THE FORTRAN II

AUTOMATIC CODING SYSTEM

FOR THE

IBM 704

TABLE OF CONTENTS

PART 1

Initial Receipt of the 704 FORTRAN II System

Definition of the Master Tape, the Editor Deck, and the System Tape

A. Part of the 704 FORTRAN II System distributed by IBM consists of a Master tape and two Editor decks. The Master tape contains both the 4K and the 8K version of the 704 FORTRAN II executive system. The 4K Editor deck is to be used by a 4K machine installation; the 8K Editor deck is for a 8K machine installation. The Master tape is NOT a running tape, and is NOT to be used for object program compilation.

The complete 704 FORTRAN II Editor deck (either the 4K or the 8K version), consists of the following programs and subroutines, and is distributed along with FORTRAN II to enable installations to maintain a current and up-to-date System tape for object program compilation. Complete descriptions of the individual programs and subroutines are found later in this Manual.

Composition of the Editor Deck:

FNEDT2 - FORTRAN II Editing Program
Control and Binary Correction cards
PLIB2 - FORTRAN II Permanent Librarian
Permanent Library cards
GLIB2 - FORTRAN II General Librarian
General Library cards
FNDE2 - FORTRAN II General Diagnostic Editing Program

The proper Editor deck, 4K or 8K, in conjunction with the Master tape, produces the 704 FORTRAN II System tape. The System tape, and only the System tape, is to be used for compiling object programs.

Master Tape Duplicating Program - F2TCVP

B. F2TCVP, the Master Tape Duplicating Program, is included with FORTRAN II. It is advisable, for safety purposes, to copy the Master tape onto additional tapes using F2TCVP. These copies are then used for generating a new System tape. The original Master tape furnished with FORTRAN II should be kept in a secure place. F2TCVP executes a checksum verification of all records duplicated from the Master tape onto the copy tape.

**Operating
Instructions -
F2TCVP**

C. F2TCVP is executed in the following manner:

1. Mount the Master tape as logical tape 5.
2. Mount the copy tape as logical tape 1.
3. Ready F2TCVP in the card reader.
4. Press LOAD CARD button.
5. Correct FINAL STOP: 320_8, indicates the tape duplication completed.
6. File-protect the duplicated tape.

**Error Halts
in F2TCVP**

D. Error Halts in F2TCVP are as follows:

Halt (octal):	Reason for Halt:	Procedure
40	Either Tape 5 incorrectly written or machine error.	Restart entire program.
43	RTT error reading tape 5.	Press START to try again.
56	False EOF, Machine error.	Restart entire program.
62	Tape 1 record word fails to agree with tape 5 record word.	Press START to try again.
64	Same as for 62.	Press START to try again.
70	RTT error reading back tape 1 record.	Press START to try again.
77	False EOR skip. Machine error.	Restart entire program.
102	False EOF skip. Machine error.	Restart entire program.
107	Checksum error reading Tape 5 record.	Press START to reread and recheck tape 5 record.
112	RTT error reading tape 5 record.	Press START to try again.

Halt (octal):	Reason for Halt:	Procedure:
130	False EOF. Machine error.	Restart entire program.
134	Tape 1 record word fails to agree with tape 5 record word.	Press START to reread and recheck tape 1 record.
136	Same as 134	Press START to reread and recheck tape 1 record.
142	RTT error reading back tape 1 record.	Press START to try again.
146	RTT stop after having encountered tape 5 file tape marks (file 1).	Press START to recheck tape mark.
160	Same as 146 (file 2)	Press START to recheck tape mark.
173	False EOR skips. Machine error.	Restart entire program.
200	False EOF skip. Machine error.	Restart entire program.
205	Check sum error after reading tape 1 record (file 1).	Press START to try again
210	RTT error after reading Tape 1 record (file 3).	Press START to try again.
226	False EOF. Machine error.	Restart entire program.
232	Tape 1 record word fails to agree with tape 5 record word.	Press START to reread and recheck tape 1 record.
234	Same as 232	Press START to reread and recheck tape 1 record.

3

Halt (octal):	Reason for Halt:	Procedure:
240	RTT error reading back Tape 1 record (file 3).	Press START to try again.
244	RTT stop after having encountered tape 5 file mark (file 3).	Press START to recheck tape mark.
256	RTT error reading Tape 1 record (file 4).	Press START to try again.
274	False EOF. Machine error.	Restart entire program.
300	Tape 1 record word fails to agree with tape 5 record word (file 4).	Press START to try again.
302	Same as 300.	Press START to try again.
306	RTT error after reading back tape 1 record (file 4).	Press START to try again.
312	RTT stop after en- countering tape 1 (4th file) tape mark.	Press START to recheck tape mark.
320	FINAL STOP.	
321	Incomplete 1st record of 1st file written on tape 1.	Press START to try again.
330	Incomplete 1st & 2nd file record written on tape 1.	Press START to try again.
346	Incomplete 3rd file record written on tape 1.	Press START to try again.
366	Incomplete 4th file record written on tape 1.	Press START to try again.

**General
Description
of the Editor
Program -
FNEDT2**

Creating and Updating the 704 FORTRAN II System Tape

A.   The purpose of the FORTRAN II Editor Program, FNEDT2, is to produce the first two files of a new, up-to-date FORTRAN II System tape from a Master tape and the Editor deck, which contains all corrections, insertions, and deletions to the Master tape. From the control cards and the binary information cards which follow it in the Editor deck, FNEDT2, in conjunction with the Master tape, generates these first two files of a new FOR-TRAN II System tape embodying the latest changes to the System. The third and fourth files of the FORTRAN II System tape are produced by other sections of the Editor deck, namely PLIB2 and FNDE2, which are described later in this Manual.

**Arrangement
of Records on
the Master
Tape**

B.   The FORTRAN II Master tape consists of four files.

Files 1 and 2 contain the executive routine or the system proper. There is a special first record, 1-CS, and 10 ordinary system records in the first file. There are 115 ordinary system records in the second file. The End of File Mark is not considered to be an ordinary system record. The first word of each system record, except in 1-CS, is a checksum for that record. The second word is a control word containing a LOAD ADDRESS (the first location into which the first word of the record is to be stored) in the address portion and the TRANSFER ADDRESS (the address to which control is to be transferred after the record has been completely read in) in the decrement portion.

File 3 contains the permanent and the general library. The permanent library consists of input-output and exponential subroutines utilized by the FORTRAN II executive system only. The general library contains mathematical subroutines distributed with FORTRAN II. The first record of a library routine, whether permanent or general, contains the control information required by the system proper for that routine. The succeeding records of a routine contain the routine in relocatable binary form.

File 4 consists of the FORTRAN II general diagnostic error comments. Each comment corresponds to a particular TSX instruction in the records of files 1 and 2, and is contained in a separate record of file 4. The first word of a record in file 4 is the record number. The succeeding words in the record contain the error comment.

NOTE: The first record, 1-CS, is special only in the fact that it does not contain the same format as the ordinary system records.

**FORTRAN II
Editor Deck**

C. There is a Master Record card in the Editor deck
for each ordinary system record of files 1 and 2 on
on the Master tape. The information contained
the Master Record card is summarized in the
following chart, columns 1-5.

RECORD NUMBER	DESCRIPTION OF RECORD	TRANSFER ADDRESS 8L DECREMENT	LOAD ADDRESS 8L ADDRESS	LAST ADDRESS 8R ADDRESS	CONTENTS OF TRANSFER WORD	CONTENTS OF LOAD WORD
FILE 1						
000	1-CS (Locs 0-27) CARD TO TAPE	----	0000	0027	-----	-0 53400 1 00000
001		0342	0110	0416	0 77200 0 00202	0 76200 0 00321
SECTION 6						
002	DIAG. CALLER FOR REC. 115	4000	4000	4021	-0 63400 2 00000	-0 63400 2 00000
003	CIT TO SAP CONVER.	0210	0210	1200	0 50000 0 00162	0 50000 0 00162
004	DIAG. CALLER FOR REC. 003	1500	1500	1521	-0 63400 2 00000	-0 63400 2 00000
005	ON-LINE PRINT	0210	0210	0551	0 77200 0 00202	0 77200 0 00202
006	DIAG. CALLER FOR REC. 005	1500	1500	1521	-0 63400 2 00000	-0 63400 2 00000
007	TAPE 3,7 TO 2,6	0210	0210	1372	0 77200 0 00202	0 77200 0 00202
008	DIAG. CALLER FOR REC. 007	1500	1500	1521	-0 63400 2 00000	-0 63400 2 00000
009	SUCCESSFUL, COMPILATION	0030	0030	0037	-0 76000 0 00007	-0 76000 0 00007
010	SOURCE PROGRAM ERROR	0030	0030	0056	-0 76000 0 00007	-0 76000 0 00007
011		---	---	---		

NOTE: ALL RECORD NUMBERS SUFFIXED BY AN "A" ARE 8K RECORDS.

7

RECORD NUMBER	DESCRIPTION OF RECORD	TRANSFER ADDRESS 8L DECREMENT	LOAD ADDRESS 8L ADDRESS	LAST ADDRESS 8R ADDRESS	CONTENTS OF TRANSFER WORD	CONTENTS OF LOAD WORD
FILE 2						
SECTION 1 (4K)						
012	BATCH COMPILATION MONITOR	0030	0030	0620	0 76000 0 00166	0 76000 0 00166
013	MACHINE ERROR	0030	0030	0035	0 00000 0 00031	0 00000 0 00031
014	COMMON (4K)	0004	0030	3437	-0 53400 1 00027	0 00000 0 00000
014A	DELETE (8K) COMMON, INITIAL, AND STATE A.	0004	0030	0000	----- - -----	----- - -----
015	WRITE DRUM (INIT.)	0004	0471	0600	-0 53400 1 00027	0 53400 1 00575
016	STATE D (4K)	0471	3440	6157	0 53400 1 00575	-0 53400 1 01117
016A	DELETE (8K) STATES B, C, AND D.	0471	6323	0000	----- - -----	----- - -----
017	STATE C (4K)	0504	3440	5043	0 53400 4 01407	0 56000 0 01405
018	STATE B (4K)	0506	3440	5214	0 53400 4 01410	0 76000 0 00140
019	STATE A (4K)	0510	3440	7306	0 53400 4 01412	-0 53400 4 02575
020*	DIAGNOSTIC FOR SEC. 1	13440	13440	17777	3 00000 4 13543	3 00000 4 13543

* RECORD 020 USES MODULO ADDRESSING.

RECORD NUMBER	DESCRIPTION OF RECORD	TRANSFER ADDRESS 8L DECREMENT	LOAD ADDRESS 8L ADDRESS	LAST ADDRESS 8R ADDRESS	CONTENTS OF TRANSFER WORD	CONTENTS OF LOAD WORD
SECTION 1 PRIME						
021	COMMON	0004	4550	7760	-0 53400 1 00027	0 00000 0 00000
022	PART A	1146	1146	3161	0 76100 0 00000	0 76100 0 00000
023	DIAG. CALLER FOR REC. 022	7755	7755	7776	-0 63400 2 00000	-0 63400 2 00000
024	PART B	0507	0507	1613	0 76100 0 00000	0 76100 0 00000
025	DIAG. CALLER FOR REC. 024	7755	7755	7776	-0 63400 2 00000	-0 63400 2 00000
026	SECTION 1"	0031	0031	1302	0 77200 0 00202	0 77200 0 00202

8

RECORD NUMBER	DESCRIPTION OF RECORD	TRANSFER ADDRESS 8L DECREMENT	LOAD ADDRESS 8L ADDRESS	LAST ADDRESS 8R ADDRESS	CONTENTS OF TRANSFER WORD	CONTENTS OF LOAD WORD
SECTION 2						
027	BLOCK 1	5522	5474	7320	0 77200 0 00224	0 00000 0 00000
028	DIAG. CALLER FOR REC. 027	7400	7400	7421	-0 63400 2 00000	-0 63400 2 00000
029	DRUM SET-UP	0004	7730	7775	-0 53400 1 00027	-0 53400 2 07770
030	BLOCK 2 - RELCON	7730	5566	6565	-0 53400 2 07770	-0 53400 1 00030
031	DIAG. CALLER FOR REC. 029 & 030	7400	7400	7421	-0 63400 2 00000	-0 63400 2 00000
032	BLOCK 2 - NORMAL	7732	5566	6650	-0 53400 2 07767	-0 63400 4 05622
033	DIAG. CALLER FOR REC. 032	7400	7400	7421	-0 63400 2 00000	-0 63400 2 00900
034	BLOCK 2 - COMMON	4012	3751	5565	0 77200 0 00223	0 00000 0 00000
035	DIAG. CALLER FOR REC. 034	7756	7756	7777	-0 63400 2 00000	-0 63400 2 00000
036	BLOCK 3 - COMMON PART 1	0004	6665	7073	-0 53400 1 00027	0 00000 0 00000
037	BLOCK 3 - PART 2	6721	7614	7774	0 50000 0 07776	-0 63400 1 77777
038	DIAG. CALLER FOR REC. 036 & 037	0300	0300	0321	-0 63400 2 00000	-0 63400 2 00000
039	BLOCK 3A	6721	6721	7113	-0 53400 1 00733	-0 53400 1 00733
040	DIAG. CALLER FOR REC. 039	0300	030C	0321	-0 63400 2 00000	-0 63400 2 00000
041	BLOCK 3B	6721	6721	7613	-0 53400 1 00733	-0 53400 1 00733
042	DIAG. CALLER FOR REC. 041	0300	0300	0321	-0 63400 2 00000	-0 63400 2 00000
043	BLOCK 3C	6721	6721	7232	-0 53400 1 00733	-0 53400 1 00733
044	DIAG. CALLER FOR REC. 043	7400	7400	7421	-0 63400 2 00000	-0 63400 2 00000
045	BLOCK 4 - RELCON	0470	0450	1443	0 50000 0 01430	+0100000000001
046	DIAG. CALLER FOR REC. 045	2000	2000	2021	-0 63400 2 00000	-0 63400 2 00000
047	BLOCK 5 - INITIALIZATION	0030	0030	0217	0 53400 1 00131	0 53400 1 00131
048	DIAG. CALLER FOR REC. 047	2000	2000	2021	-0 63400 2 00000	-0 63400 2 00000
049	BLOCK 5 - ALPHA	0062	5256	7620	0 53400 2 00146	-0 63400 4 06252

RECORD NUMBER	DESCRIPTION OF RECORD	TRANSFER ADDRESS 8L DECREMENT	LOAD ADDRESS 8L ADDRESS	LAST ADDRESS 8R ADDRESS	CONTENTS OF TRANSFER WORD	CONTENTS OF LOAD WORD
SECTION 2 (CONTINUED)						
050	DIAG. CALLER FOR REC. 049	6000	6000	6021	-0 63400 2 00000	-0 63400 2 00000
051	BLOCK 5 - BETA AND COMMON	0066	3646	6637	0 53400 2 00126	0000000000000
052	DIAG. CALLER FOR REC. 051	6000	6000	6021	-0 63400 2 00000	-0 63400 2 00000
053	BLOCK 6 - INVERSION	0030	0030	0162	0 77200 0 00224	0 77200 0 00224
054	DIAG. CALLER FOR REC. 053	7000	7000	7021	-0 63400 2 00000	-0 63400 2 00000
SECTION 3						
055	OPEN SUB-ROUTINES PART I OF MERGE	0004	7071	7777	-0 53400 1 00027	2 00001 4 0130c
056		0030	0030	2326	0 53400 1 02164	0 53400 1 02164
057	DIAG. CALLER FOR REC. 055 & 056	7755	7755	7776	-0 63400 2 00000	-0 63400 2 00000
058	PART II OF MERGE	0030	0030	2367	0 53400 4 02274	0 53400 4 02274
059	DIAG. CALLER FOR REC. 058	7755	7755	7776	-0 63400 2 00000	-0 63400 2 00000
060	PART III OF MERGE	0030	0030	2715	0 53400 4 01202	0 53400 4 01202
061	DIAG. CALLER FOR REC. 060	7755	7755	7776	-0 63400 2 00000	-0 63400 2 00000
SECTION 4 (4K)						
062	PART I	0112	0030	1327	0 77200 0 00224	0000000000000
063	DIAG. CALLER FOR REC. 062	1400	1400	1421	-0 63400 2 00000	-0 63400 2 00000
064	PART II, FIRST REC.	0004	0033	1104	-0 53400 1 00027	0 00000 0 00000
065	PART II, 2nd REC.	1063	3064	3210	-0 53400 1 00551	-0 63400 4 00122
066	DIAG. CALLER FOR REC. 064 & 065	3211	3211	3232	-0 63400 2 00000	-0 63400 2 00000
067	PART III	0111	0033	0437	-0 54300 3 07774	0000000000000

RECORD NUMBER	DESCRIPTION OF RECORD	TRANSFER ADDRESS 8L DECREMENT	LOAD ADDRESS 8L ADDRESS	LAST ADDRESS 8R ADDRESS	CONTENTS OF TRANSFER WORD	CONTENTS OF LOAD WORD
SECTION 4 (4K) (CONTINUED)						
068	DIAG. CALLER FOR REC. 067					
069	PART IV	0440	0440	0461	-0 63400 2 00000	-0 63400 2 00000
070	DIAG. CALLER FOR REC. 069	0042	0033	0161	-0 53400 1 00031	0 00001 0 00000
071	PART V	0162	0162	0203	-0 63400 2 00000	-0 63400 2 00000
072	DIAG. CALLER FOR REC. 071	0042	0033	0205	0 50000 0 00032	0 00000 7 00000
073	PART VI	0444	0444	0465	-0 63400 2 00000	-0 63400 2 00000
073A	DELETE (8K) PART IV	0100	0033	1021	0 77200 0 00224	00000000000
074	DIAG. CALLER FOR REC. 073	0100	0033	0000	-----	-----
SECTION 4 (8K)		1022	1022	1043	-0 63400 2 00000	-0 63400 2 00000
062 through 072	SAME RECORDS AS USED BY THE 4K VERSION					
073	DELETE (4K) PART VI	0000	0001	0000		
073A	PART VI (8K)	0100	0033	1021	0 77200 0 00224	00000000000
074	SAME AS 4K				-----	
SECTION 5 (4K)						
075	PART 1A-OPTIMIZE	0004	0030	5215	-0 53400 1 00027	0 76200 0 00221
075A	DELETE (8K) PART 1A	0004	0030	0000	-----	-----
076	PART 1B-INITIALIZE & PREDICT LIMIT	7337	7337	7470	0 54300 1 00362	0 53400 1 00362
076A	DELETE (8K) PART 1B	15674	15674	0000	-----	-----
077	DIAG. CALLER FOR REC. 075 & 076	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
078	PART 1C-SUCC.LIMIT	4740	4740	4773	-0 53400 1 00103	-0 53400 1 00103
078A	DELETE (8K) PART 1C	4740	4740	0000	-----	-----

11

RECORD NUMBER	DESCRIPTION OF RECORD	TRANSFER ADDRESS 8L DECREMENT	LOAD ADDRESS 8L ADDRESS	LAST ADDRESS 8R ADDRESS	CONTENTS OF TRANSFER WORD	CONTENTS OF LOAD WORD
SECTION 5 (4K)	**(CONTINUED)**					
079	DIAG. CALLER FOR REC. 078	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
080	PART 1D-PRED.UNDO	4740	4740	4773	-0 53400 1 00103	-0 53400 1 00103
080A	DELETE (8K) PART 1D	4740	4740	0000	-----	-----
081	DIAG. CALLER FOR REC. 080	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
082	PART 1E-SUCC.UNDO	4740	4740	4773	-0 53400 1 00103	-0 53400 1 00103
082A	DELETE (8K) PART 1E	4740	4740	0000	-----	-----
083	DIAG. CALLER FOR REC. 082	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
084	PART 2-PERMUTE	0320	0317	0655	0 76200 0 00223	0 00000 0 77771
084A	DELETE (8K) PART 2	0320	0317	0000	-----	-----
085	DIAG. CALLER FOR REC. 084	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
086	PART 3-GO TO N, ASCONS	0320	0320	0646	0 76200 0 00222	0 76200 0 00222
086A	DELETE (8K) PART 3	0320	0320	0000	-----	-----
087	DIAG. CALLER FOR REC. 086	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
088	PART 4-COMPILE	3541	0317	4515	-0 53400 2 00331	0 00000 0 00003
088A	DELETE (8K) PART 4	3541	0317	0000	-----	-----
089	DIAG. CALLER FOR REC. 088	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
SECTION 5 PRIME						
090	ENTIRE SECTION DIAG. CALLER FOR REC. 090	0030	0030	0444	0 76400 0 00203	0 76400 0 00203
091		0450	0450	0471	-0 63400 2 0000	-0 63400 2 0000

12

RECORD NUMBER	DESCRIPTION OF RECORD	TRANSFER ADDRESS 8L DECREMENT	LOAD ADDRESS 8L ADDRESS	LAST ADDRESS 8R ADDRESS	CONTENTS OF TRANSFER WORD	CONTENTS OF LOAD WORD
SECTION 6						
092	PRE-6	0037	0037	1500	0 77200 0 00202	0 00000 0 00000
093	DIAG. CALLER FOR REC. 092	1367	1367	1410	-0 63400 2 00000	-0 63400 2 00000
		0210	0037	0300	0 53400 2 00255	1 00037 2 00037
094	BINARY SEARCH					
095	DIAG. CALLER FOR REC. 094	1000	1000	1021	-0 63400 2 00000	-0 63400 2 00000
		0400	0210	0601	-0 75400 0 00004	1 00001 2 00211
096	ASSIGN COMMON					
097	DIAG. CALLER FOR REC. 096	1000	1000	1021	-0 63400 2 00000	-0 63400 2 00000
		0400	0400	0647	0 50000 0 00171	0 50000 0 000171
098	EQUIV-DIM					
099	DIAG. CALLER FOR REC. 098	1000	1000	1021	-0 63400 2 00000	-0 63400 2 00000
		0210	0210	0461	0 77200 0 00202	0 77200 0 00202
		0210	0210	0424	-0 53400 1 00154	-0 53400 1 00154
100	COMMON MAPPING					
101	FORTRAN FTN ASSN					
102	DIAG. CALLER FOR REC. 100 & 101	1000	1000	1021	-0 63400 2 00000	-0 63400 2 00000
		0210	0210	0700	-0 53400 1 00155	-0 53400 1 00155
103	FIRST PASS CIT					
104	DIAG. CALLER FOR REC. 103	1125	1125	1146	-0 63400 2 00000	-0 63400 2 00000
		0210	0210	0460	0 53400 4 00402	0 53400 4 00402
105	MAP FORTRAN FUNCT.					
106	DIAG. CALLER FOR REC. 105	1125	1125	1146	-0 63400 2 00000	-0 63400 2 00000
		0210	0210	0500	0 53400 4 00427	0 53400 4 00427
107	MAP EIFN					
108	DIAG. CALLER FOR REC. 107	0040	0040	0061	-0 63400 2 00000	-0 63400 2 00000
		0210	0210	0550	0 50000 0 00171	0 50000 0 00171
		0210	0210	0670	-0 53400 1 00032	-0 53400 1 00032
		0210	0210	0244	0 77200 0 00203	0 77200 0 00203
		0004	1400	2113	-0 53400 1 00027	0 56000 0 01412
		0210	0210	0735	0 77200 0 00204	0 77200 0 00204
109	MAP PROGRAM					
110	MAP OTHER VARIABLES					
111	WRITE PROG. CARD					
112	OP TABLES					
113	2nd PASS CIT					
114	DIAG. CALLER FOR REC. 109,110,111, 112, 113	0040	0040	0061	-0 63400 2 00000	-0 63400 2 00000
115	LIBRARY SEARCH AND PUNCH	0210	0210	4400	0 53400 1 00544	0 53400 1 00544

13

RECORD NUMBER	DESCRIPTION OF RECORD	TRANSFER ADDRESS 8L DECREMENT	LOAD ADDRESS 8L ADDRESS	LAST ADDRESS 8R ADDRESS	CONTENTS OF TRANSFER WORD	CONTENTS OF LOAD WORD
SECTION 1 (8K)						
014	DELETE (4K)COMMON	0000	0001	0000	----- -----	----- -----
014A	COMMON, INITIAL, AND STATE A (8K)	0004	0030	6322	-0 53400 1 00027	0 00000 0 00000
015	DELETE (4K) WRITE DRUM AND INITIAL	0000	0001	0000	----- -----	----- -----
016	DELETE (4K) STATE D	0000	0001	0000	----- -----	----- -----
016A	STATES B,C,& D (8K)	0471	6323	12764	0 53400 1 00504	0 76000 0 00140
017	DELETE (4K) STATE C	0000	0001	0000	----- -----	----- -----
018	DELETE (4K) STATE B	0000	0001	0000	----- -----	----- -----
019	DELETE (4K) STATE A	0000	0001	0000	----- -----	----- -----
020*	DIAGNOSTIC FOR SEC. 1	13440	13440	17777	3 00000 4 13543	3 00000 4 13543

* RECORD 020 USES MODULO ADDRESSING.

RECORD NUMBER	DESCRIPTION OF RECORD	TRANSFER ADDRESS 8L DECREMENT	LOAD ADDRESS 8L ADDRESS	LAST ADDRESS 8R ADDRESS	CONTENTS OF TRANSFER WORD	CONTENTS OF LOAD WORD
SECTION 5 (8K)						
075	DELETE (4K) PART 1A	0000	0001	0000	----- -----	----- -----
075A	PART 1A-OPTIMIZE	0004	0030	5715	-0 53400 1 00027	0 76200 0 00221
076	DELETE (4K)PART 1B	0000	0001	0000	----- -----	----- -----
076A	PART 1B-INITIALIZE AND PRED. LIMIT	15674	15674	16025	0 53400 1 00362	0 53400 1 00362
077	DIAG. CALLER FOR REC. 075 & 076A	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
078	DELETE(4K)PART 1C	0000	0001	0000	----- -----	----- -----
078A	PART 1C-SUCC.LIMIT	4740	4740	4773	-0 53400 1 00103	-0 53400 1 00103
079	DIAG. CALLER FOR REC. 076A	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
080	DELETE(4K)PART 1D	0000	0001	0000	----- -----	----- -----
080A	PART 1D-PRED. UNDO	4740	4740	4773	-0 53400 1 00103	-0 53400 1 00103
081	DIAG. CALLER FOR REC. 080A	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000

RECORD NUMBER	DESCRIPTION OF RECORD	TRANSFER ADDRESS 8L DECREMENT	LOAD ADDRESS .8L ADDRESS	LAST ADDRESS 8R ADDRESS	CONTENTS OF TRANSFER WORD	CONTENTS OF LOAD WORD
SECTION 5 (8K)	(CONTINUED)					
082	DELETE(4K)PART LE	0000	0001	0000	----- ----	----- ----
082A	PART LE-SUCC.UNDO	4740	4740	4773	-0 53400 1 00103	-0 53400 1 00103
083	DIAG. CALLER FOR REC. 082A	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
084	DELETE(4K) PART 2	0000	0001	0000	----- ----	----- ----
084A	PART 2-PERMUTE	0320	0317	0655	0 76200 0 00223	0 00000 0 77777
085	DIAG. CALLER FOR REC. 084A	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
086	DELETE(4K)PART3	0000	0001	0000	----- ----	----- ----
086A	PART 3- GO TO N, ASCONS	0320	0320	0647	0 76200 0 00222	0 76200 0 00222
087	DIAG. CALLER FOR REC. 086A	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000
088	DELETE(4K)PART 4	0000	0001	0000	----- ----	----- ----
088A	PART 4-COMPILE	3541	0317	4516	-0 53400 2 00331	0 00000 0 00003
089	DIAG. CALLER FOR REC. 088A	77750	77750	77771	-0 63400 2 00000	-0 63400 2 00000

1. FNEDT2 will recognize 4 types of control cards in addition to the binary information card (program card) which can follow it in the Editor deck. The following table lists these 5 types of cards along with each card's format.

Type of Card	9L Pref.	9L Decre.	Addr.	9R	8L Decre.	8L Addr.	8R Decre.	8R Addr.
Master Record	1	2	0	Check Sum	Octal Entry Point	Octal First Loc.	0	Octal Last Loc.
New Record	2	2	0	Check Sum	Octal Entry Point	Octal First Loc.	0	Octal Last Loc.
Program	0	Octal no. of words loaded	Octal loc. first word loaded	Check Sum	First word Binary corr. info.		Second word Binary corr. info.	
End File	4	0	0	Check Sum	0		0	
End	7	0	0	Check Sum	0		0	

16

PLIB2 will recognize the following listed cards which can follow it in the Editor deck:

a. Control card for the library routine. See PART III, Section D for description of the format of the control card for a general library subroutine. The format of the control card for both a permanent and a general library subroutine is the same.

b. Relocatable binary cards comprising the library routine.

c. A blank card, FNDE2000, which signals PLIB2 to execute a Load-Button sequence to load in FNDE2.

NOTE: The General Librarian Program, GLIB2, is skipped over by PLIB2 during a System tape generation. GLIB2 is completely described in PART III.

FNDE2 will recognize 3 types of cards which can follow it in the Editor deck. The following table lists these 3 types of cards along with each card's format.

Type of Card	9L Pref	9L Decre.	9L Addr.	9R	8L Decre.	8L Addr.	8R Decre.	8R Addr.
Diagnostic Master Record	4	Word Count	Number of Diagnostic Record (in Octal)	Check Sum	First Addr.	Last Addr.	0	0
Diagnostic	0	Octal No. of words loaded	Octal loc. first word loaded	Check Sum	First word Binary corr. info.		Second word Binary corr. info.	
Diagnostic End	4	0	0	0	0	0	0	0

NOTE: The program card (binary information card) of both FNEDT2 and FNDE2 is the type of binary card loaded by NYBLI. The check sum in 9R in the card included all words punched in the card including 9L but excluding 9R. NYBL1 is a SHARE Library one card loader which loads absolute binary cards. A write-up of NYBL1 may be obtained from the SHARE Distribution Agency.

Illegal Card Sequence

2. The following card sequences in the Editor deck are illegal and will cause a 107_8 stop in FNEDT2:

   a. End card followed by any other type of card, except PLIB2000.
   b. End File card followed by an End File card.
   c. End File card followed by a Program card.
   d. New Record card followed by any card except a Program card.

FORTRAN II Permanent Librarian Program - PLIB2

D. The third file of the FORTRAN II System tape, consisting of the permanent followed by the general library, is produced by the section of the Editor deck named PLIB2, the FORTRAN II Permanent Librarian Program. After generating the first two files, FNEDT2, passes control to PLIB2. PLIB2 reads the permanent library from the card reader and writes it onto the System tape. When it encounters the program cards of GLIB2, FORTRAN II General Librarian, it skips over these cards, reads the general library from the card reader and writes it onto the System tape. The reason for GLIB2 being in the Editor deck is explained later in this Manual. PLIB2 then passes control to the General Diagnostic Editing Program, FNDE2.

FORTRAN II General Diagnostic Editor - FNDE2

E. The FORTRAN II General Diagnostic Editor Program, FNDE2, is the last section of the Editor deck. Its purpose is to read the FORTRAN II General Diagnostic file from the Master tape and write it onto the new System tape.

Maintenance of the Editor Deck

F. Maintenance of the FORTRAN II Editor deck will be by binary cards, distributed by the IBM FORTRAN Maintenance group, for corrections and changes to the System. Memorandums accompanying these change or correction cards will indicate where the cards are to be incorporated into the Editor deck and the reason for the change or correction.

The following types of corrections or changes are possible in the FORTRAN II System:

1. Change existent record on the Master tape.

    If the contemplated change does not involve changing the first or last location which the record is to occupy in core storage, it is sufficient to insert the required program card(s) after the last binary card (if any) following the Master Record. If there is a change in a record's entry point, or if the first or last core location is altered, then its Master Record card must be changed accordingly.

    NOTE: There is no Master Record card in the Editor deck for the special first record, 1-CS.

2. Delete existent record on the Master tape.

    Make the first location higher than the last location on the appropriate Master Record card. This is most easily accomplished by making the last location zero.

3. Insert a New Record.

    Insert a New Record card, followed by the required program card(s), into the Editor deck where the new record is desired.

4. Insert or Delete a File Mark.

    Insert or remove the corresponding End File card in the Editor deck. This action should not be required in using FORTRAN II.

System Tape Format

G. The method of generating a record of the first two files of the System tape by FNEDT2, is as follows:

1. A buffer for each record, except the special first record, 1-CS, of files 1 and 2 is set to 0's in cores.

2. This buffer is then overwritten by any corresponding record of the Master tape (if there is a Master Record card in the Editor deck for that particular record) and in turn is overwritten by any program cards following the Master or New Record card.

3. The buffer is bounded by the first and last location data given on a Master or New Record card.

4. The buffer is preceded by a check sum and the 8L word of the Master or New Record card indicating in octal the entry point and the first location of the record.

5. This buffer is then written from cores onto the System tape as a record.

Operating Instructions - FNEDT2, PLIB2, and FNDE2

H. Upon incorporating the latest change or correction into the Editor deck, the following steps are executed to generate a new System tape. Remember that FNEDT2, PLIB2, and FNDE2 are within the complete Editor deck.

1. Mount the Master tape as logical tape 5. Keep file-protected.
2. Mount the tape, which will become the new System tape, as logical tape 1. Do not file-protect at this point.
3. Ready the FORTRAN II Editor deck in the card reader.
4. Press LOAD CARD button.
5. Correct FINAL STOP occurs at 77777_8.
6. File protect the new System tape on logical tape 1. This tape is ready for immediate FORTRAN II compilations.

Error Halts in FNEDT2, PLIB2, and FNDE2

I. Since FNEDT2, PLIB2, and FNDE2 are executed consecutively in generating a new System tape the following error halts are listed:

Halt (octal):	Reason for Halt:	Procedure:
27	Card check sum error.	Press START to accept information.
54	False EOF at card reader. Should not occur Machine error.	Get off machine, or·try again from beginning of procedure.
72	Card check sum error	Press START to accept card.
107	Illegal card sequence in Editor deck.	Get off machine. Correct Editor deck. Restart entire program.

Error Halts in FNEDT2

	Halt (octal):	Reason for Halt:	Procedure:
	176	False EOF at card reader. Should not occur. Machine error.	Get off machine, or try again from beginning of procedure.
	255	False EOF in reading record from tape 5. Machine error.	Get off machine, or try again from beginning of procedure.
	276	Redundancy or check sum error reading record from tape 5.	Press START to read tape 5 record again.
	327	Master or New Record card calls for record in Editor deck larger than capacity of FNEDT2 buffer. Buffer runs from 353_8 to end of memory.	Get off machine. Record be subdivided.
Error Halt in PLIB2	127	Card check sum error in reading library subroutines from Editor deck.	Press START to accept information.
Error Halts in FNDE2	10	False EOF in loading in FNDE2.	Press START to read more cards.
	5673	EOF at card reader.	Press START to read more cards.
	5714	Checksum error.	Press START to accept information.
	6041	RTT error on reading Master tape.	Halt occurs after 15 tries. Press START to accept information.
	77777	FINAL STOP.	Writing of the new System tape on logical tape 1 is complete.

**Description
of the General
Librarian
Program -
GLIB2**

A. As explained previously, the third file of the System tape
consists of the permanent library followed by the general
library. The permanent library is, of course, never changed.
When additions or deletions to the general library are desired,
GLIB2 makes these changes by first duplicating files 1 and 2 of
the System tape and the permanent library from the existent
System tape onto the new System tape. GLIB2 then reads the
general library from the card reader and writes it onto the
new System tape. FNDE2 then duplicates the fourth file of
diagnostic comments from the existent System tape onto the
new System tape. Each general library subroutine added to
the general library of the Editor deck by the installation must
be in relocatable binary form and preceded by its control card.
The format for a general library subroutine is found in the
FORTRAN II Programmer's Manual. The specifications for
the control card is found in PART D of this Section.

**Operating
Instructions
for GLIB2 and
FNDE2**

B. The following procedure is followed when additions or deletions
are desired in the general library:

1. Extract GLIB2 and all succeeding cards from the existent
Editor deck.
2. Make the desired changes by adding or deleting the general
library control and subroutine cards.
3. Ready this deck in the card reader. It should consist of
GLIB2, the updated general library, and FNDE2.
4. Mount the existent System tape as logical tape 5.
5. Mount the tape, which is to be the new System tape, as
logical tape 1. This tape is not to be file-protected at this
point.
6. Press LOAD CARD button.
7. Correct FINAL STOP occurs at 77777_8.
8. Restore the deck from the card reader stacker to its proper
place in the Editor deck.
9. File-protect logical tape 1. This new System tape is now
ready for immediate object program compiling.

**Error Halts in
GLIB2 and FNDE2**

C. The following error halts may occur during the execution of
GLIB2 and FNDE2:

Error Halts in (GLIB2)	Halt (octal):	Reason for Halt:	Procedure
	40	Either Tape 5 incorrectly written or machine error.	Restart entire program.
	43	RTT error reading tape 5.	Press START to try again.
	56	False EOF, machine error.	Restart entire program.
	62	Tape 1 record word fails to agree with tape 5 record word.	Press START to try again.
	64	Same as for 62.	Press START to try again.
	70	RTT error reading back tape 1 record.	Press START to try again.
	77	False EOR skip. Machine error.	Restart entire program.
	102	False EOF skip. Machine error.	Restart entire program.
	107	Checksum error. reading Tape 5 record.	Press START to reread and recheck tape 5 record.
	112	RTT error reading tape 5 record.	Press START to try again.
	130	False EOF, machine error.	Restart entire program.
	134	Tape 1 record word fails to agree with tape 5 record word.	Press START to reread and recheck tape 1 record.
	136	Same as 134	Press START to reread and recheck tape 1 record

Halt (octal):	Reason for Halt:	Procedure:
142	RTT error reading back tape 1 record.	Press START to try again.
146	RTT stop after having encountered tape 5 file tape marks (file 1)	Press START to recheck tape mark.
160	Same as 146 (file 2)	Press START to recheck tape mark.
173	False EOR skip. Machine error.	Restart entire program.
200	False EOF skip. Machine error.	Restart entire program.
206	Checksum error after reading tape 1 record (file 1)	Press START to try again.
211	RTT error after reading Tape 1 (file 3)	Press START to try again
227	False EOF. Machine error.	Restart entire program.
233	Tape 1 record word fails to agree with tape 5 record word.	Press START to reread and recheck tape 1 record
235	Same as 233	Press START to reread and recheck tape 1 record
241	RTT error reading back Tape 1 record (file 3).	Press START to try again
347	Card check sum error reading general library cards from the card reader.	Press START to accept information.

Halt (octal):	Reasons for Halt:	Procedure:
427	Incomplete 1st record of 1st file written on tape 1.	Press START to try again.
436	Incomplete 1st/2nd file record written on tape 1.	Press START to try again.
454	Incomplete perman-ent library record written on tape 1.	Press START to try again.

FNDE2

Halt (octal):	Reasons for Halt:	Procedure:
10	False End of File in loading in FNDE2.	Press START to read more cards.
5673	End of File at card reader.	Press START to read more cards.
5714	Checksum error.	Press START to accept information.
6041	R TT error on Master Tape.	Halt occurs after 15 tries. Press START to accept information.

General Library Control Card Specifications

D. Each subroutine in the General Library consists of one or more control cards, followed by the subroutine proper on relocatable binary cards. The specifications for the control cards are as follows:

Rows	Columns	
9	1	Must be punched.
	2-3	Blank
	4-18	Count of words on this card, not including the 9 row.
	19-21	Blank
	22-36	Blank

25

Rows	Columns	
	37-72	Checksum (add-and-carry Logical) of all words on this card except 9R.
8	1-3	Blank
	4-18	Length of Transfer Vector.
	19-21	Blank.
	22-36	Number of words (in octal) in subroutine.
	37-57	Blank.
	58-72	The 2's complement of the length of common storage used by the subroutine.
7	1-36	Contains the BCD representation of the name assigned to the first entry point (or to the subroutine if there is only one entry point). If the name contains fewer than 6 characters, each unused 6-digit group at the right must be filled in with the BCD character 110000.
	37-57	Blank.
	58-72	Address, relative to zero, associated with the name in columns 1-36.
6, 5, . . . ,	1-36	If the subroutine contains more than one entry point, the names assigned to the second, third, etc., entry points are listed in these fields in order, i.e., the second in row 6, the third in row 5, etc. When all names have been listed, the remaining rows are left blank. The names are represented as described for Row 7.
	37	Any entry point which will cause the specifications for a library routine to be met can be given a function name (or several names if desired). Such names can be distinguished as primary

or secondary names by not prefixing, or prefixing, the entry point with a minus sign (i.e., a punch in col. 37 of the appropriate row). The meaning of primary and secondary names arises out of the following Rule of precedence which is used by the FORTRAN II System in compiling library subroutines into the Object Program:

RULE: When a function is mentioned in a Source Program, the routine which will be used is the first routine on the System tape which meets either of the following conditions: (1) The name mentioned is a primary name of the routine; or (2) The name mentioned is a secondary name of the routine, and at least one of the primary names of the routine is also mentioned.

Example: If the general library of the System tape is arranged so that the routines which have many secondary names precede the routines with few or none, this above stated Rule will prevent unnecessary duplication of routines in the Object Program. Suppose the System tape contains an arc sine routine which also has an entry point which will compute a square root, and that this routine is given two names, ASINF (primary) and SQRTF (secondary). Also, later on the tape is an ordinary square root routine with the single name SQRTF (primary). Then a source program which asks for both ASINF and SQRTF will cause compilation of the former program only.

Rows	Columns
38-57	Blank

27

Rows	Columns	
	58-72	The address, relative to zero, associated with the name in col. 1-36.

Note: If there are more than one entry point names, one or more additional control cards are required, containing the eleventh, twelfth, etc. names. Supplementary Control Cards must have row 9 punched as described above, and the names must start in row 8.

The number of words (excluding common storage) contained in the general library subroutines along with their description is included in the following table:

Name:	No. of Words (in decimal):	Description:
LOG	39	Natural logarithm subroutine.
SIN/ COS	107	Floating point sine and cosine subroutine.
EXP	47	Floating point exponential subroutine.
SQRT	21	Square root subroutine.
ATAN	84	Floating point arctangent subroutine.
TANH	89	Floating point hyberbolic tangent subroutine.

SECTION II   Using the 704 FORTRAN II System

PART 1   Machine Operations

On-line or   A.   The card input to the 704 FORTRAN II System can be on-line
Off-line   or off-line. If on-line it consists of the Source Program
Input   Statement cards; if off-line, it consists of a tape prepared from
                         the Source Program Statements by perpherial card-to-tape
                         equipment. It should be noted that in batch compiling these two
                         modes of input cannot be inter-mixed.

Tape   B.   The following tape unit assignments are to be made:
Assignment

                 1.   Non-batch compile:

                      a.   Place the System tape on logical tape 1.
                      b.   Place the input tape on logical tape 2, if input is not cards.
                      c.   Ready logical tapes 1, 2, 3, and 4.

                      Note: Logical tape 2 is always readied regardless of whether
                             input is on cards or tape.

                 2.   Batch compile:

                      a.   Place the System tape on logical tape 1.
                      b.   Place the input tape on logical tape 5, if input is not cards.
                      c.   Ready logical tapes 1, 2, 3, 4, 5, 6, and 7.

                      Note: Logical tape 7 is not required if every Source Program
                             calls for punched card output. Logical tape 5 is always
                             readied regardless of whether input is cards or tape.

Sense   C.   The following Sense Switch settings are to be made for FORTRAN
Switch   II compiling:
Settings

                 Sense Switch 1   UP   Binary cards for the object program(s)
                                                  are punched on-line. If not batch
                                                  compiling, tape 3 contains the binary
                                                  program. If batch compiling, tape 3
                                                  contains the binary program for the
                                                  last program compiled. Tape 7 will
                                                  contain no binary programs.

	DOWN	Binary cards for the output program(s) are not punched. Tape 3 contains the binary program for the last or only source program compiled. If batch compiling, tape 7 contains the binary programs for all the source programs compiled in the order they were compiled.
Sense Switch 2	UP	Produces, on tape 2, two files for the source program compiled, containing the source program statements and a map of object program storage. If batch compiling, tape 6 will contain two files for each program compiled and tape 2 will contain two files for the last program compiled.
	DOWN	Adds a third file for each program compiled (see above) containing the object program in SAP (SHARE Assembly Program) type language on tape 2 (and tape 6, if batch compiling).
Sense Switch 3	UP	No on-line listings are produced.
	DOWN	Lists on-line the first two or three files of tape 2, depending on the setting of Sense Switch 2.
Sense Switch 4	UP	Causes FORTRAN II to produce a program optimized with respect to index registers.
	DOWN	Causes FORTRAN II to produce a program not fully optimized, with respect to index registers but which will be translated more rapidly.
Sense Switch 5	UP	Library Routines are not to be punched out or written on tape 3.
	DOWN	Causes Library Routines to be punched on-line or written on tape 3, depending on whether Sense Switch 1 is in the UP or DOWN position.

Sense Switch 6   UP   Single program compilation.

DOWN   Batch compilation.

**Console
Operations**

D. The following operations are to be performed when 704 FORTRAN II compiling:

1. Place the Share Printer Board #2 in the on-line printer.
2. For on-line card input, READY the Source program cards in the card reader.
3. For tape input, READY the card reader without any cards in the hopper.
4. Rewind the FORTRAN II System tape on logical tape 1.
5. Press LOAD TAPE button to begin compiling.

704 FORTRAN II Executive System Halts:

SECTION NUMBER.	REC. NO.	OCTAL LOC.	STOP SOURCE	PROCEDURE AND DETAILS
1-CS	000	27	Tape 1	Press START to try reading Tape 1 (System Tape) again. Tape 1 has been read once unsuccessfully due to either Redundancy error or check sum error in reading in System record.
1	013	30	Machine error.	If not batch compiling, press START to rerun problem. If batch compile, press START to rerun current problem; or, turn on Sense Light 1 and press START if next problem is to be compiled.
PRE 1	001	0147	Program	Remove cards from card reader and run out the cards in the reader. There is an impossible character (non-hollerith) in the 3rd card from the last card in the stacker. Correct the invalid character before recompiling.
Successful Compilation Record	009	35	Job Completed	Compilation is complete. All source programs have been compiled, or an attempt at compilation has been abandoned because of source program or machine error. Computer control is returned to the installation via a load button sequence. If card reader is ready, but empty of cards, this halt results.
Source Program Error Record	010	50	Source cards or tape 5	Compilation is complete. There has been a source program error if in single problem compile mode. This halt can also result if the END card in a batch compilation is missing or mispunched, or if tape 5 cannot be read successfully. Computer control is returned to the installation via a load button sequence. If card reader is ready, but empty of cards, this halt results.

tion
of FORTRAN
II Compilation

A. FORTRAN II compilations are terminated by successful compilation or machine error stops.

    1. Successful compilation.

        a. The tape and punched card output of a FORTRAN II compilation is given in B and C which follows.

        b. A load-button sequence for the card reader is executed. If the card reader is empty and the operator presses START, the FINAL STOP occurs at 35_8.

    2. Machine error stop.

        a. The FORTRAN II Diagnostic system is explained in SECTION V.

**Tape
Output**

B. **FORTRAN II** produces the following tape output (if Sense Switch 1 is DOWN):

    1.   Non-batch compile:

        a.   Logical tape 2 (for off-line printing) contains:

            File 1: Source Program
            File 2: Map of Object Program storage
            File 3: Program in SAP type language (if Sense Switch 2 is DOWN)

            Note: The printer must be on Single or Double space for off-line printing.

        b.   Logical tape 3 contains binary output as follows:

            Main Program consisting of:

            Program Card
            Program in Relocatable Binary
            Transfer card in Relocatable Binary

            <u>or</u>

            Subprogram consisting of:

            Program card
            Program in Relocatable Binary

            Note: The BSS Loader is not written on tape 3. Each tape 3 record is a card image.

    2.   Batch compile:

        a.   Logical tape 6 (for off-line printing) contains:

            Same as "1.a" for each program.

        b.   Logical tape 7 contains binary output as follows:

            Same as "1.b" for each program (if Sense Switch 1 is DOWN).

            Note: The BSS Loader is not written on tape 7. Each tape 7 record is a card image.

33

Punched Card Output

C. FORTRAN II, if Sense Switch 1 is UP, produces the following punched card output:

1. Compilation of a Main Program:

    BSS Loader (9 cards)
    Program card
    Program in Relocatable Binary
    Transfer card (9 punch in col. 1)

2. Compilation of a Subprogram:

    Program card
    Program in Relocatable Binary

    Note: The BSS Loader and the Transfer card are not
           punched out for Subprogram(s).

Executing the Object Program

Object Program Deck

Composition   A. The binary card output of a Main Program compilation consists
of the Object   of the following sequence of cards:
Program
Deck   BSS Loader (9 cards)
                            Program Card
                            Program in Relocatable Binary
                            Transfer Card (9 punch in col. 1)

                            The binary card output of a SUBROUTINE or FUNCTION sub-
                            program compilation consists of:

                            Program Card
                            Program in Relocatable Binary

                            Where a permanent or general library subroutine is called,
                            by a program compilation that does not suppress punching of
                            subroutine cards, the subroutine card output will be:

                            Program Card
                            Program in Relocatable Binary

Preparing   B. In order to run the Object Program, the FORTRAN II Object
the Object   Program deck must consist of the following sequence:
Program Deck
for Loading   BSS Loader
                        Program Card
                        Program in Relocatable Binary
                        Program Card
                        Program in Relocatable Binary
                        Program Card
                        Program in Relocatable Binary

                        --
                        --

                        Transfer Card (9 punch in col. 1)

                        One of the programs must be a Main Program and all the others
                        subprograms. The programs may be in any order.

                        The deck is readied in the card reader and the LOAD CARD
                        button is pressed.

1. All the subprograms called for in the Main Program and other subprograms must be in the deck if it is to run. Of course, they normally will be as a result of a compilation with Sense Switch 5 DOWN. If any are missing, a stop at 77756 or 77775 will occur during loading.

2. Although duplicate subroutines taken from the library tape will never occur in a single Main Program, SUBROUTINE, or FUNCTION compilation, they may easily occur in a Main Program - Subprogram sequence. If this occurs, the duplicate copies will be loaded, although only the first of these will ever be called during execution.

   a. To save core space during execution, the duplicate subroutines should be extracted from the compiled deck. This may be accomplished be searching for the program card that identifies it and removing it along with its binary cards.

      1. The program card is identified by a 9 punch in column 1 and by punching in the 8 row words. The transfer card, which also has a 9 punch in column 1, has no punches elsewhere. The program card of a subprogram is distinguished from the program card of a Main Program by not being blank in the 7 row.

      2. The physical sequence of subprograms belonging to any Main Program, SUBROUTINE, or FUNCTION compilation is the exact reverse of their appearance in that section of the Object Program Storage Map labelled "Subroutines Punched from Library."

   b. In order to save both compilation time and card searching time caused by duplications of library subroutines, binary card copies of certain of these frequently used subroutines may be kept aside and inserted into the load deck when needed. This would enable some programs to be run with Sense Switch 5 UP, which otherwise could not be.

3. The transfer card must be the last card in the load deck. It is, however, compiled as the last card in the Main Program, and the Main Program may not be the last program in the deck ready for loading. In this case, two alternatives are available:

   a. The transfer card may simply be extracted and placed at the end of the complete load deck.

   b. Another transfer card (9 punch in col. 1) may be placed at the end of the load deck. In this case a stop at 77775 will occur during loading at the time the first transfer card is encountered. Pressing the START button enables loading to continue.

The Control Card

C. The Control card is used to relocate lower memory locations upwards in cores, and Common data downwards in cores. That which is referred to in the FORTRAN II Manual as the Common Reassignment Card is a Control card with reference only to the relocation of Common. When the Control card is used, it must be placed immediately before the program card of the program concerned.

Error Halts in the BSS Loader

Error Halts
in the BSS
Loader

Halt (Octal):	Reason for Halt:	Procedure:
3	Instructions and symbol table of Loader overlap.	Terminate loading. Combination of program and transfer vectors too long. Rewrite program.
20	End of File in the card reader.	Press START to read more cards.
77453	Instructions and data overlap.	Terminate loading. Combination of instructions and data too long. Rewrite program.
77556	Check sum error.	Press START to accept information.
77756	More than 20 subroutines are missing.	If missing subroutines are at hand, press START until stop at 77775$_8$ is reached. Follow instructions (a) for that stop.
77775	Missing subroutines.	This stop indicates the TRANSFER CARD has been reached. It is caused by one of two occurrences: (a) Loading has been completed, but at least one of the subroutines called for is missing. Location 77453 contains the BCD name of the first missing subroutine, location 77454, the second, etc. If the missing subroutine(s) is immediately available, it may be loaded without starting the entire loading process over again. Place another TRANSFER CARD (9 punch in col. 1) at the end of the routine(s), ready in the card reader and press START. (b) The TRANSFER CARD encountered is really a premature one that simply has not been withdrawn. Be certain that a TRANSFER CARD is the last card at the end of the deck and press START.

Error Halts in the Object Program

Error Halts in the Object Program

There are 11 standard error halts in Object Program level Input-Output routines. They are to be recognized not by looking at the Instruction Counter but by looking at the HPR instruction itself in the Storage Register.

Halt:	Reason for Halt:	Procedure:
HPR 0,0	End of File in reading binary tape.	Press START to begin reading next file.
HPR 0,1	End of File in reading cards or BCD tape.	Press START to begin reading next file.
HPR 1,1 HPR 2,1 HPR 3,1 HPR 4,1	Inappropriate character encountered in a data field in reading cards or BCD tape.	Pressing START causes that character to be treated as a zero.
HPR 5,1	Illegal Control Character in FORMAT Statement.	Press START to continue.
HPR 0,2	Non-hollerith character encountered in reading input cards.	Correct card, ready in the card reader and press START. DO NOT press START before correcting card(s).
HPR 0,3	Redundancy check in reading BCD tape.	Press START to accept information read.
HPR 0,4	Echo check in printing.	Press START to continue. Press RESET and then START to repeat line and then continue.
HPR 7,7	Binary tape error in reading binary tape.	Press START to accept information read.

Note: The error halt HPR 7,7 in octal, as it would appear in the Storage Register, is shown as follows:

042000700007

Additional Halts in the Object Program:

If a Source Program does not end with either a PAUSE, STOP, or an IF/GO TO type statement, a card reader load button sequence of instructions is compiled as the last executable instructions in the object program. Two halts, namely HPR O, 7 and HPR 1, 7, appear in this sequence of instructions.

The compiled instructions are as follows:

```
            RCD
            CPY O
            XIT *+2
            HPR O, 7        CARD READER EMPTY
            CPY 1
            XIT O
2047D1      HPR 1, 7    CARD READER EMPTY, START BUTTON PRESSED
            TRA 2047D1
```

The HPR O, 7 signals an EOF condition at the card reader. In the event the START button is pressed, the HPR 1, 7 occurs.

Table and Description of the Permanent Library

The number of words (excluding common storage) contained in the permanent library subroutines are included in the following table along with a description of their function at Object Program execution.

Name:	No. of Words (in decimal):	Description:
DBC	462	Converts BCD to binary according to the Source Program input Format statement.
CSH	137	Reads Hollerith input data cards from the card reader and converts this data to BCD.
TSH	21	Reads BCD data from a BCD input data tape.
BDC	514	Converts internal binary to BCD according to the Source Program output Format statement.
SCH	90	Converts BCD to punch image and punches Hollerith cards on-line.
SPH	158	Converts BCD to a print image and prints and echo-checks on-line.
STH	12	Writes BCD data on BCD output tape.
LRT	80	Saves machine configuration (i.e., AC overflow, etc.) upon entering input conversion routine and restores them upon exiting back to the main program.
EXP(1	34	Exponential routines compiled by a Source Statement such as Y=E**X. One of the three routines is compiled depending on whether a fixed point base - fixed point exponent, floating point base - fixed point exponent, or a floating point base - floating point exponent mode, respectively, is specified in the Source Statement.
EXP(2	38	
EXP(3	100	

40

Note: The subroutine FIL, which controls the transmission
of any remaining BCD output, is contained in the
subroutine BDC.

The subroutine LEV, which saves all indicators before
Input-Output transmission, and the subroutine RTN,
which restores all indicators after Input-Output
transmission, are contained in the subroutine LRT.

PART 2 FORTRAN II Pseudo-Operations

FORTRAN II
Pseudo-Operations Two pseudo-operation codes, XIT and NTR, appear in the SAP
type language listing. They are compiled purely for reasons
internal to the FORTRAN II executive system. XIT is simply
another way of designating the machine code TTR (0021) and
NTR designates a TXI (1000). These are found only in
instructions resulting from Input-Output statements.

Input & Output Only
XIT same as TTR
NTR   "   "   TXI

41

The FORTRAN II Diagnostic may be considered as having two divisions -.the Section I diagnostic and the General diagnostic. As an adjunct to the diagnostic, special supervisory routine records have been inserted into the system.

**Section I
Diagnostic**

A. This diagnostic has the purpose of detecting as many errors as possible on the language or syntactical level. It results from the statement by statement scan of the entire problem that Section I performs.

1. When a Source program error is detected, a print-out occurs of the offending statement, together with an explanation of it. Section I then proceeds to its scan of the next statement. This means that the first error only in any one statement is detected. When all statements have been scanned, a stop occurs advising that the Section I diagnostic is now complete. If batch compiling, FORTRAN II will go on to the next problem (via the Source error diagnostic reference record described below).

2. If a machine error occurs, the error print-out advises on how to proceed. The operator can press START to rerun problem or key in Sense Light 1 to go on to the next problem if batch compiling. If both machine and source error occur during Section I diagnostic there will, of course, be no option of re-running the program.

**General
Diagnostic**

B. The errors covered by the General Diagnostic, its structure on the system tape, and its operation are described as follows:

1. Types of error.

In addition to machine errors, the general diagnostic covers Source Program errors revealed by Sections 1' and 1" through Section 6 of FORTRAN II.

a. Section 1" is a special diagnostic routine meant to detect the great proportion of the source program errors not found by Section 1. These are primarily errors arising from the inter-relationships among statements. Examples of such source program errors are transfer references to non-existent statement numbers, parts of the program to which there is no path of flow, and transfers to non-executable statements.

b. The source errors revealed by Sections 2 through 6 are primarily those arising from the exceeding of source program size limitations. These limitations are given in the section on maximum table sizes in the FORTRAN II Reference Manual.

2. General diagnostic on the System tape.

a. An 18 word diagnostic record follows every record-string on the System tape. This record is the diagnostic call-in. A record-string is defined as a sequence of records which are consecutively read into cores before execution of any one of them begins. A record-string may consist of one record.

b. The entire fourth file of the system tape is part of the general diagnostic. A description of the fourth file records is as follows:

(1) 1st record - a short read-in record, reading in the second or main record.

(2) 2nd record - the main record which determines the compilation stop and other necessary information involved.

(3) other records - contain the specific comments and relevant table look-ups for the particular compilation stop.

c. There are three records used in conjunction with the diagnostic. These are explained in detail in Section C below. In addition, there is a batch compile monitor record, which operates independently of the diagnostic, but which is sometimes used in the transfervance of control between these records.

(1) The three supplementary diagnostic records are the Source Program Error Diagnostic Reference Record, the Machine Error Diagnostic Reference Record, and the Successful Compilation Record. These are records 10, 13, and 9 respectively in the FORTRAN II Editor deck.

(2) The batch compile monitor is referred to only when in the batch compile mode and when it is desired to bring in the next program for compilation.

(a) After determining that there is a next program, it transfers the program from Tape 5 to Tape 2 where it is ready for compilation.

43

(b) There is one Source Program error that is found by the batch compile monitor and this is any discrepancy in the END card of the final program.

3. Operation of the General Diagnostic.

   a. When a machine or source error is encountered, the call-in record following the current record-string is read into cores.

   b. It reads the first 2048 words of cores onto Drum 4 (upper cores in case of drumless versions of FORTRAN II) and spaces forward to the 1st record of the 4th file.

   c. This record reads in the main diagnostic record. The main diagnostic record prints out the title, the number of the stop, and the number of the FORTRAN II system record in which the stop occured.

   d. The main record make a table search to determine which of the following 4th file records contains the particular information pertaining to the stop. It then reads in that record.

   e. The particular stop record contains the error comment explaining the stop. In addition, it may contain program instructions which will be executed in order to obtain detailed information that will become part of the error comment. The error comment is then printed.

   f. At this point a branching occurs, depending on whether error was a source or a machine error. For each of these cases control returns to a different point in the main diagnostic record and the printing occurs advising of the alternatives the operator may take if such alternatives are available. Then the system tape is re-wound and spaced to the particular - source or machine - diagnostic reference record.

   g. The alternatives are determined in the following manner:

      (1) If batch compiling:

         Source program error - FORTRAN II goes on to the next program, if any remain.

         Machine error - Press START to rerun current program, or key in Sense Light 1 to go on to the next program.

44

(2) Not batch compiling:

Source program error - Card reader load button sequence executed. Halt occurs at 50_8, if card reader is empty.

Machine error - To rerun problem, key in Sense Light 1 and press START.

Supplementary Records

C. The supplementary records serve two main functions.

1. They are the media through which decisions are made and control is passed when compilation is concluded on any one problem or on a series of problems that have been batch compiled. The following information giving the operations of these records should be supplemented by Section D.1, which tells which tapes are rewound by each of the records.

   a. Successful Compilation Record - Record 9

   This record is reached only when compilation is entirely completed. It executes a card reader load button sequence.

   (1) If batch compiling:

   (a) After successfully compiling last program, it is reached via the batch control monitor.

   (b) If last program is halted, because of error, it is reached via the appropriate error diagnostic reference record and the batch control monitor.

   (2) If not batch compiling, the record is reached only after successful compilation.

   b. Source Program Error Diagnostic Reference Record - Record 10

   (1) If not batch compiling - executes a card reader load button sequence.

   (2) If batch compiling - transfers directly to batch compile monitor to obtain next program. If there is no next program, the monitor transfers control to the successful compilation record.

45

(3) For certain stops during batch compilation -

There are a few stops in FORTRAN II which are most likely source errors, but which have some possibility of being machine errors. For these cases, the option is provided at the time of the stop of rerunning the problem. For this purpose, a test of Sense Light 1 is made. If the Sense Light is on, the problem is rerun.

c. Machine Error Diagnostic Reference Record - Record 13

(1) If batch compiling - press START to rerun problem. If Sense Light 1 is on, it will go to the batch control monitor for the next problem. If there is no next problem, the monitor transfers control to the successful compilation record.

(2) If not batch compiling - press START to rerun problem.

2. Supervisory and special error routines may be inserted into these records by the installation. Insertions are made by means of the Editor deck.

a. Successful Compilation Record. This record, as it is the very last record executed in most cases traced above, may be changed and added to in any desired manner. A symbolic listing of this record appears in D.2 below.

b. Machine and Source Program Error Records. It it is desired to make insertions into these records, great care must be exercised. Certain conditions are necessary for subsequent FORTRAN compilation and these conditions must not be altered.

Tape Rewind Chart

D. The following chart indicates the tape rewinds in both batch and non-batch compile mode.

Batch Compile mode:

Section 6 rewinds tapes 2, 3, and 4.

Batch compile monitor (at end of batch compiling) rewinds tapes 5 and 6.

Successful Compilation record rewinds tape 1.

Non-batch Compile mode:

Section 6 rewinds tapes 2, 3, and 4.

Successful Compilation record rewinds tape 1.

Successful Compilation Record Listing

Control is returned to this record (Master Record F0090000 in the Editor deck) at the completion of a single problem compilation, or at the end of batch compilation. Tape 1 is rewound and a load-button sequence is executed at the card reader. An installation may change this record to suit its own operating needs.

Symbolic Listing:

```
                ORG 24
START           LTM
                REW 1
                RCD 209         Card reader load-button sequence.
                CPY 0
                TRA SECCPY
                HTR 32767       Card reader empty, Halt.
SECCPY          CPY 1
                TRA 0
                END 24
```

Additional Built-in Functions

PART 1

Changes to
Section I of
FORTRAN II
Executive
Program

Changes to Section 1 of FORTRAN II Executive Program

Provision has been made for the addition of up to ten built-in
functions to the FORTRAN II system by the individual installations.
To accomplish this, certain additions and changes are to be made
to Sections I and III of the FORTRAN II system tape.

Changes in State C of Section I in the Editor deck are as follows:

1. The name of each new routine, up to ten, is added to the
   dictionary beginning at location 4756_8 (4 K version) or at location
   11143_8 (8 K version). The name consists of 3, 4, 5, or 6 alpha-
   numeric characters, omitting the terminal F used in the FOR-
   TRAN II Source language. The first character must be alpha-
   betic and must be X if the function is to be fixed point. If the
   name has fewer than 6 characters, each unused 6-digit group
   at the right must be filled in with the BCD character 110000
   (blank). The binary correction card containing this information
   is placed behind Master Record F017 (4 K version) or behind
   F016A (8 K version).

2. The decrement which controls the search of the dictionary is
   changed by a binary correction card. The decrement of the TXH
   instruction at location 4266_8 (4 K version) or at location 10453_8
   (8 K version) must be changed by -1 for each name added to
   the present number of built-in functions. At present, the
   decrement is the 2's complement of 20. If one more routine
   is added, for example, the decrement must be reset to the 2's
   complement of 21. The following shows the present TXH
   instruction for both the 4K and the 8 K versions:

   4 K version: 3 77754 2 04262   (TXH instruction at location 4266_8

   8 K version: 3 77754 2 10447   (TXH instruction at location 10453_8

   The binary correction card containing this information is placed
   behind Master Record F017 (4 K version) or behind Master
   Record F016A (8 K version).

**Changes to
Section 3 of
FORTRAN II
Executive
Program**

The function of Record 55 (Block 1B of Section 3) is to select
the open-subroutine desired and subsequently transfer to the
specific routine needed to compile instructions for the object
program. This routine can be written by the individual in-
stallation in the form required by Section 3. A listing of
Record 55 is included in Part IV of this Section of the Manual·
to serve as a reference for writing and including new routines.
Two new routines, DIM and XDIM, have been added by means
of Record 55 and will serve as an example for the installation.
These routines begin at location 7170_8 in the listing.

Changes to Record 55 are as follows:

1. The name(s) of each routine added, up to ten, is added to
   the dictionary beginning at 7124_8. The format of the name(s)
   must be exactly as used for State C of Section 1 in the Editor
   deck.

2. The decrement which controls the search of the dictionary must
   be changed. If done in binary, the correction must be made to
   the TXH instruction at 7077_8. The decrement is the 2's com-
   plement of the number of names which appear in the dictionary
   (M1D2). At present, the decrement is the 2's complement of
   2. If the routine is changed symbolically, the symbol M1D2L
   used for the decrement of the TXH instruction at 7077_8 must be
   defined. This would appear in the constant area, beginning
   at 7230_8. An example would be: M1D2L   EQU -K, where K
   depends on the number of names which appear in the dictionary.

3. Beginning at 7110_8, a series of TRA instructions are to be in-
   cluded for each routine that is added. These instructions must
   be in the same sequence as the names appear in the dictionary.
   The TRA address should be to either the octal location where
   the specific routine for compiling appears, or, if done symbol-
   ically, it should be the symbolic name of the routine.

4. The locations beginning at 7240_8 through 7777_8 can be used for
   the additional routines which will compile the actual instructions
   necessary. The operation codes used must meet the require-
   ments of the CIT specifications. The XDIM and the DIM routines
   are typical examples. These two routines have been combined by
   the use of Sense Switch 4, which is always available for the add-
   itional routines. The comments of these two routines tell ex-
   actly what is intended by each of the instruction.

5. Each new routine added must include:

    a. A TSX 7146_8, 4 (007400407146) to test the number of arguments specified.

    b. A TSX 7154_8, 4 (007400407154), which will determine the nature of the first argument and subsequently prepare the compiling locations of the calling sequence to the CIT routine. These locations will then include all necessary addresses, tags, etc.

    c. A TXI 7174_8, 1, -4 (177774107174) in order to update the input AlL buffer.

    d. A TSX 7136_8, 4 (074004 07136) in order to determine if at the end of an AlL block and if so, make the necessary adjustments.

6. If there should be exactly two arguments specified, a TSX 7152_8, 4 (007400407152) will perform this test. Also, a TSX 7154_8, 4 (007400407154) must be included again in order to determine the nature of the second argument and make the necessary adjustments. This, however, must be done after an instruction utilizing the first argument has been compiled.

7. If there are more than two arguments defined, a repetition of steps 1-5 can be performed. Exclude a check for the second argument, since, in this case, the check is not valid.

8. After all input tests have been coded, the instructions which follow should be a TSX 707_8, 4 (007400400707), followed by 4 parameters (for each instructions of the added routine) which the CIT routine of the system proper requires in determining the compiled instruction necessary to the CIT format. The initial instructions, concerning the arguments, will have their parameters initialized by the routine beginning at 7154_8 (called ARGTAG). All other instructions will generally contain a zero for the first parameter, an operation code (XXX) for the second parameter and zeroes for the third and fourth parameters. However, in the case of transfer type instructions, an * ± K is given in the third and fourth parameters to obtain the proper transfer address. A $(17)_8$ in bits S-5 of the third parameter defines the symbolic address as an *, and a ± K in the address of the fourth parameter will either increment or decrement the *.

9. The last instruction in the new routine added must be a TXI 774_8, 1, -4 (177774100774). This will restore proper linkage with the main program.

10. All constants, which are required by the added routine, and not presently included, must be added along with the specific routine.

11. If corrections are made in binary, they must be placed behind Master Record 55 in the Editor deck. If symbolic corrections are made, the record must be reassembled, and will replace the present Record 55 on the system tape. However, there will be no need to change the Master Record card for Record 55. Merely place the new binary cards behind the Master Record card.

12. The built-in function DIMF (Arg_1, Arg_2), which has served as an example, is defined as Arg_1 - Min (Arg_1, Arg_2).

    An example of use in a Source Program is as follows:

    ```
        READ 2, A, B
        BIGX = DIMF (A, B)
        PRINT 2, BIGX
    2   FORMAT ( 2D12.4)
        STOP
    ```

    The four instructions compiled in calling for DIMF in the above example, as they would appear in an actual SAP-type listing of a main program, are shown below:

    ```
    4A  CLA A          (1st instruction of DIM)
        FSB B          (2nd instruction of DIM)
        TPL *+2        (3rd instruction of DIM)
        PXD            (4th instruction of DIM)
        STO BIGX
    ```

Description of FORTRAN II CIT Format	The FORTRAN II CIT (Compiled-Instruction-Table) format consists of 4 words for each compiled instruction. The format for each of these words are shown in the following tables:

Word 1:

S	1 - 2	3 17	18-20	21 32	33 - 35
		Internal Formula Number (IFN) in binary, right-adjusted		Instruction Number within IFN. In binary and right-adjusted	

The S bit of word 1 is a minus if instruction pertains to a open subroutine.

Word 2:

S 17	18 - 20	21 35
Operation Code in BCD		Decrement, in binary and right-adjusted.

Word 3:

S   35
Symbolic address in BCD.

The symbolic address in word 3 can consist of one of the following forms:

1. If the address utilizes 6 BCD characters, it occupies the full word.

2. If the address is less than 6 BCD characters, it is terminated by a BCD blank character (110000):

Examples:

S 35	S 35
ABCDEF	21 | 22 | 23 | 24 | 25 | 26
ABCDEb	21 | 22 | 23 | 24 | 25 | 60
ABCb00	21 | 22 | 23 | 60 | 00 | 00
Ib0000	31 | 60 | 00 | 00 | 00 | 00

3. Special address signal:

A (17_8) in bits S-5 defines the symbolic address as an *, such as the case of the TPL * + 2 in DIM.

Word 4:

S	1 - 2	3 17	18-23	24 35
		Addend portion of Symbolic address or absolute address, in binary, and right-adjusted.		Symbolic tag appears as a binary number.

The S bit of word 4 is plus if there is an addend in the decrement, and minus if there is a subtrahend in the decrement.

53

PART 4   Listing of Record 55

Listing of   The SAP listing of Record 55 is as follows:
Record 55

```
                07071           ORG 3641
                                MASTER RECORD CARD = FN055
                                   ROUTINE TO HANDLE ADDITIONAL SUBROUTINES IF DESIRED      F3B12180
07071  2 00001 4 01306          TIX M13505,4,1        COMPARE M1D FOR PRESENT SUBROUTINES   F3B12190
07072 -0 53400 4 02170          LXD L(0),4            COMPARE ADD IT, OPEN SUBS. IN M1D2    F3B12200
07073  0 34000 4 07122   OP1    CAS M1D2,4            WITH CURRENT NAME.                    F3B12210
07074  1 77777 4 07077          TXI OP2,4,-1          NOT FOUND, GET NEXT M1D2 ENTRY        F3B12220
07075  0 02000 0 07101          TRA OP3               FOUND                                F3B12230
07076  1 77777 4 07077          TXI OP2,4,-1          NOT FOUND, GET NEXT M1D2 ENTRY.      F3B12240
07077  3 77776 4 07073   OP2    TXH OP1,4,M1D2L       TEST FOR END OF M1D2.                F3B12250
07100  0 07400 4 00004        , TSX 4,4               CURRENT SUB NOT IN M1D2              F3B12260
07101 -0 63400 4 02312   OP3    SXD CCELL,4           SAVE IRC FOR LATER BRANCH OF SAME INST. F3B12270
07102  1 77776 1 07103          TXI OP3+2,1,-2        INDEX TO GET NEXT 4 WORD INSTR.     F3B12280
07103  0 07400 4 07136          TSX TEST,4            TEST FOR END OF CUR. COMPAIL REC.   F3B12290
07104 -0 53400 4 02312          LXD CCELL,4           GO TO THE COMPILER FOR PART. SUBROUTINE F3B12300
07105  0 02000 4 07106   OP4    TRA OP4+1,4           COMPAIL INSTRUCTION                 F3B12310
07106  0 02000 0 07170          TRA XDIM              OPEN SUB IS XDIM                    F3B12320
07107  0 02000 0 07171          TRA DIM               OPEN SUB IS DIM                     F3B12330
07110  0 00000 0 00000          HTR                   SPACE FOR BRANCHING TO 10 ADDITIONAL F3B12340
07111  0 00000 0 00000          HTR                   OPEN SUBROUTINES THE LIST OF TRANSFERS F3B12350
07112  0 00000 0 00000          HTR                   TO ADDITIONAL OPEN SUBS MUST BE ORDER- F3B12360
07113  0 00000 0 00000          HTR                   ED IN THE SAME WAY AS THE ADDITIONAL OPEN F3B12370
07114  0 00000 0 00000          HTR                   SUB NAMES ARE ORDERED IN THE DICTION- F3B12380
07115  0 00000 0 00000          HTR                   ARY M1D2.                          F3B12390
07116  0 00000 0 00000          HTR                                                      F3B12400
07117  0 00000 0 00000          HTR                                                      F3B12410
07120  0 00000 0 00000          HTR                                                      F3B12420
07121  0 00000 0 00000          HTR                                                      F3B12430
                                THE DICTIONARY FOR ADDITIONAL OPEN SUBROUTINES, AND       F3B12440
                                CONSTANTS USED IN THE DISCRIMINATION PROCEDURE.          F3B12450
07122  672431446060     M1D2    BCD 1XDIM             OPEN SUB XDIM                      F3B12460
07123  243144606060             BCD 1DIM              OPEN SUB DIM                       F3B12470
07124  0 00000 0 00000          HTR                   SPACE FOR ADDING 10 ADDITIONAL OPEN SUBS. F3B12480
07125  0 00000 0 00000          HTR                                                      F3B12490
07126  0 00000 0 00000          HTR                                                      F3B12500
07127  0 00000 0 00000          HTR                                                      F3B12510
07130  0 00000 0 00000          HTR                                                      F3B12520
07131  0 00000 0 00000          HTR                                                      F3B12530
07132  0 00000 0 00000          HTR                                                      F3B12540
07133  0 00000 0 00000          HTR                                                      F3B12550
07134  0 00000 0 00000          HTR                                                      F3B12560
07135  0 00000 0 00000          HTR                                                      F3B12570
                                FOUR SUBROUTINES USED IN COMPILING OPEN SUBROUTINES       F3B12580
                                1.TEST                                                    F3B12590
07136 -0 63400 4 07230   TEST   SXD C,4               SAVE LINKAGE                       F3B12600
07137 -0 75400 1 00000          PXD 0,1               COMPARE CURRENT VALUE OF IR1 WITH   F3B12610
07140  0 34000 0 02305          CAS M1ALWN            2S COMPL. OF WORD COUNT.            F3B12620
07141  0 02000 4 00001          TRA 1,4                                                   F3B12630
07142  0 07400 4 00341          TSX M10210,4          CURRENT RECORD EXHAUSTED            F3B12640
07143  0 07400 4 00004          TSX 4,4               STOP. NO OF WDS. IN CUR REC EXCEEDS WD. F3B12650
                                                      COUNT                              F3B12660
07144 -0 53400 4 07230          LXD C,4               RESTORE LINKAGE                    F3B12670
07145  0 02000 4 00001          TRA 1,4               RETURN                             F3B12680
                                2 TEARG1. ROUTINE TO DET. IF TOO FEW ARGS SPECIFIED      F3B12690
07146  0 50000 1 02327   TEARG1 CLA AIL,1             TEST FOR ALL ONES IN 1ST WD OF CUR. INSTR F3B12700
```

55

```
07147  0 40200 0 02211       SUB ALLONE                                                    F3B12710
07150  0 10000 0 02155       TZE ERROR1         ALL ONES. GO TO PROPER STOP                F3B12720
07151  0 02000 4 00001       TRA 1,4            NOT ALL ONES. RETURN                        F3B12730
                                        3 TEARG2. ROUTINE TO DET. IF TOO MANY ARGS. SPECIFIED   F3B12740
07152  0 50000 1 02327  TEARG2 CLA AIL,1        TEST FOR ALL ONES IN TST WORD OF            F3B12750
07153  0 02000 0 07235       TRA SUBPAT                                                     F3B12760
07154  0 50000 1 02331  ARGTAG CLA AIL+2,1      PLACE SUMB ADDRESS OF CURRENT ARG           F3B12770
07155  0 60100 0 02324       STO M1CW+2         IN M1CW+2                                    F3B12780
07156  0 50000 1 02332       CLA AIL+3,1        PLACE RELATIVE ADD. AND TAG OF CUR-         F3B12790
07157  0 60100 0 02325       STO M1CW+3         RENT ARG. IN M1CW+3                          F3B12800
07160 -0 32000 0 02297       ANA TGMSK          TEST FOR TAG                                 F3B12810
07161  0 10000 4 00001       TZE 1,4            NO TAG. RETURN                               F3B12820
07162 -0 63400 4 07230       SXD C,4            ARG TAGGED. SAVE LINKAGE                     F3B12830
07163 -0 76000 0 00143       MSE 99             TEST FOR END OF CHTAG TABLE                  F3B12840
07164  0 07400 4 01116       TSX M1250,4        CHTAG TABLE NOT EXHAUSTED.                   F3B12850
07165  0 76000 0 00143       PSE 99             END OF CHTAG TABLE. RESTORE IN-             F3B12860
07166 -0 53400 4 07230       LXD C,4            DICATOR AND LINKAGE                          F3B12870
07167  0 02000 4 00001       TRA 1,4            RETURN                                       F3B12880
                                        THE ROUTINE FOR COMPILING THE OPEN SUBROUTINES DIM AND XDIM   F3B12890
07170  0 76000 0 00144  XDIM PSE 100            TURN ON SENSE LIGHT 100 FOR XDIM            F3B12900
07171  0 07400 4 07146  DIM  TSX TEARG1,4       TEST NO. OF ARGS SPECIFIED                  F3B12910
07172  0 07400 4 07154       TSX ARGTAG,4       TEST WHETHER FIRST ARG. IS TAGGED          F3B12920
07173  1 77774 1 07174       TXI 01,1,-4        INDEX COMPAIL RECORD TO BEG. OF NEXT REC.   F3B12930
07174  0 07400 4 07150  01   TSX TEST,4         TEST FOR END OF CURRENT AIL RECORD          F3B12940
07175  0 07400 4 07152       TSX TEARG2,4       TEST NO. OF ARGS. SPECIFIED                 F3B12950
07176  0 07400 4 00707       TSX CIT00,4        COMPILE FIRST INST. FOR DIM AND XDIM        F3B12960
07177  0 00000 0 02922       HTR M1CW           LOCATION (1ST WD)                           F3B12970
07200  0 00000 0 02215       HTR L(CLA)         CLA(2ND WD.)                                F3B12980
07201  0 00000 0 02324       HTR M1CW+2         FIRST ARG (3RD WD)                          F3B12990
07202  0 00000 0 02325       HTR M1CW+3         REL. ADD END TAG OF 1ST ARG (4TH WD)        F3B13000
07203  0 07400 4 07154       TSX ARGTAG,4       TEST WHETHER 2ND. ARG TAGGED ETC.          F3B13010
07204 -0 50000 0 07231       CAL L(SUB)         PREPARE OP. WD (2ND WD) OF 2ND AIL          F3B13020
07205 -0 76000 0 00144       MSE 100            ENTRY. OP. IS SUB. FOR XDIM                 F3B13030
07206 -0 50000 0 07232       CAL L(FSB)         FSB FOR DIM                                  F3B13040
07207  0 60200 0 02223       SLW M1CW+1                                                     F3B13050
07210  0 07400 4 00707       TSX CIT00,4        COMPILE 2ND INST FOR DIM OR XDIM            F3B13060
07211  0 00000 0 02170       HTR L(0)           0 (1ST WD)                                  F3B13070
07212  0 00000 0 02325       HTR M1CW+1         SUB(XDIM), FSB(DIM) (2ND. WD)               F3B13080
07213  0 00000 0 02324       HTR M1CW+2         2ND. ARG (3RD WD)                           F3B13090
07214  0 00000 0 02325       HTR M1CW+3         REL. ADD AND TAG OF 2ND ARG (4TH WD)        F3B13100
07215  0 07400 4 00707       TSX CIT00,4        COMPILE 3RD INST FOR DIM AND XDIM           F3B13110
07216  0 00000 0 02170       HTR L(0)           0(1ST WD)                                   F3B13120
07217  0 00000 0 07233       HTR L(TPL)         TPL(2ND WD)                                 F3B13130
07220  0 00000 0 02245       HTR L(017)         OCT. 17 IN BITS S-5                          F3B13140
07221  0 00000 0 02177       HTR L(2D)          REL. ADD 2, TAG 0 (4TH WD)                  F3B13150
07222  0 07400 4 00707       TSX CIT00,4        COMPILE LAST INST FOR DIM AND XDIM          F3B13160
07223  0 00000 0 02170       HTR L(0)           0 (1STWD)                                   F3B13170
07224  0 00000 0 07234       HTR L(PXD)         PXD (2ND WD)                                F3B13180
07225  0 00000 0 02170       HTR L(0)           0 (3RD WD)                                  F3B13190
07226  0 00000 0 02170       HTR L(0)           0 (4TH WD)                                  F3B13200
07227  1 77774 1 00774       TXI RESUME,1,-4    INDEX CUR AIL RECORD TO BEGINNING           F3B13210
                                               OF NEXT 4WD INST AND RETURN TO MAIN PROG    F3B13220
                                        CONSTANTS AND ERASABLE STORAGE FOR FOUR             F3B13230
                                        SUBROUTINES USED IN COMPILING OPEN SUBROUTINES      F3B13240
07230  0 00000 0 00000  C    HTR                                                            F3B13250
```

```
          77776 M1D2L EQU -2                    THE 2S COMPL OF THE LENGTH OF         F3813260
                                                M1D2. THIS CARD MUST BE CHANGED WHEN  F3813270
                                                ADDITIONS TO M1D2 ARE MADE            F3813280
          02170 L(0)   SYN 1144                                                       F3813290
          01306 M13505 SYN 710                                                        F3813291
          02312 CCELL  SYN 1226                                                       F3813292
          02305 M1ALWN SYN 1221                                                       F3813293
          00341 M10210 SYN 225                                                        F3813294
          02327 AIL    SYN 1239                                                       F3813295
          02211 ALLONE SYN 1161                                                       F3813300
          02155 ERROR1 SYN 1133                                                       F3813301
          02163 ERROR2 SYN 1139                                                       F3813302
          02322 M1CW   SYN 1234                                                       F3813303
          02207 TGMSK  SYN 1159                                                       F3813304
          01016 M12500 SYN 526                                                        F3813305
                                  CONSTANS USED IN COMPILING THE OPEN SUBRTNS. XDIM AND DIM  F3813310
          00707 CIT00  SYN 455                                                        F3813320
          02215 L(CLA) SYN 1165                                                       F3813330
07231 626422000000     L(SUB) BCD 1SUB000                                             F3813340
07232 266222000000     L(FSB) BCD 1FSB000                                             F3813350
07233 634743000000     L(TPL) BCD 1TPL000                                             F3813360
07234 476724000000     L(PXD) BCD 1PXD000                                             F3813370
          02245 L(017) SYN 1189                                                       F3813380
          02177 L(2D)  SYN 1151                                                       F3813390
          00774 RESUME SYN 508                                                        F3813400
07235 0 40200 0 02211 SUBPAT SUB ALLONE                                               F3813401
07236 0 10000 4 00001        TZE 1,4                                                  F3813402
07237 0 02000 0 02163        TRA ERROR2                                               F3813403
07240 0 00000 0 00000 ROOM   HTR  SPACE FROM ROOM MAY BE USED FOR ADD. OPEN SUB. COMPILATION  F3813414
          07071               END 3641
```