) is incremented by AZ(EL)HEIGHT. If the latter is small, CONTBL(+1) is decremented.

Subroutines AZSINE and ELSINE perform a table look-up operation to simulate the sine without actual computation with the Hastings approximation. The product (AZ(EL)OMEGA*THYME) is calculated, modulo 1 at B21. The high order bits in B1 are used to address SINTBL, while the low order 11 bits are used to interpolate between successive table entries. The result is multiplied by AZ(EL)AMPLITUD and added to AZ(EL)ST, in the A-register.

Subroutines AZRANDOM and ELRANDOM provide for pointing the antenna in a fixed direction. They are referenced whenever the driving specifications AZNOT and ELNOT have been entered.

Subroutine PRINTER effectively converts the azimuth and elevation commands, responses, and errors to decimal or octal and causes them to be printed on-line. The conversion of a line of data containing 7 quantities (decimal) or 9 quantities (octal mode) is multiplexed with the main pointing calculations. The list of JPTABLE specifies the order of execution of the various operations for decimal mode printing. Each time PRINTER is entered, control passes to the next subroutine in the list. GETNUMS picks up the current values of the parameters to be printed and stores them in FIELDS. FDVAR is used to transmit information from the decimal and octal conversion subroutines. The fieldata line to be printed is assembled in PRBUFER.

Each section named ---CON (example, TIMECON) converts the current value of the integer part of the specified variable to decimal fieldata. Each section named ---CONB (example, TIMECONB) performs the binary-to-decimal conversion to four decimal places for the fractional part of the same variable. The result is, in each case, stored in the appropriate area of PRBUFER. RUNPRINTER causes the contents of PRBUFER and STOPMARK to be transmitted to the on-line printer control system. It also terminates the multiplex routine PRINTER by clearing the pointer in PRINTINDIC.

PRCONV1 makes all numbers received through location NUMBER positive, splits them into integer and fractional parts, and calls INTEGERCON, which converts the integer part to a signed three-digit fieldata-decimal integer terminated by a decimal point. FRACTCON converts the fractional part stored in FRACTION.

DRIVINIT sets up interrupt locations for the azimuth and elevation output buffers. DRIVEREAL transmits data to the azimuth and elevation interface systems.

The following table gives the storage locations, binary scale factors, and units for various quantities used frequently in the testing program.

Quantity	Location
Azimuth bias, degrees, B18	AZST
Elevation bias, degrees, B18	ELST
Azimuth, degrees, B18	CONTBL
Elevation, degrees, B18	CONTBL+1
Azimuth, revolutions, B19 (command number system)	AZIMUTH
Elevation, revolutions, B19 (command number system)	ELEVATION
Azimuth encoder bit pattern (command number system)	AZOUT
Elevation encoder bit pattern (command number system)	ELOUT
Relative real time, seconds, B18	THYME

ENCODEREAL reads the azimuth and elevation encoders from the interface equipment into locations AZOUT and ELOUT, performing a small calculation to correct for angles in the overlap zones in azimuth. Subroutine DRIVFIX answers interrupts associated with the azimuth and elevation channels. Subroutine TYPEIN answers interrupts associated with the console keyboard and performs certain elementary operations. As an example, if O or D is typed, it transfers control to FIXOCTPRNT or FIXDECPRNT, respectively, which set the printing mode to octal or decimal, as indicated. It performs a similar function with respect to the characters S and P and the locations STOPRINT and GOPRINT.

Subroutine RUNNY is a substitute routine for RUNPRINTER in the sense that it terminates the print conversion computation without printing a line. JPTABLEOCT performs the same function in octal printing as does JPTABLE in decimal printing. Each routine named ---OCT calls CONOCT to convert the prefixed variable to fieldata octal (ten characters). As an example, AZDIFOCT converts the error in azimuth to octal for printing.

Since the fields for octal and decimal printing do not precisely coincide, BUFKLEER ensures that extraneous characters are not carried over from one format to the other if format is changed in mid-run.

Addition of Drive Function Subroutines to the Testing Program

A drive function subroutine may be easily added to the program by preparing it in the proper format and by making a few entries in some tables.

The call name (for console type-in) for the subroutine should be entered in fieldata in FUNCTBL. The length of the argument list and the entry address must be entered in FUNADDTBL.

Each subroutine must be prefaced with a table of the addresses and binary points of its input arguments (excluding the time variable). The binary point is placed in the upper half-word and the variable address in the lower. The first argument typed in will be placed in the last specified address, etc., so that the variable addresses are listed in the table in the reverse order from the typed-in line.

B. Program II - IBM 7094 Print Program

This program converts the 490 output tape to a BCD tape that will print on the 1401. The number of files to be processed from input tape A6 is read from A2 and a DO-LOOP is initialized for this number of iterations.

For each file to be printed, the file label is read from A7 and written in BCD mode on A6. The editing factor, N, is read from A2. From this point the program reads in 490 records of 500 36-bit words, converts them and writes them out until an end-of-file is encountered on A6, whereupon the output file on A7 is terminated and the index of the major DO incremented (statement 101).

If an end-of-file is not encountered by subroutine READER in reading A6, IOF will be zero and the program will reverse the order of the input array, storing the reversed array in BUFFER. The entire array is converted to floating point by subroutine FLOTER, and the various terms in the array are scaled by the appropriate factors (.004 for time, .000686645507 for angles). The errors in azimuth and elevation are computed and stored in DIFFER. Finally, every Nth point is written out on A7 in an appropriate format for 1401 printing.

C. Program III - IBM 7094 Plot Program

This program converts the 490 output tape to a BCD tape suitable for driving the Calcomp plotter to produce graphical output in accordance with input specifications. First, the program requests mounting of an input tape on A7 and pauses. When restored, it reads the number of graphs to be plotted from A2, initializes the Calcomp subroutine, PLOTS, and begins a DO-LOOP for the number of frames of three graphs each to be plotted.

For each graph to be plotted, A7 is rewound. The relevant file label is read from A2, along with the editing parameters. Subroutine READER is called to read the 490 output tape (A7), placing a file label in BUFXIN. The order of the words is reversed as they are transferred to BUFRIN. The file label from A7 is compared with the desired label from A7. If they do not match, A7 is advanced one file by FILSPA and the process repeated.

When the relevant file has been located in this manner, control passes to statement 24. The program section from 24 to 211 is identical to the conversion section of the program CONVERT described above. After a record has been converted, the time fields are scanned to find one greater than TIML. When this is found, the appropriate line of data is transferred to a plot buffer, and TIML is advanced by SPACE. The process continues until the input record is exhausted, then another is read (statement 240). Eventually, TIML exceeds TIMU, and the remainder of the file is spaced over.

Since the Calcomp scaling routine requires an array of non-identical entries, the plot buffers are checked for this before calling SCALE. Those arrays which are scalable and plotable are processed in accordance with indicator IUJ. After the lines of data have been plotted, AXIS and XAXIS are called to draw in the relevant axes. Finally, the label is plotted by SYMBL4, and the graph origin is reset for the next plot.

When three graphs have been drawn, the paper is advanced three inches beyond the end of the longest graph and the pen is reset to the right-hand margin. After all the graphs specified by the input deck have been plotted, the output tapes are rewound and a notice to dismount is printed on-line.

Prior to the final exit, the program pauses (HPR77777).

APPENDIX A

490 PROGRAM

SPURT OUTPUT NO. 110

ANTENATEST LDMASSEY*24JUN1964

NO. OF INSTRUCTIONS 11514

00000	THRU	01202
01210	THRU	01222
01230	THRU	01242
01244	THRU	01245
01311	THRU	01312
01315	THRU	01320
01325	THRU	01335
02465	THRU	02465
03615	THRU	03616
03620	THRU	03620
03623	THRU	03623
03626	THRU	03626
03631	THRU	03631
03634	THRU	03634
03637	THRU	03637
03642	THRU	03642
03645	THRU	03645
03650	THRU	03650
03653	THRU	03653
03656	THRU	03656
03661	THRU	03661
03664	THRU	03664
03667	THRU	03667
03672	THRU	03672

```
                SPURT OUTPUT NO. 110

              ANTENATEST          LDMASSEY*24JUN1964

CARDS   L1 ID LABEL      TA STATEMENT                          LOC    F JKB Y      NOTES

  .     00000 ANTENATEST    PROGRAM   LDMASSEY*24JUN1964

  .     00001 ANTENTRY      TYPET     $CR$$LF$$LF$THIS IS THE ANTENN00000  61000 00011
                            A TESTING PROGRAM.
                                                               00001  04030 33115
                                                               00002  16300 51630
                                                               00003  05311 51205
                                                               00004  06233 11223
                                                               00005  23060 53112
                                                               00006  30311 62314

                                                               00007  05252 72414
                                                               00010  27062 27500
                                                               00011  64120 00142
                                                               00012  00000 00047
                                                               00013  00000 00001
  .     00002 MAIN          CL   B1                            00014  12100 00000
  .     00003 SINECALC      ENT  A*B1                          00015  11001 00000
  .     00004               RSH  AQ*20D                        00016  03000 00024

  .     00005               RJP  SINEFUNCS                     00017  65000 04275
  .     00006               STR  Q*W(SINTBL+B1)                00020  14031 04513
  .     00007               BSK  B1*2048D                      00021  71100 04000
  .     00010               JP   SINECALC                      00022  61000 00015
  .     00011               TYPET     $CR$$LF$DO YOU WISH TO HAVE OU00023  61000 00037
                            TPUT ON THE ON-LINE PRINTER.$CR$
                                                               00024  04031 12405
                                                               00025  36243 20534

                                                               00026  16301 50531
                                                               00027  24051 50633
                                                               00030  12052 43231
                                                               00031  25323 10524
                                                               00032  23053 11512
                                                               00033  05242 34121
                                                               00034  16231 20525
                                                               00035  27162 33112

                                                               00036  27750 40000
                                                               00037  64120 00142
                                                               00040  00000 00065
                                                               00041  00000 00024
  .     00012               TYPET     $CR$IF SO, HOW OFTEN.$CR$    00042  61000 00047
                                                               00043  04161 30530
                                                               00044  24560 51524
                                                               00045  34052 41331
```

```
                                                        00046  12237 50400
                                                        00047  64120 00142
                                                        00050  00000 00023
                                                        00051  00000 00043
    .  00013 REACCEPT   ACCEPT   8D*ZXNLINEIND         00052  64120 00142
                                                        00053  02010 01242
                                                        00054  00000 00000
    .  00014            CL   A*                         00055  11000 00000

    .  00015            ENT  Q*W(ZXNLINEIND)            00056  10030 01242
    .  00016            LSH  Q*2                        00057  05000 00002
    .  00017            LSH  AQ*1                       00060  07000 00001
    .  00020            STR  A*U(ZXNLINEIND)*ANOT       00061  15520 01242
    .  00021            JP   INTCLKTSTA                 00062  61000 00137
    .  00022            CL   A                          00063  11000 00000
    .  00023            LSH  Q*21D                      00064  05000 00025
    .  00024            LSH  AQ*6                       00065  07000 00006

    .  00025            ENT  Q*W(ZXNLINEIND+1)          00066  10030 01243
    .  00026            LSH  AQ*12D                     00067  07000 00014
    .  00027            LSH  A*12D                      00070  06000 00014
    .  00030            ADD  A*7556                     00071  20000 07556
    .  00031            STR  A*W(NUMBER)                00072  15030 04144
    .  00032            CL   W(BINPNT)                  00073  16030 04147
    .  00033            RJP  DECON                      00074  65000 04017
    .  00034            ENT  A*W(ACCUM)                 00075  11030 04150

    .  00035            SUB  A*1                        00076  21000 00001
    .  00036            STR  A*L(ZXNLINEIND)            00077  15010 01242
    .  00037            SUB  A*24D*ANEG                 00100  21700 00030
    .  00040            JP   INTCLKTEST                 00101  61000 00140
    .  00041            TYPET     $CR$MINIMUM INTERVAL IS 25 CYC00102  61000 00120
                        LES PER PRINTED LINE, RETYPEMESSAGE.$CR$
                                                        00103  04221 62316
                                                        00104  22322 20516

                                                        00105  23311 22733
                                                        00106  06210 51630
                                                        00107  05626 50510
                                                        00110  36102 11230
                                                        00111  05251 22705
                                                        00112  25271 62331
                                                        00113  12110 52116
                                                        00114  23125 60527

                                                        00115  12313 62512
                                                        00116  22123 03006
                                                        00117  14127 50400
                                                        00120  64120 00142
                                                        00121  00000 00100
                                                        00122  00000 00103
    .  00042            JP   REACCEPT                   00123  61000 00052
    .  00043 PROGRAM    NO-OP                           00124  12000 00000
```

```
.  00044                RPT  77777                          00125  70000 77777
.  00045                ENT  Q*W(100)                       00126  10030 00100
.  00046                RPT  77777                          00127  70000 77777
.  00047                ENT  Q*W(100)                       00130  10030 00100
.  00050                RPT  77777                          00131  70000 77777
.  00051                ENT  Q*W(100)                       00132  10030 00100
.  00052                RPT  77777                          00133  70000 77777
.  00053                ENT  Q*W(100)                       00134  10030 00100

.  00054                EX-FCT    C15*0230000002            00135  13670 11502
.  00055                JP   INTCLKTEST                     00136  61000 00140
.  00056 INTCLKTSTA     CL   W(ZXNLINEIND)                  00137  16030 01242
.  00057 INTCLKTEST     NO-OP                               00140  12000 00000
.  00060                ENT  A*W(INTCLKTEST)                00141  11030 00140
.  00061                STR  A*W(36)                        00142  15030 00036
.  00062                ENT  A*W(AZST)                      00143  11030 03711
.  00063                ENT  Q*W(ELST)                      00144  10030 03712

.  00064                STR  A*W(CONTBL)                    00145  15030 01320
.  00065                STR  Q*W(CONTBL+1)                  00146  14030 01321
.  00066 CONIN          CLEAR     6*INPUTBUFER              00147  70100 00006
                                                           00150  16030 01245
.  00067                CL   W(PRINTINDIC)                  00151  16030 01156
.  00070                CLEAR     25D*PRINTBUFER            00152  70100 00031
                                                           00153  16030 10704
.  00071                TYPET     $CR$TYPE TEST IDENTIFICATION.$00154  61000 00163

                        CR$
                                                           00155  04313 62512
                                                           00156  05311 23031
                                                           00157  05161 11223
                                                           00160  31161 31610
                                                           00161  06311 62423
                                                           00162  75040 00000
                                                           00163  64120 00142

                                                           00164  00000 00033
                                                           00165  00000 00155
.  00072                ACCEPT    31D*INPUTBUFER            00166  64120 00142
                                                           00167  02037 01245
                                                           00170  00000 00000
.  00073                ENT  B3*5                           00171  12300 00005
.  00074 CONIN1         ENT  Q*W(INPUTBUFER+B3)             00172  10033 01245
.  00075                RJP  FDTOBCD                        00173  65000 04156

.  00076                STR  Q*W(INPUTBUFER+B3)             00174  14033 01245
.  00077                BJP  B3*CONIN1                      00175  72300 00172
.  00100                ENT  A*W(CBCW)                      00176  11030 01112
.  00101                STR  A*W(BCW)                       00177  15030 01113
.  00102                EX-FCT    C15*0200000002            00200  13670 11503
.  00103                NO-OP                               00201  12000 00000
.  00104                OUT  C15*W(BCW)                     00202  74670 01113
.  00105 CONINETC       TYPET     $CR$TYPE TEST PARAMETERS.$CR$ 00203  61000 00211
```

```
                                                        00204  04313 62512
                                                        00205  05311 23031
                                                        00206  05250 62706
                                                        00207  22123 11227
                                                        00210  30750 40000
                                                        00211  64120 00142
                                                        00212  00000 00027
                                                        00213  00000 00204

.    00106              ACCEPT    180D*INPUTBUFER      00214  64120 00142
                                                        00215  02264 01245
                                                        00216  00000 00000
.    00107              ENT  A*W(TYPEIN)                00217  11030 11306
.    00110              STR  A*W(42)                    00220  15030 00042
.    00111              IN   C2*W(TINBUF)*MONITOR       00221  75130 11333
.    00112              CL   A*                         00222  11000 00000
.    00113              ENT  Q*W(INPUTBUFER)            00223  10030 01245

.    00114              LSH  AQ*12D                     00224  07000 00014
.    00115              SUB  A*7575*ANOT                00225  21500 07575
.    00116              JP   NOMORE                     00226  61000 01022
.    00117              CL   A*                         00227  11000 00000
.    00120              CL   B1*                        00230  12100 00000
.    00121              CL   B3*                        00231  12300 00000
.    00122              CL   B4*                        00232  12400 00000
.    00123              CL   B6                         00233  12600 00000

.    00124              ENT  Q*W(INPUTBUFER+B1)         00234  10031 01245
.    00125              CL   W(TEMBX+B3)                00235  16033 01312
.    00126              CL   B2*                        00236  12200 00000
.    00127 PROCEEDX     LSH  AQ*6                       00237  07000 00006
.    00130              STR  A*W(TEMAX)                 00240  15030 01315
.    00131              SUB  A*77*ANOT                  00241  21500 00077
.    00132              JP   CODEDELETE                 00242  61000 00370
.    00133              ENT  A*W(TEMAX)                 00243  11030 01315

.    00134              SUB  A*57*ANOT                  00244  21500 00057
.    00135              JP   VIRGULE                    00245  61000 00375
.    00136              ENT  A*W(TEMAX)                 00246  11030 01315
.    00137              SUB  A*56*ANOT                  00247  21500 00056
.    00140              JP   COMMA                      00250  61000 00336
.    00141              ENT  A*W(TEMBX+B3)              00251  11033 01312
.    00142              STR  Q*W(TEMCX)                 00252  14030 01316
.    00143              ENT  Q*W(TEMAX)                 00253  10030 01315

.    00144              LSH  Q*24D                      00254  05000 00030
.    00145              LSH  AQ*6                       00255  07000 00006
.    00146              STR  A*W(TEMBX+B3)              00256  15033 01312
.    00147              BSK  B6*4                       00257  71600 00004
.    00150              JP   CODEDELETE                 00260  61000 00370
.    00151              BSK  B3*2                       00261  71300 00002
.    00152              JP   AGAINXY                    00262  61000 00367
.    00153              JP   AGAINY                     00263  61000 00305
```

```
.  00254                ENT  A*L(NFIELDS)                          00422  11010 01317
.  00255                SUB  A*7                                   00423  21000 00007
.  00256                STR  A*L(NFIELDS)                          00424  15010 01317
.  00257                CL   B3*                                   00425  12300 00000
.  00260 FUNIDLOOP      ENT  B2*L(TABLE+5+B3)                      00426  12213 01164
.  00261                ENT  B1*16D                                00427  12100 00020
.  00262 FUNSEARCH      ENT  A*W(B2)                               00430  11032 00000
.  00263                SUB  A*W(FUNCTBL+B1)*ANOT                  00431  21531 01202

.  00264                JP   FOUND                                 00432  61000 00464
.  00265                BJP  B1*FUNSEARCH                          00433  72100 00430
.  00266                ENT  A*W(B2)                               00434  11032 00000
.  00267                SUB  A*5600000000*ANOT                     00435  21530 11504
.  00270                JP   FOUND+2                               00436  61000 00466
.  00271                TYPET     $CR$$LF$SPECIFIED FUNCTION NOT   00437  61000 00450
                         IN MEMORY.$CR$
                                                                   00440  04033 02512

                                                                   00441  10161 31612
                                                                   00442  11051 33223
                                                                   00443  10311 62423
                                                                   00444  05232 43105
                                                                   00445  16230 52212
                                                                   00446  22242 73675
                                                                   00447  04000 00000
                                                                   00450  64120 00142

                                                                   00451  00000 00044
                                                                   00452  00000 00440
.  00272                TYPET     THIS LINE DELETED.$CR$           00453  61000 00460
                                                                   00454  31151 63005
                                                                   00455  21162 31205
                                                                   00456  11122 11231
                                                                   00457  12117 50400
                                                                   00460  64120 00142

                                                                   00461  00000 00023
                                                                   00462  00000 00454
.  00273                JP   CONINETC                              00463  61000 00203
.  00274 FOUND          ENT  A*W(FUNADDTBL+B1)                     00464  11031 01222
.  00275                STR  A*W(FUNLOC+B3)                        00465  15033 03616
.  00276                BSK  B3*1                                  00466  71300 00001
.  00277                JP   FUNIDLOOP                             00467  61000 00426
.  00300                CL   B1*                                   00470  12100 00000

.  00301                CL   B5*                                   00471  12500 00000
.  00302 BARGLOOP       ENT  B2*L(FUNLOC+B1)                       00472  12211 03616
.  00303                ENT  B3*U(FUNLOC+B1)                       00473  12321 03616
.  00304                BJP  B2*NEXT                               00474  72200 00475
.  00305 NEXT           BJP  B3*NEXT+1                             00475  72300 00476
.  00306 ARGLOOP        ENT  A*L(B2)                               00476  11012 00000
.  00307                ENT  B4*U(B2)                              00477  12422 00000
.  00310                STR  A*W(BINPNT)                           00500  15030 04147
```

```
.  00174                LSH   Q*24D                00342  05000 00030
.  00175                LSH   AQ*6                 00343  07000 00006
.  00176                STR   A*W(TEMBX+B3)        00344  15033 01312
.  00177                ENT   A*4                  00345  11000 00004
.  00200                STR   B6*L(TEMAX)          00346  16610 01315
.  00201                SUB   A*L(TEMAX)           00347  21010 01315
.  00202                ENT   Q*A                  00350  10070 00000
.  00203                MUL   6                    00351  22000 00006

.  00204                STR   Q*L(TEMAX)           00352  14010 01315
.  00205                ENT   Q*W(TEMBX+B3)        00353  10033 01312
.  00206                LSH   Q*L(TEMAX)           00354  05010 01315
.  00207                STR   Q*W(TEMBX+B3)        00355  14033 01312
.  00210                ENT   B5*L(TABLE-1+B4)     00356  12514 01156
.  00211                ENT   A*W(TEMBX)           00357  11030 01312
.  00212                STR   A*W(B5)              00360  15035 00000
.  00213                ENT   A*W(TEMBX+1)         00361  11030 01313

.  00214                STR   A*W(1+B5)            00362  15035 00001
.  00215                ENT   A*W(TEMBX+2)         00363  11030 01314
.  00216                STR   A*W(2+B5)            00364  15035 00002
.  00217                CL    B3                   00365  12300 00000
.  00220                CL    B6                   00366  12600 00000
.  00221 AGAINXY        CL    W(TEMBX+B3)          00367  16033 01312
.  00222 CODEDELETE     BSK   B2*4                 00370  71200 00004
.  00223                JP    AGAINX               00371  61000 00302

.  00224                BSK   B1*36D               00372  71100 00044
.  00225                JP    AGAINZ               00373  61000 00332
.  00226                JP    LINERROR             00374  61000 00264
.  00227 VIRGULE        STR   B4*L(NFIELDS)        00375  16410 01317
.  00230                CL    B1*                  00376  12100 00000
.  00231 CYCLE          ENT   B2*L(TABLE+B1)       00377  12211 01157
.  00232                ENT   B3*U(TABLE+B1)       00400  12321 01157
.  00233                ENT   A*W(B2)              00401  11032 00000

.  00234                STR   A*W(NUMBER)          00402  15030 04144
.  00235                ENT   A*W(1+B2)            00403  11032 00001
.  00236                STR   A*W(NUMBER+1)        00404  15030 04145
.  00237                ENT   A*W(2+B2)            00405  11032 00002
.  00240                STR   A*W(NUMBER+2)        00406  15030 04146
.  00241                STR   B3*L(BINPNT)         00407  16310 04147
.  00242                ENT   Q*W(NUMBER)          00410  10030 04144
.  00243                CL    A                    00411  11000 00000

.  00244                LSH   AQ*6                 00412  07000 00006
.  00245                SUB   A*56*ANOT            00413  21500 00056
.  00246                JP    SAMEVALUE            00414  61000 00420
.  00247                RJP   DECON                00415  65000 04017
.  00250                ENT   A*W(ACCUM)           00416  11030 04150
.  00251                STR   A*W(CONTBL+B1)       00417  15031 01320
.  00252 SAMEVALUE      BSK   B1*4                 00420  71100 00004
.  00253                JP    CYCLE                00421  61000 00377
```

```
.  00154 LINERROR    TYPET    $CR$$LF$INPUT LINE TOO LONG.  00264  61000 00276
                     THIS LINE DELETED.$CR$
                                                           00265  04031 62325
                                                           00266  32310 52116
                                                           00267  23120 53124
                                                           00270  24052 12423
                                                           00271  14750 50531
                                                           00272  15163 00521

                                                           00273  16231 20511
                                                           00274  12211 23112
                                                           00275  11750 40000
                                                           00276  64120 00142
                                                           00277  00000 00053
                                                           00300  00000 00265
.  00155             JP   CONINETC                        00301  61000 00203
.  00156 AGAINX      ENT  Q*W(TEMCX)                      00302  10030 01316

.  00157             CL   A*                              00303  11000 00000
.  00160             JP   PROCEEDX                        00304  61000 00237
.  00161 AGAINY      TYPET    $CR$$LF$AN INPUT FIELD EXCEEDS00305  61000 00316
                      15 CHARACTERS.$CR$
                                                           00306  04030 62305
                                                           00307  16232 53231
                                                           00310  05131 61221
                                                           00311  11051 23510

                                                           00312  12121 13005
                                                           00313  61650 51015
                                                           00314  06270 61031
                                                           00315  12273 07504
                                                           00316  64120 00142
                                                           00317  00000 00050
                                                           00320  00000 00306
.  00162             TYPET    THIS LINE DELETED.$CR$      00321  61000 00326

                                                           00322  31151 63005
                                                           00323  21162 31205
                                                           00324  11122 11231
                                                           00325  12117 50400
                                                           00326  64120 00142
                                                           00327  00000 00023
                                                           00330  00000 00322
.  00163             JP   CONINETC                        00331  61000 00203

.  00164 AGAINZ      CL   A*                              00332  11000 00000
.  00165             ENT  Q*W(INPUTBUFER+B1)              00333  10031 01245
.  00166             CL   B2*                             00334  12200 00000
.  00167             JP   PROCEEDX                        00335  61000 00237
.  00170 COMMA       BSK  B4*35                           00336  71400 00035
.  00171             ENT  A*W(TEMBX+B3)                   00337  11033 01312
.  00172             STR  Q*W(TEMCX)                      00340  14030 01316
.  00173             ENT  Q*W(TEMAX)                      00341  10030 01315
```

```
.  00311                ENT  B6*L(TABLE+7+B5)                00501  12615 01166
.  00312                ENT  A*W(B6)                         00502  11036 00000
.  00313                STR  A*W(NUMBER)                     00503  15030 04144
.  00314                ENT  A*W(1+B6)                       00504  11036 00001
.  00315                STR  A*W(NUMBER+1)                   00505  15030 04145
.  00316                ENT  A*W(2+B6)                       00506  11036 00002
.  00317                STR  A*W(NUMBER+2)                   00507  15030 04146
.  00320                ENT  A*W(NUMBER)                     00510  11030 04144

.  00321                SUB  A*5600000000*ANOT               00511  21530 11504
.  00322                JP   NEXTX-1                         00512  61000 00516
.  00323                RJP  DECON                           00513  65000 04017
.  00324                ENT  A*W(ACCUM)                      00514  11030 04150
.  00325                STR  A*W(B4)                         00515  15034 00000
.  00326                BJP  B2*NEXTX                        00516  72200 00517
.  00327 NEXTX          BSK  B5*100                          00517  71500 00100
.  00330                JP   NEXTX+2                         00520  61000 00521

.  00331                BJP  B3*ARGLOOP                      00521  72300 00476
.  00332                BSK  B1*1                            00522  71100 00001
.  00333                JP   BARGLOOP                        00523  61000 00472
.  00334                ENT  A*U(FUNLOC+1)                   00524  11020 03617
.  00335                ADD  A*U(FUNLOC)                     00525  20020 03616
.  00336                SUB  A*L(NFIELDS)*ANOT               00526  21510 01317
.  00337                JP   ZKFLDCNT                        00527  61000 00547
.  00340                TYPET     $CR$$LF$INCORRECT NUMBER OF FI00530  61000 00543

                        ELDS.  THIS LINE DELETED.$CR$
                                                             00531  04031 62310
                                                             00532  24272 71210
                                                             00533  31052 33222
                                                             00534  07122 70524
                                                             00535  13051 31612
                                                             00536  21113 07505
                                                             00537  05311 51630

                                                             00540  05211 62312
                                                             00541  05111 22112
                                                             00542  31121 17504
                                                             00543  64120 00142
                                                             00544  00000 00062
                                                             00545  00000 00531
.  00341                JP   CONINETC                        00546  61000 00203
.  00342 ZKFLDCNT       JP   FIDGE*KEY1                      00547  61100 00551

.  00343                JP   DRIVINIT                        00550  61000 11210
.  00344 FIDGE          CL   W(17)                           00551  16030 00017
.  00345                ENT  A*W(DRIVE2)                     00552  11030 01145
.  00346                STR  A*W(36)                         00553  15030 00036
.  00347 INITRET        ENT  A*W(CONTBL)                     00554  11030 01320
.  00350                ENT  Q*W(CONTBL+1)                   00555  10030 01321
.  00351                STR  A*W(AZST)                       00556  15030 03711
.  00352                STR  Q*W(ELST)                       00557  14030 03712
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.  00353                RJP  DEGCON                00560  65000 01114
.  00354                STR  A*W(AZIMUTH)          00561  15030 01331
.  00355                STR  Q*W(ELEVATION)        00562  14030 01332
.  00356                ENT  Q*W(CONTBL+2)         00563  10030 01322
.  00357                MUL  250D                  00564  22000 00372
.  00360                SUB  Q*1                   00565  27000 00001
.  00361                STR  Q*W(NWAIT)            00566  14030 01325
.  00362                ENT  Q*W(CONTBL+3)         00567  10030 01323

.  00363                MUL  250D                  00570  22000 00372
.  00364                SUB  Q*1                   00571  27000 00001
.  00365                STR  Q*W(NRUN)             00572  14030 01326
.  00366                ENT  Q*W(CONTBL+4)         00573  10030 01324
.  00367                SUB  Q*1                   00574  27000 00001
.  00370                STR  Q*W(FREQOUT)          00575  14030 01311
.  00371                ENT  B1*3750D              00576  12100 07246
.  00372                ENT  A*77774               00577  11000 77774

.  00373                STR  A*U(17)               00600  15020 00017
.  00374 FIRSTPOSIT     RJP  DRIVE*KEY1            00601  65100 01135
.  00375                JP   FIDGET*KEY1           00602  61100 00604
.  00376                RJP  DRIVEREAL             00603  65000 11224
.  00377 FIDGET         BJP  B1*FIRSTPOSIT         00604  72100 00601
.  00400                ENT  B1*L(NRUN)            00605  12110 01326
.  00401                ENT  B4*U(NRUN)            00606  12420 01326
.  00402                ENT  B2*L(FREQOUT)         00607  12210 01311

.  00403                ENT  B5*L(NWAIT)           00610  12510 01325
.  00404                CL   W(FIRST)              00611  16030 04134
.  00405                CL   B6*                   00612  12600 00000
.  00406 POINTGEN       ENT  A*W(NRUN)             00613  11030 01326
.  00407                ADD  A*L(NWAIT)            00614  20010 01325
.  00410                SUB  A*B1                  00615  21001 00000
.  00411                CL   Q                     00616  10000 00000
.  00412                RSH  AQ*15D                00617  03000 00017

.  00413                SUB  A*B4                  00620  21004 00000
.  00414                LSH  AQ*3                  00621  07000 00003
.  00415                DIV  250D                  00622  23000 00372
.  00416                STR  Q*W(THYME)            00623  14030 03713
.  00417                RJP  L(FUNLOC+1)           00624  65010 03617
.  00420                STR  A*W(CONTBL+1)         00625  15030 01321
.  00421                RJP  L(FUNLOC)             00626  65010 03616
.  00422                STR  A*W(CONTBL)           00627  15030 01320

.  00423                ENT  Q*W(CONTBL+1)         00630  10030 01321
.  00424                RJP  DEGCON                00631  65000 01114
.  00425                STR  A*W(AZIMUTH)          00632  15030 01331
.  00426                STR  Q*W(ELEVATION)        00633  14030 01332
.  00427                RJP  DRIVE*KEY1            00634  65100 01135
.  00430                JP   FIDGETTE*KEY1         00635  61100 00637
.  00431                RJP  DRIVEREAL             00636  65000 11224
.  00432 FIDGETTE       BJP  B5*POINTGEN           00637  72500 00613
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.  00433                BJP   B2*BUFDONE                    00640  72200 00642
.  00434                JP    WRITEBUF                      00641  61000 00706
.  00435 BUFDONE        ENT   A*U(ZXNLINEIND)*ANOT          00642  11520 01242
.  00436                JP    PRINTRET                      00643  61000 00650
.  00437                BJP   B3*PRINTRETEX                 00644  72300 00646
.  00440                JP    WRITELINE                     00645  61000 00703
.  00441 PRINTRETEX     ENT   A*W(PRINTINDIC)*AZERO         00646  11430 01156
.  00442                RJP   PRINTER                       00647  65000 10602

.  00443 PRINTRET       BJP   B1*POINTGEN                   00650  72100 00613
.  00444                ENT   B1*77777                      00651  12100 77777
.  00445                BJP   B4*POINTGEN                   00652  72400 00613
.  00446                ENT   A*W(INTCLKTEST)               00653  11030 00140
.  00447                STR   A*W(36)                       00654  15030 00036
.  00450                TERM  C2*INPUT                      00655  66100 00000
.  00451                STR   B6*W(TEMAX)                   00656  16630 01315
.  00452                ENT   A*600D                        00657  11000 01130

.  00453                RPL   A-Y*W(TEMAX)                  00660  25030 01315
.  00454                ENT   A*W(FIRST)*ANOT               00661  11530 04134
.  00455                JP    CLRBUFA                       00662  61000 00676
.  00456                CLEAR       W(TEMAX)*BUFB+B6        00663  70130 01315
                                                            00664  16036 02465
.  00457 ZZZZ           JP    ZZZZ*C15*ACTIVEOUT            00665  63640 00665
.  00460                RJP   TAPEWRITE                     00666  65000 01075
.  00461                ENT   A*W(AZST)                     00667  11030 03711

.  00462                ENT   Q*W(ELST)                     00670  10030 03712
.  00463                STR   A*W(CONTBL)                   00671  15030 01320
.  00464                STR   Q*W(CONTBL+1)                 00672  14030 01321
.  00465                ENT   A*W(INTCLKTEST)               00673  11030 00140
.  00466                STR   A*W(36)                       00674  15030 00036
.  00467                JP    PROGRAM                       00675  61000 00124
.  00470 CLRBUFA        CLEAR       W(TEMAX)*BUFA+B6        00676  70130 01315
                                                            00677  16036 01335

.  00471 ZXYZ           JP    ZXYZ*C15*ACTIVEOUT            00700  63640 00700
.  00472                RJP   TAPEWRITE                     00701  65000 01075
.  00473                JP    PROGRAM                       00702  61000 00124
.  00474 WRITELINE      ENT   B3*L(ZXNLINEIND)              00703  12310 01242
.  00475                RJP   PRINTER                       00704  65000 10602
.  00476                JP    PRINTRET                      00705  61000 00650
.  00477 WRITEBUF       ENT   B2*L(FREQOUT)                 00706  12210 01311
.  00500                RJP   ENCODE                        00707  65000 01146

.  00501                ENT   A*W(NRUN)                     00710  11030 01326
.  00502                ADD   A*L(NWAIT)                    00711  20010 01325
.  00503                STR   B1*L(TEMAX)                   00712  16110 01315
.  00504                STR   B4*U(TEMAX)                   00713  16420 01315
.  00505                SUB   A*W(TEMAX)                    00714  21030 01315
.  00506                STR   A*W(TIME)                     00715  15030 01330
.  00507                ENT   A*W(FIRST)*ANOT               00716  11530 04134
.  00510                JP    USEBUFA                       00717  61000 00762
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                CL   Q*                        00720  10000 00000
                ENT  A*W(TIME)                 00721  11030 01330
                RSH  AQ*6                      00722  03000 00006
                STR  A*W(BUFB+B6)              00723  15036 02465
                CL   A*                        00724  11000 00000
                LSH  AQ*12D                    00725  07000 00014
                ENT  Q*W(AZIMUTH)*QPOS         00726  10230 01331
                SUB  Q*1                       00727  27000 00001

                LSH  AQ*18D                    00730  07000 00022
                STR  A*W(BUFB+1+B6)            00731  15036 02466
                CL   A*                        00732  11000 00000
                LSH  AQ*18D                    00733  07000 00022
                ENT  Q*W(AZOUT)                00734  10030 01333
                LSH  AQ*12D                    00735  07000 00014
                STR  A*W(BUFB+2+B6)            00736  15036 02467
                CL   A*                        00737  11000 00000

                LSH  AQ*24D                    00740  07000 00030
                ENT  Q*W(ELEVATION)*QPOS       00741  10230 01332
                SUB  Q*1                       00742  27000 00001
                LSH  AQ*6                      00743  07000 00006
                STR  A*W(BUFB+3+B6)            00744  15036 02470
                STR  Q*W(BUFB+4+B6)            00745  14036 02471
                ENT  Q*W(ELOUT)                00746  10030 01334
                STR  Q*W(BUFB+5+B6)            00747  14036 02472

                BSK  B6*594D                   00750  71600 01122
                JP   UNFULLB                   00751  61000 00755
                RJP  TAPEWRITE                 00752  65000 01075
                CL   W(FIRST)                  00753  16030 04134
                JP   BUFDONE                   00754  61000 00642
       UNFULLB  STR  B6*L(TEMAX)               00755  16610 01315
                ENT  Q*5                       00756  10000 00005
                RPL  Y+Q*L(TEMAX)              00757  34010 01315

                ENT  B6*L(TEMAX)               00760  12610 01315
                JP   BUFDONE                   00761  61000 00642
       USEBUFA  CL   Q*                        00762  10000 00000
                ENT  A*W(TIME)                 00763  11030 01330
                RSH  AQ*6                      00764  03000 00006
                STR  A*W(BUFA+B6)              00765  15036 01335
                CL   A*                        00766  11000 00000
                LSH  AQ*12D                    00767  07000 00014

                ENT  Q*W(AZIMUTH)              00770  10030 01331
                LSH  AQ*18D                    00771  07000 00022
                STR  A*W(BUFA+1+B6)            00772  15036 01336
                CL   A*                        00773  11000 00000
                LSH  AQ*18D                    00774  07000 00022
                ENT  Q*W(AZOUT)                00775  10030 01333
                LSH  AQ*12D                    00776  07000 00014
                STR  A*W(BUFA+2+B6)            00777  15036 01337
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.  00571                CL   A*                                  01000  11000 00000
.  00572                LSH  AQ*24D                              01001  07000 00030
.  00573                ENT  Q*W(ELEVATION)                      01002  10030 01332
.  00574                LSH  AQ*6                                01003  07000 00006
.  00575                STR  A*W(BUFA+3+B6)                      01004  15036 01340
.  00576                STR  Q*W(BUFA+4+B6)                      01005  14036 01341
.  00577                ENT  Q*W(ELOUT)                          01006  10030 01334
.  00600                STR  Q*W(BUFA+5+B6)                      01007  14036 01342

.  00601                BSK  B6*594D                             01010  71600 01122
.  00602                JP   UNFULLA                             01011  61000 01015
.  00603                RJP  TAPEWRITE                           01012  65000 01075
.  00604                RPL  Y+1*W(FIRST)                        01013  36030 04134
.  00605                JP   BUFDONE                             01014  61000 00642
.  00606 UNFULLA        STR  B6*L(TEMAX)                         01015  16610 01315
.  00607                ENT  Q*5                                 01016  10000 00005
.  00610                RPL  Y+Q*L(TEMAX)                        01017  34010 01315

.  00611                ENT  B6*L(TEMAX)                         01020  12610 01315
.  00612                JP   BUFDONE                             01021  61000 00642
.  00613 NOMORE         TYPET     $CR$$LF$DO YOU WISH TO CONTINU 01022  61000 01031
                        E$CR$
                                                                 01023  04031 12405
                                                                 01024  36243 20534
                                                                 01025  16301 50531
                                                                 01026  24051 02423

                                                                 01027  31162 33212
                                                                 01030  04000 00000
                                                                 01031  64120 00142
                                                                 01032  00000 00032
                                                                 01033  00000 01023
.  00614                ACCEPT    4*CONTIND                     01034  64120 00142
                                                                 01035  02004 03615
                                                                 01036  00000 00000

.  00615                CL   W(TEMA)                             01037  16030 04135
.  00616                CL   A*                                  01040  11000 00000
.  00617                ENT  Q*W(CONTIND)                        01041  10030 03615
.  00620                LSH  Q*2                                 01042  05000 00002
.  00621                LSH  AQ*1*ANOT                           01043  07500 00001
.  00622                RPL  Y+1*W(TEMA)                         01044  36030 04135
.  00623                TYPET     $CR$$LF$DO YOU WISH TO REWIND  01045  61000 01056
                        OUTPUT TAPE.$CR$

                                                                 01046  04031 12405
                                                                 01047  36243 20534
                                                                 01050  16301 50531
                                                                 01051  24052 71234
                                                                 01052  16231 10524
                                                                 01053  32312 53231
                                                                 01054  05310 62512
                                                                 01055  75040 00000
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                                                    01056  64120 00142
                                                    01057  00000 00045
                                                    01060  00000 01046
    .  00624            ACCEPT    4*CONTIND         01061  64120 00142
                                                    01062  02004 03615
                                                    01063  00000 00000
    .  00625            CL    A*                    01064  11000 00000
    .  00626            ENT   Q*W(CONTIND)          01065  10030 03615

    .  00627            LSH   Q*2                   01066  05000 00002
    .  00630            LSH   AQ*1*ANOT             01067  07500 00001
    .  00631            JP    MAIN                  01070  61000 00014
    .  00632            EX-FCT     C15*2110000002   01071  13670 11505
    .  00633            ENT   A*W(TEMA)*ANOT        01072  11530 04135
    .  00634            JP    MAIN                  01073  61000 00014
    .  00635            JP    137                   01074  61000 00137
    .  00636 TAPEWRITE  RESERVE   1                 01075  00000 00000

    .  00637            ENT   A*W(INTERR)           01076  11030 04155
    .  00640            STR   A*W(35)               01077  15030 00035
    .  00641            ENT   A*W(FIRST)*ANOT       01100  11530 04134
    .  00642            ENT   A*W(ABCW)*SKIP        01101  11130 01110
    .  00643            ENT   A*W(BBCW)             01102  11030 01111
    .  00644            STR   A*W(BCW)              01103  15030 01113
    .  00645            EX-FCT     C15*0200000002   01104  13670 11503
    .  00646            NO-OP                       01105  12000 00000

    .  00647            OUT   C15*W(BCW)            01106  74670 01113
    .  00650 PROCEEDTAP JP    L(TAPEWRITE)          01107  61010 01075
    .  00651 ABCW       U-TAG      BUFA+599D*BUFA   01110  02464 01335
    .  00652 BBCW       U-TAG      BUFB+599D*BUFB   01111  03614 02465
    .  00653 CBCW       U-TAG      INPUTBUFER+5*INPUTBUFER 01112  01252 01245
    .  00654 BCW        RESERVE    1                01113  00000 00000
    .  00655 DEGCON     RESERVE    1                01114  00000 00000
    .  00656            STR   A*W(ACSTORE)          01115  15030 01132

    .  00657            CL    A*                    01116  11000 00000
    .  00660            LSH   AQ*30D                01117  07000 00036
    .  00661            RSH   AQ*29D                01120  03000 00035
    .  00662            DIV   W(FACTOR)             01121  23030 01134
    .  00663            STR   Q*W(QSTORE)           01122  14030 01133
    .  00664            CL    A*                    01123  11000 00000
    .  00665            ENT   A*W(ACSTORE)          01124  11030 01132
    .  00666            RSH   AQ*29D                01125  03000 00035

    .  00667            DIV   W(FACTOR)             01126  23030 01134
    .  00670            LSH   AQ*30D                01127  07000 00036
    .  00671            ENT   Q*W(QSTORE)           01130  10030 01133
    .  00672            JP    L(DEGCON)             01131  61010 01114
    .  00673 ACSTORE    RESERVE    1                01132  00000 00000
    .  00674 QSTORE     RESERVE    1                01133  00000 00000
    .  00675 FACTOR     550                         01134  00000 00550
    .  00676 DRIVE      RESERVE    1                01135  00000 00000  ST DRIVE
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.  00677                ENT   A*W(DRIVE2)                 01136  11030 01145
.  00700                STR   A*W(36)                     01137  15030 00036
.  00701                JP    DRIVE+1                     01140  61000 01136
.  00702 DRIVE1         ENT   A*77774                     01141  11000 77774
.  00703.               STR   A*U(17)                     01142  15020 00017
.  00704                RIL                               01143  60000 00000
.  00705                JP    L(DRIVE)                    01144  61010 01135
.  00706 DRIVE2         JP    DRIVE1                      01145  61000 01141

.  00707 ENCODE         RESERVE   1                       01146  00000 00000  ST ENCODE
.  00710                JP    ENCODEX*KEY1                01147  61100 01151
.  00711                JP    ENCODEREAL                  01150  61000 11243
.  00712 ENCODEX        ENT   A*W(AZIMUTH)                01151  11030 01331
.  00713                ENT   Q*W(ELEVATION)              01152  10030 01332
.  00714                STR   A*W(AZOUT)                  01153  15030 01333
.  00715                STR   Q*W(ELOUT)                  01154  14030 01334
.  00716                JP    L(ENCODE)                   01155  61010 01146

.  00717 BANG           EQUALS    18D
.  00720 PRINTINDIC     RESERVE   1                       01156  00000 00000
.  00721 TABLE          U-TAG     BANG*THETAFD            01157  00022 03620
.  00722                U-TAG     BANG*PHIFD              01160  00022 03623
.  00723                U-TAG     ZERO*TWAITFD            01161  00000 03626
.  00724                U-TAG     ZERO*TRUNFD             01162  00000 03631
.  00725                U-TAG     ZERO*IWRITEFD           01163  00000 03634
.  00726                U-TAG     ZERO*FAZI               01164  00000 03637

.  00727                U-TAG     ZERO*FELE               01165  00000 03642
.  00730                U-TAG     ZERO*ARG1               01166  00000 03645
.  00731                U-TAG     ZERO*ARG2               01167  00000 03650
.  00732                U-TAG     ZERO*ARG3               01170  00000 03653
.  00733                U-TAG     ZERO*ARG4               01171  00000 03656
.  00734                U-TAG     ZERO*ARG5               01172  00000 03661
.  00735                U-TAG     ZERO*ARG6               01173  00000 03664
.  00736                U-TAG     ZERO*ARG7               01174  00000 03667

.  00737                U-TAG     ZERO*ARG8               01175  00000 03672
.  00740                U-TAG     ZERO*ARG9               01176  00000 03675
.  00741                U-TAG     ZERO*ARG10              01177  00000 03700
.  00742                U-TAG     ZERO*ARG11              01200  00000 03703
.  00743                U-TAG     ZERO*ARG12              01201  00000 03706
.  00744 FUNCTBL        RESERVE   6                       01202  00000 00000
.  00745                FD    1*ELNOT                     01210  12212 32431
.  00746                FD    1*AZNOT                     01211  06372 32431

.  00747                FD    1*ELPOL                     01212  12212 52421
.  00750                FD    1*AZPOL                     01213  06372 52421
.  00751                FD    1*ELSIN                     01214  12213 01623
.  00752                FD    1*AZSIN                     01215  06373 01623
.  00753                FD    1*ELSTE                     01216  12213 03112
.  00754                FD    1*AZSTE                     01217  06373 03112
.  00755                FD    1*ELIMP                     01220  12211 62225
.  00756                FD    1*AZIMP                     01221  06371 62225
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.  00757 FUNADDTBL    RESERVE   6                        01222  00000 00000
.  00760              U-TAG     NARANDOM*ELRANDOM        01230  00001 10573
.  00761              U-TAG     NARANDOM*AZRANDOM        01231  00001 10577
.  00762              U-TAG     NAPOLY*ELPOLY            01232  00006 03727
.  00763              U-TAG     NAPOLY*AZPOLY            01233  00006 03757
.  00764              U-TAG     NASINE*ELSINE            01234  00002 10545
.  00765              U-TAG     NASINE*AZSINE            01235  00002 10516
.  00766              U-TAG     NASTEP*ELSTEP            01236  00003 04403

.  00767              U-TAG     NASTEP*AZSTEP            01237  00003 04364
.  00770              U-TAG     NAIMPULSE*ELIMPULSE      01240  00004 04463
.  00771              U-TAG     NAIMPULSE*AZIMPULSE      01241  00004 04431
.  00772 ZERO         EQUALS    00000
.  00773 NARANDOM     EQUALS    1
.  00774 NAPOLY       EQUALS    6
.  00775 NASINE       EQUALS    2
.  00776 NASTEP       EQUALS    3

.  00777 NAIMPULSE    EQUALS    4
.  01000 ZXNLINEIND   RESERVE   2                        01242  00000 00000
.  01001 CLKTEST      RESERVE   1                        01244  00000 00000
.  01002 INPUTBUFER   RESERVE   360                      01245  00000 00000
.  01003 FREQOUT      RESERVE   1                        01311  00000 00000
.  01004 TEMBX        RESERVE   3                        01312  00000 00000
.  01005 TEMAX        RESERVE   1                        01315  00000 00000
.  01006 TEMCX        RESERVE   1                        01316  00000 00000

.  01007 NFIELDS      RESERVE   1                        01317  00000 00000
.  01010 CONTBL       RESERVE   5                        01320  00000 00000
.  01011 NWAIT        RESERVE   1                        01325  00000 00000
.  01012 NRUN         RESERVE   1                        01326  00000 00000
.  01013 ANGLESAVE    RESERVE   1                        01327  00000 00000
.  01014 TIME         RESERVE   1                        01330  00000 00000
.  01015 AZIMUTH      RESERVE   1                        01331  00000 00000
.  01016 ELEVATION    RESERVE   1                        01332  00000 00000

.  01017 AZOUT        RESERVE   1                        01333  00000 00000
.  01020 ELOUT        RESERVE   1                        01334  00000 00000
.  01021 BUFA         RESERVE   600D                     01335  00000 00000
.  01022 BUFB         RESERVE   600D                     02465  00000 00000
.  01023 CONTIND      RESERVE   1                        03615  00000 00000
.  01024 FUNLOC       RESERVE   2                        03616  00000 00000
.  01025 THETAFD      RESERVE   3                        03620  00000 00000
.  01026 PHIFD        RESERVE   3                        03623  00000 00000

.  01027 TWAITFD      RESERVE   3                        03626  00000 00000
.  01030 TRUNFD       RESERVE   3                        03631  00000 00000
.  01031 IWRITEFD     RESERVE   3                        03634  00000 00000
.  01032 FAZI         RESERVE   3                        03637  00000 00000
.  01033 FELE         RESERVE   3                        03642  00000 00000
.  01034 ARG1         RESERVE   3                        03645  00000 00000
.  01035 ARG2         RESERVE   3                        03650  00000 00000
.  01036 ARG3         RESERVE   3                        03653  00000 00000
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.  01037 ARG4          RESERVE   3                    03656  00000 00000
.  01040 ARG5          RESERVE   3                    03661  00000 00000
.  01041 ARG6          RESERVE   3                    03664  00000 00000
.  01042 ARG7          RESERVE   3                    03667  00000 00000
.  01043 ARG8          RESERVE   3                    03672  00000 00000
.  01044 ARG9          RESERVE   3                    03675  00000 00000
.  01045 ARG10         RESERVE   3                    03700  00000 00000
.  01046 ARG11         RESERVE   3                    03703  00000 00000

.  01047 ARG12         RESERVE   3                    03706  00000 00000
.  01050 AZST          RESERVE   1                    03711  00000 00000
.  01051 ELST          RESERVE   1                    03712  00000 00000
.  01052 THYME         RESERVE   1                    03713  00000 00000
.  01053 THETA         RESERVE   1                    03714  00000 00000
.  01054 PHI           RESERVE   1                    03715  00000 00000
.  01055 TWAIT         RESERVE   1                    03716  00000 00000
.  01056 TRUN          RESERVE   1                    03717  00000 00000

.  01057 IWRITE        RESERVE   1                    03720  00000 00000
.  01060               U-TAG     AX+13*18D            03721  04015 00022
.  01061               U-TAG     AX+12*18D            03722  04014 00022
.  01062               U-TAG     AX+11*18D            03723  04013 00022
.  01063               U-TAG     AX+10*18D            03724  04012 00022
.  01064               U-TAG     AX+7*18D             03725  04011 00022
.  01065               U-TAG     AX+6*18D             03726  04010 00022
.  01066 ELPOLY        RESERVE   1                    03727  00000 00000

.  01067               STR   B1*L(POLYB)              03730  16110 04016
.  01070               CL    A                        03731  11000 00000
.  01071               ENT   Q*W(THYME)               03732  10030 03713
.  01072               LSH   AQ*4                     03733  07000 00004
.  01073               DIV   10D                      03734  23000 00012
.  01074               STR   Q*W(THYMEX)              03735  14030 04001
.  01075               ENT   B1*4                     03736  12100 00004
.  01076               ENT   Q*W(AX+13)               03737  10030 04015

.  01077 ELPOLYLOOP    MUL   W(THYMEX)                03740  22030 04001
.  01100               RSH   AQ*22D                   03741  03000 00026
.  01101               ADD   Q*W(AX+6+B1)             03742  26031 04010
.  01102               BJP   B1*ELPOLYLOOP            03743  72100 03740
.  01103               STR   Q*W(QSAVE)               03744  14030 04143
.  01104               ENT   A*W(QSAVE)               03745  11030 04143
.  01105               ADD   A*W(ELST)                03746  20030 03712
.  01106               ENT   B1*L(POLYB)              03747  12110 04016

.  01107               JP    L(ELPOLY)                03750  61010 03727
.  01110               U-TAG     AX+5*18D             03751  04007 00022
.  01111               U-TAG     AX+4*18D             03752  04006 00022
.  01112               U-TAG     AX+3*18D             03753  04005 00022
.  01113               U-TAG     AX+2*18D             03754  04004 00022
.  01114               U-TAG     AX+1*18D             03755  04003 00022
.  01115               U-TAG     AX*18D               03756  04002 00022
.  01116 AZPOLY        RESERVE   1                    03757  00000 00000
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.  01117                STR  B1*L(POLYB)          03760  16110 04016
.  01120                CL   A                    03761  11000 00000
.  01121                ENT  Q*W(THYME)           03762  10030 03713
.  01122                LSH  AQ*4                 03763  07000 00004
.  01123                DIV  10D                  03764  23000 00012
.  01124                STR  Q*W(THYMEX)          03765  14030 04001
.  01125                ENT  B1*4                 03766  12100 00004
.  01126                ENT  Q*W(AX+5)            03767  10030 04007

.  01127 AZPOLYLOOP     MUL  W(THYMEX)            03770  22030 04001
.  01130                RSH  AQ*22D               03771  03000 00026
.  01131                ADD  Q*W(AX+B1)           03772  26031 04002
.  01132                BJP  B1*AZPOLYLOOP        03773  72100 03770
.  01133                STR  Q*W(QSAVE)           03774  14030 04143
.  01134                ENT  A*W(QSAVE)           03775  11030 04143
.  01135                ADD  A*W(AZST)            03776  20030 03711
.  01136                ENT  B1*L(POLYB)          03777  12110 04016

.  01137                JP   L(AZPOLY)            04000  61010 03757
.  01140 THYMEX         RESERVE   1               04001  00000 00000
.  01141 AX             RESERVE   12D             04002  00000 00000
.  01142 POLYB          RESERVE   1               04016  00000 00000
.  01143 DECON          RESERVE   1               04017  00000 00000
.  01144                STR  A*W(ASAVE)           04020  15030 04141
.  01145                STR  Q*W(QSAVE)           04021  14030 04143
.  01146                STR  B1*U(BSAVE)          04022  16120 04142

.  01147                STR  B2*L(BSAVE)          04023  16210 04142
.  01150                CL   W(NDEC)              04024  16030 04151
.  01151                CL   W(DECSIGNFLG)        04025  16030 04133
.  01152                CL   W(FIRST)             04026  16030 04134
.  01153                CL   W(ACCUM)             04027  16030 04150
.  01154                CL   B1*                  04030  12100 00000
.  01155 LOOPA          CL   A*                   04031  11000 00000
.  01156                ENT  Q*W(NUMBER+B1)       04032  10031 04144

.  01157                ENT  B2*4                 04033  12200 00004
.  01160 LOOPB          LSH  AQ*6                 04034  07000 00006
.  01161                STR  A*W(TEMC)            04035  15030 04137
.  01162                SUB  A*56*ANOT            04036  21500 00056
.  01163                JP   SCALING              04037  61000 04075
.  01164                ENT  A*W(TEMC)            04040  11030 04137
.  01165                SUB  A*41*ANOT            04041  21500 00041
.  01166                JP   AMINUS               04042  61000 04073

.  01167                ENT  A*W(TEMC)            04043  11030 04137
.  01170                SUB  A*42*ANOT            04044  21500 00042
.  01171                JP   DECRET               04045  61000 04064
.  01172 GOODY          ENT  A*W(TEMC)            04046  11030 04137
.  01173                SUB  A*75*ANOT            04047  21500 00075
.  01174                JP   DECIMAL              04050  61000 04071
.  01175                ENT  A*W(TEMC)            04051  11030 04137
.  01176                STR  Q*W(TEMA)            04052  14030 04135
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.  01177                ENT  Q*17                          04053  10000 00017
.  01200                STR  LP*W(TEMB)                    04054  47030 04136
.  01201                ENT  Q*W(ACCUM)                    04055  10030 04150
.  01202                MUL  10D                           04056  22000 00012
.  01203                ADD  Q*W(TEMB)                     04057  26030 04136
.  01204                STR  Q*W(ACCUM)                    04060  14030 04150
.  01205                ENT  Q*W(TEMA)                     04061  10030 04135
.  01206                ENT  A*U(DECSIGNFLG)*AZERO         04062  11420 04133

.  01207                RPL  Y+1*W(NDEC)                   04063  36030 04151
.  01210 DECRET         CL   A*                            04064  11000 00000
.  01211                BJP  B2*LOOPB                      04065  72200 04034
.  01212                BSK  B1*2                          04066  71100 00002
.  01213                JP   LOOPA                         04067  61000 04031
.  01214                JP   SCALING                       04070  61000 04075
.  01215 DECIMAL        RPL  Y+1*U(DECSIGNFLG)             04071  36020 04133
.  01216                JP   DECRET                        04072  61000 04064

.  01217 AMINUS         RPL  Y+1*L(DECSIGNFLG)             04073  36010 04133
.  01220                JP   DECRET                        04074  61000 04064
.  01221 SCALING        RPL  Y-1*W(NDEC)*APOS              04075  37630 04151
.  01222                JP   NOSCALE                       04076  61000 04104
.  01223                ENT  Q*10D                         04077  10000 00012
.  01224                RPT  W(NDEC)                       04100  70030 04151
.  01225                MUL  10D                           04101  22000 00012
.  01226                STR  Q*W(TENPOWER)                 04102  14030 04140

.  01227                JP   BINSCALE                      04103  61000 04106
.  01230 NOSCALE        ENT  Q*1                           04104  10000 00001
.  01231                STR  Q*W(TENPOWER)                 04105  14030 04140
.  01232 BINSCALE       ENT  Q*W(ACCUM)                    04106  10030 04150
.  01233                ENT  A*U(BINPNT)*AZERO             04107  11420 04147
.  01234                JP   BINEG                         04110  61000 04115
.  01235                CL   A*                            04111  11000 00000
.  01236                LSH  AQ*L(BINPNT)                  04112  07010 04147

.  01237                DIV  W(TENPOWER)                   04113  23030 04140
.  01240                JP   SIGNFIX                       04114  61000 04121
.  01241 BINEG          CL   A*                            04115  11000 00000
.  01242                DIV  W(TENPOWER)                   04116  23030 04140
.  01243                CL   A*                            04117  11000 00000
.  01244                RSH  Q*L(BINPNT)                   04120  01010 04147
.  01245 SIGNFIX        STR  Q*W(ACCUM)                    04121  14030 04150
.  01246                ENT  A*L(DECSIGNFLG)*ANOT          04122  11510 04133

.  01247                JP   THRU                          04123  61000 04126
.  01250                CL   A*                            04124  11000 00000
.  01251                RPL  A-Y*W(ACCUM)                  04125  25030 04150
.  01252 THRU           ENT  A*W(ASAVE)                    04126  11030 04141
.  01253                ENT  Q*W(QSAVE)                    04127  10030 04143
.  01254                ENT  B1*U(BSAVE)                   04130  12120 04142
.  01255                ENT  B2*L(BSAVE)                   04131  12210 04142
.  01256                JP   L(DECON)                      04132  61010 04017
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01257 DECSIGNFLG    RESERVE   1                    04133  00000 00000
01260 FIRST         RESERVE   1                    04134  00000 00000
01261 TEMA          RESERVE   1                    04135  00000 00000
01262 TEMB          RESERVE   1                    04136  00000 00000
01263 TEMC          RESERVE   1                    04137  00000 00000
01264 TENPOWER      RESERVE   1                    04140  00000 00000
01265 ASAVE         RESERVE   1                    04141  00000 00000
01266 BSAVE         RESERVE   1                    04142  00000 00000

01267 QSAVE         RESERVE   1                    04143  00000 00000
01270 NUMBER        RESERVE   3                    04144  00000 00000
01271 BINPNT        RESERVE   1                    04147  00000 00000
01272 ACCUM         RESERVE   1                    04150  00000 00000
01273 NDEC          RESERVE   1                    04151  00000 00000
01274 FIXTC         RESERVE   1                    04152  00000 00000
01275               STR  C15*W(TEMA)               04153  17670 04135
01276               RILJP     L(FIXTC)             04154  60110 04152

01277 INTERR        RJP  FIXTC                     04155  65000 04152
01300 FDTOBCD       RESERVE   1                    04156  00000 00000
01301               ENT  B1*4                      04157  12100 00004
01302               CL   W(ANZ)                    04160  16030 04174
01303 FDTOBCD1      CL   A                         04161  11000 00000
01304               LSH  AQ*6                      04162  07000 00006
01305               ENT  B2*A                      04163  12270 00000
01306               ENT  A*W(BCDTBL+B2)            04164  11032 04175

01307               LSH  AQ*54D                    04165  07000 00066
01310               ENT  A*W(ANZ)                  04166  11030 04174
01311               LSH  AQ*6                      04167  07000 00006
01312               STR  A*W(ANZ)                  04170  15030 04174
01313               BJP  B1*FDTOBCD1               04171  72100 04161
01314               ENT  Q*W(ANZ)                  04172  10030 04174
01315               JP   L(FDTOBCD)                04173  61010 04156
01316 ANZ           RESERVE   1                    04174  00000 00000

01317 BCDTBL        60                             04175  00000 00060
01320               0                              04176  00000 00000
01321               0                              04177  00000 00000
01322               0                              04200  00000 00000
01323               0                              04201  00000 00000
01324               60                             04202  00000 00060
01325               21                             04203  00000 00021
01326               22                             04204  00000 00022

01327               23                             04205  00000 00023
01330               24                             04206  00000 00024
01331               25                             04207  00000 00025
01332               26                             04210  00000 00026
01333               27                             04211  00000 00027
01334               30                             04212  00000 00030
01335               31                             04213  00000 00031
01336               41                             04214  00000 00041
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.  01337   42      04215  00000 00042
.  01340   43      04216  00000 00043
.  01341   44      04217  00000 00044
.  01342   45      04220  00000 00045
.  01343   46      04221  00000 00046
.  01344   47      04222  00000 00047
.  01345   50      04223  00000 00050
.  01346   51      04224  00000 00051

.  01347   62      04225  00000 00062
.  01350   63      04226  00000 00063
.  01351   64      04227  00000 00064
.  01352   65      04230  00000 00065
.  01353   66      04231  00000 00066
.  01354   67      04232  00000 00067
.  01355   70      04233  00000 00070
.  01356   71      04234  00000 00071

.  01357   55      04235  00000 00055
.  01360   52      04236  00000 00052
.  01361   32      04237  00000 00032
.  01362   0       04240  00000 00000
.  01363   35      04241  00000 00035
.  01364   0       04242  00000 00000
.  01365   0       04243  00000 00000
.  01366   53      04244  00000 00053

.  01367   54      04245  00000 00054
.  01370   75      04246  00000 00075
.  01371   0       04247  00000 00000
.  01372   0       04250  00000 00000
.  01373   0       04251  00000 00000
.  01374   0       04252  00000 00000
.  01375   73      04253  00000 00073
.  01376   60      04254  00000 00060

.  01377   0       04255  00000 00000
.  01400   1       04256  00000 00001
.  01401   2       04257  00000 00002
.  01402   3       04260  00000 00003
.  01403   4       04261  00000 00004
.  01404   5       04262  00000 00005
.  01405   6       04263  00000 00006
.  01406   7       04264  00000 00007

.  01407   10      04265  00000 00010
.  01410   11      04266  00000 00011
.  01411   0       04267  00000 00000
.  01412   0       04270  00000 00000
.  01413   61      04271  00000 00061
.  01414   33      04272  00000 00033
.  01415   34      04273  00000 00034
.  01416   0       04274  00000 00000
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.  01417 SINEFUNCS     RESERVE   1                    04275  00000 00000
.  01420               CL   W(TEMB)                   04276  16030 04136
.  01421               ENT  Y-Q*4000000*ANEG          04277  31730 11506
.  01422               JP   SINEFUNCS2                04300  61000 04304
.  01423               RPL  Y+1*W(TEMB)               04301  36030 04136
.  01424               ENT  Y-Q*10000000              04302  31030 11507
.  01425               RSH  AQ*30D                    04303  03000 00036
.  01426 SINEFUNCS2    ENT  Y-Q*2000000*ANEG          04304  31730 11510

.  01427               JP   SINEFUNCS1                04305  61000 04310
.  01430               ENT  Y-Q*4000000               04306  31030 11506
.  01431               RSH  AQ*30D                    04307  03000 00036
.  01432 SINEFUNCS1    RJP  SINEFUN                   04310  65000 04325
.  01433               STR  Q*W(TEMA)                 04311  14030 04135
.  01434               ENT  A*W(TEMB)*ANOT            04312  11530 04136
.  01435               JP   SINEFUNCS3                04313  61000 04317
.  01436               CL   Q                         04314  10000 00000

.  01437               SUB  Q*W(TEMA)                 04315  27030 04135
.  01440               JP   L(SINEFUNCS)              04316  61010 04275
.  01441 SINEFUNCS3    ENT  Q*W(TEMA)                 04317  10030 04135
.  01442               JP   L(SINEFUNCS)              04320  61010 04275
.  01443 AZAMPLITUD    RESERVE   1                    04321  00000 00000
.  01444 ELAMPLITUD    RESERVE   1                    04322  00000 00000
.  01445 AZOMEGA       RESERVE   1                    04323  00000 00000
.  01446 ELOMEGA       RESERVE   1                    04324  00000 00000

.  01447 SINEFUN       RESERVE   1                    04325  00000 00000
.  01450               STR  Q*W(REVS)                 04326  14030 04352
.  01451               MUL  W(REVS)                   04327  22030 04352
.  01452               RSH  AQ*21D                    04330  03000 00025
.  01453               STR  Q*W(REVS2)                04331  14030 04353
.  01454               ENT  Q*W(C9)                   04332  10030 04360
.  01455               MUL  W(REVS2)                  04333  22030 04353
.  01456               RSH  AQ*21D                    04334  03000 00025

.  01457               ADD  Q*W(C7)                   04335  26030 04357
.  01460               MUL  W(REVS2)                  04336  22030 04353
.  01461               RSH  AQ*21D                    04337  03000 00025
.  01462               ADD  Q*W(C5)                   04340  26030 04356
.  01463               MUL  W(REVS2)                  04341  22030 04353
.  01464               RSH  AQ*21D                    04342  03000 00025
.  01465               ADD  Q*W(C3)                   04343  26030 04355
.  01466               MUL  W(REVS2)                  04344  22030 04353

.  01467               RSH  AQ*21D                    04345  03000 00025
.  01470               ADD  Q*W(C1)                   04346  26030 04354
.  01471               MUL  W(REVS)                   04347  22030 04352
.  01472               RSH  AQ*21D                    04350  03000 00025
.  01473               JP   L(SINEFUN)                04351  61010 04325
.  01474 REVS          RESERVE   1                    04352  00000 00000
.  01475 REVS2         RESERVE   1                    04353  00000 00000
.  01476 C1            62207732                       04354  00622 07732
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01477 C3            7265210412                    04355  72652 10412
01500 C5            1214642567                    04356  12146 42567
01501 C7            6633314703                    04357  66333 14703
01502 C9            475534435                     04360  04755 34435
01503               U-TAG      AZPERIOD*18D       04361  04417 00022
01504               U-TAG      AZHEIGHT*18D       04362  04420 00022
01505               U-TAG      AZTIME*18D         04363  04421 00022
01506 AZSTEP        RESERVE   1                   04364  00000 00000

01507               ENT  Q*W(THYME)               04365  10030 03713
01510               SUB  Q*W(AZTIME)              04366  27030 04421
01511               CL   A                        04367  11000 00000
01512               DIV  W(AZPERIOD)              04370  23030 04417
01513               SUB  A*777*ANEG               04371  21700 00777
01514               JP   AZSTEP1                  04372  61000 04376
01515               ENT  Q*W(AZHEIGHT)            04373  10030 04420
01516               RPL  Y+Q*W(CONTBL)            04374  34030 01320

01517               JP   L(AZSTEP)                04375  61010 04364
01520 AZSTEP1       ENT  A*W(CONTBL)              04376  11030 01320
01521               JP   L(AZSTEP)                04377  61010 04364
01522               U-TAG      ELPERIOD*18D       04400  04422 00022
01523               U-TAG      ELHEIGHT*18D       04401  04423 00022
01524               U-TAG      ELTIME*18D         04402  04424 00022
01525 ELSTEP        RESERVE   1                   04403  00000 00000
01526               ENT  Q*W(THYME)               04404  10030 03713

01527               SUB  Q*W(ELTIME)              04405  27030 04424
01530               CL   A                        04406  11000 00000
01531               DIV  W(ELPERIOD)              04407  23030 04422
01532               SUB  A*777*ANEG               04410  21700 00777
01533               JP   ELSTEP1                  04411  61000 04415
01534               ENT  Q*W(ELHEIGHT)            04412  10030 04423
01535               RPL  Y+Q*W(CONTBL+1)          04413  34030 01321
01536               JP   L(ELSTEP)                04414  61010 04403

01537 ELSTEP1       ENT  A*W(CONTBL+1)            04415  11030 01321
01540               JP   L(ELSTEP)                04416  61010 04403
01541 AZPERIOD      RESERVE   1                   04417  00000 00000
01542 AZHEIGHT      RESERVE   1                   04420  00000 00000
01543 AZTIME        RESERVE   1                   04421  00000 00000
01544 ELPERIOD      RESERVE   1                   04422  00000 00000
01545 ELHEIGHT      RESERVE   1                   04423  00000 00000
01546 ELTIME        RESERVE   1                   04424  00000 00000

01547               U-TAG      AZPERIOD*18D       04425  04417 00022
01550               U-TAG      AZDURAT*18D        04426  04512 00022
01551               U-TAG      AZHEIGHT*18D       04427  04420 00022
01552               U-TAG      AZTIME*18D         04430  04421 00022
01553 AZIMPULSE     RESERVE   1                   04431  00000 00000
01554               ENT  Q*W(THYME)               04432  10030 03713
01555               SUB  Q*W(AZTIME)              04433  27030 04421
01556               STR  Q*W(TEMA)                04434  14030 04135
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01557               CL    A                     04435  11000 00000
01560               DIV   W(AZPERIOD)           04436  23030 04417
01561               SUB   A*777*ANEG            04437  21700 00777
01562               JP    AZIMPULSE1            04440  61000 04444
01563               ENT   Q*W(AZHEIGHT)         04441  10030 04420
01564               RPL   Y+Q*W(CONTBL)         04442  34030 01320
01565               JP    L(AZIMPULSE)          04443  61010 04431
01566 AZIMPULSE1    ENT   Q*W(TEMA)             04444  10030 04135

01567               SUB   Q*W(AZDURAT)          04445  27030 04512
01570               CL    A                     04446  11000 00000
01571               DIV   W(AZPERIOD)           04447  23030 04417
01572               SUB   A*777*ANEG            04450  21700 00777
01573               JP    AZIMPULSE2            04451  61000 04455
01574               ENT   Q*W(AZHEIGHT)         04452  10030 04420
01575               RPL   Y-Q*W(CONTBL)         04453  35030 01320
01576               JP    L(AZIMPULSE)          04454  61010 04431

01577 AZIMPULSE2    ENT   A*W(CONTBL)           04455  11030 01320
01600               JP    L(AZIMPULSE)          04456  61010 04431
01601               U-TAG      ELPERIOD*18D     04457  04422 00022
01602               U-TAG      ELDURAT*18D      04460  04511 00022
01603               U-TAG      ELHEIGHT*18D     04461  04423 00022
01604               U-TAG      ELTIME*18D       04462  04424 00022
01605 ELIMPULSE     RESERVE    1                04463  00000 00000
01606               ENT   Q*W(THYME)            04464  10030 03713

01607               SUB   Q*W(ELTIME)           04465  27030 04424
01610               STR   Q*W(TEMA)             04466  14030 04135
01611               CL    A                     04467  11000 00000
01612               DIV   W(ELPERIOD)           04470  23030 04422
01613               SUB   A*777*ANEG            04471  21700 00777
01614               JP    ELIMPULSE1            04472  61000 04476
01615               ENT   Q*W(ELHEIGHT)         04473  10030 04423
01616               RPL   Y+Q*W(CONTBL+1)       04474  34030 01321

01617               JP    L(ELIMPULSE)          04475  61010 04463
01620 ELIMPULSE1    ENT   Q*W(TEMA)             04476  10030 04135
01621               SUB   Q*W(ELDURAT)          04477  27030 04511
01622               CL    A                     04500  11000 00000
01623               DIV   W(ELPERIOD)           04501  23030 04422
01624               SUB   A*777*ANEG            04502  21700 00777
01625               JP    ELIMPULSE2            04503  61000 04507
01626               ENT   Q*W(ELHEIGHT)         04504  10030 04423

01627               RPL   Y-Q*W(CONTBL+1)       04505  35030 01321
01630               JP    L(ELIMPULSE)          04506  61010 04463
01631 ELIMPULSE2    ENT   A*W(CONTBL+1)         04507  11030 01321
01632               JP    L(ELIMPULSE)          04510  61010 04463
01633 ELDURAT       RESERVE    1                04511  00000 00000
01634 AZDURAT       RESERVE    1                04512  00000 00000
01635 SINTBL        RESERVE    2049D            04513  00000 00000
01636               U-TAG      AZAMPLITUD*21D   10514  04321 00025
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.  01637                U-TAG     AZOMEGA*24D                10515  04323 00030
.  01640 AZSINE         RESERVE   1                          10516  00000 00000
.  01641                STR   B1*L(TEMA)                     10517  16110 04135
.  01642                ENT   Q*W(AZOMEGA)                   10520  10030 04323
.  01643                MUL   W(THYME)                       10521  22030 03713
.  01644                LSH   AQ*39D                         10522  07000 00047
.  01645                ENT   LP*7777777                     10523  40030 11511
.  01646                CL    Q                              10524  10000 00000

.  01647                LSH   AQ*50D                         10525  07000 00062
.  01650                ENT   B1*A                           10526  12170 00000
.  01651                LSH   Q*10D                          10527  05000 00012
.  01652                ENT   A*W(SINTBL+1+B1)               10530  11031 04514
.  01653                SUB   A*W(SINTBL+B1)                 10531  21031 04513
.  01654                STR   A*W(TEMB)                      10532  15030 04136
.  01655                MUL   W(TEMB)                        10533  22030 04136
.  01656                RSH   AQ*10D                         10534  03000 00012

.  01657                ADD   Q*W(SINTBL+B1)                 10535  26031 04513
.  01660                MUL   W(AZAMPLITUD)                  10536  22030 04321
.  01661                LSH   AQ*6                           10537  07000 00006
.  01662                ADD   A*W(AZST)                      10540  20030 03711
.  01663                ENT   B1*L(TEMA)                     10541  12110 04135
.  01664                JP    L(AZSINE)                      10542  61010 10516
.  01665                U-TAG     ELAMPLITUD*21D             10543  04322 00025
.  01666                U-TAG     ELOMEGA*24D                10544  04324 00030

.  01667 ELSINE         RESERVE   1                          10545  00000 00000
.  01670                STR   B1*L(TEMA)                     10546  16110 04135
.  01671                ENT   Q*W(ELOMEGA)                   10547  10030 04324
.  01672                MUL   W(THYME)                       10550  22030 03713
.  01673                LSH   AQ*39D                         10551  07000 00047
.  01674                ENT   LP*7777777                     10552  40030 11511
.  01675                CL    Q                              10553  10000 00000
.  01676                LSH   AQ*50D                         10554  07000 00062

.  01677                ENT   B1*A                           10555  12170 00000
.  01700                LSH   Q*10D                          10556  05000 00012
.  01701                ENT   A*W(SINTBL+1+B1)               10557  11031 04514
.  01702                SUB   A*W(SINTBL+B1)                 10560  21031 04513
.  01703                STR   A*W(TEMB)                      10561  15030 04136
.  01704                MUL   W(TEMB)                        10562  22030 04136
.  01705                RSH   AQ*10D                         10563  03000 00012
.  01706                ADD   Q*W(SINTBL+B1)                 10564  26031 04513

.  01707                MUL   W(ELAMPLITUD)                  10565  22030 04322
.  01710                LSH   AQ*6                           10566  07000 00006
.  01711                ADD   A*W(ELST)                      10567  20030 03712
.  01712                ENT   B1*L(TEMA)                     10570  12110 04135
.  01713                JP    L(ELSINE)                      10571  61010 10545
.  01714                U-TAG     TEMA*0                     10572  04135 00000
.  01715 ELRANDOM       RESERVE   1                          10573  00000 00000
.  01716                ENT   A*W(ELST)                      10574  11030 03712
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.  01717                JP   L(ELRANDOM)                10575  61010 10573
.  01720                U-TAG     TEMA+0                10576  04135 00000
.  01721 AZRANDOM       RESERVE   1                     10577  00000 00000
.  01722                ENT  A*W(AZST)                  10600  11030 03711
.  01723                JP   L(AZRANDOM)                10601  61010 10577
.  01724 PRINTER        RESERVE   1                     10602  00000 00000
.  01725                RPL  Y+1*W(PRINTINDIC)          10603  36030 01156
.  01726                ENT  87*L(PRINTINDIC)           10604  12710 01156

.  01727                JP   L(JPTABLE+87-1)            10605  61017 10605
.  01730 JPTABLE        0    GETNUMS                    10606  00000 10627
.  01731                0    BUFKLEER                   10607  00000 11461
.  01732                0    TIMECON                    10610  00000 10736
.  01733                0    TIMECONB                   10611  00000 10744
.  01734                0    AZINCON                    10612  00000 10750
.  01735                0    AZINCONB                   10613  00000 10756
.  01736                0    AZOUTCON                   10614  00000 10762

.  01737                0    AZOUTCONB                  10615  00000 10770
.  01740                0    AZDIFCON                   10616  00000 10774
.  01741                0    AZDIFCONB                  10617  00000 11002
.  01742                0    ELINCON                    10620  00000 11006
.  01743                0    ELINCONB                   10621  00000 11014
.  01744                0    ELOUTCON                   10622  00000 11020
.  01745                0    ELOUTCONB                  10623  00000 11026
.  01746                0    ELDIFCON                   10624  00000 11032

.  01747                0    ELDIFCONB                  10625  00000 11040
.  01750                0    RUNPRINTER                 10626  00000 11044
.  01751 GETNUMS        ENT  A*W(THYME)                 10627  11030 03713
.  01752                STR  A*W(FIELDS)                10630  15030 10666
.  01753                ENT  Q*W(AZIMUTH)               10631  10030 01331
.  01754                STR  Q*W(FIELDS+8D)*QPOS        10632  14230 10676
.  01755                SUB  Q*1                        10633  27000 00001
.  01756                MUL  264                        10634  22000 00264

.  01757                STR  Q*W(FIELDS+1)              10635  14030 10667
.  01760                ENT  Q*W(ELEVATION)             10636  10030 01332
.  01761                STR  Q*W(FIELDS+10D)*QPOS       10637  14230 10700
.  01762                SUB  Q*1                        10640  27000 00001
.  01763                MUL  264                        10641  22000 00264
.  01764                STR  Q*W(FIELDS+4)              10642  14030 10672
.  01765                RJP  ENCODE                     10643  65000 01146
.  01766                ENT  A*W(AZOUT)                 10644  11030 01333

.  01767                STR  A*W(FIELDS+2)*APOS         10645  15630 10670
.  01770                ADD  A*1                        10646  20000 00001
.  01771                STR  A*W(FIELDS+9D)             10647  15030 10677
.  01772                ENT  Q*W(ELOUT)*QPOS            10650  10230 01334
.  01773                ADD  Q*1                        10651  26000 00001
.  01774                STR  Q*W(FIELDS+11D)*QPOS       10652  14230 10701
.  01775                SUB  Q*1                        10653  27000 00001
.  01776                MUL  264                        10654  22000 00264
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.  01777                STR  Q*W(FIELDS+5)          10655  14030 10673
.  02000                SUB  Q*W(FIELDS+4)          10656  27030 10672
.  02001                STR  Q*W(FIELDS+6)          10657  14030 10674
.  02002                ENT  Q*W(FIELDS+2)          10660  10030 10670
.  02003                MUL  264                    10661  22000 00264
.  02004                STR  Q*W(FIELDS+2)          10662  14030 10670
.  02005                SUB  Q*W(FIELDS+1)          10663  27030 10667
.  02006                STR  Q*W(FIELDS+3)          10664  14030 10671

.  02007                JP   L(PRINTER)             10665  61010 10602
.  02010 FIELDS         RESERVE   12D               10666  00000 00000
.  02011 FDVAR          RESERVE   2                 10702  00000 00000
.  02012 PRBUFER        RESERVE   25D               10704  00000 00000
.  02013 STOPMARK       7777777777                  10735  77777 77777
.  02014 TIMECON        ENT  A*W(FIELDS)            10736  11030 10666
.  02015                STR  A*W(NUMBER)            10737  15030 04144
.  02016                RJP  PRCONV1                10740  65000 11063

.  02017                ENT  A*W(FDVAR)             10741  11030 10702
.  02020                STR  A*W(PRBUFER+1)         10742  15030 10705
.  02021                JP   L(PRINTER)             10743  61010 10602
.  02022 TIMECONB       RJP  FRACTCON               10744  65000 11103
.  02023                ENT  A*W(FDVAR+1)           10745  11030 10703
.  02024                STR  A*W(PRBUFER+2)         10746  15030 10706
.  02025                JP   L(PRINTER)             10747  61010 10602
.  02026 AZINCON        ENT  A*W(FIELDS+1)          10750  11030 10667

.  02027                STR  A*W(NUMBER)            10751  15030 04144
.  02030                RJP  PRCONV1                10752  65000 11063
.  02031                ENT  A*W(FDVAR)             10753  11030 10702
.  02032                STR  A*W(PRBUFER+4)         10754  15030 10710
.  02033                JP   L(PRINTER)             10755  61010 10602
.  02034 AZINCONB       RJP  FRACTCON               10756  65000 11103
.  02035                ENT  A*W(FDVAR+1)           10757  11030 10703
.  02036                STR  A*W(PRBUFER+5)         10760  15030 10711

.  02037                JP   L(PRINTER)             10761  61010 10602
.  02040 AZOUTCON       ENT  A*W(FIELDS+2)          10762  11030 10670
.  02041                STR  A*W(NUMBER)            10763  15030 04144
.  02042                RJP  PRCONV1                10764  65000 11063
.  02043                ENT  A*W(FDVAR)             10765  11030 10702
.  02044                STR  A*W(PRBUFER+7)         10766  15030 10713
.  02045                JP   L(PRINTER)             10767  61010 10602
.  02046 AZOUTCONB      RJP  FRACTCON               10770  65000 11103

.  02047                ENT  A*W(FDVAR+1)           10771  11030 10703
.  02050                STR  A*W(PRBUFER+8D)        10772  15030 10714
.  02051                JP   L(PRINTER)             10773  61010 10602
.  02052 AZDIFCON       ENT  A*W(FIELDS+3)          10774  11030 10671
.  02053                STR  A*W(NUMBER)            10775  15030 04144
.  02054                RJP  PRCONV1                10776  65000 11063
.  02055                ENT  A*W(FDVAR)             10777  11030 10702
.  02056                STR  A*W(PRBUFER+10D)       11000  15030 10716
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02057              JP    L(PRINTER)                      11001  61010 10602
02060 AZDIFCONB    RJP   FRACTCON                        11002  65000 11103
02061              ENT   A*W(FDVAR+1)                    11003  11030 10703
02062              STR   A*W(PRBUFER+11D)                11004  15030 10717
02063              JP    L(PRINTER)                      11005  61010 10602
02064 ELINCON      ENT   A*W(FIELDS+4)                   11006  11030 10672
02065              STR   A*W(NUMBER)                     11007  15030 04144
02066              RJP   PRCONV1                         11010  65000 11063

02067              ENT   A*W(FDVAR)                      11011  11030 10702
02070              STR   A*W(PRBUFER+13D)                11012  15030 10721
02071              JP    L(PRINTER)                      11013  61010 10602
02072 ELINCONB     RJP   FRACTCON                        11014  65000 11103
02073              ENT   A*W(FDVAR+1)                    11015  11030 10703
02074              STR   A*W(PRBUFER+14D)                11016  15030 10722
02075              JP    L(PRINTER)                      11017  61010 10602
02076 ELOUTCON     ENT   A*W(FIELDS+5)                   11020  11030 10673

02077              STR   A*W(NUMBER)                     11021  15030 04144
02100              RJP   PRCONV1                         11022  65000 11063
02101              ENT   A*W(FDVAR)                      11023  11030 10702
02102              STR   A*W(PRBUFER+16D)                11024  15030 10724
02103              JP    L(PRINTER)                      11025  61010 10602
02104 ELOUTCONB    RJP   FRACTCON                        11026  65000 11103
02105              ENT   A*W(FDVAR+1)                    11027  11030 10703
02106              STR   A*W(PRBUFER+17D)                11030  15030 10725

02107              JP    L(PRINTER)                      11031  61010 10602
02110 ELDIFCON     ENT   A*W(FIELDS+6)                   11032  11030 10674
02111              STR   A*W(NUMBER)                     11033  15030 04144
02112              RJP   PRCONV1                         11034  65000 11063
02113              ENT   A*W(FDVAR)                      11035  11030 10702
02114              STR   A*W(PRBUFER+19D)                11036  15030 10727
02115              JP    L(PRINTER)                      11037  61010 10602
02116 ELDIFCONB    RJP   FRACTCON                        11040  65000 11103

02117              ENT   A*W(FDVAR+1)                    11041  11030 10703
02120              STR   A*W(PRBUFER+20D)                11042  15030 10730
02121              JP    L(PRINTER)                      11043  61010 10602
02122 RUNPRINTER   ENT   A*W(PRBCW)                      11044  11030 11055
02123              STR   A*W(BCWPRINTER)                 11045  15030 11056
02124              ENT   A*W(PRINTINTER)                 11046  11030 11057
02125              STR   A*W(23)                         11047  15030 00023
02126              EX-FCT     C3*1201000001              11050  13170 11512

02127              NO-OP                                 11051  12000 00000
02130              OUT   C3*W(BCWPRINTER)                11052  74170 11056
02131              CL    W(PRINTINDIC)                   11053  16030 01156
02132              JP    L(PRINTER)                      11054  61010 10602
02133 PRBCW        U-TAG      PRINTBUFER+25D*PRINTBUFER  11055  10735 10704
02134 PRINTBUFER   EQUALS     PRBUFER
02135 BCWPRINTER   RESERVE    1                          11056  00000 00000
02136 PRINTINTER   RJP   PRINTINTER+1                    11057  65000 11060
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.  02137              RESERVE   1                    11060  00000 00000
.  02140              STR  C3*W(TEMA)                11061  17170 04135
.  02141              RILJP     L(PRINTINTER+1)      11062  60110 11060
.  02142 PRCONV1      RESERVE   1                    11063  00000 00000
.  02143              CL   W(FDVAR)                  11064  16030 10702
.  02144              ENT  A*W(NUMBER)               11065  11030 04144
.  02145              CL   Q                         11066  10000 00000
.  02146              JP   TROUBLE*ANEG              11067  60700 11076

.  02147 TRBLFIXT     RSH  AQ*18D                    11070  03000 00022
.  02150              STR  A*W(INTEGER)*APOS         11071  15630 11101
.  02151              CP   Q                         11072  14000 00000
.  02152              STR  Q*W(FRACTION)             11073  14030 11102
.  02153              RJP  INTEGERCON                11074  65000 11147
.  02154              JP   L(PRCONV1)                11075  61010 11063
.  02155 TROUBLE      STR  A*W(FDVAR)                11076  15030 10702
.  02156              CP   A                         11077  15040 00000

.  02157              JP   TRBLFIXT                  11100  61000 11070
.  02160 INTEGER      RESERVE   1                    11101  00000 00000
.  02161 FRACTION     RESERVE   1                    11102  00000 00000
.  02162 FRACTCON     RESERVE   1                    11103  00000 00000
.  02163              ENT  Q*W(FRACTION)             11104  10030 11102
.  02164              LSH  Q*29D                     11105  05000 00035
.  02165              CL   A                         11106  11000 00000
.  02166              DIV  W(TENTH)                  11107  23030 11137

.  02167              STR  Q*W(FRAC)                 11110  14030 11143
.  02170              LSH  AQ*30D                    11111  07000 00036
.  02171              CL   A                         11112  11000 00000
.  02172              DIV  W(TENTH+1)                11113  23030 11140
.  02173              STR  Q*W(FRAC+1)               11114  14030 11144
.  02174              LSH  AQ*30D                    11115  07000 00036
.  02175              CL   A                         11116  11000 00000
.  02176              DIV  W(TENTH+2)                11117  23030 11141

.  02177              STR  Q*W(FRAC+2)               11120  14030 11145
.  02200              LSH  AQ*30D                    11121  07000 00036
.  02201              CL   A                         11122  11000 00000
.  02202              DIV  W(TENTH+3)                11123  23030 11142
.  02203              LSH  Q*24D                     11124  05000 00030
.  02204              ENT  A*W(FRAC+2)               11125  11030 11145
.  02205              LSH  AQ*54D                    11126  07000 00066
.  02206              ENT  A*W(FRAC+1)               11127  11030 11144

.  02207              LSH  AQ*54D                    11130  07000 00066
.  02210              ENT  A*W(FRAC)                 11131  11030 11143
.  02211              LSH  AQ*48D                    11132  07000 00060
.  02212              ADD  Q*60606060                11133  26030 11513
.  02213              LSH  Q*6                       11134  05000 00006
.  02214              STR  Q*W(FDVAR+1)              11135  14030 10703
.  02215              JP   L(FRACTCON)               11136  61010 11103
.  02216 TENTH        03146314631463                 11137  03146 31463
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.  02217                0024365605                    11140  00243 65605
.  02220                0002030446                    11141  00020 30446
.  02221                0000150667                    11142  00001 50667
.  02222 FRAC           RESERVE   4                   11143  00000 00000
.  02223 INTEGERCON     RESERVE   1                   11147  00000 00000
.  02224                ENT  Q*W(INTEGER)             11150  10030 11101
.  02225                CL   A                        11151  11000 00000
.  02226                DIV  10D                      11152  23000 00012

.  02227                STR  A*W(UNIT)                11153  15030 11201
.  02230                CL   A                        11154  11000 00000
.  02231                DIV  10D                      11155  23000 00012
.  02232                LSH  AQ*30D*ANOT              11156  07500 00036
.  02233                JP   HUNDZERO                 11157  61000 11172
.  02234                CL   B7                       11160  12700 00000
.  02235                LSH  Q*24D                    11161  05000 00030
.  02236                LSH  AQ*12D                   11162  07000 00014

.  02237 FIXTEN         ADD  A*W(UNIT)                11163  20030 11201
.  02240                LSH  AQ*6                     11164  07000 00006
.  02241                ENT  Q*W(FDVAR)*QNEG          11165  10330 10702
.  02242                SEL  SET*W(GIMMICK+37)*SKIP   11166  50137 11202
.  02243                SEL  SET*W(GIMMICK+B7+3)      11167  50037 11205
.  02244                STR  A*W(FDVAR)               11170  15030 10702
.  02245                JP   L(INTEGERCON)            11171  61010 11147
.  02246 HUNDZERO       LSH  AQ*30D*ANOT              11172  07500 00036

.  02247                JP   TENZERO                  11173  61000 11177
.  02250                ENT  B7*1                     11174  12700 00001
.  02251                LSH  A*6                      11175  06000 00006
.  02252                JP   FIXTEN                   11176  61000 11163
.  02253 TENZERO        ENT  B7*2                     11177  12700 00002
.  02254                JP   FIXTEN                   11200  61000 11163
.  02255 UNIT           RESERVE   1                   11201  00000 00000
.  02256 GIMMICK        0060606075                    11202  00606 06075

.  02257                0000606075                    11203  00006 06075
.  02260                0000006075                    11204  00000 06075
.  02261                4160606075                    11205  41606 06075
.  02262                0041606075                    11206  00416 06075
.  02263                0000416075                    11207  00004 16075
.  02264 DRIVINIT       ENT  A*W(DRIVINTERR)          11210  11030 11276
.  02265                STR  A*W(53)                  11211  15030 00053
.  02266                STR  A*W(52)                  11212  15030 00052

.  02267                STR  A*W(73)                  11213  15030 00073
.  02270                STR  A*W(72)                  11214  15030 00072
.  02271                ENT  A*W(INTCLKTEST)          11215  11030 00140
.  02272                STR  A*W(36)                  11216  15030 00036
.  02273                OUT  C13*W(UTAZBCW)*MONITOR   11217  76570 11304
.  02274                JP   WEREHEREA-2              11220  61000 11220
.  02275                OUT  C12*W(UTELBCW)*MONITOR   11221  76530 11305
.  02276 WEREHEREA      JP   WEREHEREA                11222  61000 11222
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.  02277                JP   INITRET                    11223  61000 00554
.  02300 DRIVEREAL      RESERVE   1                     11224  00000 00000
.  02301                ENT  A*W(INTCLKTEST)           11225  11030 00140
.  02302                STR  A*W(36)                   11226  15030 00036
.  02303                ENT  A*W(AZIMUTH)*APOS         11227  11630 01331
.  02304                ADD  A*1                       11230  20000 00001
.  02305                STR  A*W(AZIMUTH)              11231  15030 01331
.  02306                ENT  A*W(ELEVATION)*APOS       11232  11630 01332

.  02307                ADD  A*1                       11233  20000 00001
.  02310                STR  A*W(ELEVATION)            11234  15030 01332
.  02311                OUT  C13*W(UTAZBCW)            11235  74570 11304
.  02312                NO-OP                          11236  12000 00000
.  02313                OUT  C12*W(UTELBCW)*MONITOR    11237  76530 11305
.  02314                NO-OP                          11240  12000 00000
.  02315 WEREHEREB      JP   WEREHEREB                 11241  61000 11241
.  02316                JP   L(DRIVEREAL)              11242  61010 11224

.  02317 ENCODEREAL     IN   C13*W(INAZBCW)            11243  73570 11302
.  02320                NO-OP                          11244  12000 00000
.  02321                IN   C12*W(INELBCW)            11245  73530 11303
.  02322                NO-OP                          11246  12000 00000
.  02323                CL   A                         11247  11000 00000
.  02324                ENT  Q*W(AZOUT)                11250  10030 01333
.  02325                LSH  AQ*13*QPOS                11251  07200 00013
.  02326                LSH  AQ*35*SKIP                11252  07100 00035

.  02327                LSH  AQ*61*SKIP                11253  07100 00061
.  02330                RSH  AQ*12*SKIP                11254  03100 00012
.  02331                STR  Q*W(AZOUT)*SKIP           11255  14130 01333
.  02332                STR  A*W(AZOUT)                11256  15030 01333
.  02333                ENT  A*W(AZOUT)*APOS           11257  11630 01333
.  02334                SUB  A*1                       11260  21000 00001
.  02335                STR  A*W(AZOUT)                11261  15030 01333
.  02336                CL   A                         11262  11000 00000

.  02337                ENT  Q*W(ELOUT)                11263  10030 01334
.  02340                LSH  AQ*13*QPOS                11264  07200 00013
.  02341                LSH  AQ*35*SKIP                11265  07100 00035
.  02342                LSH  AQ*61*SKIP                11266  07100 00061
.  02343                RSH  AQ*12*SKIP                11267  03100 00012
.  02344                STR  Q*W(ELOUT)*SKIP           11270  14130 01334
.  02345                STR  A*W(ELOUT)                11271  15030 01334
.  02346                ENT  A*W(ELOUT)*APOS           11272  11630 01334

.  02347                SUB  A*1                       11273  21000 00001
.  02350                STR  A*W(ELOUT)                11274  15030 01334
.  02351                JP   L(ENCODE)                 11275  61010 01146
.  02352 DRIVFIX        RJP  DRIVFIX+1                 11276  65000 11277
.  02353                RESERVE   1                    11277  00000 00000
.  02354                RPL  Y+1*W(DRIVFIX+1)          11300  36030 11277
.  02355                RILJP     L(DRIVFIX+1)         11301  60110 11277
.  02356 DRIVINTERR     EQUALS    DRIVFIX
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.  02357 INAZBCW     U-TAG     AZOUT*AZOUT                  11302  01333 01333
.  02360 INELBCW     U-TAG     ELOUT*ELOUT                  11303  01334 01334
.  02361 UTAZBCW     U-TAG     AZIMUTH*AZIMUTH              11304  01331 01331
.  02362 UTELBCW     U-TAG     ELEVATION*ELEVATION          11305  01332 01332
.  02363 TYPEIN      RJP  TYPEIN+1                          11306  65000 11307
.  02364             RESERVE   1                            11307  00000 00000
.  02365             STR  A*W(BLT)                          11310  15030 11335
.  02366             ENT  A*W(TYPT)                         11311  11030 11334

.  02367             SUB  A*57*ANOT                         11312  21500 00057
.  02370             RILJP     PROGRAM                      11313  60100 00124
.  02371             ENT  A*W(TYPT)                         11314  11030 11334
.  02372             SUB  A*11*ANOT                         11315  21500 00011
.  02373             JP   FIXDECPRNT                        11316  61000 11337
.  02374             ENT  A*W(TYPT)                         11317  11030 11334
.  02375             SUB  A*24*ANOT                         11320  21500 00024
.  02376             JP   FIXOCTPRNT                        11321  61000 11336

.  02377             ENT  A*W(TYPT)                         11322  11030 11334
.  02400             SUB  A*30*ANOT                         11323  21500 00030
.  02401             JP   STOPRINT                          11324  61000 11344
.  02402             ENT  A*W(TYPT)                         11325  11030 11334
.  02403             SUB  A*25*ANOT                         11326  21500 00025
.  02404             JP   GOPRINT                           11327  61000 11345
.  02405 ZOTZ        IN   C2*W(TINBUF)*MONITOR              11330  75130 11333
.  02406             ENT  A*W(BLT)                          11331  11030 11335

.  02407             RILJP     L(TYPEIN+1)                  11332  60110 11307
.  02410 TINBUF      U-TAG     TYPT*TYPT                    11333  11334 11334
.  02411 TYPT        RESERVE   1                            11334  00000 00000
.  02412 BLT         RESERVE   1                            11335  00000 00000
.  02413 FIXOCTPRNT  ENT  A*W(EIGHTGO)*SKIP                 11336  11130 11342
.  02414 FIXDECPRNT  ENT  A*W(DECGO)                        11337  11030 11343
.  02415             STR  A*W(JPTABLE-1)                    11340  15030 10605
.  02416             JP   ZOTZ                              11341  61000 11330

.  02417 EIGHTGO     JP   L(JPTABLEOCT+87-1)                11342  61017 11354
.  02420 DECGO       JP   L(JPTABLE+87-1)                   11343  61017 10605
.  02421 STOPRINT    ENT  A*W(STOPPER)*SKIP                 11344  11130 11351
.  02422 GOPRINT     ENT  A*W(GOER)                         11345  11030 11352
.  02423             STR  A*W(JPTABLE+16D)                  11346  15030 10626
.  02424             STR  A*W(JPTABLEOCT+16D)               11347  15030 11375
.  02425             JP   ZOTZ                              11350  61000 11330
.  02426 STOPPER     0    RUNNY                             11351  00000 11353

.  02427 GOER        0    RUNPRINTER                        11352  00000 11044
.  02430 RUNNY       CL   W(PRINTINDIC)                     11353  16030 01156
.  02431             JP   L(PRINTER)                        11354  61010 10602
.  02432 JPTABLEOCT  0    GETNUMS                           11355  00000 10627
.  02433             0    BUFKLEER                          11356  00000 11461
.  02434             0    TIMECON                           11357  00000 10736
.  02435             0    TIMECONB                          11360  00000 10744
.  02436             0    AZINCON                           11361  00000 10750
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                O     AZINCONB               11362  00000 10756
                O     ELINCON                11363  00000 11006
                O     ELINCONB               11364  00000 11014
                O     AZINOCT                11365  00000 11376
                O     AZOUTOCT               11366  00000 11406
                O     ELINOCT                11367  00000 11416
                O     ELOUTOCT               11370  00000 11426
                O     AZDIFOCT               11371  00000 11464

                O     ELDIFOCT               11372  00000 11473
                O     RUNNY+1                11373  00000 11354
                O     RUNNY+1                11374  00000 11354
                O     RUNPRINTER             11375  00000 11044
      AZINOCT   ENT   A*W(FIELDS+8D)         11376  11030 10676
                STR   A*W(NUMBER)            11377  15030 04144
                RJP   CONOCT                 11400  65000 11436
                ENT   A*W(FDVAR)             11401  11030 10702

                STR   A*W(PRBUFER+7)         11402  15030 10713
                ENT   A*W(FDVAR+1)           11403  11030 10703
                STR   A*W(PRBUFER+8D)        11404  15030 10714
                JP    L(PRINTER)             11405  61010 10602
      AZOUTOCT  ENT   A*W(FIELDS+9D)         11406  11030 10677
                STR   A*W(NUMBER)            11407  15030 04144
                RJP   CONOCT                 11410  65000 11436
                ENT   A*W(FDVAR)             11411  11030 10702

                STR   A*W(PRBUFER+10D)       11412  15030 10716
                ENT   A*W(FDVAR+1)           11413  11030 10703
                STR   A*W(PRBUFER+11D)       11414  15030 10717
                JP    L(PRINTER)             11415  61010 10602
      ELINOCT   ENT   A*W(FIELDS+10D)        11416  11030 10700
                STR   A*W(NUMBER)            11417  15030 04144
                RJP   CONOCT                 11420  65000 11436
                ENT   A*W(FDVAR)             11421  11030 10702

                STR   A*W(PRBUFER+16D)       11422  15030 10724
                ENT   A*W(FDVAR+1)           11423  11030 10703
                STR   A*W(PRBUFER+17D)       11424  15030 10725
                JP    L(PRINTER)             11425  61010 10602
      ELOUTOCT  ENT   A*W(FIELDS+11D)        11426  11030 10701
                STR   A*W(NUMBER)            11427  15030 04144
                RJP   CONOCT                 11430  65000 11436
                ENT   A*W(FDVAR)             11431  11030 10702

                STR   A*W(PRBUFER+19D)       11432  15030 10727
                ENT   A*W(FDVAR+1)           11433  11030 10703
                STR   A*W(PRBUFER+20D)       11434  15030 10730
                JP    L(PRINTER)             11435  61010 10602
      CONOCT    RESERVE   1                  11436  00000 00000
                CL    A                      11437  11000 00000
                STR   B6*L(TEMA)             11440  16610 04135
                ENT   Q*W(NUMBER)            11441  10030 04144
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02517           ENT  B6*4                11442  12600 00004
02520           LSH  A*3                 11443  06000 00003
02521           LSH  AQ*3                11444  07000 00003
02522           ADD  A*60                11445  20000 00060
02523           BJP  B6*CONOCT+5         11446  72600 11443
02524           STR  A*W(FDVAR)          11447  15030 10702
02525           CL   A                   11450  11000 00000
02526           ENT  B6*4                11451  12600 00004

02527 LOWHALF   LSH  A*3                 11452  06000 00003
02530           LSH  AQ*3                11453  07000 00003
02531           ADD  A*60                11454  20000 00060
02532           BJP  B6*LOWHALF          11455  72600 11452
02533           STR  A*W(FDVAR+1)        11456  15030 10703
02534           ENT  B6*L(TEMA)          11457  12610 04135
02535           JP   L(CONOCT)           11460  61010 11436
02536 BUFKLEER  CLEAR     25D*PRBUFER    11461  70100 00031

                                         11462  16030 10704
02537           JP   L(PRINTER)          11463  61010 10602
02540 AZDIFOCT  ENT  A*W(FIELDS+8D)      11464  11030 10676
02541           SUB  A*W(FIELDS+9D)      11465  21030 10677
02542           STR  A*W(NUMBER)         11466  15030 04144
02543           RJP  CONOCT              11467  65000 11436
02544           ENT  A*W(FDVAR+1)        11470  11030 10703
02545           STR  A*W(PRBUFER+22D)    11471  15030 10732

02546           JP   L(PRINTER)          11472  61010 10602
02547 ELDIFOCT  ENT  A*W(FIELDS+10D)     11473  11030 10700
02550           SUB  A*W(FIELDS+11D)     11474  21030 10701
02551           STR  A*W(NUMBER)         11475  15030 04144
02552           RJP  CONOCT              11476  65000 11436
02553           ENT  A*W(FDVAR+1)        11477  11030 10703
02554           STR  A*W(PRBUFER+24D)    11500  15030 10734
02555           JP   L(PRINTER)          11501  61010 10602

                                         11502  02300 00002
                                         11503  02000 00002
                                         11504  56000 00000
                                         11505  21100 00002
                                         11506  00040 00000
                                         11507  00100 00000
                                         11510  00020 00000
                                         11511  00077 77777

                                         11512  12010 00001
                                         11513  00606 06060
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SPURT OUTPUT NO. 111

ANTENATEST LDMASSEY*24JUN1964

LABEL	LOC	LABEL	LOC	LABEL	LOC
A$$$$$1111	00011	A$$$$$1112	00001	A$$$$$1113	00037
A$$$$$1114	00024	A$$$$$1115	00047	A$$$$$1116	00043
A$$$$$1117	00120	A$$$$$1118	00103	A$$$$$1119	11502
A$$$$$111A	00163	A$$$$$111B	00135	A$$$$$111C	11503
A$$$$$111D	00211	A$$$$$111E	00204	A$$$$$111F	00276
A$$$$$111G	00265	A$$$$$111H	00316	A$$$$$111I	00306
A$$$$$111J	00326	A$$$$$111K	00322	A$$$$$111L	11504
A$$$$$111M	00450	A$$$$$111N	00440	A$$$$$1110	00460
A$$$$$111P	00454	A$$$$$111Q	00543	A$$$$$111R	00531
A$$$$$111S	01031	A$$$$$111T	01023	A$$$$$111U	01056
A$$$$$111V	01046	A$$$$$111W	11505	A$$$$$111X	11506
A$$$$$111Y	11507	A$$$$$111Z	11510	A$$$$$1121	11511
A$$$$$1122	11512	A$$$$$1123	11513	ABCW	01110
ACCUM	04150	ACSTORE	01132	AGAINX	00302
AGAINXY	00367	AGAINY	00305	AGAINZ	00332
AMINUS	04073	ANGLESAVE	01327	ANTENTRY	00000
ANZ	04174	ARG1	03645	ARG10	03700
ARG11	03703	ARG12	03706	ARG2	03650
ARG3	03653	ARG4	03656	ARG5	03661
ARG6	03664	ARG7	03667	ARG8	03672
ARG9	03675	ARGLOOP	00476	ASAVE	04141
AX	04002	AZOMEGA	04323	AZOUT	01333
AZOUTOCT	11406	AZOUTCON	10762	AZOUTCONB	10770
AZAMPLITUD	04321	AZDIFOCT	11464	AZDIFCON	10774
AZDIFCONB	11002	AZDURAT	04512	AZHEIGHT	04420
AZIMPULSE	04431	AZIMPULSE1	04444	AZIMPULSE2	04455
AZIMUTH	01331	AZINOCT	11376	AZINCON	10750
AZINCONB	10756	AZPOLY	03757	AZPOLYLOOP	03770
AZPERIOD	04417	AZRANDOM	10577	AZSINE	10516
AZST	03711	AZSTEP	04364	AZSTEP1	04376
AZTIME	04421	BANG	00022	BARGLOOP	00472
BBCW	01111	BCDTBL	04175	BCW	01113
BCWPRINTER	11056	BINEG	04115	BINPNT	04147
BINSCALE	04106	BLT	11335	BSAVE	04142
BUFA	01335	BUFB	02465	BUFDONE	00642
BUFKLEER	11461	CODEDELETE	00370	COMMA	00336
CONOCT	11436	CONIN	00147	CONIN1	00172
CONINETC	00203	CONTBL	01320	CONTIND	03615
C1	04354	C3	04355	C5	04356
C7	04357	C9	04360	CBCW	01112
CLKTEST	01244	CLRBUFA	00676	CYCLE	00377

DECON	04017	DECGO	11343	DECIMAL	04071
DECRET	04064	DECSIGNFLG	04133	DEGCON	01114
DRIVE	01135	DRIVE1	01141	DRIVE2	01145
DRIVEREAL	11224	DRIVFIX	11276	DRIVINIT	11210
DRIVINTERR	11276	EIGHTGO	11342	ELOMEGA	04324
ELOUT	01334	ELOUTOCT	11426	ELOUTCON	11020
ELOUTCONB	11026	ELAMPLITUD	04322	ELDIFOCT	11473
ELDIFCON	11032	ELDIFCONB	11040	ELDURAT	04511
ELEVATION	01332	ELHEIGHT	04423	ELIMPULSE	04463
ELIMPULSE1	04476	ELIMPULSE2	04507	ELINOCT	11416
ELINCON	11006	ELINCONB	11014	ELPOLY	03727
ELPOLYLOOP	03740	ELPERIOD	04422	ELRANDOM	10573
ELSINE	10545	ELST	03712	ELSTEP	04403
ELSTEP1	04415	ELTIME	04424	ENCODE	01146
ENCODEREAL	11243	ENCODEX	01151	FOUND	00464
FACTOR	01134	FAZI	03637	FDTOBCD	04156
FDTOBCD1	04161	FDVAR	10702	FELE	03642
FIDGE	00551	FIDGET	00604	FIDGETTE	00637
FIELDS	10666	FIRST	04134	FIRSTPOSIT	00601
FIXOCTPRNT	11336	FIXDECPRNT	11337	FIXTC	04152
FIXTEN	11163	FRAC	11143	FRACTCON	11103
FRACTION	11102	FREQOUT	01311	FUNADDTBL	01222
FUNCTBL	01202	FUNIDLOOP	00426	FUNLOC	03616
FUNSEARCH	00430	GOODY	04046	GOER	11352
GOPRINT	11345	GETNUMS	10627	GIMMICK	11202
HUNDZERO	11172	INAZBCW	11302	INELBCW	11303
INITRET	00554	INPUTBUFER	01245	INTCLKTEST	00140
INTCLKTSTA	00137	INTEGER	11101	INTEGERCON	11147
INTERR	04155	IWRITE	03720	IWRITEFD	03634
JPTABLE	10606	JPTABLEOCT	11355	LOOPA	04031
LOOPB	04034	LOWHALF	11452	LINERROR	00264
MAIN	00014	NOMORE	01022	NOSCALE	04104
NAIMPULSE	00004	NAPOLY	00006	NARANDOM	00001
NASINE	00002	NASTEP	00003	NDEC	04151
NEXT	00475	NEXTX	00517	NFIELDS	01317
NRUN	01326	NUMBER	04144	NWAIT	01325
POINTGEN	00613	POLYB	04016	PHI	03715
PHIFD	03623	PROCEEDTAP	01107	PROCEEDX	00237
PROGRAM	00124	PRBCW	11055	PRBUFER	10704
PRCONV1	11063	PRINTBUFER	10704	PRINTER	10602
PRINTINDIC	01156	PRINTINTER	11057	PRINTRET	00650
PRINTRETEX	00646	QSAVE	04143	QSTORE	01133
REACCEPT	00052	REVS	04352	REVS2	04353
RUNNY	11353	RUNPRINTER	11044	SAMEVALUE	00420
SCALING	04075	SIGNFIX	04121	SINECALC	00015
SINEFUN	04325	SINEFUNCS	04275	SINEFUNCS1	04310
SINEFUNCS2	04304	SINEFUNCS3	04317	SINTBL	04513
STOPMARK	10735	STOPPER	11351	STOPRINT	11344

TABLE	01157	TAPEWRITE	01075	TEMA	04135
TEMAX	01315	TEMB	04136	TEMBX	01312
TEMC	04137	TEMCX	01316	TENPOWER	04140
TENTH	11137	TENZERO	11177	THETA	03714
THETAFD	03620	THRU	04126	THYME	03713
THYMEX	04001	TIME	01330	TIMECON	10736
TIMECONB	10744	TINBUF	11333	TROUBLE	11076
TRBLFIXT	11070	TRUN	03717	TRUNFD	03631
TWAIT	03716	TWAITFD	03626	TYPEIN	11306
TYPT	11334	UNFULLA	01015	UNFULLB	00755
UNIT	11201	USEBUFA	00762	UTAZBCW	11304
UTELBCW	11305	VIRGULE	00375	WEREHEREA	11222
WEREHEREB	11241	WRITEBUF	00706	WRITELINE	00703
ZOTZ	11330	ZERO	00000	ZKFLDCNT	00547
ZXNLINEIND	01242	ZXYZ	00700	ZZZZ	00665

SPURT OUTPUT NO. 112

ANTENATEST LDMASSEY*24JUN1964

LABEL	LOC	LABEL	LOC	LABEL	LOC
ZERO	00000	ANTENTRY	00000	NARANDOM	00001
A$$$$$1112	00001	NASINE	00002	NASTEP	00003
NAIMPULSE	00004	NAPOLY	00006	A$$$$$1111	00011
MAIN	00014	SINECALC	00015	BANG	00022
A$$$$$1114	00024	A$$$$$$1113	00037	A$$$$$1116	00043
A$$$$$1115	00047	REACCEPT	00052	A$$$$$1118	00103
A$$$$$1117	00120	PROGRAM	00124	INTCLKTSTA	00137
INTCLKTEST	00140	CONIN	00147	A$$$$$111B	00155
A$$$$$111A	00163	CONIN1	00172	CONINETC	00203
A$$$$$111E	00204	A$$$$$111D	00211	PROCEEDX	00237
LINERROR	00264	A$$$$$111G	00265	A$$$$$111F	00276
AGAINX	00302	AGAINY	00305	A$$$$$1111	00306
A$$$$$111H	00316	A$$$$$111K	00322	A$$$$$111J	00326
AGAINZ	00332	COMMA	00336	AGAINXY	00367
CODEDELETE	00370	VIRGULE	00375	CYCLE	00377
SAMEVALUE	00420	FUNIDLOOP	00426	FUNSEARCH	00430
A$$$$$111N	00440	A$$$$$111M	00450	A$$$$$111P	00454
A$$$$$1110	00460	FOUND	00464	BARGLOOP	00472
NEXT	00475	ARGLOOP	00476	NEXTX	00517
A$$$$$111R	00531	A$$$$$111Q	00543	ZKFLDCNT	00547
FIDGE	00551	INITRET	00554	FIRSTPOSIT	00601
FIDGET	00604	POINTGEN	00613	FIDGETTE	00637
BUFDONE	00642	PRINTRETEX	00646	PRINTRET	00650
ZZZZ	00665	CLRBUFA	00676	ZXYZ	00700
WRITELINE	00703	WRITEBUF	00706	UNFULLB	00755
USEBUFA	00762	UNFULLA	01015	NOMORE	01022
A$$$$$111T	01023	A$$$$$111S	01031	A$$$$$111V	01046
A$$$$$111U	01056	TAPEWRITE	01075	PROCEEDTAP	01107
ABCW	01110	BBCW	01111	CBCW	01112
BCW	01113	DEGCON	01114	ACSTORE	01132
QSTORE	01133	FACTOR	01134	DRIVE	01135
DRIVE1	01141	DRIVE2	01145	ENCODE	01146
ENCODEX	01151	PRINTINDIC	01156	TABLE	01157
FUNCTBL	01202	FUNADDTBL	01222	ZXNLINEIND	01242
CLKTEST	01244	INPUTBUFER	01245	FREQOUT	01311
TEMBX	01312	TEMAX	01315	TEMCX	01316
NFIELDS	01317	CONTBL	01320	NWAIT	01325
NRUN	01326	ANGLESAVE	01327	TIME	01330
AZIMUTH	01331	ELEVATION	01332	AZOUT	01333
ELOUT	01334	BUFA	01335	BUFB	02465
CONTIND	03615	FUNLOC	03616	THETAFD	03620

PHIFD	03623	TWAITFD	03626	TRUNFD	03631
IWRITEFD	03634	FAZI	03637	FELE	03642
ARG1	03645	ARG2	03650	ARG3	03653
ARG4	03656	ARG5	03661	ARG6	03664
ARG7	03667	ARG8	03672	ARG9	03675
ARG10	03700	ARG11	03703	ARG12	03706
AZST	03711	ELST	03712	THYME	03713
THETA	03714	PHI	03715	TWAIT	03716
TRUN	03717	IWRITE	03720	ELPOLY	03727
ELPOLYLOOP	03740	AZPOLY	03757	AZPOLYLOOP	03770
THYMEX	04001	AX	04002	POLYB	04016
DECON	04017	LOOPA	04031	LOOPB	04034
GOODY	04046	DECRET	04064	DECIMAL	04071
AMINUS	04073	SCALING	04075	NOSCALE	04104
BINSCALE	04106	BINEG	04115	SIGNFIX	04121
THRU	04126	DECSIGNFLG	04133	FIRST	04134
TEMA	04135	TEMB	04136	TEMC	04137
TENPOWER	04140	ASAVE	04141	BSAVE	04142
QSAVE	04143	NUMBER	04144	BINPNT	04147
ACCUM	04150	NDEC	04151	FIXTC	04152
INTERR	04155	FDTOBCD	04156	FDTOBCD1	04161
ANZ	04174	BCDTBL	04175	SINEFUNCS	04275
SINEFUNCS2	04304	SINEFUNCS1	04310	SINEFUNCS3	04317
AZAMPLITUD	04321	ELAMPLITUD	04322	AZOMEGA	04323
ELOMEGA	04324	SINEFUN	04325	REVS	04352
REVS2	04353	C1	04354	C3	04355
C5	04356	C7	04357	C9	04360
AZSTEP	04364	AZSTEP1	04376	ELSTEP	04403
ELSTEP1	04415	AZPERIOD	04417	AZHEIGHT	04420
AZTIME	04421	ELPERIOD	04422	ELHEIGHT	04423
ELTIME	04424	AZIMPULSE	04431	AZIMPULSE1	04444
AZIMPULSE2	04455	ELIMPULSE	04463	ELIMPULSE1	04476
ELIMPULSE2	04507	ELDURAT	04511	AZDURAT	04512
SINTBL	04513	AZSINE	10516	ELSINE	10545
ELRANDOM	10573	AZRANDOM	10577	PRINTER	10602
JPTABLE	10606	GETNUMS	10627	FIELDS	10666
FDVAR	10702	PRINTBUFER	10704	PRBUFER	10704
STOPMARK	10735	TIMECON	10736	TIMECONB	10744
AZINCON	10750	AZINCONB	10756	AZOUTCON	10762
AZOUTCONB	10770	AZDIFCON	10774	AZDIFCONB	11002
ELINCON	11006	ELINCONB	11014	ELOUTCON	11020
ELOUTCONB	11026	ELDIFCON	11032	ELDIFCONB	11040
RUNPRINTER	11044	PRBCW	11055	BCWPRINTER	11056
PRINTINTER	11057	PRCONV1	11063	TRBLFIXT	11070
TROUBLE	11076	INTEGER	11101	FRACTION	11102
FRACTCON	11103	TENTH	11137	FRAC	11143
INTEGERCON	11147	FIXTEN	11163	HUNDZERO	11172
TENZERO	11177	UNIT	11201	GIMMICK	11202

DRIVINIT	11210	WEREHEREA	11222	DRIVEREAL	11224
WEREHEREB	11241	ENCODEREAL	11243	DRIVFIX	11276
DRIVINTERR	11276	INAZBCW	11302	INELBCW	11303
UTAZBCW	11304	UTELBCW	11305	TYPEIN	11306
ZOTZ	11330	TINBUF	11333	TYPT	11334
BLT	11335	FIXOCTPRNT	11336	FIXDECPRNT	11337
EIGHTGO	11342	DECGO	11343	STOPRINT	11344
GOPRINT	11345	STOPPER	11351	GOER	11352
RUNNY	11353	JPTABLEOCT	11355	AZINOCT	11376
AZOUTOCT	11406	ELINOCT	11416	ELOUTOCT	11426
CONOCT	11436	LOWHALF	11452	BUFKLEER	11461
AZDIFOCT	11464	ELDIFOCT	11473	A$$$$$1119	11502
A$$$$$111C	11503	A$$$$$111L	11504	A$$$$$111W	11505
A$$$$$111X	11506	A$$$$$111Y	11507	A$$$$$111Z	11510
A$$$$$1121	11511	A$$$$$1122	11512	A$$$$$1123	11513

APPENDIX B

7094 PRINT PROGRAM

```
*      LIST8
CCONVERT
C      THIS PROGRAM READS A TAPE PREPARED ON THE UNIVAC 490 AND PRINTS IT
C      WITH SOME SMALL CALCULATIONS
       DIMENSION BUFFER(500 ),DIFFER(200),BUFFRX(500)
       READ INPUT TAPE 2,100,NTIM
  100  FORMAT (I10)
       DO 101 III=1,NTIM
   10  IOF=0
       CALL READER (BUFFRX(5),5,IOF)
       DO 102 NN=1,5
       NNNN=6-NN
  102  BUFFER(NN)=BUFFRX(NNNN)
       WRITE OUTPUT TAPE 6,20,(BUFFER(L),L=1,5)
   20  FORMAT (5A6)
       READ INPUT TAPE 2,6,N
    6  FORMAT (I10)
       M=0
   12  CALL READER (BUFFRX(500),500,IOF)
       IF (IOF) 11,104,11
  104  DO 103 NN=1,500
       NNNN=501-NN
  103  BUFFER(NN)=BUFFRX(NNNN)
       DO 2 LDEX=1,500
    2  CALL FLOTER (BUFFER(LDEX))
       DO 3 LDEX=1,496,5
       BUFFER(LDEX)=BUFFER(LDEX)*.004
       DO 4 NDEX=1,4
       JDEX=LDEX+NDEX
    4  BUFFER(JDEX)=BUFFER(JDEX)*.000686645507
    3  CONTINUE
       DO 5 LDEX=1,100
       JDEX=2*LDEX-1
       NDEX=5*LDEX-3
       MDEX=NDEX+1
       DIFFER(JDEX)=BUFFER(NDEX)-BUFFER(MDEX)
    5  DIFFER(JDEX+1)=BUFFER(NDEX+2)-BUFFER(MDEX+2)
       DO 7 LDEX=1,100
       JDEX=XMODF(M,N)
       M=M+1
       IF (JDEX) 7,8,7
    8  NDEX=5*LDEX-4
       IDEX=2*LDEX-1
       NXDEX=NDEX+4
       IXDEX=IDEX+1
       WRITE OUTPUT TAPE 6,9,((BUFFER(I),I=NDEX,NXDEX),(DIFFER(I),I=IDEX,
      1IXDEX))
    9  FORMAT (9X,5F15.5,2E15.8)
    7  CONTINUE
       GO TO 12
   11  END FILE 7
  101  CONTINUE
       CALL EXIT
       END
*      FAP
```

APPENDIX C

7094 PLOT PROGRAM

```
*      LIST8
CPLOTTER
C      THIS PROGRAM ACCEPTS THE CONVERTED UNIVAC 490 TAPE AND PLOTS THE
C      DATA IN ACCORDANCE WITH THE INPUT SPECIFICATIONS.
       DIMENSION BUFFER(1000),BUFRIN(500),BUFXIN(500),DIFFER(200),
      1                                                PLOTB1(5000),PLOTB2(50
      200),PLOTB3(5000),PLOTB4(5000),XLABEL(5),XLABSR(5),XLEN(5)
       PRINT 15
       WRITE OUTPUT TAPE 3,15
    15 FORMAT (46H1MOUNT INPUT TAPE ON A7 AND SCRATCH TAPE ON A6)
       PAUSE 70707
       READ INPUT TAPE 2,1,NGRAPH
     1 FORMAT (I10)
       XSTA=0.0
       YLEN=6.0
       CALL PLOTS (BUFFER(1000),1000)
       NGR=((NGRAPH-1)/3)+1
       DO 2 I=1,NGR
       CALL PLOT (0.0,-29.0,-3)
       CALL PLOT (0.0,2.5,-3)
       DO 3 J=1,3
       NTEST=((I-1)*3)+J
       YSTA=0.0
       REWIND 7
       READ INPUT TAPE 2,21,(XLABSR(L),L=1,5)
       READ INPUT TAPE 2,4,JTEST,SPACE,TIML,TIMU,XLEN(J),IUJ
    21 FORMAT (5A6)
     4 FORMAT (I10,4F10.0,I10)
    25 CALL READER (BUFXIN(5),5,IOF)
       DO 100 NN=1,5
       NNNN=6-NN
   100 XLABEL(NN)=BUFXIN(NNNN)
       DO 22 L=1,5
B      XLABEL(L)=(XLABEL(L)*(-XLABSR(L)))+(XLABSR(L)*(-XLABEL(L)))
       IF (XLABEL(L)) 23,22,23
    22 CONTINUE
       GO TO 24
    23 CALL FILSPA
       GO TO 25
    24 KN=1
   240 INDIC=1
       CALL READER (BUFXIN(500),500,IOF)
       IF (IOF) 205,206,205
   206 DO 207 NN=1,500
       NNNN=501-NN
   207 BUFRIN(NN)=BUFXIN(NNNN)
       DO 208 LDEX=1,500
   208 CALL FLOTER (BUFRIN(LDEX))
       DO 209 LDEX=1,496,5
       BUFRIN(LDEX)=BUFRIN(LDEX)*.004
       DO 210 NDEX=1,4
       JDEX=NDEX+LDEX
   210 BUFRIN(JDEX)=BUFRIN(JDEX)*.000686645507
   209 CONTINUE
       DO 211 LDEX=1,100
       JDEX=2*LDEX-1
       NDEX=5*LDEX-3
       MDEX=NDEX+1
```

```
      DIFFER(JDEX)=BUFRIN(NDEX)-BUFRIN(MDEX)
  211 DIFFER(JDEX+1)=BUFRIN(NDEX+2)-BUFRIN(MDEX+2)
  218 DO 212 LDEX=INDIC,496,5
      IF(BUFRIN(LDEX)-TIML) 212,213,213
  212 CONTINUE
      GO TO 240
  213 INDIC=LDEX
      TIML=TIML+SPACE
      PLOTB1(KN)=BUFRIN(INDIC)
      LDEX=(2*(INDIC-1)/5)+1
      IF(JTEST) 214,215,214
  214 PLOTB2(KN)=BUFRIN(INDIC+3)
      PLOTB3(KN)=BUFRIN(INDIC+4)
      PLOTB4(KN)=DIFFER(LDEX+1)
      GO TO 216
  215 PLOTB2(KN)=BUFRIN(INDIC+1)
      PLOTB3(KN)=BUFRIN(INDIC+2)
      PLOTB4(KN)=DIFFER(LDEX)
  216 KN=KN+1
      INDIC=INDIC+5
      IF (5000-KN) 217,219,219
  219 IF (TIML-TIMU) 218,218,217
  217 CALL FILSPA
  205 IB2=1
      KN=KN-1
      DO 1004 KXY=1,KN
      IF(PLOTB2(KXY)-PLOTB2(1)) 1005,1004,1005
 1004 CONTINUE
      IB2=0
 1005 IB4=1
      DO 1006 KXY=1,KN
      IF (PLOTB4(KXY)-PLOTB4(1)) 1007,1006,1007
 1006 CONTINUE
      IB4=0
 1007 CALL SCALE(PLOTB1,KN,XLEN(J),XMIN,DX)
      IF(IB2+IB4) 1014,12,1014
 1014 IF(IB2) 1010,1011,1010
 1010 CALL SCALE(PLOTB2,KN,5.0,YMIN2,DY2)
      DO 16 K=1,KN
   16 PLOTB3(K)=(PLOTB3(K)-YMIN2)*10./(DY2)
 1011 IF(IB4) 1012,1013,1012
 1012 CALL SCALE(PLOTB4,KN,5.0,YMIN4,DY4)
 1013 IF(IB2) 1040,1041,1040
 1040 IF (IUJ)1101,12,1101
 1101 IF (XMODF(IUJ,2)) 1102,1103,1102
 1102 CALL LINE(PLOTB1,PLOTB2,KN)
 1103 IF (XMODF(IUJ,4) - 2) 1041,1104,1104
 1104 CALL LINE(PLOTB1,PLOTB3,KN)
 1041 IF(IB4) 1042,1043,1042
 1042 IF (XMODF(IUJ,8) - 4) 1043,1105,1105
 1105 CALL LINE(PLOTB1,PLOTB4,KN)
 1043 CALL  AXIS(XSTA,YSTA,4HTIME,4,XLEN(J),0.0,XMIN,DX
      XSTAX=XSTA-0.5
      IF (JTEST) 11,10,11
   10 IF(IB2) 1020,1021,1020
 1020 CALL  AXIS(XSTA,YSTA,7HAZIMUTH,7,5.0,90.0,YMIN2,DY2  )
 1021 IF(IB4) 1022,12,1022
 1022 CALL XAXIS(XSTAX,YSTA,13HAZIMUTH ERROR,13,5.0,90.0,YMIN4,DY4,3)
      GO TO 12
```

```
     11 IF(IB2)1030,1031,1030
   1030 CALL  AXIS(XSTA,YSTA,9HELEVATION,9,5.0,90.0,YMIN2,DY2  )
   1031 IF(IB4) 1032,12,1032
   1032 CALL XAXIS(XSTAX,YSTA,15HELEVATION ERROR,15,5.0,90.0,YMIN4,DY4,3)
     12 X=XSTA+3.0
        Y=YSTA+5.5
        DO 1050 NANCY=1,5
        NANX=6-NANCY
   1050 XLABEL(NANCY)=XLABSR(NANX)
        CALL SYMBL4(X,Y,.21,XLABEL(5),0.0,30)
        CALL PLOT (0.0,8.5,-3)
        IF (NTEST-NGRAPH) 3,13,3
      3 CONTINUE
        IZ=1
        DO 14 J=1,3
        IF (IZ) 32,31,32
     32 IZ=0
        JSV=J
        GO TO 14
     31 IF (XLEN(J)-XLEN(JSV)) 14,14,17
     17 JSV =J
     14 CONTINUE
        XLEN(JSV)=XLEN(JSV)+4.0
        CALL PLOT(XLEN(JSV),0.0,-3)
      2 CONTINUE
        REWIND 6
        REWIND 7
     13 PRINT 30
        WRITE OUTPUT TAPE 3,30
     30 FORMAT (49H1DISMOUNT TAPE A6 AND PLOT IT, SAVE INPUT TAPE A7)
        PAUSE 77777
        CALL EXIT
        END
```

APPENDIX D

MODIFIED AXIS PLOTTING PROGRAM

```
*     LIST8
CXAXIS
      SUBROUTINE XAXIS (X,Y,BCD,NC,SIZE,THETA,YMIN,DY,IPEN)
      TH = THETA / 57.29578
      N=SIZE+0.50
      YB=SINF(TH)
      XA=X-0.1*YB
      XB=COSF(TH)
      XC=X
      YA=Y-0.1*XB
      YC=Y
      CHAR=ABSF(YMIN)
      VALUE=ABSF(YMIN+DY)
      IF(CHAR-VALUE)5,6,6
    5 CHAR=VALUE
    6 N1=0
      VALUE=10000.
      I3=3
   14 IF(CHAR-VALUE)15,16,16
   15 N1=N1+1
      VALUE=VALUE/10.0
      GO TO 14
   16 DO 20 I=1,N
      CALL PLOT(XA,YA,I3)
      CALL PLOT(XC,YC,IPEN)
      XC=XC+XB
      YC=YC+YB
      XA=XA+XB
      YA=YA+YB
      CALL PLOT(XC,YC,IPEN)
   20 I3=IPEN
      CALL PLOT(XA,YA,IPEN)
      XA=XC-.12
      YA=YC-.12
      XC=XC*XB
      YC=YC*YB
      N=N+1
      DO 30 I=1,N
      VALUE=((XC+YC)*DY/10.0)+YMIN
      CALL NUMBER(XA,YA,0.10,VALUE,THETA,N1)
      XA=XA-XB
      YA=YA-YB
      XC=XC-XB
   30 YC=YC-YB
      VALUE=NC/2
      XC=X+XB*(SIZE/2.0-0.12*VALUE)-0.3*YB
      YC=Y+YB*(SIZE/2.0-0.12*VALUE)-0.46*XB
      CALL SYMBL4(XC,YC,0.14,BCD,THETA,NC)
      RETURN
      END
```

APPENDIX E

TAPE READING SUBROUTINE

```
        ENTRY   READER
READER  CLA     1,4
        STA     CWORD
        CLA*    2,4
        STD     CWORD
        RTBA    7
        RCHA    CWORD
        TCOA    *
        TEFA    END
        STZ*    3,4
        TRA     4,4
END     CLA     =1
        STO*    3,4
        TRA     4,4
CWORD   IORP    ,,
        IOCD    ,,
        END
```

APPENDIX F

FLOATING POINT CONVERSION SUBROUTINE

```
*       FAP
        ENTRY   FLOTER
FLOTER  CAL*    1,4
        ALS     6
        PBT
        TRA     *+7
        CLA     =1
        STO     ZIG
        CAL*    1,4
        ORA     =0770000000000
        COM
        TRA     *+2
        CAL*    1,4
        ORA     =0233000000000
        SLW*    1,4
        CLA     ZIG
        TZE     ZAG
        PXA     ,,
        FSB*    1,4
        TRA     ZOG
ZAG     PXA     ,,
        FAD*    1,4
ZOG     STO*    1,4
        TRA     2,4
ZIG     PZE
        END
```

APPENDIX G

FILE SPACING SUBROUTINE

```
*       FAP
        ENTRY   FILSPA
FILSPA  RTBA    7
        RCHA    CWORD
        TCOA    *
        TEFA    *+2
        TRA     *-4
        TRA     1,4
CWORD   IORP    ,,
        IOCD    ,,
        END
```

-62-2863

```
READY
    LD□S2□321□10000®
READY
    PS□10000®

THIS IS THE ANTENNA TESTING PROGRAM.

DO YOU WISH TO HAVE OUTPUT ON THE ON-LINE PRINTER.

IF SO, HOW OFTEN.

    YES□250®
TYPE TEST IDENTIFICATION.

    SINE AND STEP FUNCTIONS®
TYPE TEST PARAMETERS.

    90,0,1,100,1,AZSINE,ELSTEP,.02,5,5,3,7.5,®
TYPE TEST IDENTIFICATION.

    POLY AND IMPULSE FUNCTIONS®
TYPE TEST PARAMETERS.

    ,45,,85,,AZPOLY,ELIMP,3,72.6,-46.495214,12.3,-1.65,.03,
    5,10,.5,10,®
TYPE TEST IDENTIFICATION.

    CONSTANT BIASES®
TYPE TEST PARAMETERS.

    92.109375,42.890625,,10,100,AZNOT,ELNOT,,,®
TYPE TEST IDENTIFICATION.

    END OF DEMONSTRATION®
TYPE TEST PARAMETERS.

    ..®

DO YOU WISH TO CONTINUE

    NO®

DO YOU WISH TO REWIND OUTPUT TAPE.

    YES®
READY
```

Fig. 1. Sample console communications.

-62-2864

0.9959	90.6241	90.6241	0.0000	0.0000	0.0000	0.0000
1.9959	91.2407	91.2380	-0.0027	0.0000	0.0000	0.0000
2.9959	91.8381	91.8354	-0.0027	0.0000	0.0000	0.0000
3.9959	92.4060	92.4039	-0.0020	0.0000	0.0000	0.0000
4.9959	92.9367	92.9347	-0.0020	0.0000	0.0000	0.0000
5.9959	93.4208	93.4188	-0.0020	2.9999	2.9999	0.0000
6.9959	93.8507	93.8493	-0.0013	2.9999	2.9999	0.0000
7.9959	94.2201	94.2187	-0.0013	2.9999	2.9999	0.0000
8.9959	94.5229	94.5215	-0.0013	2.9999	2.9999	0.0000
9.9959	94.7543	94.7536	-0.0006	2.9999	2.9999	0.0000
10.9959	94.9108	94.9102	-0.0006	2.9999	2.9999	0.0000
11.9959	94.9898	94.9891	-0.0006	2.9999	2.9999	0.0000
12.9959	94.9898	94.9898	0.0000	5.9999	5.9999	0.0000
13.9959	94.9115	94.9122	0.0006	5.9999	5.9999	0.0000
14.9959	94.7557	94.7563	0.0006	5.9999	5.9999	0.0000
15.9959	94.5249	94.5256	0.0006	5.9999	5.9999	0.0000
16.9959	94.2228	94.2242	0.0013	5.9999	5.9999	0.0000
17.9959	93.8541	93.8555	0.0013	5.9999	5.9999	0.0000
18.9959	93.4243	93.4263	0.0020	5.9999	5.9999	0.0000
19.9959	92.9409	92.9429	0.0020	5.9999	5.9999	0.0000
20.9959	92.4108	92.4128	0.0020	8.9998	8.9998	0.0000
21.9959	91.8429	91.8450	0.0020	8.9998	8.9998	0.0000
22.9959	91.2455	91.2483	0.0027	8.9998	8.9998	0.0000
23.9959	90.6289	90.6310	0.0020	8.9998	8.9998	0.0000
24.9959	90.0020	90.0048	0.0027	8.9998	8.9998	0.0000
25.9959	89.3600	89.3627	0.0027	8.9998	8.9998	0.0000
26.9959	88.7441	88.7461	0.0020	8.9998	8.9998	0.0000
27.9959	88.1474	88.1494	0.0020	11.9998	11.9998	0.0000
28.9959	87.5795	87.5816	0.0020	11.9998	11.9998	0.0000
29.9959	87.0501	87.0522	0.0020	11.9998	11.9998	0.0000
30.9959	86.5674	86.5695	0.0020	11.9998	11.9998	0.0000
31.9959	86.1389	86.1403	0.0013	11.9998	11.9998	0.0000
32.9959	85.7709	85.7723	0.0013	11.9998	11.9998	0.0000
33.9959	85.4701	85.4708	0.0006	11.9998	11.9998	0.0000
34.9959	85.2401	85.2415	0.0013	11.9998	11.9998	0.0000
35.9959	85.0856	85.0863	0.0006	14.9997	14.9997	0.0000
36.9959	85.0087	85.0087	0.0000	14.9997	14.9997	0.0000
37.9959	85.0101	85.0101	0.0000	14.9997	14.9997	0.0000
38.9959	85.0904	85.0904	0.0000	14.9997	14.9997	0.0000
39.9959	85.2484	85.2477	-0.0006	14.9997	14.9997	0.0000
40.9959	85.4811	85.4798	-0.0013	14.9997	14.9997	0.0000
41.9959	85.7846	85.7833	-0.0013	14.9997	14.9997	0.0000
42.9959	86.1554	86.1534	-0.0020	17.9997	17.9997	0.0000
43.9959	86.5859	86.5846	-0.0013	17.9997	17.9997	0.0000
44.9959	87.0707	87.0687	-0.0020	17.9997	17.9997	0.0000
45.9959	87.6022	87.6001	-0.0020	17.9997	17.9997	0.0000
46.9959	88.1707	88.1687	-0.0020	17.9997	17.9997	0.0000
47.9959	88.7688	88.7660	-0.0027	17.9997	17.9997	0.0000
48.9959	89.3854	89.3833	-0.0020	17.9997	17.9997	0.0000
49.9959	90.0123	90.0096	-0.0027	17.9997	17.9997	0.0000
50.9959	90.6234	90.6214	-0.0020	20.9996	20.9996	0.0000
51.9959	91.2407	91.2380	-0.0027	20.9996	20.9996	0.0000
52.9959	91.8381	91.8354	-0.0027	20.9996	20.9996	0.0000
53.9959	92.4060	92.4039	-0.0020	20.9996	20.9996	0.0000
54.9959	92.9367	92.9347	-0.0020	20.9996	20.9996	0.0000
55.9959	93.4208	93.4188	-0.0020	20.9996	20.9996	0.0000
56.9959	93.8507	93.8493	-0.0013	20.9996	20.9996	0.0000
57.9959	94.2201	94.2187	-0.0013	23.9996	23.9996	0.0000
58.9959	94.5229	94.5215	-0.0013	23.9996	23.9996	0.0000
59.9959	94.7543	94.7536	-0.0006	23.9996	23.9996	0.0000
60.9959	94.9108	94.9102	-0.0006	23.9996	23.9996	0.0000
61.9959	94.9898	94.9891	-0.0006	23.9996	23.9996	0.0000
62.9959	94.9898	94.9898	0.0000	23.9996	23.9996	0.0000
63.9959	94.9115	94.9122	0.0006	23.9996	23.9996	0.0000
64.9959	94.7557	94.7563	0.0006	23.9996	23.9996	0.0000
65.9959	94.5249	94.5256	0.0006	26.9995	26.9995	0.0000
66.9959	94.2228	94.2242	0.0013	26.9995	26.9995	0.0000
67.9959	93.8541	93.8555	0.0013	26.9995	26.9995	0.0000
68.9959	93.4243	93.4263	0.0020	26.9995	26.9995	0.0000
69.9959	92.9409	92.9429	0.0020	26.9995	26.9995	0.0000
70.9959	92.4108	92.4128	0.0020	26.9995	26.9995	0.0000
71.9959	91.8429	91.8450	0.0020	26.9995	26.9995	0.0000
72.9959	91.2455	91.2483	0.0027	29.9995	29.9995	0.0000
73.9959	90.6289	90.6310	0.0020	29.9995	29.9995	0.0000
74.9959	90.0020	90.0048	0.0027	29.9995	29.9995	0.0000
75.9959	89.3600	89.3627	0.0027	29.9995	29.9995	0.0000
76.9959	88.7441	88.7461	0.0020	29.9995	29.9995	0.0000
77.9959	88.1474	88.1494	0.0020	29.9995	29.9995	0.0000
78.9959	87.5795	87.5816	0.0020	29.9995	29.9995	0.0000
79.9959	87.0501	87.0522	0.0020	29.9995	29.9995	0.0000
80.9959	86.5674	86.5695	0.0020	32.9994	32.9994	0.0000
81.9959	86.1389	86.1403	0.0013	32.9994	32.9994	0.0000
82.9959	85.7709	85.7723	0.0013	32.9994	32.9994	0.0000
83.9959	85.4701	85.4708	0.0006	32.9994	32.9994	0.0000
84.9959	85.2401	85.2415	0.0013	32.9994	32.9994	0.0000
85.9959	85.0856	85.0863	0.0006	32.9994	32.9994	0.0000
86.9959	85.0087	85.0087	0.0000	32.9994	32.9994	0.0000
87.9959	85.0101	85.0101	0.0000	35.9994	35.9994	0.0000
88.9959	85.0904	85.0897	-0.0006	35.9994	35.9994	0.0000
89.9959	85.2484	85.2477	-0.0006	35.9994	35.9994	0.0000
90.9959	85.4811	85.4798	-0.0013	35.9994	35.9994	0.0000
91.9959	85.7846	85.7833	-0.0013	35.9994	35.9994	0.0000
92.9959	86.1554	86.1534	-0.0020	35.9994	35.9994	0.0000
93.9959	86.5859	86.5846	-0.0013	35.9994	35.9994	0.0000
94.9959	87.0707	87.0687	-0.0020	35.9994	35.9994	0.0000
95.9959	87.6022	87.6001	-0.0020	38.9994	38.9994	0.0000
96.9959	88.1707	88.1687	-0.0020	38.9994	38.9994	0.0000
97.9959	88.7688	88.7660	-0.0027	38.9994	38.9994	0.0000
98.9959	89.3854	89.3833	-0.0020	38.9994	38.9994	0.0000
99.9959	90.0123	90.0096	-0.0027	38.9994	38.9994	0.0000

Fig. 2. Sample decimal on-line output. (See Fig. 1, Sine and Step functions run.)

-62-2865

0.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000
1.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000
2.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000
3.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000
4.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000
5.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000
6.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000
7.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000
8.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000
9.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000

Fig. 3. Sample on-line octal output. (See Fig. 1, Constant Biases run.)

-62-2866

```
*    DATA
       2
      10
      10
```

Fig. 4. Sample input deck to 7094 print program.

SINE AND STEP FUNCTIONS

0.99600	90.62416	90.62416	0.	0.	0. 0.
1.03600	90.64888	90.64613	0.	0.	0.27465820E-02 0.
1.07600	90.67360	90.67085	0.	0.	0.27465820E-02 0.
1.11600	90.69832	90.69626	0.	0.	0.20599365E-02 0.
1.15600	90.72372	90.72098	0.	0.	0.27465820E-02 0.
1.19600	90.74844	90.74570	0.	0.	0.27465820E-02 0.
1.23600	90.77316	90.77041	0.	0.	0.27465820E-02 0.
1.27600	90.79788	90.79513	0.	0.	0.27465820E-02 0.
1.31600	90.82260	90.82054	0.	0.	0.20599365E-02 0.
1.35600	90.84732	90.84526	0.	0.	0.20599365E-02 0.
1.39600	90.87204	90.86998	0.	0.	0.20599365E-02 0.
1.43600	90.89676	90.89470	0.	0.	0.20599365E-02 0.
1.47600	90.92148	90.91942	0.	0.	0.20599365E-02 0.
1.51600	90.94620	90.94414	0.	0.	0.20599365E-02 0.
1.55600	90.97091	90.96885	0.	0.	0.20599365E-02 0.
1.59600	90.99563	90.99357	0.	0.	0.20599365E-02 0.
1.63600	91.02035	91.01761	0.	0.	0.27465820E-02 0.
1.67600	91.04507	91.04233	0.	0.	0.27465820E-02 0.
1.71600	91.06979	91.06705	0.	0.	0.27465820E-02 0.
1.75600	91.09382	91.09176	0.	0.	0.20599365E-02 0.
1.79600	91.11854	91.11580	0.	0.	0.27465820E-02 0.
1.83600	91.14326	91.14052	0.	0.	0.27465820E-02 0.
1.87600	91.16730	91.16524	0.	0.	0.20599365E-02 0.
1.91600	91.19201	91.18927	0.	0.	0.27465820E-02 0.
1.95600	91.21605	91.21399	0.	0.	0.20599365E-02 0.
1.99600	91.24077	91.23802	0.	0.	0.27465820E-02 0.
2.03600	91.26480	91.26274	0.	0.	0.20599365E-02 0.
2.07600	91.28952	91.28677	0.	0.	0.27465820E-02 0.
2.11600	91.31355	91.31080	0.	0.	0.27465820E-02 0.
2.15600	91.33758	91.33552	0.	0.	0.20599365E-02 0.
2.19600	91.36230	91.35956	0.	0.	0.27465820E-02 0.
2.23600	91.38634	91.38359	0.	0.	0.27465820E-02 0.
2.27600	91.41037	91.40762	0.	0.	0.27465820E-02 0.
2.31600	91.43440	91.43165	0.	0.	0.27465820E-02 0.
2.35600	91.45843	91.45569	0.	0.	0.27465820E-02 0.
2.39600	91.48247	91.47972	0.	0.	0.27465820E-02 0.
2.43600	91.50650	91.50375	0.	0.	0.27465820E-02 0.
2.47600	91.53053	91.52778	0.	0.	0.27465820E-02 0.
2.51600	91.55456	91.55182	0.	0.	0.27465820E-02 0.
2.55600	91.57791	91.57585	0.	0.	0.20599365E-02 0.
2.59600	91.60194	91.59988	0.	0.	0.20599365E-02 0.
2.63600	91.62597	91.62323	0.	0.	0.27465820E-02 0.
2.67600	91.64932	91.64726	0.	0.	0.20599365E-02 0.
2.71600	91.67335	91.67061	0.	0.	0.27465820E-02 0.
2.75600	91.69670	91.69464	0.	0.	0.20599365E-02 0.
2.79600	91.72073	91.71799	0.	0.	0.27465820E-02 0.
2.83600	91.74408	91.74202	0.	0.	0.20599365E-02 0.
2.87600	91.76742	91.76536	0.	0.	0.20599365E-02 0.
2.91600	91.79077	91.78871	0.	0.	0.20599365E-02 0.
2.95600	91.81480	91.81206	0.	0.	0.27465820E-02 0.
2.99600	91.83815	91.83540	0.	0.	0.27465820E-02 0.
3.03600	91.86149	91.85875	0.	0.	0.27465820E-02 0.
3.07600	91.88484	91.88209	0.	0.	0.27465820E-02 0.
3.11600	91.90750	91.90544	0.	0.	0.20599365E-02 0.
3.15600	91.93085	91.92879	0.	0.	0.20599365E-02 0.
3.19600	91.95419	91.95213	0.	0.	0.20599365E-02 0.
3.23600	91.97754	91.97479	0.	0.	0.27465820E-02 0.
3.27600	92.00020	91.99814	0.	0.	0.20599365E-02 0.
3.31600	92.02354	92.02080	0.	0.	0.27465820E-02 0.

Fig. 5. Sample output of 7094 print program.

```
*     DATA                                                    -62-2868
          8
SINE AND STEP FUNCTIONS
          0         .03          1          100          8          1
SINE AND STEP FUNCTIONS
          0         .03          1          100          8          4
SINE AND STEP FUNCTIONS
          1         .006         4           6           8          1
SINE AND STEP FUNCTIONS
          1         .008         4           6           8          4
POLY AND IMPULSE FUNCTIONS
          0         .02          7          70           8          1
POLY AND IMPULSE FUNCTIONS
          0         .02          1          85           8          1
POLY AND IMPULSE FUNCTIONS
          1         .008         4           6           8          1
POLY AND IMPULSE FUNCTIONS
          1         .008         4           6           8          4
```

Fig. 6. Sample input deck to 7094 plot program.

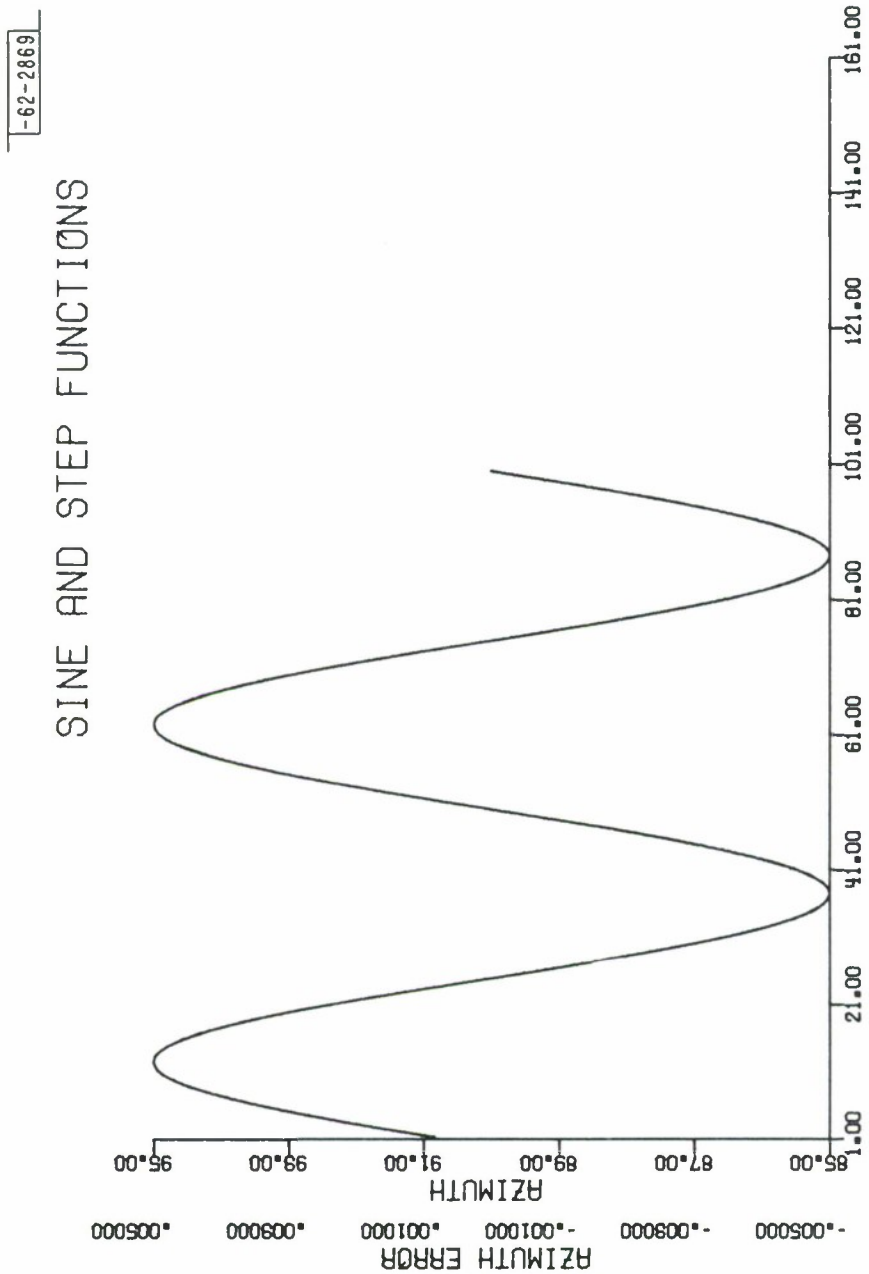

Fig. 7. Azimuth angle (sine function).

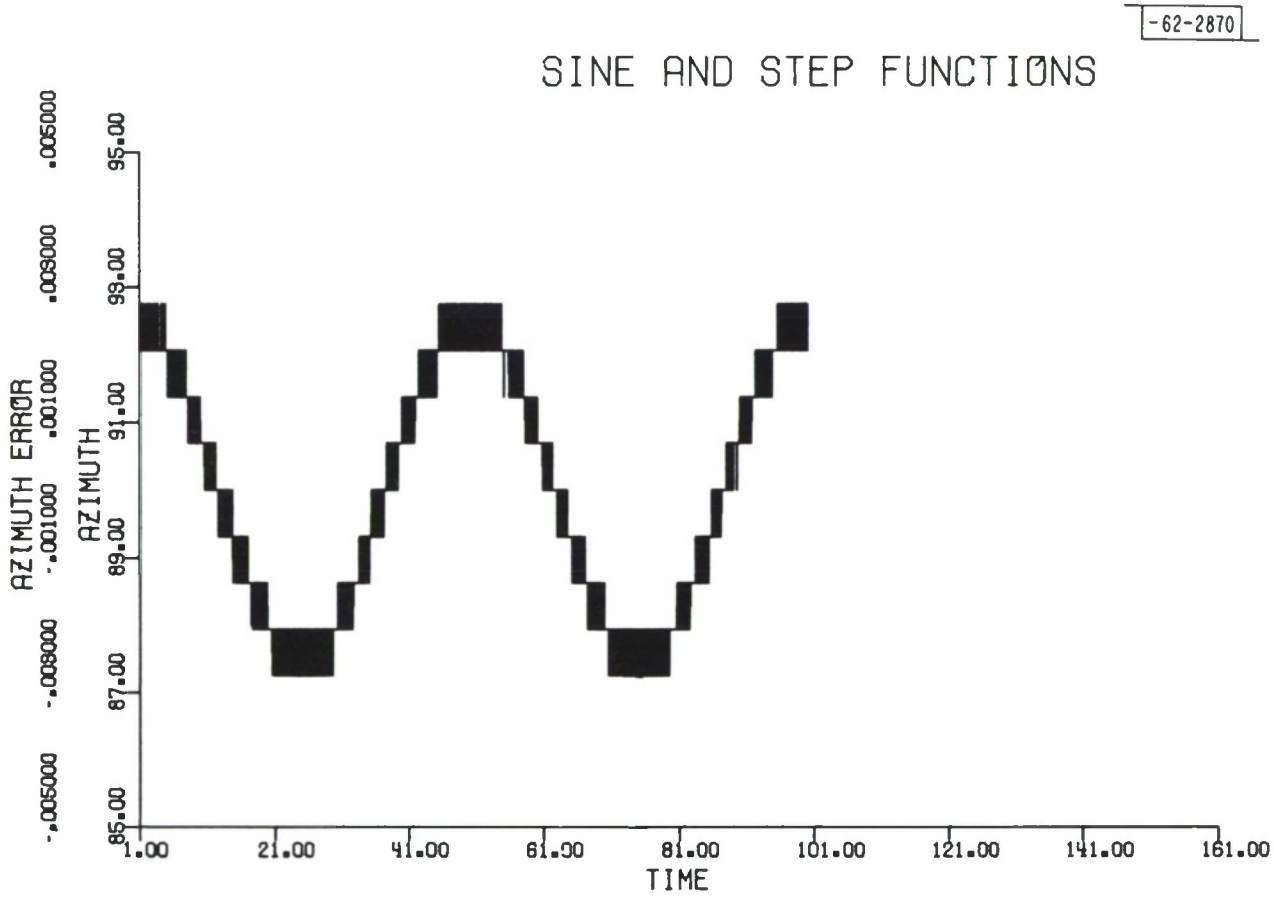

Fig. 8. Azimuth error (sine function).

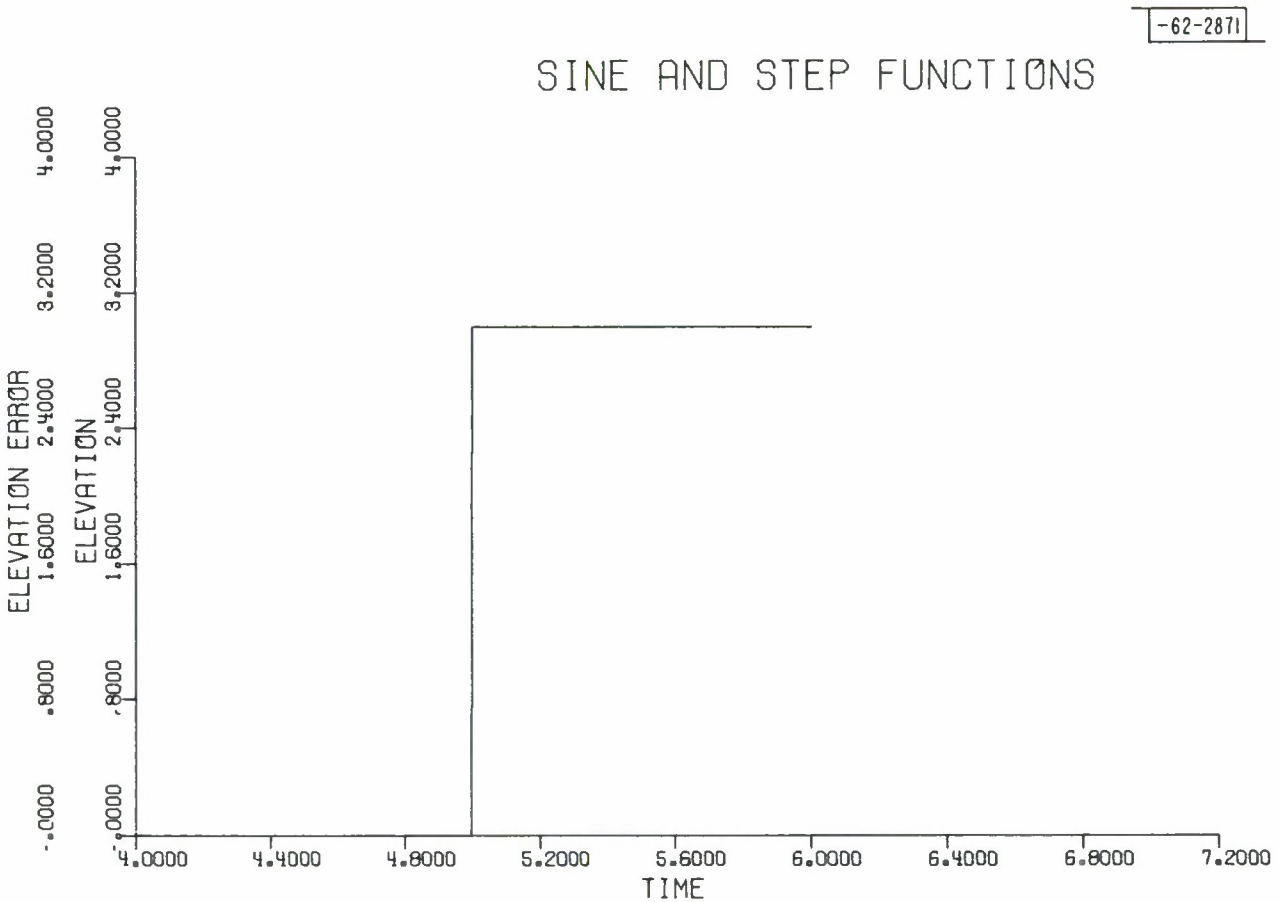

Fig. 9. Elevation angle (step function).

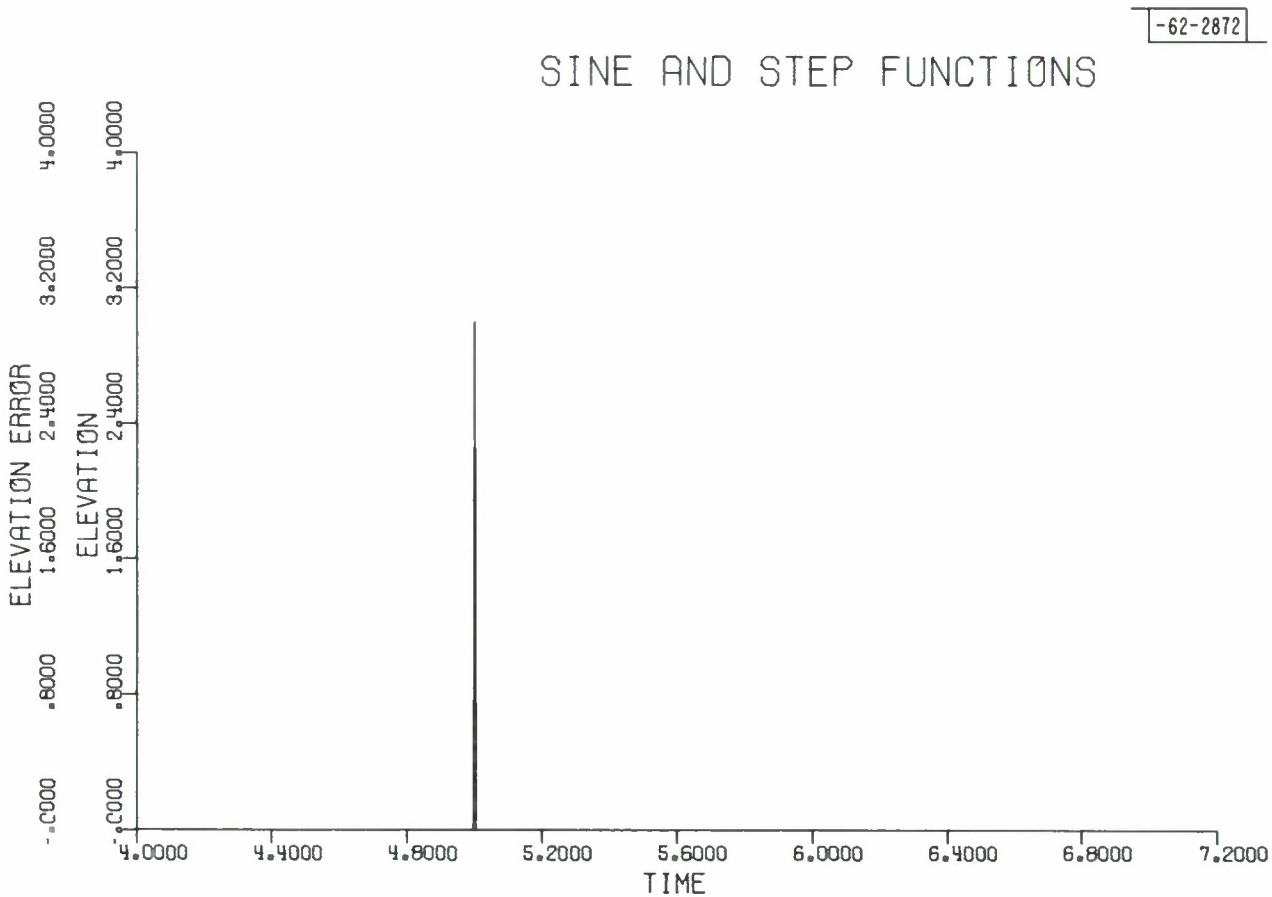

Fig. 10. Elevation error (step function).

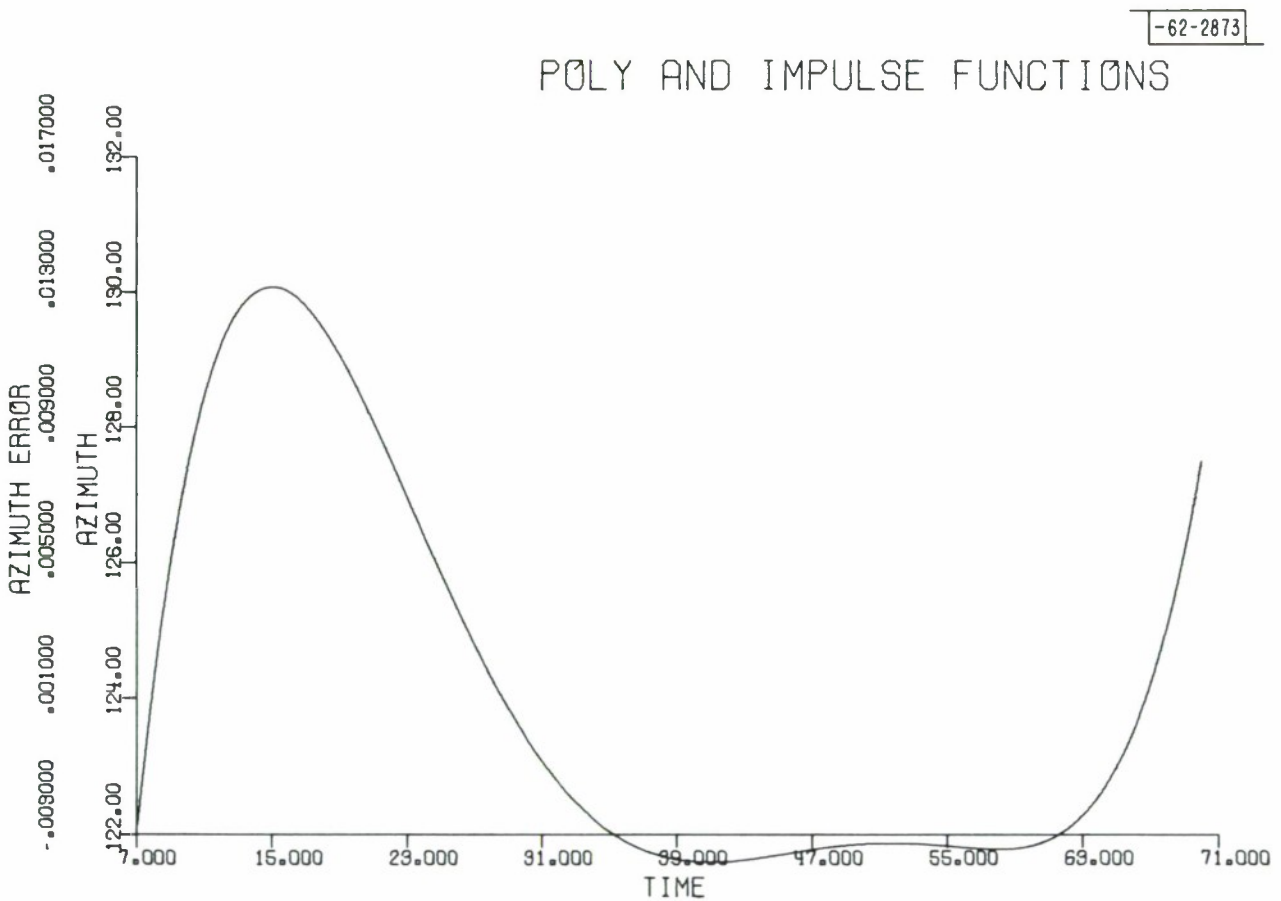

Fig. 11. Azimuth angle (5th order polynomial).

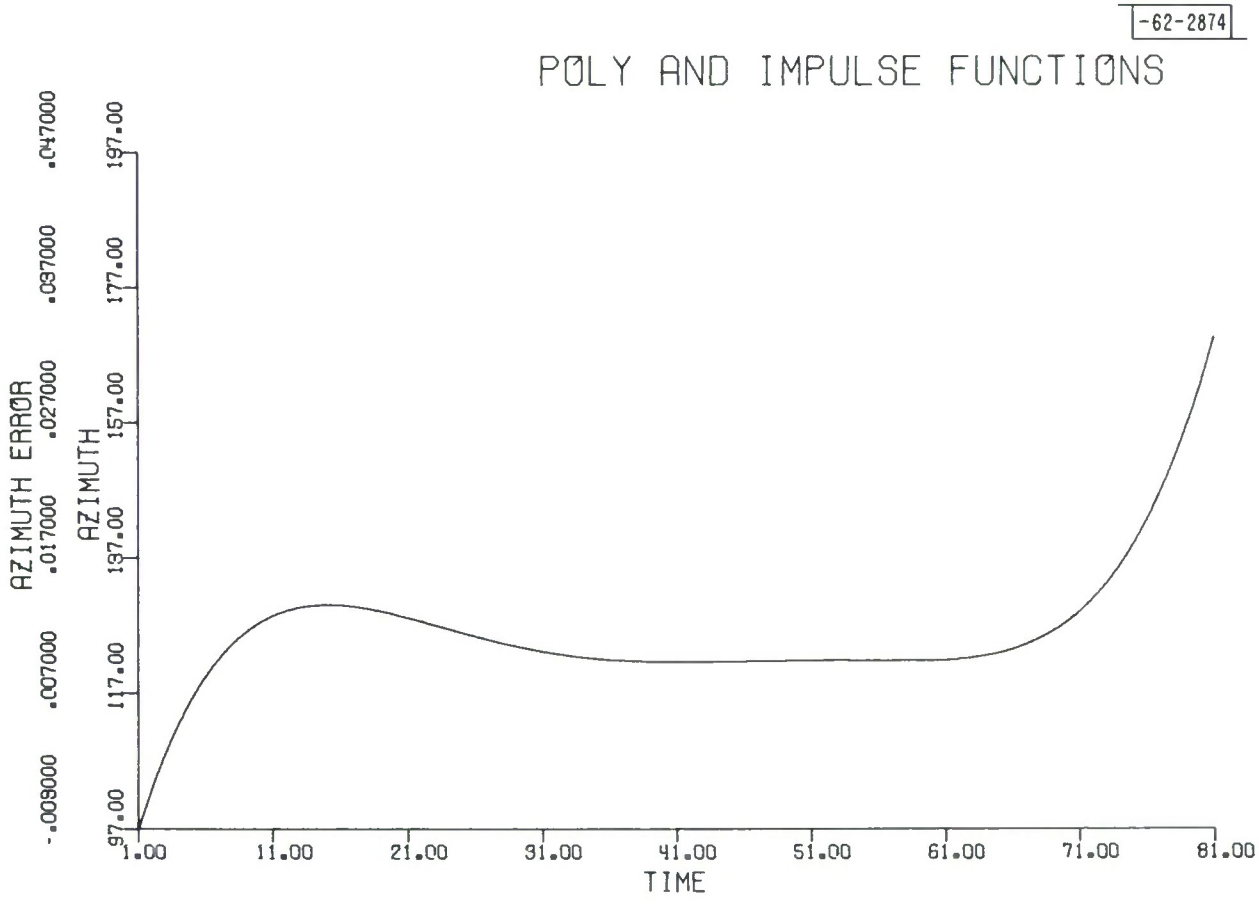

Fig. 12. Azimuth angle (5th order polynomial). Plotted with different time limits.

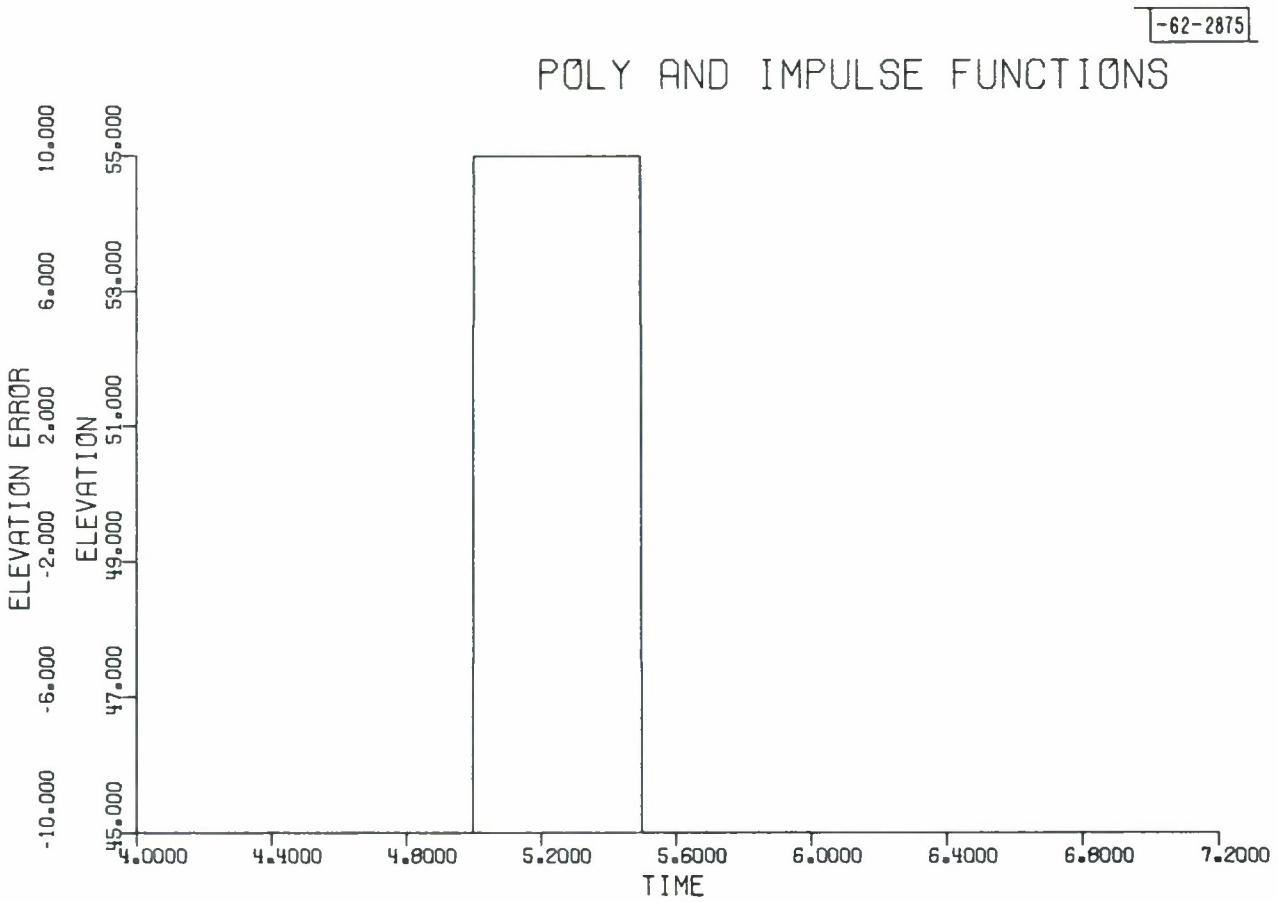

Fig. 13. Elevation angle (impulse function).

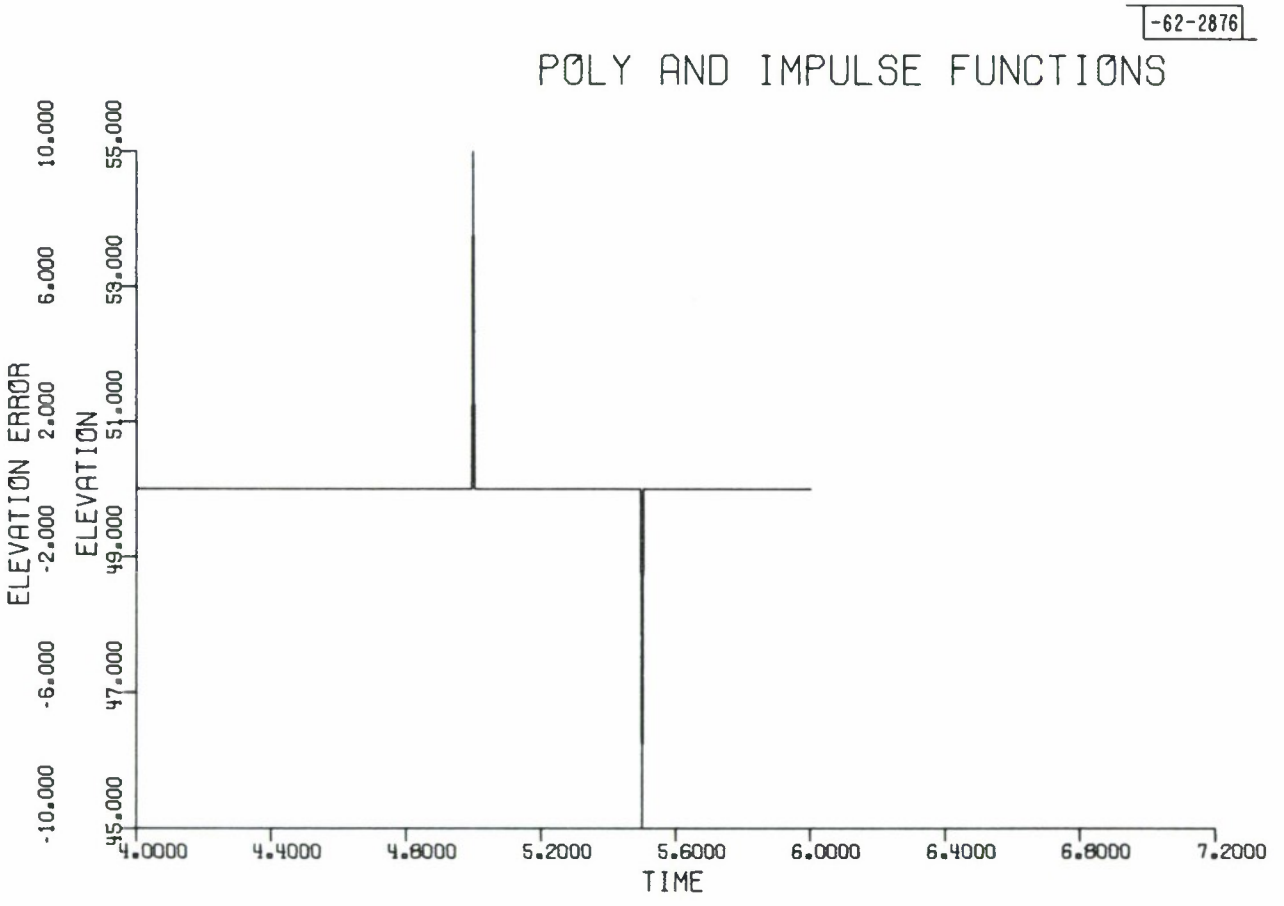

Fig. 14. Elevation error (impulse function).

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3. REPORT TITLE

COMPUTER PROGRAMS FOR HAYSTACK SERVO TESTING

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

GROUP 62

5. AUTHOR(S) *(Last name, first name, initial)*

Massey, L.D.

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
21 Jul 64	82	0

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
AF19(628)500	1964-38
b. PROJECT NO.	
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The facilities available for testing the performance of the Haystack servo system using the Univac 490 digital computer are described. Sine, step, impulse, and polynomial inputs may be applied to the system. Operating instructions and examples of inputs and outputs from the various programs are given. A fairly detailed description of the program logic is provided and complete listing are included for all non-library programs.

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