DISCLAIMER

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1620 USERS GROUP PROGRAM REVIEW AND EVALUATION

(fill out in typewriter or pencil, do not use ink)

Program No._____ Date_____

Program Name:_____

1. Does the abstract adequately describe what the program is and what it does? Yes___ No___
   Comment_____

2. Does the program do what the abstract says? Yes___ No___
   Comment_____

3. Is the Description clear, understandable, and adequate? Yes___ No___
   Comment_____

4. Are the Operating Instructions understandable and in sufficient detail? Yes___ No___
   Comment_____
   Are the Sense Switch options adequately described (if applicable)? Yes___ No___
   Are the mnemonic labels identified or sufficiently understandable? Yes___ No___
   Comment_____

5. Does the source program compile satisfactorily (if applicable)? Yes___ No___
   Comment_____

6. Does the object program run satisfactorily? Yes___ No___
   Comment_____

7. Number of test cases run_____. Are any restrictions as to data, size, range, etc. covered adequately in description? Yes___ No___
   Comment_____

8. Does the Program Meet the minimal standards of the 1620 Users Group? Yes___ No___
   Comment_____

9. Were all necessary parts of the program received? Yes___ No___
   Comment_____

10. Please list on the back any suggestions to improve the usefulness of the program. These will be passed onto the author for his consideration.

Please return to:

Mr. Richard L. Pratt
Data Corporation
7500 Old Xenia Pike
Dayton, Ohio 45432

Your Name _____

Company _____

Address _____

User Group Code_____

THIS REVIEW FORM IS PART OF THE 1620 USER GROUP ORGANIZATION'S PROGRAM REVIEW AND EVALUATION PROCEDURE. NONMEMBERS ARE CORDIALLY INVITED TO PARTICIPATE IN THIS EVALUATION.

GOTAFIT--GOTRAN and AFIT FORTRAN
for Monitor I System

by

Joel C. Ewing
Dept. Mathematics and Astronomy
University of Oklahoma
Norman, Oklahoma

5171

January 15, 1965

Modifications or revisions to this program, as they occur, will be announced in the appropriate Catalog of Programs for IBM Data Processing Systems. When such an announcement occurs, users should order a complete new program from the Program Information Department.

DECK KEY

Deck 1	GOTRAN, AFIT FORTRAN, and associated programs in core image format with appropriate Monitor I Control Cards

1620 USERS GROUP LIBRARY
PROGRAM ABSTRACT

1. TITLE (If subroutine, state in Title): GOTAFIT--GOTRAN and AFIT FORTRAN for MONITOR I SYSTEM Subject Classification: 1.2
2. Author; Organization: Joel C. Ewing, Dept. of Mathematics and Astronomy, University of Oklahoma
   Date: 1/15/65 Users Group Membership Code: 5171
3. Direct Inquiries to Name: Joel C. Ewing, 816 College Avenue, Norman, Oklahoma 73069
   Phone: JE-4-0956
4. Description/Purpose: (5. Method; 6. Restriction/Range; When Applicable):
   The deck supplied loads the GOTRAN Compiler/Interpreter and the AFIT FORTRAN Processor, loader, and subroutines onto the 1311 disk pack, together with those routines necessary for calling these programs through the MONITOR I CONTROL SYSTEM. Loading is done by the MONITOR I DISK UTILITY program. The need for loading GOTRAN and AFIT FORTRAN from cards is eliminated with a consequent saving of time. GOTRAN has been modified to return control to the MONITOR SYSTEM, permitting batch running of GOTRAN programs.
   5-6 N/A

7. Specifications (Check or fill in appropriate spaces):

   a. Storage used by program: 20K; Sectors 105165-105199, 105400-105999

   b. Equipment required by program: Card x ; Magnetic Tape ; Number of Drives ; Paper Tape ; Disk File x ; Number of Drives ; TNS, TNF, MF ; Auto divide x ; Indirect addressing ; Floating Point Hardware ; 1620 Model I ; Model II ; 1443 Printer ; Index Registers ; Binary Capabilities ; Other (specify)

   Can program be used on lesser machine? Yes . Specify which requirements can be easily removed Auto- Divide .

   c. Programmed in: Fortran without Format ; Fortran with Format ; Fortran II ; Other Fortran (specify) ; SPS (specify assembler used) ; Other (specify) Machine Language and SPS II D (Monitor I Control System)

   d. Type of Program: Mainline, complete ; Subroutine ; If subroutine, for use with SPS (specify type of SPS) ; Fortran (specify type of Fortran ; Other (specify)

8. Additional Remarks: The following programs were incorporated in GOTAFIT after appropriate modifications: GOTRAN 1620-PR-011
   AFIT Improved FORTRAN (1.1.010)

CONTENTS

FORWARD

GOTAFIT is a modification for 1620 with disk of standard 1620 GOTRAN and AFIT Improved FORTRAN. Familiarity of the reader with these two programming languages is assumed. AFIT FORTRAN is described in program writeup 1.1.010 of the 1620 General Program Library. GOTRAN is described in publication C26-5594-1 .

Inquiries should be directed to Joel C. Ewing, 816 College Ave., Norman, Oklahoma, 73069 .

ACKNOWLEDGEMENTS

The heart of GOTAFIT is the AFIT Improved FORTRAN (1.1.010) of 1/Lt. Richard L. Pratt and the standard IBM GOTRAN (1620-PR-011).

The author wishes to thank Dave Ashbaucher of the University of Oklahoma Computer Lab for providing information on the necessary structure of a program writeup and for the prodding which caused this paper to be written. The author is also grateful for helpful hints on operation of the Monitor I System from Walter Daugherity, currently a student at Oklahoma Christian College in Oklahoma City.

GOTAFIT--GOTRAN and AFIT FORTRAN for Monitor I System

MACHINE SPECIFICATIONS

GOTAFIT is designed for use on a 20K 1620 with a 1311 Disk Storage unit and the auto-divide feature. Modification for a machine not having hardware divide is simple (see APPENDIX B). In the preparation of the original GOTAFIT program the IA (Indirect Addressing) feature was occasionally used, but this could easily have been avoided. The GOTAFIT program itself does not use the IA feature.

PURPOSE

A. AFIT FORTRAN

Because of several features of the AFIT Improved FORTRAN (efficient compilation and execution times and noncritical input format) which were not available with the FORTRAN IID of the Monitor I System, it was considered highly desirable to have the AFIT FORTRAN System stored on the disk so as to eleminate the time-consuming task of loading the Processor and Subroutine card decks. Only the input source for the Processor, Loader, and Subroutines has been changed. The basic Processor and Subroutines are unaltered and are as described in the AFIT FORTRAN writeup (1.1.010) with the following exceptions: (1) The procedure for loading the Processor and Object programs has been slightly modified, and (2) it is no longer possible to add additional subroutines to the AFIT System (the system as supplied has EXP, LOG, SIN-COS, ATAN, SQRT, and ABS Subroutines).

B. GOTRAN

GOTRAN has been in use here for several years as a teaching device. Although in theory one loading of the GOTRAN deck is sufficient for the running of any number of programs, in practice certain programming errors will destroy various parts of the Compiler-Interpreter and necessitate reloading of the deck. For this reason a disk version of GOTRAN was created which could be loaded before each individual program to insure that any incorrect results were because of a programming error in the present program, rather than an error in some previous program.

GOTRAN has been modified to return control to the Monitor Supervisor if (1) an END or STOP statement is executed, (2) an "End of Job" card is detected while reading data from cards, (3) an error is detected during compilation, or (4) STOP, RESET, INSERT, RELEASE, and START keys are depressed. This feature permits the batch running of GOTRAN programs and the mixing of GOTRAN programs with programs using the facilities of the Monitor I System. The PLOT Subroutine has been alterred (1) to eliminate a plotting error

of the standard GOTRAN, (2) to provide the option of plotting on either the typewriter or on cards, and (3) to speed up plotting on the typewriter by tabulating whenever it is necessary for the typewriter carriage to move 17 or more spaces. The option of not loading the trigonometric functions is no longer available. The remaining parts of the GOTRAN Compiler-Interpreter are unchanged and are as described in C26-5594-1 .

C. MACHINE LANGUAGE LOAD

A one sector routine has been stored on the disk under the name MLCARD. This routine resets indicators 06, 07, 09, 14, 15, 16, 17, 19, 36, 37, 38, and 39 and then simulates the LOAD key on the card reader, making it possible to have a self-loading deck automatically loaded by the Monitor I System.

METHOD

A. AFIT FORTRAN

The Processor deck was loaded, including the function list at the end of the deck. At this point a halt instruction at 16876 is executed. It was decided to place the disk write routine at 19000 as this was in the middle of the symbol table and would be cleared during initialisation (various constants and instructions of the Processor are stored in the region 00000 - 00079). As was also the case with the Subroutines and with GOTRAN, it was impossible to use Monitor directly for loading from disk because the memory locations required by Monitor's loading routine were needed by the program. Therefore, a separate program which could be loaded by Monitor was written to read the Processor from disk. As this reading routine was designed to read a full 20K into memory, it was necessary that it be stored in memory along with the write disk routine before writing the Processor on disk. Otherwise, the reading routine would destroy itself while reading the Processor from disk. The write disk routine was then executed, and after recalling Monitor, the Disk Utility Program (DUP) was used to permanently assign the Processor to sectors 105600 - 105799 . The same read disk routine was then compiled as an SPS IID program (DORG at 19064) and stored in core image on disk with the name AFITPR, enabling the calling of the Processor from disk by an "##XEQ AFITPR" card. AFITPR was then permanently assigned to sector 105400 by DUP.

More extensive modifications were necessary for the Loader and Subroutines. The Loader and Subroutines are essentially divided into four parts: (1) the Loader, which reads the object program from cards (and then reads the Subroutine Relocater); (2) the Subroutine Relocater, which reads in the necessary Relocatable Subroutines; (3) the Relocatable Subroutines; and (4) the I/O and Arithmetic Subroutines.

Cards 1 - 52 of the Loader were loaded into memory and modified to read the Subroutine Relocater from sectors 105800 through 105822. The card sequence counts were set for card 54, the first card of the object program. The Loader (in memory locations 00100 - 03099) was then written onto the disk work cylinders and later permanently assigned to sectors 105170 through 105199.

The Subroutine Relocater was loaded using a loading routine of essentially the same design as the one included in the original Loader deck. The Relocater was modified to read the Relocatable Subroutines from disk, one sector at a time, and to read the I/O and Arithmetic Subroutines from disk. The Subroutine Relocater was then written on the work cylinders in two parts, memory locations 01000 - 03299 in Part 1 and locations 07820 - 08019 in Part 2. Through the use of DUP Part 1 was permanently assigned to sectors 105800 - 105822, and Part 2 was permanently assigned to sectors 105823 - 105824 .

To simplify the storing of the Relocatable Subroutines on disk, the alphabetic information on the heading cards for the various subroutines was converted into the corresponding numeric codes, and the format of these cards and of card 4900 was changed to the following:

Card No.	Contents of Card
2100	bbbb$\bar{4}$56757bbbb$\bar{2}$100bbb...
2200	bbbb$\bar{5}$35647bbbb$\bar{2}$200bbb...
2300	bbbb$\bar{2}$24955bbbb$\bar{2}$300bbb...
2400	bbbb$\bar{4}$1634155bb$\bar{2}$400bbb...
2500	bbbb$\bar{2}$2585963bb$\bar{2}$500bbb...
2600	bbbb$\bar{4}$14262bbbb$\bar{2}$600bbb...
4900	bbbbbbbbbbbbbb$\bar{4}$900bb$\bar{1}$bbb...

The Relocatable Subroutines were then stored on the disk work cylinders, one card per sector, in sectors 100225 - 100315 and permanently assigned through DUP to sectors 105825 - 105915 .

The I/O and Arithmetic Subroutines were then loaded into the memory using a loading routine similar to that used for the Subroutine Relocater. The I/O and Arithmetic Subroutines, contained in memory locations 00410 - 07909, were then written on the work cylinders of the disk and permanently assigned to sectors 105925 - 105999 by DUP.

An SPS IID program which would read the AFIT Loader and Part 2 of the AFIT Subroutine Relocater and then branch to the beginning of the Loader was assembled and stored in core image on the disk and was given the name AFITLD. Through the use of DUP, AFITLD was permanently assigned to sectors 105166 - 105167.

The complete loading sequence for an AFIT FORTRAN Object program is as follows:

(1) A Monitor Control Card, "##XEQ AFITLD" causes the program AFITLD to be read from disk into 04000 - 04149 and executed;
(2) AFITLD reads the AFIT Loader into 00100 - 03099 and Part 2 of the Subroutine Relocater into 07820 - 08019 and branches to the AFIT Loader;
(3) AFIT Loader reads object deck from cards and stores it in 08000 - 19999;

(4) AFIT Loader reads Part 1 of the Subroutine Relocater from disk into 01000 - 03299 and branches to Subroutine Relocater;
(5) Relocater reads Relocatable Subroutines from disk and stores as required into 08000 - 19999;
(6) Relocater reads I/O and Arithmetic Subroutines from disk into 00410 - 09909 and branches to starting address (02056).

B. GOTRAN

The standard GOTRAN deck was loaded into memory from cards. After adding modifications, memory locations 00100 - 19999 were written on the work cylinders and permanently assigned to sectors 105491 - 105599 by DUP. An SPS IID program was assembled to read GOTRAN from disk into locations 00100 - 19999 and then branch to the initialization routine, "CLEARJ", located at 18000 (the read disk routine is transmitted to 00000 - 00082 before it is executed). This program was stored on the disk in core image with the assigned name GOTR3D (GOTRAN, modified plot version 3, for Disk), and was permanently assigned to sectors 105168 - 105169 by DUP.

C. MACHINE LANGUAGE LOADER

An SPS IID program to reset all indicators, read a card into 00000 - 00079, and branch to location 00000 was assembled. The program was stored on the disk in core image and permanently assigned to sector 105165 with the name MLCARD.

LOADING GOTAFIT ON DISK

A. GENERAL INFORMATION

The Monitor I System must be loaded on the disk pack mounted on disk drive 0. Sectors 105165 - 105199 (inclusive) and sectors 105400 - 105999 (inclusive) must not have been permanently assigned. If the parameters have been redefined (by a "DEFINE" card), these sectors must still be available for program storage, and the work cylinders must begin with sector 100000. The names AFITLD, AFITPR, GOTR3D, MLCARD, and GOTAFT must not be already in use in the equivalence table (the name GOTAFT is needed only in the loading process and will not be left in the equivalence table). Space for at least six additional entries in the DIM table is required.

B. LOADING PROCEDURE

(1) Place the GOTAFIT deck in the read hopper of the card reader.
(2) Press the RESET and LOAD keys.
(3) The Monitor Supervisor is called from disk, the sector requirements for GOTAFIT are printed, and a halt is executed. Press START to proceed.
(4) GOTAFIT is loaded onto disk.
(5) "END OF JOB" is printed.

C. DUP ERRORS DURING LOADING

If any DUP Error messages are printed during the loading process, one or more of the following may have occured:

(1) A permanently assigned program has been found within sectors 105165 - 105199 or sectors 105400 - 105999.
(2) A name required by GOTAFIT was already in use in the equivalence table.
(3) Parameters have been redefined such that the required sectors are no longer available for program storage,or such that the work cylinders do not begin at sector 100000.

If an error occurs, stop the loading process (STOP key), recall the Monitor Supervisor, and delete those parts of GOTAFIT which have already been loaded by using the DELET routine of DUP and the DIM entry number which was typed during the loading process (Note that although one DIM number may have been used twice at different times in the loading process, it only needs to be deleted once). Using the DDUMP routine of DUP, obtain a listing of the Availability List, Sequential Program Table, DIM Table, and Equivalence Table and determine the cause of the Error. (See the Monitor I System Reference Manual C26-5739-2 for an explanation of the format of these tables.) Permanently assigned programs within the required sectors must be moved or deleted and conflicting names in the equivalence table must be changed or deleted. If (3) is the cause of the error, parameters must be redefined so that the required sectors are available and the work cylinders begin at sector 100000.

D. TYPEWRITER OUTPUT DURING LOADING

Note 1: DIM entry numbers may vary from the listing given depending on contents of DIM table prior to loading.

Note 2: It was discovered that when a program which did not contain an integral multiple of three sectors was punched on cards, reloading from cards onto disk resulted in the assignment to the program of one extra sector containing the zeros used to fill out the last card. To get around this the following procedure was used:

(1) DLOAD was used to read the program from cards and place it on the disk. As a result of DLOAD the program was also left sitting in the work cylinders.
(2) DELET was used to delete the program from the program storage area leaving it only in the work cylinders.
(3) DLOAD was used to load the correct number of sectors from the work cylinders and permanently assign them in the program storage area of the disk.

This procedure was unnecessary for the AFIT Loader as it required exactly 30 sectors.

```
‡‡JOB 5                          LOAD GOTRAN 3D AND AFIT FORTRAN ON DISK
‡‡          IF SECTORS 105165-105199 AND 105400-105999 ARE NOT PERMANENTLY
‡‡PAUS      ASSIGNED, PRESS START TO PROCEED
‡‡DUP 5
*DLOADMLCARD                                  0111102222C1
DK LOADED MLCARD Õ170 1Õ5132Õ02Õ1111Õ2222‡
‡‡DUP 5
*DELETMLCARD

‡‡DUP 5
*DLOADMLCARD        10000010000010516502402024020D1
DK LOADED MLCARD Õ170 1Õ5165Õ01Õ2402Õ2402‡
‡‡DUP 5
*DLOADAFITLD                                  0111102222C1
DK LOADED AFITLD Õ171 1Õ5147Õ03Õ1111Õ2222‡
‡‡DUP 5
*DELETAFITLD

‡‡DUP 5
*DLOADAFITLD        10000010000011051660400004000D1
DK LOADED AFITLD Õ171 1Õ5166Õ02Õ4000Õ4000‡
‡‡DUP 5
*DLOADGOTR3D                                  0111102222C1
DK LOADED GOTR3D Õ172 1Õ5147Õ03Õ1111Õ2222‡
‡‡DUP 5
*DELETGOTR3D

‡‡DUP 5
*DLOADGOTR3D        10000010000011051680240202402D1
```

Store MLCARD on Disk

Store AFITLD on Disk

Store GOTR3D on Disk


```
DK LOADED GOTR3D Õ172 1Õ5168Õ02Õ2402Õ2402‡
‡‡      AFIT LOADER
‡‡DUP 5
*DLOAD                                        1051700010001000C1
DK LOADED        Õ173 1Õ5170Õ30Õ0100Õ1000‡
‡‡DUP 5
*DLOADAFITPR                                  0111102222C1
DK LOADED AFITPR Õ174 1Õ5132Õ02Õ1111Õ2222‡
‡‡DUP 5
*DELETAFITPR

‡‡DUP 5
*DLOADAFITPR        10000010000010540019064190640D1
DK LOADED AFITPR Õ174 1Õ5400Õ01Ī9064Ī9064‡
‡‡    GOTRAN MOD 3, AFIT PROCESSOR, AFIT SUBROUTINES
‡‡DUP 5
*DLOADGOTAFT                                  0111102222C1
DK LOADED GOTAFT Õ175 1Õ7000Õ00Õ1111Õ2222‡
‡‡DUP 5
*DELETGOTAFT

‡‡DUP 5
*DLOAD              10000010059810540101111102222D1
DK LOADED        Õ175 1Õ5401Ī99Õ1111Õ2222‡
END OF JOB
```

Store AFIT Loader on Disk

Store AFITPR on Disk

Store GOTRAN, AFIT Processor, AFIT Subroutines on Disk

(Approximate Loading time is 12 minutes.)

OPERATING INSTRUCTIONS

A. AFIT FORTRAN

1. To call the AFIT Processor from disk
   (1) Call the Monitor Supervisor from disk if it is not already in memory.
   (2) Enter the Monitor Control Cards
   ```
   ††JOB 5
   ††XEQ AFITPR
   ```
   (the JOB card may be omitted if Monitor Supervisor has just been called from disk by the operator).
   (3) AFITPR is read and executed. The AFIT Processor is read from disk and a halt instruction is executed.
   (4) Proceed as if the AFIT Processor deck had just been loaded. Switch settings and Error messages are as described in the AFIT FORTRAN writeup (1.1.010).
   (5) After all programs have been compiled or precompiled, to resume operation under the Monitor System it is necessary for the operator to recall the Monitor Supervisor from disk.

   If during the execution of the AFITPR program the Any Data Check indicator is found on after reading the Processor from disk, the message "D-CK" is printed and the program halts. To retry loading of the Processor, press RESET and START.

2. To load an object program
   (1) Call the Monitor Supervisor from disk if it is not already in memory.
   (2) Enter the Monitor Control Cards
   ```
   ††JOB 5
   ††XEQ AFITLD
   ```
   followed by the object program deck. Data to be read from cards should immediately follow the object deck. As described above for the Processor, under certain conditions the JOB card may be omitted.
   (3) AFITLD is read and executed. The Loader is read from disk, the object deck is read from cards, the Subroutines are read from disk, and the program halts.
   (4) Proceed as if the Loader, Object deck, and Subroutine deck had just been read from cards (press START to begin execution). Switch settings and Error messages are as described in the AFIT FORTRAN writeup.
   (5) To resume operation under the Monitor System it is necessary for the operator to recall the Monitor Supervisor from disk.

   If during the execution of the AFITLD program the Any Data Check indicator is found ON after reading from disk, the message "D-CK" is printed and the program halts. To retry reading the Loader from disk, press RESET and START.

B. GOTRAN

To use the disk version of GOTRAN
(1) Call the Monitor Supervisor from disk if it is not already stored in memory.
(2) Enter the Monitor Control Cards
```
††JOB 5
††XEQ GOTR3D
```
followed by the GOTRAN program to be run. If the program requires data on cards, data cards should follow the END statement (or the XEQ card if the program is to be entered on the typewriter). An "End of Job" card should follow the last card of data (the END statement if no data on cards, or the XEQ card if neither program nor data is from cards).
(3) GOTR3D is read from disk and executed. The GOTRAN Compiler-Interpreter is read from disk and the program halts.
(4) Set Program Switches for Compilation--

	ON	OFF
SW 1	Source Program entered on cards	Source program entered on console typewriter
SW 2	Source statements punched on cards as they are read	Source statements not punched
SW 3	Source statements are typed on console typewriter	Source statements not typed

SW 4 Normally OFF. If a typing error is detected before the R/S key is pressed, turn SW 4 ON, press the R/S key, and turn SW 4 OFF. The Statement may now be retyped.

(5) Press START. GOTRAN statements are read and compiled. When the END statement is detected, the program will return the carriage twice and halt.
(6) Set Program Switches for Execution--

	ON	OFF
SW 1	Data to be entered on cards	Data to be entered on console typewriter
SW 2	Trace results of arithmetic operations on typewriter	Do not trace (normal setting)
SW 3	When PLOT statement found, plot on cards	When PLOT statement found, plot on typewriter

SW 4 Normally OFF. If a typing error is detected before the R/S key is pressed, turn SW 4 ON, press the R/S key, and turn SW 4 OFF. The last entered data number may now be retyped.

(7) If the program will produce output on typewriter, margins and tabs should be set--
left margin 11; tabs at 28, 45, 62, 79, 96; right margin 97
(the margins and tab settings may vary from these values, but if any plotting on the typewriter is to be done, the 17 space interval between tab stops must be observed)

(8) Press START. Execution of compiled program begins.
(9) When card data is exhausted and the "End of Job" card is read as data, or when an END or STOP Statement is executed, the Monitor Supervisor Program is automatically reloaded.
(10) If the program does not stop itself, it may be stopped and the Monitor Supervisor reloaded by pressing the STOP, RESET, INSERT, RELEASE, and START keys.

Error Detection

If during the execution of the GOTR3D program the Any Data Check indicator is found on after reading GOTRAN from disk, the message "D-CK" is printed and the program halts. To retry loading of GOTRAN, press RESET and START.

If an error is detected during compilation, the Monitor Supervisor Program is automatically reloaded. The Supervisor ignors all remaining cards until a Monitor Control Card is found.

As with standard GOTRAN, certain programming errors may result in a Check Stop during either compilation or execution. If a Check Stop occurs, press RESET, INSERT, RELEASE, and START and the Monitor Supervisor will be reloaded.

Error messages during execution are the same as described for standard GOTRAN with the exception that one additional error message has been added, ERROR F8, which signifies that an attempt was made to plot a number having an absolute value greater than 70.

Modified Plot

The Plot Subroutine has been extensively modified to speed up typewriter plotting and provide the option of plotting on either the typewriter or cards. Only the absolute value of the units and tens digits of the variable being plotted are examined.

If plotting is done on cards (Sw 3 ON during execution), the absolute value of the plotted variable may be from 0 to 70 inclusive, for which the character specified by the PLOT statement will be punched in a card within columns 10 through 80. If the absolute value of the units and tens digits of the variable being plotted is greater than 70, the message "ERROR F8" will be typed and "ERROR F8" will be punched in columns 1 - 8 of a card.

If plotting is done on the typewriter (Sw 3 OFF during execution), tab stops must be set every 17 spaces. The typewriter will tab until the point to be plotted is less than 17 spaces away and then space to the proper point. As with standard GOTRAN, a PRINT statement must be used to return the typewriter carriage. If only one variable is printed by the PRINT statement, the variable to be plotted should be scaled between 0 and 69 (using the margin and tab settings given under (7) on the previous page). If two variables are printed, the variable to be plotted should be scaled between 0 and 52.

Multiple plotting cannot be done on the typewriter unless points to be plotted on the same line are less than 17 spaces apart or unless a program is written which is elaborate enough to take into account the location of the typewriter carriage relative

to the next tab stop. Multiple plotting can be achieved rather easily by (1) plotting the functions alternately on cards and using a specially wired 407 board to list several cards per line or (2) plotting each function separately on cards and using a reproducer punch to reproduce the information from the several decks onto one deck.

Program Size

Maximum number of variables, constants, and statement numbers must be less than 462.

The following equation may be used as a rough estimate as to whether a long program will fit into available memory space:

$14(N_s) + 10(N_v + N_c) = K$, where
N_s = the number of statements,
N_v = the number of symbols used, and
N_c = the number of different constants used.
The program should fit if K is less than 4642.

A more accurate calculation of storage space required by a program may be made by the following:

10(V + C + S) + 3(P + IO) +4L + 6GO + 16IF + 21DO + 7FX1 + 9FX2 + 14F= K
where V =number of floating-point variables (count a dimensioned variable as n+1 variables where n is the number associated with that variable in the DIMENSION statement),
C =number of different floating point constants,
S =number of statements having statement numbers,
P =number of PAUSE and STOP statements,
IO =number of input or output statements,
L =total number of variable names listed in input or output statements,
GO = number of GO TO statements,
IF = number of IF statements,
DO = number of DO statements,
FX1= number of fixed-point arithmetic statements of form v=c,
FX2= number of fixed-point arithmetic statements of the form v=v±c ,
F = number of floating-point arithmetic statements (involving either an arithmetic operation or a function) and PLOT statements.
As before, K must be less than 4642 for the program to fit.

Batch Running--Additional notes

When several GOTRAN programs in succession are to be run, a JOB card is necessary only for the first program in the batch. If it is desired to keep typewriter output from the various programs on separate sheets, a Monitor PAUS Control Card may be inserted between the End of Job card of one program and the XEQ card of the following program, giving the operator a chance to change the typewriter paper.

C. MACHINE LANGUAGE LOAD

(1) It is assumed that the Monitor Supervisor Program would already be in memory whenever it were desired to use this routine, otherwise it would be simpler to use the RESET and LOAD keys.

(2) Place the following Monitor Control Cards in front of the deck to be loaded;
##JOB 5
##XEQ MLCARD

(3) MLCARD is read from disk and executed. All indicators are reset, a card is read into 00000 - 00079, and the program branches to location 00000.

LISTINGS

A. AFIT FORTRAN

1. Disk Write and Read routines added to Processor (entered manually on console typewriter so as to disturb only locations 00000 - 00012 of the Processor)

```
         DORG 19000                                  19000
         RNTY 0,,, ENTER 4900558 TO RESTORE PROCESSOR
                                                     19000 36 00000 00100
         SK   DISKA                                  19012 34 19050 00701
         WDN  DISKA,,,HAVE DISK SW. ON STOP          19024 38 19050 00702
         CDN  DISKA,,,TO DETECT READ-BACK CK.          19036 36 19050 00703
         H                                           19048 48 00000 00000
         DORG *-9                                    19050
DISKA    DDA  ,1,0,200,0                             19050 00006 100000
                                                     19056 00003 200
                                                     19059 00005 00000
START    SK   DISK                                   19064 34 19132 00701
         RDN  DISK                                   19076 36 19132 00702
         BNA  16876                                  19088 47 16876 01900
         WATY MESS,,,ANY DATA CK. IS ON              19100 39 19115 00100
         H                                           19112 48 00000 00000
MESS     DAC  5,D-CK@,*-8                            19115 00010
         B7   START                                  19124 49 19064 00000
DISK     DDA  ,1,5600,200,0                          19132 00006 105600
                                                     19138 00003 200
                                                     19141 00005 00000
```

2. AFITPR Program

```
*LIST TYPEWRITER
*STORE CORE IMAGE
*NAME AFITPR

         DORG 19064                                  19064
START    SK   DISK                                   19064 34 19132 00701
         RDN  DISK                                   19076 36 19132 00702
         BNA  16876                                  19088 47 16876 01900
         WATY MESS,,,ANY DATA CK. IS ON              19100 39 19115 00100
         H                                           19112 48 00000 00000
MESS     DAC  5,D-CK@,*-8                            19115 00010
         B7   START                                  19124 49 19064 00000
DISK     DDA  ,1,5600,200,0                          19132 00006 105600
                                                     19138 00003 200
                                                     19141 00005 00000
         DEND START                                  19064
```

3. Modifications to Loader (machine language entered manually from typewriter to avoid destroying other parts of the Loader).

```
 SEQNO  DC   4,54,606,  CHANGE SEQ. CNT. FOR   00606 00004 0054
 LSQ    DC   4,53,671,  CARD 54               00671 00004 0053
*ROUTINE TO READ PART 1, SUBR. RELOCATER
        DORG 754                              00754
 B      NOP                                   00754 41 00000 00000
        RDN  DISK                             00766 36 00798 00702
        NOP                                   00778 41 00000 00000
        B7   1000,,,BRANCH TO RELOCATER       00790 49 01000 00000
 DISK   DDA  ,1,5800,23,1000                  00798 00006 105800
                                              00804 00003 023
                                              00807 00005 01000
```

4. Program to write Loader on the work cylinders. Program was loaded from a card and executed with Disk Switch on STOP to detect any read-back check.

```
00000 34 00038 00701
00012 38 00038 00702 Write Loader on Sectors 100000-100029
00024 36 00038 00703
00036 48
00038 100000030000100
```

5. AFITLD Program

```
*LIST TYPEWRITER
*STORE CORE IMAGE
*NAME AFITLD

        DORG 4000                             04000
 START  SK   DISK1                            04000 34 04112 00701
        RDN  DISK1,,,READ AFIT LOADER         04012 36 04112 00702
        BNA  A                                04024 47 04068 01900
 B      WATY MESS,,,ANY DATA CK. IS ON        04036 39 04051 00100
        H                                     04048 48 00000 00000
 MESS   DAC  5,D-CK@,*-8                      04051 00010
        B7   START                            04060 49 04000 00000
 A      SK   DISK2                            04068 34 04126 00701
        RDN  DISK2,,,READ PART 2 OF RELOCATER 04080 36 04126 00702
        BNA  1000,,,BRANCH TO LOADER          04092 47 01000 01900
        B7   B                                04104 49 04036 00000
 DISK1  DDA  ,1,5170,30,100                   04112 00006 105170
                                              04118 00003 030
                                              04121 00005 00100
```



```
 DISK2  DDA  ,1,5823,2,7820                   04126 00006 105823
                                              04132 00003 002
                                              04135 00005 07820
        DEND START                            04000
```

6. Modifications to Subroutine Relocater (machine language entered manually from typewriter to avoid destroying other parts of the Relocater). UM signifies unmodified.

```
*MODIFICATION TO RNCD INSTRUCTION, CHANGING TO RDN
        DORG 1624                             01624
 READ   TFM  DISKB+13,TEST                    01624 16 01201 03074
        RDN  DISKB,,,READ NEXT SECTOR         01636 36 01188 00702
        NOP                                   01648 41 00000 00000
 SEQ    DS   5,*,  LABEL USED IN AFIT LISTING 01659 00005
        AM   DISKB+5,1,, INCREMENT FOR NEXT SECTOR
                                              01660 11 01193 00001
        NOP                                   01672 41 00000 00000
*MODIFICATION OF SUBROUTINE HEADING CARD READER
        DORG 1108                             01108
 START  TFM  DISKB+13,ATEST-1                 01108 16 01201 03060
        TDM  IGSW,0,,              UM         01120 15 01130 00000
 IGSW   DS   1,*-1,                UM         01130 00001
        RDN  DISKB,,,READ NEXT SECTOR         01132 36 01188 00702
        AM   DISKB+5,1,,INCREMENT FOR NEXT SECTOR
                                              01144 11 01193 00001
        TF   SEQ,TEST+3                       01156 26 01659 03077
        BD   FINAL,ATEST+19,, CK FOR CARD 4900 01168 43 02452 03080
        B7   A10-36,,,PATCH BACK INTO AFIT    01180 49 01204 00000
 DISKB  DDA  ,1,5825,1,ATEST-1                01188 00006 105825
                                              01194 00003 001
                                              01197 00005 03060
*MODIFICATION TO READ I/O, ARITHMETIC SUBR. FROM DISK
        DORG 7828                             07828
 C      TR   0,C+12                           07828 31 00000 07840
        B7   2056                             07840 49 02056 00000
        DC   1,@                              07847 00001 ‡
 DISKA  DDA  ,1,5925,75,410                   07848 00006 105925
                                              07854 00003 075
                                              07857 00005 00410
        DORG 7868                             07868
 FINAL1 RDN  DISKA,,,READ I/O, ARITH. SUBR.   07868 36 07848 00702
        TD   2728,401                         07880 25 02728 00401
        TD   2752,401                         07892 25 02752 00401
        TD   2928,401                         07904 25 02828 00401
        TD   2840,401                         07916 25 02840 00401
        TD   2956,401                         07928 25 02956 00401
        TD   2968,401                         07940 25 02968 00401
        SF   7251                             07952 32 07251 00000
        B7   C                                07964 49 07828 00000
```

7. Routine used to load Subroutine Relocater (cards 2000 - 2040) into memory. Routine was loaded from cards.

```
00000 36 00100 00500
00012 31 00167 00102
00024 47 00000 00900
00036 48 00000 00000
```

8. Routines used to store Part 1 and Part 2 of the Subroutine Relocater on the Work cylinders. Routines were loaded from cards. Disk Switch was on STOP to detect any Read-Back Check.

```
00000 34 00038 00701
00012 38 00038 00702  Load Part 1 on Sectors 100200 -
00024 36 00038 00703    100222
00036 48
00038 10020002301000

00000 38 00026 00702  Load Part 2 onto Sectors 100223 -
00012 36 00026 00703    100224
00024 48
00026 10022300207820
```

9. Routine used to read Relocatable Subroutines from cards 2100 - 4900 and store them on the disk work cylinders. Cards 2100, 2200, 2300, 2400, 2500, 2600, and 4900 were replaced as described on page 3. The program was loaded from cards after clearing the memory to zeros and loading the addition table.

Card 1

```
00000 36 00400 00500
00012 36 00460 00500
00024 49 00400
```

Card 2

```
00000 34 00480 00701
00412 36 00600 00500
00424 38 00480 00702  Write one sector on work cylinders
00436 36 00480 00703
00448 46 00494 01900
```

Card 3

```
00460 11 00485 00001  Increment Sector address
00472 49 00412 0
00480 10022500100600
00494 48 00000 00000  Data Check. Press RESET and START after
00506 49 00400        preparing the reader to reread the
                      last card read.
```


10. Routine used to read I/O and Arithmetic Subroutines (cards 5001 - 5134) into memory and store them on the disk work cylinders. Disk Switch was on STOP to detect any Read-Back Check. The program was loaded from cards.

Card 1

```
00000 36 00080 00500
00012 36 00100 00500
00024 31 00167 00102
00036 47 00012 00900
00048 34 00086 00701
00060 38 00086 00702
00072 36 00086 0
```

Card 2

```
00080          0703
00084 48
00086 10032507500410
```

B. OOTRAN

1. Modifications to PLOT Subroutine. UM signifies an unmodified instruction.

```
        DORG 4582                                    04582
FPLTA   DC   10,5810000000,,          UM             04591 00010 5810000000
        DS   10,,                     UM             04601 00010
FPLOT   TF   FAC,FPLTA,,              UM             04602 26 00060 04591
        BT   FAD,FPLOT-1,,            UM             04614 27 09554 04601
        SF   FAC-1,,,                 UM             04626 32 00059 00000
        CF   FAC,,,MAKE NUMBER POSITIVE              04638 33 00060 00000
        B    FPLOT2                                  04650 49 14820 00000
        A    *+30,FAC,,         MOVE CHARACTER       04662 21 04692 00060
        A    *+18,FAC,,         TO BE PLOTTED        04674 21 04692 00060
        TF   CHI+18,WK+10,,     TO OUTPUT            04686 26 12773 00859
        WACD CHI                                     04698 39 12755 00400
        CF   FAC-1                                   04710 33 00059 00000
        B7   INT,,,                   UM             04722 49 00488 00000
        DORG 14820                                   14820
FPLOT2  BC3  PLT2,,,SELECT PLOT OUTPUT DEVICE        14820 46 14976 00300
        CM   FAC,17,10,TYPEWRITER PLOT ROUTINE       14832 14 00060 00017
        BN   PLT1,,,       TAB IF MORE THAN 16       14844 47 14888 01300
        TBTY                                         14856 34 00000 00108
        SM   FAC,17,10,    DECREMENT BY 17           14868 12 00060 00017
        B7   FPLOT2+12                               14880 49 14832 00000
PLT1    CM   FAC,0,10                                14888 14 00060 00000
        BNH  PLT3,,,     SPACE IF MORE THAN ZERO     14900 47 14944 01100
        SPTY                                         14912 34 00000 00101
PLTCH   DAC  2,@,*-8                                 14915 00004
        SM   FAC,1,10,     DECREMENT BY 1            14924 12 00060 00001
        B7   PLT1+12                                 14936 49 14900 00000
PLT3    TF   PLTCH,WK+10                             14944 26 14915 00859
        WATY PLTCH,,,PLOT CHARACTER IS TYPED         14956 39 14915 00100
        B7   FPLOT+108,,,BRANCH TO END OF SUBR.      14968 49 04710 00000
```

```
PLT2    TFM   FPLOT+90,CHI+18,,CARD PLOT ROUTINE14976 16 04692 T2773
        TFM   PLT2+30,CHI,,     CLEAR OUTPUT AREA14988 16 15006 T2755
        TFM   CHI,0,10                          15000 16 12755 00000
        AM    PLT2+30,2,10                      15012 11 15006 00002
        CM    PLT2+30,CHI+160                   15024 14 15006 T2915
        BNE   PLT2+24                           15036 47 15000 01200
        CM    FAC,70,10                         15048 14 00060 00070
        BNH   FPLOT+60                          15060 47 04662 01100
        BTM   ERROR,67800,,ABS VALUE ABOVE 70   15072 17 06078 67800
        DC    1,@,*                             15083 00001 ‡
        TR    CHI-1,OUCH,,ERROR F8 TO OUTPUT    15084 31 12754 06060
        TDM   CHI+16,0,,  ERASE RECORD MARK     15096 15 12771 00000
        WACD  CHI                               15108 39 12755 00400
        B7    FPLOT+108,,,BRANCH TO END OF SUBR.15120 49 04710 00000
```

2. **The following modifications transmit the Call Monitor Routine to 00000, initialize COTRAN to store the compiled program at 15128, and suppress the option of not loading SIN-COS, and ATN functions. The last modification was required because the modified PLOT Subroutine was stored following these functions.**

```
        DORG  18000                             18000
CLEARJ  TR    0,XYZ,,                 UM        18000 31 00000 18180
        SF    CLEAR+23,,,             UM        18012 32 07385 00000
        TFM   ZZZ,640,8,              UM        18024 16 07207 00640
        DC    1,@,*,                  UM        18035 00001 ‡
        TDM   400,4,,                 UM        18036 15 00400 00004
        BV    *+12,,,RESET OVERFLOW               18048 46 18060 01400
        TFM   INT+11,15128                      18060 16 00499 T5128
        NOP                                     18072 41 00000 00000
        TFM   L,15128                           18084 16 05838 T5128
        NOP                                     18096 41 00000 00000
        NOP                                     18108 41 00000 00000
        NOP                                     18120 41 00000 00000
        NOP                                     18132 41 00000 00000
        NOP                                     18144 41 00000 00000
        H     333,,,                  UM        18156 48 00333 00000
        B     CLEAR,,,                UM        18168 49 07362 00000
XYZ     SK    32,,,CALL MONITOR ROUTINE         18180 34 00032 00701
        RDN   32                                18192 36 00032 00702
        B7    2402                              18204 49 02402 00000
        DSC   1,5                               18211 00001 5
        DDA   ,1,19636,113,102                  18212 00006 T19636
                                                18218 00003 T113
                                                18221 00005 00102
        DC    1,@                               18226 00001 ‡
```


3. **Modification to CLEAR routine. Prevents the destruction of the modified PLOT Subroutine during clearing of the symbol table.**

```
        DORG  7398                              07398
        CM    *-18,15130                        07398 14 07380 T5130
```

4. **Modifications to END Subroutine (also used as last part of STOP Subroutine). UM signifies unmodified.**

```
        DORG  1794                              01794
END     RCTY  ,,,                     UM        01794 34 00000 00102
        WATY  MESS-22,,,              UM        01806 39 09265 00100
        RCTY  ,,,                     UM        01818 34 00000 00102
        RCTY  ,,,                     UM        01830 34 00000 00102
        B7    0,,,RESTORE MONITOR               01842 49 00000 00000
*PATCH FOR READ SUBR. TO DETECT END OF JOB CARD
MOD3D   BNR   *+20,CHI                          01850 45 01870 12755
        B7    0,,,RESTORE MONITOR               01862 49 00000 00000
        BT    INSTRM,INSTRM-1,,ORIGINALLY AT 1978  01870 27 01608 0160

        B7    RR+56,,,RETURN TO READ SUBR.      01882 49 01990 00000
*BRANCH TO READ SUBR. PATCH.  INSERTED IN READ SUBR.
        DORG  1978                              01978
        B     MOD3D                             01978 49 01850 00000
```

5. **Modification to ERROR Subroutine causing a branch to Call Monitor routine if an error is detected during compilation.**

```
        DORG  6126                              06126
        BD    0,COMPSW                          06126 43 00000 06107
```

6. **Modification to Subroutine Interpreting routine to prevent random setting of the Arithmetic Check Indicator. See APPENDIX A for a more detailed explanation. UM signifies unmodified.**

```
        DORG  4730                              04730
FUNCT   AM    INT+11,14,10,           UM        04730 11 00499 00014
        TF    *+54,WK+4                         04742 26 04796 00853
        TF    *+46,WK+7                         04754 26 04800 00856
        BD    INDEXA,WK+8,,           UM        04766 43 04858 00857
        TF    *+41,WK+11,,            UM        04778 26 04819 00860
        BT    19999,19999                       04790 27 19999 19999
        BD    INDEXB,WK+12                      04802 43 04890 00861
        TF    19999,FAC,,             UM        04814 26 19999 00060
        TF    IC+6,*-6,,              UM        04826 26 00662 04820
        BC2   IC+24,,,                UM        04838 46 00680 00200
        B7    INT,,,                  UM        04850 49 00488 00000
INDEXA  TD    *+22,WK+8,,             UM        04858 25 04880 00857
        S     *-58,19997,,            UM        04870 22 04812 19997
        B7    *-104,,,                UM        04882 49 04778 00000
```

```
INDEXB TD   *+22,WK+12,,          UM        04890 25 04912 00861
       S    *-83,19997,,          UM        04902 22 04819 19997
       B    *-100                           04914 49 04814 00000
```

7. GOTR3D Program

```
*LIST TYPEWRITER
*STORE CORE IMAGE
*NAME GOTR3D.


       START  TR   0,A                                02402 31 00000 02434
              TR   60,B                               02414 31 00060 02494
              B7   0                                  02426 49 00000 00000
       A      SK   68,,,EXECUTED FROM ADDRESS  00000  02434 34 00068 00701
              RDN  68,,,                       00012  02446 36 00068 00702
              BNA  18000,,,                    00024  02458 47 18000 01900
              WATY 51,,,ANY DATA CK. IS ON     00036  02470 39 00051 00100
              H    ,,,                         00048  02482 48 00000 00000
              DAC  5,0-CK@,*-8,                00051  02485 00010
       B      B7   0,,,                        00060  02494 49 00000 00000
              DDA  ,1,5401,199,100,            00068  02502 00006 10̄5401
                                                      02508 00003 1̄99
                                                      02511 00005 0̄0100
              DC   1,@                                02516 00001 ‡
              DEND START                              02402
```

C. MACHINE LANGUAGE LOAD MLCARD Program

```
*LIST TYPEWRITER
*STORE CORE IMAGE
*NAME MLCARD


       START  BI   *+12,600,,RESET ALL INDICATORS     02402 46 02414 00600
              TF   START+9,LIST                       02414 26 02411 02470
              TR   LIST-1,LIST+1                      02426 31 02469 02471
              BNR  START,START+9                      02438 45 02402 02411
              RNCD 0,,,SIMULATE LOAD KEY              02450 36 00000 00500
              B7   0                                  02462 49 00000 00000
       LIST   DVLC ,2,7,2,9,2,14,2,15,2,16,2,17,2,36,2,37,2,38
                                                      02470 00018 0̄709̄14̄15
       1̄61̄7363̄738
              DC   2,@                                02488 00002 0̄‡
              DEND START                              02402
```


D. GOTAFIT DECK

```
3400032007013600032007024902402511963611300102
‡‡JOB 5                              LOAD GOTRAN 3D AND AFIT FORTRAN ON DISK
‡‡              IF SECTORS 105165-105199 AND 105400-105999 ARE NOT PERMANENTLY
‡‡PAUS          ASSIGNED, PRESS START TO PROCEED
‡‡DUP 5
*DLOADMLCARD                                  01111102222CI
46024140060026024110247031024690247145024020241136000000050049000000-7-9J4J5-0001
J6J7L6L7L8-‡71445595956590000000000000000000000000000C000000000000000000000000000000-0002
R9999‡00000000000000000000000000000000000000000000000000000000000000000000000000000-0003
‡‡DUP 5
*DELETMLCARD
‡‡DUP 5
*DLOADMLCARD          1000001000001051650240202402DI
‡‡DUP 5
*DLOADAFITLD                                  01111102222CI
340411200701360411200702470406801903904051001004834204352034904000034041260001
0070136041260070247010000190049040360 1-5170-30-01001-5823-02-7820201300221 9-0002
8850452032198830000211988819885210452019888320278C000000000000000000000000000-0003
R9999‡00000000000000000000000000000000000000000000000000000000000000000000000000000-0004
‡‡DUP 5
*DELETAFITLD
‡‡DUP 5
*DLOADAFITLD          1000001000011051660400004000DI
‡‡DUP 5
*DLOADGOTR3D                                  01111102222CI
3100000024343100060024944900000034000680070136000680070247180000190039000 51-0001
0010048M4204352 0‡490000001-5401J99-0100‡070-0713400000001023902485001004800-0002
0C000000490079602 2-2576‡0-4800-01J0860‡22-2599‡0-CC000000000000000C00C00C0C-0003
R9999‡0000000000000000600000000000000000000000000000C000000000000000000000C0C0-0004
‡‡DUP 5
*DELETGOTR3D
‡‡DUP 5
*DLOADGOTR3D          1006001000011051680240202402DI
‡‡      AFIT LOADER
‡‡DUP 5
*DLOAD                                  10517000100010000I
CC000000000100203040000204060800030609021004080216 1C0500151020060218142C07C4-0001
1128200806142230090317263000000000506070809001214161815181124272024282236 3-CCC2
52035304540363248445532494653604846546275445362 71‡01234567891234567 89-23456-0003
789-J3456789-JK456789-JKL56789-JKLM6789-JKLMN789-JKLMNC89-JKLMNCP9-JKLMNCPQ-0004
‡C39004170010C4862455801‡049007 54‡050014005900-0124700402012002600480005783-0005
1-0426005131100449C-0014900426000000004900754‡0000C000000000000000000000000-0006
000000000000000000000000-C4260C000000-0110000000000340-0540010239006750C1CC3-0007
8C0668001CC26C0666005994800000C0000C4900000-0C53‡5M34159440056646300564 6CC62-0008
4558644555434 5C041466345590043415944005564544245590 00‡4100000000003600798C0-0009
7C241C0000000C0490100001058000230100C000000000000002600844009243 1-304CCC859-C01C
490075400356560544155680044566 2C04955004 1C0554562630‡000000000000000-3040-0011
00000000-0520000006000090000000000C00C0000000C0C0000000000000000000000000000-0012
```

```
1600856-0754150029900008460103601400360310000500320317500000240317900606460-0013
1096012001700600-1036110067100O-11100606000-11403101000-0470209201200140310-0014
3000-0470236801200140310600R99470204801200140234O-401746012520120034000000-0015
1023902995001004800000000003600402005002400481006066401300012001700600-1252-0016
1100606000-11100671000-1250164200417250173100417360310000500240317900606460-0017
1396012001700600-13481100606000-11100671000-115-3160000-*3102927-3150440148-0018
8029352601473016452600007029344901640044018280293633029360000049016400440l8-0019
4002933140293l000-0460160401100340000000102390293900100380293300100160293l--0020
0009260293302931260163301645160000100OM926J99990293612017340O0-11201645000--0021
11201425000-11201442000-11401443-3100460142001300160049gJ99992200499004l646-0022
0189601200140049g-0060470179601100160049g-00602101426004992101443004994901l-0023
480440152002934240164600421460164001100440165202932260164602936490165202601-0024
914004113200000000001101913000-12401913004204701908013002602002004102602014-0025
0041026020260041026004990000926004970000726004910000116006060K0004900754031-0026
-8000031072603099031132102054031064901036043022320310026029290310332031050O-0027
0002602931031062602936217031-31800292831-33460310711021570O0-1210217003106-0028
1102170-00011102221-00-14901036043027760310126031130309926031250311314024342-0029
-561747023360130034000000010239030410010048000000000049010360l1-40170310211-0030
02342-00404901036016024O3-31711102403-00102403103000004702380012002602439O2-0031
4033102928000001202221000-14702488012001602158-31801602170-33462602511029335-0032
3103956000001402930000004602732012001402930000M8460267601200210396202054210-0033
3974020342602650020544402644031181602638-39432102638029303200000000003100O0-0034
0839562102054029304902048021039860205411039g6-00241103998-00242103998020544-0035
9025840210401002054110401O-00361103998-00364902712026028350234212028l5-0037-0036
1402835-4020470103601300240310500000470103601200260289502835110289S-0002260-0037
2898020543100000000001102054-00361202342-00404902776000000000*0455444546649-0038
3948440002634162345544555630055645442459900O*M9545759565745590044560062455B6-0039
4495543495547003565600544155680044566200495500410055456263O*000000000000000-0040
R9999000000000000000000000000000000000000000000000000000000000000000000000-0041
**DUP 5
*DLOADAFITPR                                  0111102222CI
3419132007013619132007024716876019003919115001004BM2043520*491906401-5600K-0001
00-000033-06402-1660000000000000000000000000000000000000000000000000000000-0002
R9999000000000000000000000000000000000000000000000000000000000000000000000-0003
**DUP 5
*DELETAFITPR
**DUP 5
*DLOADAFITPR         1000001000001054001906419064DI
**    GOTRAN MOD 3, AFIT PROCESSOR, AFIT SUBROUTINES
**DUP 5
*DLOADGOTAFT                                  0111102222CI
000000000000102030400020406080003060902100408021610050015102006021814200704-0001
1128200061422300908172630000000005060708090012141618151811242720242822363-0002
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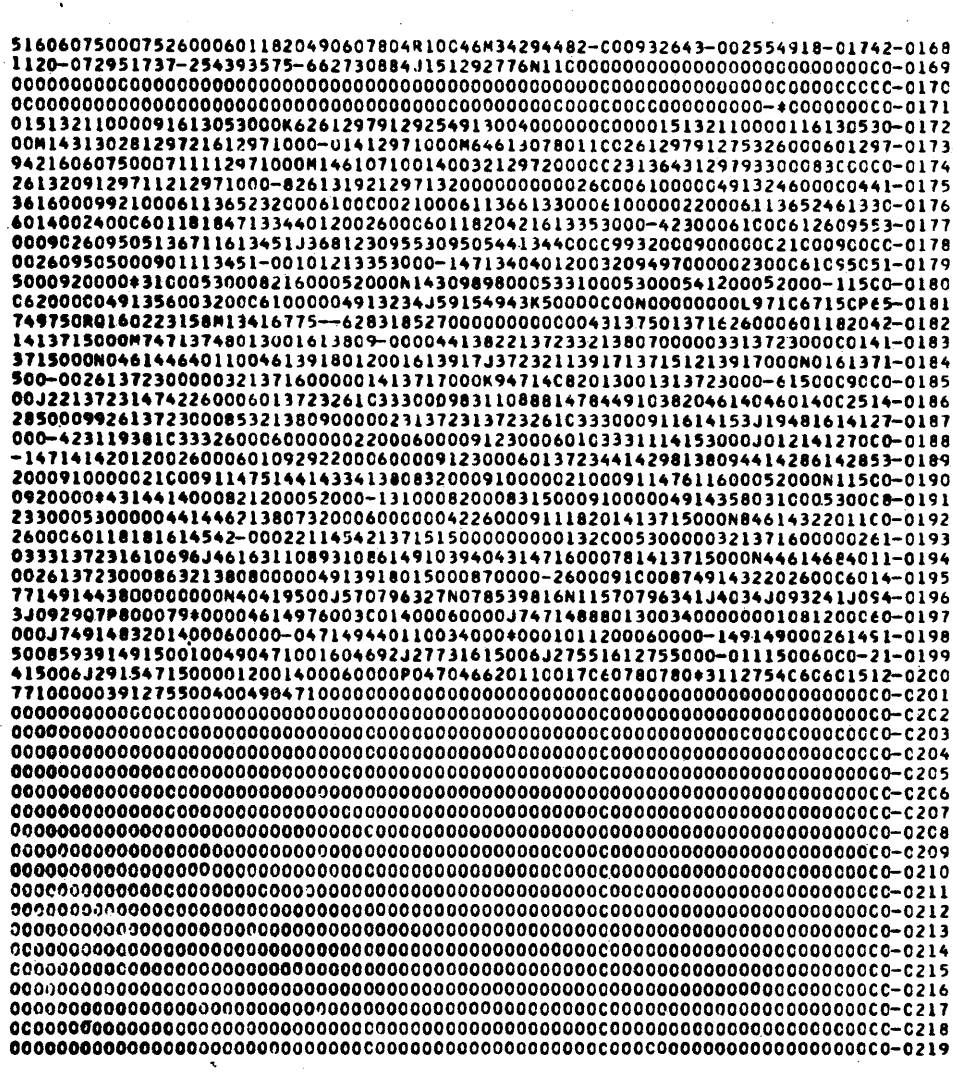

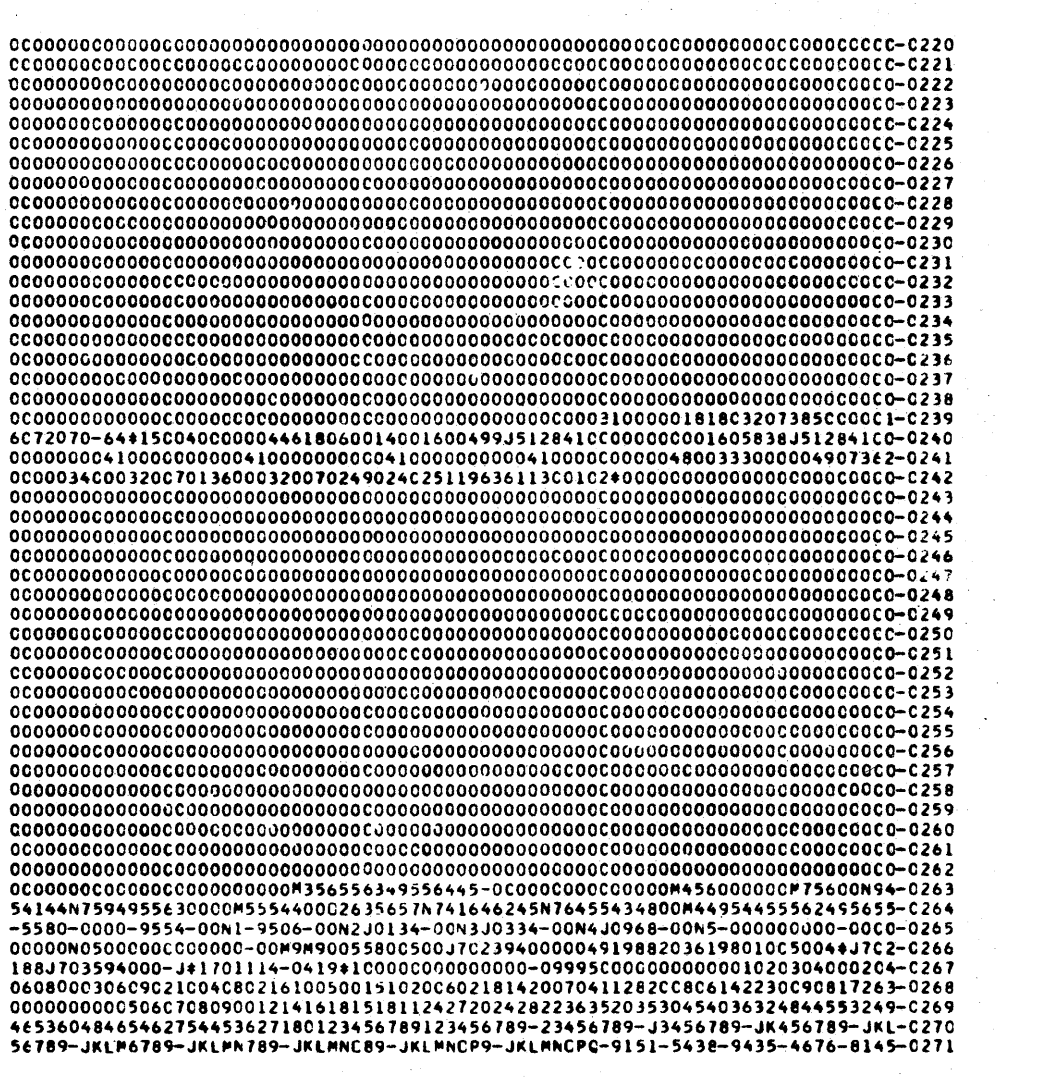

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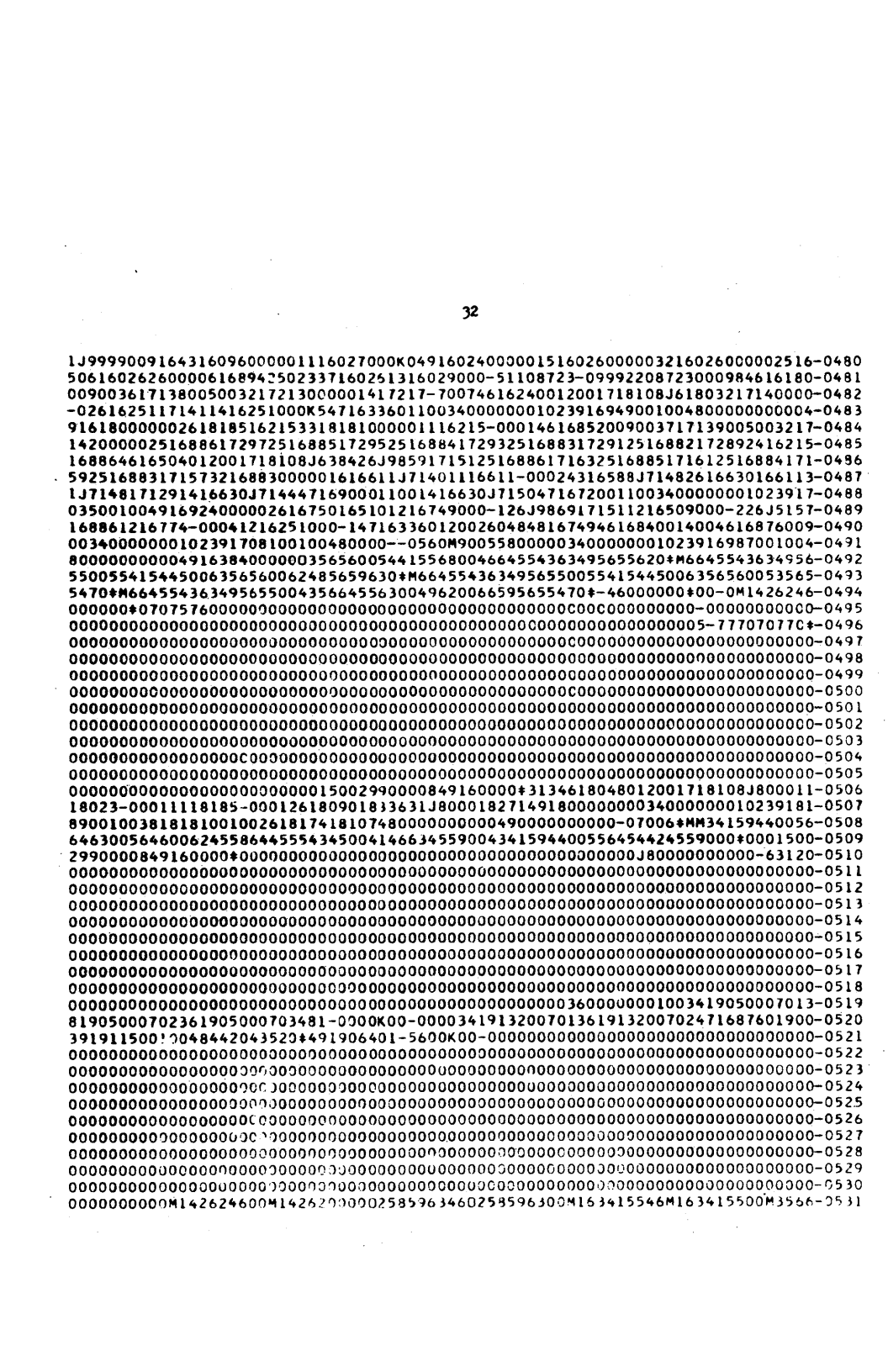

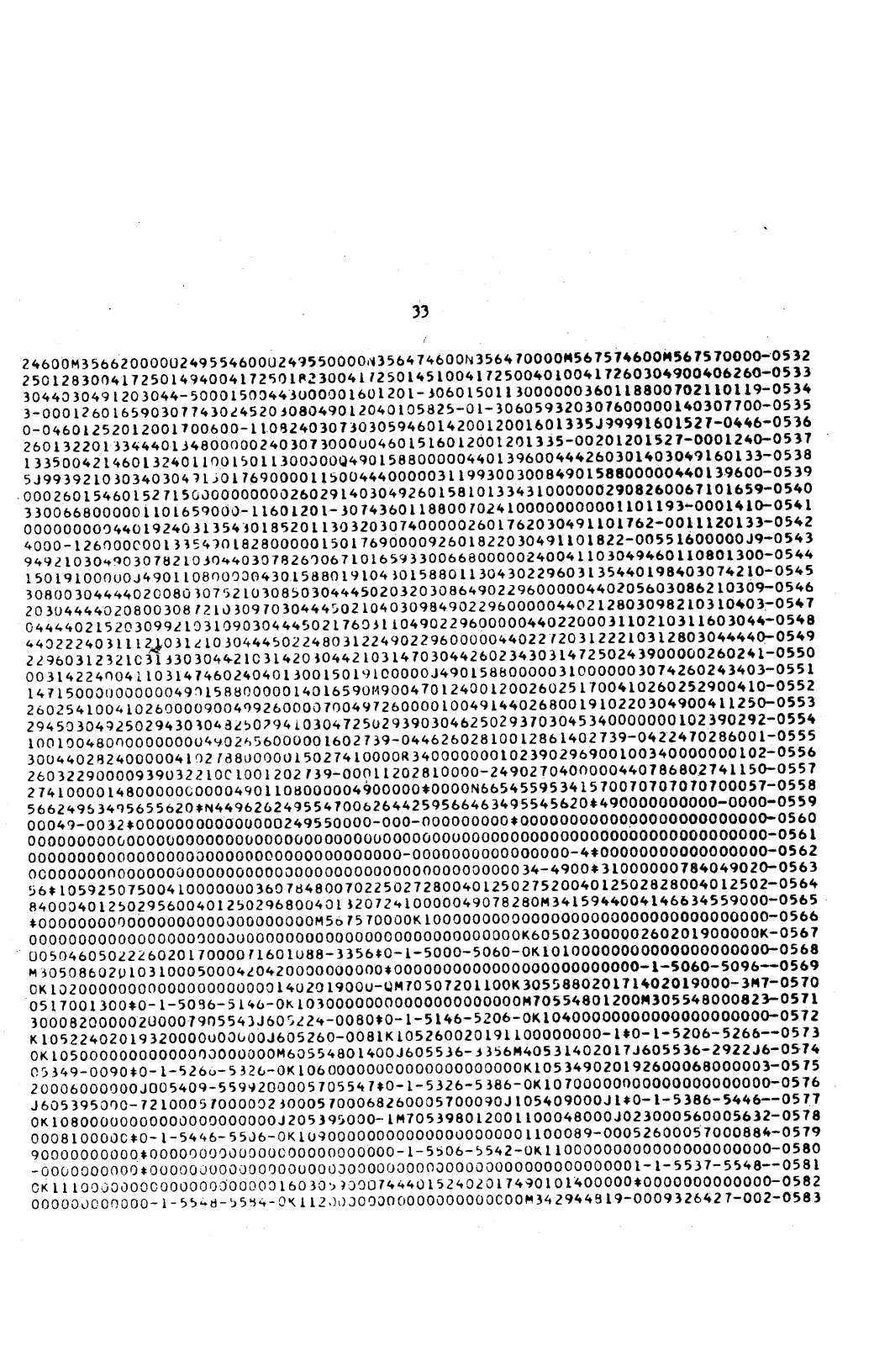

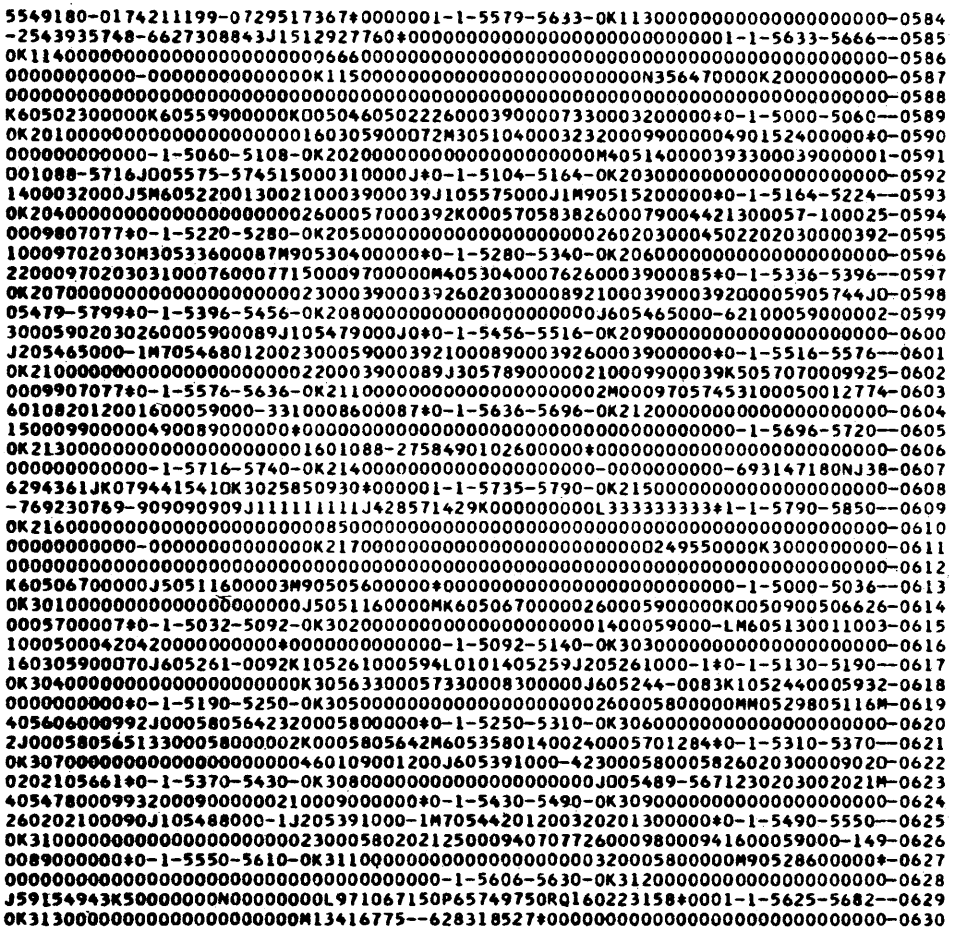

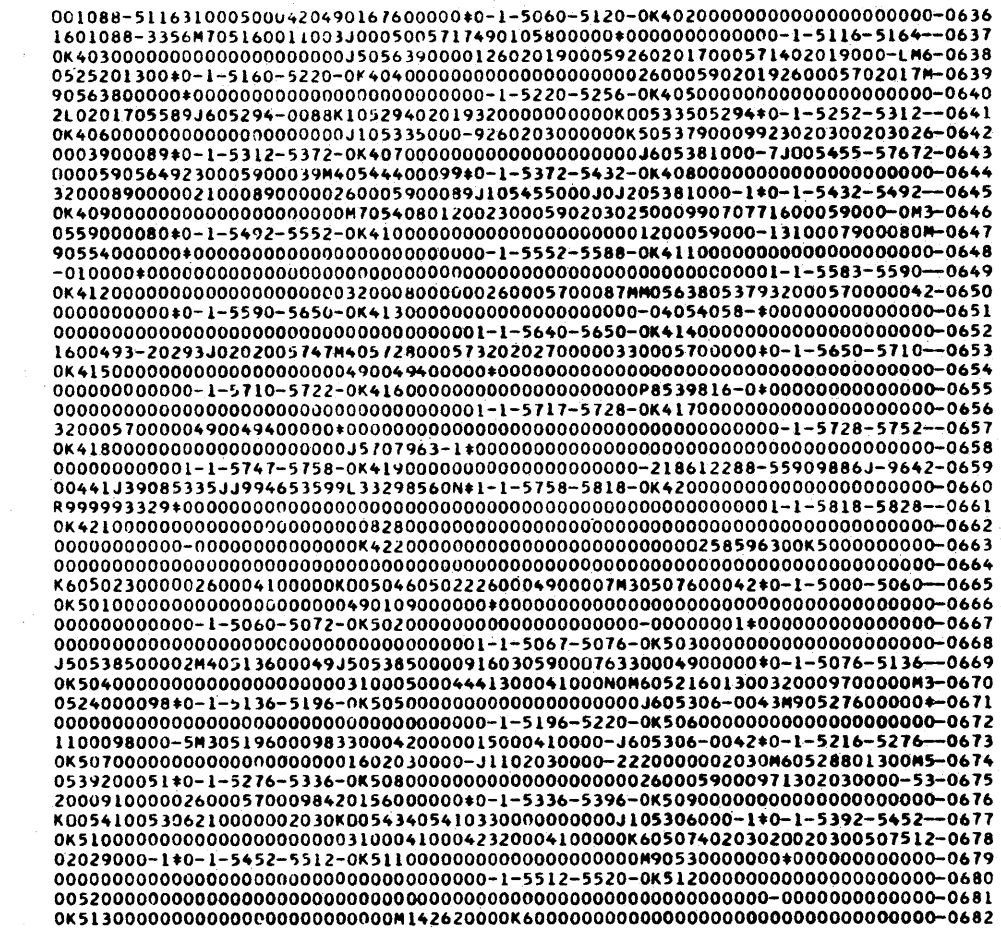

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107652-000225000000707739078170010016076 83-78171600000000-01407688-79914607-0796
102013001107688-000249076820160305900079390304500100120713 7000-544037460740-0797
44503746056174904454-0000000-0#000034-4900#3100000078404902056#105925075004-0798
100000003607848007022502728004012502752004012502820000000000000000000000000-0799
R9999#000000000000000000000000000000000000000000000000000000000000000000000000-0800
##DUP 5
•DELETGOTAFT
##DUP 5
•DLOAD                  1000001005981054010111102222DI
####
```


APPENDIX A

Random Setting of Arithmetic Check Indicator by Standard GOTRAN During Execution of PLOT Statement

GOTRAN compiles a PLOT statement as $\bar{0}4602\bar{A}AAI_a\bar{C}CXX\ddagger$, where 1AAA9 is the address of the variable to be plotted, I_a is a subscript code (0, 1, 2, 3, 4, 5, or 9) used to modify the address of a subscripted variable, and CC is the alphanumeric code of the character with which to plot. The two digit group XX is miscellaneous garbage left from compiling the previous statement.

During execution of a program the PLOT command is interpreted by the same routine as floating arithmetic subroutine commands, which are in the form $\bar{S}SSSS\bar{A}AAI_a\bar{B}BBI_b\ddagger$, where SSSSS is the subroutine address, $AAAI_a$ and $BBBI_b$ are compressed addresses, and the operation is B←FUNCT(A) .

In standard GOTRAN the check for a subscripted B address ($I_b \neq 0$) and any necessary address modification is performed before branching to the subroutine, although the B address is not needed until after the return from the subroutine (PLOT returns to a different point and needs no B address). Under certain conditions compilation of a PLOT statement can result in the units position of XX being an invalid subscript code. An attempt to add a non-existent subscript to a three-digit field turns on the Arithmetic Check indicator.

When the PLOT subroutine is finally reached, the first operation it performs uses the floating addition subroutine to add 10,000,000 to the number being plotted to position the number in the units position of the floating accumulator. With the Arithmetic Check indicator on, the floating addition subroutine adds incorrectly, and as a result the PLOT routine plots incorrectly. In certain cases (plotting a number between -1.0 and 1.0 , or a number greater in magnitude than 1.0E+15) the floating addition routine does not reset the Arithmetic Check indicator and later arithmetic operations are adversely affected.

This fault was corrected in the manner shown under part 6 of the GOTRAN listings (page 19). The BD and BT instructions, originally at 04790 and 04802 respectively, were interchanged so that no check for $I_b \neq 0$ would be made until after the return from the subroutine. For the PLOT subroutine, which returns to 00488, this check will never be made. It was also necessary to modify the addresses of the instructions at 04742, 04754, and 04914 , which referred to the two interchanged instructions.

APPENDIX B

Modification for Machines Without Auto-Divide

There is only one instruction in the system which uses divide hardware. This instruction is in the AFIT Subroutines and is the modification suggested by the author of AFIT FORTRAN for improving the speed of floating addition and subtraction on machines having divide hardware (see Note 3 of "Remarks on AFIT FORTRAN, 1.1.010").

To replace this modification with the original instruction, which does not require hardware divide, a change must be made in the GOTAFIT deck in the card with sequence number 0705 (this card is less than one inch from the end of the deck and is the only card in the whole deck with this sequence number).

Replace the 280009300057 in columns 45 - 56 of card 0705 with 230005700445 .