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SEPAC FLIGHT SOFTWARE

DETAILED DESIGN SPECIFICATIONS

IR-AL-002

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VOLUME I

INTERMETRICS, INC.

SEPAC FLIGHT SOFTWARE

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PREFACE

This document contains the Detailed Design Specifications (As Built) for the SEPAC Flight Software.

This work was performed for Marshall Space Flight Center's Data Systems Laboratory, Software Engineering Division under NASA Contract NAS8-34747.

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to define the detailed design specifications (as built) for the SEPAC Flight Software. The design includes a description of the total software system and of each individual module within the system.

The design specifications describe the decomposition of the software system into its major components. The system structure is expressed in the following forms:

- The control-flow hierarchy of the system
- The data-flow structure of the system
- The task hierarchy
- The memory structure
- The software to hardware configuration mapping

The component design description includes details on the following elements:

- Register conventions
- Module (Subroutine) invocation
- Module functions
- Interrupt servicing
- Data definitions
- Database structure

This Detailed Design Document provides the basis for maintenance and configuration control of the SEPAC Flight Software.

1.2 SCOPE

The SEPAC project has several distinct software packages including the following:

- SEPAC DEP Flight Software (NSSC-II)
- SEPAC ECAS Software (Spacelab Experiment Computer)
- SEPAC IU Software
- SEPAC EOIVS (ECOS/ECAS/Link Manager) Software
- SEPAC EOIVS Development and Support Tools
- SEPAC Intel MDS (PCM Display) Software

This document contains the design specifications for the SEPAC DEP Flight Software; i.e., the software resident in the NSSC-II computer. The reader should be familiar with the concepts of the Spacelab Command and Data Management Systems, the Experiment Computer Operating System, the Experiment Computer Application Software, SEPAC Instrument Unit, the Experiment Operation and Interface Verification (EOIVS) System, and the NSSC-II computer.

Where applicable, the interface requirements and design of the SEPAC DEP Flight Software to other SEPAC software packages are detailed. A design specification of those packages is not included in this document. The interface design does imply certain operational characteristics of the software packages.

1.3 REFERENCE DOCUMENTS

The following documents are reference documents for SEPAC.

SEPAC FLIGHT SOFTWARE DESIGN SPECIFICATION
Revision 4
ACI-041081-S
Atsuko Computing International and MSFC
September 1981

SEPAC SOFTWARE REQUIREMENT SPECIFICATIONS
Revision 1
SE-015
Institute of Space & Aeronautical Science
University of Tokyo
May 31, 1978

SPACELAB MISSION 1 EXPERIMENT OPERATING PROCEDURES INS002 SEPAC
Revision A
JA-090
NASA
July 1980

SPACELAB MISSION ONE - MISSION OPERATIONS REQUIREMENTS DOCUMENT FOR EXPERIMENT INS002 - SPACE EXPERIMENT WITH PARTICLE ACCELERATORS
Review Copy
NASA
March 1980

SEPAC INTERFACE UNIT REQUIREMENTS AND CAPABILITIES DOCUMENT
Southwest Research Institute
February 1979

NASA STANDARD SPACECRAFT COMPUTER (NSSC-II) - PRINCIPLES OF OPERATION
7935402
International Business Machines Corp.
May 1979

NASA STANDARD SPACECRAFT COMPUTER (NSSC-II) - LINKAGE EDITOR
7935413
International Business Machines, Corp.
December 1977

NASA STANDARD SPACECRAFT COMPUTER (NSSC-II) - ASSEMBLY LANGUAGE
7935401
International Business Machines, Corp.
December 1971

An integral part of this design document is the SEPAC DEP Flight Software listing. A copy of the listing is attached for reference.

2.0 SEPAC DEP FLIGHT SOFTWARE GENERAL INFORMATION

The SEPAC DEP Flight Software is written in a combination of NSSC-II Assembly Language and NSSC-II FORTRAN IV. The development flow for the SEPAC software is shown in Figure 2-1.

The NSSC-II Utility Development programs utilized were:

- NSSC-II Assembler
- NSSC-II FORTRAN IVH Compiler
- NSSC-II Link Editor

These utility programs were resident on the System/360-75 located in the Data Systems Laboratory of Marshall Space Flight Center. The S/360 is a batch oriented system with jobs submitted and returned through the Control Desk.

The NSSC-II Assembly Language is based on the standard S/360 instruction set with the following exceptions:

1. The only I/O instruction supported by the NSSC-II Assembler is the SIO instruction.

2. The NSSC-II Timer Read and Set (TMRS) instruction is supported by the NSSC-II Assembler.

3. The NSSC-II Assembler does not support the S/360 Long or Extended Floating Point Feature instructions, the Decimal Feature instructions, the Direct Control Feature instructions, the Channel Command Word (CCW) assembler instruction, or the Insert Storage Key (ISK) instruction.

4. No S/370 instructions are supported by the NSSC-II Assembler.

5. The NSSC-II Assembler supports the NSSC-II unique short precision fixed point instructions and the double precision fixed point instructions.

The NSSC-II Fortran compiler is based on the S/360 FORTRAN H Compiler. Since the NSSC-II FORTRAN Compiler was designed to generate code for the IBM 360/370 and not for the NSSC-II, there are several restrictions on the use of FORTRAN as follows:

- Do not use mixed mode, i.e., do not mix the use of integer and real data within a Fortran statement.
- Do not use input/output statements.
- Do not use double precision.
- Use the Fortran program as a subroutine rather than a main program.
- Do not use a STOP statement.
- Do not call subroutines from the IBM 360/370 Fortran Library (SYS1.FORTLIB).

The NSSC-II FORTRAN does not utilize the NSSC-II short operand or double precision instructions.

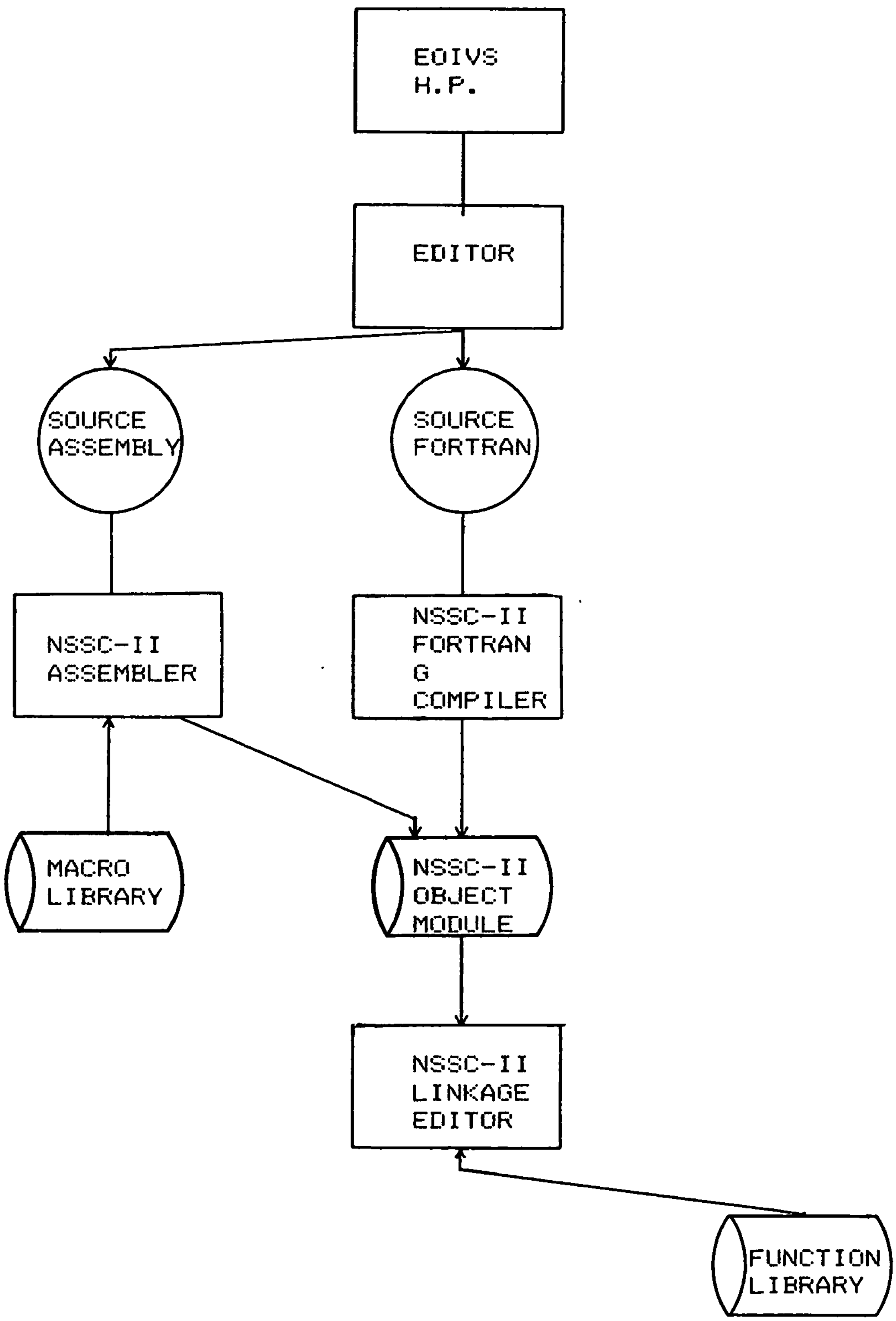


FIGURE 2-1: NSSC-II SOFTWARE RELATIONSHIP

2.1 REGISTER CONVENTIONS

The SEPAC DEP Flight software uses the standard S/360 - S/370 FORTRAN register conventions. The register conventions are:

R15 = Address of Subroutine to be called

R14 = Return address for exit from subroutine

R0 = Return value for Function type routines

R1 = Address of Subroutine Parameter List

R12 = Base register for Routine

R13 = Address of Save area (18 words)

2.2 SUBROUTINE INVOCATION

The typical set of instructions required to call a subroutine is:

```
             L          R1,APARM         SET PARAMETER LIST REGISTER
             L          R15,AROUTINE     SET ROUTINE ADDRESS REGISTER
             BALR       R14, R15         BRANCH TO ROUTINE
             NEXT INSTRUCTION            ROUTINE RETURNS TO HERE
             .
             .
APARM        DC         A(PARMLIST)      ADDRESS OF PARAMETER LIST
AROUTINE     DC         A(ROUTINEX)      ADDRESS OF ROUTINE TO BE CALLED
PARMLIST     DC         A(PARM1)         PARAMETER LIST
             DC         A(PARM2)
             -          -
             -          -
             -          -
             DC         X'80', AL3       (PARMN)
```

2.3 SUBROUTINE PROTOCOL

The standard prolog for a subroutine is:

```
STM  14,12,12(13)      Store Registers in Save Register
LR   12, 15            Establish R12 as Base
LR   2, 13
LA   13, SAVEAREA      Set R13 to new Savearea
st   2, 4(13)
st   13,8(2)
```

2.4 SUBROUTINE EPILOG

The standard epilog for subroutines is:

```
L    13, SAVEAREA + 4 Restore R13 to old Save Register
LM   14, 12, 12(13)   Restore Registers
BR   14               Return
```

2.5 SUBROUTINE REGISTER SAVE AREA DEFINITION

The save area is defined with a DS statement, and consists of 18 fullwords, each aligned on fullword boundary.

```
SAVEAREA    DS     18F    REGISTER SAVE AREA
```

The save area is not filled with the register's content until the subroutine is entered. The subroutine prologue described above will save the contents of the registers in the save area along with other linkage information. The subroutine epilogue restores the registers from the save area prior to returning to the calling program.

The format of the save area is:

WORD	BYTE	CONTENTS	
1	0	A(SAVEAREA)	Address of Savearea
2	4	A(OLD-SAVEAREA)=R13	Address of old (back link) Savearea
3	8	A(NEW-SAVEAREA)	Address of new (forward link) Savearea
4	12	R14	Register 14
5	16	R15	Register 15
6	20	R0	Register 0
7	24	R1	Register 1
8	28	R2	Register 2
9	32	R3	Register 3
10	36	R4	Register 4
11	40	R5	Register 5
12	44	R6	Register 6
13	48	R7	Register 7
14	52	R8	Register 8
15	56	R9	Register 9
16	60	R10	Register 10
17	64	R11	Register 11
18	68	R12	Register 12

The first three words provide a link list of the save areas for program analysis.

2.6 SUBROUTINE ARGUMENTS

Arguments are passed to a subroutine through general register 1 which contains the address of a parameter list. The parameter list is a list of addresses of variables, arrays, or subprogram names. Each parameter list entry is an address of 4 bytes aligned on a fullword boundary; i.e., type of DC A(parameter).

The last three bytes of each entry contains the 24 bit address of an argument. The first byte contains zeros, unless it is the last entry in the argument list. If this is the last entry, the sign bit in the entry is set to 1.

2.7 SEPAC FLIGHT SOFTWARE SOURCE FILES

The SEPAC Flight Software source files are maintained on the EOIVS (Hewlett Packard 1000) system on the disk pack 'DSL-SEPAC'. The source files are edited using the H.P. Editor.

A source tape is generated that is transferred to the S/360 for assembly and compilation of the programs. This process is detailed in section 2.8.

The source files are:

SPCASM - SEPAC Assembly Source

SPCFOR - SEPAC FORTRAN Source

FOMTAB - SEPAC FO Menu Database Segment

FOTAB - SEPAC FO Table Definition Database Segment

PCFTAB - SEPAC PCF Tables Database Segment

COMTAB - SEPAC Command Table Database Segment

HEXTAB - SEPAC HEX Table Routines Database Segment

The content of each file is listed in the following tables.

TABLE 2-1: SPCASM CONTENTS

FILENAME = SPCASM

CSECT	DESCRIPTION
DRIVER	SEPAC Executive and Interrupt Service
STASK	I/O Interrupt Lookup Function
SINGLE	Single Command Function
PATCH	Program Patch/Dump Function
RTDRV	Real Time Driver Function
RTCMD	Real Time Command Setup Function
MSGIN	Message Input Function
MSOUT1	Message Output Function
MSGHAN	Message Output Handler Function
CGMT	Compare GMT Function
SGMT	Subtract GMT Function
ECMAG	Magnetic Field Function
GNC	GN&C Function
ECBML	Burst Mode Logic Function
IUGMT	Read IU GMT Function
SETHTR	Set Heater (PCF#34) Function
C22DWN	Manual Shutdown Function
IUCMD	Write IU Command Registers Function
SPM	Write Scratch Pad Memory Function
ECSMO	SMO (SEPAC Manual Operation) Function
AEPIOF	AEPI Synchronization Function
MANUAL	Manual Driver Function
EXSPM	SPM Data Setup Function
DEPDMP	Dump DEP Memory Function
UHEADR	Unpack Message Input Header Function
PHEADR	Pack Message Output Header Function
FLT16	Convert to Float Point Function
INT16	Integer 16 Utility Functions
SIN	SIN/COS/TAN Function
ARCTAN	ARCTAN Function
ROOT	ROOT Function
GARBAG	Program Undefined Stubs

TABLE 2-2: SPCFOR CONTENTS

FILENAME = SPCFOR

CSECT	DESCRIPTION
ECFO	FO Schedule Function
SEPACM	FO Timeline Monitor Function
PASSX	FO Command Generation Function
DOIF	IF Statement Function
DOCALC	Calculation Statement Function
ECPCF	PCF Handler Function

TABLE 2-3: FOMTAB CONTENTS

FILENAME = FOMTAB

CSECT	DESCRIPTION
FOMTAB	FO Menu Models

TABLE 2-4: FOTAB CONTENTS

FILENAME = FOTAB

CSECT	DESCRIPTION
FOTAB	FO Command Table Sets

TABLE 2-5: PCFTAB CONTENTS

FILENAME = PCFTAB

CSECT	DESCRIPTION
PCFTAB	PCF Default Tables

TABLE 2-6: COMTAB CONTENTS

FILENAME = COMTAB

CSECT	DESCRIPTION
COMTAB	IU Command Descriptions

TABLE 2-7: HEXTAB CONTENTS

FILENAME = HEXTAB

CSECT	DESCRIPTION
HEXTAB	SEPAC Hardware and Instrument Level Routines

2.8 SEPAC LOAD TAPE GENERATION

The following steps are used to generate a SEPAC Load Tape:

1. Generate the FOCSCT file
2. Generate the HXCSCT file
3. Generate the HP1000 Source Tape
4. Submit S/360 Batch Job

Each of these steps is defined in the following sections.

2.8.1 GENERATE FOCSCT FILE

The FOCSCT file contains an array of vectors that index into the FOTAB data array with the FOCSCT vectors arranged in ascending order. The FOCSCT data is used by the SEPAC program for a fast access into the FOTAB data table.

The FOCSCT file is generated on the HP1000 by the program FOIND. The user must delete any existing FOCSCT files before running FOIND. The FOIND program has as its input the HP1000 file FOTAB and generates as output the HP1000 file FOCSCT.

2.8.2 GENERATE HXCSCT FILE

The HXCSCT file contains an array of vectors that index into the HEXTAB data array with the HXCSCT vectors arranged in ascending order. The HXCSCT data is used by the SEPAC program for a fast access into the HEXTAB data tables.

The HXCSCT file is generated on the HP1000 by the program HEXIN. The user must delete any existing HXCSCT files before running HEXIN. The HEXIN program has as its input the HP1000 file HEXTAB and generates as output the HP1000 file HXCSCT.

2.8.3 GENERATE HP1000 SOURCE TAPE

The HP1000 Source Tape submitted to the S/360 is generated using the HP1000 program REC80 which translates the HP1000 source files from HP format variable length records into IBM format fixed length (80 bytes) records.

The REC80 program is initiated by the command "RU,REC80" and prompts the user for the files to be copied to tape. The S/360 Batch Job expects REC80 to copy the SEPAC files to tape in the order shown in Table 2-8.

TABLE 2-8: SEPAC HP1000 SOURCE TAPE

FILE #	FILE NAME
1	SPASM
2	SPCFOR
3	FOMTAB
4	FOTAB
5	PCFTAB
6	COMTAB
7	HEXTAB
8	FOCSCT
9	HXCSCT

2.8.4 SEPAC S/360 BATCH JOB

To generate a SEPAC load tape and compiled source listing, a batch job is submitted to the S/360. The SEPAC batch input and output items are:

INPUT - SEPAC HP1000 Source Tape

OUTPUT - SEPAC Load Tape (Minireel)
SEPAC Compiled Listing

The SEPAC S/360 Batch job card is shown in Figure 2-2 where the input SEPAC HP1000 Source tape is 'IM007' and the output load minireel tape is 'MINI01'. The NSSC-II Compiler and Assembler are resident on MSFC's disk pack 'S4PROG'.

THE S/360 JCL cards used to compile, assemble, and link the SEPAC software are contained in the accompanying program listing volume.

A03,3,35),1HEF3542055 0HINTZE,MSGLEVEL=(1,1),REGION=256K

64

CORE SIZE ___ k	BIN. NO. ___			CLOCK NO ___
OUTPUT ITEMS	YES	NO	OPER NO	RUN ___ OF ___
PUNCH $		✓		INPUT TAPES
PLOTS		✓		
MINI01	✓			IM007
COMMENTS				
S4 PROG				
MINI01 ISA MINIREEL				

MSFC - Form 306 (July 1972)

AP111-21 BSC   RUN CARD NO. 2

FIGURE 2-2: SEPAC JOB CARD

3.0 NSSC-II AND IU CHARACTERISTICS

The NSSC-II Computer, the SEPAC Instrument Unit, and the Control Panel form the Command and Data Management Subsystem for SEPAC. The NSSC-II is the NASA Standard Space qualified Computer that has been chosen as the SEPAC Dedicated Experiment Processor.

3.1 NSSC-II INSTRUCTION SET

The NSSC-II has an instruction repertoire based on the IBM 360 assembly language. The NSSC-II has the following instructions that are supported:

- 83 S/360 Standard Fired Point Instructions
- 22 S/360 Floating Point Instruction
- 3 Special I/O, Timer, Memory Control Instructions
- 53 Short Operand, Fixed Point (16-bit) Instructions
- 10 Double Precision, Fixed Point (64-Bit) Instrutions

There is a total of 171 valid NSSC-II instructions. Eighty three are from the 87 member S/360 Standard Instruction set. Omitted from the S/360 set for NSSC-II are HIO, SIO, TCH, and TIO.

3.2 NSSC-II I/O

The I/O portion of the NSSC-II provides the means of communication between the NSSC-II and the SEPAC Instrument Unit. The NSSC-II I/O is implemented as a 16 bit parallel channel providing direct I/O and external interrupt capabilities. The NSSC-II has only one I/O instruction - the SIO (Start I/O) instruction.

The syntax of the SIO instruction is:

```
SIO                    ROUT,RIN,@COMMAND WORD
```

where:

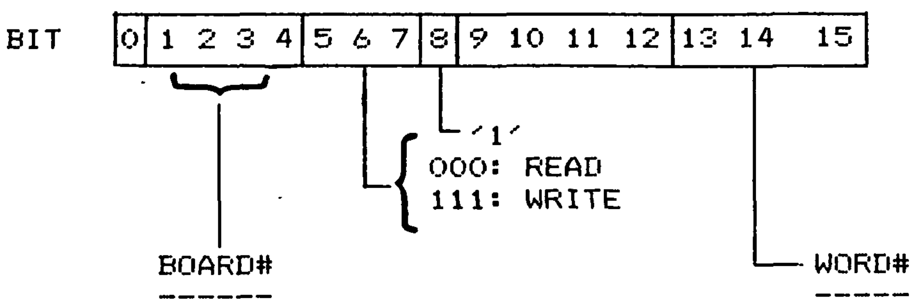
```
ROUT                   = Output Register (0 to 16)
RIN                    = Input Register (0 to 16)
@COMMAND WORD          = Address of Command Word
```

The format of the SIO Command Word for SEPAC is shown in Figure 3-1.

Input and output of the SIO registers are to and from the low order 16 bits of the registers. For output, the high order 16 bits should be set to 0.

All I/O operations with the IU are initiated with the SIO instruction with the exception of the Burst Mode Logic (BML) Direct Memory Access (DMA). The BML-DMA is initiated and controlled by the IU.

The SIO Command Word allows the NSSC-II to read or write data to the following IU ports.



BOARD#		WORD#
0=0000		0=000 IU#4 INPUT REGISTER
1=0001	MTV	1-001 IU#3 INPUT REGISTER
2=0010	DGP	2=010 IU#2 INPUT REGISTER
3=0011	HVC	3=011 IU#1 INPUT REGISTER
4=0100	GPS/MPD	4=100 IU#4 OUTPUT REGISTER
5=0101	SCRATCH-PAD MEMORY	5=101 IU#3 OUTPUT REGISTER
6=0110	GMT	6=110 IU#2 OUTPUT REGISTER
7=0111	DUAL PORT MEMORY	7=111 IU#1 OUTPUT REGISTER
9=1001	PERIPHERAL INTERFACE BOARD	* When Board #5 and 7 are selected Bits 8 and 9-15 are used for an address of Scratch-Pad Memory.

FIGURE 3-1: COMMAND WORD BIT ASSIGNMENTS

- MTV Command Board

  - 4 Input Registers (Register = 16 bits)
  - 4 Output Registers

- DGP Command Board

  - 4 Input Registers (Register = 16 bits)
  - 4 Output Registers

- HVC Command Board

  - 4 Input Registers (Register = 16 bits)
  - 4 Output Registers

- GPS/MPD Command Board

  - 4 Input Registers (Register = 16 bits)
  - 4 Output Registers

- Scratch Pad Memory

  - 256 Word Memory (Word = 8 bits)

- GMT

- Dual Port Memory

  - 256 Word Memory (Word = 8 bits)

- Peripheral Interface Board

The recommended set of instructions for starting an I/O operation is:

```
SIO  Ri, Ro, @command
BNZ  *-4
```

The BNZ instruction waits for the I/O operation completion.

3.3 NSSC-II/IU INTERRUPTS

The NSSC-II has 5 basic interrupts:

- External
- Supervisor Call
- Program Check
- Machine Check
- Input/Output

Interrupts are taken only when the CPU is interruptable for the interrupt source. The system mask, program mask, and machine check mask bits in the PSW are used to mask interrupts.

EXTERNAL INTERRUPT
****

CODE	
00H	1HZ INTERRUPT FROM IU

I/O INTERRUPTS
****

CODE	
2065H	MESSAGE READY FROM EXPERIMENT COMPUTER
2081H	GNC DATA READY (RECEIVED FROM E.C.)
201FH	DUMP DEP REQUEST
6000H	MESSAGE BUFFER #1 CLEARED
6001H	MESSAGE BUFFER #2 CLEARED
6002H	MESSAGE BUFFER #1 RETRANSMIT REQUEST
6003H	MESSAGE BUFFER #2 RETRANSMIT REQUEST

3.4 NSSC-II/IU I/O OPERATIONS

The following sections describe the normal NSSC-II/IU Input/Output operations.

3.4.1 PROCEDURE TO READ GMT CLOCK

1. ISSUE "DIRECT IN = 3085H" (Board #6, Address #205)

This will result in resetting the "RDTIME" status bit. If successful, the GMT clock will return its status word as FFE2H. This indicates that (see bit assignments for status word) the read was good, that RDTIME is reset and that there was no conflict between the DEP and the PCM telemetry subsystem for use of the GMT clock. If any other status word is returned (i.e., FFFFH), the read was not done successfully and must be tried again.

2. ISSUE "DIRECT IN = TO 3083H"

This will cause a snapshot of the GMT clock counters to be latched in the output buffer/latch array. If successful, a status word of FFF1H will be returned.

If any other status word is returned, a conflict has arisen and the DEP must request time again by another "Direct In 3083H".

3. Issue a "Direct In" to any of the following addresses to receive GMT milliseconds of day information.

```
ADDRESS              DATA

       0  1  2  3  4  5  6  7  8  9  10   11  12  13  14  15
       *****************************************************
        7  6  5  4  3  2  0
3084H  2  2  2  2  2  2  2  -----NOT USED-----


                 FRACTIONAL MILLISECONDS COUNTER

        15 `14  13  12  11  10  9  8  7  6  5  4  3  2  1  0
3082H  2   2   2   2   2   2   2  2  2  2  2  2  2  2  2  2


                  MILLISECONDS OF DAY COUNTER

3086H   NOT USED -----      26  25  24  23  22  21  20  19  18  17  16
                           2   2   2   2   2   2   2   2   2   2   2


                                      MILLISECONDS OF DAY COUNTER

                                   8  7  6  5  4  3  2  1  0
3081H  NOT USED---                2  2  2  2  2  2  2  2  2


                                   DAY OF YEAR COUNTER
```

BIT 0 IS MSB
BIT 15 IS LSB

4. To retest for conflicts that may have arisen as this data was being read, issue a "Direct In" to 3085 and recheck the status word for FFE2H.

5. The bit assignments for the GMT Clock status word are defined as follows:

BIT LOCATION		DEFINITION
BITS 00-10	NOT USED	(Always "1" state)
BIT 11	"RDTIME"	A DEP request for time has been received and honored if bit is active.
BIT 12	"BUS BUSY"	A DEP request was received but the output bus was in use at the time of the request and it was not honored.
BIT 13	"LDEUS"	If low, this bit indicates that a DEP read request was received at a time when the data bus used to transmit GMT data to P.C.M. was not busy.
BIT 14	"GMTRD6"	Decoded status bit which is used to set the "RDTIME" control line.
BIT 15	"GMTRD5"	Decoded status bit used to reset the "RDTIME" control line.

3.4.2 SEPAC/AEPI JOINT OPERATION

SEPAC will begin the joint operation as scheduled in the Master Timeline or as agreed upon by both PI's.

SEPAC will send only the AEPI Sync pulse (which occurs 5 seconds prior to MPD firing and is coincident with one of the 4 pps pulses from the EC) until AEPI raises the AEPI READY SIGNAL. When AEPI READY is ready, the IU will change and send only the MOD pulse. Thus with normal SEPAC/AEPI operation the SEPAC to AEPI line will appear to have both the AEPI Sync and MOD pulse. These signals are actually being selected by the AEPI to SEPAC Ready Signal.

SEPAC will generate the AEPI SYNC Signal 5 seconds prior to the MPD firing. The MPD will actually fire approximately 1.35 ms after the MFD pulse which is coincident with the 20th pulse of the 4 pps signal from the EC.

SEPAC does not Sync to AEPI and does not wait for AEPI to become ready. Hold/Restart or minor change in start of AEPI or SEPAC FO's will not effect this operation.

MOD pulse position and width depends on the FO and PCF selected.

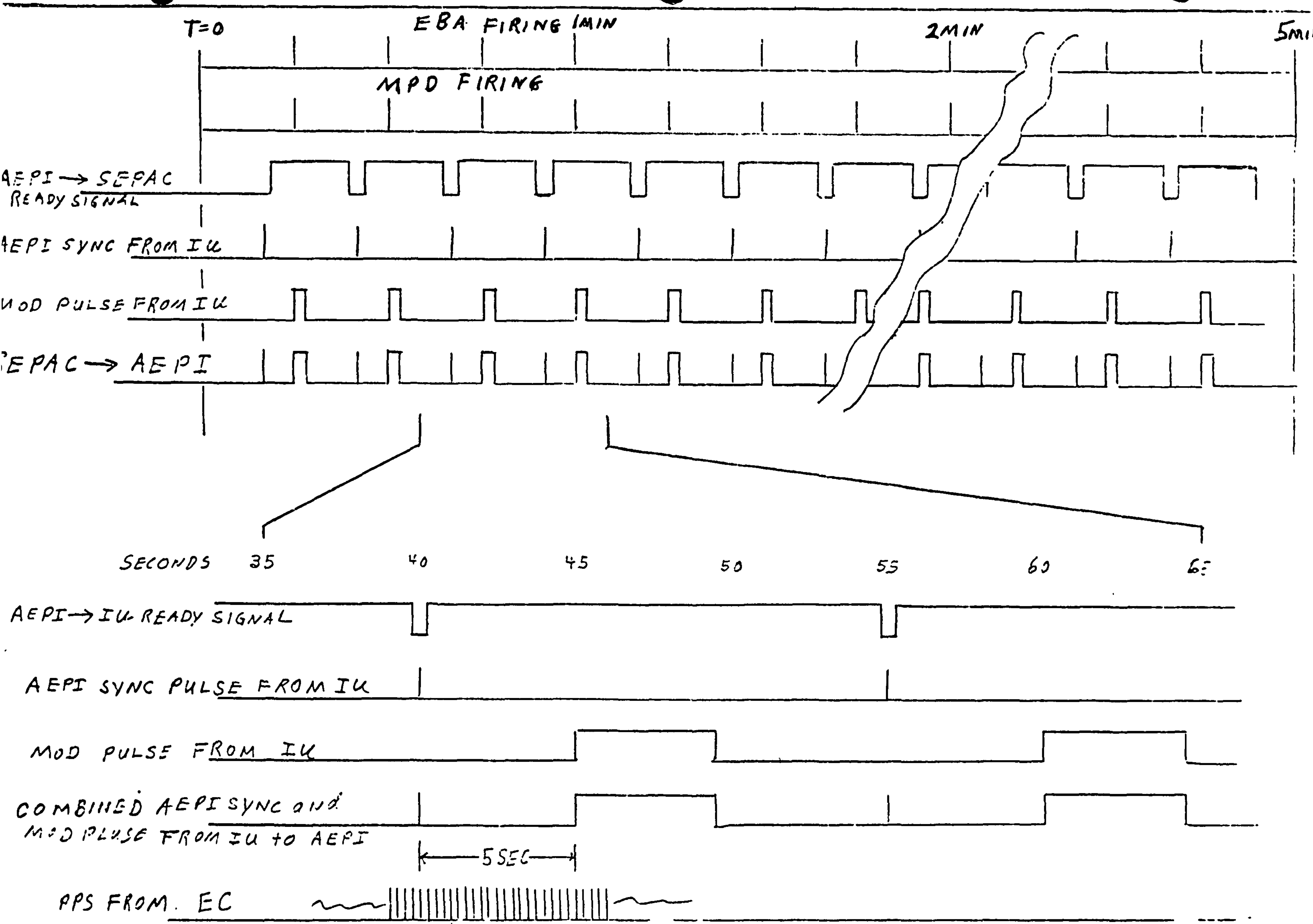


FIGURE 3-2: SEPAC/AEPI JOINT OPERATION TIMING

3.4.3 INSTRUMENT COMMAND DESCRIPTION

The instrument command interface, in the form of the individual command channel boards, accepts a direct out instruction from the DEP and forwards that information to the SEPAC scientific instruments in the form of a descrete level on one of 64 possible lines, or an analog voltage from one of 8 possible digital to analog converters. The individual command boards are designed so that the DEP can verify the command register contents by reading back any one of the 16 command word registers (4 boards by 4 input and 4 output registers) via a direct in instruction. Each command word register is 16 bits wide. The IU multiport registers allow the DEP to read the input command registers without conflict over priority with the PCM telemetry system.

3.4.3.1 COMMAND FORMAT DESCRIPTION

The IU has two kinds of command registers, one is Input Register, the other is Output Register which is directly connected to the instrument.

The commanding sequence is as follows:

- Read the Input Register and merge new command
- Write the Input Register
- Read the Input Register for Verification
- Write the Output Register to issue the command to the instrument

3.4.3.2 COMMAND BOARD DESCRIPTION

The following pages are provided to represent each command position in the command boards.

- Although SEPAC signal name is made less than 6 characters, a number is added to indicate its power-of-two position.
- All commands have a positive true logic.
- DEP1HZ (board #3, word #0, bit 14) is not a command. This represents the transition of the Fundamental Time Clock.

** COMMAND BOARD # 1 **

#4 (COMMAND WORD # 3)

BITS	SIGNAL	INSTR	TYPE
00	LENISL	MTV	D
01	SENSL	MTV	D
02	VIDEON	MTV	D
03	LENCS	MTV	D
04	TEST	MTV	D
05	MTVPS	MTV	D
06	HDM0	IU	D
07	HDM1	IU	D
08	HDM2	IU	D
09	HD0	IU	D
10	HD1	IU	D
11	HD2	IU	D
12	HD3	IU	D
13	HPWM0	IU	D
14	HPWM1	IU	D
15	HPWM2	IU	D

#3 (COMMAND WORD # 2)

BITS	SIGNAL	INSTR	TYPE
00	LENIS0	MTV	A
01	LENIS1	MTV	A
02	LENIS2	MTV	A
03	LENIS3	MTV	A
04	LENIS4	MTV	A
05	LENIS5	MTV	A
06	LENIS6	MTV	A
07	LENIS7	MTV	A
08	SENAD0	MTV	A
09	SENAD1	MTV	A
10	SENAD2	MTV	A
11	SENAD3	MTV	A
12	SENAD4	MTV	A
13	SENAD5	MTV	A
14	SENAD6	MTV	A
15	SENAD7	MTV	A

#2 (COMMAND WORD # 1)

BITS	SIGNAL	INSTR	TYPE
00	GPAZS0	MTV	A
01	GPAZS1	MTV	A
02	GPAZS2	MTV	A
03	GPAZS3	MTV	A
04	GPAZS4	MTV	A
05	GPAZS5	MTV	A
06	GPAZS6	MTV	A
07	GPAZS7	MTV	A
08	GPELS0	MTV	A
09	GPELS1	MTV	A
10	GPELS2	MTV	A
11	GPELS3	MTV	A
12	GPELS4	MTV	A
13	GPELS5	MTV	A
14	GPELS6	MTV	A
15	GPELS7	MTV	A

#1 (COMMAND WORD # 0)

BITS	SIGNAL	INSTR	TYPE
00	EPW0	IU	D
01	EPW1	IU	D
02	EPW2	IU	D
03	EPW3	IU	D
04	EDM0	IU	D
05	EDM1	IU	D
06	EDM2	IU	D
07	ED0	IU	D
08	ED1	IU	D
09	ED2	IU	D
10	ED3	IU	D
11	HPW0	IU	D
12	HPW1	IU	D
13	HPW2	IU	D
14	HPW3	IU	D
15	SPARE1		

** COMMAND BOARD # 2 **

#8

(COMMAND WORD # 3)

BITS	SIGNAL	INSTR	TYPE
00	PHOAG0	DCP	D
01	PHOAG1	DCP	D
02	PHOAG2	DCP	D
03	PHOAG3	DCP	D
04	PHOAG4	DCP	D
05	PHFLC0	DCP	D
06	PHFLC1	DCP	D
07	PHIRC0	DCP	D
08	PHIRC1	DCP	D
09	PHIRC2	DCP	D
10	PHIRC3	DCP	D
11	PHOCLC	DCP	D
12	DFPSC	DCP	D
13	DPPHOC	DCP	D
14	DPPLPC	DCP	D
15	DPPUPC	DCP	D

#7

(COMMAND WORD # 2)

BITS	SIGNAL	INSTR	TYPE
00	PULF0	DCP	D
01	PULF1	DCP	D
02	PULF2	DCP	D
03	PULF3	DCP	D
04	PULF4	DCP	D
05	PULF5	DCP	D
06	PULF6	DCP	D
07	PULF7	DCP	D
08	PULCAL	DCP	D
09	PULCH	DCP	D
10	DPEPEC	DCP	D
11	DPEPVC	DCP	D
12	DCPSPC	DCP	D
13	FPCAL	DCP	D
14	HCMVSU	HCP	D
15	SPARE2		

#6

(COMMAND WORD # 1)

BITS	SIGNAL	INSTR	TYPE
00	PWHF0	DCP	D
01	PWHF1	DCP	D
02	PWHF2	DCP	D
03	PWHF3	DCP	D
04	PWHF4	DCP	D
05	PWHF5	DCP	D
06	PWHF6	DCP	D
07	PWHF7	DCP	D
08	PWHF8.	DCP	D
09	PWHF9	DCP	D
10	PWHF10	DCP	D
11	PWHBS	DCP	D
12	PWHCAL	DCP	D
13	PWHCH	DCP	D
14	SPARE3		
15	SPARE4		

#5

(COMMAND WORD # 0)

BITS	SIGNAL	INSTR	TYPE
00	EPAFX0	DCP	D
01	EPAFX1	DCP	D
02	EPAFX2	DCP	D
03	EPAFX3	DCP	D
04	EPAFX4	DCP	D
05	EPAHVC	DCP	D
06	EPAFIX	DCP	D
07	EPACAL	DCP	D
08	EPVFON	DCP	D
09	EPVCAL	DCP	D
10	EPVFCC	DCP	D
11	~~ENLTY~~ SPARE8	~~IU~~	~~CIO~~
12	LPCAL	DCP	D
13	LPSW	DCP	D
14	LPFIX0	DCP	D
15	LPFIX1	DCP	D

** COMMAND BOARD # 3 **

#12 (COMMAND WORD # 3)

BITS	SIGNAL	INSTR	TYPE
00	BMVADJ0	HVC	A
01	BMVADJ1	HVC	A
02	BMVADJ2	HVC	A
03	BMVADJ3	HVC	A
04	BMVADJ4	HVC	A
05	BMVADJ5	HVC	A
06	BMVADJ6	HVC	A
07	BMVADJ7	HVC	A
08	HVCSW1	HVC	D
09	HVCSW2	HVC	D
10	HVCSW3	HVC	D
11	HVCSW4	HVC	D
12	HVCSW5	HVC	D
13	HVCSW6	HVC	D
14	BATOSW	HVC	D
15	HRESET	HVC	D

#11 (COMMAND WORD # 2)

BITS	SIGNAL	INSTR	TYPE
00	BMPSW	HVC	D
01	PFMCSW	CHG	D
02	FAVCSW	CHG	D
03	TRCCSW	CHG	D
04	CHCDM1	CHG	D
05	CHCDM2	CHG	D
06	CHCCK1	CHG	D
07	CHCCK2	CHG	D
08	SPARE5		
09	PFMTST	CHG	D
10	CHCSW1	CHG	D
11	CHCSW2	CHG	D
12	EBASET	IU	D
13	MPDSET	IU	D
14	MGPSET	IU	D
15	MPDLY	IU	D

#10 (COMMAND WORD # 1)

BITS	SIGNAL	INSTR	TYPE
00	M1D00	IU	D
01	M1D01	IU	D
02	M1D02	IU	D
03	M1D03	IU	D
04	M1D04	IU	D
05	M1D05	IU	D
06	M1D06	IU	D
07	M1D07	IU	D
08	M1D08	IU	D
09	M1D09	IU	D
10	M1D10	IU	D
11	M1D11	IU	D
12	M2D00	IU	D
13	M2D01	IU	D
14	M2D02	IU	D
15	M2D03	IU	D

#9 (COMMAND WORD # 0)

BITS	SIGNAL	INSTR	TYPE
00	M2D04	IU	D
01	M2D05	IU	D
02	M2D06	IU	D
03	M2D07	IU	D
04	ENAKUM	IU	D
05	ESWPLS	IU	D
06	EPWM0	IU	D
07	EPWM1	IU	D
08	EPWM2	IU	D
09	MSWPLS	IU	D
10	MHARUM	IU	D
11	ENTRC	IU	D
12	ENPFM	IU	D
13	ENFAV	IU	D
14	DEP1HZ	IU	
15	ENHMC	IU	D

** COMMAND BOARD # 4 **

#16

(COMMAND WORD # 3)

BITS	SIGNAL	INSTR	TYPE
00	PFHSW1	MPD	D
01	PFHSW2	MPD	D
02	PFHSW3	MPD	D
03	PFHSW4	MPD	D
04	AT1VSW	MPD	D
05	AT2VSW	MPD	D
06	SPARE6		
07	CAPDMP	MPD	D
08	FAVSLT	MPD	D
09	TRGSLT	MPD	D
10	SPARE7		
11	GSMVSW	MPD	D
12	GSDVSW	MPD	D
13	BMCRNG	GPS	D
14	MODFSW	GPS	D
15	GRESET	GPS	D

#15

(COMMAND WORD # 2)

BITS	SIGNAL	INSTR	TYPE
00	HTRADJ0	GPS	A
01	HTRADJ1	GPS	A
02	HTRADJ2	GPS	A
03	HTRADJ3	GPS	A
04	HTRADJ4	GPS	A
05	HTRADJ5	GPS	A
06	HTRADJ6	GPS	A
07	HTRADJ7	GPS	A
08	BMCADJ0	GPS	A
09	BMCADJ1	GPS	A
10	BMCADJ2	GPS	A
11	BMCADJ3	GPS	A
12	BMCADJ4	GPS	A
13	BMCADJ5	GPS	A
14	BMCADJ6	GPS	A
15	BMCADJ7	GPS	A

#14

(COMMAND WORD # 1)

BITS	SIGNAL	INSTR	TYPE
00	DEFCHX0	GPS	A
01	DEFCHX1	GPS	A
02	DEFCHX2	GPS	A
03	DEFCHX3	GPS	A
04	DEFCHX4	GPS	A
05	DEFCHX5	GPS	A
06	DEFCHX6	GPS	A
07	DEFCHX7	GPS	A
08	DEFCHY0	GPS	A
09	DEFCHY1	GPS	A
10	DEFCHY2	GPS	A
11	DEFCHY3	GPS	A
12	DEFCHY4	GPS	A
13	DEFCHY5	GPS	A
14	DEFCHY6	GPS	A
15	DEFCHY7	GPS	A

#13

(COMMAND WORD # 0)

BITS	SIGNAL	INSTR	TYPE
00	FOCCH0	GPS	A
01	FOCCH1	GPS	A
02	FOCCH2	GPS	A
03	FOCCH3	GPS	A
04	FOCCH4	GPS	A
05	FOCCH5	GPS	A
06	FOCCH6	GPS	A
07	FOCCH7	GPS	A
08	DEFSWX	GPS	D
09	DEFSWY	GPS	D
10	DEFPLX	GPS	D
11	DEFPLY	GPS	D
12	GPSSW	GPS	D
13	HTRSW	GPS	D
14	FOCSW	GPS	D
15	ANODSW	GPS	D

3.4.4 BURST MODE LOGIC DESCRIPTION

The function of the burst mode logic subsystem is to acquire data from the EBA and MPD SEPAC system at the required rate, store the data in the DEP via DMA transfer, and finally, to read the data back out of the DEP for presentation to the PCM subsystem at the appropriate time.

- Digitize up to 34 analog channels of EBA/MPD.
  - 8 bits resolution
- 8160 bytes at 31.0 ms measurements
- EBA data sampling
  - 32 channels
  - 250 points/channel within 31.0ms
- MPD data sampling
  - 2 channels
  - 250 points/channel within 3.75ms
- The start of a burst mode logic measurement is synchronized to the beginning of a PCM major frame.

The BML data is blocked into 250 sets of 35 data items.

To support the required SEPAC graphic display requirement the DEP software performs the following:

- Fetch DMA/BML signal data (each beam emission)
  - 250 points/signal
  - 10 signals
- Filter Data (maximum/minimum)
- Compute peak values
- Compute signal average value
  - Average of last five (5) points data
- Compute 10 or 20 values per signal for M & D based on averaging technique
- Send 2 serial messages to EC containing the data

Table 3-1 identifies the BML data signal, the first and last address for the signal, and the processing requirements. Table 3-2 is a convenient reference table to determine the address of a BML data item within a part BML set.

TABLE 3-1: BML DATA ADDRESS <BYTE>

BML NO.	SIGNAL ID	FIRST	LAST	DDU PROCESSING REQUIREMENTS
1 (1)	PWHAGC	DCD6	FFDA	02G 10 SAMPLES
2 (2)	MPD SPARE	DCD7	FFDB	
3 (3)	DSCHGV	DCD8	FFDC	02G 20 SAMPLES
4 (4)	MANODC	DCD9	FFDD	02G 20 SAMPLES
5 (5)	ANODV	DCDA	FFDE	02A 1 SAMPLE <PEAK>
6 (6)	PHOGNM	DCDB	FFDF	
7 (7)	FPBTLG	DCDC	FFE0	
8 (8)	PWHREF	DCDD	FFE1	
9 (9)	ANODC	DCDE	FFE2	02A 1 SAMPLE <PEAK>
10 (A)	PHOGNL	DCDF	FFE3	
11 (B)	FPLMMN	DCE0	FFE4	
12 (C)	EPVHGD	DCE1	FFE5	
13 (D)	BMV	DCE2	FFE6	02G 10 SAMPLES
				02A 1 SAMPLE
14 (E)	LPDH	DCE3	FFE7	02G 1 AVERAGE VALUE
15 (F)	PWLFCL	DCE4	FFE8	
16 (10)	EPVLGD	DCE5	FFE9	
17 (11)	CATHCH	DCE6	FFEA	02G 10 SAMPLES
				02A 1 SAMPLE
18 (12)	LPDL	DCE7	FFEB	
19 (13)	PWLFCH	DCE8	FFEC	
20 (14)	FPMDLG	DCE9	FFED	
21 (15)	CATCHCL	DCEA	FFEE	
22 (16)	FPTPHG	DCEB	FFEF	02G 10 SAMPLES
23 (17)	PWLPTL	DCEC	FFF0	
24 (18)	PWHSWL	DCED	FFF1	
25 (19)	BODYCH	DCEF	FFF2	02A 1 SAMPLE <PEAK>
26 (1A)	FPTPLG	DCEF	FFF3	
27 (1B)	PWLPTH	DCF0	FFF4	
28 (1C)	EPAFC1	DCF1	FFF5	
29 (1D)	BODYCL	DCF2	FFF6	
30 (1E)	FPMDHG	DCF3	FFF7	
31 (1F)	PWLREF	DCF4	FFF8	
32 (20)	EPAFCZ	DCF5	FFF9	
33 (21)	PHOGNH	DCF6	FFFA	
34 (22)	FPBTHG	DCF7	FFFB	
35 (23)	PWHSWH	DCF8	FFFC	
36 (24)	EBA SPARE	DCF9	FFFD	

TABLE 3-2: BML BLOCK ADDRESSES

	01	02	03	04	05	06	07	08	09	10
00	DCD6	DCFA	DD1E	DD42	DD66	DD8A	DDAE	DDD2	DDF6	DE1A
10	DE3E	DE62	DE86	DEAA	DECE	DEF2	DF16	DF3A	DF5E	DF82
20	DFA6	DFCA	DFEE	E012	E036	E05A	E07E	E0A2	E0C6	E0EA
30	E10E	E132	E156	E17A	E19E	E1C2	E1E6	E20A	E22E	E252
40	E276	E29A	E2BE	E2E2	E306	E32A	E34E	E372	E396	E3BA
50	E3DE	E402	E426	E44A	E46E	E492	E4B6	E4DA	E4FE	E522
60	E546	E56A	E58E	E5B2	E5D6	E5FA	E61E	E642	E666	E68A
70	E6AE	E6D2	E6F6	E71A	E73C	E762	E786	E7AA	E7CE	E7F2
80	E816	E83A	E85E	E882	E8A6	E8CA	E8EE	E912	E936	E95A
90	E97E	E9A2	E9C6	E9EA	E9DE	EA32	EA56	EA7A	EA9E	EAC2
100	EAE6	EB0A	EB2E	EB52	EB76	EB9A	EBBE	EBE2	EC06	EC2A
110	EC4E	EC72	EC96	ECBA	ECDE	ED02	ED26	ED4A	ED6E	ED92
120	EDB6	EDDA	EDFE	EE22	EE46	EE6A	EE8E	EEB2	EED6	EEFA
130	EF1E	EF42	EF66	EF8A	EFAE	EFD2	EFF6	F01A	F03E	F062
140	F086	F0AA	F0CE	F0F2	F116	F13A	F15E	F182	F1A6	F1CA
150	F1EE	F212	F236	F25A	F27E	F2A2	F2C6	F2EA	F303	F332
160	F356	F37A	F39E	F3C2	F3E6	F40A	F42E	F452	F476	F49A
170	F4BE	F4E2	F506	F52A	F54E	F572	F596	F5BA	F5DE	F602
180	F626	F64A	F66E	F692	F6B6	F6DA	F6FE	F722	F746	F76A
190	F78E	F7B2	F7D6	F7FA	F81E	F842	F866	F88A	F8AE	F8D2
200	F8F6	F91A	F93E	F962	F986	F9AA	F9CE	F9F2	FA16	FA3A
210	FA5E	FA82	FAA6	FACA	FAEE	FB12	FB36	FB5A	FB7E	FBA2
220	FBC6	FBEA	FC0E	FC32	FC56	FC7A	FC9E	FCC2	FCE6	FD0A
230	FD2E	FD52	FD76	FD9A	FDBE	FDE2	FE06	FE2A	FE4E	FE72
240	FE96	FEBA	FEDE	FE02	FF26	FF4A	FF6E	FF92	FF86	FFDA

3.4.5 DUAL PORT MEMORY (DPM)

The Dual Port Memory is a 256 word by 16 bit memory located in the IU and shared by the NSSC-II and the IU. The DPM provides the mechanism for transfer of messages between the NSSC-II and the IU using a "store and forward" scheme. Messages originating from the Experiment Computer and sent to the IU via the RAU are stored in the DPM. The NSSC-II is notified of an IU stored message through an I/O Interrupt. Messages originating from the DEP(NSSC-II) are "written into" DPM and the IU notified by bits being set in the Communication Status Registers in DPM.

The contents of Dual Port Memory are shown in Figure 3-3. The NSSC-II reads or writes to DPM via a direct I/O SIO instruction where the Command Word addresses Board #7 and the address bits index into Dual Port Memory. Figure 3-4 contains the formats of the Communication Status Registers of the DPM.

ADDRESS (HEX)	CONTENTS
00-1D	PROGRAM LOAD/OUTPUT MESSAGE BUFFER 1 AREA
1E	DUMP DEP STARTING ADDRESS
1F	NUMBER OF WORDS TO BE DUMPED
20-3F	KEYBOARD/MDM DATA BUFFER AREA
40-5F	ORBITAL PARAMETER DATA
60-7F	OUTPUT MESSAGE BUFFER 2 AREA
80-7F	GN&C NAVIGATION DATA
A0-BF	GN&C ATTITUDE DATA
C0-DF	USER MESSAGE DATA
E0-F9	TIME LINE DATA
FA	LINK MANAGER STATUS WORD
FB	COMMUNICATION STATUS REGISTER WORD 1
FC	COMMUNICATION STATUS REGISTER WORD 2
FD	COMMUNICATION STATUS REGISTER WORD 3
FE	COMMUNICATION STATUS REGISTER WORD 4
FF	INTERRUPT CODE WORD

FIGURE 3-3: DUAL PORT MEMORY MAP

WORD 1 <LM->DEP>

BIT	CONTENTS
0	NEW DATA AVAILABLE
1	GMT
2	ORBIT PARAMETER
3	VEHICLE PARAMETER
4	GN&C #1
5	GN&C #2
6	KEYBOARD DATA
7	MDM DATA
8	TIME LINE DATA
9	DUMP DEP MEMORY
10	PARITY ERROR
11	FORMAT ERROR
12	LINK ERROR
13	SPARE
14	SPARE
15	SPARE <WAS: DEP GO/NOGO)>

WORD 2 <LM->DEP>

BIT	CONTENTS
0	NEW DEP MESSAGE AVAILABLE
1	2**1 BIT OF MESSAGE TYPE CODE
2	2**0 BIT OF MESSAGE TYPE CODE
3	2**4 BIT OF USER MESSAGE LENGTH
4	2**3 BIT OF USER MESSAGE LENGTH
5	2**2 BIT OF USER MESSAGE LENGTH
6	2**1 BIT OF USER MESSAGE LENGTH
7	2**0 BIT OF USER MESSAGE LENGTH
8	2**7 BIT OF USER MESSAGE NUMBER <MULTI MESSAGE>
9	2**6 BIT OF USER MESSAGE NUMBER <MULTI MESSAGE>
10	2**5 BIT OF USER MESSAGE NUMBER <MULTI MESSAGE>
11	2**4 BIT OF USER MESSAGE NUMBER <MULTI MESSAGE>
12	2**3 BIT OF USER MESSAGE NUMBER <MULIT MESSAGE>
13	2**2 BIT OF USER MESSAGE NUMBER <MULTI MESSAGE>
14	2**1 BIT OF USER MESSAGE NUMBER <MULTI MESSAGE>
15	2**0 BIT OF USER MESSAGE NUMBER <MULTI MESSAGE>

FIGURE 3-4: COMMUNICATION STATUS REGISTER FORMAT

WORD 3 <DEP->LM>

BIT	CONTENTS
0	OUTPUT MESSAGE REQUEST
1	DATA SOLICIT REQUEST
2	GMT REQUEST
3	GN&C REQUEST
4	INITIAL LINK REQUEST
5	DEP MEMORY DUMP REQUEST
6	2**1 BIT OF OUTPUT BUFFER ID CODE
7	2**0 BIT OF OUTPUT BUFFER ID CODE
8	USER MESSAGE REQUEST
9	2**1 BIT OF MESSAGE TYPE CODE
10	2**0 BIT OF MESSAGE TYPE CODE
11	2**4 BIT OF MESSAGE LENGTH
12	2**3 BIT OF MESSAGE LENGTH
13	2**2 BIT OF MESSAGE LENGTH
14	2**1 BIT OF MESSAGE LENGTH
15	2**0 BIT OF MESSAGE LENGTH

WORD 4 <DEP->LM>

BIT	CONTENTS
0	FO PROGRAM SEGMENT LOAD REQUEST #1
1	2**6 BIT OF FO PROGRAM SEGMENT NUMBER
2	2**5 BIT OF FO PROGRAM SEGMENT NUMBER
3	2**4 BIT OF FO PROGRAM SEGMENT NUMBER
4	2**3 BIT OF FO PROGRAM SEGMENT NUMBER
5	2**2 BIT OF FO PROGRAM SEGMENT NUMBER
6	2**1 BIT OF FO PROGRAM SEGMENT NUMBER
7	2**0 BIT OF FO PROGRAM SEGMENT NUMBER
8	FO PROGRAM SEGMENT LOAD REQUEST #2
9	2**6 BIT OF FO PROGRAM SEGMENT NUMBER
10	2**5 BIT OF FO PROGRAM SEGMENT NUMBER
11	2**4 BIT OF FO PROGRAM SEGMENT NUMBER
12	2**3 BIT OF FO PROGRAM SEGMENT NUMBER
13	2**2 BIT OF FO PROGRAM SEGMENT NUMBER
14	2**1 BIT OF FO PROGRAM SEGMENT NUMBER
15	2**0 BIT OF FO PROGRAM SEGMENT NUMBER

NOTE: COMMUNICATION STATUS REGISTER WORD 4 WILL NOT BE REQUIRED FOR SL-1 EXPERIMENTS.

FIGURE 3-4: COMMUNICATION STATUS REGISTER FORMAT
(CONTINUED)

MESSAGE TYPE CODE CONDITION
----

00 SINGLE MESSAGE TRANSMISSION

01 FIRST MESSAGE OF MULTI MESSAGE TRANSMISSION

10 INTERMEDIATE MESSAGE OF MULTI MESSAGE TRANSMISSION

11 LAST MESSAGE OF MULTI MESSAGE TRANSMISSION

3.4.6 SCRATCH PAD MEMORY (SPM)

The Scratch Pad Memory (SPM) is a 256 word by 16 bit dual port memory in the IU. The SPM can be read or written into by the DEP. The IU's PCM telemetry subsystem reads data from SPM and encodes the data into the PCM telemetry format. Therefore, the SPM provides the means for sending DEP status and operational data directly into the PCM serial bit telemetry stream.

3.4.6.1 SCRATCH PAD MEMORY ALLOCATION

Figure 3-5 depicts the SPM locations that are written into by the DEP. Data is written into SPM either once per second by the ECSPM routine or on occurrence of an event by CODESTRT, STASK, GNC or MSOUT1 routines.

A-INITIALIZE
****

SPM locations 0 and 5 are used to provide status during the IU-DEP initialize phase. When the IPL interrupt is received, the DEP writes the value 'FOOF' to SPM location 0. Approximately 10 to 20 milliseconds later, the memory checksum is then written to SPM(0). The memory checksum is a logical add of memory locations '0000' to 'AFFE'. After completing the checksum, the DEP waits for 10 seconds to allow the IU to complete its initialization. The 10 second wait is based on the occurrence of 10 1Hz interrupts. After a 1Hz interrupt is detected, the DEP decrements the wait counter (initialized to 10) and writes the counter value to SPM(5).

SPM

LOCATION		REFRESH RATE	CONTENTS			
0	0	INITIALIZE	CODESTRT	A:	Initialize 'FOOF'	
		INITIALIZE	CODESTRT		Calculated Memory Checksum	
5	5	INITIALIZE	CODESTRT		60 Second Countdown Counter	
********	********	********	********	********	********	********
0	0	1/sec	ECST 1	B:	Experiment id (OD) + FO Model #	
10-51	16-79	ON OCCURRENCE	CODESTRT	C:	Program Check - Memory 0000 to 003F	
	130	On Receipt	STASK		Block #10	Block Id Word
	131	(1/2 sec)		D:	(Magnetic Field)	Status Word #1
						Status Word #2
	133					PCF Word
	134					B(x)
	135					
	136					B(y)
	137					
	138					B(z)
	139					
	140					Azimuth
	141					
	142					Co-el
	143					
	144					GMT
	145					
	146					
********	********	********	********	********	********	********
	147	1/sec	ECSPM	E:	FO Start Time	(GMT)
	148					
	149					
********	********	********	********	********	********	********
	150	On Receipt	GNC	F:	GNC	Day of Year
	151	(1/2 sec)				Time of Day (10 ms)
	152					
	153					GMT

FIGURE 3-5: SPM FORMAT

LOCATION	REFRESH RATE			CONTENTS
154				X Position
155				
156				Y Position
157				
158				Z Position
159				
160				X Velocity
161				
162				Y Velocity
163				
164				Z Velocity
165				
166				X Angular Position
167				
168				Y Angular Position
169				
170				Z Angular Position
171				
172				X Angular Rate
173				
174				Y Angular Rate
175				
176				Z Angular Rate
177				
180	On Receipt	STASK	G: BLOCK #8&9	Block Id Word
181				Command Word #1
182				Command Word #2
183				PCF Word
184				FO Model #
185				FO GMT
186				FO GMT
187				FO GMT

****

FIGURE 3-5: SPM FORMAT
(CONTINUED)

LOCATION	REFRESH RATE	CONTENTS		
192	1/2 sec	MSOUT1	H: Block #1&2	Block Id Word
193				Status Word #1
194				Status Word #2
195				PCF Word
196				BML Update Flags
197	1/sec	ECSPM	I: MPD Firing	
198	1/sec	ECSPM	J: Pitch Angle	
200	1/sec	ECSPM	K: DEP Status Word #1	
201			DEP Status Word #2	
202			DEP FO Time (seconds)	
203			DEP Relative FO Time (seconds)	
204			NSSC-II RTC	
205			NSSC-II RTC	
206			1HZ Counter	
207			1HZ Counter	
208				

FIGURE 3-5: SPM FORMAT
(CONTINUED)

B-EXPERIMENT ID & FO MODEL #
****

After the DEP initialize phase, once per second the SEPAC Experiment ID 'OD' and the FO Model Number are written to SPM(0). The FO Model Number is an integer value ranging from 1 to 18.

C-PROGRAM CHECK
****

On the occurrence of a Program Check or Machine Check interrupt, the NSSC-II memory locations '00' to '3F' are written to SPM (16 to 79). These NSSC-II memory locations contain the interrupt vectors and executive flags.

D-BLOCK #10 (MAGNETIC FIELD)
****

On the receipt of a Block #10 message from ECOS/ECAS, the DEP writes the contents of the Block #10 message to SPM (130-146). Under normal conditions, the Magnetic Field data should be received from ECOS/ECAS every two seconds.

E-FO START TIME
****

Once per second (routine ECSPM) writes the FO start Time into SPM (147-149). The FO Start Time is found in COMMON/FOFLG/FOSTRT(3). The routine SEPAC reads GMT and stores the value of GMT into FOSTRT when the FO Preparation state is started.

F-GNC
*****

Upon receipt of GNC data from ECOS/ECAS through the IU, the DEP writes the GNC buffer to SPM (150-177). Under normal conditions, the GNC data should be received from ECOS/ECAS every two seconds.

G-BLOCK #8 AND #9
****

Each time the DEP receives either a Block #8 (PCF Solicit/Update) or a Block #9 (FO Schedule) from ECOS/ECAS, the first 8 words of those messages are written into SPM (180-187). For Block #8, only the first 4 words contain meaningful data (Block ID, Command Word 1, Command Word 2, PCF Word). For Block #9, the 8 words contain the Block ID, Command Word 1, Command Word 2, PCF Word, FO Model Number, and 3 words for FO GMT.

H-BLOCK #1 AND #2
****

When the DEP transmits a Burst Mode Logic (BML) Message block (Block 1 and 2) to ECOS/ECAS, the first four words of the message are written into SPM (192-196). The (BML) Message blocks that are transmitted to ECOS/ECAS are Block #1 (BML Message Block 1) and Block #2 (BML Message Block 2).

I-MPD FIRING
****

Once per second the PCF values that are associated with the MPD firing are encoded into one word and are written into SPM (197). The format of the SPM word is as shown in the figure 3-6.

J-PITCH ANGLE
****

Once per second the pitch angle PCF entries 48 or 49 are written to SPM (198). The pitch angles are alternated every 60 seconds with PCF (48) being selected first.

60	59	58	57	56	55	54	53	52	51	50	SPM(197)

PCF	PARAMETER	RANGE	DESCRIPTION
50	FP	1 TO 4	FAV PRESSURE 2 OR 3 ATM
51	PFNCV	1 TO 4	PFN CHARGE VOLTAGE
52	PF1	0 TO 1	MPD PFN MODULE 1 ON/OFF
53	PF2	0 TO 1	MPD PFN MODULE 2 ON/OFF
54	PF3	0 TO 1	MPD PFN MODULE 3 ON/OFF
55	PF4	0 TO 1	MPD PFN MODULE 4 ON/OFF
56	TRGS	0 TO 1	MPD TRG MODULE A OR B
57	FAVS	0 TO 1	MPD FAV MODULE A OR B
58	PFNTS	0 TO 1	PFN CHARGE CURRENT .2A/1.00
59	NOCHG	1 TO 2	NUMBER OF CHARGERS
60	TRGCFO	0 TO 1	SELECT CAPDMP OR TRGSCR

FIGURE 3-6: MPD FIRING SPM WORD FORMAT

K-STATUS WORDS
****

Once per second the DEP status words are written to SPM(200-207). This first status word contains status information for the previous 1 second, while the second DEP status word contains a summary for the FO. The format and contents of the DEP status words are shown in Figure 3-7.

0 = Retransmit Buffer #1
1 = Retransmit Buffer #2
2 = Buffer #1 Clear
3 = Buffer #2 Clear
4 = Buffer #1 Selected
5 = Buffer #2 Selected
6 = Output Block #1 On Queue
7 = Output Block #2 On Queue
8 = Output Block #3 On Queue
9 = IU Command Register
12-15 = State

0	1	2	3	4	5	6	7	8	9	10	11	12.....15
												STATE

FIGURE 3-7: DEP STATUS WORD FORMAT

The FO time in seconds is written to SPM(202). This time ranges from -2400 seconds to +1560 seconds and is in COMMON/TLBUF/TLHED(3). The FO Node relative time in seconds is written to SPM(203). The node time is in COMMON/TLBUF/TLHED(4). SPM(204,205) will contain the value of the NSSC-II Real Time Clock at the last interval timer interrupt. The value is located in low memory address 72(048H). The 1Hz interrupt counter is located in low memory address 68(044H) and is written to SPM (206-207).

3.4.6.2 SPM OUTPUT PROCEDURE

The utility routine SPM is used to write DEP memory to SPM. The parameters for SPM are:

1. Address of Data in DEP Memory

2. Number of Words (16 bit)

3. Address of Byte String containing encoded SPM addresses.

The SPM output routine writes consecutive words to SPM starting at the designated DEP memory address and continuing for the specified number of words. The DEP to IU interface for Scratch Pad Memory addresses is a logical mirror image. The NSSC-II SIO Command Word has the following format for writing to SPM:

A1D1D2D3D4010203K1A2A3A4A5A6A7A8

where the D field (D1D2D3D4 = '0101') selects the SPM device, the S field (S1S2S3 = '111') selects the write operation and the K field (K1='1') is a constant value of '1'. The address field (A1A2A3A4A5A6A7A8) selects the address in SPM where the data is to be written. A1 is the least significant bit of the SPM address and A8 is the most significant bit of the SPM address.

The SPM routine generates the NSSC-II SIO command word from a byte string containing encoded SPM addresses. Each byte represents an SPM address and is of the form A1A2A3A4A5A6A7A8. Table 3-3 is a conversion table of SPM addresses to the encoded form used by the SPM routines.

TABLE 3-3: SPM ENCODED ADDRESSES

		LEAST SIGNIFICANT DIGIT															
	HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	DEC	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
HEX	DEC																
00	0	00	80	40	C0	20	A0	60	E0	10	90	50	D0	30	B0	70	F0
10	16	08	88	48	C8	28	A8	68	E8	18	98	58	D8	38	B8	78	F8
20	32	04	84	44	C4	24	A4	64	E4	14	94	54	D4	34	B4	74	F4
30	48	0C	8C	4C	CC	2C	AC	6C	EC	1C	9C	5C	DC	3C	BC	7C	FC
40	64	02	82	42	C2	22	A2	62	E2	12	92	52	02	32	B2	72	F2
50	80	0A	8A	4A	CA	2A	AA	6A	EA	1A	9A	5A	DA	3A	BA	7A	FA
60	96	06	86	46	C6	26	A6	66	E6	16	96	56	D6	36	B6	76	F6
70	112	0E	8E	4E	CE	2E	AE	6E	EE	1E	9E	5E	DE	3E	BE	7E	FE
80	128	01	81	41	C1	21	A1	61	E1	11	91	51	D1	31	B1	71	F1
90	144	09	89	49	C9	29	A9	69	E9	19	99	59	D9	39	B9	79	F9
A0	160	05	85	45	C5	25	A5	65	E5	15	95	55	D5	35	85	75	F5
B0	176	0D	8D	4D	CD	2D	AD	6D	ED	1D	9D	5D	DD	3D	BD	7D	FD
C0	192	03	83	43	C3	23	A3	63	E3	13	93	53	D3	33	B3	73	F3
D0	208	0B	8B	4B	CB	2B	AB	6B	EB	1B	9B	5B	DB	3B	BB	7B	FB
E0	224	07	87	47	C7	27	A7	67	E7	17	97	57	D7	37	B7	77	F7
F0	240	0F	8F	4F	CF	2F	AF	6F	EF	1F	9F	5F	DF	3F	BF	7F	FF

MOST SIGNIFICANT DIGIT

3.5 NSSC-II - IU RESTRICTIONS

The following restrictions have been noted and are contained in the SEPAC Flight software.

1. Inhibiting interrupts may cause the IU firmware or the NSSC-II software to enter infinite loop. The conditions for a loop are:

```
          NSSC-II                             IU
          *******                             **

                              <-------------  I/O Interrupt
      Service Interrupt
      Inhibit I/O Interrupt
      Perform SIO Operations
          SIO R1,R2, Command
          BNZ *-4             <-------------- I/O Interrupt Request
```

The NSSC-II SIO Operation cannot be completed since the IU has entered I/O Interrupt Service and the IU I/O Interrupt Service Request cannot be honored since an SIO operation is ongoing. Therefore, NSSC-II I/O operations should not be performed on an NSSC-II interrupt level.

2. To load command registers, the following I/O sequence must be used:

```
          SIO                 Rx,Ry, COMMAND:READ-INPUT-REGISTER
          BNZ                 *-4
          .
          .
          .
          SIO                 Rx, Ry, COMMAND:WRITE-INPUT-REGISTER
          BNZ                 *-4
          .
          .
          .
          SIO                 Rx, Ry, COMMAND:READ-INPUT-REGISTER
          BNZ                 *-4
          .
          .
          .
          SIO                 Rx, Ry, COMMAND:WRITE-INPUT-REGISTER
          BNZ                 *-4
```

The first READ-INPUT is necessary to allow time for address lines to be latched to correct Command Register.

3. If the NSSC-II performs SIO's to Dual Port Memory or Scratch Pad Memory at a high density, the probability of collisions between NSSC-II and IU access of those memories is significantly increased. When many collisions occur, there is a degradation in system performance.

4. When the NSSC-II sends a serial message to the IU to be transferred to the Experiment Computer, the NSSC-II expects one of two responses:

a) I/O Interrupt that the Message Buffer Cleared - transaction complete (code=6000 or 6001),

b) I/O Interrupt that the Message Buffer should be retransmitted (Error Condition) - (code=6002 and 6003).

If neither of these responses is sensed, the Flight Software will switch to the opposite output block in DPM.

4.0 MEMORY ALLOCATION

The memory allocation for the SEPAC flight software based on Version 2.6 is summarized in the following table.

TABLE 4-1: MEMORY ALLOCATION SUMMARY

	ADDRESS RANGE	NUMBER BYTES	PERCENTAGE
Assembly Language Routines	0000 - 018E	400	0.6
	04B0 - 2E76	10,696	16.3
Patch Space	0190 - 04AE	800	1.2
Database	2E78 - 6BD6	15,712	24.0
FORTRAN Routines	6BD8 - A6C6	15,088	23.0
FORTRAN Common Blocks	A6C8 - DA54	13,198	20.1
Spare	DA56 - DC06	434	0.7
BML	DC08 - FFFF	9,208	14.1
		65,536	100.0%

The allocation between logic code and data structures is shown in the following table.

TABLE 4-2: SEPAC FLIGHT SOFTWARE
VERSION 3
MEMORY MAP

ADDRESS		SIZE	TYPE	CONTENTS		
0000	0B0E	2832	A	DRIVER	:	SEPAC EXECUTIVE
0B10	0C56	328	A	STASK	:	TASK DISPATCHER
0C58	0D56	256	A	SINGLE	:	SINGLE COMMAND DRIVER
0D58	0E2E	216	A	PATCH	:	PATCH SPACE
0E30	0F1E	240	A	RTDRV	:	REAL TIME DRIVER-100 MILLISECONDS
0F20	10C6	424	A	RTCMD	:	COMMAND OUTPUT
10C8	1126	96	A	MSGIN	:	SERIAL MESSAGE INPUT
1128	132E	520	A	MSOUT1	:	SERIAL MESSAGE OUTPUT
1330	14C6	408	A	MSGHAN	:	MESSAGE HANDLER
14C8	15AE	232	A	CGMT	:	COMPARE GMT
15B0	1606	88	A	SGMT	:	SUBTRACT GMT
1608	1676	112	A	ECMAG	:	EXECUTIVE CONTROL MAGNETIC FIELD
1678	1776	256	A	GNC	:	GNC HANDLER
1778	1A26	688	A	ECBML	:	EXECUTIVE CONTROL BML
1A28	1B86	352	A	IUGMT	:	READ GMT
1B88	1C86	256	A	SETHTR	:	SET HEATER CURRENT PCF
1C88	1E4E	456	A	C22DWN	:	SINGLE INSTRUMENT SHUTDOWN
1E50	1F7E	304	A	IUCMD	:	WRITE IU COMMAND REGISTERS
1F80	1FC6	72	A	SPM	:	WRITE IU SPM
IFC8	218E	456	A	ECSMO	:	EXECUTIVE CONTROL SMO
2190	21F6	104	A	AEPIOF	:	AEPI INTERFACE
21F8	2366	368	A	MANUAL	:	MANUAL FO DRIVER
2368	2556	496	A	EXSPM	:	MASTER SPM DRIVER
2558	262E	219	A	DEPDMP	:	DEP DUMP
2630	2716	232	A	UHEADR	:	UNPACK MESSAGE HEADER
2718	2806	240	A	PHEADR	:	PACK MESSAGE HEADER
2808	2896	142	A	FLT16	:	FLOAT 16 BIT INTEGER
2898	2BBE	808	A	INT16	:	16 BIT INTEGER BOOLEAN ROUTINES
2BC0	2CE6	296	A	SIN	:	SIN/COS/TAN MATH UTILITIES
2CE8	2D86	160	A	ARCTAN	:	ARC TANGENT UTILITY
2D88	2E6E	232	A	ROOT	:	ROOT UTILITY
2E70	2E76	8		SPARE	:	
2E78	305E	488	D	FOMCOM	:	FO MENU DATA BASE
3060	39AE	2384	D	FOCOM	:	FO DEFINITION TABLE
39B0	3DB6	1032	D	PCFCOM	:	PCF DEFAULT DATA
3DB8	408E	728	D	CMDCOM	:	IU INSTRUMENT COMMAND DEFINITION

TABLE 4-2: SEPAC FLIGHT SOFTWARE
VERSION 3
MEMORY MAP
(CONTINUED)

ADDRESS		SIZE	TYPE	CONTENTS
4090	69B6	1053	D	HEXCOM : SEPAC HARDWARE/INSTURMENT ROUTINES
69B8	6A1E	104	D	FOCSCT : FO DEFINITION TABLE INDEX
6A20	6BD6	440	D	HXCSCT : HEXCOM INDEX
6BD8	6F0E	822	F	ECFO : EXECUTIVE CONTROL FO START
6F10	7E6E	3936	F	SEPACM : SEPAC MODE EXECUTIVE
7E70	93B6	5448	F	PASSX : INSTRUMENT COMMAND BUILD
93B8	98AE	1272	F	DOIF : IF STATEMENT PROCESSING
98B0	A476	3016	F	DOCALC : CALCULATION STATEMENT PROCESSING
A478	A6C6	592	F	ECPCF : EXECUTIVE CONTROL PCF MESSAGES
A6C8	A73E	120	C	DEPCOM : FORTRAN MASTER COMMON
A740	A78E		80	C COEFF : FORTRAN COEFFICIENT COMMON
A790	A7AE		32	C STATW1 : FORTRAN STATUS 1 COMMON
A7B0	A8AE	256	C	OUTCOM : FORTRAN OUTPUT MESSAGES COMMMON
A8B0	A8CE		32	C FOFL6 : FORTRAN FO FLAGS COMMON
A8D0	D7BE	1201	C	TLBUF : FORTRAN COMMAND DATA COMMON
D7C0	D886	200	C	MSGCOM : FORTRAN INPUT MESSAGES COMMON
D888	D8A6		32	C STATW2 : FORTRAN STATUS 2 COMMON
D8A8	D9DE	312	C	PCFBUF : PCF DATA AREA COMMON
D9E0	DA16		56	C GNCCOM : GNC DATA AREA COMMON
DA18	DA36		32	C UCMDW2 : COMMAND DATA COMMON
DA38	DA58		34	C UCMDW1 : COMMAND DATA COMMON
DA5A	DC06	440		SPARE : SPARE UNUSED DATA AREA
DC08	FFFE	9208	A	BML : BML DMA DATA AREA

		65536		

A = Assembly Language (Code + Data)

F = FORTRAN (Code + Data)

C = FORTRAN Common Block

D = Assembly Data

TABLE 4-3: LOGIC VERSUS DATA MEMORY

	SIZE (BYTES)	PERCENTAGE
LOGIC CODE	26,184	39.9
PATCH & SPARE	1,234	1.9
DATA	28,900	44.1
BML	9,208	14.1
	65,526	100.0%

The allocation of memory is based on the following groundrules:

1. NSSC-II memory address space '0000' to 007E' is reserved by the NSSC-II for interrupt vectors.

2. The Burst Mode Logic data is transferred to the NSSC-II memory address space 'DCA8' to 'FFFE' by the IU through the NSSC-II DMA port. This address space must be reserved for the BML data.

3. The allocation of patch space to low memory (starting address of '0190') is done to simplify software patches. Low memory address may be referenced without a base register, thereby simplifying patch instructions.

4. The IU PROMS containing the SEPAC Flight software load image is limited to the NSSC-II address space '0000' to AFFE'. When the IU performs an NSSC-II memory load operation, the address space '0000' to AFFE' is loaded from PROMS. This places a requirement that the following elements be allocated to that address space:

- All software logic code (Assembly & FORTRAN)
- Patch space
- Database

The other elements (primarily the FORTRAN COMMON Blocks) can reside above address 'AFFE'.

5.0 SEPAC DEP FLIGHT SOFTWARE STRUCTURE

The overall structural design of the SEPAC DEP Flight Software is built around the NSSC-II's interrupt structure.

Executive Initialize Process
****

The Executive Initialize Process consists of the Executive Initialize which is entered by the NSSC-II firmware when an IPL PSW Load interrupt is detected. Upon completion of the initialize process, the executive begins the background process. The Executive Initialize Process is executed on the NSSC-II user processing level.

Executive Background Process
****

Executive Background Process consists of the Task Dispatcher for executing the 19 predefined functions (see Table 5-1). The Executive Background Process remains active unless interrupted by the processor and is executed on the NSSC-II user processor level.

External Interrupt Process
****

The External Interrupt Process consists of the External Interrupt service logic. Both the IU 1HZ interrupts (code=0000H) and the NSSC-II Interval Timer interrupt (code=0080H) are serviced by the External Interrupt service logic.

This process is executed on the NSSC-II External Interrupt processing level and is activated on the occurrence of an NSSC-II external interrupt. Control is passed to the External Interrupt service handler - 'EXTINT'.

I/O Interrupt Process
****

The I/O Interrupt Process is activated on the occurrence of an NSSC-II I/O interrupt. Control is passed to the I/O Interrupt service handler -'IOINT'. This process services the NSSC-II I/O interrupts and is terminated with control returned to the process interrupted by the I/O interrupt.

Program/Machine Check Process
****

The Program/Machine Check Process is activated on the occurrence of an NSSC-II Program Check Interrupt or an NSSC-II Machine Check Interrupt. Control is passed to the Program Check/Machine Check service handler -'PRGINTER'. This process services the NSSC-II interrupt and is terminated with the NSSC-II processor being placed in the wait state.

TABLE 5-1: TASK SCHEDULE TABLE
(WORKLIST)

ENTRY	TASK NAME	TASK ROUTINE	DESCRIPTION
1	TIOINT	IOINT	IO INTERRUPT HANDLER
2	WIUI	IUINT	IU INITIALIZATION
3	TADUMBF	ADUMBF	IU MESSAGE RECOVERY
4	TSTASK	STASK	INPUT MESSAGE HANDLER
5	TECFO	ECFO	FO SCHEDULER
6	TPATCH	PATCH	PATCH/DUMP UTILITY
7	TMANUAL	MANUAL	MANUAL FO DRIVER
8	TECPCF	ECPCF	PCF UPDATE HANDLER
9	TECMAG	ECMAG	MAGNETIC FIELD HANDLER
10	TGNC	GNC	GN&C HANDLER
11	TECSMO	ECSMO	SMO CONTROL
12	TSWMASK	SWMASK	SOFTWARE MASK
13	TECBML	ECBML	BURST MODE LOGIC
14	TSINGLE	SINGLE	SINGLE COMMAND
15	XMAN	ECMAN	MANUAL FO DRIVER
16	WSEP	SEPACM	FO TIMELINE EXECUTIVE
17	MSG	MSGHAN	I/O MESSAGE DISPATCHER
18	TSPM	EXSPM	SCRATCH PAD MEMORY OUTPUT
19	TDEPDMP	DEPDMP	DEP MEMORY DUMP

5.1 SEPAC SOFTWARE MODULE TREE STRUCTURE

The following is the SEPAC Software Module Tree Structure.

```
EXTINT                           External Interrupt Service Process
   RTCMD
      AEPION
      AEPIOF
      IUCMD
      WORK
IOINT                           I/O Interrupt Service Process
PGRINTER                        Program Check/Machine Check
                                Interrupt Service Process
   SPM
CODESTRT                        Initial Program Load
                                Start Point
   IOINT                        I/O Interrupt Handler Process
   IUINT                        Initialization Process
      PASSO
      PASSX
          DOIF
              IEOR
              ISHIF
              IAND
          ZAP
          PHEADR
          IAND
          REV8
          MSOUT1
          IOR
          IEOR
          ISHIF
          DOCALC
              MOVE
              INT16
              SIN
              ROOT
              COS
              TAN
              ARCTAN
              FLT16
          MOVE
          FLT16
          INT16
          EXTRCT
          GETCMD
      RTCMD
          AEPION
          AEPIOF
          IUCMD
          WORK
```

```
ADUMBF                          Message Recovery Process
   MSOUT1
STASK                           Message Input Service Process
   MSGIN
   SPM
ECFO                            FO Schedule Process
   EXTRCT
   PASSO
ZAP
MANUAL                          Manual FO Process
   MSOUT1
   RTCMD
       AEPION
       AEPIOF
       IUCMD
       WORK
   PASSX
       DOIF
           IEOR
           ISHIF
           IAND
       ZAP
       PHEADR
       IAND
       REV8
       MSOUT1
       IOR
       IEOR
       ISHIF
       DOCALC
           MOVE
           INT16
           SIN
           ROOT
           COS
           TAN
           ARCTAN
           FLT16
       MOVE
       FLT16
       INT16
       EXTRCT
       GETCMD
   PASSO
ECPCF                           PCF Handler Process
   UHEADR
   SETHTR
       DOCALC
           MOVE
           INT16
           SIN
           COS
           ROOT
           TAN
           ARCTAN
```

```
          FLT16
      REV8
ECMAG                        Magnetic Field Process
GNC                           GN&C Process
   SPM
   SWMASK
PATCH                        Patch/Dump Process
   MSOUT1
       SPM
ECSMO                        SMO Process
   PASSX
       DOIF
           IEOR
           ISHIF
           IAND
       ZAP
       PHEADR
       IAND
       REV8
       MSOUT1
       IOR
       IEOR
       ISHIF
       DOCALC
           MOVE
           INT16
           SIN
           ROOT
           COS
           TAN
           ARCTAN
           FLT16
       MOVE
       FLT16
       INT16
       EXTRCT
       GETCMD
   RTDRV
       RTCMD
           AEPION
           AEPIOF
           IUCMD
SWMASK                       S/W Mask Process
ECBML                        Burst Mode Logic Process
   REV8
SINGLE                       Single Command Process
   MSOUT1
ECMAN
   RTCMD
```

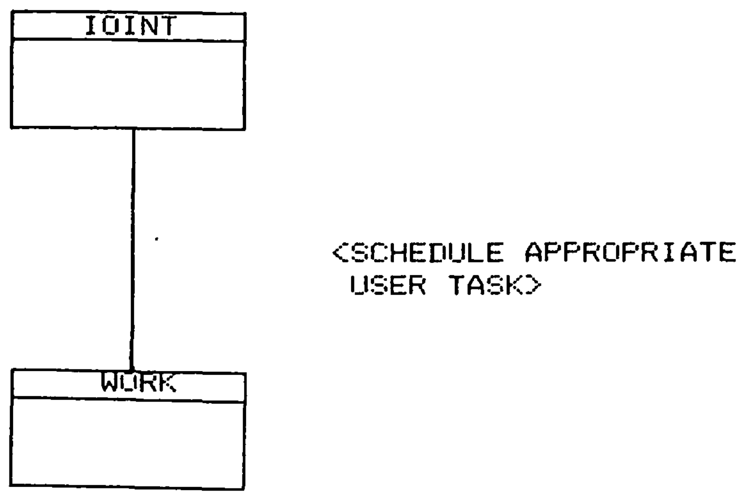
```
          AEPION
          AEPIOF
          IUCMD
DEPDMP                          Dump DEP Process
MSGHAN                          Message Output Handler Process
     PHEADR
     MSOUT1
EXSPM                           SPM Status Handler Process
     SPM
SEPACM                          FO Executive Process
     PASSX
          DOIF
               IEOR
               ISHIF
               IAND
          ZAP
          PHEADR
          IAND
          REV8
          MSOUT1
          IOR
          IEOR
          ISHIF
          DOCALC
               MOVE
               INT16
               SIN
               COS
               ROOT
               TAN
               ARCTAN
               FLT16
          MOVE
          FLT16
          INT16
          EXTRCT
          GETCMD
     RTDRV
          RTCMD
               AEPION
               AEPIOF
               IUCMD
               WORK
     INHIBT
     ENABLE
     C22DWN
     CGMT
```

```
          IUGMT
     SGMT
     IUGMT
          SGMT
     EXTRCT
     DOCALC
          MOVE
          INT16
          SIN
          ROOT
          COS
          TAN
          ARCTAN
          FLT16
     IAND
     DEPRTC
```

5.2 SEPAC PROCESSES

Each of the SEPAC processes is described in the following section.

I/O INTERRUPT PROCESS
****

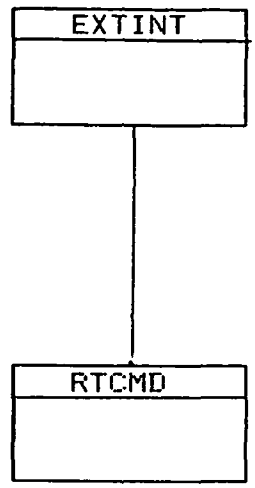


IONIT is the head of the I/O Interrupt Process. Execution of IOINT begins on an I/O Interrupt occurrence. IOINT schedules tasks or sets event flags based on the interrupt received; see I/O-INT Table below. The I/O Interrupt Process is terminated by returning control to the interrupted process.

TABLE 5-2: I/O-INT TABLE

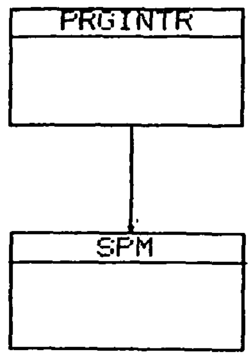
INTERRUPT CODE	ACTION
2065	SCHEDULE STASK
2081	SCHEDULE GNC
201F	SCHEDULE DEPDMP
6000	CLEAR BUFFER #1 FLAGS
6001	CLEAR BUFFER #2 FLAGS
6002	SET B#1 RETRANSMIT SCHEDULE ADUMBF
6003	SET B#2 RETRANSMIT SCHEDULE ADUMBUF

EXTERNAL INTERRUPT PROCESS
****



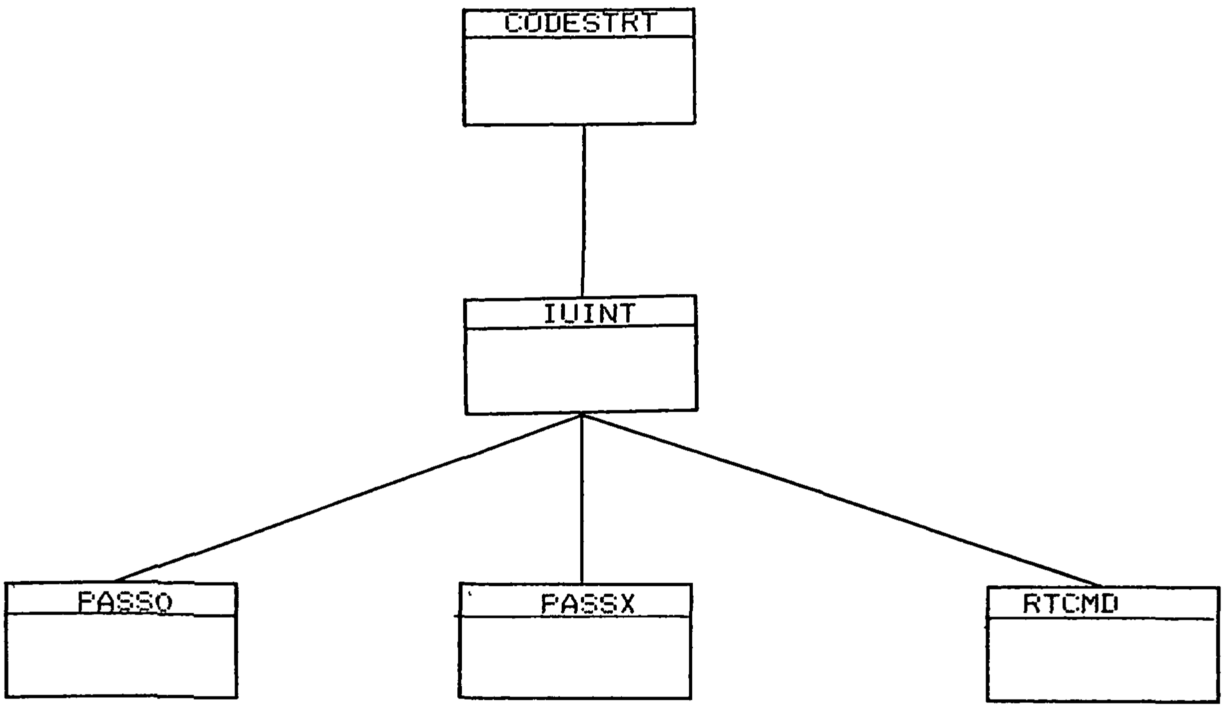
EXTINT is invoked when the NSSC-II Timer or IU 1HZ Interrupt occurs. The external (timer) process performs the output to the IU Command Registers and has a 100 millisecond cyclic schedule. EXTINT also contains the logic for syncing the NSSC-II Interval Timer and the IU 1HZ Interrupt every second. The External Interrupt process is terminated by returning control to the interrupted process.

PROGRAM/MACHINE CHECK INTERRUPT PROCESS
****



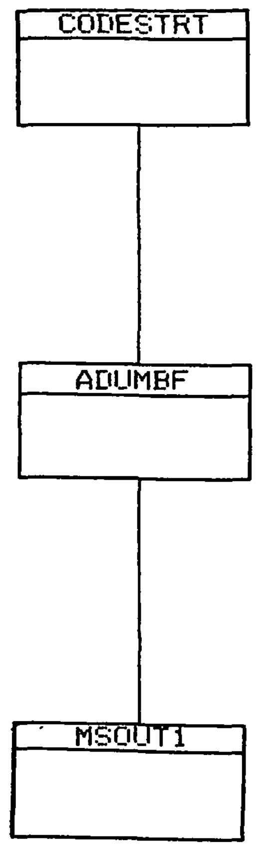
The Program Check or Machine Check Interrupt Process is started when a Program Check Interrupt or a Machine Check Interrupt occurs. The interrupt vector (PSW) transfers control to PRGINTR. This process writes low memory data to SPM and then causes the NSSC-II to enter a wait state.

IU COMMAND REGISTER INITIALIZATION
****



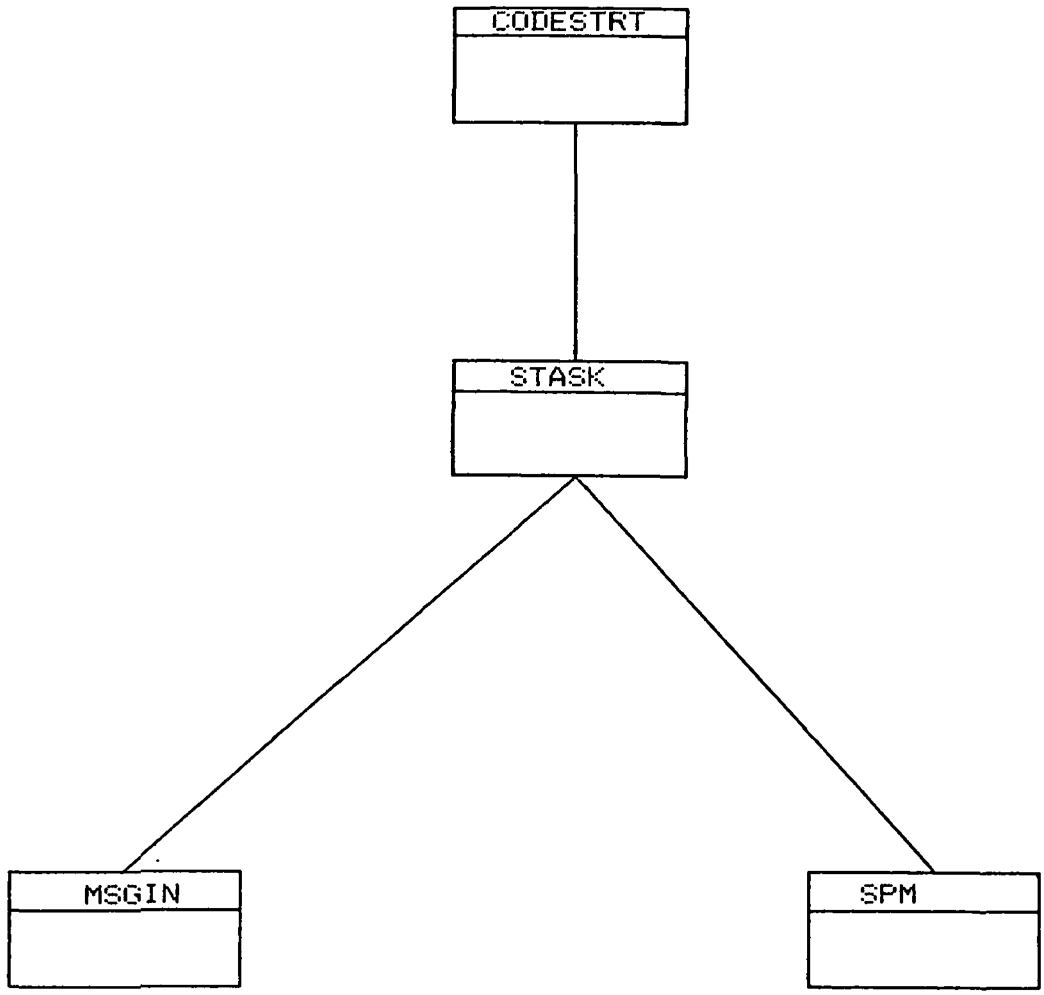
The process for performing IU Command Register Initialization is performed after the NSSC-II/DEP synchronization. The IU Command Registers are initialized per the command values specified in HEXTAB Subroutine IUINT. A command chain sequence is generated and executed for initializing the IU Command Registers.

MESSAGE RETRANSMIT PROCESS
****



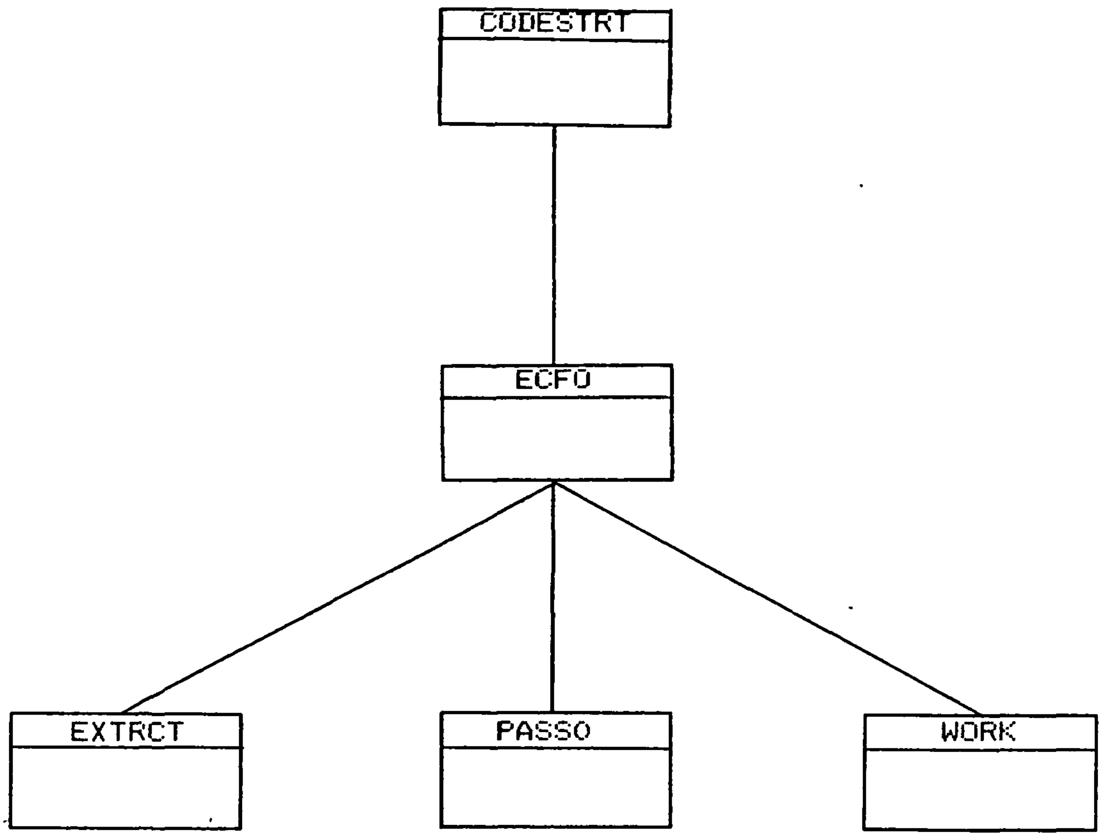
The Message Retransmit Process is invoked through the task dispatcher of CODESTRT when the ADUMBF task is set. ADUMBF task is set by the I/O Interrupt process when an I/O 6002H or 6003H interrupt occurs. The Message Retransmit Process retransmits the last IU message.

MESSAGE INPUT PROCESS
****



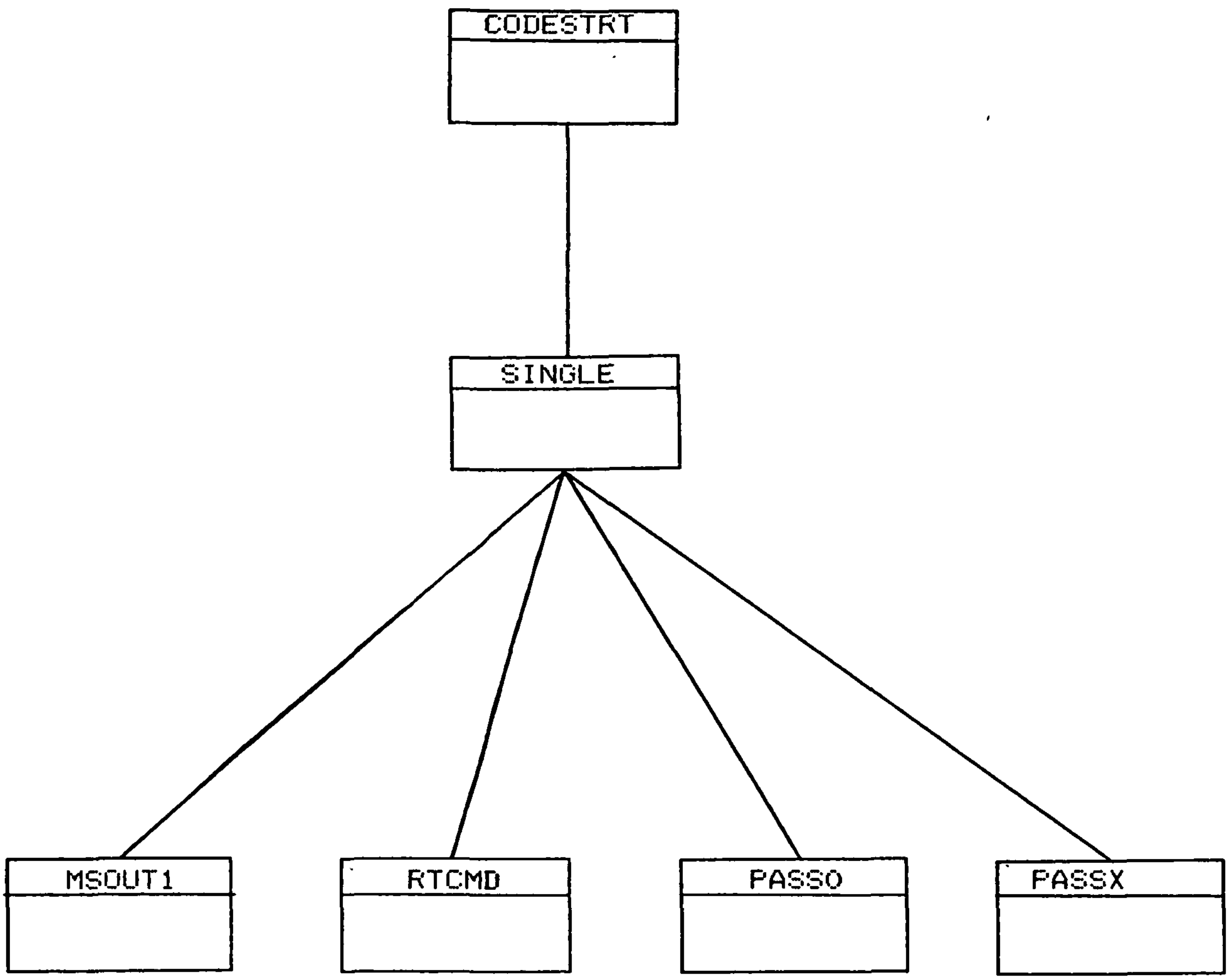
The Message Input Process is invoked through the task dispatcher of CODESTRT when the task STASK is set. STASK is set by the I/O Interrupt Process when an I/O 2065H interrupt occurs. The Message Input Process reads the message data from the IU's Dual Port Memory, deposits the data in FORTRAN COMMON, and writes the message header data to Scratch Pad Memory for telemetry. STASK also schedules other tasks as required.

FO INITIATION PROCESS
****



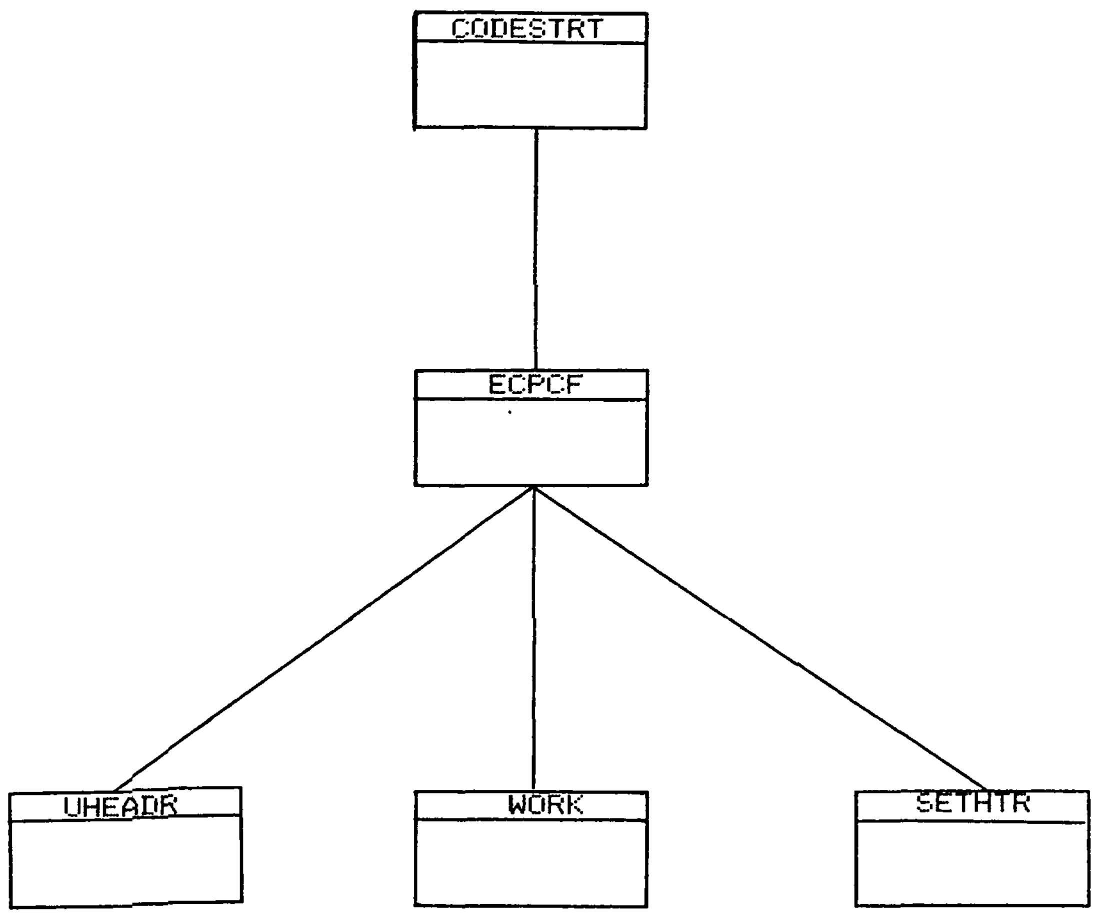
The FO Initiation Process is invoked through the task dispatcher of CODESTRT when the task ECFO is set. ECFO is set when a Block ID 9 message is received from the IU requesting the initiation of an FO. The FO Initiation Process performs the PCF initialization, initializes the FO data, and schedules the SEPACM task.

SINGLE COMMAND PROCESS
****



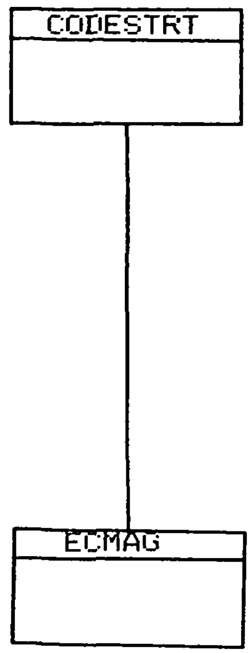
The Single Command Process is invoked through the task dispatcher of CODESTRT when the task SINGLE is set. SINGLE is set when a Block ID 11 message is received from the IU requesting the execution of a single IU command register output. The Single Command Process sets up the default PCF table, initializes the FO dependent variables, and reads/writes the IU Command Registers.

PCF UPDATE/QUERY PROCESS
****



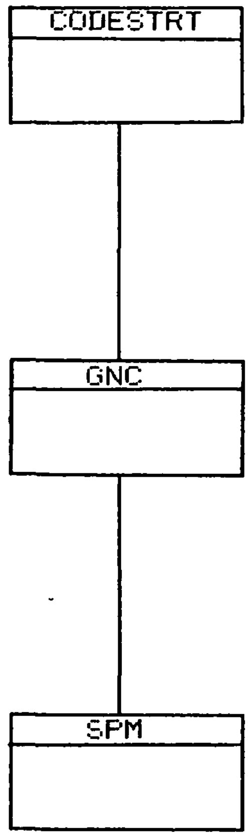
The PCF Update/Query Process is invoked through the task dispatcher of CODESTRT when the task ECPCF is set. ECPCF is set when a Block ID 8 message is received from the IU requesting a PCF Update or Query action. One special handled PCF Update is the Set Heater Current PCF where the command value is inserted immediately in the command registers.

MAGNETIC FIELD PROCESS
****



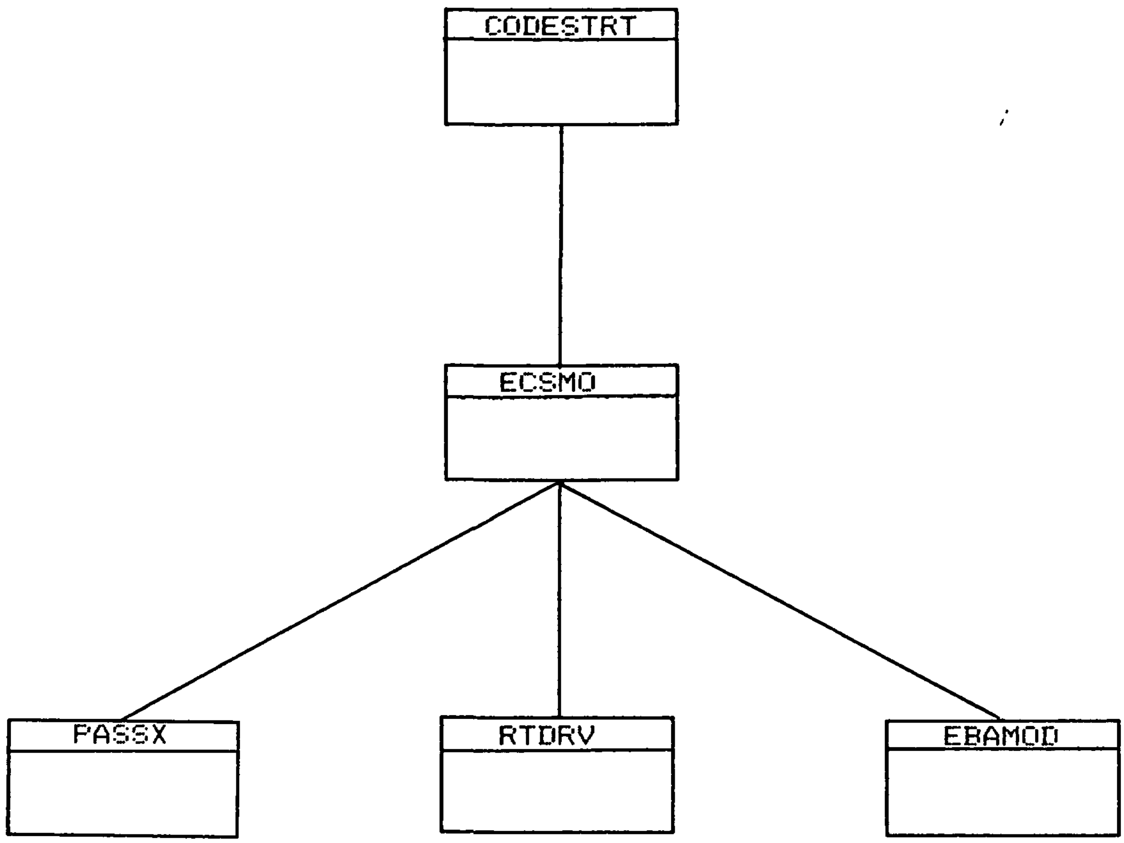
The Magnetic Field Process is invoked through the task dispatcher of CODESTRT when the task ECMAG is set. ECMAG is set when a Block ID 10 message is received from the IU indicating that Magnetic Field data is present in the Dual Port Memory(DPM). The Magnetic Field data is read from DPM and stored in FORTRAN COMMON.

GN&C PROCESS
****



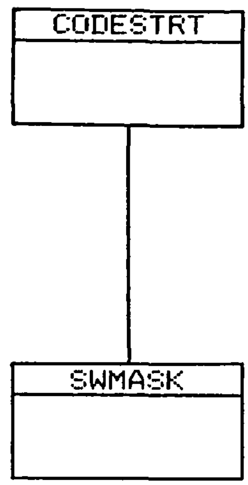
The GN&C Process is invoked through the task dispatcher of CODESTRT when the task GNC is set. GNC is set when an I/O Interrupt 2081H is received indicating that GN&C data is present in the IU's Dual Port Memory (DPM). This process reads the GN&C data from DPM, writes the data to Scratch Pad Memory, and deposits the data in FORTRAN COMMON.

SMO PROCESS
****



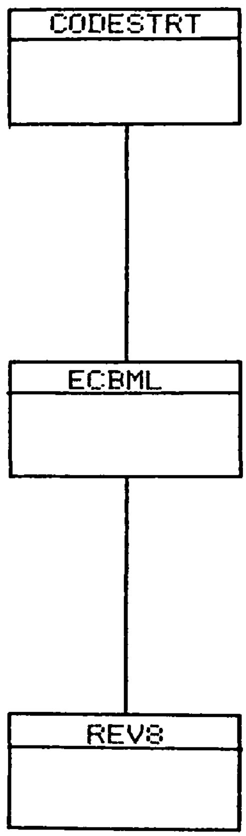
The SMO Process is invoked through the task dispatcher of CODESTRT when task ECSMO is set. ECSMO is set by the task SEPACM when the SMO is selected and the SMO time window is present. The selected SMO operation is performed.

SOFTWARE MASK PROCESS
****



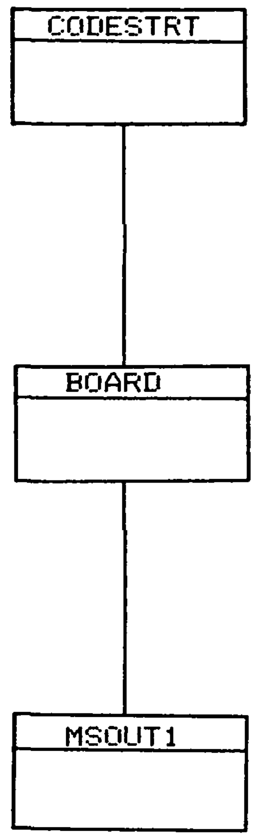
The Software Mask Process is invoked through the task dispatcher of CODESTRT when the task SWMASK is set. SWMASK task is not set for the first flight of SEPAC; i.e., the requirement for this function has been wavered for SEPAC first flight.

BURST MODE LOGIC PROCESS
****



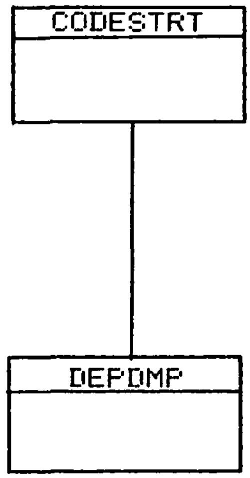
The Burst Mode Logic Process is performed at every EBA or MPD firing and is invoked through the task dispatcher of CODESTRT when task TECBML is set.

SINGLE BOARD COMMAND
****



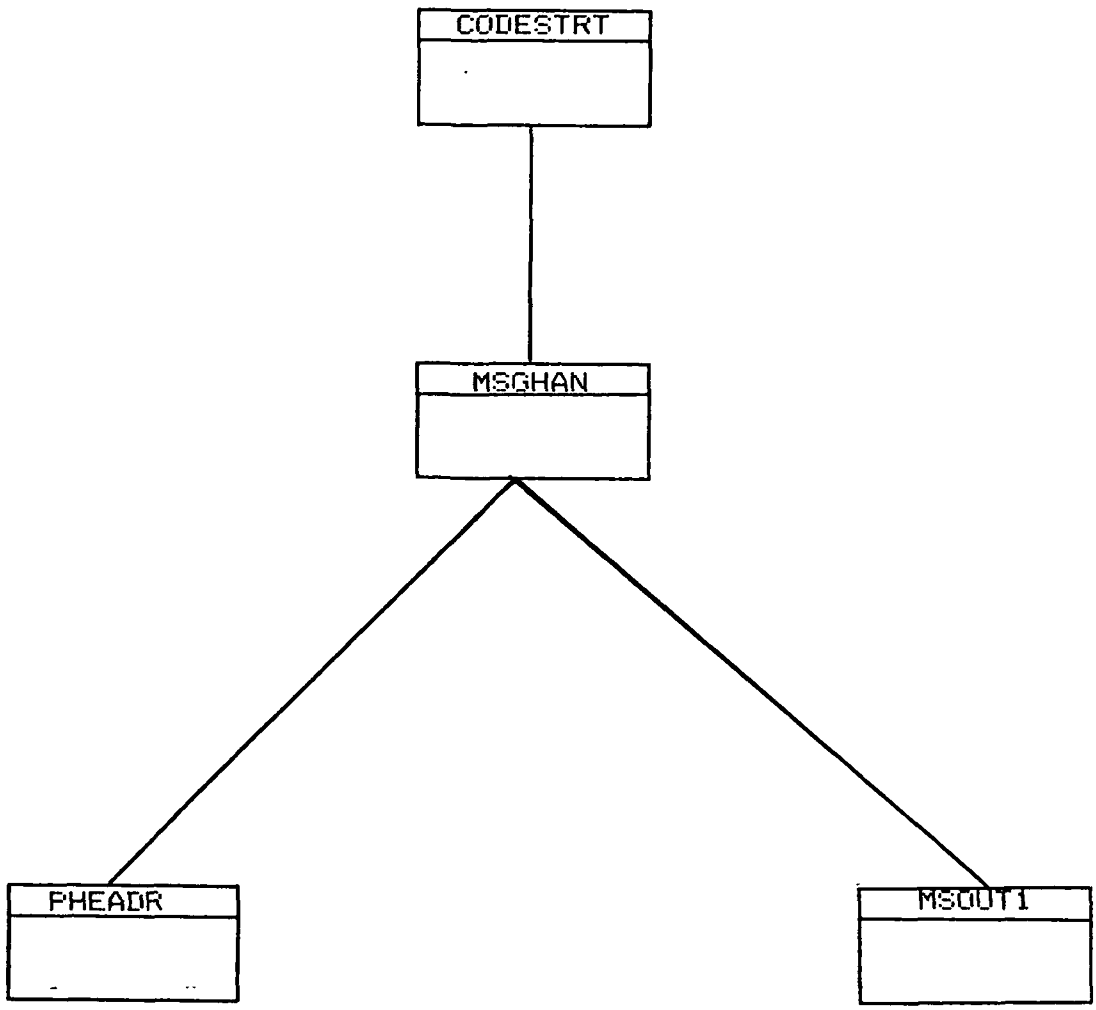
The Single Board Command process is invoked when a ground test command from EOIVS is received requesting a single board command function. The TSINGLE task of CODESTRT is activated.

DUMP DEP FUNCTION TASK
****



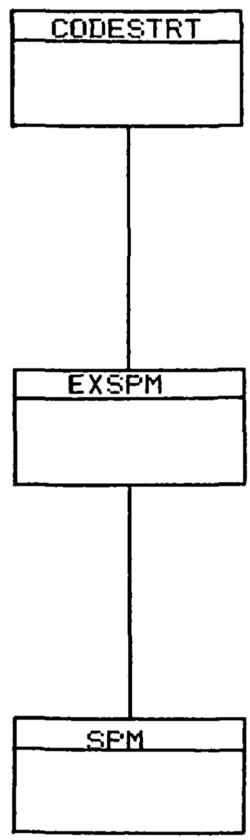
The Dump DEP function task is activated when task DEPDMP of CODESTRT is set. The Dump DEP task is activated in response to a Dump DEP Interrupt (201FH).

I/O SERIAL MESSAGE HANDLER
****



The I/O Serial Message Handler is activated once per second to output serial messages on the message queue. The I/O Serial Message Handler task is MSG of CODESTRT.

SCRATCH PAD MEMORY TASK
****



The Scratch Pad Memory task is activated once per second to output status data to the SPM. The SPM task is TSPM of CODESTRT.

5.3 SEPAC INITIALIZATION

The NSSC-II memory is initially loaded by the IU through the standard IPL loading sequence. The IU PROM's load NSSC-II memory to address AFFEH. Upon completion of the load, the SEPAC 'DEP software is started by an NSSC-II IPL interrupt. On receipt of the IPL interrupt, the NSSC-II firmware loads the PSW from low memory address 0 (IPL PSW). The IPL PSW vectors the starting address to the routine 'CODESTRT'.

The following steps are performed as part of the initialize phase.

1. R12 is established as base register.

2. R13 is loaded to address of SAVEAREA.

3. NSSC-II RTC is set to 0.

4. The External Interrupt New PSW is initialized to trap External Interrupts to 'EXT77'. This prevents servicing of External Interrupts until the initialize phase is completed. The interrupt PSW vector is reinitialized in step 10.

5. The I/O Interrupt New PSW is initialized to trap I/O interrupts to IO77. This prevents servicing of I/O interrupts until the initialize phase is completed. The interrupt PSW vector is reinitialized in step 10.

6. The value 'FOOF' is written into SPM location 0 to signal that the NSSC-II initialize has been initiated.

7. NSSC-II memory address space '0000' to 'DBFE' is protected against Direct Memory Access (DMA) storing through initialization of the SET STORAGE KEY (SSK) instruction. This protects against inadvertent DMA storing by the IU of Burst Mode Logic data in an address space other than 'DC08' to DFFE'.

8. A memory checksum is computed off the NSSC-II memory address space '0000' to 'AFFE'. The checksum is computed as a logical sum of the 16 bit memory cells. The checksum value is written to SPM location 0.

9. A sixty (10) second wait is executed to allow the IU to complete its initialization and to establish communication with the RAU. The IU 1HZ interrupt is used to count the 10 seconds. A counter value is loaded to a value of 10 and on each 1HZ interrupt, the value is decremented and written to SPM address 5.

During this segment of code, the IU 1HZ interrupt (code=0000) is trapped to CODE45.

10. The NSSC-II interrupt PSW vectors and IU enable masks are initialized to allow both I/O and External interrupts. The I/O and External interrupts are vectored to the normal interrupt service routines.

11. The SEPAC Task Schedule Table is initialized to deactivate all tasks except the 'SEPACM' task and the 'IUINT' task. These two tasks are initially active since IUINT initializes the IU Command Registers and SEPAC initializes the FORTRAN COMMON Block data values.

12. The following data items are initialized:

    - The executive control flags located in low memory (address '8' to '56') are set to zero.

    - The SEPAC state variable (COMMON/DEPCOM/STATE) is set to zero.

    - The output message block (COMMON/OUTCOM) is initialized to zero.

    - The RTDRV stop flag (COMMON/FOFLG/STFLG) is set to 'FF'.

13. The last step of the initialize phase is to enable the I/O and External Interrupts in the NSSC-II.

6.0 SEPAC DATABASE

The SEPAC Database consists of seven distinct but interrelated data files. These data files and their program FORTRAN names are:

```
FOMTAB  -  FORTRAN  COMMON/FOCOM/FOMTAB( )
FOCSCT  -  FORTRAN  COMMON/FOCSCT/ FOIND( )
FOTAB   -  FORTRAN  COMMON/FOCOM/FOTAB( )
HXCSCT  -  FORTRAN  COMMON/HXCSCT/HEXIND( )
HEXTAB  -  FORTRAN  COMMON/HEXCOM/HEXTAB( )
COMTAB  -  FORTRAN  COMMON/CMDCOM/COMTAB( )
PCFBUF  -  FORTRAN  COMMON/PCFCOM/PCFBUF( )
```

The relationship between the data files is shown in Figure 6-1.

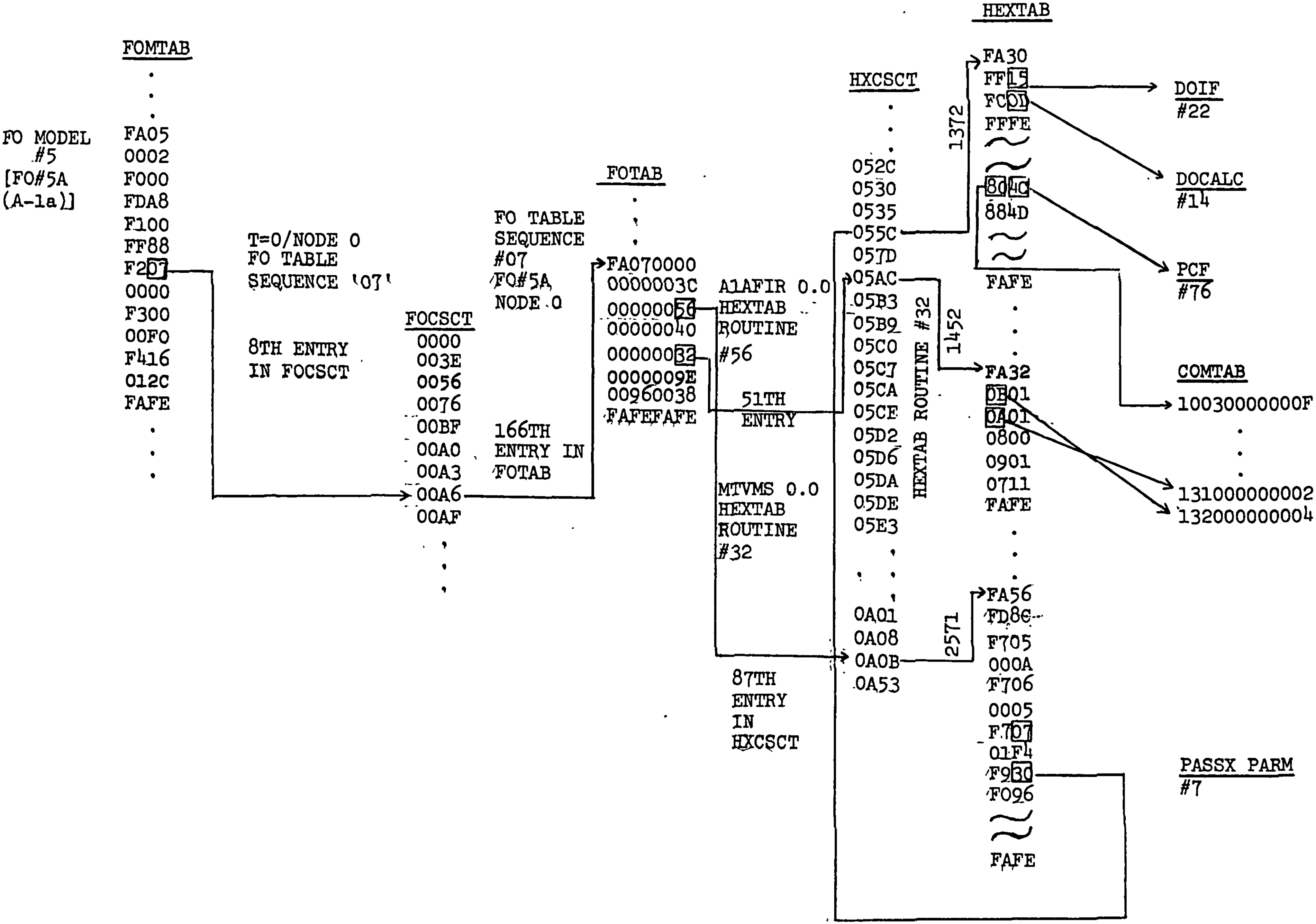


FIGURE 6-1: SEPAC DATABASE INTERRELATIONSHIP

6.1 FO MODEL (FOMTAB)

Each of the 18 FO's is defined by an FO Model in COMMON/FOMCOM/FOMTAB. The FO Models contain the following information:

- FO Model Number
- FO Type (EBA/MPD/NGP)
- FO Initialization Sequence Identifier
  - -ISO EBA
  - -ISO EBA-MPD
  - -ISO MPD I
  - -ISO MPD II
  - -None
- FO Preparation Start Reference Time
- SMO Start Reference Time
- FO Node 0 Sequence Identifier
- FO Nodes 1 - 5 Sequence Identifiers
- FO Nodes 1 - 5 Start Reference Times
- 60 Seconds to Power Off Reference Time
- FO Power Off Sequence Identifier
- FO Power Off Start Reference Time

The general structure for an FO Model is shown below.

```
FAMM    FA-MODEL #MM
000Y       TYPE = Y
FOII    FO-PREP SEQUENCE = IT
TTTT       FO PREP REFERENCE TIME
F100    SMO
SSSS       SMO REFERENCE TIME
F2NN    FO-NODE-SEQUENCE = NN
UUUU       NODE REFERENCE TIME = UUUU
F8JJ    F8-ARTIFICAL NODE - SEQUENCE = JJ
VVVV       ARTIFICAL NODE REFERENCE TIME = VVVV
F300    F3-60 SECONDS TO POWER OFF
WWWW       TIME = WWWW
F4KK    F4-POWER OFF SEQUENCE = KK
ZZZZ       POWER OFF REFERENCE TIME = ZZZZ
FAFE    FAFE-END OF MODEL
```

The following provides a more detailed description of the items in a model. Reference Table 6-1 for the specifics for each FO.

MM = FO Model Number in hexadecimal.
Valid numbers are 01 to 12.

Y = FO Type
1 = NOT EBA, NOT MPD
2 = EBA, NOT MPD
3 = NOT EBA, MPD
4 = EBA, MPD
The FO Type is needed to determine the Hold/Restart or MFO modified Power ON/OFF sequences.

II = FO Preparation Sequence Identifier that references a Sequence Table in FOTAB.
'00' = ISO EBA
'31' = ISO EBA-MPD
'01' = ISO MPD-I
'02' = ISO MPD-II

TTTT = FO Preparation Reference Time
SSSS = SMO Reference Time
UUUU = Node Reference Time
VVVV = Artificial Node Reference Time
WWWW = 60 Seconds to Power Off Reference Time
ZZZZ = Power Off Reference Time

All times are referenced to T=0 and are two's complement integer with the least significant bit equal to one second.

NN = Node Sequence Identifier that references a Sequence Table in FOTAB.

JJ = Artificial Node Sequence Identifier that references a Sequence Table in FOTAB.
Artificial nodes are necessary since some FO's require a large number of command points.

KK = Power Off Sequence Identifier that references a Sequence Table in FOTAB.
'16' = POWER OFF

TABLE 6-1: SEPAC FO MODEL NUMBERS

MODEL #	FO #	FO ID	
1	FO-1	(CFO)	SEPAC SYSTEM CHECKOUT
2	FO-2	(T-1)	EBA FIRING TEST LEVEL
3	FO-3	(T-2)	MPD FIRING TEST
4	FO-4	(T-3)	EBA FIRING TEST LEVEL II
5	FO-5	(A-1A)	ELECTRON BEAM EXPERIMENT 1
6	FO-5	(A-1B)	ELECTRON BEAM EXPERIMENT 2
7	FO-6	(A-2)	ELECTRON BEAM EXPERIMENT 2
8	FO-7	(A-3)	ELECTRON BEAM EXPERIMENT 3
9	FO-8	(A-4)	PLASMA BEAM PROPAGATION
10	FO-9	(A-5A)	ARTICIFIAL AURORA (EBA/NGP)
11	FO-9	(A-5B)	ARTIFICIAL AURORA (EBA/MPD)
12	FO-9	(A-5C)	ARTIFICIAL AURORA (EBA)
13	FO-10	(A-6)	EQUATORIAL AEROCHEMISTRY
14	FO-11	(A-7)	ELECTRON ECHO
15	FO-12	(A-8A)	E//B EXPERIMENT (EGA/MPD)
16	FO-12	(A-8B)	E//B EXPERIMENT (EGA/NGP)
17	FO-13	(P-1)	PASSIVE EXPERIMENT
18	FO-14	(P-2)	1ES020 EXPERIMENT SUPPORT

6.2 FO TABLES (FOTAB)

The FO Sequence Tables are composed of two common blocks, COMMON/FOCSCT/FOIND and COMMON/FOCOM/FOTAB. FOIND is a mapping index into the FOTAB array. FOTAB contains the Sequence Tables that define the initialization sequences, the power off sequences, the FO node sequences, or the modified power on/off sequences.

Each Sequence Table begins with an entry of the format 'FAXX0000' where XX is the Sequence Table identifier and ends with an entry of the format "FAFEFAFE'. The number of entries between the first entry and the last entry is variable.

The entries in the Sequence Table are of the format TTTTRRRR where TTTT is the time in seconds and RRRR is the HEXTAB routine identifier. The valid HEXTAB routine identifier range is '0000' to '00F5'. Identifiers in the range '00F6' to '00FF' are indirect identifiers. The true identifier is contained in COMMON/FOFLG/ROUTIX(1-10). The following Table summarizes the Identifiers.

TABLE 6-2: FOTAB KEYS

FOTAB ENTRY	IDENTIFIER
'0000' TO '00F5'	'0000' TO '00EF'
'F6'	ROUTIX(1)
'F7'	ROUTIX(2)
'F8'	ROUTIX(3)
'F9'	ROUTIX(4)
'FA'	ROUTIX(5)
'FB'	ROUTIX(6)
'FC'	ROUTIX(7)
'FD'	ROUTIX(8)
'FE'	ROUTIX(9)
'FF'	ROUTIX(10)

FOTAB/FOCOM INDEX

ID #	DESCRIPTION	ID #	DESCRIPTION
00	ISO EBA	17	FO#2 T-1 NODE 0
01	ISO MPD-I	18	FO#2 T-1 NODE 1
02	ISO MPD-II	19	FO#2 T-1 NODE 2
03	FO#01 (CFO)	1A	FO#2 T-1 NODE 3
04	FO#05 (A-1B) NODE 1	1B	FO#2 T-1 NODE 4
05	DUMMY FO	1C	FO#2 T-1 NODE 5
06	SMO-EBA	1D	FO#3 T-2 NODE 0
07	FO#05 (A-1A)	1E	FO#3 T-2 NODE 1
08	FO#05 (A-1B) NODE 0	1F	FO#4 T-3 NODE 0
09	FO#06 (A-2)	20	FO#4 T-3 NODE 1
0A	FO#07 (A-3)	21	FO#4 T-3 NODE 2
0B	FO#08 (A-4)	22	FO#4 T-3 NODE 3
0C	FO#09 (A-5A)	23	MODIFIED OFF
0D	FO#09 (A-5B)	24	
0E	FO#09 (A-5C)	25	MODIFIED ON
0F	FO#10 (A-6)	26	FO#12 (A-8A) NODE 1
10	FO#11 (A-7)	27	FO#12 (A-8B) NODE 1
11	FO#12 (A-8A)	28	HVCRST
12	FO#12 (A-8B)	29	
13	FO#13 (P-1)	2A	
14	FO#14 (P-2)	2B	
15	FO#15 (BAT)	2C	
16	PWROFF	2D	

FOTAB/FOCOM
(CONTINUED)

ID #	DESCRIPTION
2E	
2F	
30	
31	ISO EBA-MPD

6.3 HEXTAB

The HEXTAB portion of the SEPAC Flight Software database consists of "routines" that represent the SEPAC Instrument Level Routines, the Hardware Level Routines, the FO Timeline sequence routines, or general command/parameter routines.

Entries in the HEXTAB are of two formats:

```
FORMAT 1:  WWXX

FORMAT 2:  WWXX
           YYYY

where    WW = function index or command index
         XX = function subcode or command data (8 bits)
       YYYY = function data (16 bits)
```

The function indexes and command indexes are summarized in Table 6-3 and are described in the following paragraphs.

TABLE 6-3: HEXTAB COMMAND/FUNCTION SUMMARY

COMMAND/FUNCTION INDEX (VV)	FORMAT	DESCRIPTION
'00XX' TO '7FXX'	1	DIRECT COMMAND SIGNAL WW = INDEX INTO COMTAB XX = COMMAND SIGNAL DATA VALUE
'80XX' TO 'EFXX'	1	INDIRECT COMMAND SIGNAL WW-'80' = INDEX INTO COMTAB XX = PCF INDEX OF DATA
'F0XX'	1	NOT ASSIGNED
'F1XX'	1	NOT ASSIGNED
'F2XX' 'YYYY'	2	SKIP TO HEXTAB ENTRY YYYY XX = '00' YYYY = HEXTAB INDEX
'F3XX'	1	DELAY TIME - INDIRECT XX = INDEX IN ACAL; ACAL(XX) WHERE ACAL(XX) = DELAY TIME IN .1 SECONDS
'F4XX' 'YYYY'	2	DELAY TIME - LONG FORMAT XX = '00' YYYY = DELAY TIME IN .1 SECONDS
'F5XX'		NOT ASSIGNED
'F6XX'		NOT ASSIGNED
'F7XX' 'YYYY'		SET PARAMETERS XX = PARAMETER SUBCODE (SEE TABLE XX) YYYY = PARAMETER DATA
'F8XX'	1	CALL SUBROUTINE XX IN SERIES XX = SUBROUTINE IDENTIFIER
'F9XX'	1	CALL SUBROUTINE XX IN PARALLEL XX = SUBROUTINE IDENTIFIER

TABLE 6-3: HEXTAB COMMAND/FUNCTION SUMMARY
(CONTINUED)

COMMAND/FUNCTION INDEX (VV)	FORMAT	DESCRIPTION
'FAXX'	1	START OF HEXTAB ROUTINE XX XX = ROUTINE IDENTIFIER
'FAFE'	1	END OF HEXTAB ROUTINE
'FBXX'	1	NOP XX = '00'
'FCXX'	1	CALL CALCULATION NUMBER XX XX = INDEX INTO 'DOCALC' CALCULATIONS
'FDXX'	1	DELAY TIME - SHORT FORMAT XX = DELAY TIME IN .1 SECONDS (MAXIMUM = 25.5 SECONDS)
'FEFE'	1	END OF HEXTAB
'FFXX'	1	START OF IF STATEMENT XX XX = INDEX INTO 'DOIF'
'FFFE'	1	END OF IF STATEMENT

TABLE 6-4: SET PARAMETER SUBCODES

HEXTAB	DESCRIPTION
'F701' YYYY	SET FAVP TO YYYY YYYY=2 OR 3 ZCAL(27) = FAVP = 2.0 ATM OR 3.0 ATM ACAL(4) = 1 WHEN FAVP = 2.0 ATM ACAL(4) = 2 WHEN FAVP = 3.0 ATM PCF(50) 1: FAVP = 2.0 ATM 2: FAVP = YYYY ATM 3: FAVP = 5.0 ATM - YYYY ATM 4: FAVP = 3.0 ATM
'F702' YYYY	SET MPDV TO YYYY YYYY=380 OR 480 ZCAL(25) = MPDV = 380.0 KV OR 480.0 KV PCF(51) 1: MPDV = 380.0 2: MPDV = YYYY 3: MPDV = 860.0 - YYYY 4: MPDV = 480.0
'F703' YYYY	NOT ASSIGNED
'F704' YYYY	NOT ASSIGNED
'F705' YYYY	SET EBAV ZBAV = ZCAL(30) = YYYY * PCF(32)/100.0 YYYY = EBA VOLTAGE * 100.0 ZCAL(30) = EBAV PCF(32) = EBAV FACTOR
'F706' YYYY	SET EBAI EBAI = ZCAL(31) = YYYY * PCF(33)/100.0 YYYY = EBA CURRENT * 1000.0 ZCAL(31) = EBAI PCF(33) = EBAI FACTOR
'F707" YYYY	SET EBA PULSE WIDTH EBAPW = ACAL(5) = YYYY ACAL(5) = EBA PULSE WIDTH IN MILLISECONDS
'F708' YYYY	SELECT AF/BF COEFFICIENTS AF/BF = ACAL(2) = YYYY ACAL(2) = AF/BF SELECTOR

TABLE 6-4: SET PARAMETER SUBCODES
(CONTINUED)

```
HEXTAB          DESCRIPTION
------          -----------

'F709'          SAVE MTV AZ AND COEL - FIXED
YYYY            MTV COEL SAVE = PCF(80) = CL
                MTV AZ SAVE = PCF(79) = AZ
                YYYY = AZCL

'F70A'          SAVE MTV AZ AND COEL - CALCULATED
YYYY            PCF(79) = PCF(77), MTV AZ
                PCF(80) = PCF(78), MTV COEL
                PCF(79) = MTV AZ SAVE
                PCF(77) = MTV AZ CALCULATED
                PCF(80) = MTV COEL SAVE
                PCF(77) = MTV COEL CALCULATED

'F70B'          SET FAVPON SWITCH IXFP
YYYY              ACAL(4) = YYYY
                  ACAL(4) = IXFP SWITCH
                     YYYY=0  ACAL(4)=1 IF FAVP [ZCAL(27)]=2.0
                             ACAL(4)-2 IF FAVP [ZCAL(27)]=3.0
                     YYYY=0  ACAL(4)=YYYY

'F70C'          SAME AS 'F70D'
YYYY

'F70D'          SET SMO BEAM VOLTAGE AND CURRENT
YYYY              ZCAL(30)=PCF(2)/4.0
                  ZCAL(31)=PCF(3)/10.0
                  ZCAL(30)=EBAV
                  PCF(2)=SMO EBAV
                  ZCAL(31)=EBAI
                  PCF(3)=SMO EBAI

'F70E'          SET CALIBRATION MODE
YYYY              PURE=YYYY
                  PURE=CALIBRATION MODE FLAG
                     1=CALIBRATION
                     0=NOT CALIBRATION

'F70F'          SET NGMVSW OVERRIDE
YYYY              ACAL(6)=YYYY
                  ACAL(6)=NGMVSW OVERRIDE
                     1=OVERRIDE
                     0=NOT OVERRIDE

'F710'          SET PRESET ROUTINE IDENTIFIER
YYYY              ROUTIX(1)=YYYY+1
                  ROUTIX(1)=PRESET ROUTINE
```

TABLE 6-4: SET PARAMETER SUBCODES
(CONTINUED)

```
HEXTAB         DESCRIPTION
------         -----------

   HEXTAB
   ------
    FFXX           XX=FE   START "IF" STATEMENT
    FFFE                   END IF
    FEFE                   END OF HEXTAB
    FDXX                   DELAY XX/10
    FCXX                   CALL CALC (#XX+1)
    FBXX                   NOP
    FAXX           XX=FE   START HEXTAB SUBROUTINE
    FAFE                   END HEXTAB SUBROUTINE
    F9XX                   CALL HEXTAB SUBROUTINE XX-PARALLEL
    F8XX                   CALL HEXTAB SUBROUTINE XX-SERIES
    F7XX                   SET PARAMETERS ##-ZCAL?
    F70E                   SET PARAMETERS 0001 NO FACTOR
    YYYY                    YYYY=DATA
    F200                   SKIP TO INDEX YYYY
    YYYY                   ?COMTAB
    XXYY                   XX=COMMAND INDEX-YY=DATA
                            OR YY=PCF INDEX
XX=00-7F                   COMMAND + IMMEDIATE DATA
   80-F1                   COMMAND + PCF INDEX
    F3,F4,F5,F6            UNDEFINED



   FOTAB
   -----
    FAXX           XX=FE   START OF ROUTINE SET
    FAFE                   END OF ROUTINE SET
    TIME+HEXTAB    INDEX   YYYYIIII INDEX ----?



   FOMTAB
   ------
    FAXX           XX=FE   START OF FO MODE
    FAFE                   END OF FO MODEL
    FOXX YYYY      INIT    (FO PREP) XX=INDEX FOTAB
    F100 YYYY      SMO
    F2XX YYYY      NODE, XX=INDEX FOTAB
    F8XX YYYY      ARTIFICIAL NODE XX FOTAB INDEX
    F300 YYYY      60 SECS POWER OFF
    F4XX YYYY      POWER OFF XX=FOTAB INDEX
```

HEXTAB/HEXCOM

ROUTINE #	ROUTINE	ROUTINE #	ROUTINE
00	EBAINT	15	CHGCHK
01	EBASET	16	CHGSTD
02	EBACHK	17	DPSPON
03	EBAHTR	18	DPSPOF
04	EGABMI	19	EPEOFF
05	EBABMV	1A	PHOSTW
06	EBAFCS	1B	PHOCHK
07	EBADEF	1C	ISOFIR
08	HVCRST	1D	PLLCHK
09	EBADWN	1E	HGPFIR
0A	MPDINT	1F	PLECHK
0B	MPDSET	20	PWPCHK
0C	MPDFIR	21	TRGFIR
0D	NGPCHK	22	TRGSET
0E	FAVCHK	23	EPECHK
0F	TRGCHK	24	
10	PFNCHK	25	EPVCHK
11	GASCHK	26	MTVINT
12	FAVPON	27	MTVOFF
13	FAVPOF	28	MTVCHK
14	MPDOFF	29	

HEXTAB/HEXCOM
(CONTINUED)

ROUTINE #	ROUTINE	ROUTINE #	ROUTINE
2A	IUINT	3E	DGPIS2
2B		3F	DGPIS3
2C	EBADW1	40	DGA1A
2D	EBADW2	41	DGA1B
2E	MTVOF1	42	DGA1B1
2F	EBST1	43	DGA2
30	EBAFIR	44	DGA3
31	MTVISO	45	DGA4
32	MTVMS1	46	DGA5A
33	MTVMS2	47	DGA5B
34	MTVMS3	48	PHO5B
35	MTVMS4	49	EFE5B
36	MTVMS5	4A	DGA7
37	MTVPAS	4B	PWH4
38	MTVEB1	4C	PWL4
39	MTVMP1	4D	EPE4
3A	MTVMP2	4E	PHO5C
3B	MTVDGP	4F	EPE5C
3C	MTVEB2	50	EPE6
3D	DGPIS1	51	MTVSLV

HEXTAB/HEXCOM
(CONTINUED)

ROUTINE #	ROUTINE	ROUTINE #	ROUTINE
52	MTVCK1	65	T1FIR3
53	SF05N1	66	TIFIR4
54	TIMTG1	67	TIFIR5
55	F05ILV	68	T2MPD
56	A1AFIR	69	T3ISET
57	A1BFIR	6A	T3FIR0
58	A2FIR	6B	T3FIR1
59	SF05N0	6C	F02HT1
5A	A4FIR	6E	F02HT2
5B	A5AFIR	6E	DGPT10
5C	A5BFIR	6F	DGPT11
5D		70	DGPT12
5E	A8FIR	71	DGPT13
5F	A7FIR	72	DGPT14
60	A8FIR	73	DGPT15
61	TIMTAG	74	DGPT20
62	T1FIR0	75	DGPT21
63	T1FIR1	76	DGPT30
64	T1FIR2	77	DGPT31

HEXTAB/HEXCOM
(CONTINUED)

ROUTINE #	ROUTINE	ROUTINE#	ROUTINE
78		8F	T3OMPD
79	DGPT33	90	T4OSET
7A	PHO8A	91	T3NGP
7B	PLL8	92	A2NGP
7C	PWH8	93	A3MPD*
7D	PWL8	94	A5ANGP*
7E	EPE8	94	A5ANGP*
7F	PHO8B	95	T7OSET
80	MTVSO1	96	T8OSET
81	MTVSO2	97	T81SET
82	MTVSOBB3	98	A5ANGP
83	MTVSO4	99	IFPSET
84	MTVEB	9A	
85	MTVON1	9B	A6SET
86	MTVOF2	9C	A7SET
87	A1BO1BB	9D	IMPDST
88		9E	CALSET5
89	A1BO3	9F	CALSET4
8A	ABASET	A0	PHO8A1
8B	A3MPD	A1	PLL81
8C	A8BNGP	A2	PWH81
8D	T3OSET	A3	PWL81
8E	T3NGP	A4	EPE81

6.4 COMTAB

The COMTAB data structure contains information on the IU command registers for formatting instrument commands into the paper register and bit positions. There is an entry in COMTAB for each of the instrument commands.

The general format of COMTAB is depicted below and each of the fields of COMTAB is defined.

```
COMTAB (12 BYTE X______) ARRAY
  BWSLPPXYMMMM

    B    = IU Command Register Board #
           0, 1, 2, 3

    W    = IU Command Register Word #
           0, 1, 2, 3

    S    = Starting Bit Number
           0...F (0...15)
           0 = left most or most significant bit

    L    = Length in bits of command
           0...F (0...15)
           0 = length of 1 bit, F = length of 16

    PP   = Associated PCF Index (if required)

    X    = Special Logic Function #1
           0 = No special logic
           4 = Invoke PCF Note #4

    Y    = Special Logic Function #2
           0 = No special logic
           8 = Command to be sealed

    MMMM = Command Mask
```

6.5 SEPAC NSSC-II LOW MEMORY ASSIGNMENTS

Because of the nature of the NSSC-II, the low memory is reserved for special hardware requirements and ease in addressing. The SEPAC low memory assignments are detailed below.

BYTE HEX	BYTE DEC	BYTE MAD	CONTENTS
00	0	********	Initial PSW
08	8	*	1HZ Occurrence Flag
09	9	***	Space
0C	12	*	Buffer #1 Retransmit Flag
0D	13	*	Buffer #2 Retransmit Flag
0E	14	*	Buffer #1 Busy Flag
0F	15	*	Buffer #2 Busy Flag
1D	16	********	Space
18	24	********	External Interrupt Old PSW
20	32	********	SVC Interrupt Old PSW
28	40	********	Program Interrupt Old PSW
30	48	********	Machine Check Interrupt Old PSW
38	56	********	I/O Interrupt Old PSW
40	64	********	Test Compare Display Slots
48	72	****	RTC Read
4C	76	**	Checksum
4E	78	**	DEP Status Word #1
50	80	**	1HZ Flip Flop Flag
52	82	--**----	DEP Status Word #2
54	84	****	Spare
58	88	********	External Interrupt New PSW
60	96	********	SVC Interrupt New PSW
68	102	********	Program Interrupt New PSW
70	110	********	Machine Check Interrupt New PSW
78	118	********	I/O Interrupt New PSW

6.6 SEPAC TIMELINE STATE DEFINITIONS

The SEPAC Timeline for performing a FO is partitioned into 13 states. These states control the logic being performed by routine SEPACM, the SEPAC Timeline Executive. The states are:

STATE	DEFINITION
0	Perform first pass initialization
1	Idle-Wait for FO Schedule
2	Test for FO Prep Start
3	Test for SMO Start
4	Perform SMO
5	Test for T=0 Start
6	Perform FO & Test for Nodes Power Off, or Holds
7	Perform Hold Modified Off
8	In Hold Mode, Test for Restart
9	Begin Power Off
10	Wait for Restart to Complete
11	Select Restart Node
12	Wait for Power Off to Complete
13	Schedule Power Off

6.7 FO INSTRUMENT COMMAND DATA STRUCTURE

The two data structures TLHED and CXREG of common block TLBUF contain the prebuilt instrument commands for a given FO. These data structures are defined below.

TLHED(6)	-	Integer (16 Bit) array containing header indexes and time
CXREG(6,1000)	-	Integer (16 Bit) array containing IU Command Register words with corresponding time. CXREG is a forware/reverse link list type data structure.

The detailed contents for the data structures are defined below.

TLHED

TLHED (1):	Number of Commands in Structure 0<=TLHED(1)<=1000
TLHED (2):	Current Index Reference into CXREG
TLHED (3):	Unused
TLHED (4):	Total Elapsed seconds for FO
TLHED (5):	Relative Elapsed seconds for FO Phase
TLHED (6):	Relative Elapsed Milliseconds mod/second

CXREG

CXREG (1,*):	Time in units of 100 milliseconds
CXREG (2,*):	Register Number 1<=CXREG(2,*)<=16
CXREG (3,*):	Command Register Mask
CXREG (4,*):	Command Register Data
CXREG (5,*):	Forward Index Link
CXREG (6,*):	Reverse Index Link

The entries in CXREG are sorted first by ascending time (i.e., CXREG (1,*)) and then by ascending command register (i.e., CXREG (2,*)).

6.8 FACTORABLE COMMANDS

Five Instrument Commands are defined as factorable commands; i.e., there is a PCF value to be applied as a factor to the command data value. These five commands are:

COMMAND	PCF-INDEX	NOTE
LENIS	74	1,4
SENAD	75	1,4
PHIRCO-3	61	2,4
BM-V	32	3,4
BM-C	33	3,4

NOTE 1: The commands LENIS and SENAD have an inverse relation between counts and voltages. The factor values are to be applied to the voltage values. The following equation is used:

DATA VOLTAGE = 127-(127-DATACOUNTS)*FACTOR

NOTE 2: The command PHIRCO-3 is directly factored from the data base to the command word.

NOTE 3: The commands BM-V and BM-C are factored when the beam voltage and beam current calculations are performed.

NOTE 4: All factoring of commands is performed before the commands are bit rolled.

6.9 INSTRUMENT SHUTDOWN COMMANDS

The Instrument shutdown commands result in a one time setting of instrument commands which remain frozen to those values for the FO duration. The shutdown commands are defined per the following:

SHUTDOWN COMMAND		SHUTDOWN SET
STD1	EBA	I
STD2	HVC	Special
STD3	MPD	I & II
STD5	PWR	I & II
STD6	DGP	III
STD7	MTV	IV

The Shutdown sets are as follows:

SHUTDOWN SET I (EBA)
ENBMC = 1
BMPSW = 0
BMCADJ = 0.0V
HTRSW = 0
HTRADJ = 0.0.V
FOCCN = 0.0A
FOCSW = 0
DEFXSW = 0
DEFYSW = 0
DEFCNX = 0
DEFCNY = 0
BMCADJ = 0.0A
MODPLS = 0

SHUTDOWN SET II (PWR AND MPD)
CHGSW1 = 1
CHGSW2 = 1

SHUTDOWN SET III (DGP)
PHIRC0-3 = 0
PHFLC0-1 = 3
EPAHVC = 0
EPAFX0-4 = 0
EPAFIX = 1
EPVFON = 0

SHUTDOWN SET IV (MTV)
LENCS = 1
SENAD = 0.0V
SENSL = 1

To implement the instrument shutdowns, five tables are defined for the shutdown commands.

STD1-EBA
****

REGISTER,WORD	MASK	DATA	COMMAND
1,0	0000	0000	
1,1	0000	0000	
1,2	0000	0000	
1,3	0000	0000	
2,0	0000	0000	
2,1	0000	0000	
2,2	0000	0000	
2,3	0000	0000	
3,0	8000	8000	ENBMC=1
3,1	0000	0000	
3,2	1001	0000	BMPSW=0,MODPLS=0
3,3	00FF	00FE	BMVADJ=0.0V
4,0	63FF	00FE	HTRSW=0,FOCCN=0.0A,FOCSW1,0,DEFXSW=0, DEFYSW=0
4,1	FFFF	FEFE	DEFCNX=0,DEFCNY=0
4,2	FFFF	FEFE	HTRADJ=0.0A,BMCADJ=0.0A
4,3	0000	0000	

STD3-MPD
****

REGISTER,WORD	MASK	DATA	COMMAND
1,0	0000	0000	
1,1	0000	0000	
1,2	0000	0000	
1,3	0000	0000	
2,0	0000	0000	
2,1	0000	0000	
2,2	0000	0000	
2,3	0000	0000	
3,0	8000	8000	ENBMC=1
3,1	0000	0000	
3,2	1C01	0C00	BMPSW=0,MODPLS=0
3,3	00FF	00FE	BMVADJ=0.0V
4,0	63FF	00FE	HTRSW=0,FOCCN=0.0A,FOCSW1,0,DEFXSW=0, DEFYSW=0
4,1	FFFF	FEFE	DEFCNX=0,DEFCNY=0
4,2	FFFF	FEFE	HTRADJ=0.0A,BMCADJ=0.0A
4,3	0000	0000	

STD5-MPD,PWR
****

REGISTER,WORD	MASK	DATA	COMMAND
1,0	0000	0000	
1,1	0000	0000	
1,2	0000	0000	
1,3	0000	0000	
2,0	0000	0000	
2,1	0000	0000	
2,2	0000	0000	
2,3	0000	0000	
3,0	8000	8000	ENBMC=1
3,1	0000	0000	
3,2	1C01	0000	BMPSW=0,MODPLS=0,CHGSW1=1,CHGSW2=1
3,3	00FF	00FE	BMVADJ=0.0V
4,0	63FF	00FE	HTRSW=0,FOCCN=0.0A,FOCSW1,0,DEFXSW=0, DEFYSW=0
4,1	FFFF	FEFE	DEFCNX=0,DEFCNY=0
4,2	FFFF	FEFE	HTRADJ=0.0A,BMCADJ=0.0A
4,3	0000	0000	

STD6-DGP
****

REGISTER,WORD	MASK	DATA	COMMAND
1,0	0000	0000	
1,1	0000	0000	
1,2	0000	0000	
1,3	0000	0000	
2,0	017F	0040	EPAHVC=0,EPAFX0-4=0,EPAFIX=1,EPVFON=0
2,1	0000	0000	
2,2	0000	0000	
2,3	07E0	0060	PHIRC0-3,PHFLC0-1=3
3,0	0000	0000	
3,1	0000	0000	
3,2	0000	0000	
3,3	0000	0000	
4,0	0000	0000	
4,1	0000	0000	
4,2	0000	0000	
4,3	0000	0000	

STD7-MTV
****

REGISTER,WORD	MASK	DATA	COMMAND
1,0	0000	0000	
1,1	0000	0000	
1,2	FF00	FF00	SENAD=0.0V
1,3	000A	000A	LENCS=1,SENSL=1
2,0	0000	0000	
2,1	0000	0000	
2,2	0000	0000	
2,3	0000	0000	
3,0	0000	0000	
3,1	0000	0000	
3,2	0000	0000	
3,3	0000	0000	
4,0	0000	0000	
4,1	0000	0000	
4,2	0000	0000	
4,3	0000	0000	

6.10 CALCULATION AND IF STATEMENT DATA STRUCTURES

Three data structures are used to support calculation (DOCALC) and if statement (DOIF) processing.

```
ACAL(10)          - Integer (16 bit) Array
ZCAL(32)          - Single precision array
PCFBFR(76...80) - Extension of PCF Integer array
```

A definition of the calculations and If statement follows.

CALCULATION
****

```
C# 1:   L=HVCSW1+HVCSW2+HVCSW3+HVCSW4+HVCSW5+HVCSW6
        L=> ZCAL(1)

C# 2:   VBMAX = 1.25 * L
        VBMAX => ZCAL(2)

C# 3:   IBMAX = 7.8E-02 * VBMAX**(3/2)
        IBMAX => ZCAL(3)

C# 4:   HTRADJ = AH * I + BH
        HTRADJ => ZCAL(4), PCFBFR(76) (See Note 1)

C# 5:   IBO = 1.56-02 * VB**(3/2)
        IBO = > ZCAL(5)

C# 6:   IBC = 5.1E-03 * VB
        IBC => ZCAL(6)

C# 7:   IF BV = 0.0
           THEN BMCADJ = 0.0
           ELSE BMCADJ = (AIB*(IB+BIB*VB+CID)**(2/3)+DIB)/VB
        END
        BMCADJ => ZCAL(7), PCFBFR(76) (See Note 1)

C# 8:   IF BV = 0.0
           THEN BMCADJ = 0.0
           ELSE BMCADJ=(IB/IBC)*(AIB1*(IBC+BIB*VB+CIB)**(2/3)+DIB))/VB
        END
        BMCADJ => ZCAL(8), PCFBFR(76) (See Note 1)
```

```
C# 9:   BMVADJ = AVB*VB+BVB
        BMVADJ => ZCAL(9), PCFBF7(76) (See Note 1)

C#10:   Select XAF,XBF Values
        FOCCN = (AF*AFO)*VB**(1/8)*IB**(1/4)+BF
        FOCCN => ZCAL(10), PCFBFR(76) (See Note 1)

C#11:   DEFCNX = AX*SQRT(VB)*ABS(THETXO)+CX
        DEFCNX => ZCAL(11), PCFBFR(76) (See Note 1)

C#12:   DEFCNY = AY*SQRT(VB)*ABS(THETYO)+CY
        DEFCNY => ZCAL(12), PCFBFR(76) (See Note 1)

C#13:   NOCM = PF1+PF2+PF3+PF4
        NOCM => ZCAL(13)

C#14:   VB=VBMAX
        VB => ZCAL(30)

C#15:   IB=IBMAX
        IB => ZCAL(31)

C#16:   EDO-3 = (TAUEM+500)/100
        EDO-3 => PCFBFR(76)

C#17:   XAIB1=22.5, XBIB1-0.0, XCIB1=0.0, XDIB1=0.79

C#18:   XAIB1=36.3, XBIB1=-1.2E-3, XCIB1=1.3E-3, XDIB1=4.08

C#19:   Select Pitch From PCF's 48 or 49 (Switch every 1 minute)
        Fetch Magnetic Field Az and COEL
        Limit MF-AZ 0.0<=AZ<=360.0
        Limit MFCOEL 0.0<=COEL<=180.0
        IF 11 OR 12
           THEN REORIENT AZ AND COEL
        END
        THETXO = ARCTAN(TAN(COEL-PITCH)*COS(AZ))
        THETYO = ARCTAN(TAN(COEL-PITCH)*SIN(AZ))
        THETXO => ZCAL(16)
        THETYO => ACAL(17)

C#20:   IB = .078*VB**3/2
        IB => ZCAL(31)
```

```
C21:    No Calculation

C#22:   Calculate MTVEBA
        AZMIUTH => PCFBFR(77)
        COEL => PCFBFR(78)

C#23:   IF PW1DTH < .1 EPW=PWIDTH*100, EPWM=1
        IF PWIDTH < 1.0 EPW=PWIDTH*10, EPWM=2
        IF PWIDTH < 10.0 EPW=PWIDTH, EPWM=3
        EPW => PCFBFR(76)
        EPWM => PCFBFR(77)

C#24:   EPMO-3 = PWIDTH
        EPMO-3 => PCFBFR(76)

C#25:   Limit PWIDTH TO 255
        PWIDTH => ACAL(5)

C#26:   Not Used

C#27:   Set SMO Calculation to use SMO THED


NOTE 1: Engineering unit values are converted to IU counts
        by equation:

          LIMIT 0.0 <= Engineering Value <= 5.0
          COUNTS = 128.0-128.0/4.98*(Engineering Value-.02)
          COUNTS => PCFBFR(76)
```

IF STATEMENTS
****

IF# 1:	IFICNT=0	ICNT=PCF45
IF# 2:	IF ICNT < > 0	
IF# 3:	IF IB >= IBO	
IF# 4:	IF IB < IBO	
IF# 5:	IF IB >= IBC	
IF# 6:	IF IB = IBC	
IF# 7:	IF THED < > 0	THED=PCF48 OR 49
IF# 8:	IF THED < > 0	
IF# 9:	IF THETXO >= 0	
IF#10:	IF THETXO < 0	
IF#11:	IF THETYO >= 0	
IF#12:	IF THETYO < 0	
IF#13:	IF PT > 25	
IF#14:	IF ANGL = 0	ANGL = PCF 71
IF#15:	IF ANGL < > 0	
IF#16:	IF EHVC = 1	EHVC = PCF 70
IF#17:	IF EHVC < > 1	
IF#18:	IF VFON = 1	VFON = PCF 72
IF#19:	IF VFON < > 1	
IF#20:	IF IXFP = 1	
IF#21:	IF IXFP < > 1	
IF#22:	IF VB > VBMAX	
IF#23:	IF IB > IBMAX	
IF#24:	IF CNT = 1	CNT=PCF 45
IF#25:	IF PWIDTH < 10	
IF#26:	IF FO #2	
IF#27:	IF PWIDTH >= 10	
IF#28:	IF TRGCFO = 0	TRGCFO = PCF 60
IF#29:	IF TRGCFO < > 0	
IF#30:	IF PWIDTH >= 1.0	
IF#31:	IF SMO THED = 0	SMO THED = PCF 1
IF#32:	IF SMO THED < > 0	
IF#33:	IF NOT FO #2	
IF#34:	IF NOT NGMVSW AND FO #9	

REAL CALCULATION VECTOR
****

ZCAL(1)	L	(#1)
ZCAL(2)	VBMAX	(#2)
ZCAL(3)	IBMAX	(#3)
ZCAL(4)	HTRADJ	(#4)
ZCAL(5)	IBO	(#5)
ZCAL(6)	IBC	(#6)
ZCAL(7)	BMCADJ	(#7)
ZCAL(8)	BMCADJ	(#8)
ZCAL(9)	BMVADJ	(#9)
ZCAL(10)	FOCCN	(#10)
ZCAL(11)	DEFCNX	(#11)
ZCAL(12)	DEFCNY	(#12)
ZCAL(13)	NOCM	(#13)
ZCAL(14)	PT	
ZCAL(15)		
ZCAL(16)	AZ, THETXO	(#19)
ZCAL(17)	COEL, THETYO	(#19)
ZCAL(18)		
ZCAL(19)		
ZCAL(20)		
ZCAL(21)		
ZCAL(22)	MAGNETIC FIELD-AZ	(#22)
ZCAL(23)	MAGNETIC FIELD-COEL	(#23)
ZCAL(24)		
ZCAL(25)	MPDV 380.0,480.0	
ZCAL(26)		
ZCAL(27)	FAVP 2.0, 3.0	
ZCAL(28)		
ZCAL(29)		
ZCAL(30)	EBA-V (VB)	(#14)
ZCAL(31)	EBA-I (IB)	(#15, #20)

INTEGER CALCULATION VECTOR
****

ACAL(1)	15/31 SEC MPD FIRING 0,1,2
ACAL(2)	AF/BF SELECTION
ACAL(3)	
ACAL(4)	IXFP SETTING 1,2
ACAL(5)	EBA PULSE WIDTH
ACAL(6)	NGMVSW OVERRIDE
ACAL(7)	
ACAL(8)	
ACAL(9)	
ACAL(10)	

6.11 PCF DEFINITION

The PCF values are stored in the data array PCFBFR which is defined as a 80 x 16 integer array. Each PCFBFR entry has a range 0 to 255 units.

The SEPAC PCF values are stored in entries 1 to 75. Entries 15 to 80 are used for passing parameters and computed values during the PASSX computations.

/

ECAS PARM	FORMAT TYPE	CONVERSION RANGE	ASSY CODE	PARAMETER	RANGE	DEFAULT	DESCRIPTION
26	B	0-9		TAUEM	-500 RO 400MS	NOTE 1	EBA/MPD TIME DELAY
27	B	0-9		TAUEN	-500 TO 400MS	NOTE 1	EBA/NGP TIME DELAY
28	A	1 OR 0		SMO	1 OR 0	0	SMO OR NO SMO
29				SPARE			
30	A	1 OR 0		AEPI	1 OR 0	0	AEPI ENABLE/INHIBIT
31	A	1 OR 0	EBA	SELMAS	1 OR 0	1	SW MASK ENABLE/INHIBIT
32	B	0-10	EBA	FVB	0.0 TO 1.0	NOTE 1	FACTOR BEAM VOLTAGE
33	B	0-10	EBA	FIB	0.0 TO 1.0	NOTE 1	FACTOR BEAM CURRENT
34	B	0-180	EBA	IHTR	0.0 TO 18.0AMP	NOTE 3	EBA HEATER CURRENT
35	A	1 OR 0	EBA	HTRONF	1 OR 0	NOTE 1	EBA HEATER SWITCH ON OR OFF
36	A	1 OR 0	EBA	FOCONF	1 OR 0	1	FOCUS COIL CURRENT ON OR OFF
37	A	1 OR 0	EBA	DFXONF	1 OR 0	1	DEFLECTION COIL X ON OR OFF
38	A	1 OE 0	EBA	DFYONF	1 OR 0	1	DEFLECTION COIL Y ON OR OFF
39	A	1 OR 0	EBA	SW1FLG	1 OR 0	NOTE 1	HVC MODULE 1 ON OR OFF
40	A	1 OR 0	EBA	SW2FLG	1 OR 0	NOTE 1	HVC MODULE 2 ON OR OFF
41	A	1 OR 0	EBA	SW3FLG	1 OR 0	1	HVC MODULE 3 ON OR OFF
42	A	1 OR 0	EBA	SW4FLG	1 OR 0	1	HVC MODULE 4 ON OR OFF
43	A	1 OR 0	EBA	SW5FLG	1 OR 0	1	HVC MODULE 5 ON OR OFF
44	A	1 OR 0	EBA	SW6FLG	1 OR 0	1	HVC MODULE 6 ON OR OFF
45	A	1 OR 0	EBA	CNT	1 OR 0	0	EBA CONTINGENCY OR NORMAL
46	C	0-255	EBA	AF	0.00 TO 2.00	1.00	FOCUS COEFFICIENT
47	C	0-255	EBA	BF	-2.00 TO 2.00	0.05	FOCUS COEFFICIENT
48	A	0-180	EBA	THED1	0 TO 180 DEG	NOTE 7	PITCH ANGLE (1ST PART)
49	A	0-180	EBA	THED2	0 TO 180 DEG	NOTE 7	PITCH ANGLE (2ND PART)
50	A	1-4	MPD	FP	1 TO 4	NOTE 4	FAV PRESSURE 2 OR 3ATM
51	A	1-4	MPD	PFNCV	1 TO 4	NOTE 5	PFN CHARGE VOLTAGE
52	A	1 OR 0	MPD	PF1	1 OR 0	1	MPD PFN MODULE 1 ON OR OFF
53	A	1 OR 0	MPD	PF2	1 OR 0	1	MPD PFN MODULE 2 ON OR OFF
54	A	1 OR 0	MPD	PF3	1 OR 0	1	MPD PFN MODULE 3 ON OR OFF
55	A	1 OR 0	MPD	PF4	1 OR 0	1	MPD PFN MODULE 4 ON OR OFF
56	A	1 OR 0	MPD	TRGS	1 OR 0	0	MPD TRG MODULE B OR A
57	A	1 OR 0	MPD	FAVS	1 OR 0	0	MPD FAV MODULE B OR A
58	A	1 OR 0	MPD	PFNTS	1 OR 0	0	PFN CHARGE CURRENT 0.2A/1.0A
59	A	1 OR 2	MPD	NOCHG	1 OR 2	2	NUMBER OF CHARGERS
60	A	1 OR 0	MPD	TRGCFO	1 OR 0	NOTE 1	SELECT CAPDMP OR TRGSCR

FIGURE 6-2: SEPAC PARAMETER CHANGE FILE

ECAS PARM	FORMAT TYPE	CONVERSION RANGE	ASSY CODE	PARAMETER	RANGE	DEFAULT	DESCRIPTION
61	B	1-150	DGP	PHOFIR	0.1 TO 15.0	1.0	FACTOR IRIS CONTROL
62	A	0-3	DGP	PWHFGN	0 TO 3	NOTE 6	PWP-HF GAIN SELECT
63	A	0-3	DGP	PWHFBS	0 TO 3	NOTE 6	PWP-HF BAND SELECT
64	A	1 OR 0	DGP	PWLFGN	1 OR 0	0	PWP-LF GAIN REVERSE OR NORMAL
65	A	1 OR 0	DGP	PA	1 OR 0	1	PLP POWER ON OR OFF
66	A	1 OR 0	DGP	PB	1 OR 0	1	PWP POWER ON OR OFF
67	A	1 OR 0	DGP	PC	1 OR 0	1	EPE POWER ON OR OFF
68	A	1 OR 0	DGP	PD	1 OR 0	1	EPV POWER ON OR OFF
69	A	1 OR 0	DGP	PE	1 OR 0	1	PHO POWER ON OR OFF
70	A	1 OR 0	DGP	EHVC	1 OR 0	NOTE 1	EPE HIGH VOLTAGE ON OR OFF
72	A	1 OR 0	DGP	VFON	1 OR 0	NOTE 1	EPV FILAMENT ON OR OFF
73	A	1 OR 0	DGP	VFMT	1 OR 0	0	SELECT EPV FILAMENT #2 OR #1
74	B	1-30	MTV	FILV	0.1 TO 3.0	1.0	FACTOR OF ILV
75	B	1-30	MTV	FSLV	0.1 TO 3.0	1.0	FACTOR OF SLV

NOTE 1. REFER TO SEPAC SDS SECT. 4 F.O. PCF DEFAULT VALUES.

NOTE 2. DELETED (1/20/81)

NOTE 3. APPLICABLE EXCEPT FOR FO#01 (CFO) AND FO#02 (T-1). DEFAULT 14A EXCEPT FO#02 WHICH IS FIXED AT 9A, 12A, and 14A.

NOTE 4. FP=1 (2ATM), FP=2 (LIKE SEQ CHART), FP=3 (COMPLEMENT), FP=4 (3TM).

NOTE 5. PFNCV=1 (400V), PFNCV=2 (LIKE SEQ CHART) PFNCV=3 (COMPLEMENT), PFNCV=4 (480V).

NOTE 6. 0 (ALL "0"), 1 (SEQ CHART). 2 (COMPLEMENT), 3 (ALL "1") IN THE TIME SEQUENCE CHART.

NOTE 7. THEDI (1ST MINUTE), THED2 (2ND MINUTE), THED1 (3RD MINUTE), ETC.

FIGURE 6-2: SEPAC PARAMETER CHANGE FILE
(CONTINUED)

ECAS PARM	FORMAT TYPE	CONVERSION RANGE	ASSY CODE	PARAMETER	RANGE	DEFAULT	DESCRIPTION
1	A	0-180	EBA	PITCH	0 TO 180 DEG	0	PITCH ANGLE
2	B	0-30	EBA	VB	0.0 TO 7.5 KV	7.5	BEAM VOLTAGE
3	B	0-16	EBA	IB	0.0 TO 1.6 A	1.6	BEAM CURRENT
4*	B	0-255	EBA	PWIDTH	0.0 TO 25.5 SEC	0.1	PULSE WIDTH DELAY
5*	A	0-255	EBA	ERPTN	0 TO 255	1	EBA REPETITION NO.
6*	B	0-255	EBA	PINT	0.0 TO 25.5 SEC	15	EBA PULSE INTERVAL
7*	A	1 OR 2	MPD	FP	1 OR 2	2	FAV PRESSURE 2/3 ATM
8*	A	1 OR 2	MPD	PFNCY	1 OR 2	2	PFN CHARGE 400/480 V
9*	A	0-60	MPD	MRPTN	0 TO 60	1	MPD SHOT NUMBER
10*	A	0-60	NGP	NRPTN	0 TO 60	0	NGP SHOT NUMBER
11*	A	0-30	NGP	NINT	0 TO 30 SEC	15	NGP PULSE INTERVAL
12*	B	0-9		TAUEM	-500 TO 400MS	0	EBA/MPD TIME DELAY
13*	B	0-9		TAUEN	-500 TO 400MS	0	EBA/NGP TIME DELAY
14	A	0-7		TFLG	0 TO 7	3	NOTE 1
15*	A	1 OR 0		TEBACK	1 OR 0	0	EBACHK ON OR OFF
16*	A	1 OR 0		TFAVCK	1 OR 0	0	FAVCHK ON OR OFF
17*	A	1 OR 0		TTRGCK	1 OR 0	0	TRGCHK ON OR OFF
18*	A	1 OR 0		TPFNCK	1 OR 0	0	PFNCHK ON OR OFF
19*	A	1 OR 0		TGASCK	1 OR 0	0	GASCHK ON OR OFF
20*	A	1 OR 0		TNGPCK	1 OR 0	0	NGPCHK ON OR OFF
21*	A	1 OR 0		TCHGCK	1 OR 0	0	CHGCHK ON OR OFF
22*				SPARE 1			
23*				SPARE 2			
24	B	10-150		PW/FO-11	0.1 TO 1.5	0.5	PULSE WIDTH FOR FO-11
25	A	0-2		GRNTST	0 TO 2	0,NOTE 2	FLIGHT/GROUND TEST INDICATOR

*NOT USED ON SL1, DEP WILL RETURN A ZERO VALUE AND MESSAGE #2, "NOT ALLOWED" WILL BE DISPLAYED.

NOTE 1: TFLG = 0* IMPLIES CHECK SEQUENCE
= 1* IMPLIES TRG FIRING
= 2* IMPLIES MPD FIRING
= 3 IMPLIES EBA FIRING (5 SECOND) (DEFAULT)
= 4* IMPLIES EBA/MPD FIRING
= 5* IMPLIES EBA/NGP FIRING
= 6 1 KHz MODULATION
= 7 (MAXIMUM MODULATION .LE. 5 KHz)

NOTE 2: 0 = FLIGHT (DEFAULT) , 1 = GROUND (FLIGHT SENSOR), 2 = GROUND (DUMMY SENSOR)

FIGURE 6-3: SEPAC SMO PARAMETER CHANGE FILE

7.0 SEPAC CONVERSION TABLES

The following tables are used by SEPAC.

TABLE 7-1: FO SUMMARY

MODEL #	FO #	FOID		PREP	(TIME)	SMO	FO TIME
1	FO-1	(CFO)	SEPAC SYSTEM CHECKOUT	---	0	NO	480
2	FO-2	(T-1)	EBA FIRING TEST LEVEL	ISO EBA	2760	NO	1440
3	FO-3	(T-2)	MPD FIRING TEST	ISO MPDII	300	NO	480
4	FO-4	(T-3)	EBA FIRING TEST LEVEL II	ISO EBA	600	NO	960
5	FO-5	(A-1A)	ELECTRON BEAM EXP. 1	ISO EBA	600	YES	300
6	FO-5	(A-1B)	ELECTRON BEAM EXP. 2	ISO EBA	600	YES	300
7	FO-6	(A-2)	ELECTROL BEAM EXP. 2	ISO EBA	600	YES	300
8	FO-7	(A-3)	ELECTRON BEAM EXP. 3	ISO EBA	600	YES	300
9	FO-8	(A-4)	PLASMA BEAM PROPAGATION	ISO MPDI	600	YES	300
10	FO-9	(A-5A)	ARTIFICIAL AURORA (EBA/EGP)	ISO EBA	600	YES	300
11	FO-9	(A-5B)	ARTIFICIAL AURORA (EBA/MPD	ISO EBA	600	YES	300
12	FO-9	(A-5C)	ARTIFICIAL AURORA (EBA)	ISO EBA	600	YES	300
13	FO-10	(A-6)	EQUATORIAL AERO CHEMISTRY	ISO EBA	600	YES	300
14	FO-11	(A-7)	ELECTRON ECHO	ISO EBA	600	YES	300
15	FO-12	(A-8A)	E//B EXPERIMENT (EGA/MPD)	ISO EBA	600	YES	300
16	FO-12	(A-8B)	E//B EXPERIMENT (EBA/NGP)	ISO EBA	600	YES	300
17	FO-13	(P-1)	PASSIVE EXPERIMENT	----	0	NO	900
18	FO-14	(P-2)	1ES020 EXPERIMENT	----	0	NO	300

TABLE 7-2: GPELS CONVERSION

RANGE	VOLTS	COUNTS	COUNTS(16)	COUNTS(R/16)
120	-5.00	255	FF	FF
110	-4.33	238	EE	77
100	-3.66	221	DD	BB
90	-2.99	204	CC	33
80	-2.33	187	BB	DD
70	-1.66	170	AA	55
60	-0.99	153	99	99
50	-0.33	136	88	11
40	0.33	119	77	EE
30	1.00	102	66	66
20	1.66	85	55	AA
10	2.33	68	44	22
0	3.00	51	33	CC
-10	3.66	34	22	44
-20	4.33	17	11	88
-30	5.00	00	00	00

```
RANGE  -20     120
VOLTS  5.00    -5.00      RANGE-->VOLTS V=5.0-10(R+30)
                                               ---
                                               150
COUNTS 0       255
                          RANGE-->COUNTS    C=255(R+30)
                                               ---
                                               150
```

TABLE 7-3: GAPZS CONVERSIONS

RANGE	VOLTS	COUNTS	COUNTS(16)	COUNTS(R/16)
90	-5.00	255	FF	FF
100	-4.44	240	F0	0F
110	-3.88	226	E2	47
120	-3.33	212	D4	2B
130	-2.77	198	C6	63
135	-2.5	191	BF	
140	-2.22	184	B8	1D
150	-1.66	170	AA	55
160	-1.11	155	9B	D9
170	-0.55	141	8D	B1
180	0.00	127	7E	FE
190	0.55	113	71	8E
200	1.11	99	63	C6
210	1.66	85	55	AA
220	2.22	70	46	62
225	2.5	63	3F	
230	2.77	56	38	1C
240	3.33	42	2A	54
250	3.88	28	1C	38
260	4.44	14	0E	70
270	5.00	0	00	00

RANGE	90	270	RANGE-->COUNTS	$C=255-\frac{255(R-90)}{180}$
COUNTS	255	0		
VOLTS	-5.00	5.00	RANGE-->VOLTS	$V=\frac{10(R-90)}{180}-5.0$
				$R=\left(\frac{(V+5.0)180}{10}\right)+90$

TABLE 7-4: SENAD (SLV) CONVERSION

RANGE	VOLTS	COUNTS	COUNTS(16)	COUNTS(R/16)
0	.02	128	80	01
1	.73	109	6D	B6
	1.00	103	67	
2	1.44	91	5B	DA
2.78	2.00	77	4D	
3	2.15	73	49	92
4	2.86	54	36	6C
	3.00	51	33	
5	3.57	36	24	24
5.59	4.00	26	1A	
6	4.28	18	12	48
7	5.00	0	00	00

RANGE 0 7 RANGE-->COUNTS $C+128-\frac{128R}{7}$

COUNTS 128 0

VOLTS .02 5.00 RANGE-->VOLTS $V=\frac{4.98R}{7}+.02$

TABLE 7-5: LENIS (ILV) CONVERSIONS

RANGE	VOLTS	COUNTS	COUNTS(16)	COUNTS(R/16)
0	0.02	128	80	01
1	0.35	119	77	EE
2	0.68	110	6E	76
3	1.01	102	66	66
4	1.34	93	5D	BA
5	1.68	85	55	AA
6	2.01	76	4C	32
7	2.34	68	44	22
8	2.67	59	3B	DC
9	3.00	51	33	CC
10	3.34	42	2A	54
11	3.67	34	22	44
12	4.00	25	19	98
13	4.33	17	11	88
14	4.66	8	08	10
15	5.00	0	00	00

RANGE	0	15	RANGE-->COUNTS	$C=128-\frac{128R}{15}$
VOLTS	.02	5.00		
COUNTS	128	0	RANGE-->VOLTS	$V=\frac{4.98R}{15}+.02$

TABLE 7-6: ANALOG COMMAND -- [illegible]TPUT VOLTAGE CONVERSION TABLE

UPPER \ LOWER	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	5.00	4.96	4.92	4.88	4.84	4.80	4.76	4.73	4.69	4.65	4.61	4.57	4.53	4.49	4.45	4.41
1	4.37	4.33	4.29	4.25	4.22	4.18	4.14	4.10	4.06	4.02	3.98	3.94	3.90	3.86	3.82	3.78
2	3.75	3.71	3.67	3.63	3.59	3.55	3.51	3.47	3.43	3.39	3.35	3.31	3.27	3.24	3.20	3.16
3	3.11	3.08	3.04	3.00	2.96	2.92	2.88	2.84	2.80	2.76	2.73	2.69	2.65	2.61	2.57	2.53
4	2.49	2.45	2.41	2.37	2.33	2.29	2.25	2.22	2.18	2.14	2.10	2.06	2.02	1.98	1.94	1.90
5	1.86	1.82	1.78	1.75	1.71	1.67	1.63	1.59	1.55	1.51	1.47	1.43	1.39	1.35	1.31	1.27
6	1.23	1.20	1.16	1.12	1.08	1.04	1.00	0.96	0.92	0.88	0.84	0.80	0.76	0.73	0.69	0.65
7	0.61	0.57	0.53	0.49	0.45	0.41	0.37	0.33	0.29	0.25	0.22	0.18	0.14	0.10	0.06	0.02
8	-0.02	-0.06	-0.10	-0.14	-0.18	-0.22	-0.25	-0.29	-0.33	-0.37	-0.41	-0.45	-0.49	-0.53	-0.57	-0.61
9	-0.65	-0.69	-0.73	-0.76	-0.80	-0.84	-0.88	-0.92	-0.96	-1.00	-1.04	-1.08	-1.12	-1.16	-1.20	-1.24
A	-1.27	-1.31	-1.35	-1.39	-1.43	-1.47	-1.51	-1.55	-1.59	-1.63	-1.67	-1.71	-1.75	-1.78	-1.82	-1.86
B	-1.90	-1.94	-1.98	-2.02	-2.06	-2.10	-2.14	-2.18	-2.22	-2.25	-2.29	-2.33	-2.37	-2.41	-2.45	-2.49
C	-2.53	-2.57	-2.61	-2.65	-2.69	-2.73	-2.76	-2.80	-2.84	-2.88	-2.92	-2.96	-3.00	-3.04	-3.08	-3.12
D	-3.16	-3.20	-3.24	-3.27	-3.31	-3.35	-3.39	-3.43	-3.47	-3.51	-3.55	-3.59	-3.63	-3.67	-3.71	-3.75
E	-3.78	-3.82	-3.86	-3.90	-3.94	-3.98	-4.02	-4.06	-4.10	-4.14	-4.18	-4.22	-4.25	-4.29	-4.33	-4.37
F	-4.41	-4.45	-4.49	-4.53	-4.57	-4.61	-4.65	-4.69	-4.73	-4.76	-4.80	-4.84	-4.88	-4.92	-4.96	-5.00

TABLE 7-7: DEMUX DATA TO VOLTAGE CONVERSION

UPPER \ LOWER	0	1	2	3	4	5	6	7	8	9
00	-5.12	-5.08	-5.04	-5.00	-4.96	-4.92	-4.88	-4.84	-4.80	-4.76
01	-4.72	-4.68	-4.64	-4.60	-4.56	-4.52	-4.48	-4.44	-4.40	-4.36
02	-4.32	-4.28	-4.24	-4.20	-4.16	-4.12	-4.08	-4.04	-4.00	-3.96
03	-3.92	-3.88	-3.84	-3.80	-3.76	-3.72	-3.68	-3.64	-3.60	-3.56
04	-3.52	-3.48	-3.44	-3.40	-3.36	-3.32	-3.28	-3.24	-3.20	-3.16
05	-3.12	-3.08	-3.04	-3.00	-2.96	-2.92	-2.88	-2.84	-2.80	-2.76
06	-2.72	-2.68	-2.64	-2.60	-2.56	-2.52	-2.48	-2.44	-2.40	-2.36
07	-2.32	-2.28	-2.24	-2.20	-2.16	-2.12	-2.08	-2.04	-2.00	-1.96
08	-1.92	-1.88	-1.84	-1.80	-1.76	-1.72	-1.68	-1.64	-1.60	-1.56
09	-1.52	-1.48	-1.44	-1.40	-1.36	-1.32	-1.28	-1.24	-1.20	-1.16
10	-1.12	-1.08	-1.04	-1.00	-0.96	-0.92	-0.88	-0.84	-0.80	-0.76
11	-0.72	-0.68	-0.64	-0.60	-0.56	-0.52	-0.48	-0.44	-0.40	-0.36
12	-0.32	-0.28	-0.24	-0.20	-0.16	-0.12	-0.08	-0.04	0.00	0.04
13	0.08	0.12	0.16	0.20	0.24	0.28	0.32	0.36	0.40	0.44
14	0.48	0.52	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.84
15	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.20	1.24
16	1.28	1.32	1.36	1.40	1.44	1.48	1.52	1.56	1.60	1.64
17	1.68	1.72	1.76	1.80	1.84	1.88	1.92	1.96	2.00	2.04
18	2.08	2.12	2.16	2.20	2.24	2.28	2.32	2.36	2.40	2.44
19	2.48	2.52	2.56	2.60	2.64	2.68	2.72	2.76	2.80	2.84
20	2.88	2.92	2.96	3.00	3.04	3.08	3.12	3.16	3.20	3.24
21	3.28	3.32	3.36	3.40	3.44	3.48	3.52	3.56	3.60	3.64
22	3.68	3.72	3.76	3.80	3.84	3.88	3.92	3.96	4.00	4.04
23	4.08	4.12	4.16	4.20	4.24	4.28	4.32	4.36	4.40	4.44
24	4.48	4.52	4.56	4.60	4.64	4.68	4.72	4.76	4.80	4.84
25	4.88	4.92	4.96	5.00	5.04	5.08				

TABLE 7-8: KILOVOLT CONVERSION TABLE (BMVADJ)

KV	VOLTS	ANA COM	KV	VOLTS	ANA COM
0.0	0.00	7F	2.0	1.33	5D
0.1	0.06	7E	2.1	1.40	5C
0.2	0.13	7C	2.2	1.46	5A
0.3	0.20	7A	2.3	1.53	58
0.4	0.26	79	2.4	1.60	57
0.5	0.33	77	2.5	1.66	55
0.6	0.40	75	2.6	1.73	53
0.7	0.46	74	2.7	1.80	51
0.8	0.53	72	2.8	1.86	50
0.9	0.60	70	2.9	1.93	4E
1.0	0.66	6F	3.0	2.00	4C
1.1	0.73	6D	3.1	2.06	4B
1.2	0.80	6B	3.2	2.13	49
1.3	0.86	69	3.3	2.20	47
1.4	0.93	68	3.4	2.26	46
1.5	1.00	66	3.5	2.33	44
1.6	1.06	64	3.6	2.40	42
1.7	1.13	63	3.7	2.46	41
1.8	1.20	61	3.8	2.53	3F
1.9	1.26	5F	3.9	2.60	3D

TABLE 7-8: KILOVOLT CONVERSION TABLE (BMVADJ)
(CONTINUED)

KV	VOLTS	ANA COM	KV	VOLTS	ANA COM
4.0	2.66	3C	6.0	4.00	19
4.1	2.73	3A	6.1	4.06	18
4.2	2.80	38	6.2	4.13	16
4.3	2.86	36	6.3	4.20	14
4.4	2.93	35	6.4	4.26	13
4.5	3.00	33	6.5	4.33	11
4.6	3.06	31	6.6	4.40	0F
4.7	3.13	30	6.7	4.46	0E
4.8	3.20	2E	6.8	4.53	0C
4.9	3.26	2C	6.9	4.60	0A
5.0	3.33	2A	7.0	4.66	09
5.1	3.40	29	7.1	4.73	07
5.2	3.46	27	7.2	4.80	05
5.3	3.53	25	7.3	4.86	03
5.4	3.60	24	7.4	4.93	02
5.5	3.66	22	7.5	5.00	02
5.6	3.73	20			
5.7	3.80	1E			
5.8	3.86	1D			
5.9	3.93	1B			

TABLE 7-9: AMPERES CONVERSION TABLE (BMCADJ)

AMPS	VOLTS	ANA COM	AMPS	VOLTS	ANA COM
0.00	0.00	7F	0.20	0.62	70
0.01	0.03	7F	0.21	0.65	6F
0.02	0.06	7E	0.22	0.68	6E
0.03	0.09	7D	0.23	0.71	6D
0.04	0.12	7C	0.24	0.75	6C
0.05	0.15	7C	0.25	0.78	6B
0.06	0.18	7B	0.26	0.81	6B
0.07	0.21	7A	0.27	0.84	6A
0.08	0.25	79	0.28	0.87	69
0.09	0.28	78	0.29	0.90	68
0.10	0.31	78	0.30	0.93	68
0.11	0.34	77	0.31	0.96	67
0.12	0.37	76	0.32	1.00	66
0.13	0.40	75	0.33	1.03	65
0.14	0.43	74	0.34	1.06	64
0.15	0.46	74	0.35	1.09	64
0.16	0.50	73	0.36	1.12	63
0.17	0.53	72	0.37	1.15	62
0.18	0.56	71	0.38	1.18	61
0.19	0.59	70	0.39	1.21	61

TABLE 7-9: AMPERES CONVERSION TABLE (BMCADJ)
(CONTINUED)

AMPS	VOLTS	ANA COM	AMPS	VOLTS	ANA COM
0.40	1.25	5F	0.60	1.87	50
0.41	1.28	5F	0.61	1.90	4F
0.42	1.31	5E	0.62	1.93	4E
0.43	1.34	5D	0.63	1.96	4D
0.44	1.37	5C	0.64	2.00	4C
0.45	1.40	5C	0.65	2.03	4C
0.46	1.43	5B	0.66	2.06	4B
0.47	1.46	5A	0.67	2.09	4A
0.48	1.50	59	0.68	1.12	49
0.49	1.53	58	0.69	2.15	49
0.50	1.56	58	0.70	2.18	48
0.51	1.59	57	0.71	2.21	47
0.52	1.62	56	0.72	2.25	46
0.53	1.65	55	0.73	2.28	45
0.54	1.68	55	0.74	2.31	44
0.55	1.71	54	0.75	2.34	44
0.56	1.75	53	0.76	2.37	43
0.57	1.78	52	0.77	2.40	42
0.58	1.81	51	0.78	2.43	41
0.59	1.84	51	0.79	2.46	41

TABLE 7-9: AMPERES CONVERSION TABLE (BMCADJ)
(CONTINUED)

AMPS	VOLTS	ANA COM	AMPS	VOLTS	ANA COM
0.80	2.50	40	1.00	3.12	30
0.81	2.53	3F	1.01	3.15	2F
0.82	2.56	3E	1.02	3.18	3E
0.83	2.59	3E	1.03	3.21	2E
0.84	2.62	3D	1.04	3.25	2D
0.85	2.65	3C	1.05	3.28	2C
0.86	2.68	3B	1.06	3.31	2B
0.87	2.71	3A	1.07	3.34	2A
0.88	2.75	39	1.08	3.37	29
0.89	2.78	38	1.09	3.40	29
0.90	2.81	38	1.10	3.43	28
0.91	2.84	37	1.11	3.46	27
0.92	2.87	36	1.12	3.50	26
0.93	2.90	35	1.13	3.53	25
0.94	2.93	35	1.14	3.56	25
0.95	2.96	34	1.15	3.59	24
0.96	3.00	33	1.16	3.62	23
0.97	3.03	32	1.17	3.65	22
0.98	3.06	31	1.18	3.68	22
0.99	3.09	31	1.19	3.71	21

TABLE 7-9: AMPERES CONVERSION TABLE (BMCADJ)
(CONTINUED)

AMPS	VOLTS	ANA COM	AMPS	VOLTS	ANA COM
1.20	3.75	22	1.40	4.37	10
1.21	3.78	1F	1.41	4.40	0F
1.22	3.81	1E	1.42	4.43	0E
1.23	3.84	1D	1.43	4.46	0E
1.24	3.87	1D	1.44	4.50	0D
1.25	3.90	1C	1.45	4.53	0C
1.26	3.93	1B	1.46	4.56	0B
1.27	3.96	1A	1.47	4.59	0A
1.28	4.00	19	1.48	4.62	0A
1.29	4.03	19	1.49	4.65	09
1.30	4.06	18	1.50	4.68	08
1.31	4.09	17	1.51	4.71	07
1.32	4.12	17	1.52	4.75	06
1.33	4.15	16	1.53	4.78	05
1.34	4.18	15	1.54	4.81	05
1.35	4.21	14	1.55	4.84	04
1.36	4.25	13	1.56	4.87	03
1.37	4.28	12	1.57	4.90	02
1.38	4.31	11	1.58	4.93	02
1.39	4.34	11	1.59	4.96	01
			1.60	5.00	00

TABLE 7-10: LIMITS ON IU HOUSEKEEPING SIGNALS

ITEM NUMBER	SIGNAL DESCRIPTION	ITEM NAME	UPPER ENTRY	LOWER LIMIT (V)	LIMIT (V)
1	5.0 V	IUHK01	IU5V	5.12	3.5
2	15.0 V	IUHK02	IU15V	5.12	3.5
3	-15.0 V	IUHK03	IUM15V	-3.5	-5.12
4	28.0 V	IUHK04	IU28V	3.5	2.22
5	0.0 V CAL	IUHK05	---	0.12	-0.12
6	- 2.54 V CAL	IUHK06	---	-2.0	-3.0
7	25.0 V CAL	IUHK07	---	3.0	2.0
8	5.0 V CAL	IUHK08	---	5.12	1.0
9	5.0 V CONV TEMP	IUHK09	IUSET	4.5 (+45 DEG C)	-4.5
10	15.0 CONV TEMP (+/-)	IUHK10	---	4.5 (+45 DEG C)	-4.5
11	ENCODER TEMP	IUHK11	IUENT	4.0 (+40 DEG C)	-2.0
12	TOTAL CURRENT	IUHK12	IU28C	3.5 (+14A)	0.24
13	5 V CURRENT	IUHK13	IU5C	2.5 (+2.5 A)	1.0
14	BML TEMP	IUHK14	IUBMT	5.0 (+50 DEG C)	-4.0

NOTE:

Signal name is the PCM signal name
Item entry is the IIA signal name
If item 1, I.U. 5V monitor chips below 3.5 v, commands to instruments may be erroneous and SEPAC operations are dangerous.

If item 12, I.U. total current exceeds 14A, the system should be shut down immediately!

If item 13, I.U. 5V current exceeds 2.5A, the power should be removed and later (.GT. 2 minutes) applied again and retested. Continued high current levels indicate a major problem and I.U. operation may be dangerous to SEPAC instruments.

APPENDIX A

SEPAC FLOWCHARTS

APPENDIX A

SEPAC FLOWCHARTS

The Flowcharts for each of the SEPAC Routines are contained in this section.

ROUTINE NAME	TYPE	DESCRIPTION
DRIVER	ASSEMBLY LANGUAGE	SEPAC Task Control Program; includes Initial Program start, IU Initialize, Interrupt Handlers and Task work list CODESTRT EXTINT IUINT PRGINTER Interrupt Handlers service associated interrupts ADUMBF SVCINT IOSERV
STASK	ASSEMBLY LANGUAGE	Routine that determines the Experiment Computer Message Block ID and activates the appropriate task Scheduled on IU '2065' Interrupt
RTDRV	ASSEMBLY LANGUAGE	Routine that synchronizes to 1HZ Interrupt and initiates first command interrupt
RTCMD	ASSEMBLY LANGUAGE	Routine that constructs IU command registers from command list Scheduled on 100 millisecond interrupt
MSGIN	ASSEMBLY LANGUAGE	Routine that reads Experiment Computer Message from Dual Port Memory Called as needed
MSOUT1	ASSEMBLY LANGUAGE	Routine that selects output Buffer and loads Dual Port Memory to output message. Called as needed
MSGHAN	ASSEMBLY LANGUAGE	Routine that selects output message BML Block ID 1, BML Block 2, or other messages Scheduled on every second IU '2004' Interrupt

CGMT	ASSEMBLY LANGUAGE	Utility routine that compares current GMT to specified GMT Called as needed
SGMT	ASSEMBLY LANGUAGE	Utility routine that calculates the DELTA Time between two given GMT's Called as needed
ECMAG	ASSEMBLY LANGUAGE	Routine that processes Magnetic Field Data Scheduled by STASK on Block ID = "A"
GNC	ASSEMBLY LANGUAGE	Routine that processes GN&C Data Scheduled on IU '2081' Interrupt
IUGMT	ASSEMBLY LANGUAGE	Routine that reads GMT for IU Called as needed
INHIBT	ASSEMBLY LANGUAGE	Function to Inhibit NSSC-II Timer interrupts Called as needed
ENABLE	ASSEMBLY LANGUAGE	Function to enable NSSC-II Timer interrupts Called as needed
SETHTR	ASSEMBLY LANGUAGE	Routine to merge Heater Current PCF update into command register Called on PCF (34) update
C22DWN	ASSEMBLY LANGUAGE	Routine to set the instrument powerdown masks and commands for Command Registers Called in response to Shutdown command detection
C22RST	ASSEMBLY LANGUAGE	
IUCMD	ASSEMBLY LANGUAGE	Routine to write command data to IU Command Registers Called as needed

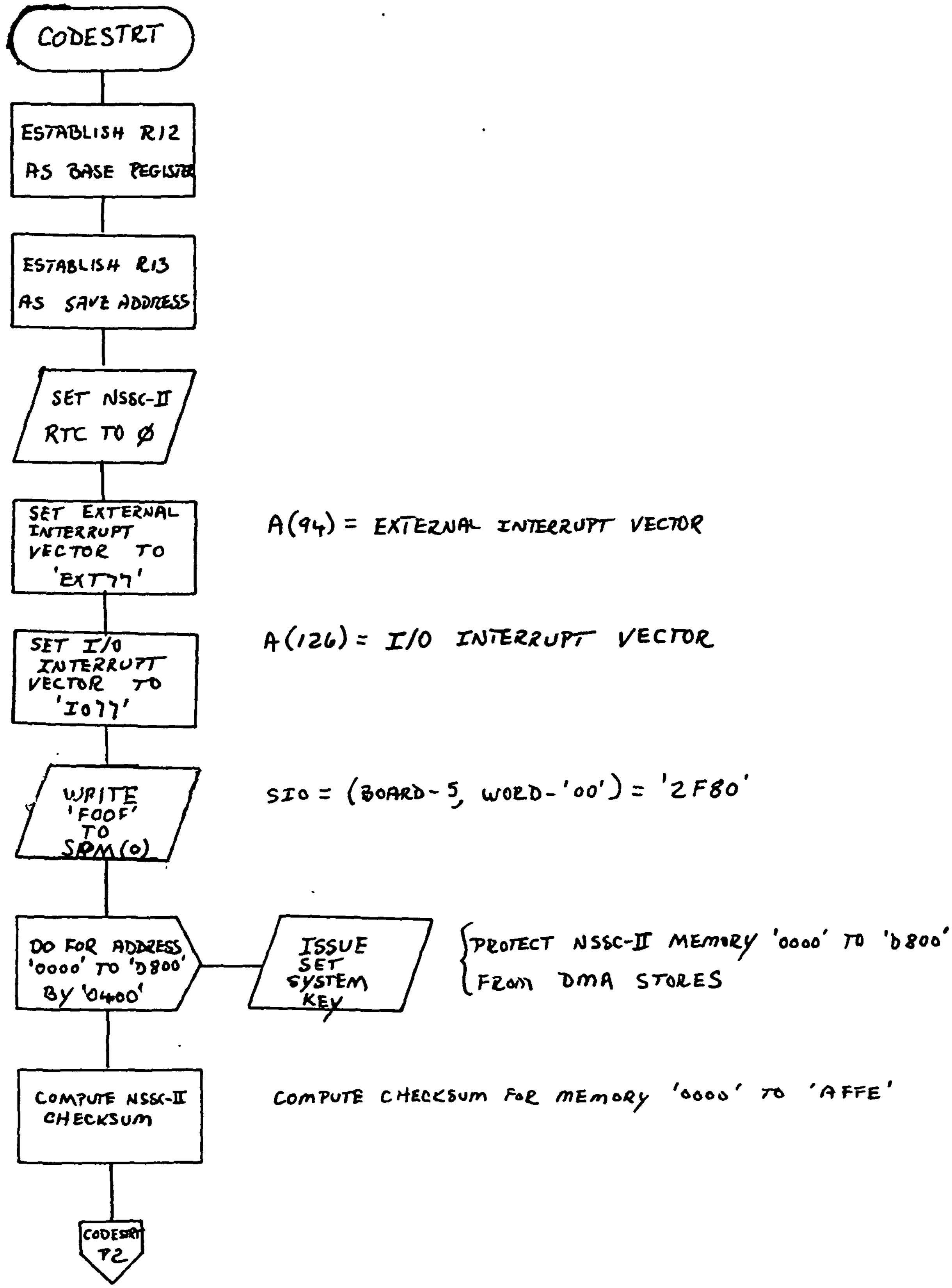
SPM	ASSEMBLY LANGUAGE	Routine to write data to Scratch Pad Memory Called as needed
AEPIOF	ASSEMBLY LANGUAGE	Routine to disable AEPI ready Called as needed
AEPION	ASSEMBLY LANGUAGE	Routine to enable AEPI ready and sync to AEPI Called at T=0 by ATDRV
SINGLE	ASSEMBLY LANGUAGE	Control routine to perform manual mode FO and HEXTAB runs Scheduled by STASK on Block ID="2"
EXSPM	ASSEMBLY LANGUAGE	Routine to set up Experiment ID, Mode, Start, FO Time, Patch Angle, and MPD firing information Scheduled on IU '2004' Interrupt
DEPDMP	ASSEMBLY LANGUAGE	Routine to dump DEP memory to Experiment Computer Scheduled on IU '201F Interrupt
UHEADER	ASSEMBLY LANGUAGE	Routine to unpack Message Block ID Command Words and PCF update information Called as needed
PATCH	ASSEMBLY LANGUAGE	
ECSMO	ASSEMBLY LANGUAGE	
PHEADR	ASSEMBLY LANGUAGE	Routine to pack Status Words, Block ID, PCF Update Information, and Message Number Called as needed
FLT16	ASSEMBLY LANGUAGE	Utility to convert 16 bit integer to 32 bit Floating Point
INT16	ASSEMBLY LANGUAGE	Utility to convert 32 bit Floating Point to 16 bit integer

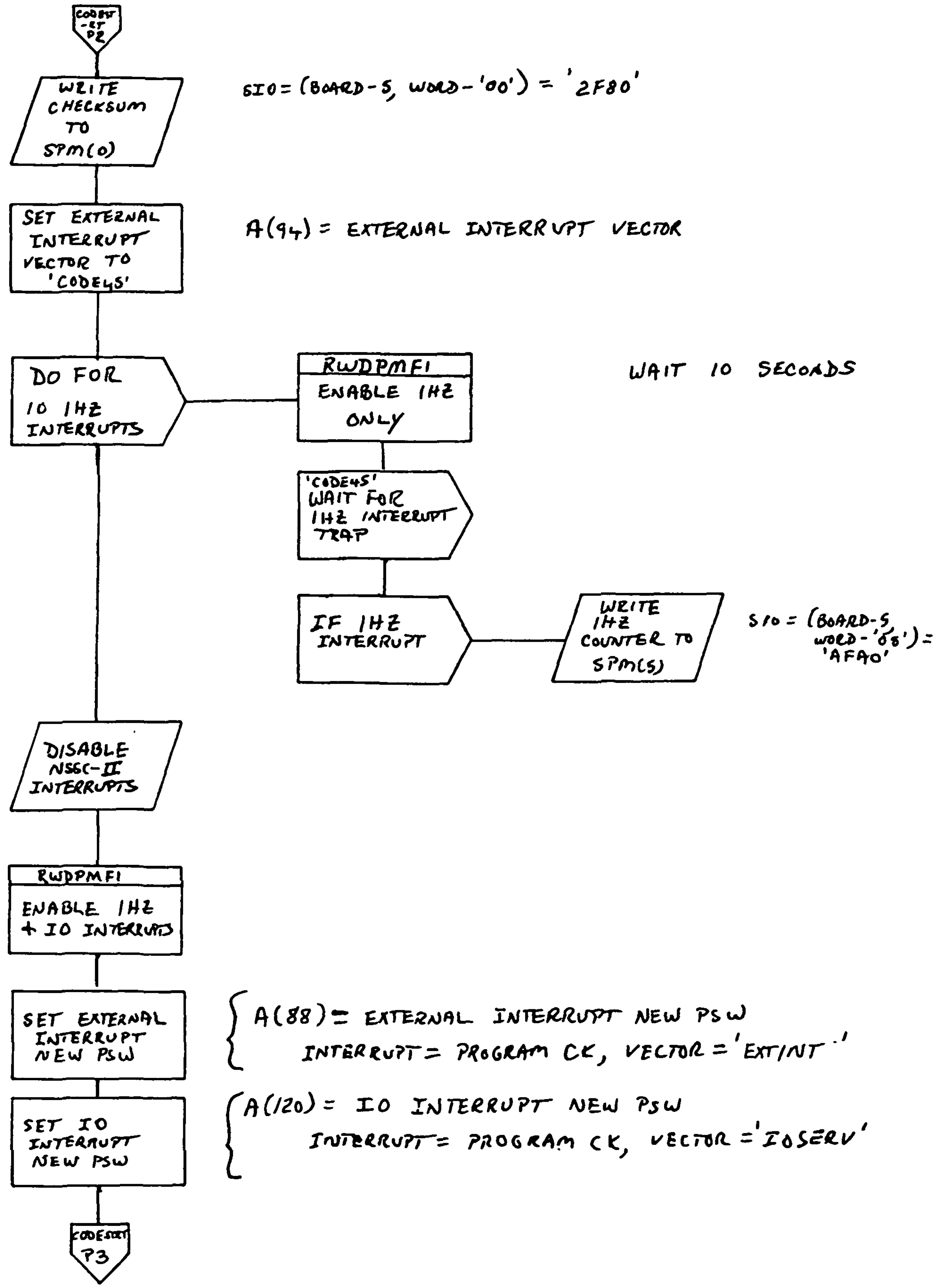
BOOL16	ASSEMBLY LANGUAGE	Utility to perform shift, and, or, Xor on 16 bit integers
IAND		
IOR		
IEOR		
ISHIF		
GETCMD	ASSEMBLY LANGUAGE	Utility to fetch parameters from COMTAB
REV8	ASSEMBLY LANGUAGE	Utility to rotate 8 bits
EXTRCT	ASSEMBLY LANGUAGE	Utility to fetch parameters from FOMTAB, FOTAB, or HEXTAB
ZAP	ASSEMBLY LANGUAGE	Utility to zero blocks of memory
MOVE	ASSEMBLY LANGUAGE	Utility to move blocks of memory
PASSO	ASSEMBLY LANGUAGE	Routine to move default SPCF/PCF values to PCF Table (PCFBUF) Called by ECFO
ABS	ASSEMBLY LANGUAGE	Utility to take absolute value of 32 bit Floating Point
SIN	ASSEMBLY LANGUAGE	Utility to perform SIN function (Floating Point)
COS		
IAN		
DEPRTC		
MODSEQ		
ARCTAN	ASSEMBLY LANGUAGE	Utility to perform ARCTAN function (Floating Point)
ROOT	ASSEMBLY LANGUAGE	Utility to perform X**Y function (Floating Point)

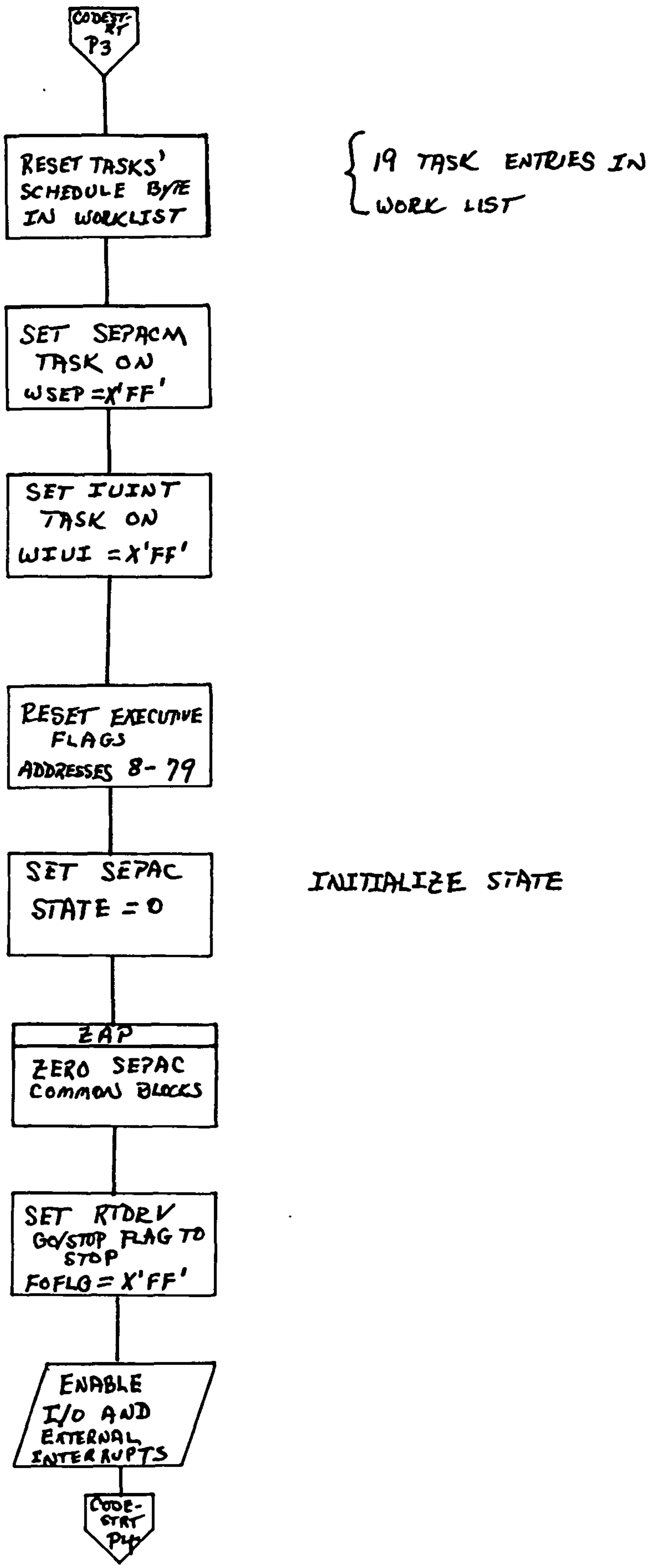
GARBAG	ASSEMBLY LANGUAGE	CSECT for program entry points not implemented
PCFCOM	DATA BASE	PCF/SPCF Default Values
CMDCOM	DATA BASE	Command Table
FOMCOM	DATA BASE	FO Menus
FOCSCT	DATA BASE	Index array into FOCOM
FOCOM	DATA BASE	Command Groups
HXCSCT	DATA BASE	Index array into HEXCOM
HEXCOM	DATA BASE	"Command" Subroutines/Sets
ECFO	FORTRAN	Routine to service FO schedule request
		Scheduled by STASK on Block ID = "9"
SEPACM	FORTRAN	FO Timeline Executive
		Always scheduled
PASSX	FORTRAN	Routine to generate Command Sequence
		Called as needed
DOIF	FORTRAN	Routine to perform "IF" Statement
		Called by PASSX as needed
DGCALC	FORTRAN	Routine to perform "Calculations"
		Called by PASSX as needed.
ECPCF	FORTRAN	Routine to service PCF Updates
		Scheduled by STASK on Block ID = "8"
ECBML	ASSEMBLY LANGUAGE	Routine to process Burst Mode logic data
		Scheduled on every 5th IU '2004' Interrupt

DEPCOM	COMMON BLOCK	DATA - General Data Area
COEFF	COMMON BLOCK	DATA - Coefficient values for calculations
STATW1	COMMON BLOCK	DATA - STATUS WORD 1
STATW2	COMMON BLOCK	DATA - STATUS WORD 2
FOFIG	COMMON BLOCK	DATA - General Data Area
MSGCOM	COMMON BLOCK	DATA - Message Input Areas
OUTCOM		
TLBUF	COMMON BLOCK	DATA - Command Sequence Area
PCFBUF	COMMON BLOCK	DATA - PCF Data Area
GNCCOM	COMMON BLOCK	DATA - GN2 Data Area
UCMDW1	COMMON BLOCK	DATA - Command Word 1
UCMDW2	COMMON BLOCK	DATA - Command Word 2

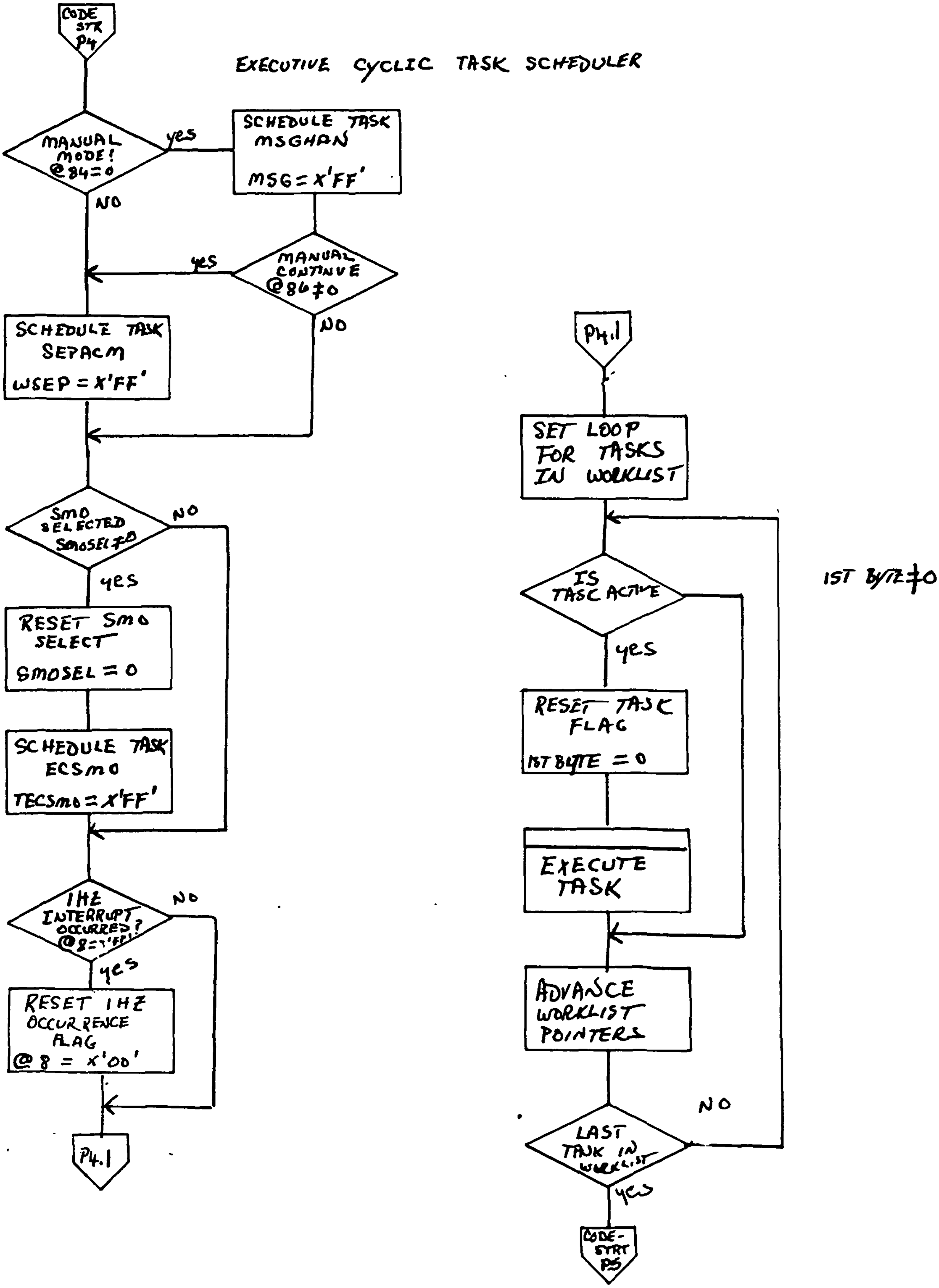
SEPAC PROGRAM START

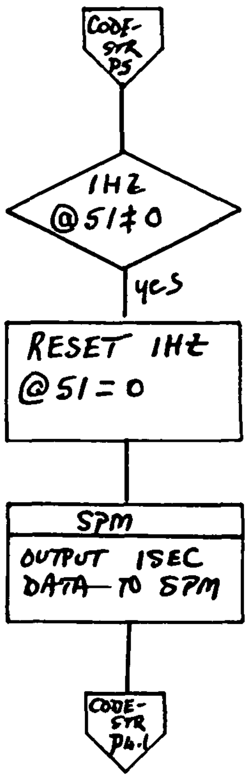



CODESTRT P2
WRITE CHECKSUM TO SPM(0)
SIO = (BOARD-5, WORD-'00') = '2F80'
SET EXTERNAL INTERRUPT VECTOR TO 'CODE45'
A(94) = EXTERNAL INTERRUPT VECTOR
DO FOR 10 1HZ INTERRUPTS
RWDPMFI
ENABLE 1HZ ONLY
WAIT 10 SECONDS
'CODE45' WAIT FOR 1HZ INTERRUPT TRAP
IF 1HZ INTERRUPT
WRITE 1HZ COUNTER TO SPM(5)
SIO = (BOARD-5, WORD-'08') = 'AFA0'
DISABLE NSSC-II INTERRUPTS
RWDPMFI
ENABLE 1HZ + IO INTERRUPTS
SET EXTERNAL INTERRUPT NEW PSW
A(88) = EXTERNAL INTERRUPT NEW PSW
INTERRUPT = PROGRAM CK, VECTOR = 'EXTINT'
SET IO INTERRUPT NEW PSW
A(120) = IO INTERRUPT NEW PSW
INTERRUPT = PROGRAM CK, VECTOR = 'IOSERV'
CODESTRT P3


CODESTRT P3
RESET TASKS' SCHEDULE BYTE IN WORKLIST
19 TASK ENTRIES IN WORK LIST
SET SEPACM TASK ON
WSEP = X'FF'
SET IUINT TASK ON
WIUI = X'FF'
RESET EXECUTIVE FLAGS
ADDRESSES 8-79
SET SEPAC STATE = 0
INITIALIZE STATE
ZAP
ZERO SEPAC COMMON BLOCKS
SET RTDRV GO/STOP FLAG TO STOP
FOFLG = X'FF'
ENABLE I/O AND EXTERNAL INTERRUPTS
CODESTRT P4

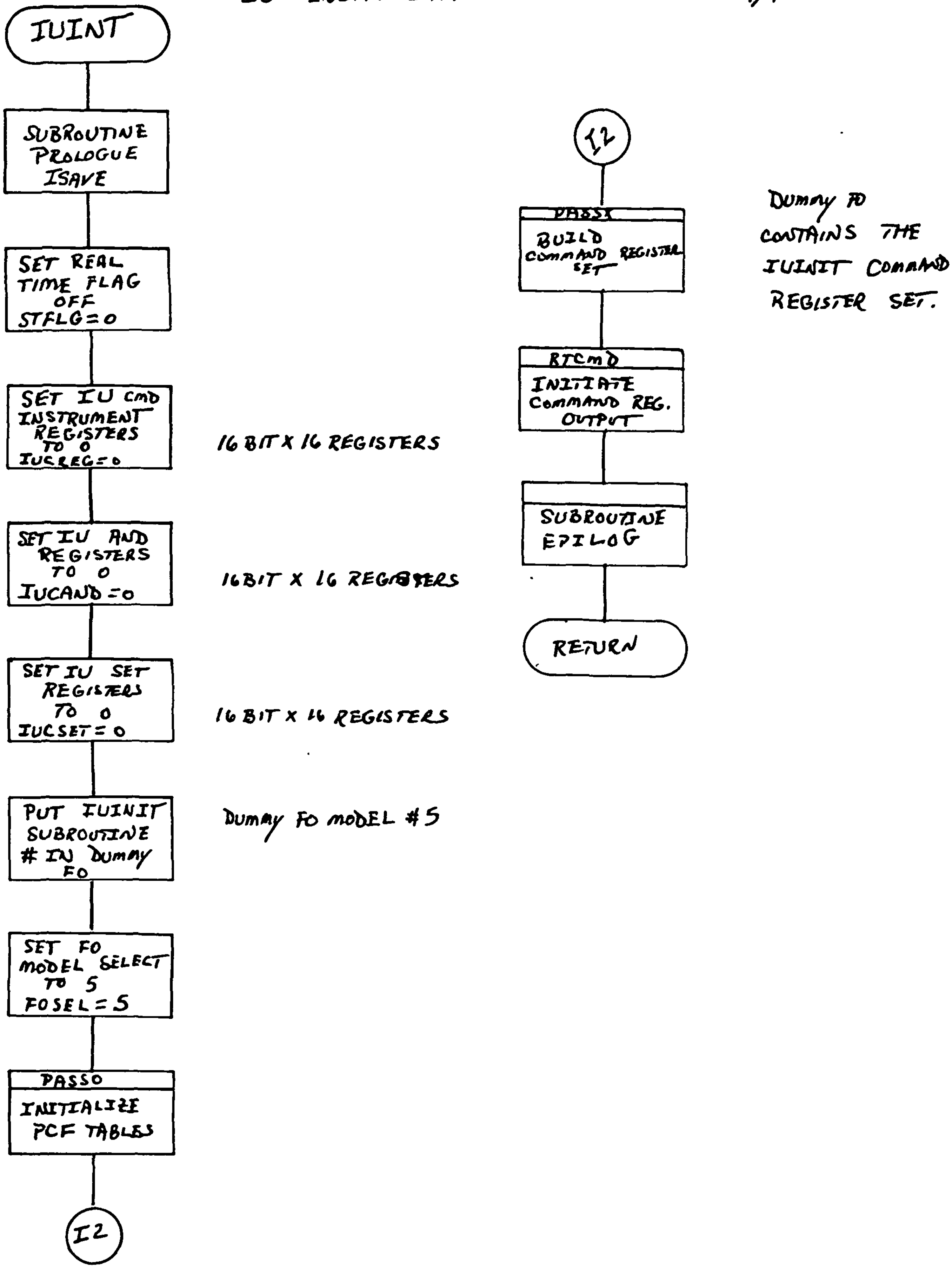
EXECUTIVE CYCLIC TASK SCHEDULER





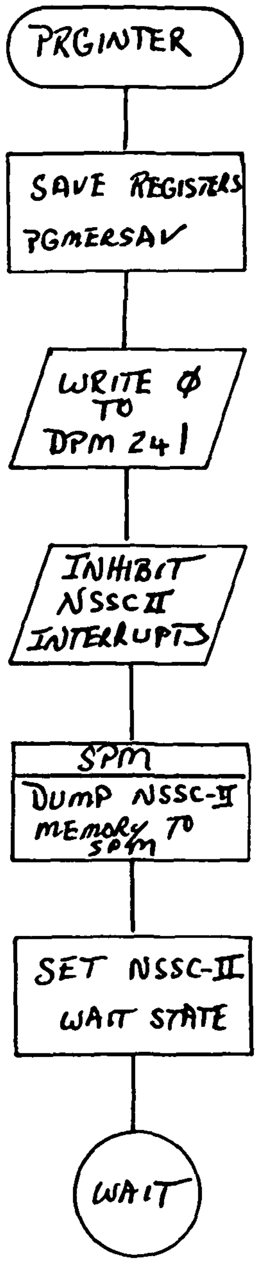
RTC & 1HZ COUNTER

IU INITIALIZATION



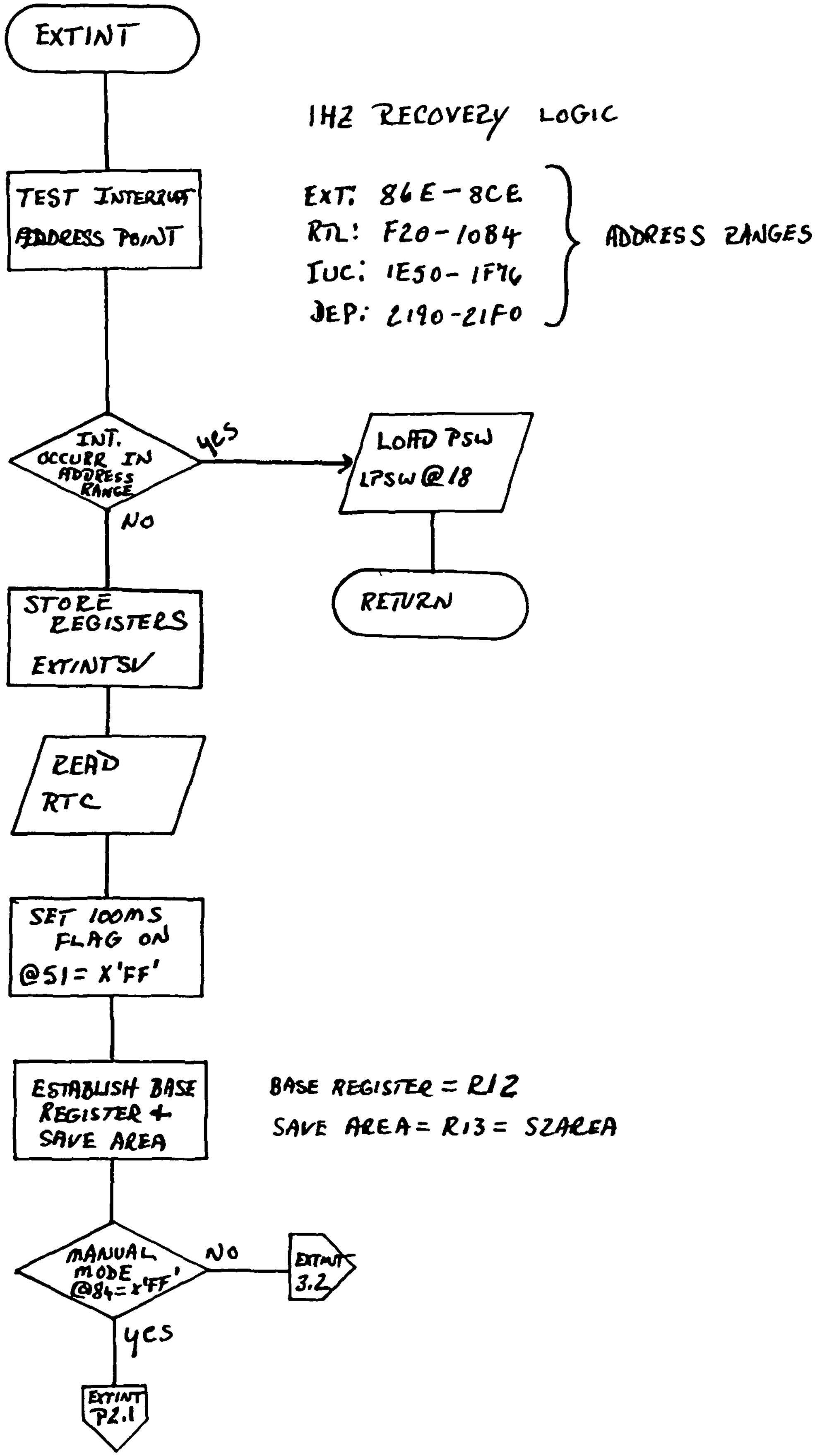
PRGINTER 1/1

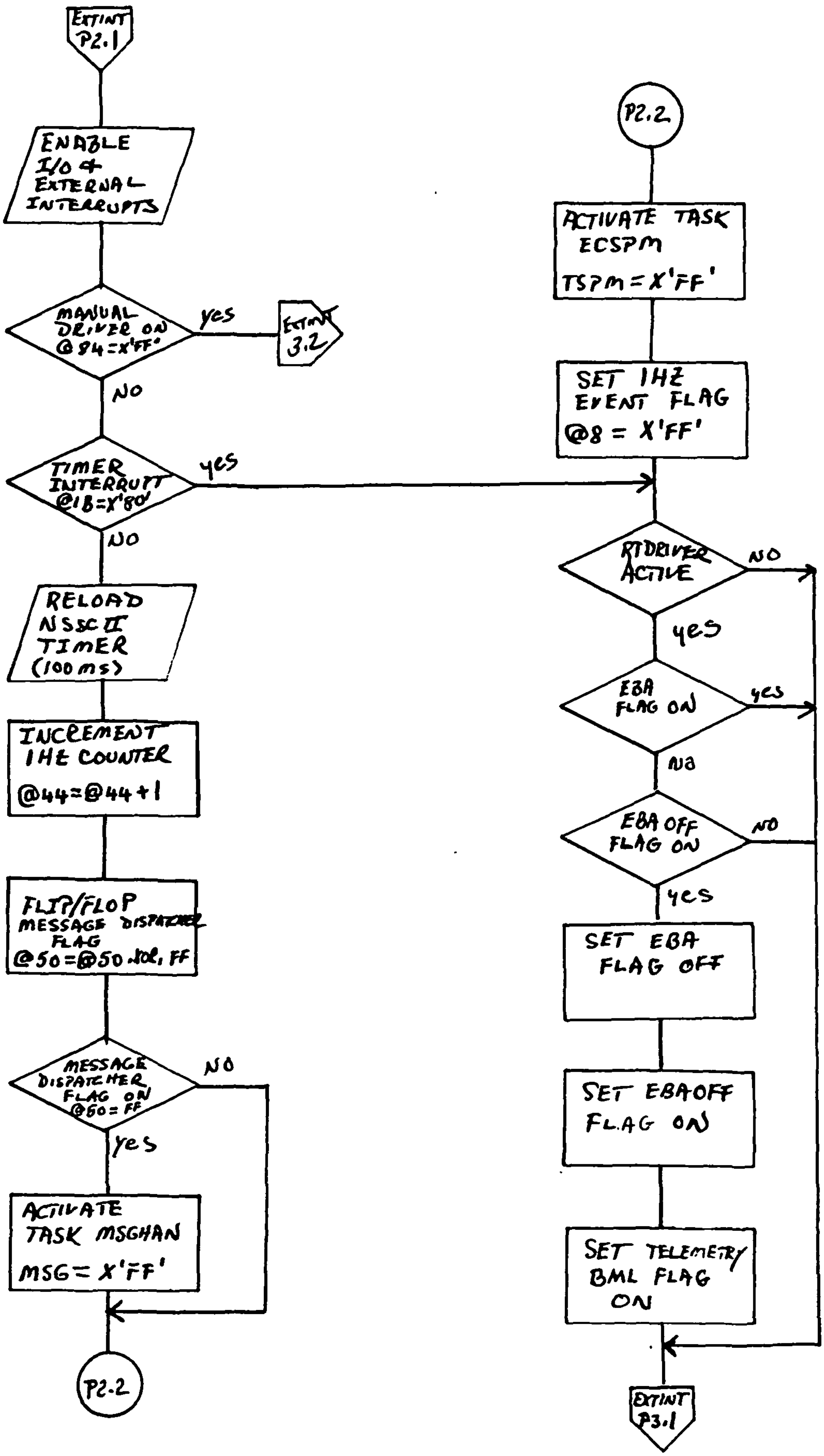
INTERRUPT VECTOR: PROGRAM CHECK
MACHINE CHECK

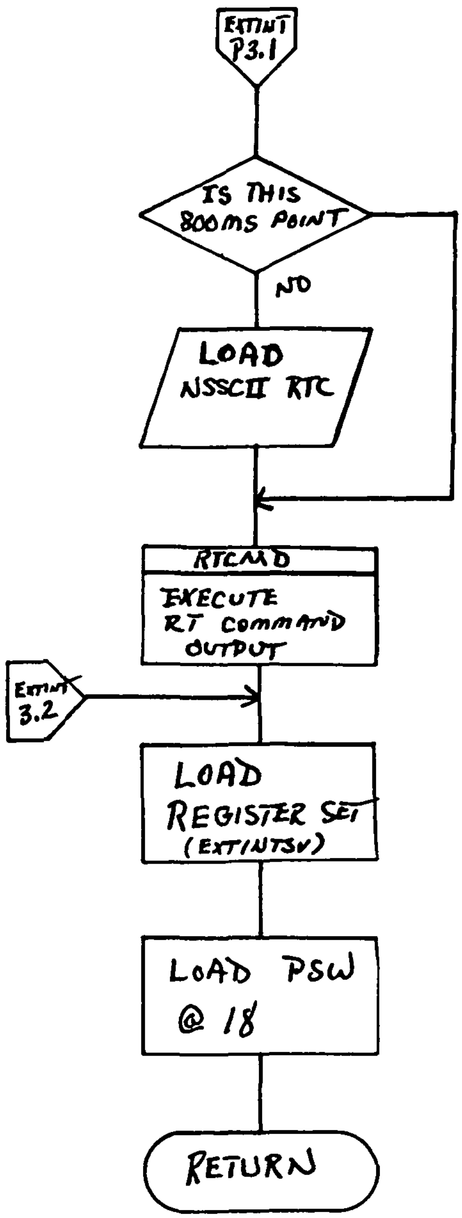


LOW MEMORY (0000H TO 0080H) WRITTEN TO SPM 0...

INTERRUPT VECTOR: EXTERNAL INTERRUPTS

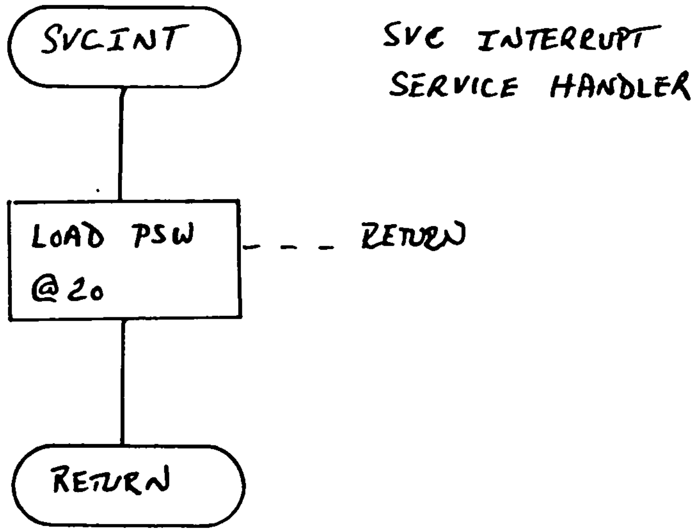


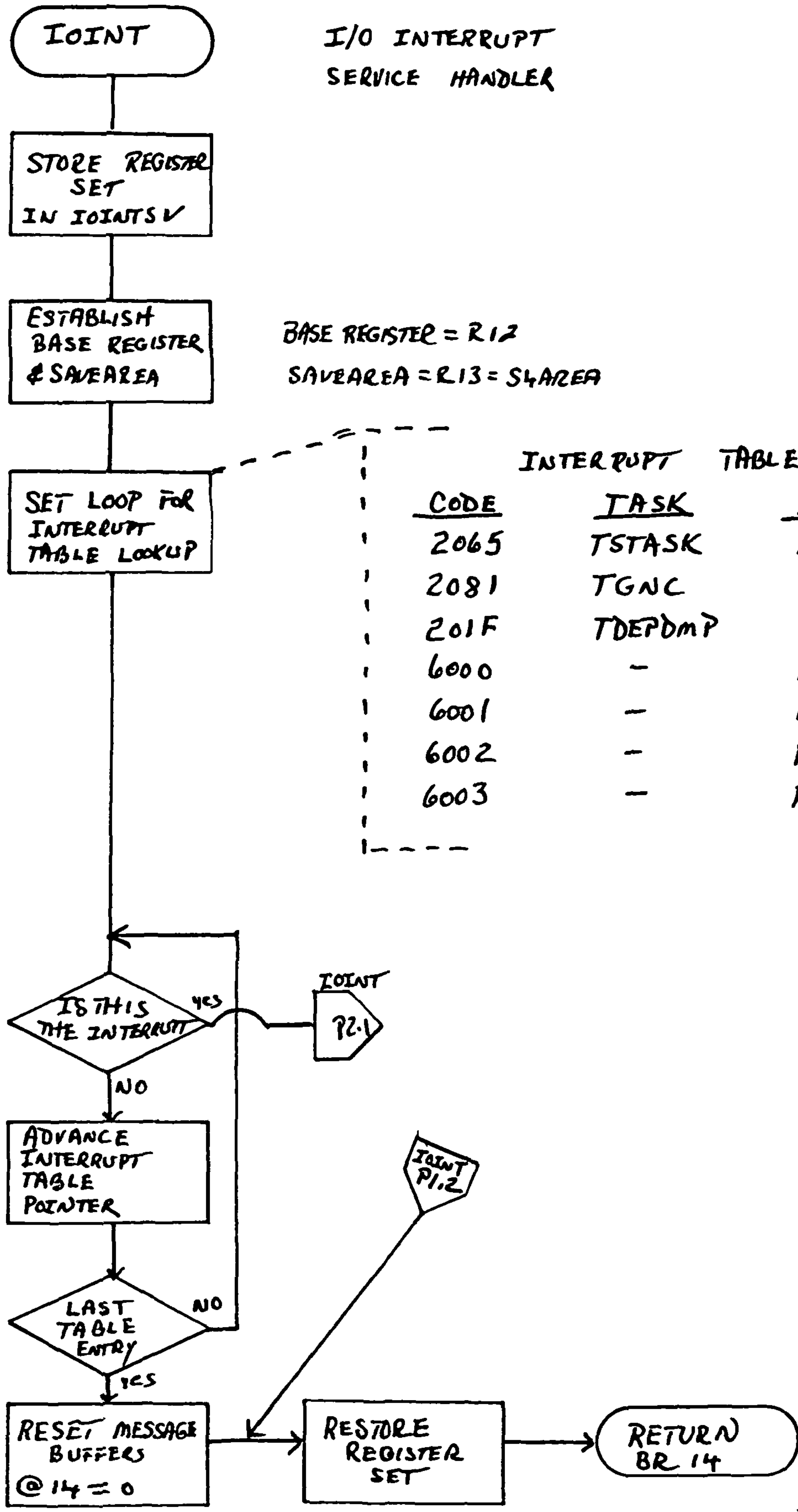

EXTINT P2.1
ENABLE I/O + EXTERNAL INTERRUPTS
MANUAL DRIVER ON @84=X'FF'
yes
EXTINT 3.2
NO
TIMER INTERRUPT @18=X'80'
yes
NO
RELOAD NSSC II TIMER (100ms)
INCREMENT IHE COUNTER
@44=@44+1
FLIP/FLOP MESSAGE DISPATCHER FLAG
@50=@50 XOR, FF
MESSAGE DISPATCHER FLAG ON @50=FF
NO
yes
ACTIVATE TASK MSGHAN
MSG=X'FF'
P2.2
P2.2
ACTIVATE TASK ECSPM
TSPM=X'FF'
SET IHE EVENT FLAG
@8 = X'FF'
RTDRIVER ACTIVE
NO
yes
EBA FLAG ON
yes
NO
EBA OFF FLAG ON
NO
yes
SET EBA FLAG OFF
SET EBAOFF FLAG ON
SET TELEMETRY BML FLAG ON
EXTINT P3.1


EXTINT P3.1
IS THIS 800ms POINT
NO
LOAD NSSCII RTC
RTCMD
EXECUTE RT COMMAND OUTPUT
EXTINT 3.2
LOAD REGISTER SET (EXTINTSV)
LOAD PSW @ 18
RETURN

SVCINT

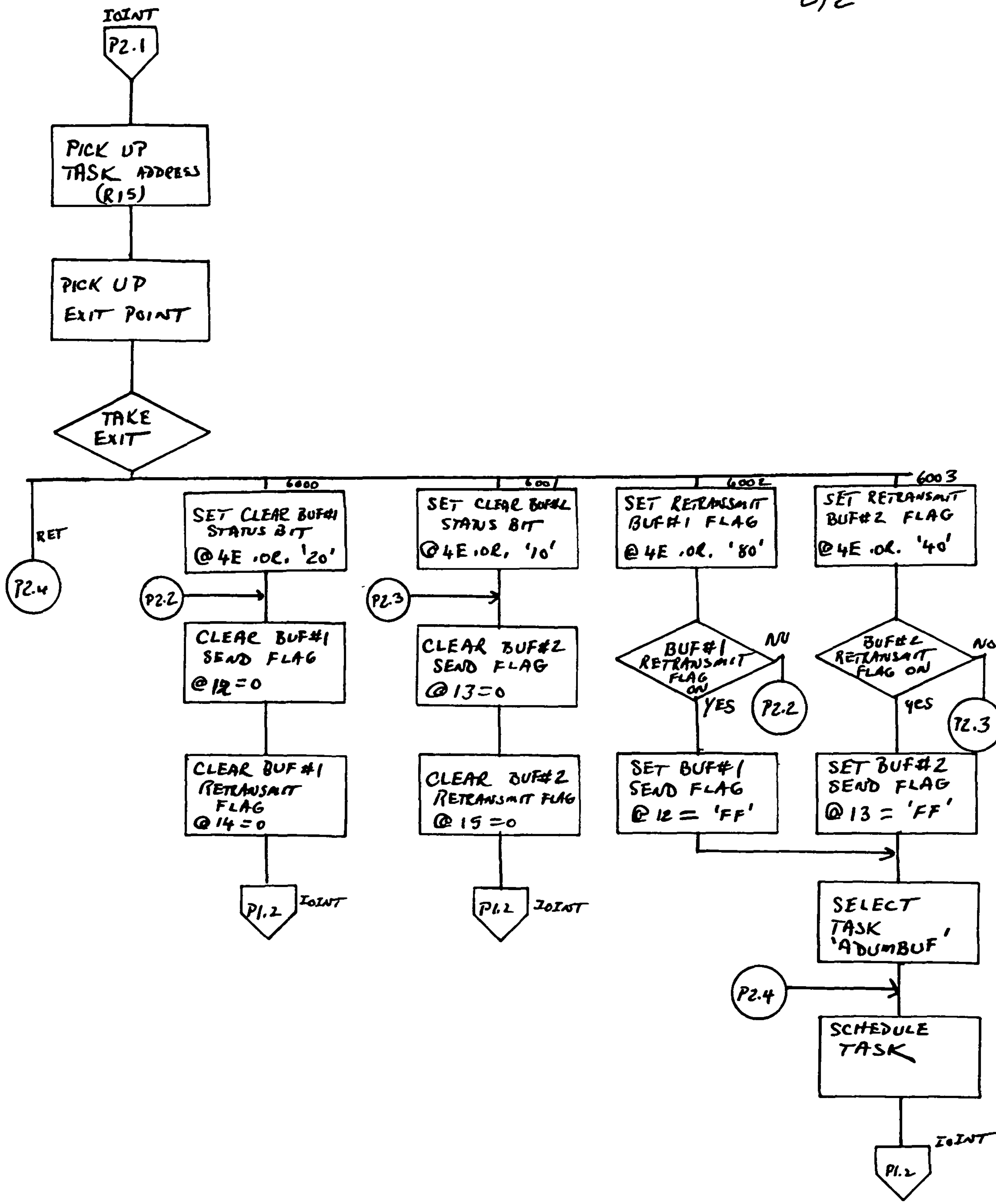
1/1


SVCINT
SVC INTERRUPT
SERVICE HANDLER
LOAD PSW
@20
RETURN
RETURN



INTERRUPT TABLE

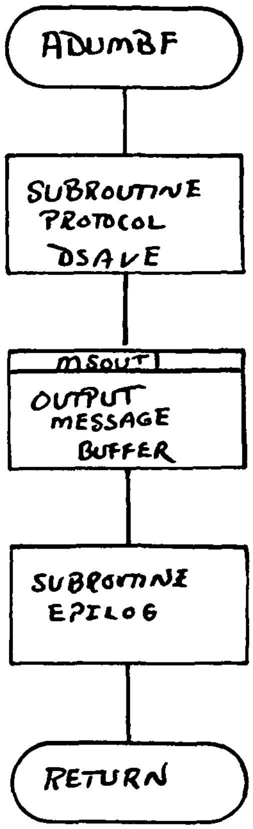
CODE	TASK	EXIT	
2065	TSTASK	RET	I/O MESSAGE
2081	TGNC	RET	GNC
201F	TDEPDMP	RET	DEP DUMP
6000	–	R6000	BUF#1 CLEAR
6001	–	R6001	BUF#2 CLEAR
6002	–	R6002	BUF#1 RETRANSMIT
6003	–	R6003	BUF#2 RETRANSMIT


IOINT
P2.1
PICK UP TASK ADDRESS (R15)
PICK UP EXIT POINT
TAKE EXIT
RET
P2.4
6000
SET CLEAR BUF#1 STATUS BIT @4E .OR. '20'
P2.2
CLEAR BUF#1 SEND FLAG @12=0
CLEAR BUF #1 RETRANSMIT FLAG @14=0
P1.2 IOINT
6001
SET CLEAR BUF#2 STATUS BIT @4E .OR. '10'
P2.3
CLEAR BUF#2 SEND FLAG @13=0
CLEAR BUF#2 RETRANSMIT FLAG @15=0
P1.2 IOINT
6002
SET RETRANSMIT BUF#1 FLAG @4E .OR. '80'
BUF#1 RETRANSMIT FLAG ON
NO
YES
P2.2
SET BUF#1 SEND FLAG @12 = 'FF'
6003
SET RETRANSMIT BUF#2 FLAG @4E .OR. '40'
BUF#2 RETRANSMIT FLAG ON
NO
YES
P2.3
SET BUF#2 SEND FLAG @13 = 'FF'
SELECT TASK 'ADUMBUF'
P2.4
SCHEDULE TASK
IOINT
P1.2

MESSAGE RETRANSMIT

ADUMBF

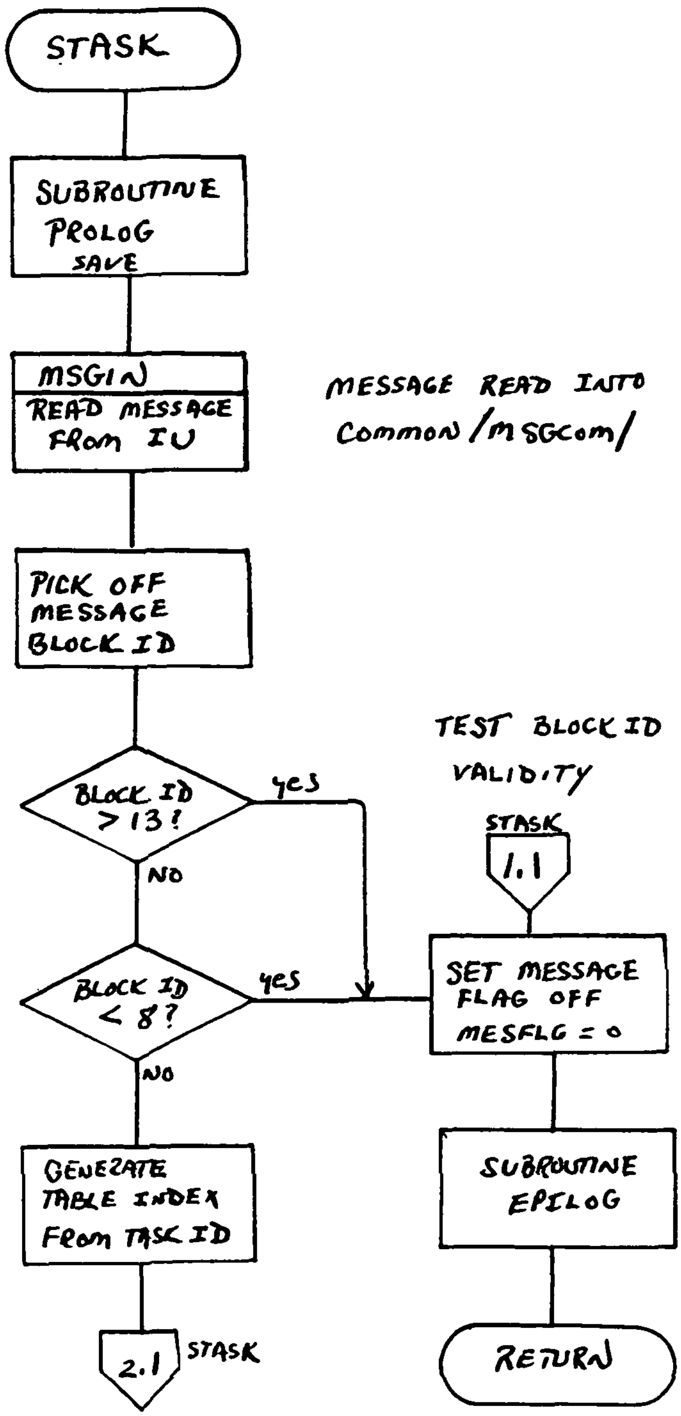
1/1



TASK SCHEDULER

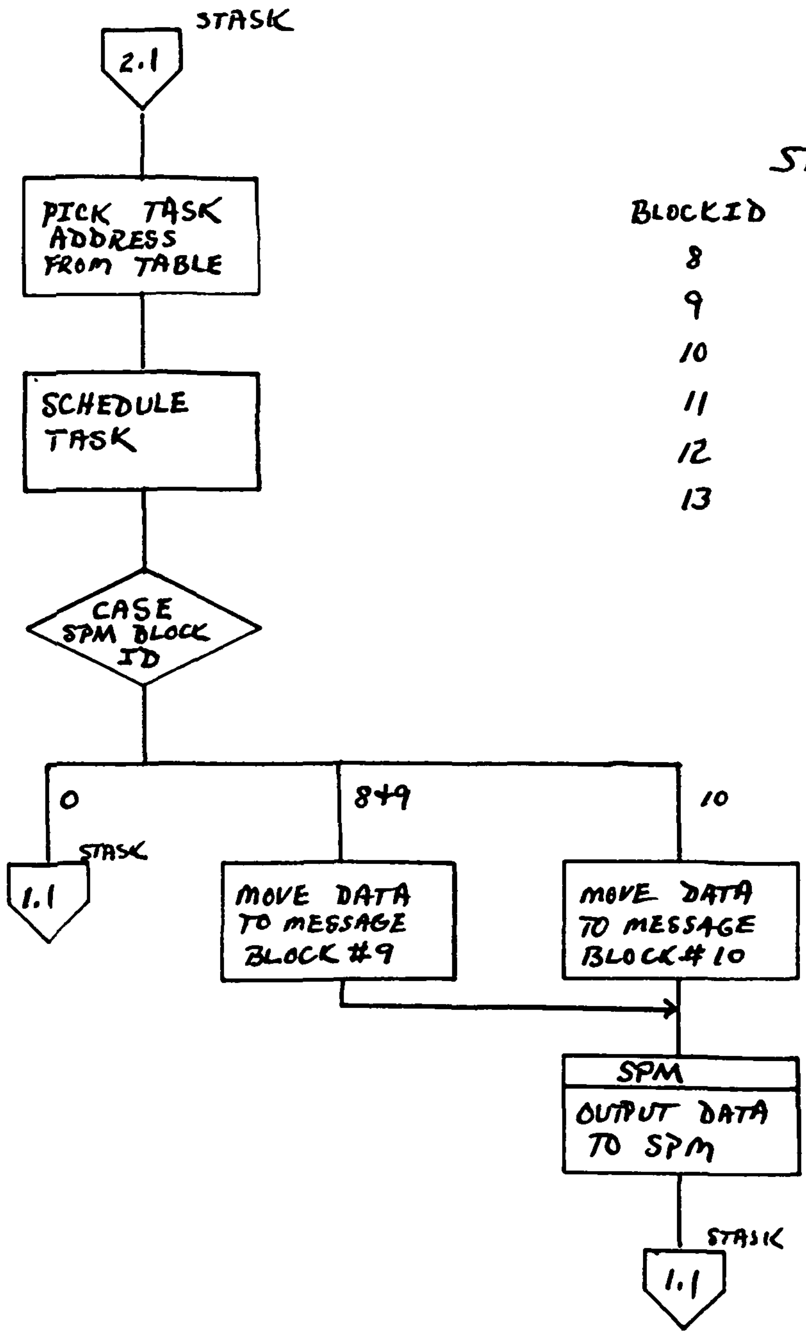
STASK

1/2



STASK

2/2



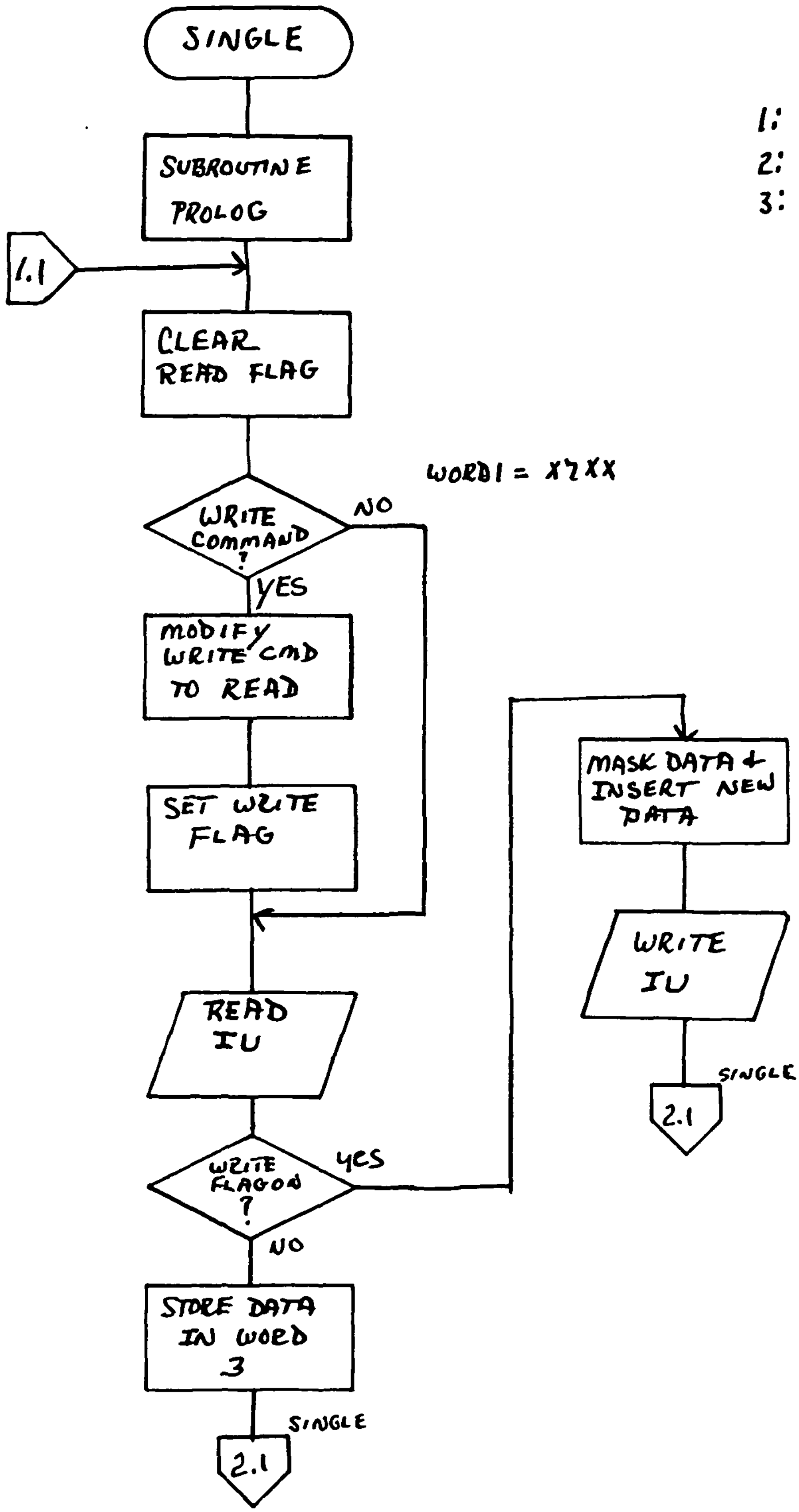
STASK TABLE

BLOCK ID	TASK	SPM BLOCK ID
8	ECPCF	8
9	ECFO	9
10	ECMAG	10
11	SINGLE	0
12	MANUAL	0
13	PATCHER	0

MANUAL COMMAND SERVICE

SINGLE

1/2



MESSAGE WORDS

1: WBBBBRRRIWWWWWWW

2: 000●SSSS0000EEEE

3: DDDDDDDDDDDDDDDD

W = WORD #

B = BOARD #

R = 000, READ

= 111, WRITE

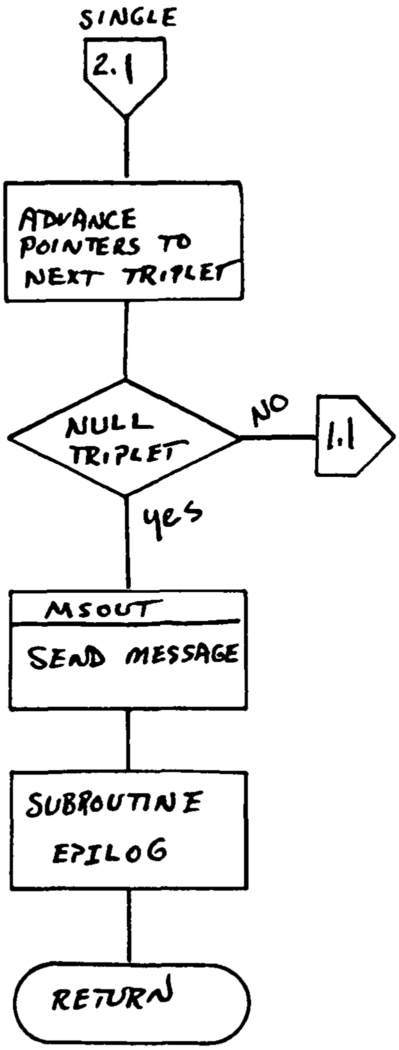
S = START BIT #

E = LENGTH

D = DATA

SINGLE

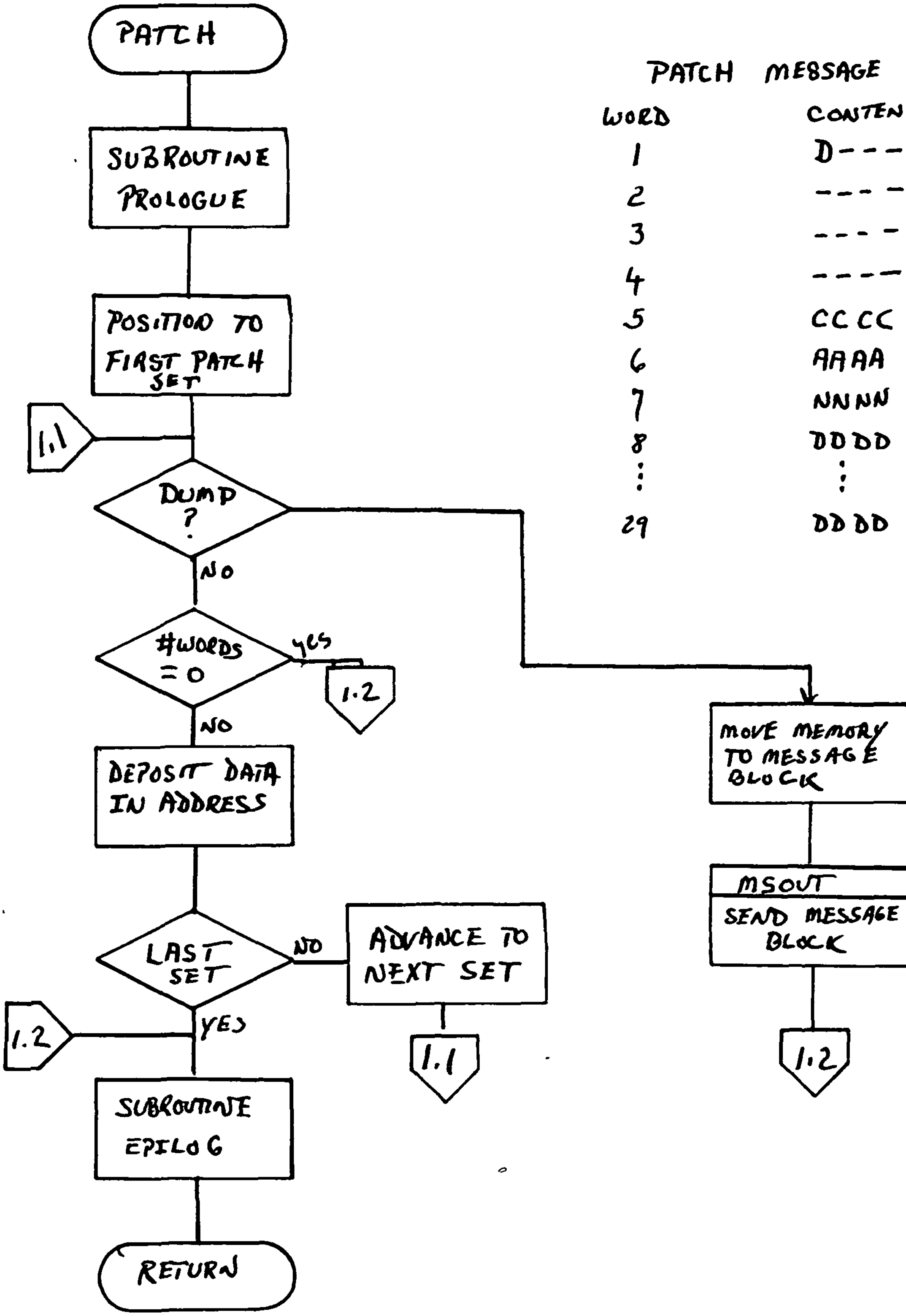
2/2


SINGLE
2.1
ADVANCE POINTERS TO NEXT TRIPLET
NULL TRIPLET
NO
1.1
yes
MSOUT
SEND MESSAGE
SUBROUTINE EPILOG
RETURN

PROGRAM PATCH/DUMP TASK

PATCH

1/1



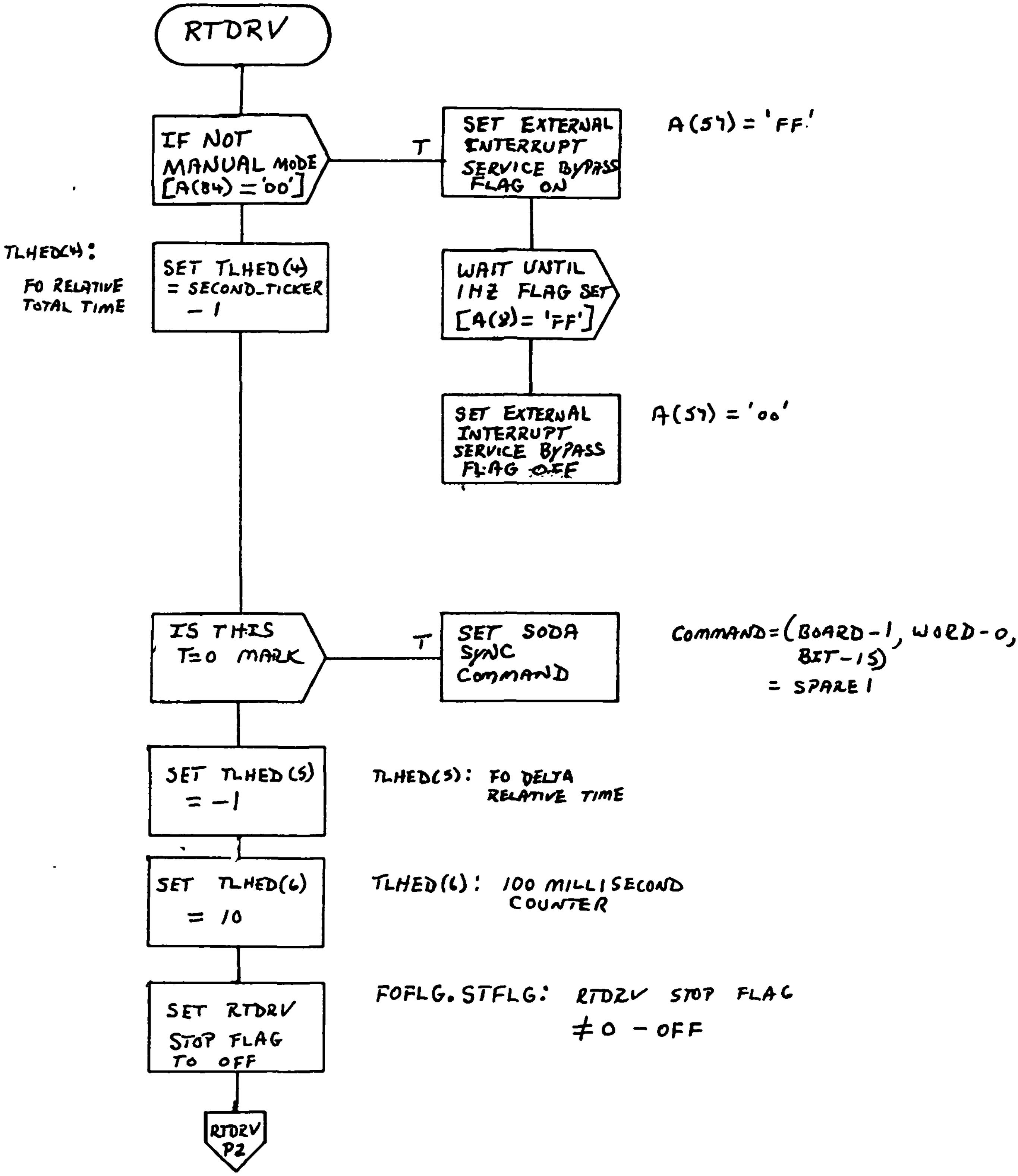
PATCH MESSAGE BLOCK

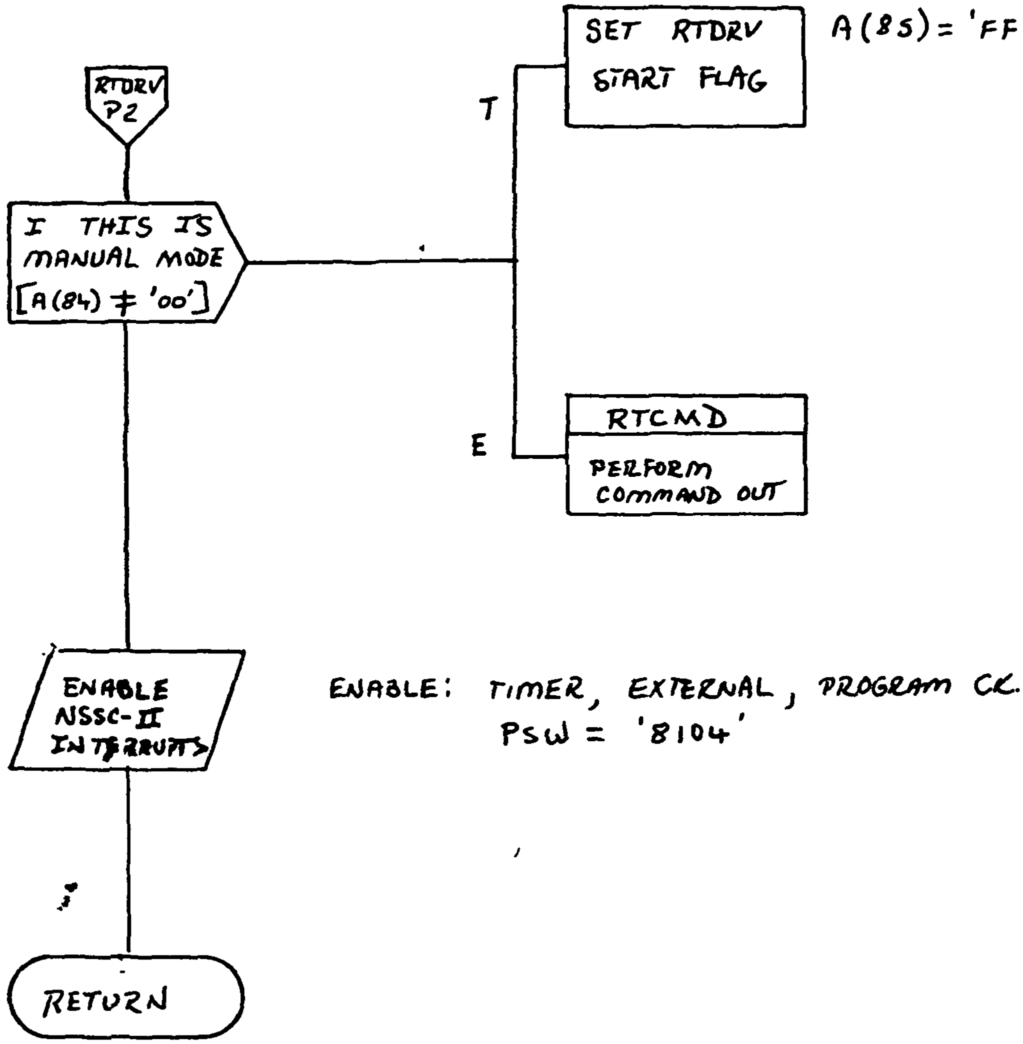
WORD	CONTENTS	DESCRIPTION
1	D---	BLOCK ID = 13
2	----	
3	----	
4	----	
5	CCCC	C = CODE 0-DUMP 1-PATCH
6	AAAA	A = ADDRESS
7	NNNN	N = # WORDS
8	DDDD	D = DATA
⋮	⋮	
29	DDDD	

REAL TIME COMMAND DRIVER

RTDRV

1/2

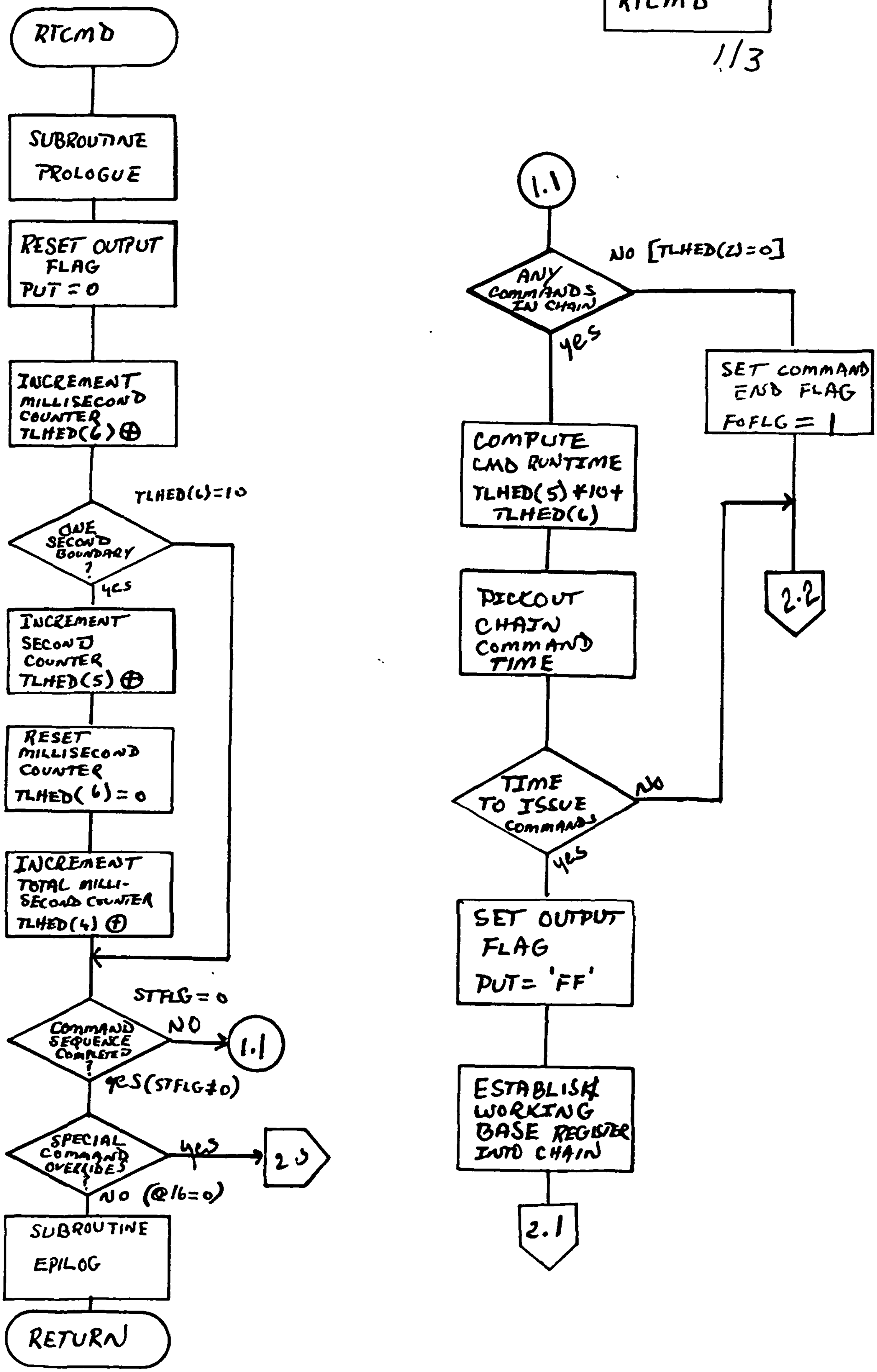



RTDRV P2
I THIS IS MANUAL MODE [A(84) ≠ '00']
T
SET RTDRV START FLAG
A(85) = 'FF'
E
RTCMD
PERFORM COMMAND OUT
ENABLE NSSC-II INTERRUPTS
ENABLE: TIMER, EXTERNAL, PROGRAM CK.
PSW = '8104'
RETURN

REAL TIME COMMAND SCHEDULER

RTCMD

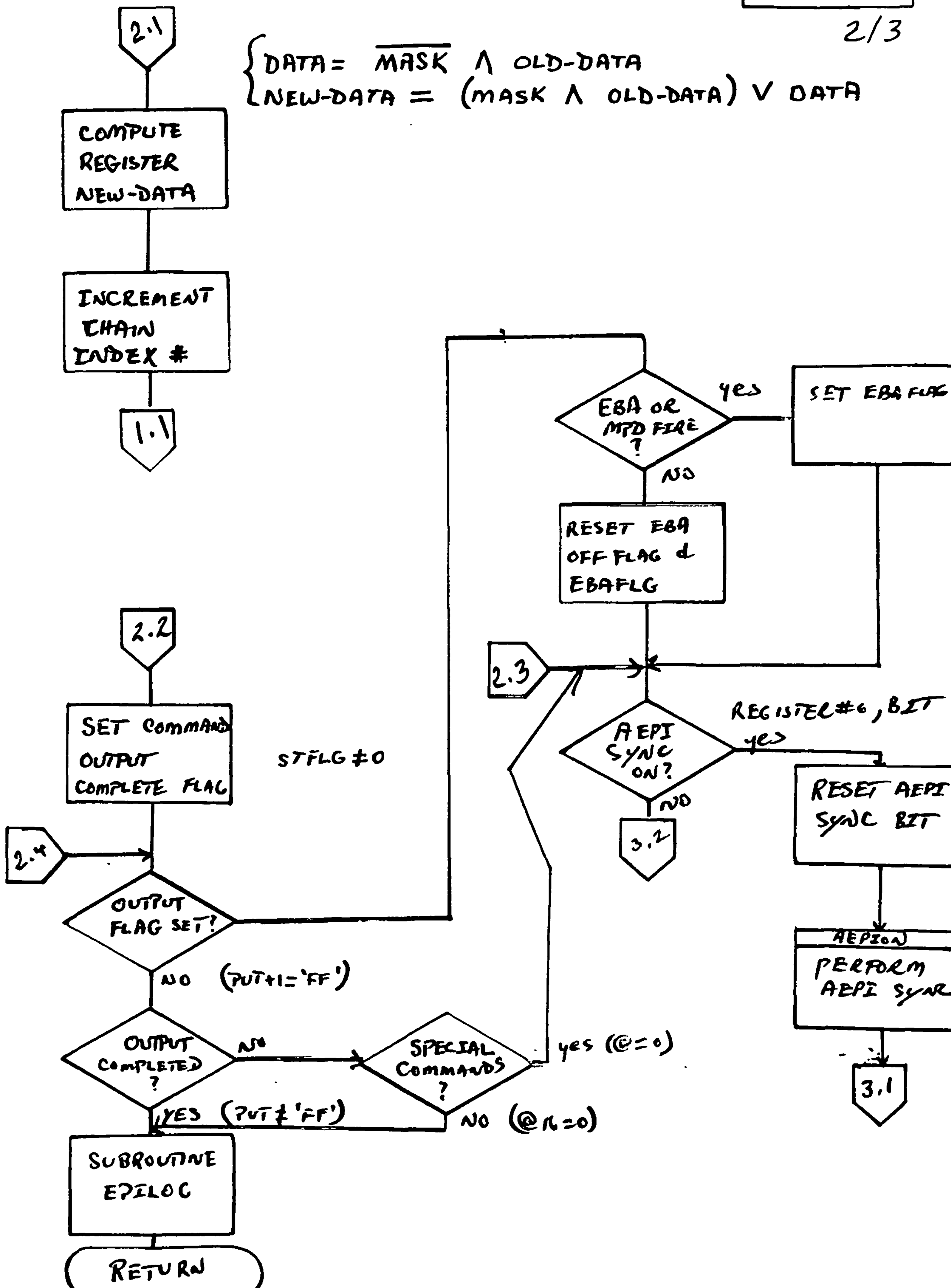
1/3

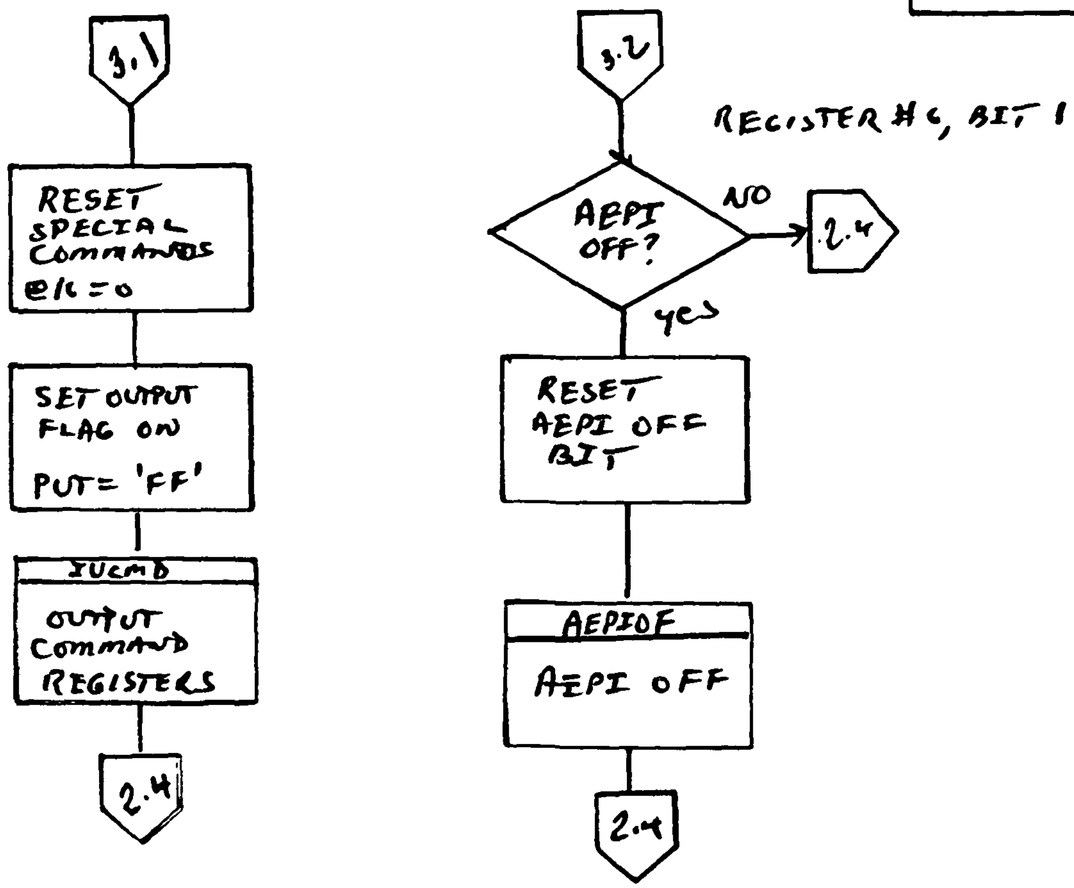


RTCMD

2/3

$$\begin{cases} DATA = \overline{MASK} \wedge OLD\text{-}DATA \\ NEW\text{-}DATA = (MASK \wedge OLD\text{-}DATA) \vee DATA \end{cases}$$

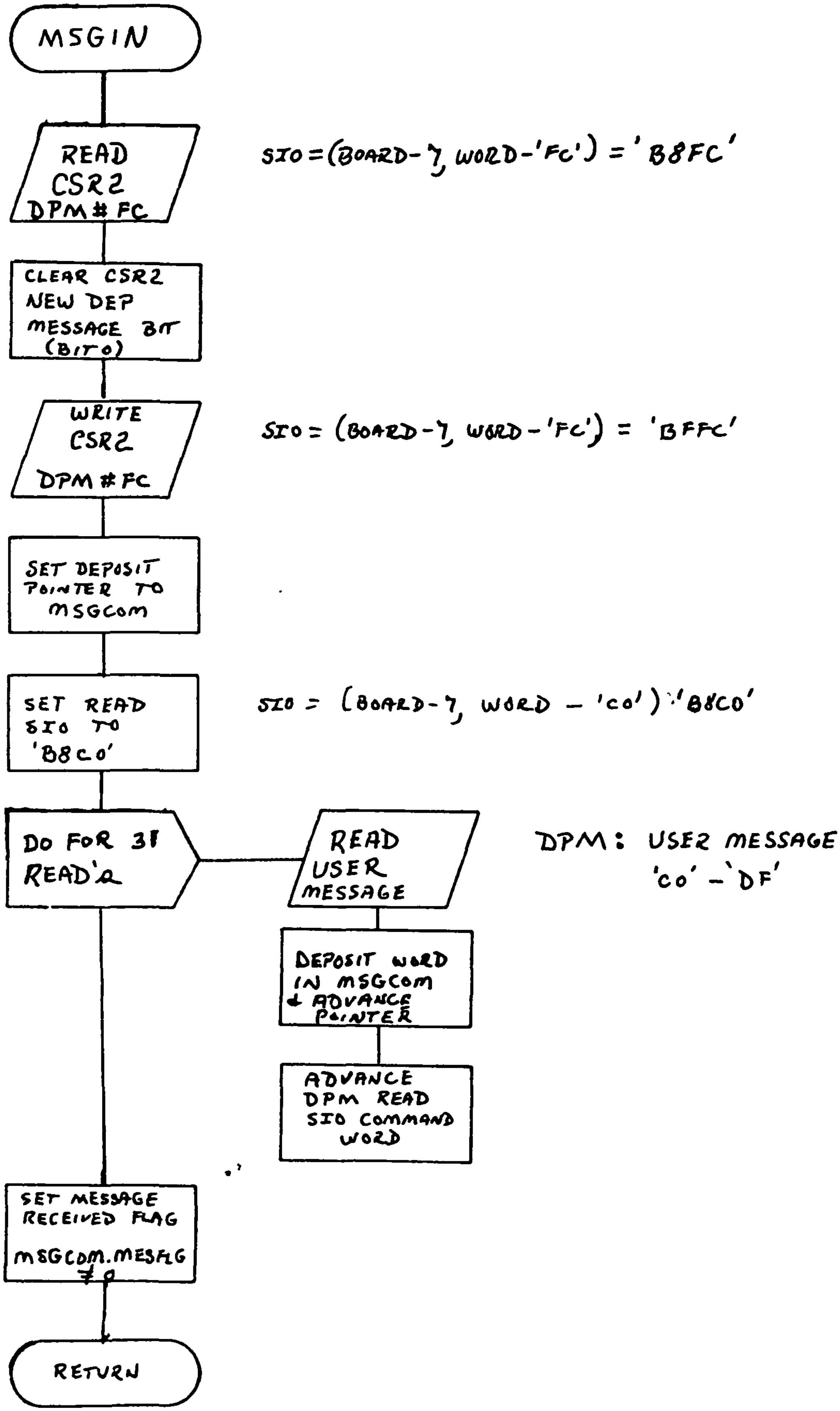



3.1
RESET SPECIAL COMMANDS
@K=0
SET OUTPUT FLAG ON
PUT='FF'
IUCMD
OUTPUT COMMAND REGISTERS
2.4
3.2
REGISTER #6, BIT 1
AEPI OFF?
NO
2.4
YES
RESET AEPI OFF BIT
AEPIOF
AEPI OFF
2.4

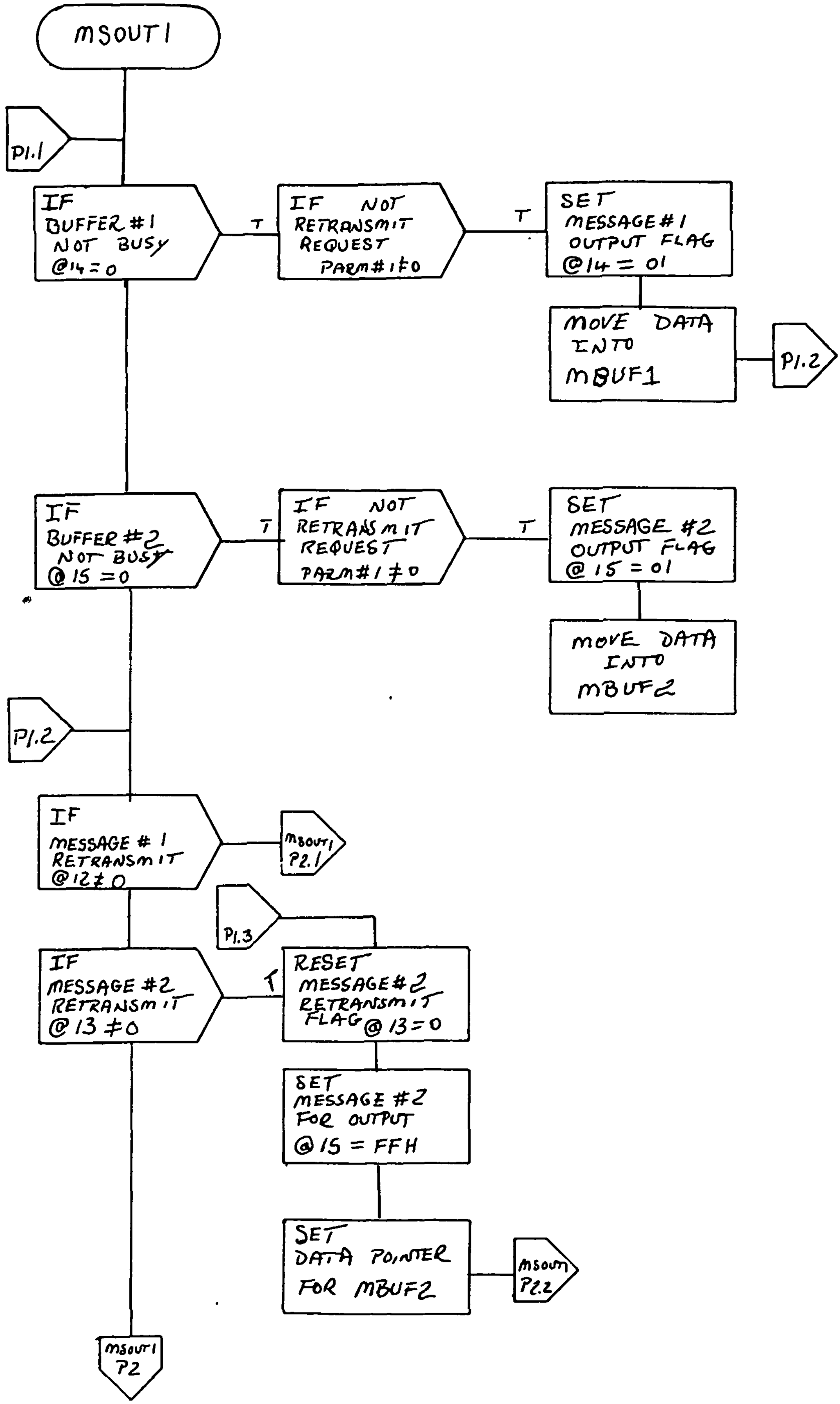
MESSAGE INPUT HANDLER

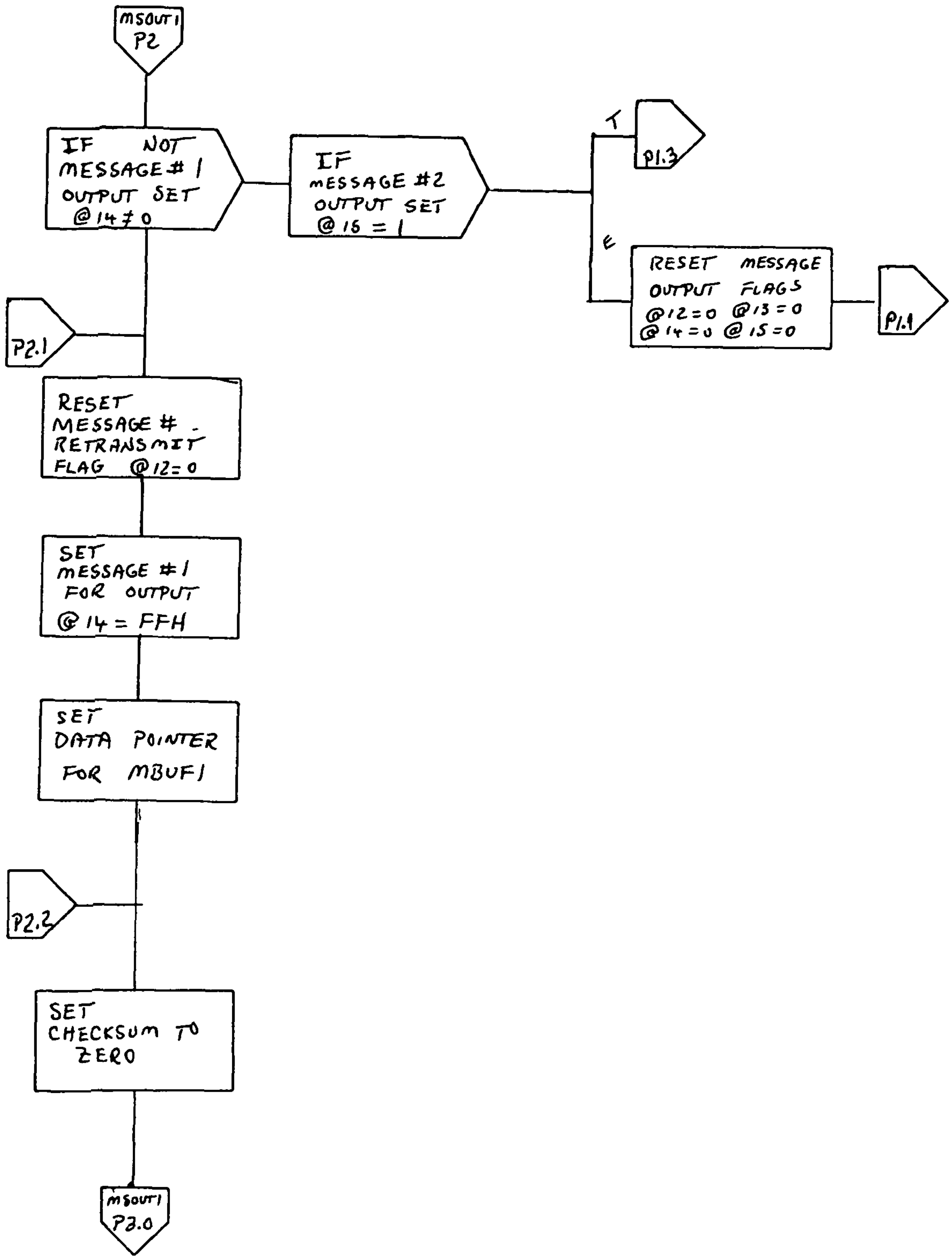
MSGIN

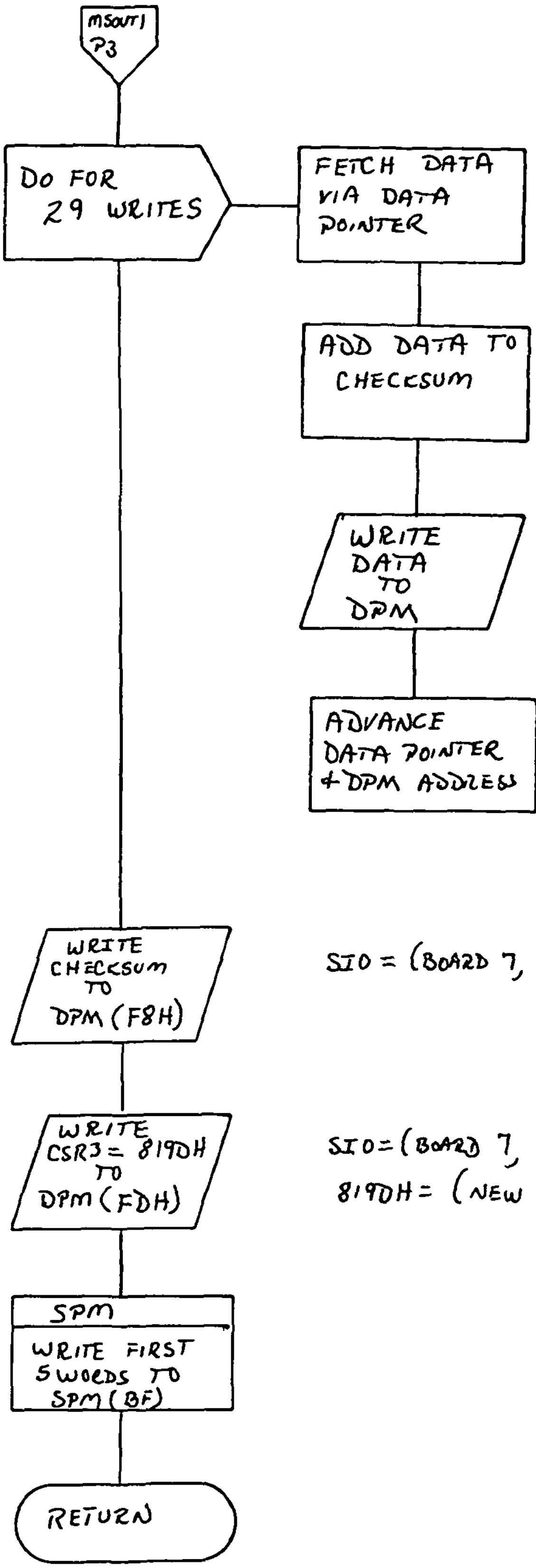
1/1



MESSAGE OUTPUT HANDLER




MSOUT1 P2
IF NOT MESSAGE #1 OUTPUT SET @14≠0
IF MESSAGE #2 OUTPUT SET @15 = 1
T
P1.3
E
RESET MESSAGE OUTPUT FLAGS @12=0 @13=0 @14=0 @15=0
P1.1
P2.1
RESET MESSAGE # RETRANSMIT FLAG @12=0
SET MESSAGE #1 FOR OUTPUT @14 = FFH
SET DATA POINTER FOR MBUF1
P2.2
SET CHECKSUM TO ZERO
MSOUT1 P3.0

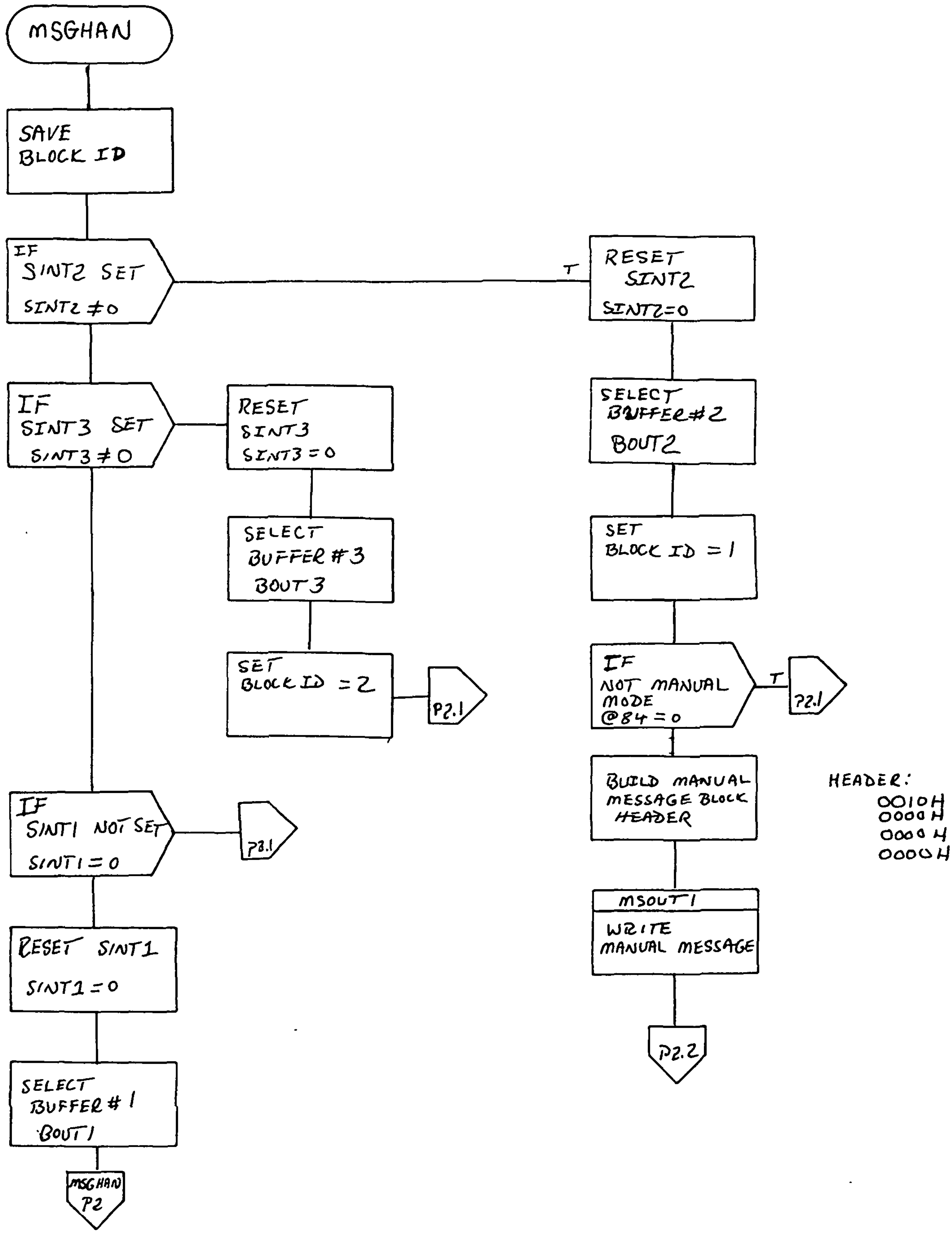


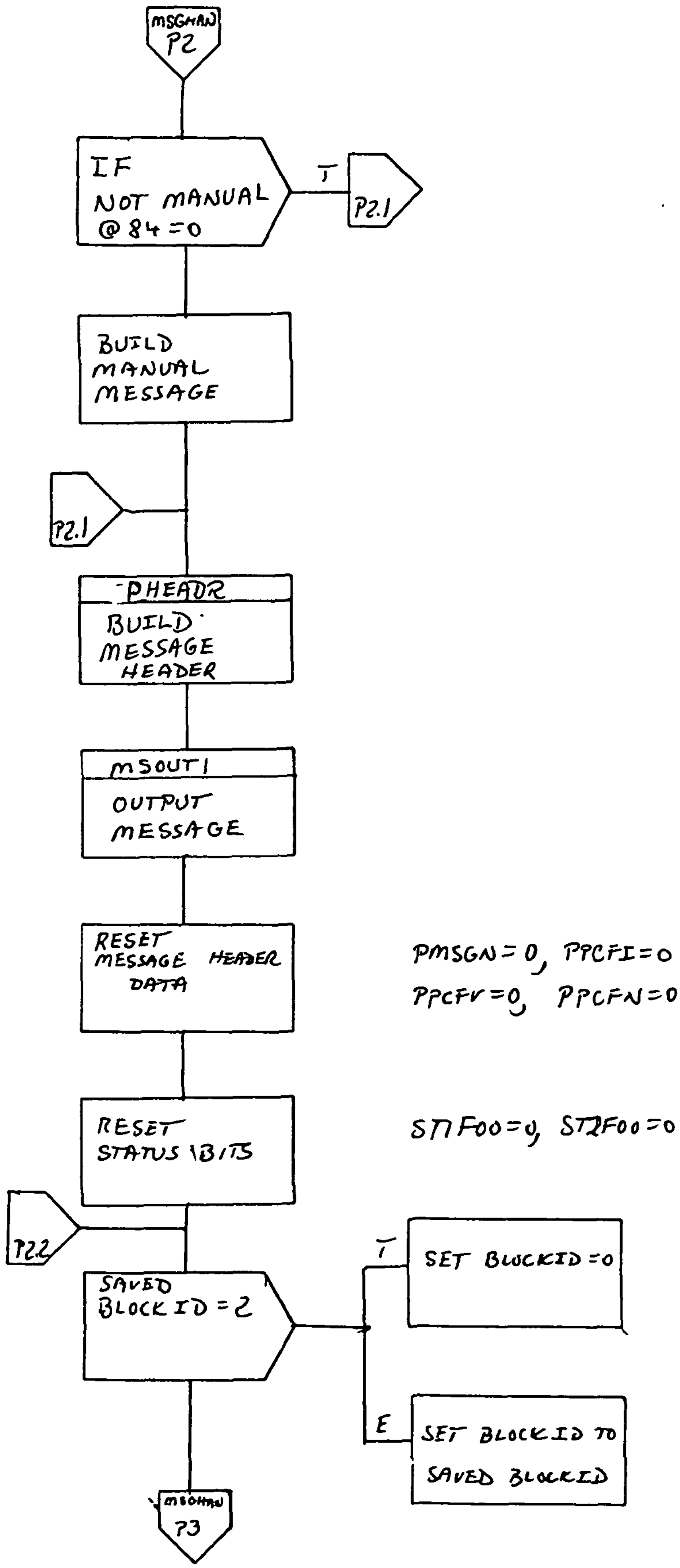
SIO = (BOARD 7, WORD 80H) = 3F80H
MESSAGE IN DPM (00H TO 1DH)

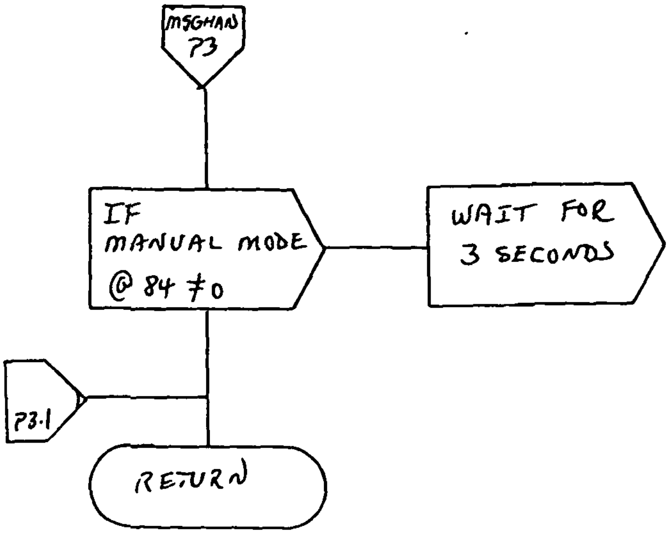
SIO = (BOARD 7, WORD F8H) = BFF8H

SIO = (BOARD 7, WORD FDH) = BFFD H
819DH = (NEW MESSAGE, BUFFER #1, 29 WORDS)

MESSAGE HANDLER



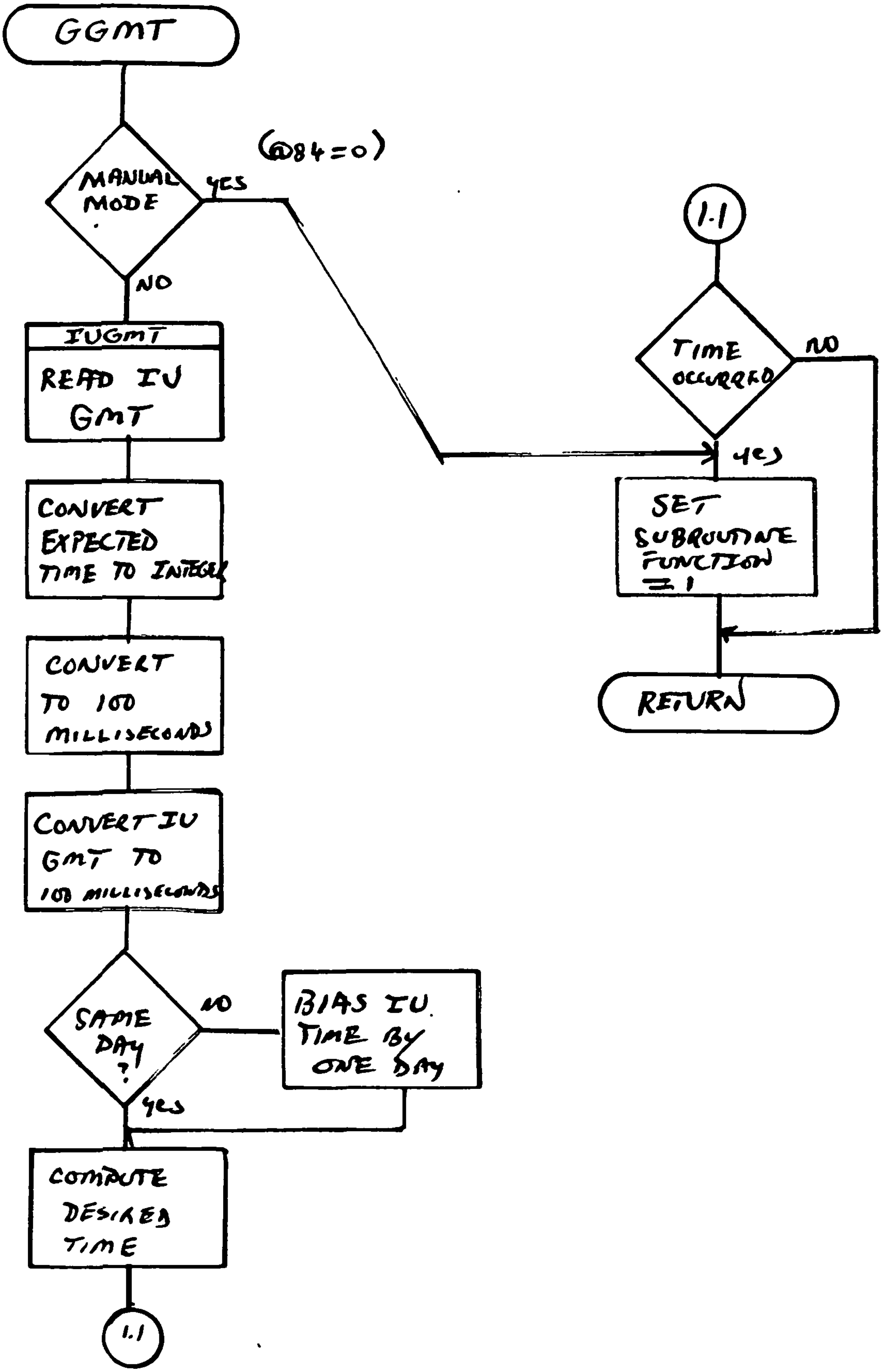

MSGHAN P2
IF NOT MANUAL @84=0
T
P2.1
BUILD MANUAL MESSAGE
P2.1
PHEADR
BUILD MESSAGE HEADER
MSOUT1
OUTPUT MESSAGE
RESET MESSAGE HEADER DATA
PMSGN=0, PPCFI=0
PPCFV=0, PPCFN=0
RESET STATUS BITS
ST1F00=0, ST2F00=0
P2.2
SAVED BLOCKID=2
T
SET BLOCKID=0
E
SET BLOCKID TO SAVED BLOCKID
MSGHAN P3


MSGHAN
73
IF
MANUAL MODE
@ 84 ≠ 0
WAIT FOR
3 SECONDS
73.1
RETURN

COMPARE GMT'S

CGMT

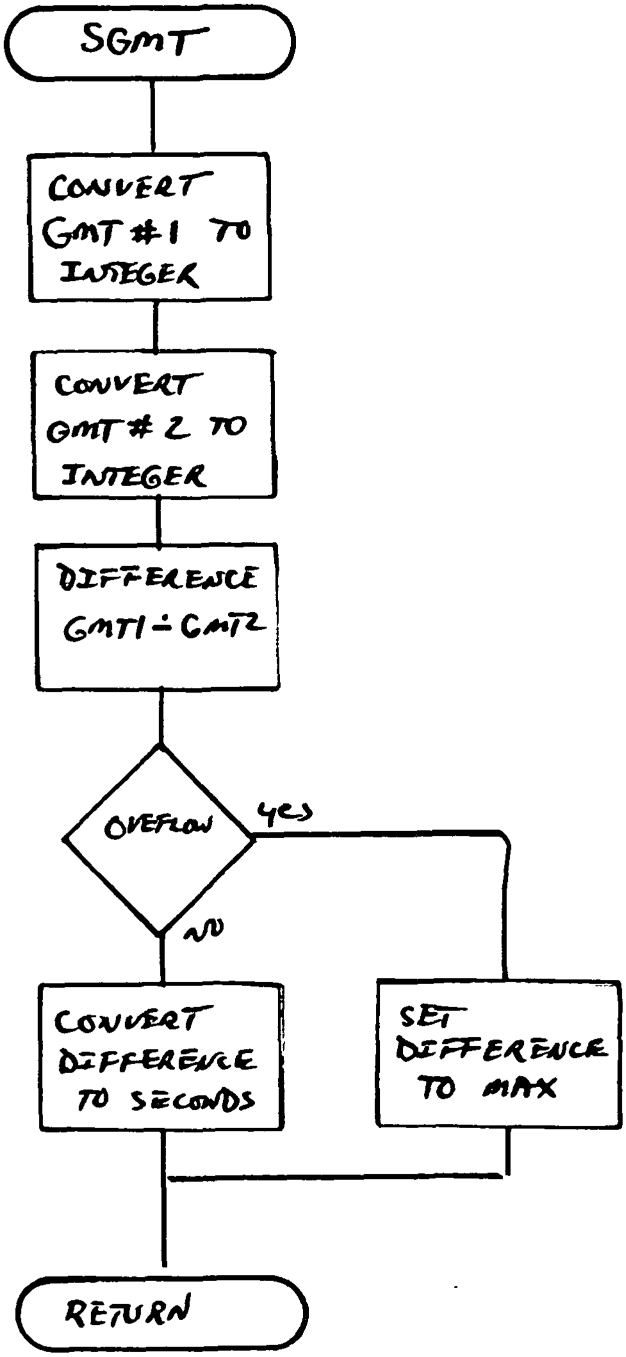
1/1



SUBTRACT GMT'S UTILITY

SGMT

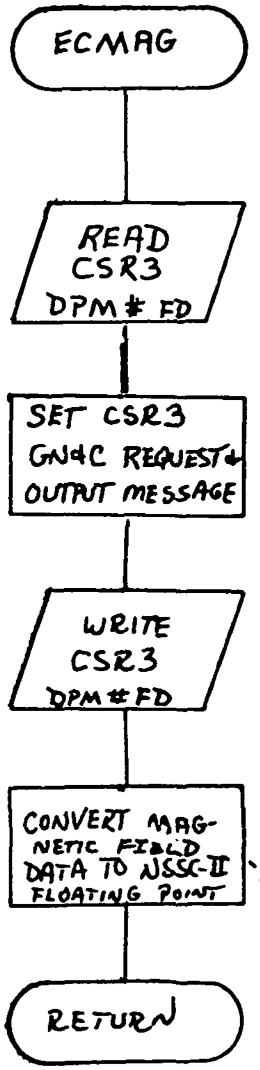
1/1



SERVICE MAGNETIC FIELD DATA

ECMAG

1/1



SIO = (BOARD-7, WORD-'FD') = 'B8FD'

GN&C REQUEST = BIT 3

OUTPUT MESSAGE REQUEST = BIT 0

S/O = (BOARD-7, WORD-'FD') = 'BFFD'

MAGNETIC FIELD → MSGCOM.MSGBLA

CONVERT FROM MITRA FLOATING POINT TO NSSC-II FLOATING POINT

MSGBLA (4 & 5) = B_x

MSGBLA (6 & 7) = B_y

MSGBLA (8 & 9) = B_z

MSGBLA (10 + 11) = AZIMUTH

MSGBLA (12 + 13) = COELEVATION

IF MITRA FP POSITIVE

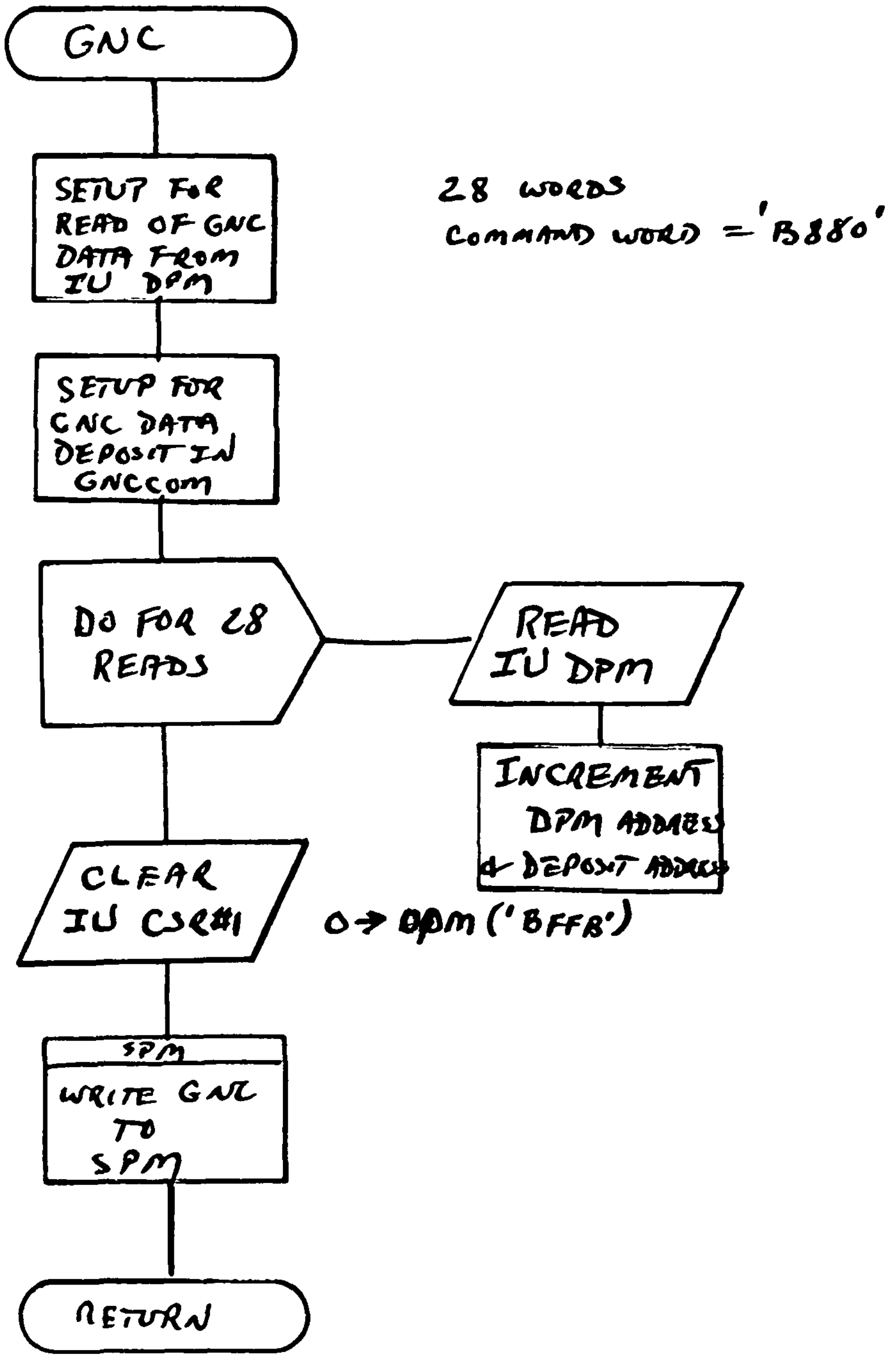
THEN NO CONVERSION

ELSE NSSC-II FP = 2's COMPLEMENT OF MITRA FP ORED '80000000'

SERVICE GNC DATA

GNC

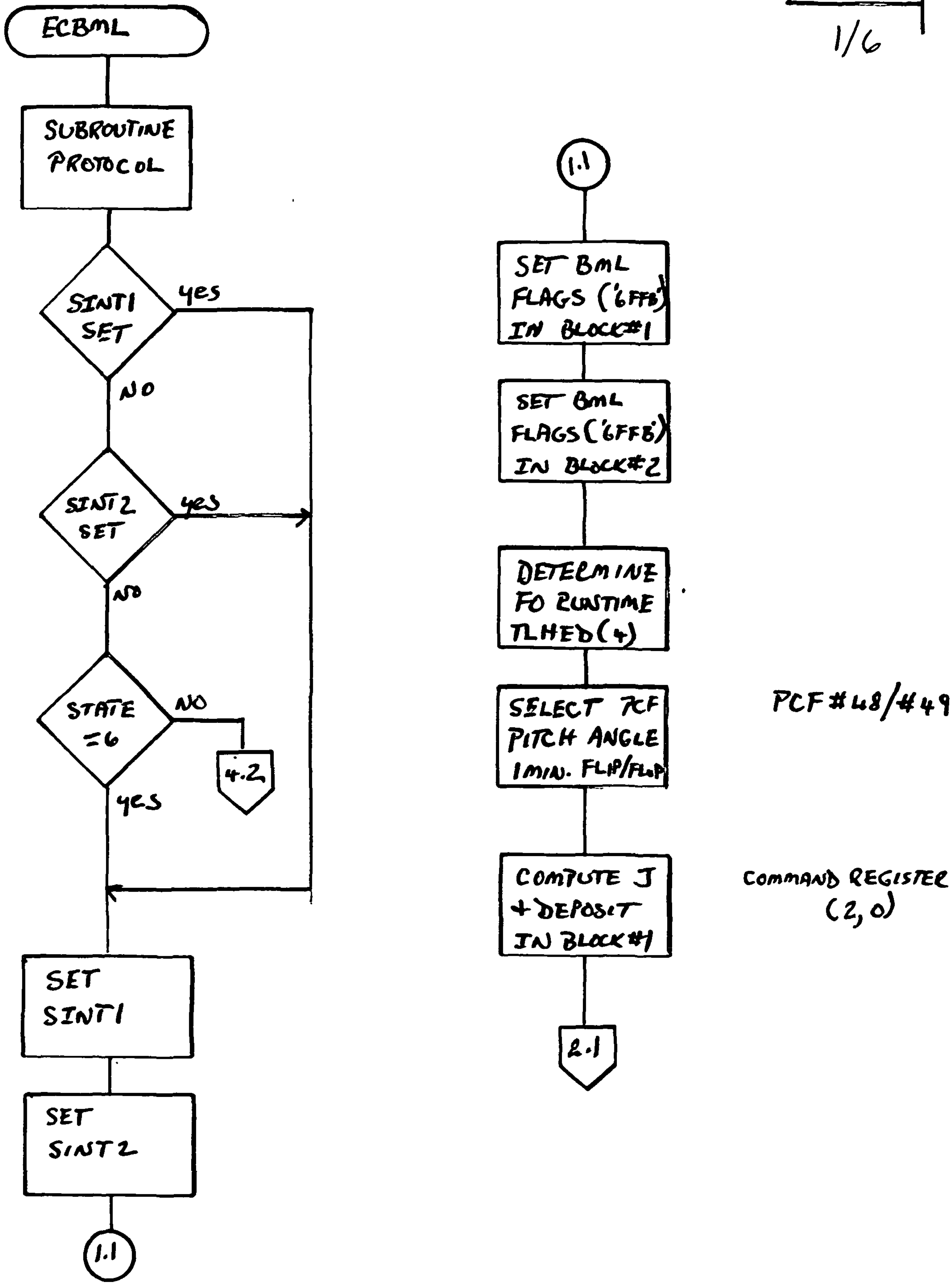
1/1



BURST MODE LOGIC SERVICE

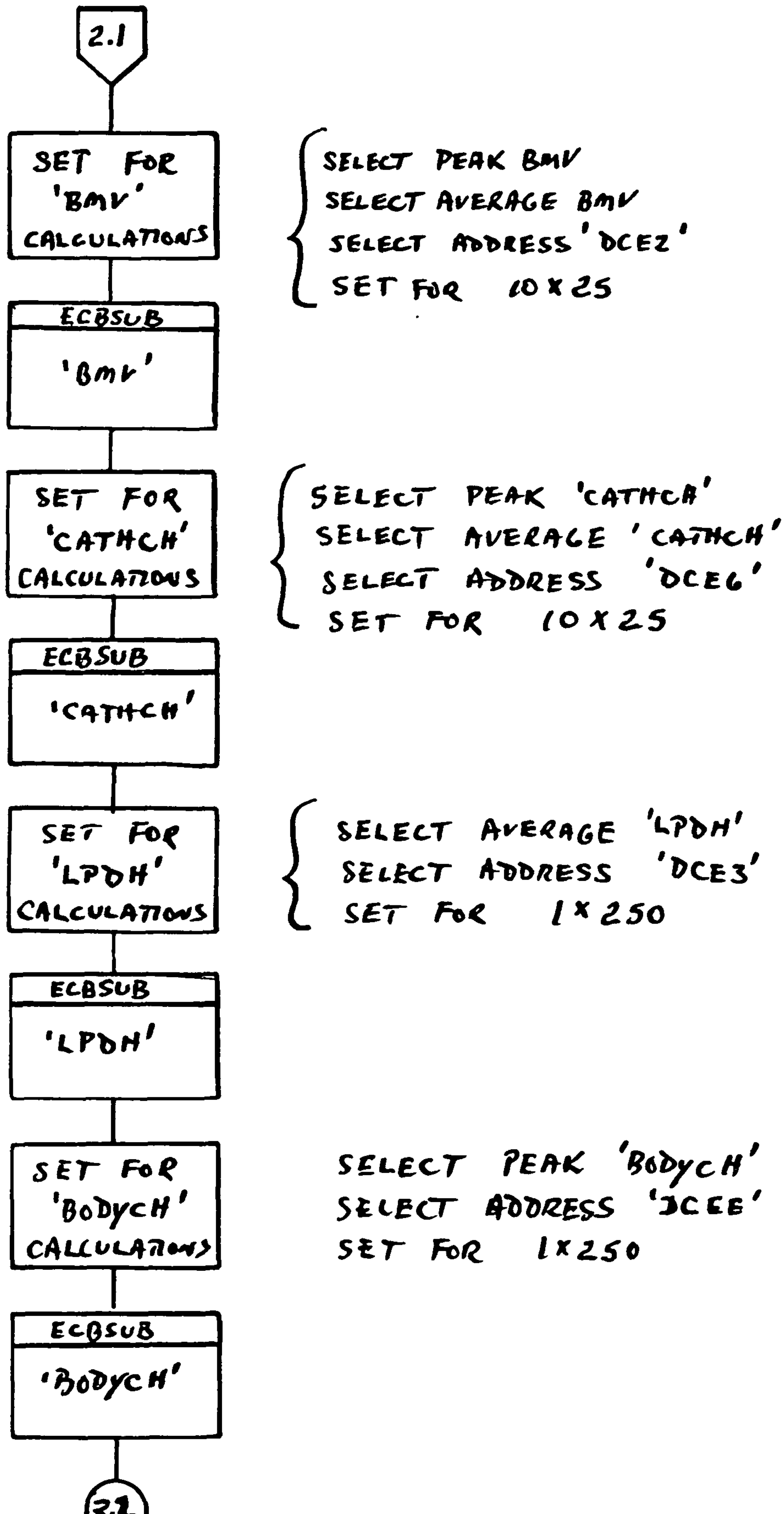
ECBML

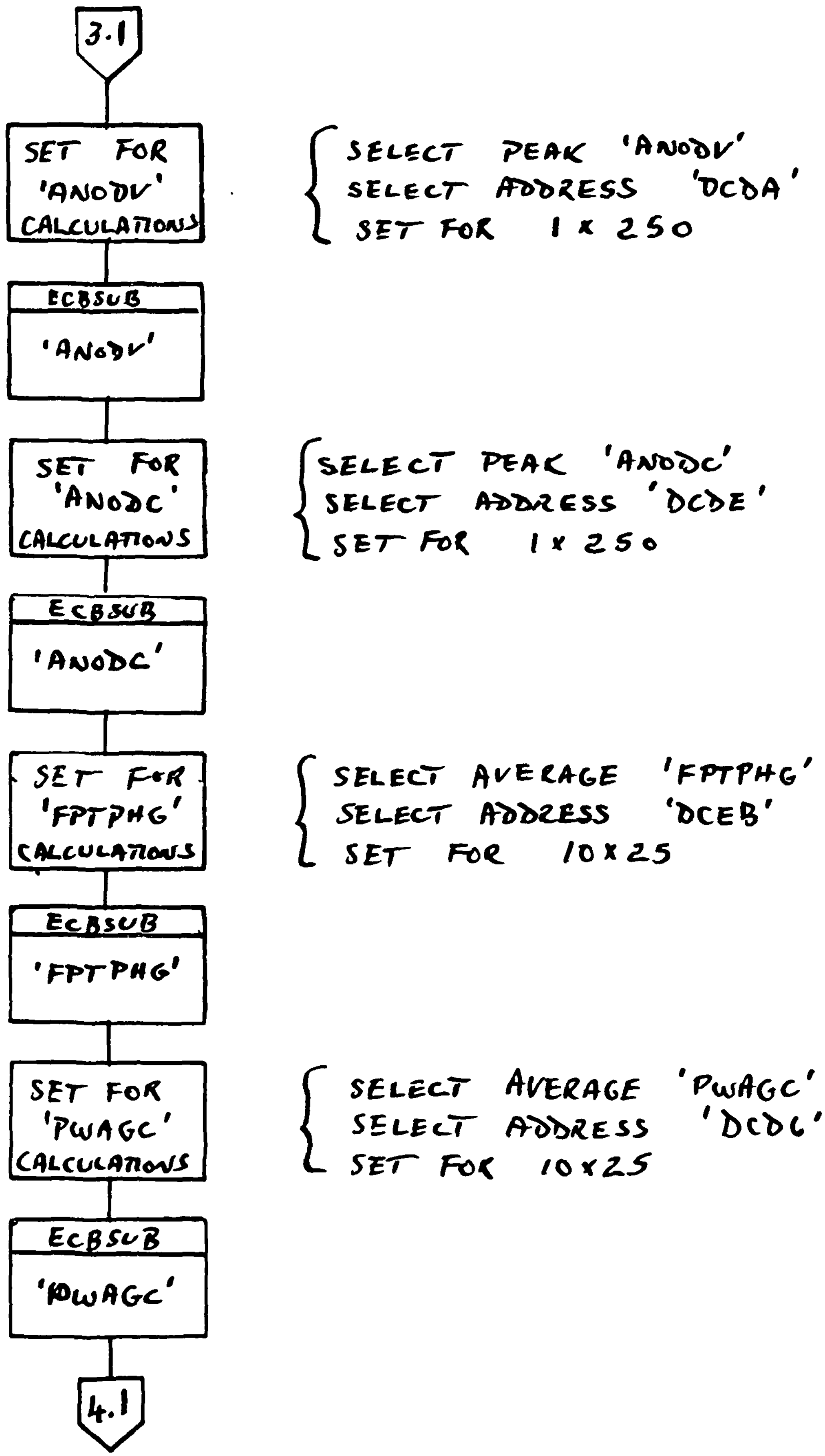
1/6

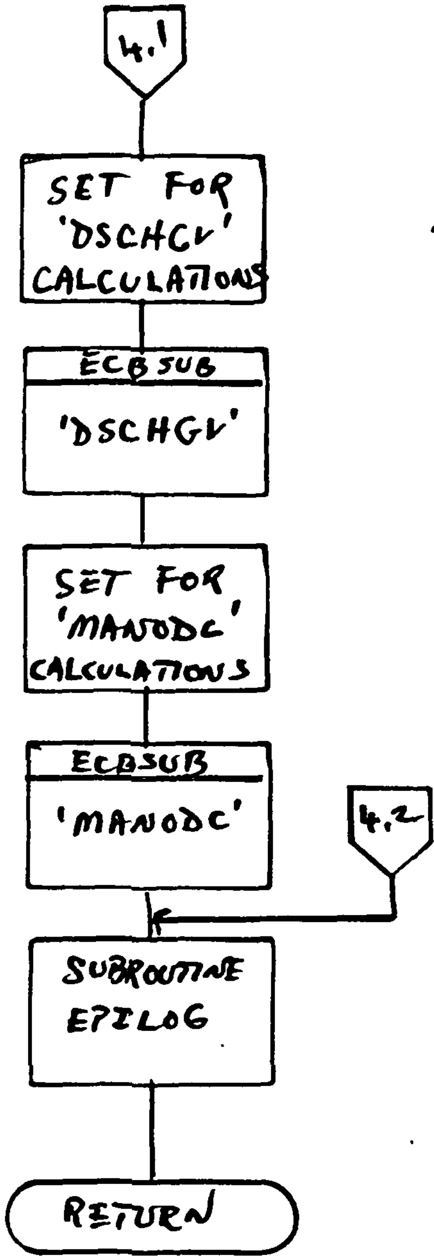


ECBML

2/6

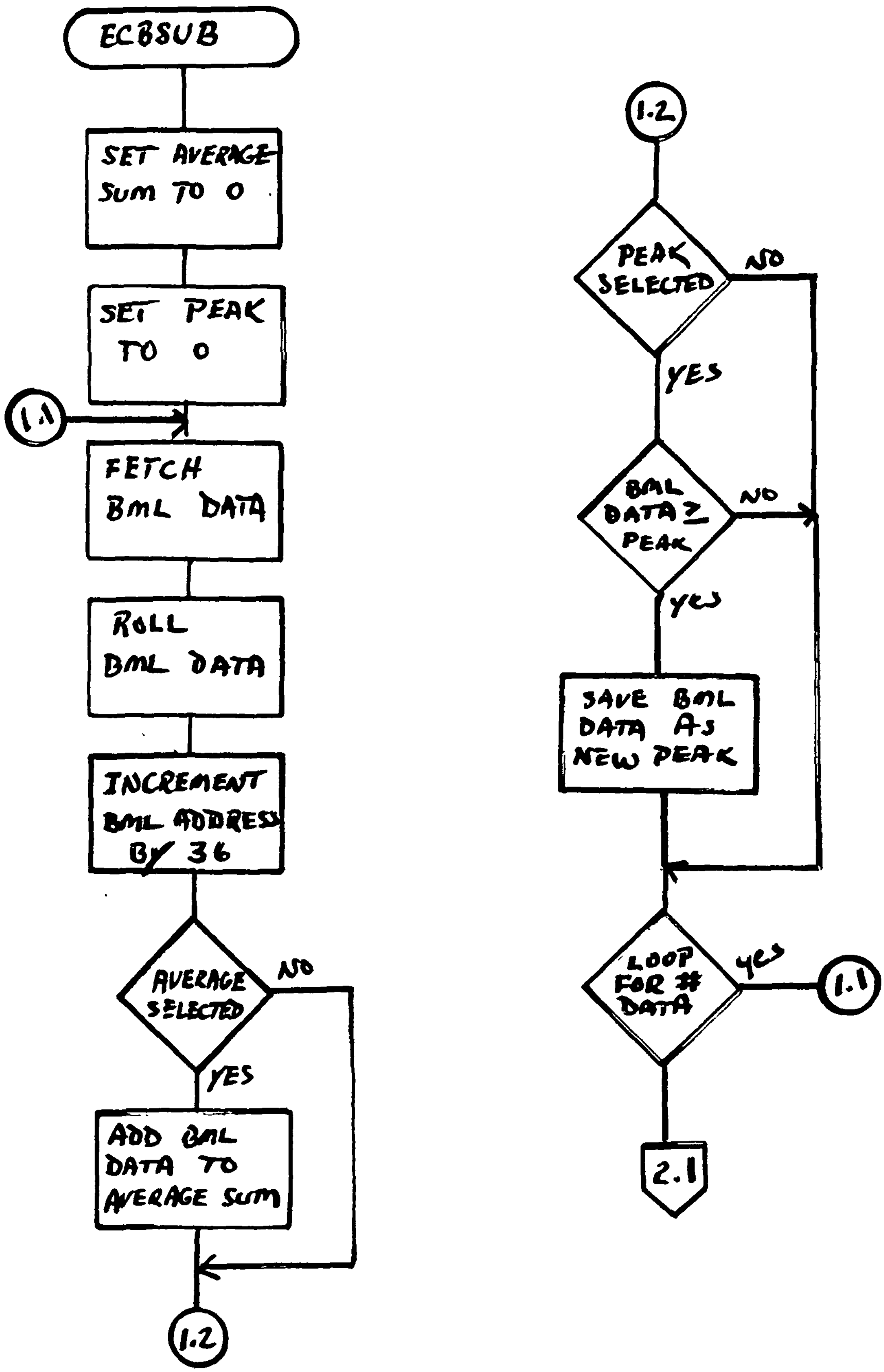

2.1
SET FOR 'BMV' CALCULATIONS
SELECT PEAK BMV
SELECT AVERAGE BMV
SELECT ADDRESS 'DCE2'
SET FOR 10 X 25
ECBSUB
'BMV'
SET FOR 'CATHCH' CALCULATIONS
SELECT PEAK 'CATHCH'
SELECT AVERAGE 'CATHCH'
SELECT ADDRESS 'DCE6'
SET FOR 10 X 25
ECBSUB
'CATHCH'
SET FOR 'LPDH' CALCULATIONS
SELECT AVERAGE 'LPDH'
SELECT ADDRESS 'DCE3'
SET FOR 1 X 250
ECBSUB
'LPDH'
SET FOR 'BODYCH' CALCULATIONS
SELECT PEAK 'BODYCH'
SELECT ADDRESS 'DCEE'
SET FOR 1 X 250
ECBSUB
'BODYCH'
3.2


3.1
SET FOR 'ANODV' CALCULATIONS
SELECT PEAK 'ANODV'
SELECT ADDRESS 'DCDA'
SET FOR 1 x 250
ECBSUB
'ANODV'
SET FOR 'ANODC' CALCULATIONS
SELECT PEAK 'ANODC'
SELECT ADDRESS 'DCDE'
SET FOR 1 x 250
ECBSUB
'ANODC'
SET FOR 'FPTPHG' CALCULATIONS
SELECT AVERAGE 'FPTPHG'
SELECT ADDRESS 'DCEB'
SET FOR 10 x 25
ECBSUB
'FPTPHG'
SET FOR 'PWAGC' CALCULATIONS
SELECT AVERAGE 'PWAGC'
SELECT ADDRESS 'DCD6'
SET FOR 10 x 25
ECBSUB
'PWAGC'
4.1



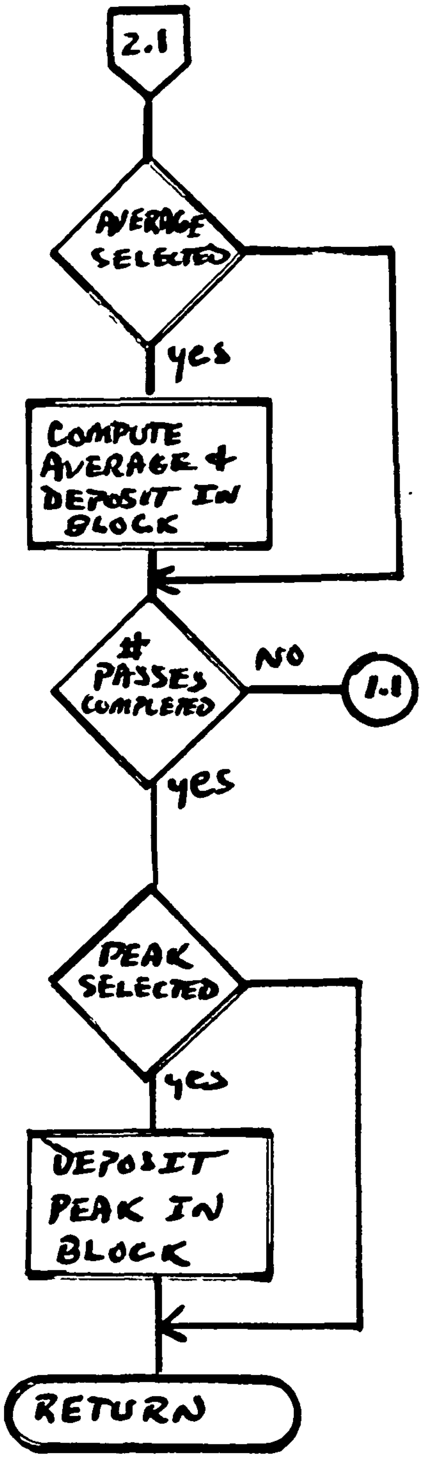
SELECT AVERAGE 'DSCHGV'
SELECT ADDRESS 'DCD8'
SET FOR 20 x 12

SELECT AVERAGE 'MANODC'
SELECT ADDRESS 'DCD9'
SET FOR 20 x 12


ECBSUB
SET AVERAGE SUM TO 0
SET PEAK TO 0
1.1
FETCH BML DATA
ROLL BML DATA
INCREMENT BML ADDRESS BY 36
AVERAGE SELECTED
NO
YES
ADD BML DATA TO AVERAGE SUM
1.2
1.2
PEAK SELECTED
NO
YES
BML DATA ≥ PEAK
NO
YES
SAVE BML DATA AS NEW PEAK
LOOP FOR # DATA
YES
1.1
2.1

ECBML

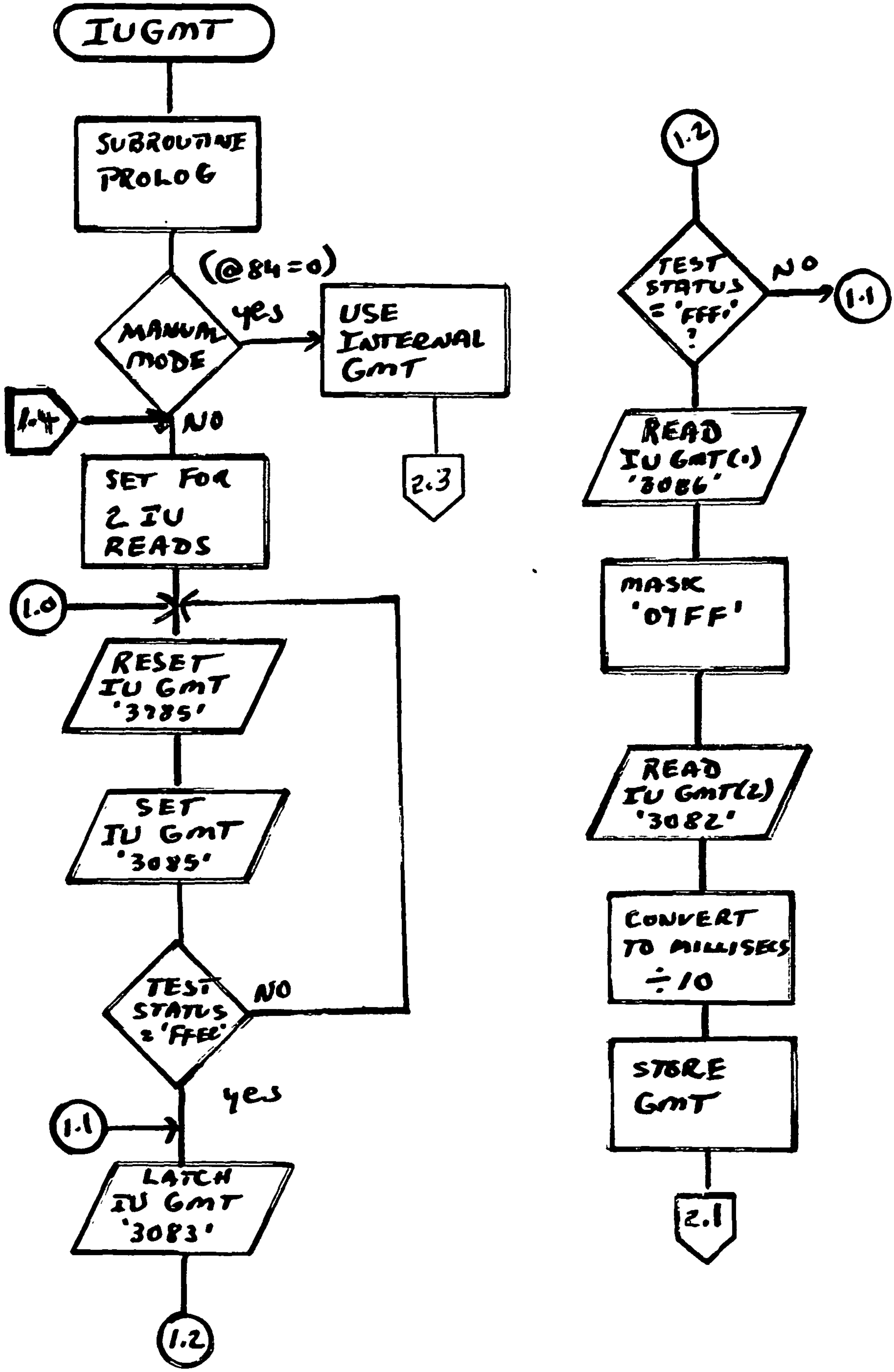
6/6

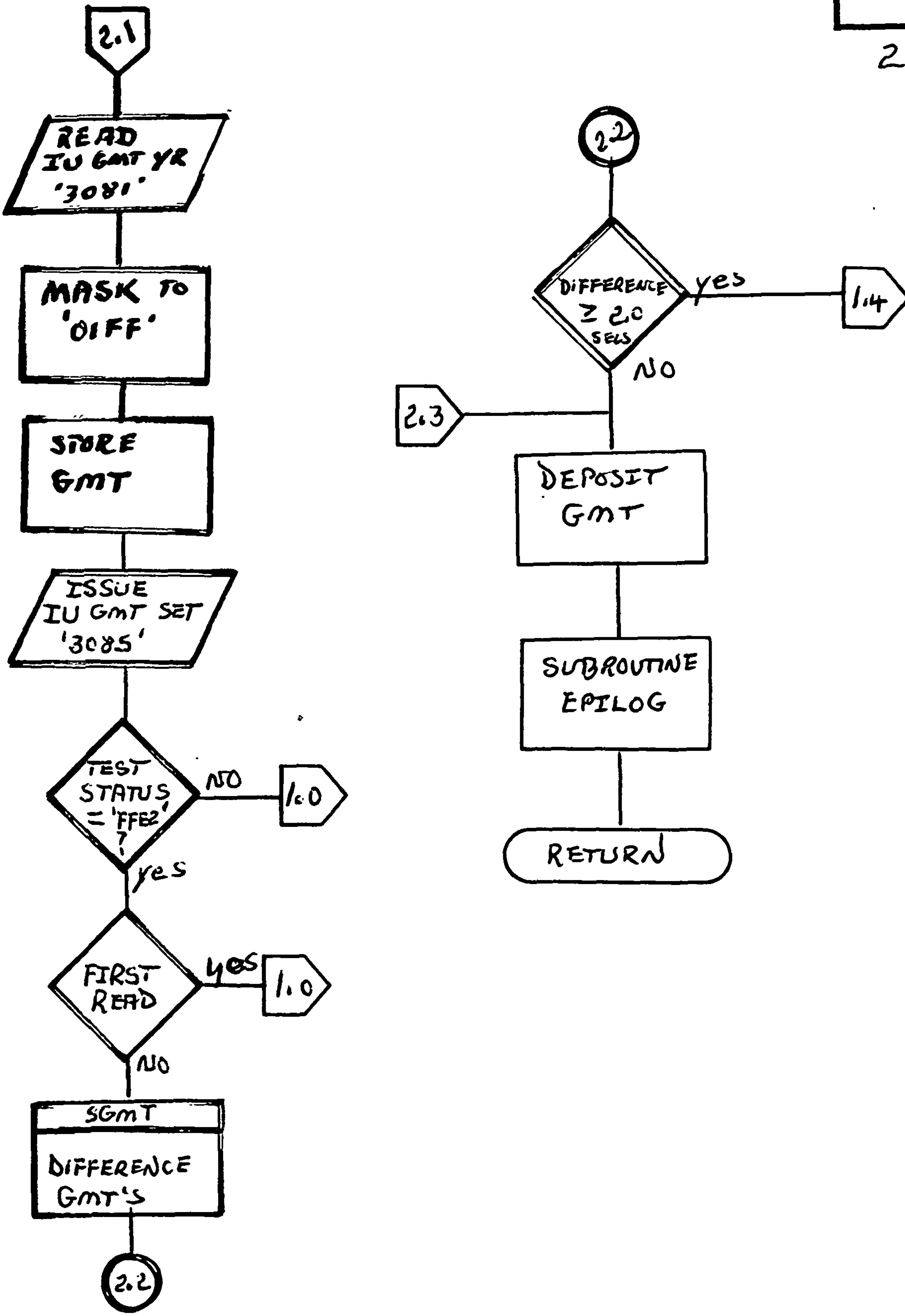

2.1
AVERAGE SELECTED
yes
COMPUTE AVERAGE & DEPOSIT IN BLOCK
PASSES COMPLETED
NO
1.1
yes
PEAK SELECTED
yes
DEPOSIT PEAK IN BLOCK
RETURN

READ IU GMT

IUGMT

1/2

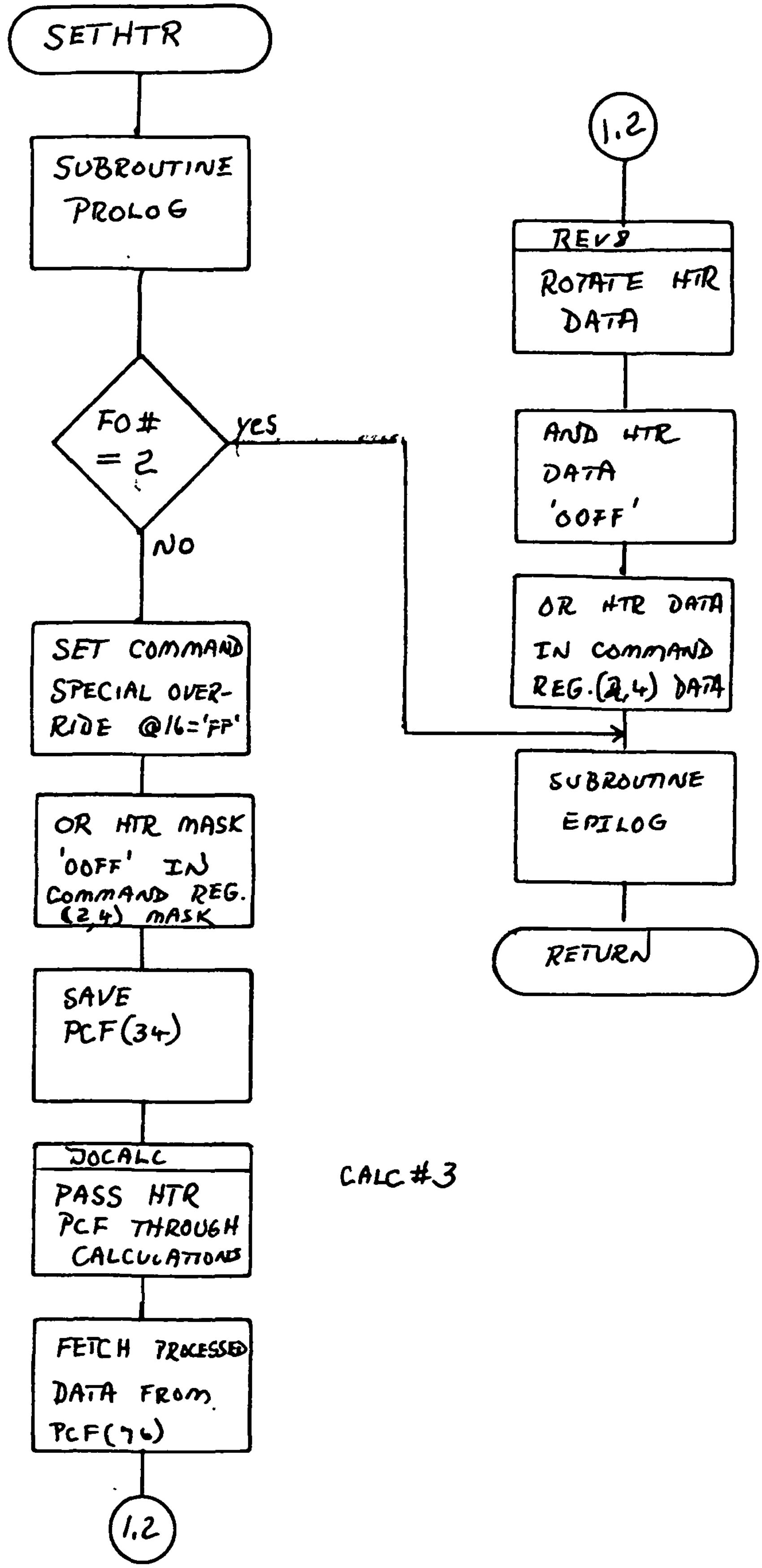



2.1
READ IU GMT YR '3081'
MASK TO 'DIFF'
STORE GMT
ISSUE IU GMT SET '3085'
TEST STATUS = 'FFE2' ?
NO
1.0
yes
FIRST READ
yes
1.0
NO
SGMT
DIFFERENCE GMT'S
2.2
2.2
DIFFERENCE ≥ 20 SECS
yes
1.4
NO
2.3
DEPOSIT GMT
SUBROUTINE EPILOG
RETURN

SET HEATER CURRENT VALUE IN COMMANDS

SETHTR

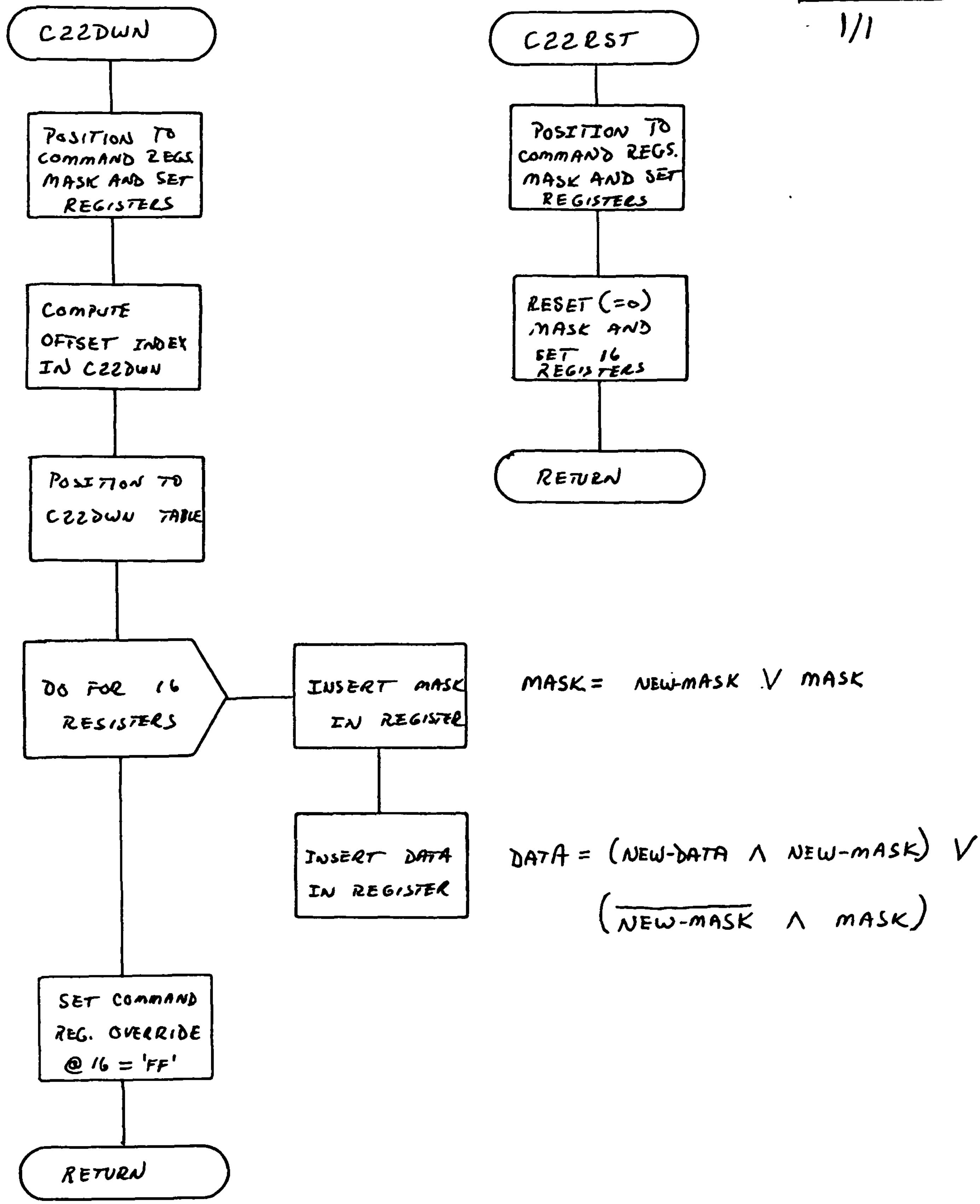
1/1



SERVICE COMMAND INSTRUMENT SHUTDOWN'S

C22DWN

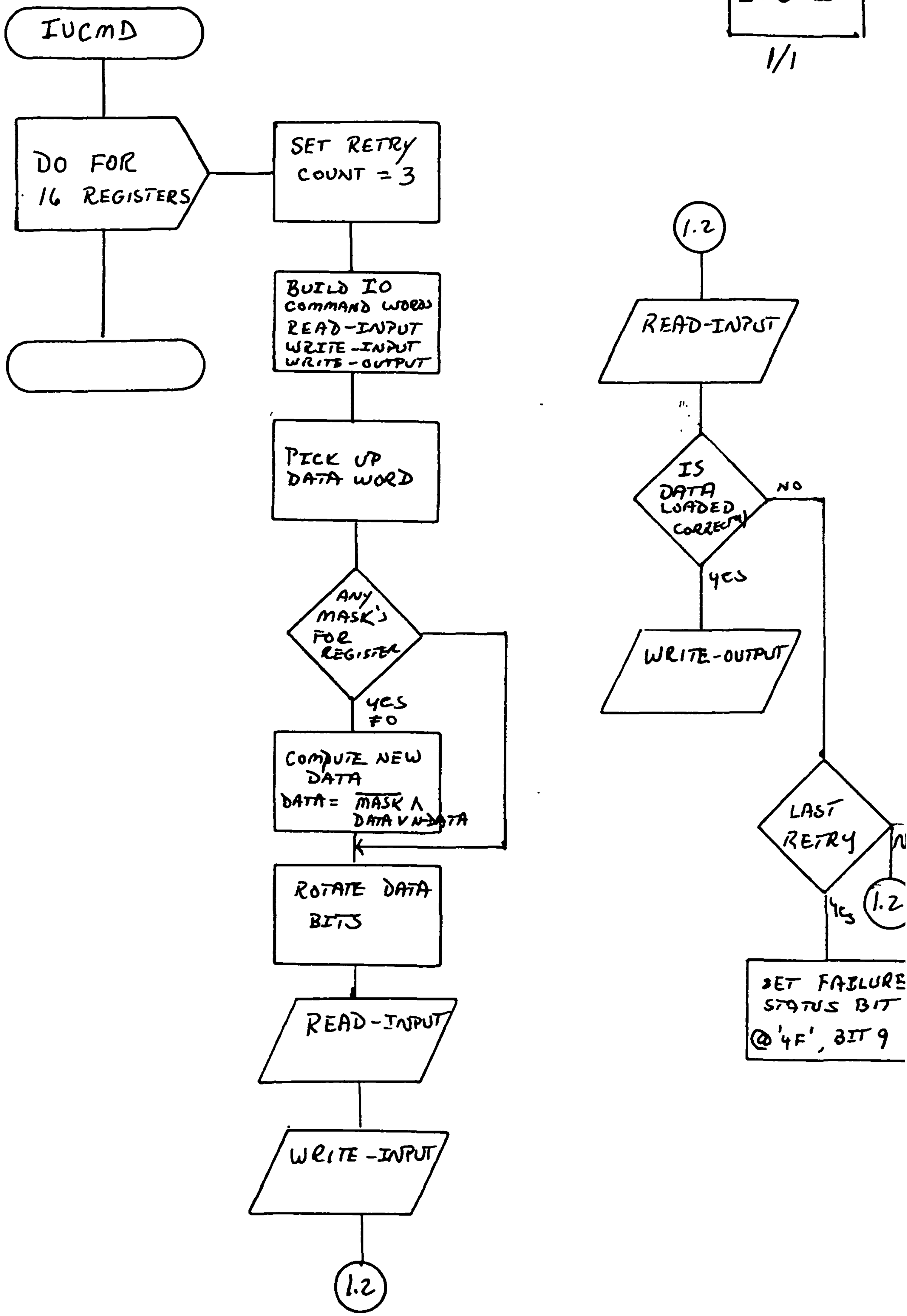
1/1



WRITE IU COMMAND REGISTERS

IUCMD

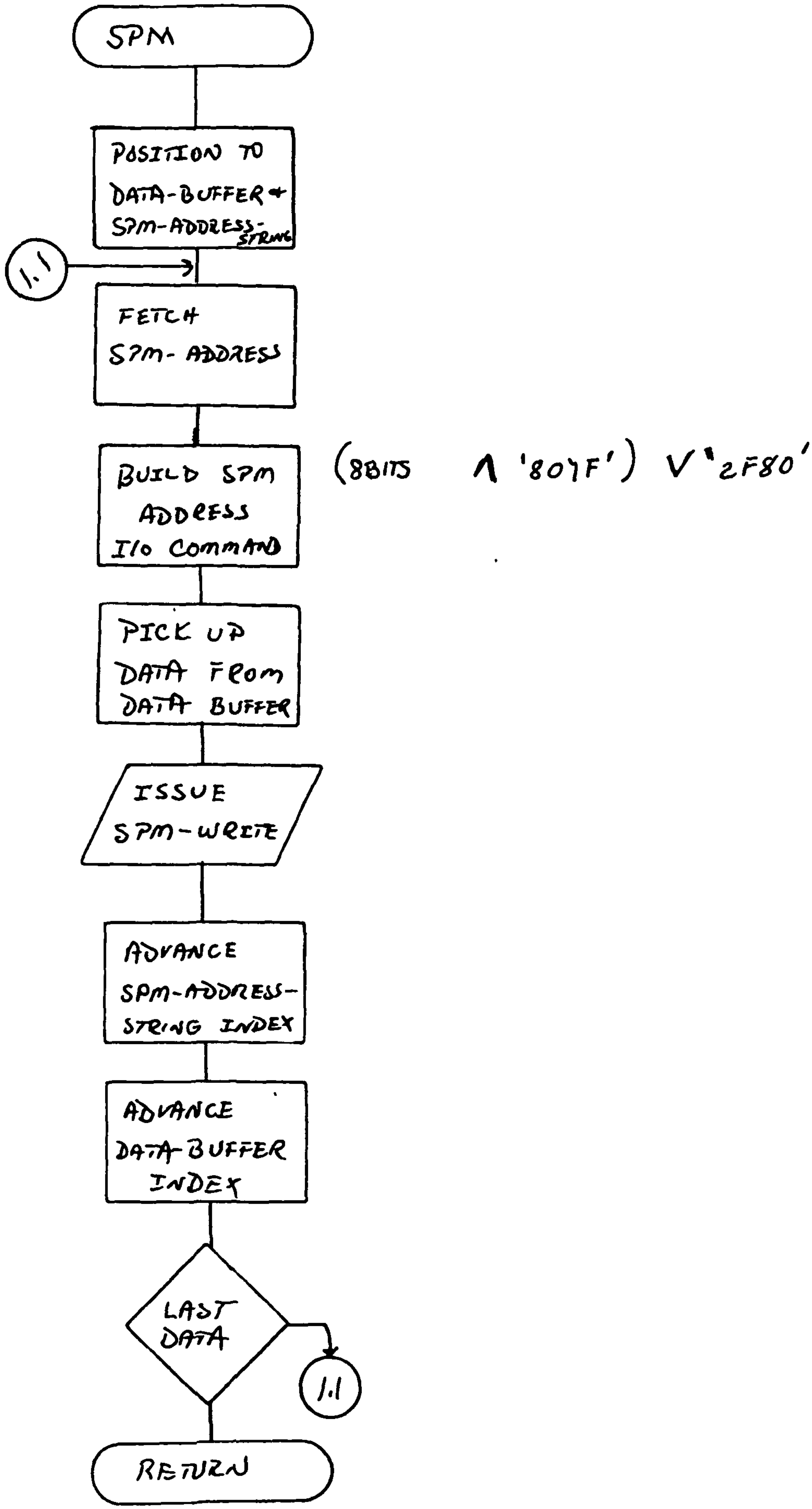
1/1



WRITE IU SPM UTILITY

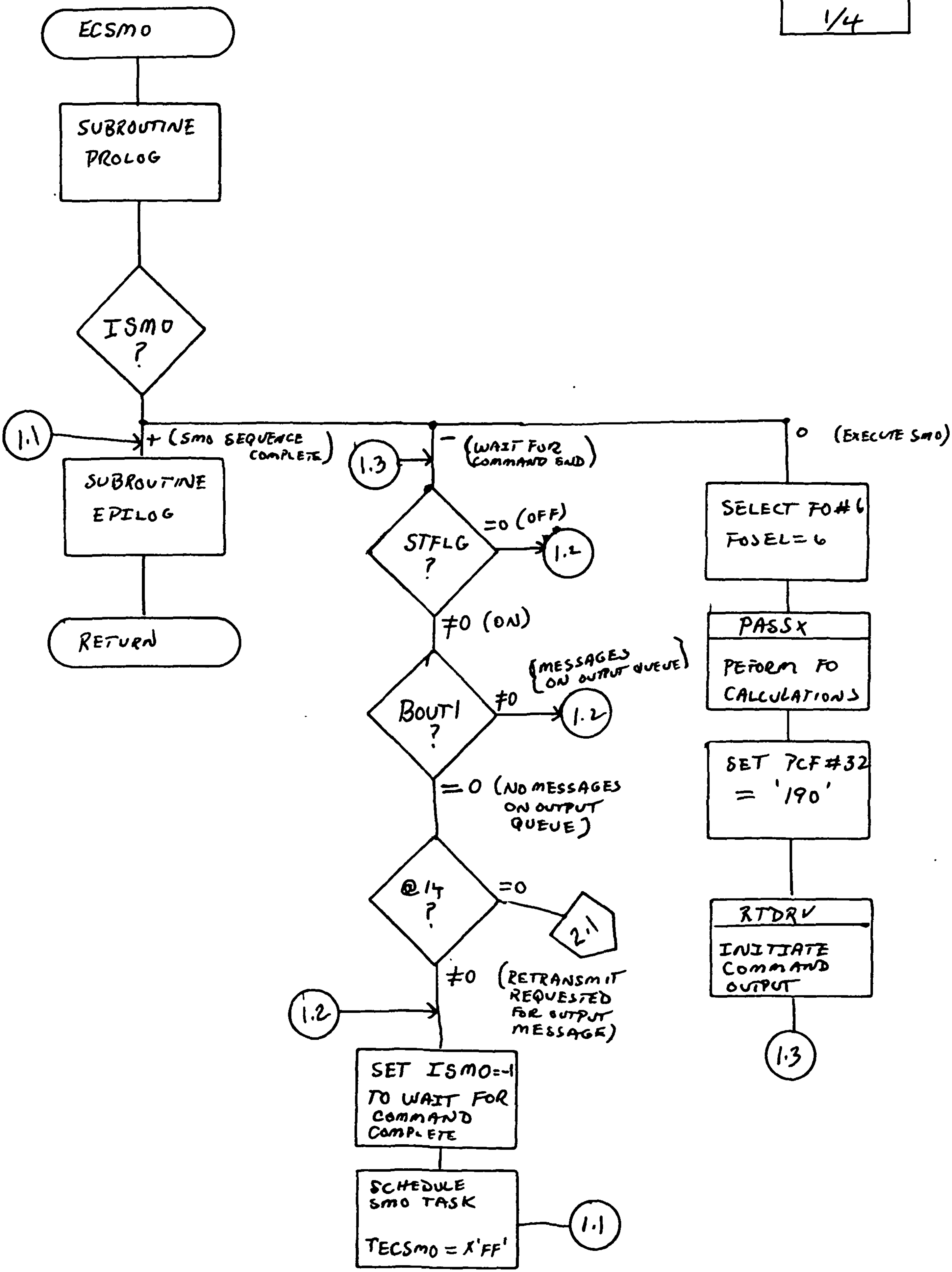
SPM

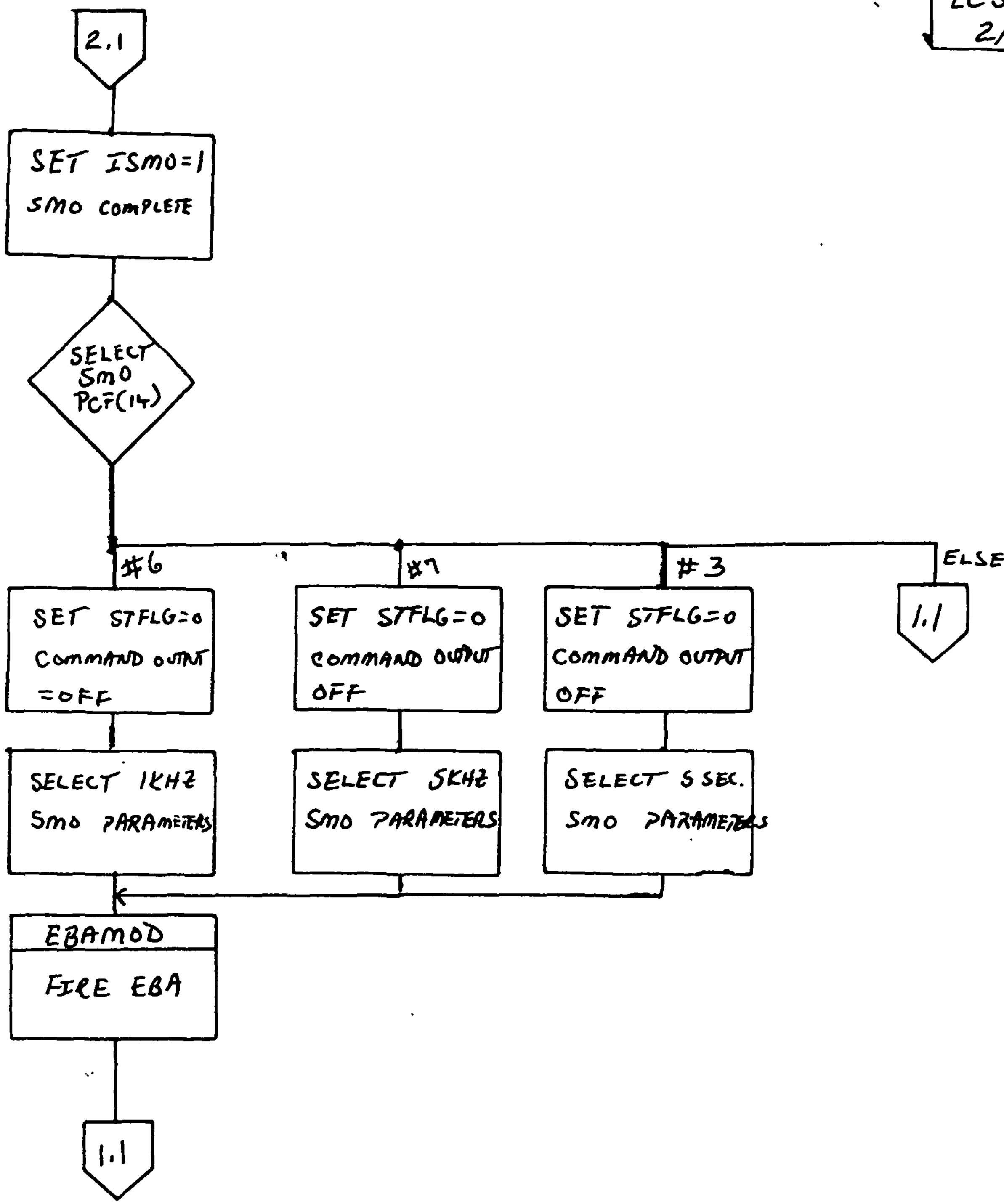
1/1

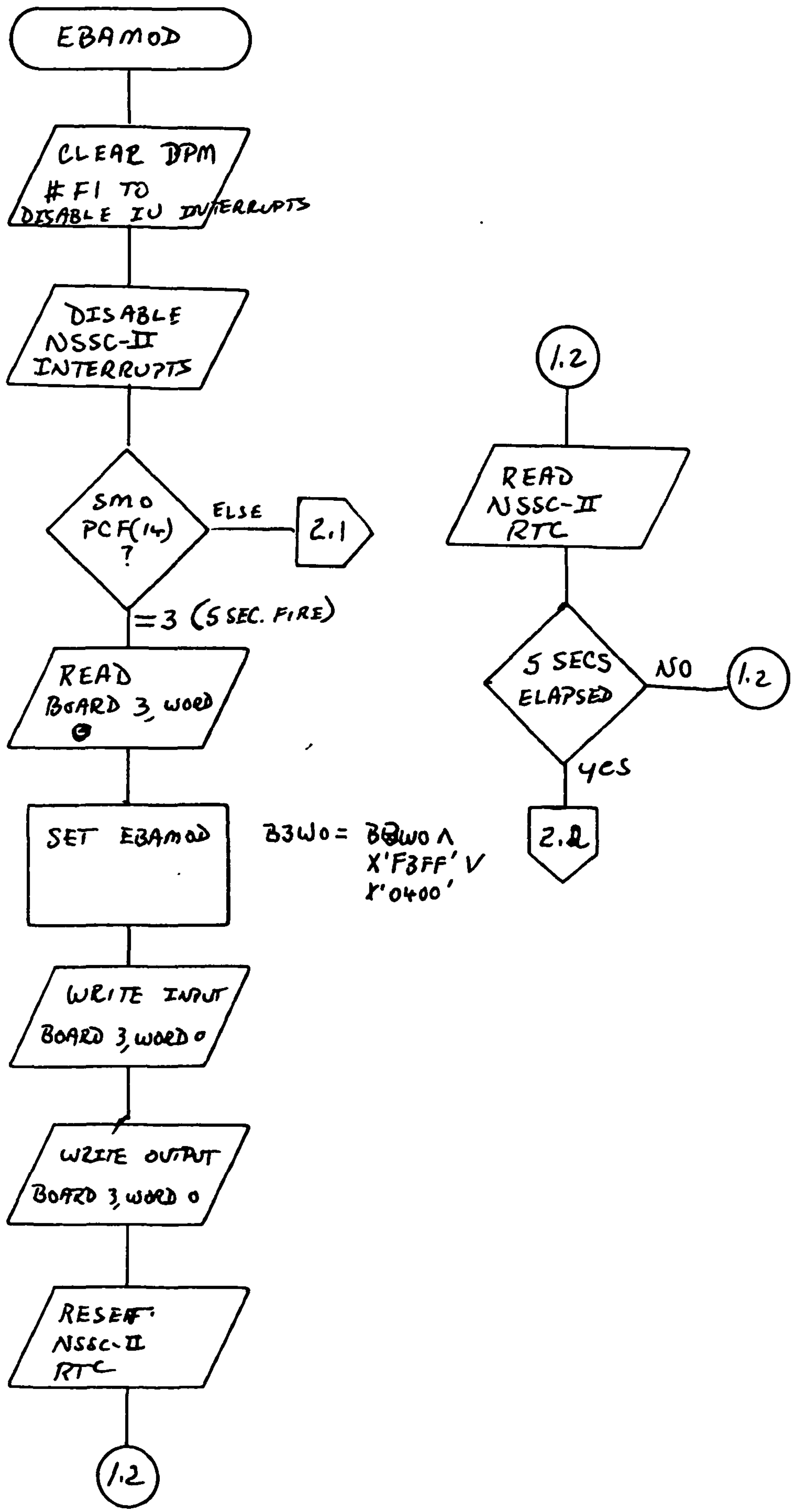


SMO EXECUTIVE

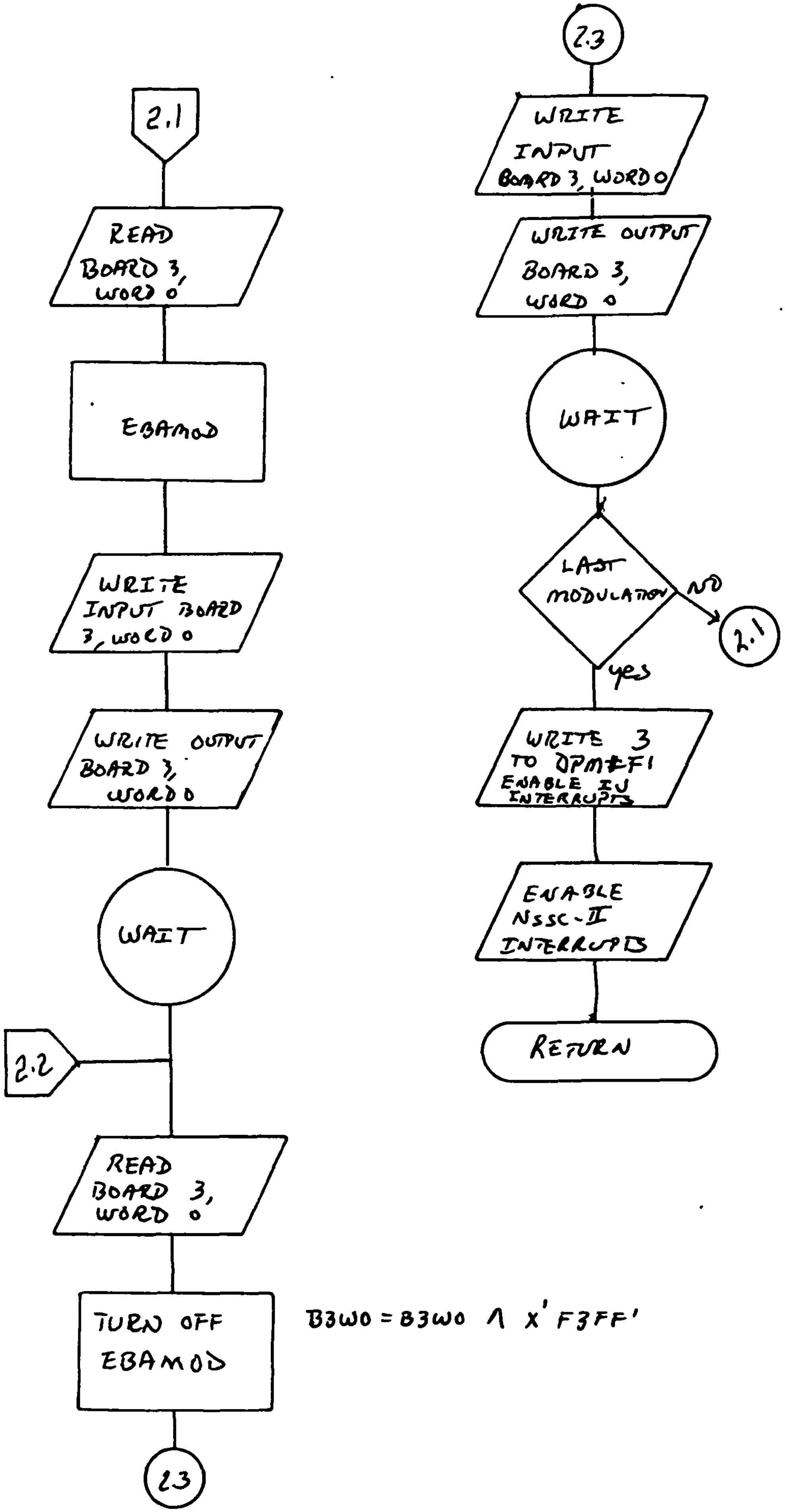
ECSMO
1/4




2.1
SET ISMO=1
SMO COMPLETE
SELECT SMO PCF(14)
#6
#7
#3
ELSE
1.1
SET STFLG=0
COMMAND OUTPUT =OFF
SET STFLG=0
COMMAND OUTPUT OFF
SET STFLG=0
COMMAND OUTPUT OFF
SELECT 1KHZ
SMO PARAMETERS
SELECT 5KHZ
SMO PARAMETERS
SELECT 5 SEC.
SMO PARAMETERS
EBAMOD
FIRE EBA
1.1


EBAMOD
CLEAR DPM
#F1 TO
DISABLE IU INTERRUPTS
DISABLE
NSSC-II
INTERRUPTS
SMO
PCF(14)
?
ELSE
2.1
=3 (5 SEC. FIRE)
READ
BOARD 3, WORD
0
SET EBAMOD
B3W0 = B3W0 ∧
X'FBFF' V
X'0400'
WRITE INPUT
BOARD 3, WORD 0
WRITE OUTPUT
BOARD 3, WORD 0
RESET
NSSC-II
RTC
1.2
1.2
READ
NSSC-II
RTC
5 SECS
ELAPSED
NO
1.2
YES
2.2

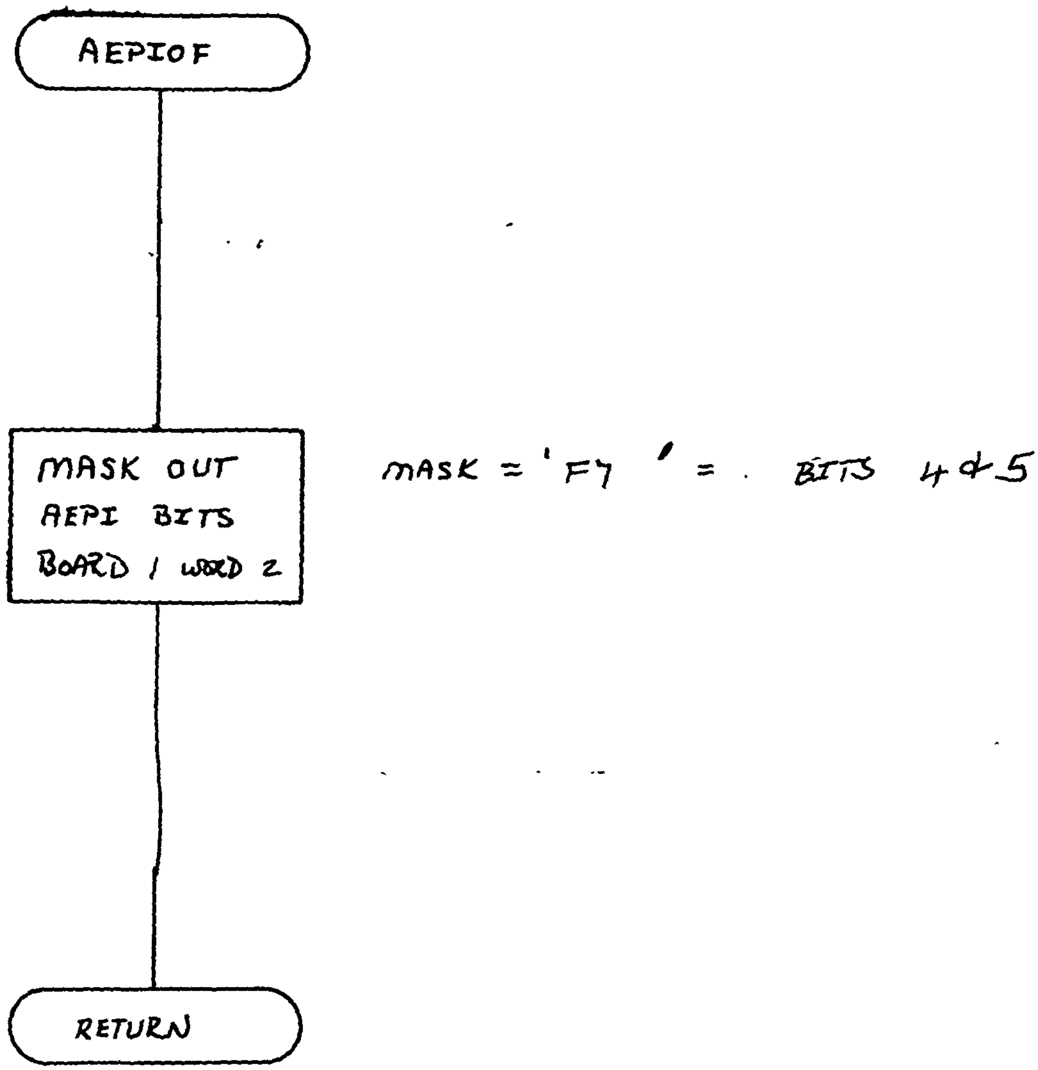
ECSMO
4/4


2.1
READ BOARD 3, WORD 0
EBAMOD
WRITE INPUT BOARD 3, WORD 0
WRITE OUTPUT BOARD 3, WORD 0
WAIT
2.2
READ BOARD 3, WORD 0
TURN OFF EBAMOD
B3W0 = B3W0 ∧ X'F3FF'
2.3
2.3
WRITE INPUT BOARD 3, WORD 0
WRITE OUTPUT BOARD 3, WORD 0
WAIT
LAST MODULATION
NO
2.1
YES
WRITE 3 TO DPM#F1 ENABLE IU INTERRUPTS
ENABLE NSSC-II INTERRUPTS
RETURN

AEPI OFF UTILITY

AEPIOF

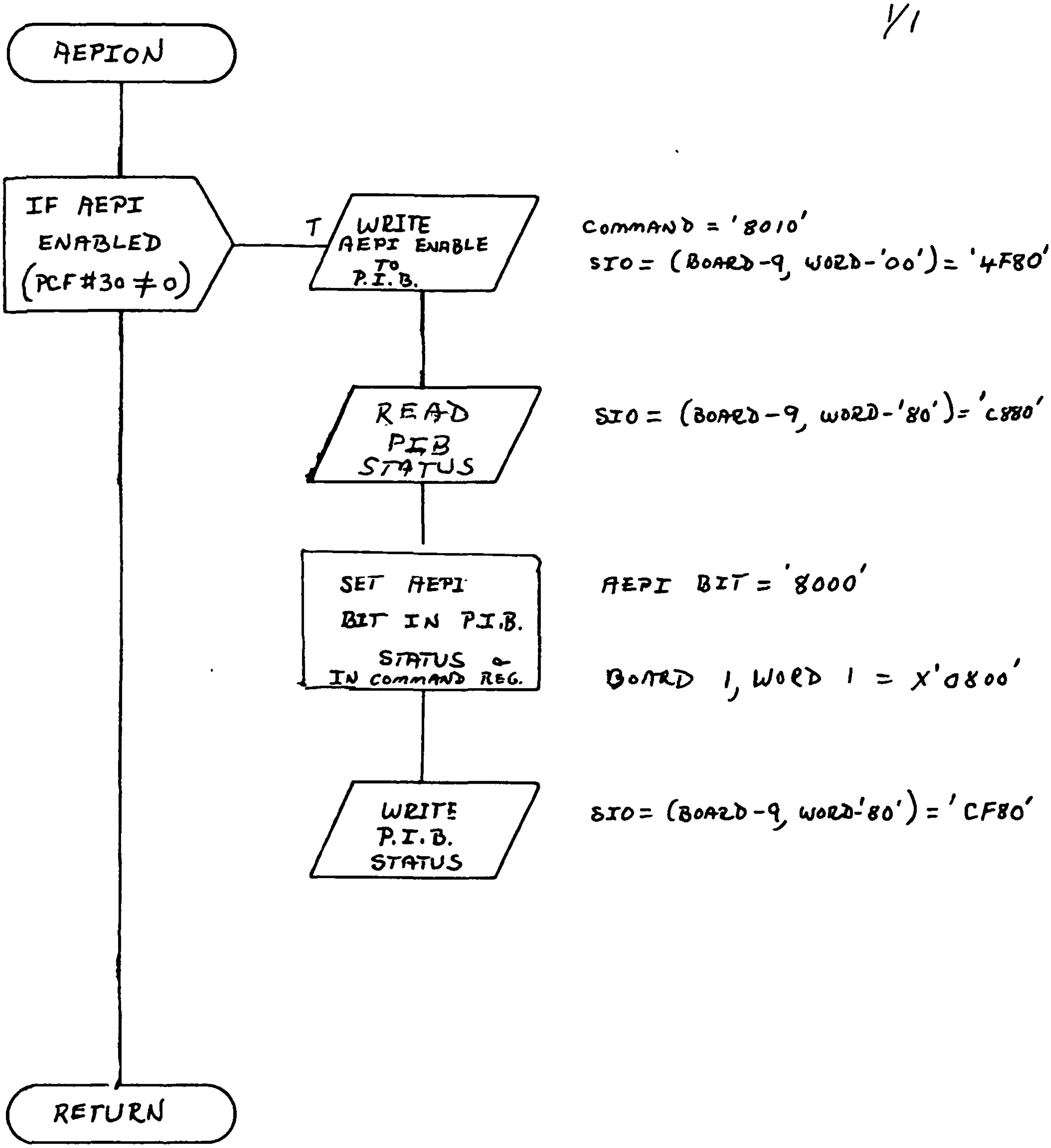
1/1



AEPI ON UTILITY

AEPION

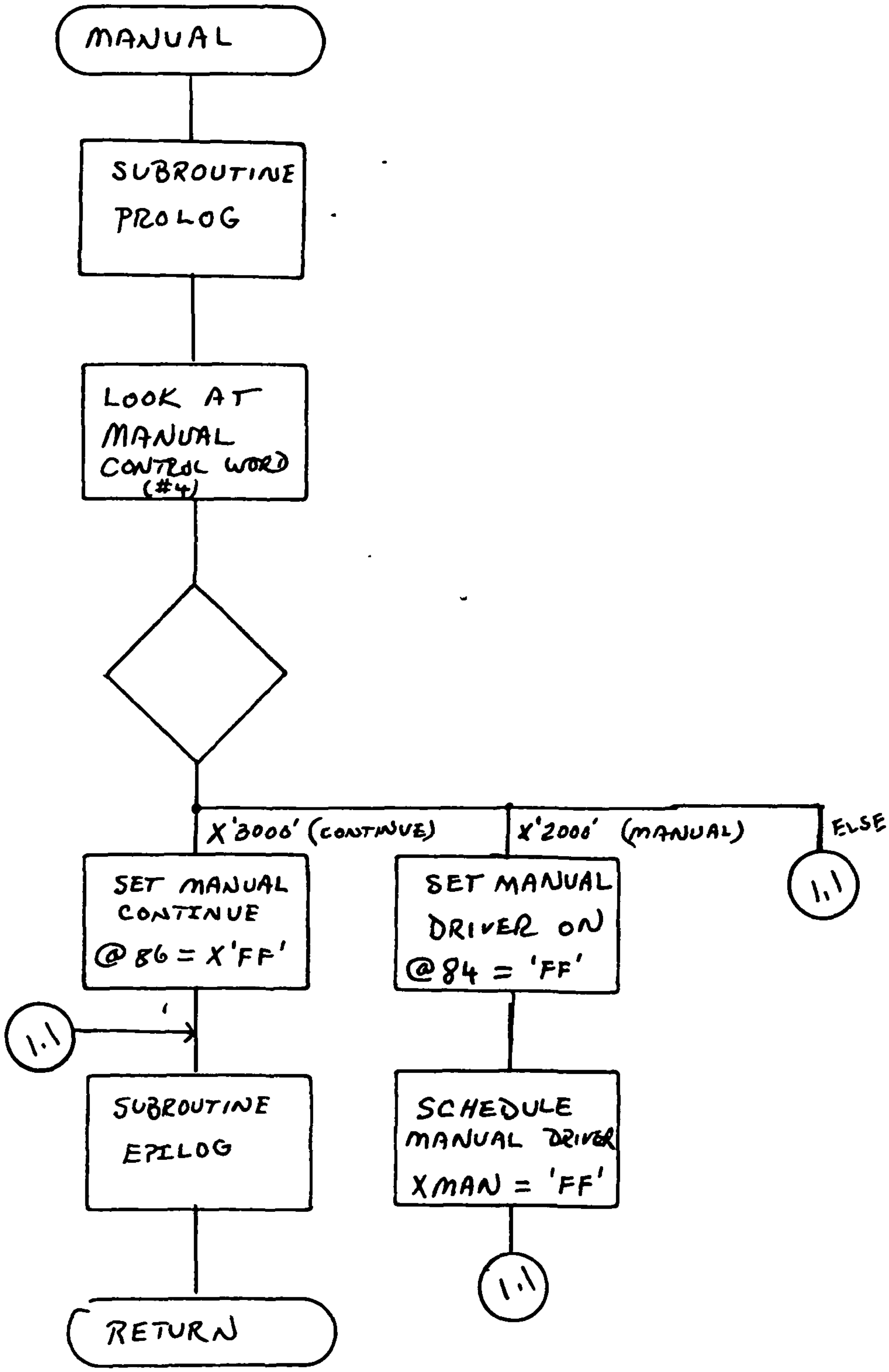
1/1

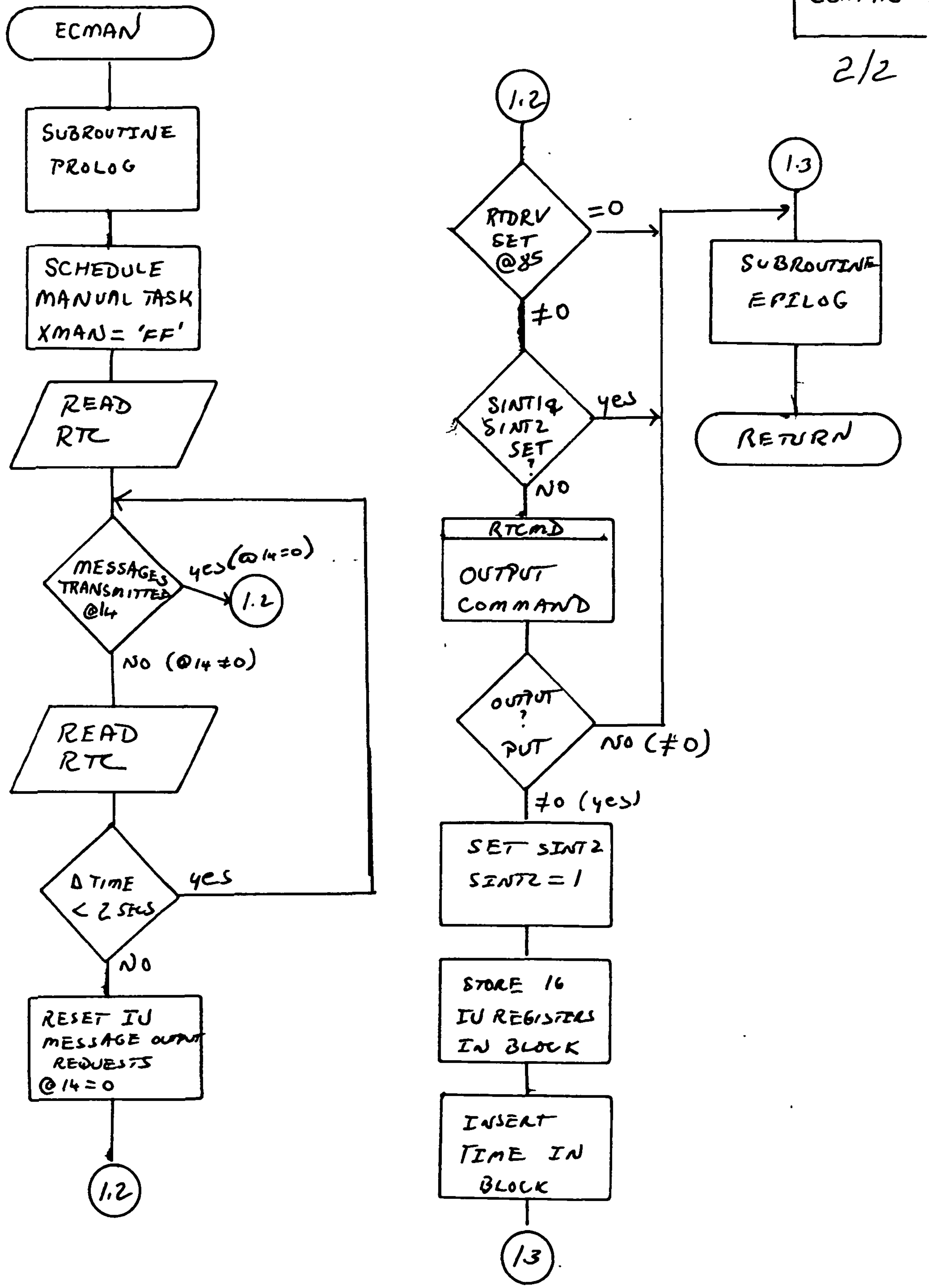


MANUAL FO EXECUTIVE

ECMAN

1/2

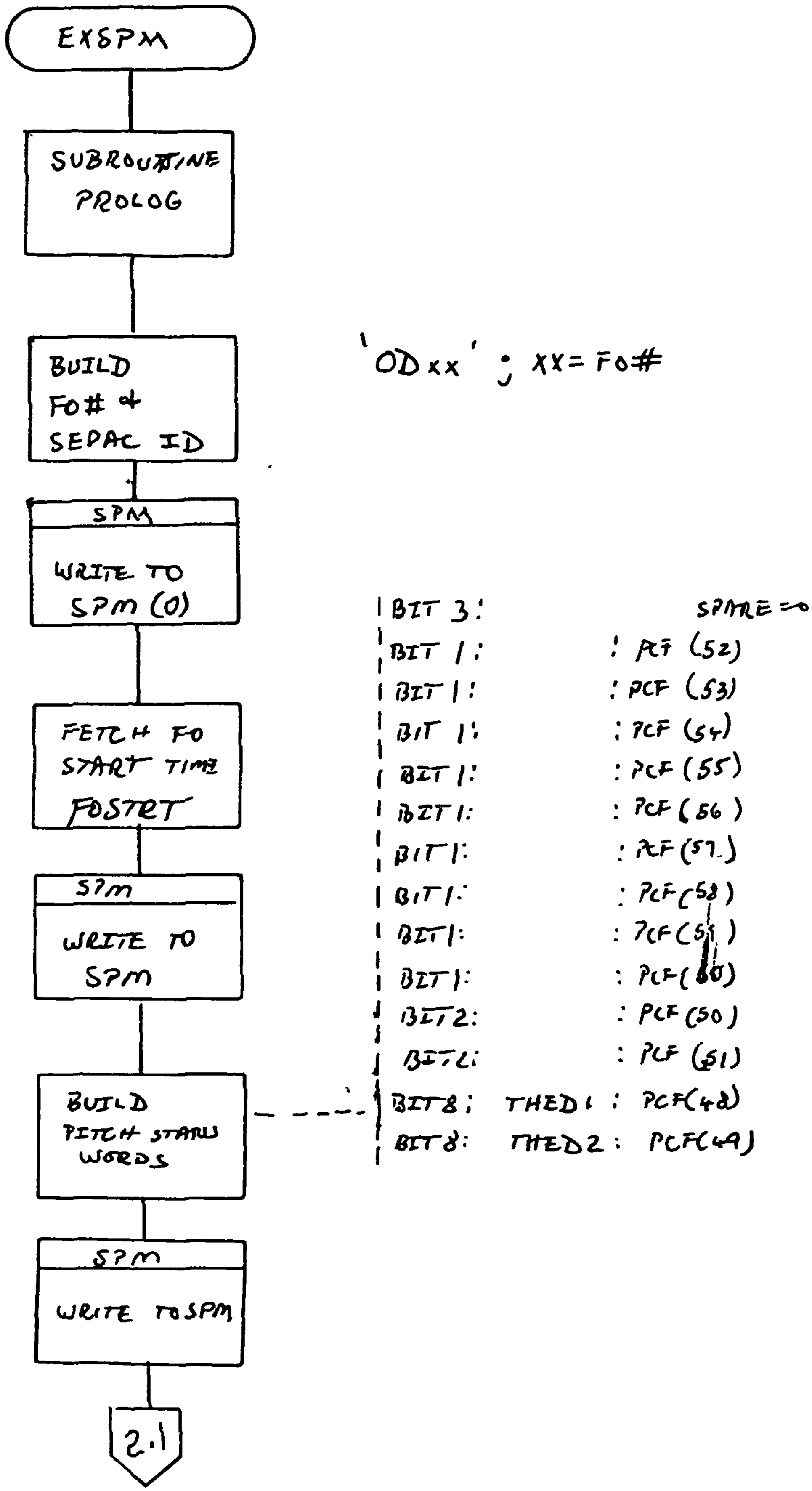


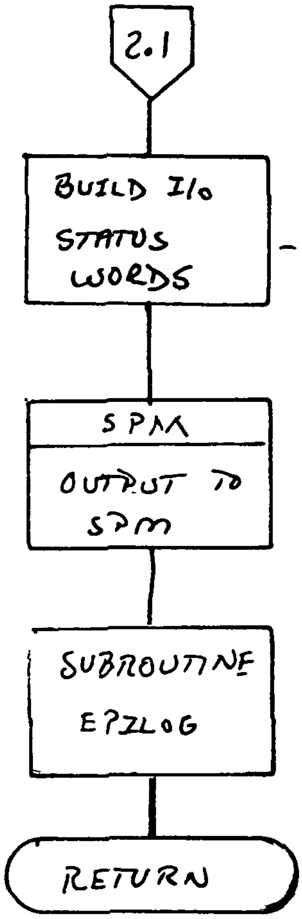

ECMAN
SUBROUTINE PROLOG
SCHEDULE MANUAL TASK XMAN= 'FF'
READ RTC
MESSAGES TRANSMITTED @14
yes (@14=0)
1.2
NO (@14≠0)
READ RTC
Δ TIME < 2 SECS
yes
NO
RESET IU MESSAGE OUTPUT REQUESTS @14=0
1.2
1.2
RTDRV SET @85
=0
≠0
SINT1 & SINT2 SET ?
yes
NO
RTCMD
OUTPUT COMMAND
OUTPUT ? PUT
NO (≠0)
≠0 (yes)
SET SINT2 SINT2=1
STORE 16 IU REGISTERS IN BLOCK
INSERT TIME IN BLOCK
1.3
1.3
SUBROUTINE EPILOG
RETURN

SPM EXECUTIVE

EXSPM

1/2

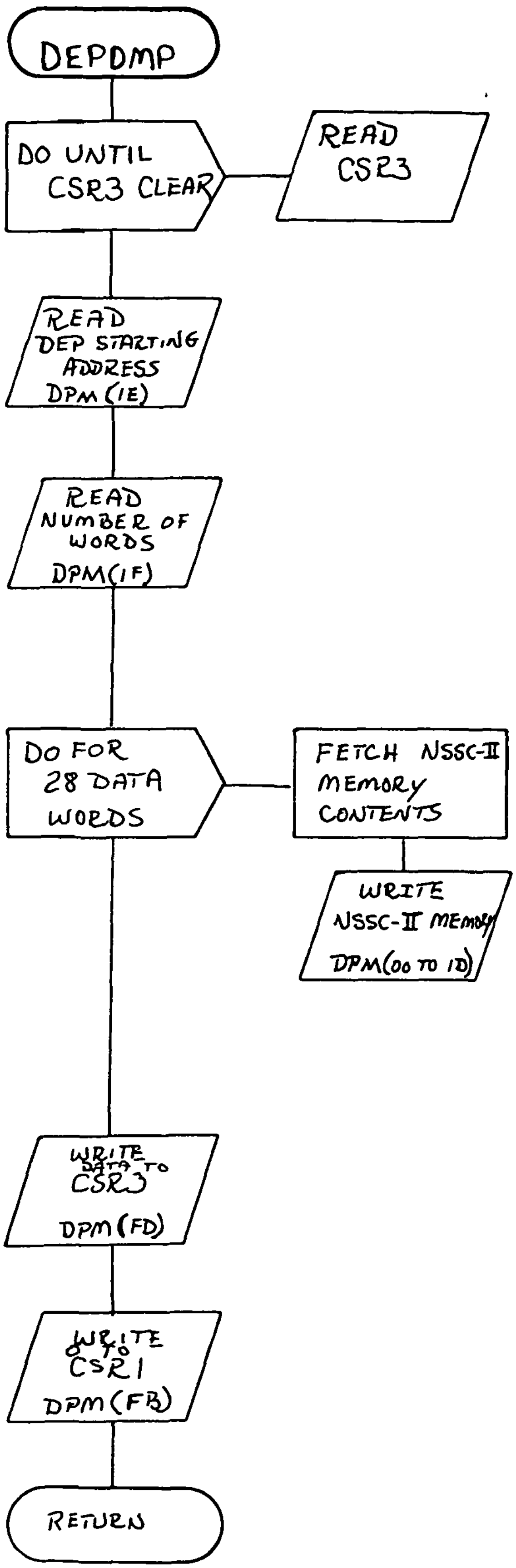




DATA: BIT(3): @4E
BIT(1): BUFF# 1 BUSY : @14
BIT(1): BUFF# 2 BUSY : @6
BIT(1): BOUT1
BIT(1): BOUT2
BIT(1): BOUT3
BIT(8): STATE
DATA+2: ORED HISTORY OF DATA : BIT(16)
DATA+4: BIT(8); TLHED(4)
BIT(8); TLHED(5)

DUMP DEP MEMORY

DEPDMP
1/1



SIO = (BOARD 7, WORD 'FD') = 'B8FD'
CSR3.BIT 0 = OUTPUT MESSAGE REQUEST

SIO = (BOARD 7, WORD '1E') = '389E'
DEP STARTING ADDRESS @ DPM('1E')

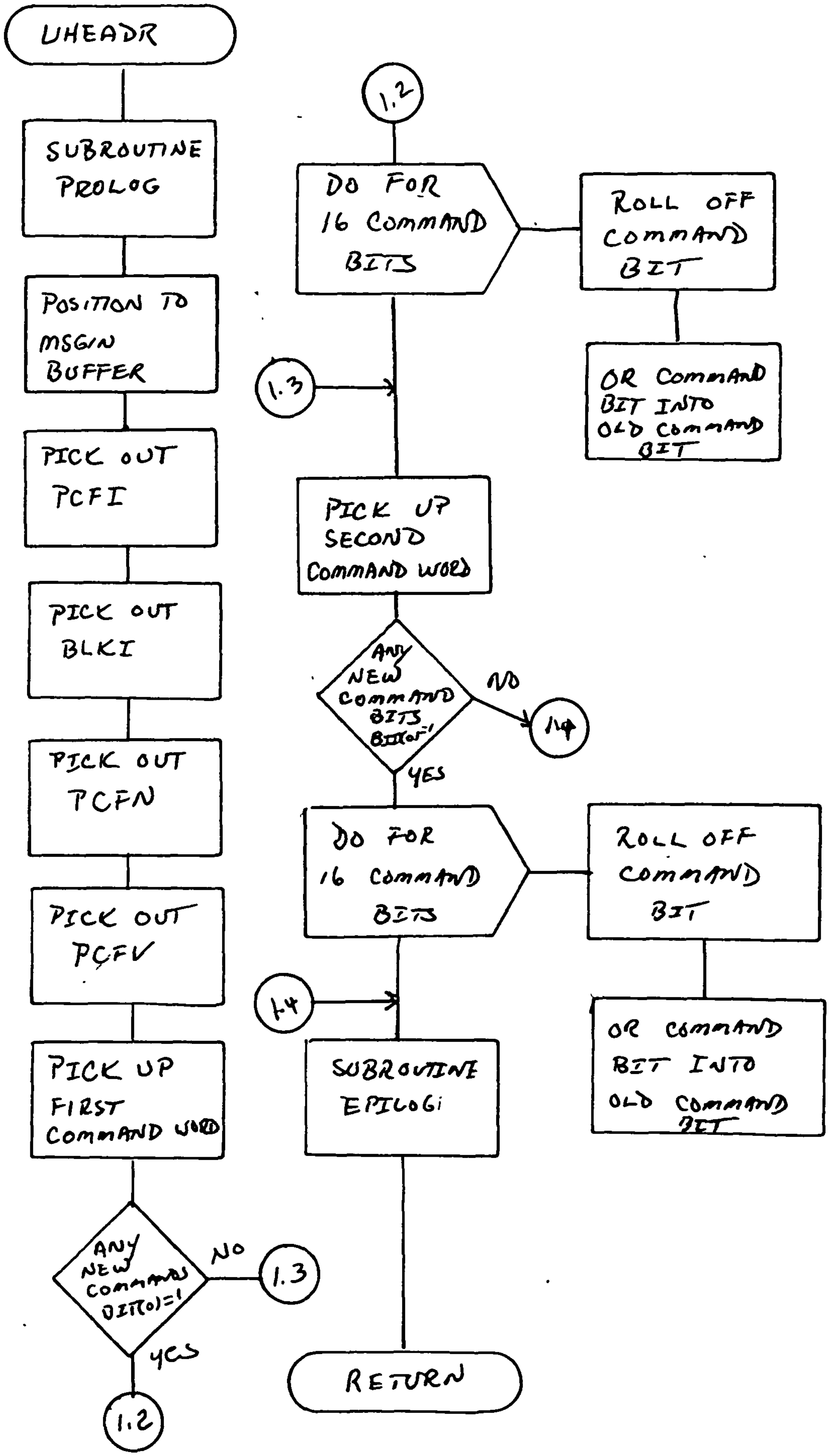
SIO = (BOARD 7, WORD '1F') = '389F'
NUMBER OF WORDS @ DPM ('1F')

DPM ('00' TO '1D') = DEP DUMP AREA

SIO = (BOARD 7, WORD 'FD') = 'BFFD'
DATA = 1000 0101 000XXXXX B
BIT 0 = OUTPUT MESSAGE REQUEST
BIT 5 = DEP MEMORY DUMP
BIT 7 = OUTPUT BUFFER #1
BITS 11 TO 15 = MESSAGE LENGTH

SIO = (BOARD 7, WORD 'FB') = 'BFFB'

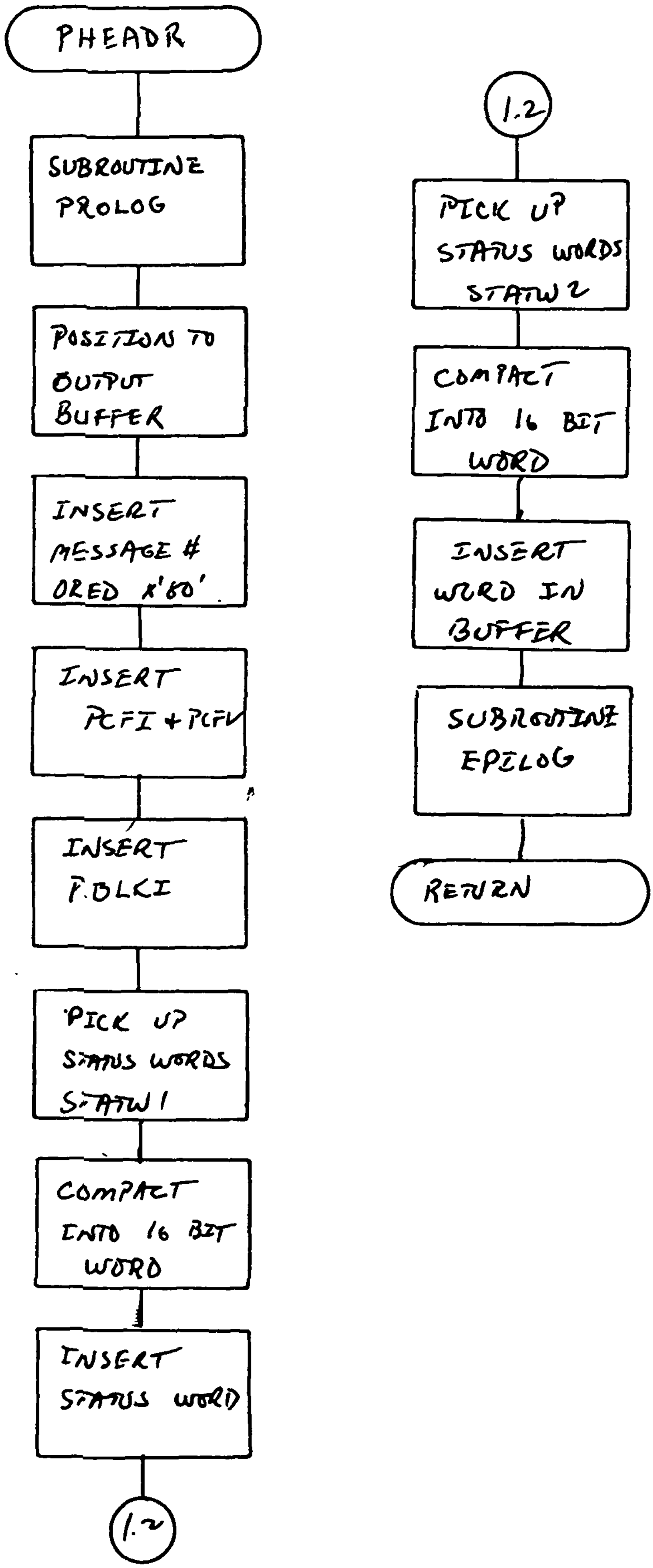
UNPACK MESSAGE HEADER



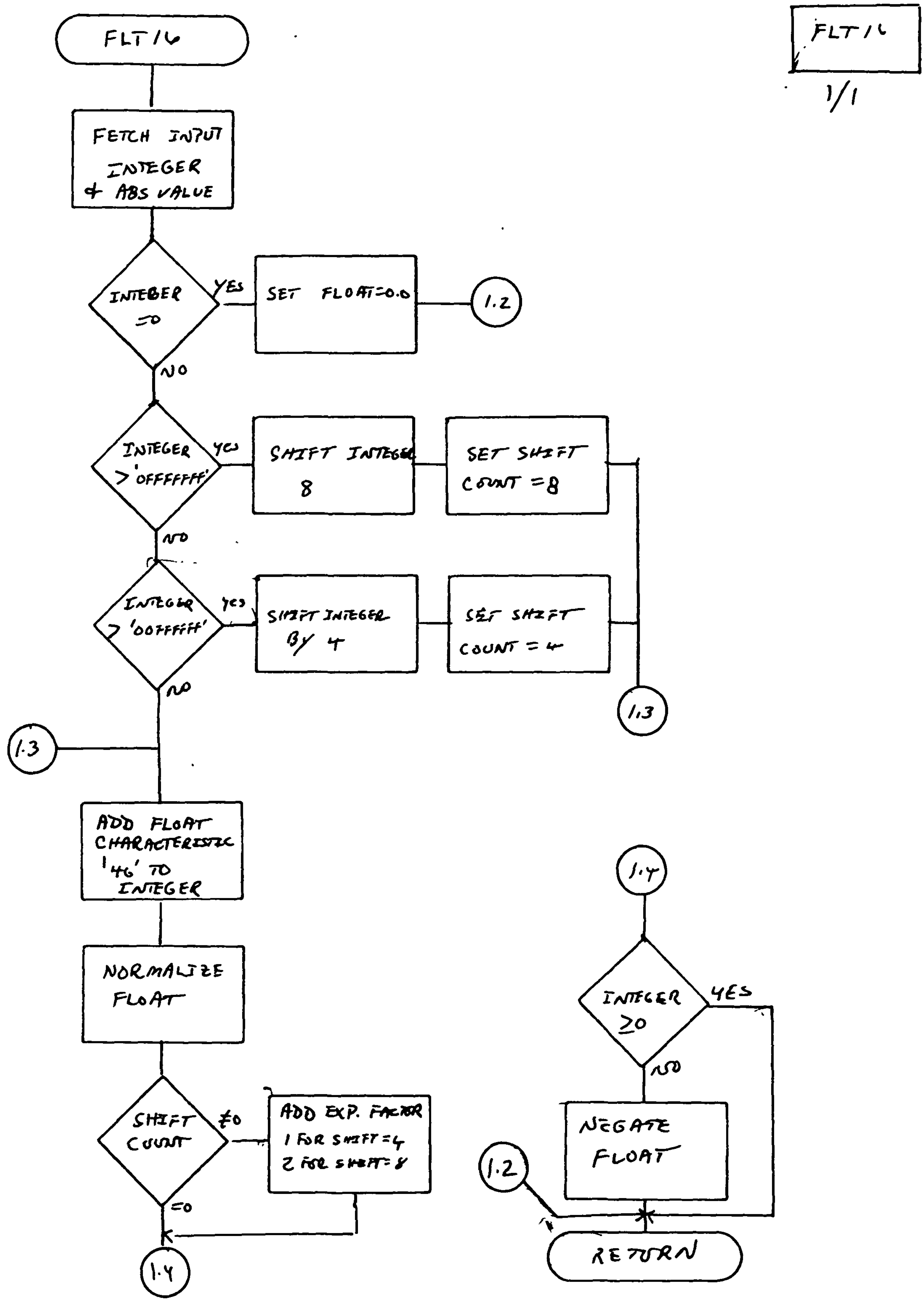
PACK MESSAGE HEADER

PHEADR

1/1



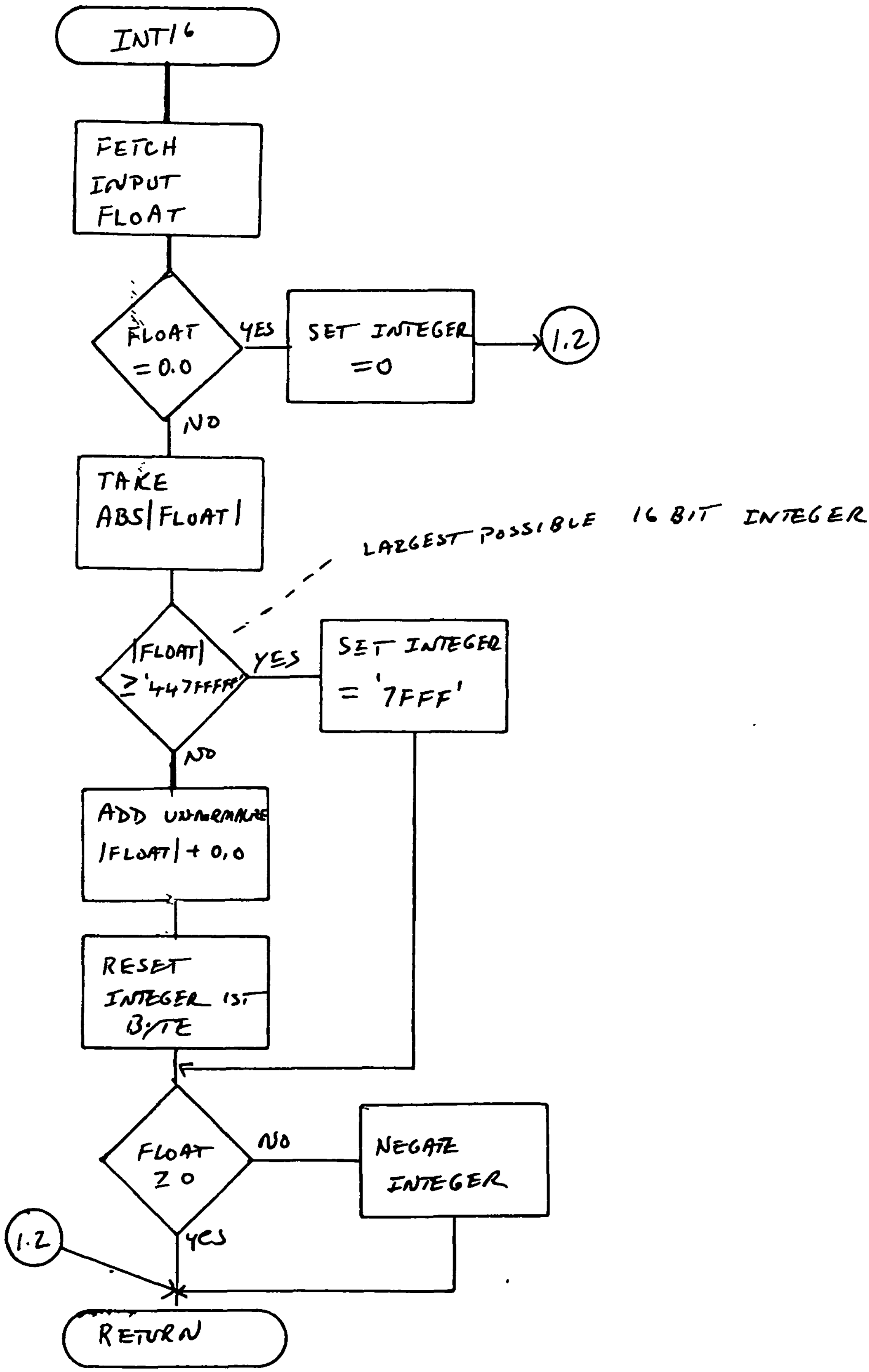
INTEGER TO FLOAT UTILITY



FLOAT TO INTEGER UTILITY

INT16

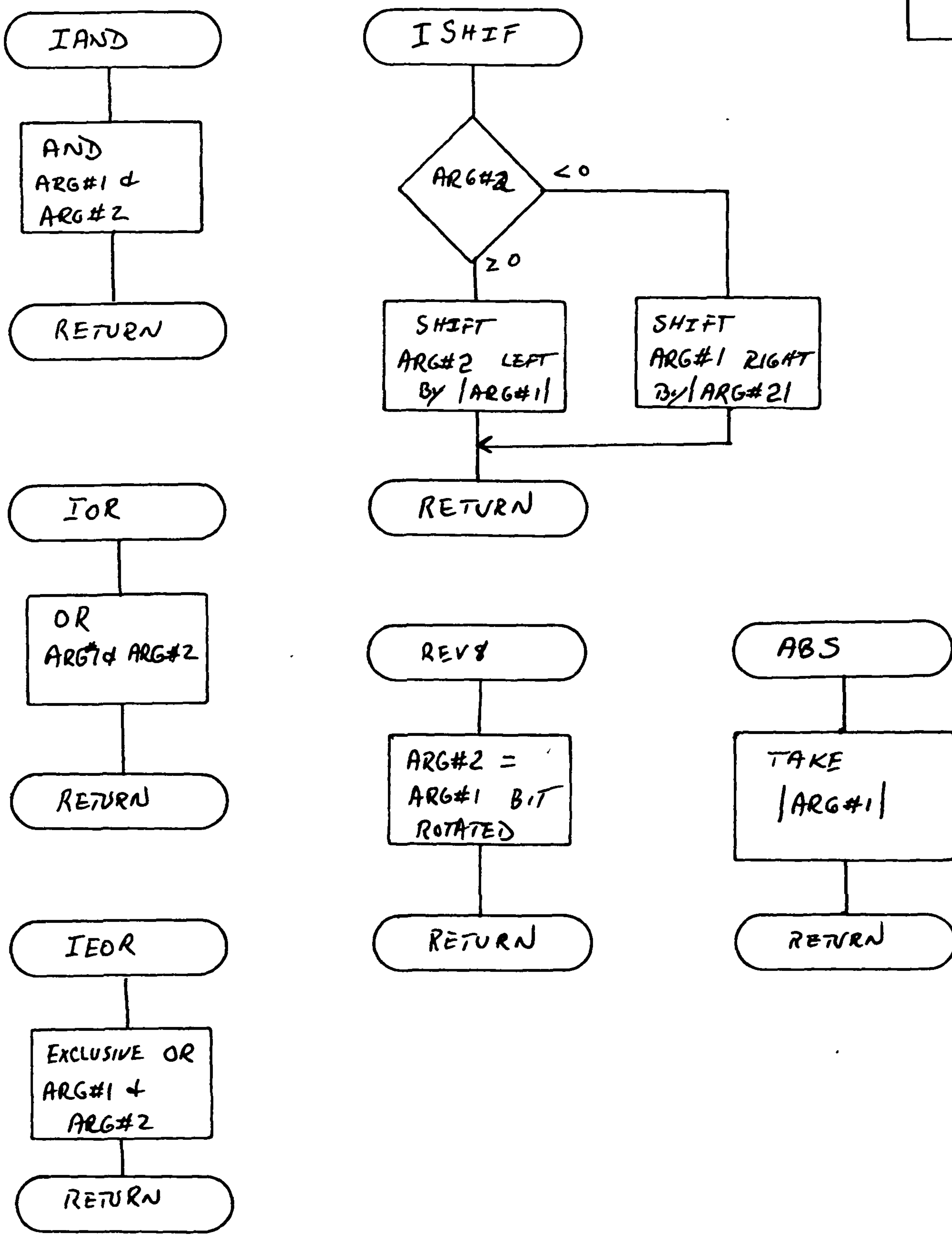
1/1



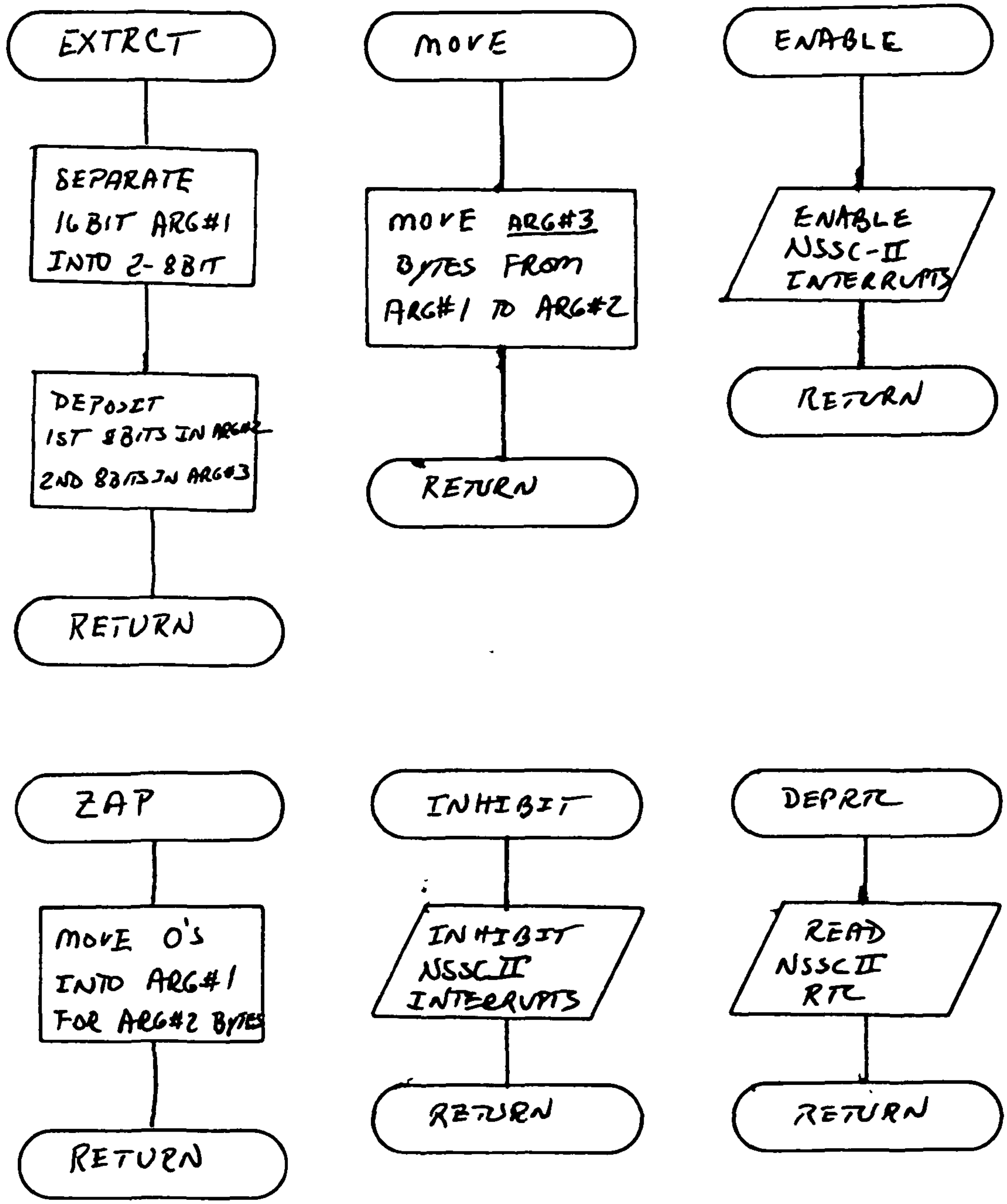
BOOLEAN UTILITY FUNCTIONS

BOOLIL

1/2

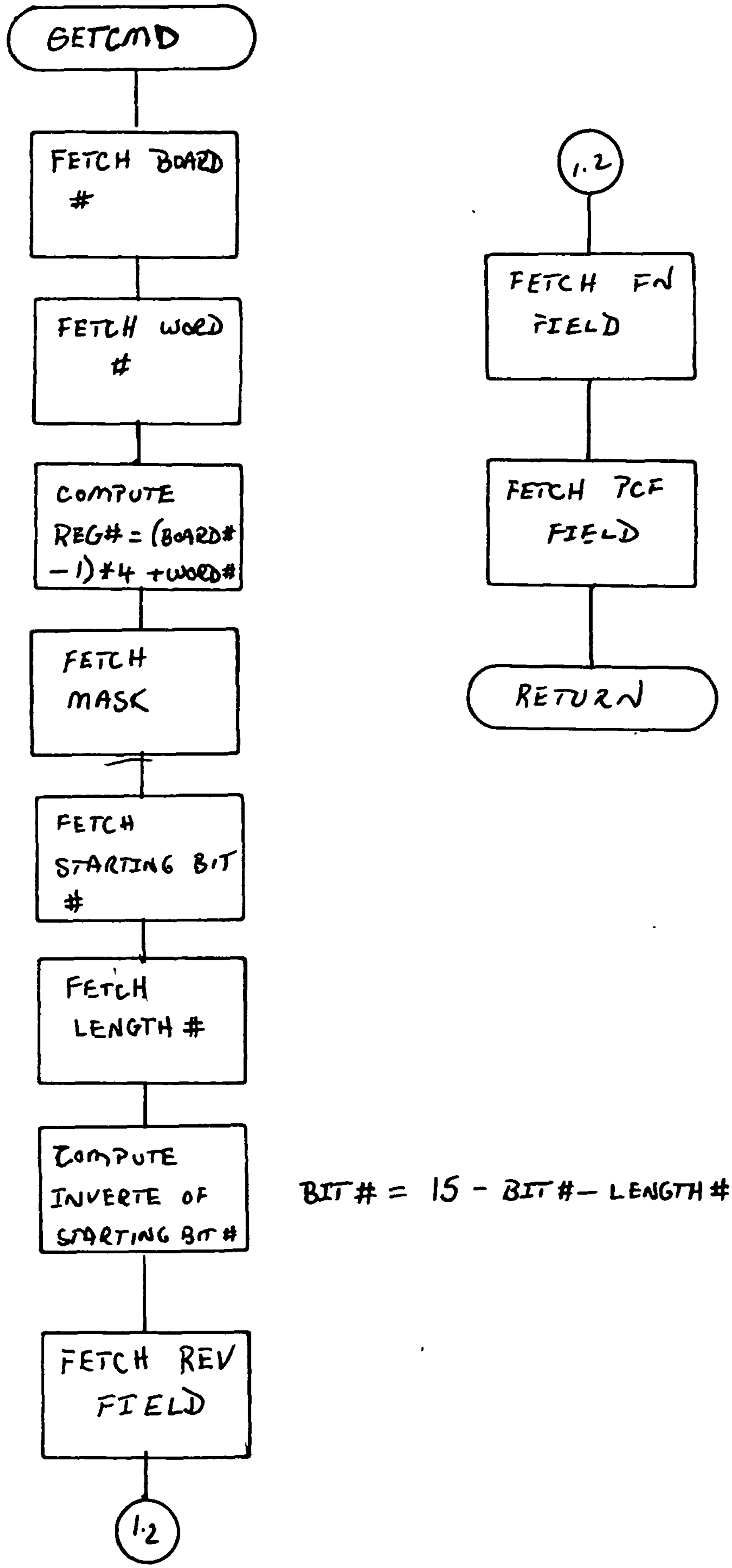


BOOL16

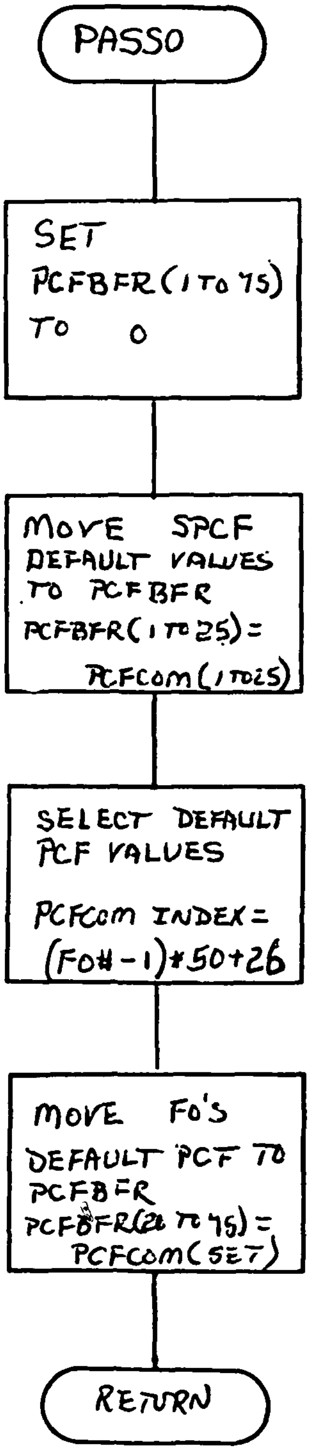

EXTRCT
SEPARATE 16BIT ARG#1 INTO 2-8BIT
DEPOSIT 1ST 8BITS IN ARG#2 2ND 8BITS IN ARG#3
RETURN
MOVE
MOVE ARG#3 BYTES FROM ARG#1 TO ARG#2
RETURN
ENABLE
ENABLE NSSC-II INTERRUPTS
RETURN
ZAP
MOVE 0'S INTO ARG#1 FOR ARG#2 BYTES
RETURN
INHIBIT
INHIBIT NSSC II INTERRUPTS
RETURN
DEPRTC
READ NSSC II RTC
RETURN

EXTRACT CMDBUF DATA FIELDS

GETCMD
1/1



PASS 0 - PCF INITIALIZATION



PCFBFR(1 TO 75) ARE ACTIVE PCF VALUES.

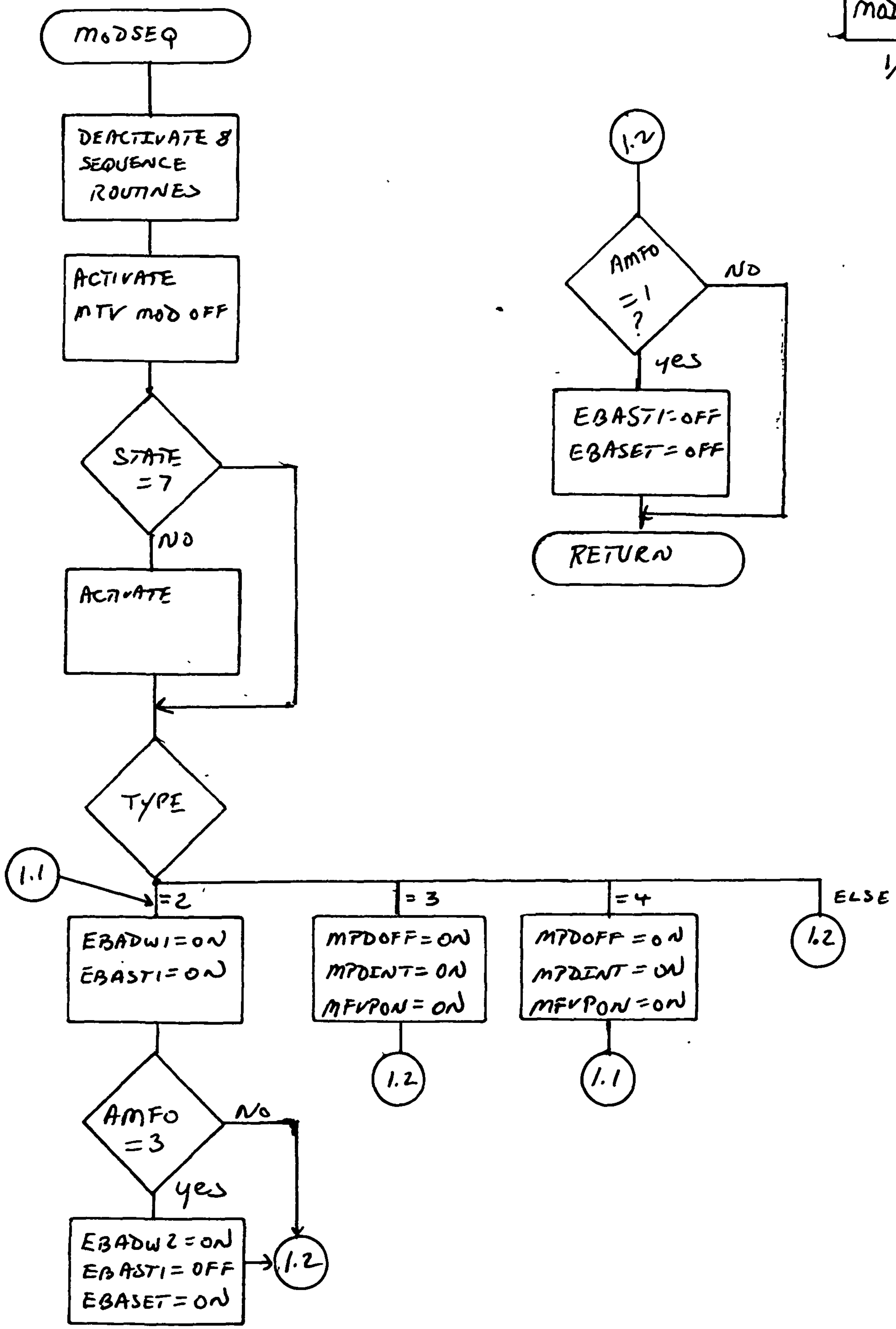
PCFBFR(1 TO 25) = ACTIVE SPCF VALUES
PCFCOM(1 TO 25) = DEFAULT SPCF VALUES

PCFCOM (1 TO 25) = DEFAULT SPCF
PCFCOM (26 TO 75) = FO#1 DEFAULT PCF
PCFCOM (76 TO 125) = FO#2 DEFAULT PCF
• • • • • •
PCFCOM (976 TO 1025) = FO#20 DEFAULT PCF

BUILD MODIFY OFF SEQUENCE

MODSEQ

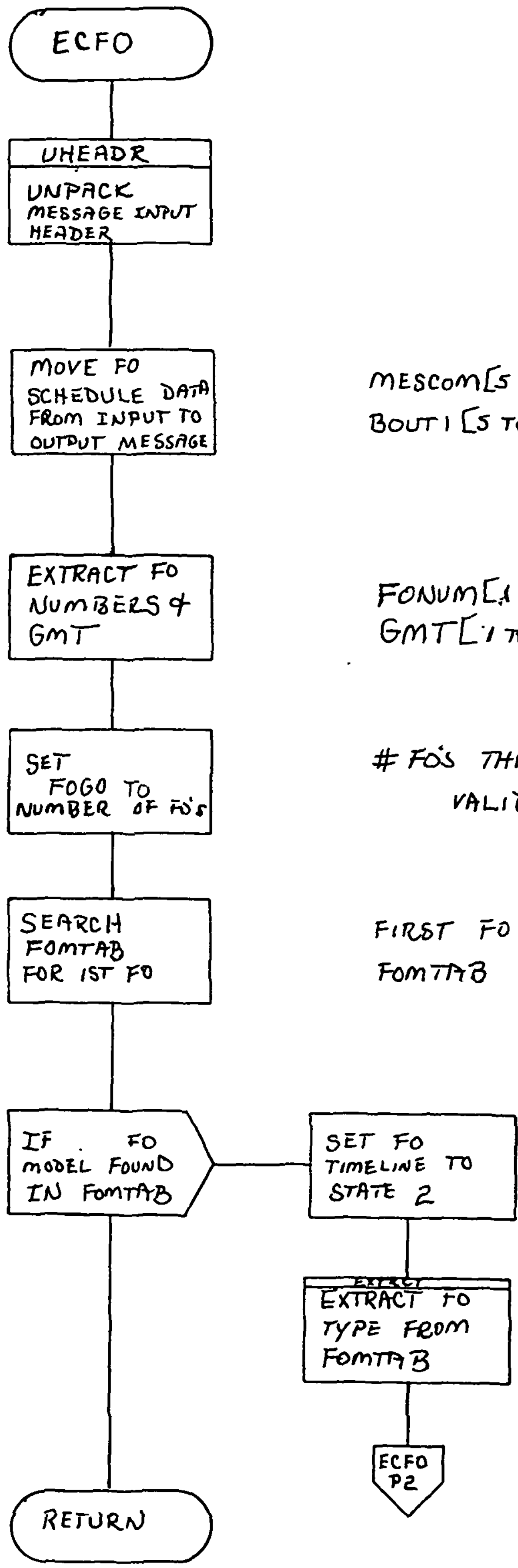
1/1



SCHEDULE FO EXECUTIVE

ECFO

1/2



MESCOM[5 TO 20] = INPUT MESSAGE

BOUT1 [5 TO 20] = OUTPUT MESSAGE BLOCK #1

FONUM[1 TO 4] = FO MODEL NUMBERS

GMT[1 TO 3, 1 TO 4] = FO GMT'S

FO'S THIS SCHEDULE REQUEST

VALID FO NUMBERS ARE [1 TO 20]

FIRST FO MODEL NUMBER = FONUM(1)

FOMTAB ENTRY = FAxxH WHERE XX= FONUM(1)

STATE 2 = FO PREP START

ECFO P2

MARK FOMTAB INDEX MENIND

EXTRCT
EXTRACT FIRST FO ACTIVITY FROM FOMTAB

IF FIRST FO ACTIVITY IS T=0

SET FO TIMELINE TO STATE 5

F2xxH = FOMTAB ACTIVITY OF T=0
STATE 5 = 'T=0' SCHEDULE

INITIALIZE MESSAGE PARAMETERS

BLOCK ID = PBLKI = 9
PCF INDEX = PPCFI = 0
EC MESSAGE = PMSGN = 0

SET OUTPUT MESSAGE #1
SINT
SINTI=1

OUTPUT MESSAGE #1 TO BE TRANSMITTED BY MSGHAN AT NEXT AVAILABLE TIME.

DASSO
INITIALIZE FO'S PCF

SET FO ISO DEPENDENT ROUTINE
ROUTIX(1)

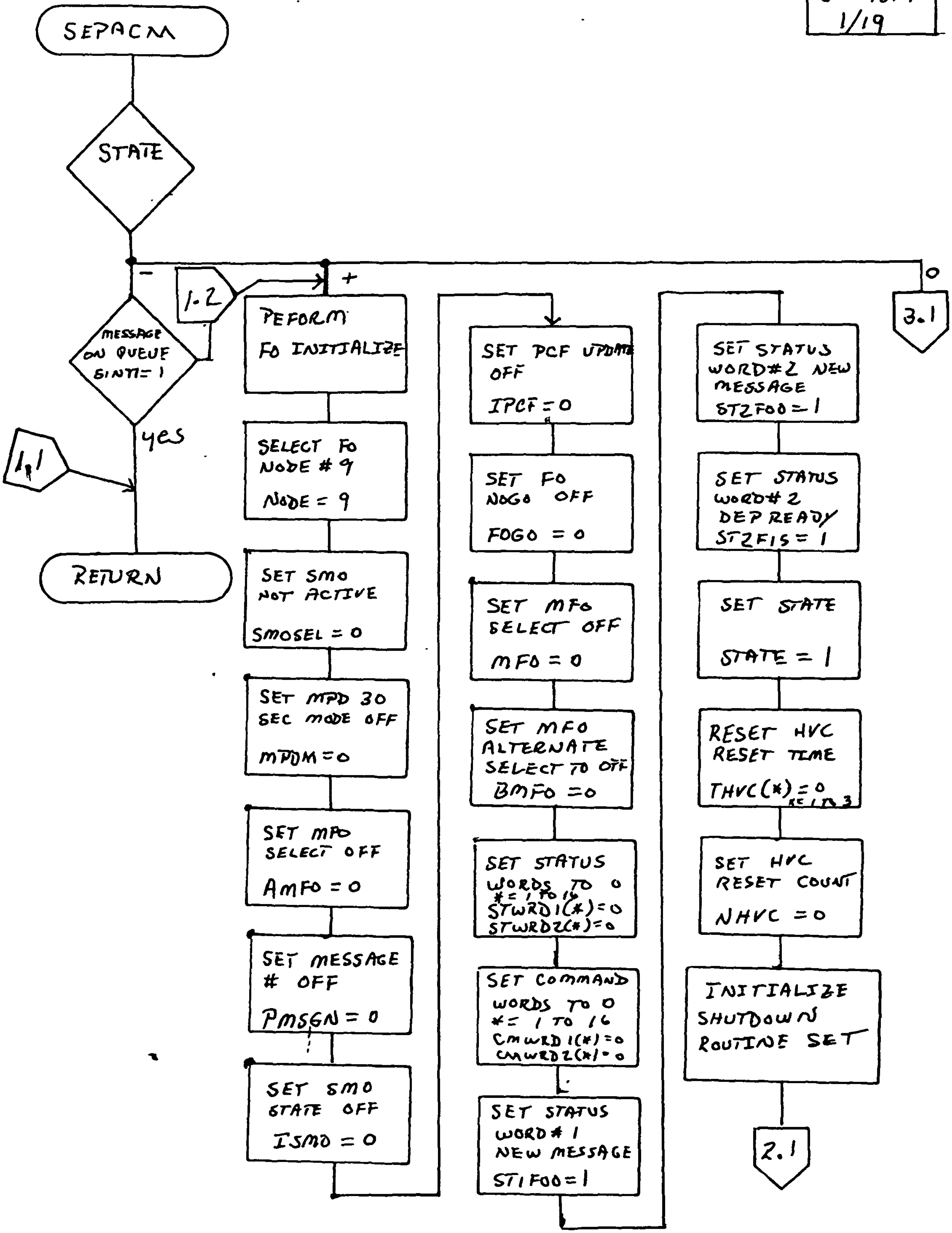
FO ISO DEPENDENT ROUTINE COMPUTED AS FONUM(1) + 165

SET MFO TO # OF FO'S

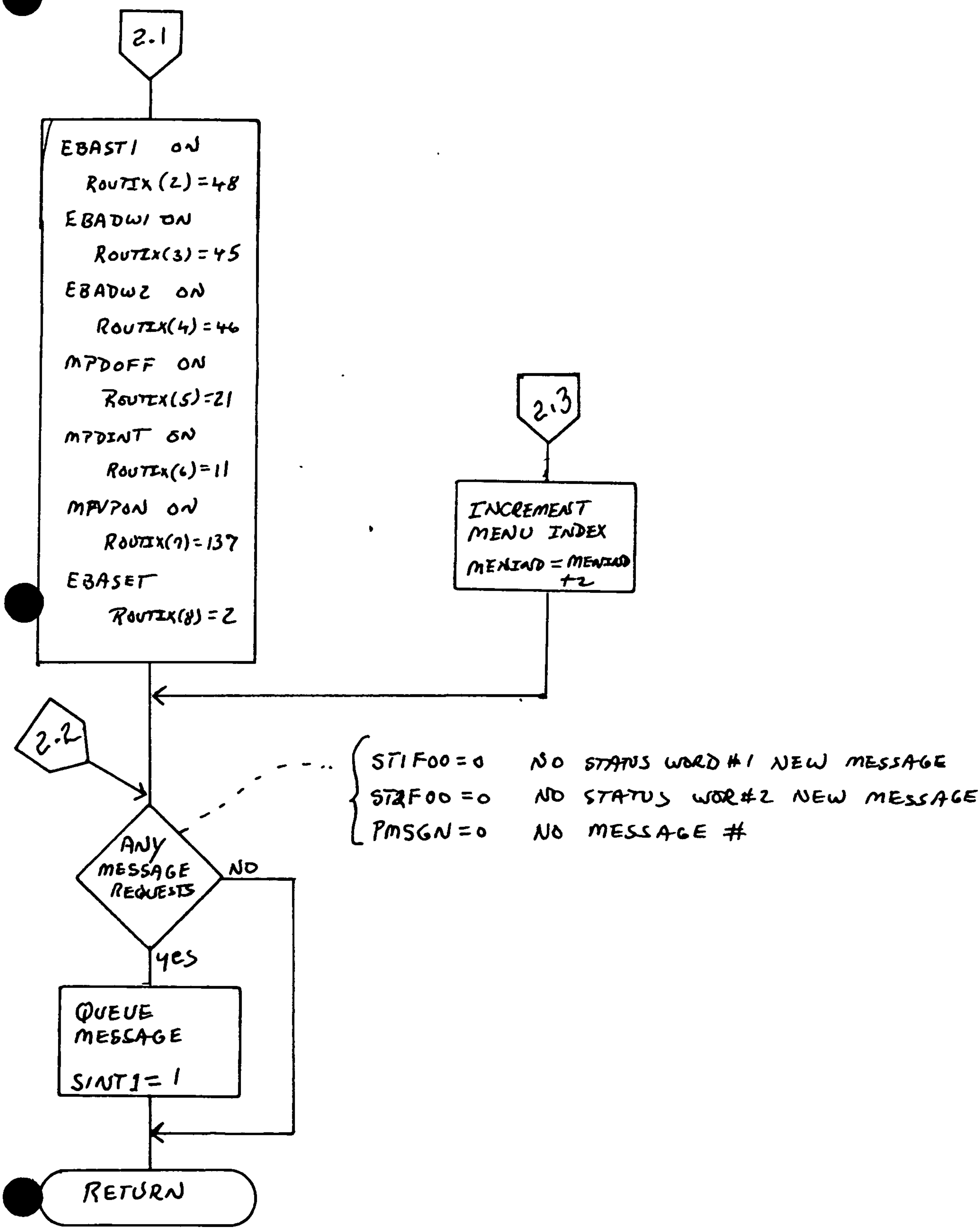
RETURN

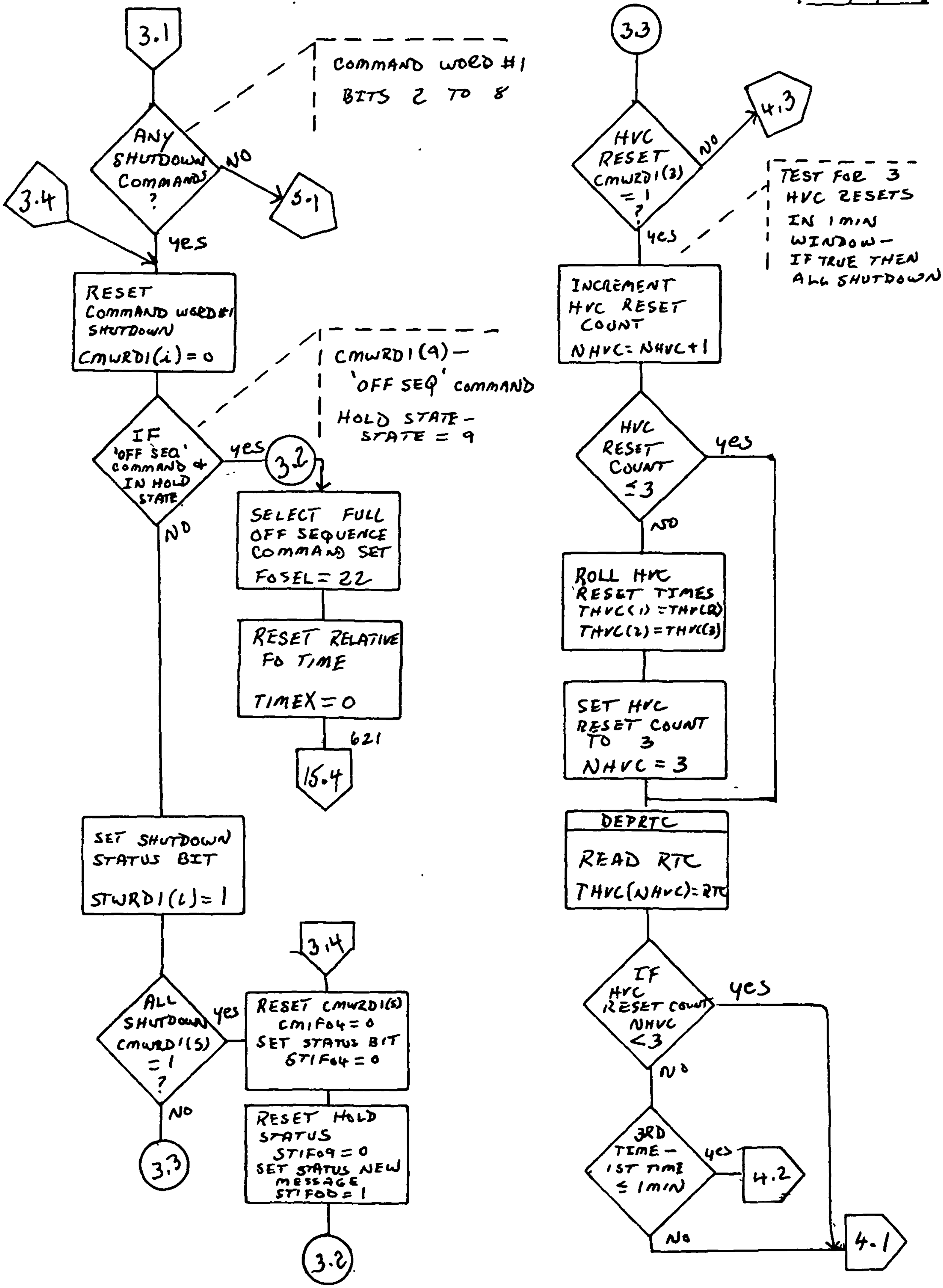
FO TIMELINE EXECUTIVE

SEPACM
1/19

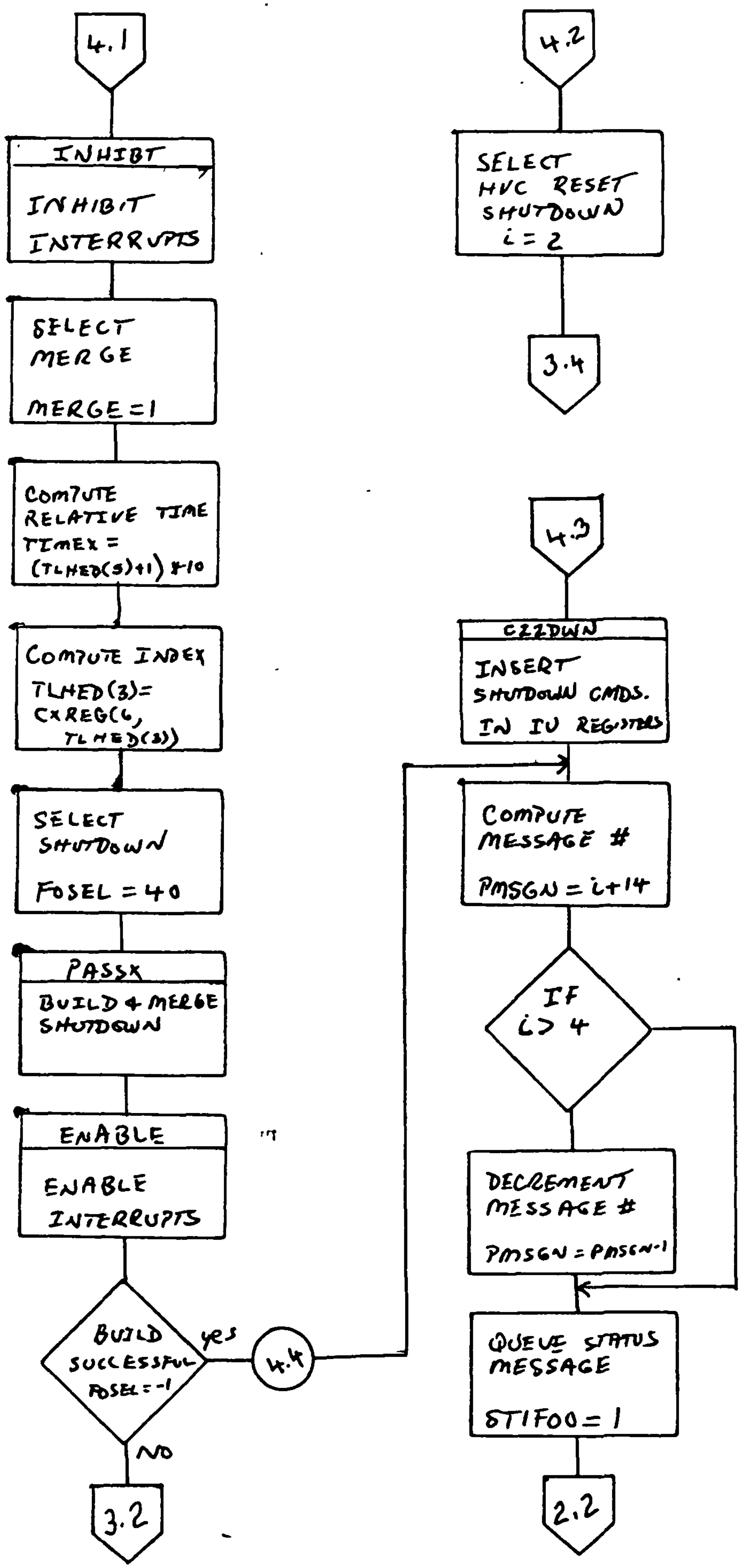


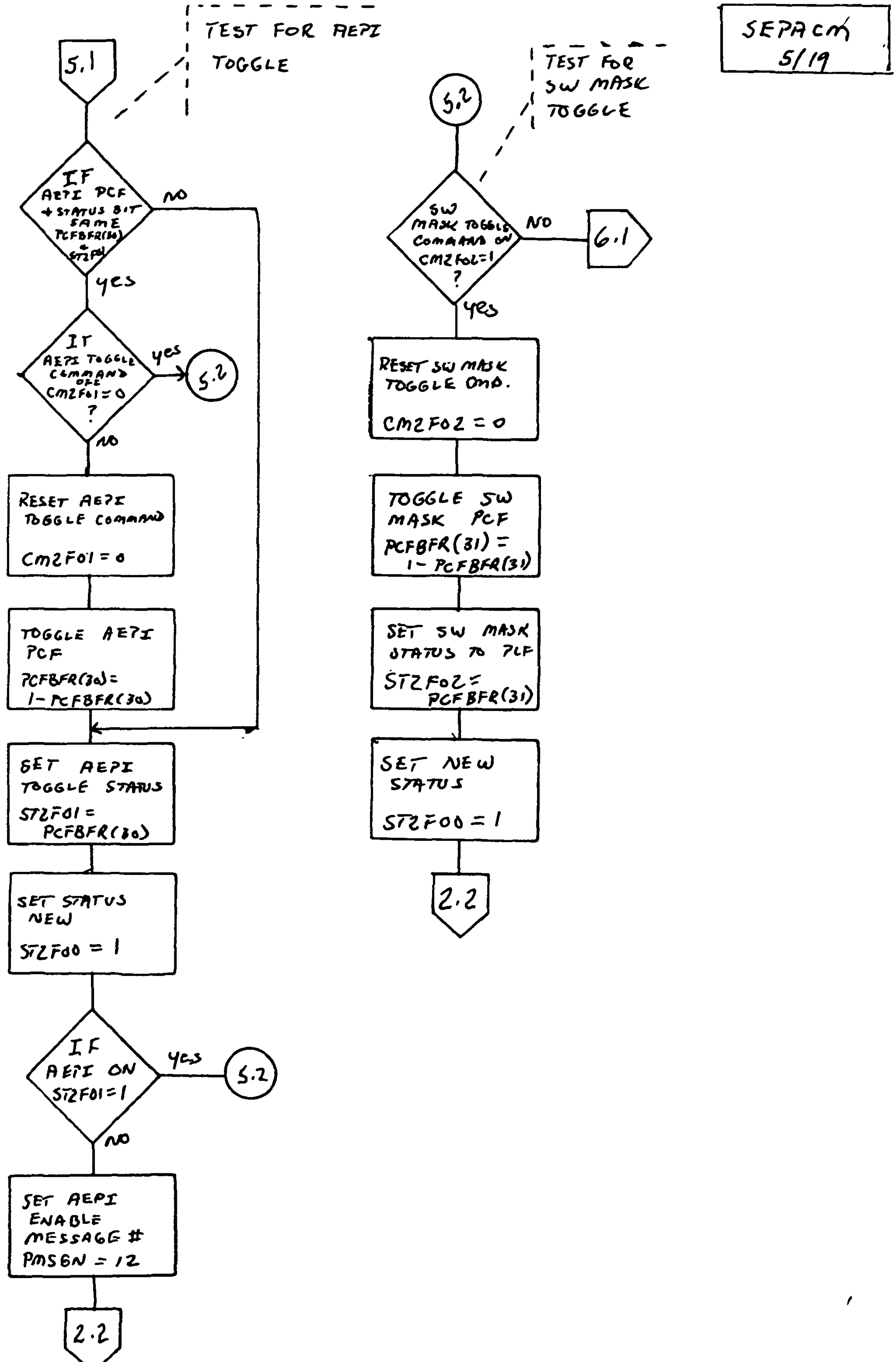
SEPACM
2/19


2.1
EBAST1 ON
ROUTIX(2)=48
EBADW1 ON
ROUTIX(3)=45
EBADW2 ON
ROUTIX(4)=46
MPDOFF ON
ROUTIX(5)=21
MPDINT ON
ROUTIX(6)=11
MFVPON ON
ROUTIX(7)=137
EBASET
ROUTIX(8)=2
2.3
INCREMENT MENU INDEX
MENIND = MENIND +2
2.2
ST1F00=0 NO STATUS WORD #1 NEW MESSAGE
ST2F00=0 NO STATUS WOR#2 NEW MESSAGE
PMSGN=0 NO MESSAGE #
ANY MESSAGE REQUESTS
NO
yes
QUEUE MESSAGE
SINT1=1
RETURN

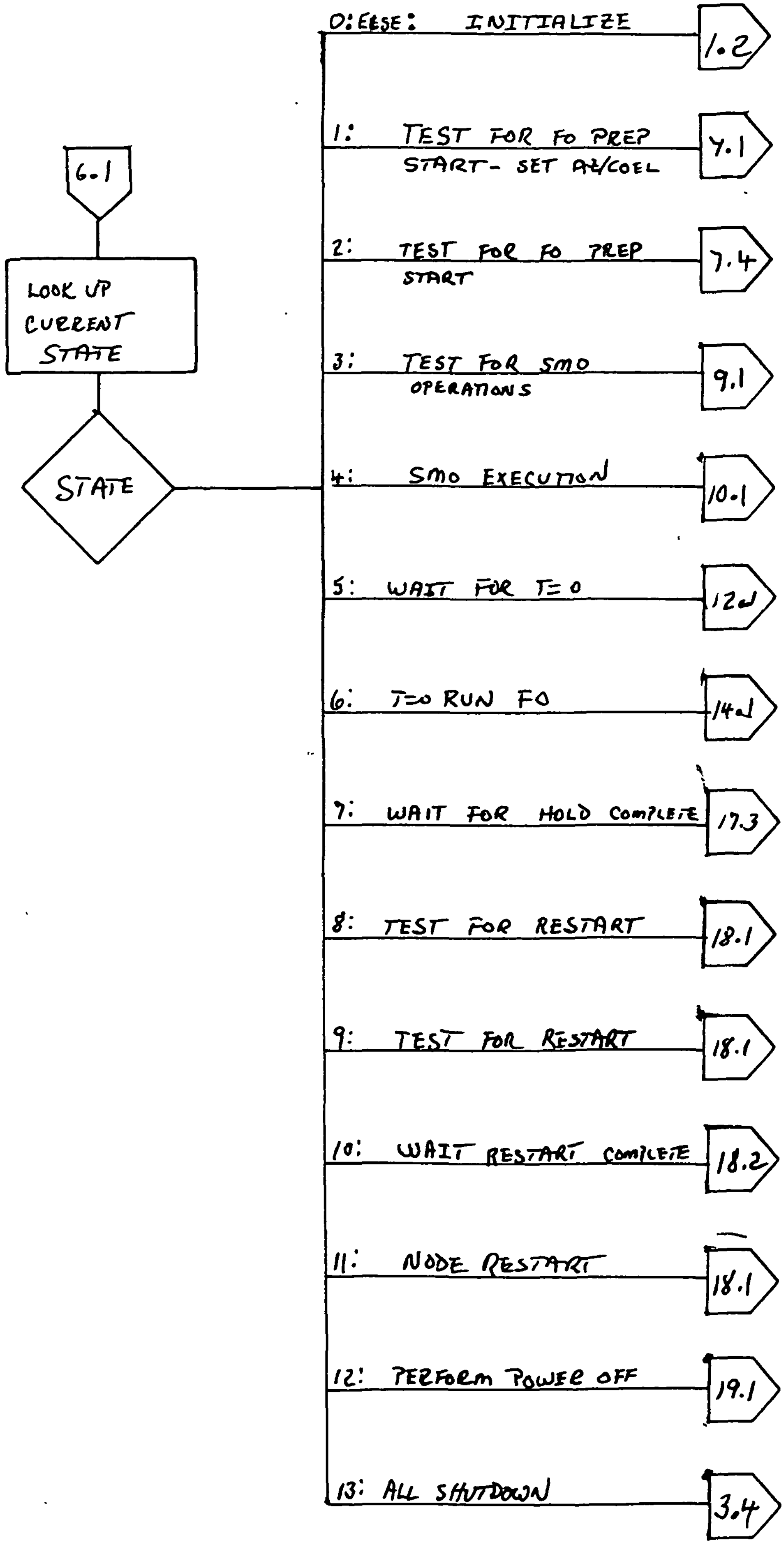

3.1
ANY SHUTDOWN COMMANDS ?
COMMAND WORD #1
BITS 2 TO 8
NO
5.1
3.4
YES
RESET COMMAND WORD #1 SHUTDOWN
CMWRD1(i) = 0
CMWRD1(9) — 'OFF SEQ' COMMAND
HOLD STATE — STATE = 9
IF 'OFF SEQ' COMMAND & IN HOLD STATE
YES
3.2
NO
SELECT FULL OFF SEQUENCE COMMAND SET
FOSEL = 22
RESET RELATIVE FO TIME
TIMEX = 0
621
15.4
SET SHUTDOWN STATUS BIT
STWRD1(i) = 1
ALL SHUTDOWN CMWRD1(5) = 1 ?
YES
NO
3.3
3.4
RESET CMWRD1(5)
CM1F04 = 0
SET STATUS BIT
ST1F04 = 0
RESET HOLD STATUS
ST1F09 = 0
SET STATUS NEW MESSAGE
ST1F0D = 1
3.2
3.3
HVC RESET CMWRD1(3) = 1 ?
NO
4.3
TEST FOR 3 HVC RESETS IN 1 MIN WINDOW — IF TRUE THEN ALL SHUTDOWN
YES
INCREMENT HVC RESET COUNT
NHVC = NHVC+1
HVC RESET COUNT ≤ 3
YES
NO
ROLL HVC RESET TIMES
THVC(1) = THVC(2)
THVC(2) = THVC(3)
SET HVC RESET COUNT TO 3
NHVC = 3
DEPRTC
READ RTC
THVC(NHVC) = RTC
IF HVC RESET COUNT NHVC < 3
YES
NO
3RD TIME — 1ST TIME ≤ 1 MIN
YES
4.2
NO
4.1

SEPACM
4/19

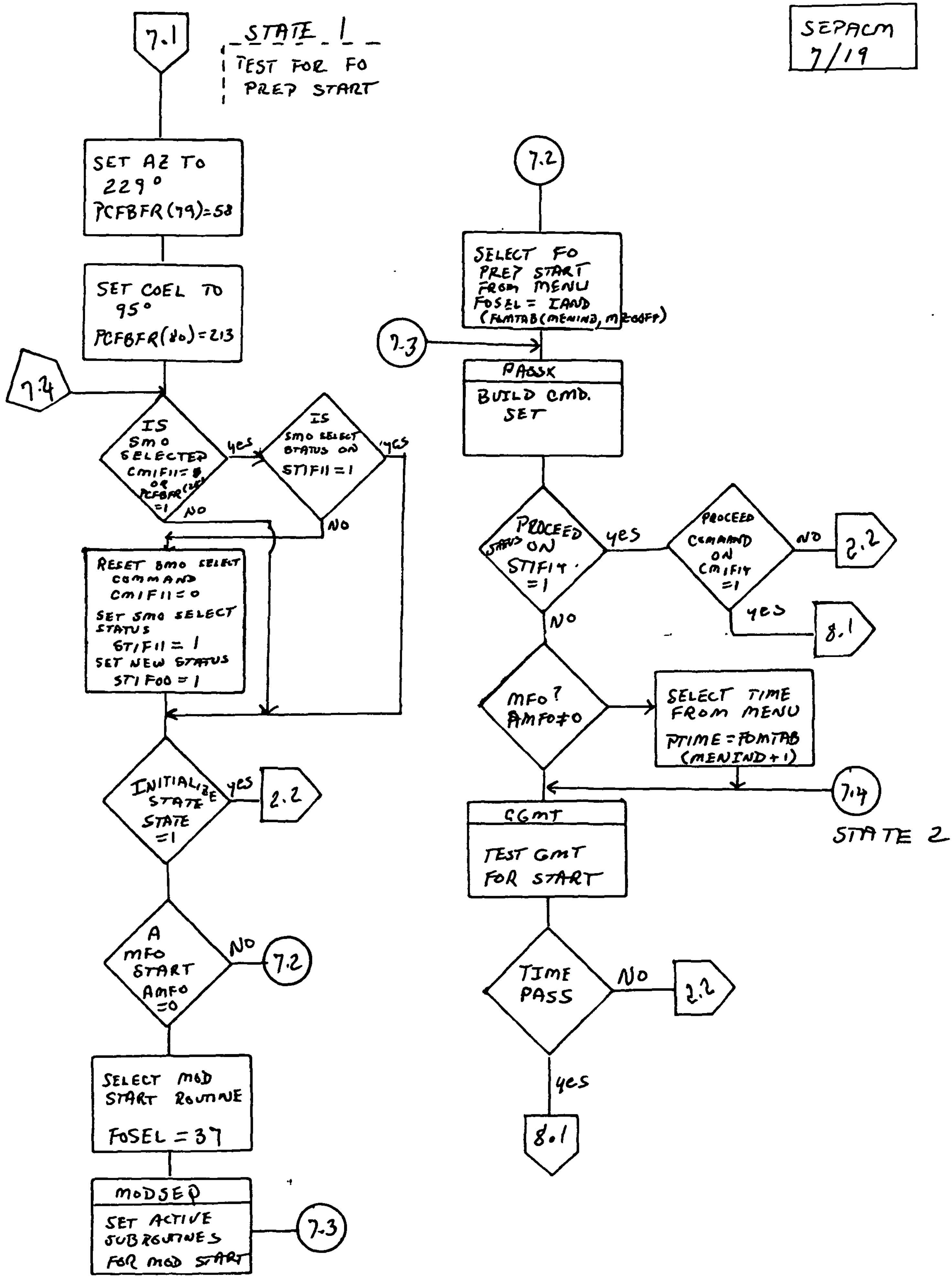

4.1
INHIBT
INHIBIT INTERRUPTS
SELECT MERGE
MERGE=1
COMPUTE RELATIVE TIME
TIMEX = (TLHED(5)+1)*10
COMPUTE INDEX
TLHED(3)= CXREG(6, TLHED(3))
SELECT SHUTDOWN
FOSEL = 40
PASSX
BUILD & MERGE SHUTDOWN
ENABLE
ENABLE INTERRUPTS
BUILD SUCCESSFUL FOSEL=-1
yes
NO
4.4
3.2
4.2
SELECT HVC RESET SHUTDOWN
i = 2
3.4
4.3
CZZDWN
INSERT SHUTDOWN CMDS. IN IU REGISTERS
COMPUTE MESSAGE #
PMSGN = i+14
IF i > 4
DECREMENT MESSAGE #
PMSGN = PMSGN-1
QUEUE STATUS MESSAGE
STIF00 = 1
2.2


SEPACM
5/19
TEST FOR AEPI TOGGLE
5.1
IF AEPI PCF + STATUS BIT SAME PCFBFR(30) & ST2F01
NO
yes
IF AEPI TOGGLE COMMAND OFF CM2F01 = 0 ?
yes
5.2
NO
RESET AEPI TOGGLE COMMAND
CM2F01 = 0
TOGGLE AEPI PCF
PCFBFR(30) = 1 - PCFBFR(30)
SET AEPI TOGGLE STATUS
ST2F01 = PCFBFR(30)
SET STATUS NEW
ST2F00 = 1
IF AEPI ON ST2F01 = 1
yes
5.2
NO
SET AEPI ENABLE MESSAGE #
PMSGN = 12
2.2
TEST FOR SW MASK TOGGLE
5.2
SW MASK TOGGLE COMMAND ON CM2F02 = 1 ?
NO
6.1
yes
RESET SW MASK TOGGLE CMD.
CM2F02 = 0
TOGGLE SW MASK PCF
PCFBFR(31) = 1 - PCFBFR(31)
SET SW MASK STATUS TO PCF
ST2F02 = PCFBFR(31)
SET NEW STATUS
ST2F00 = 1
2.2

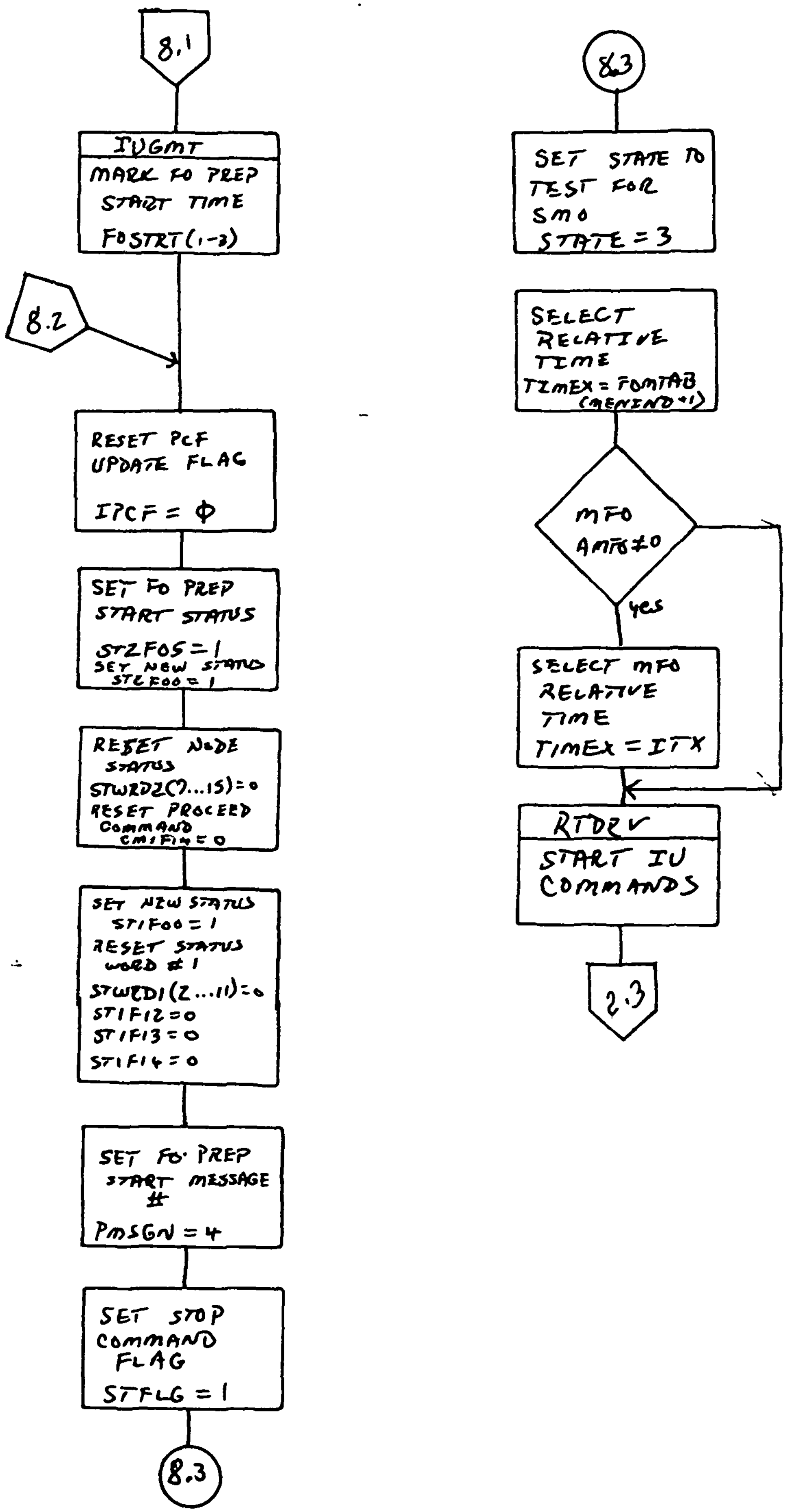
SEPACM 6/19


6.1
LOOK UP CURRENT STATE
STATE
0: ELSE: INITIALIZE
1.2
1: TEST FOR FO PREP START - SET AZ/COEL
7.1
2: TEST FOR FO PREP START
7.4
3: TEST FOR SMO OPERATIONS
9.1
4: SMO EXECUTION
10.1
5: WAIT FOR T=0
12.1
6: T=0 RUN FO
14.1
7: WAIT FOR HOLD COMPLETE
17.3
8: TEST FOR RESTART
18.1
9: TEST FOR RESTART
18.1
10: WAIT RESTART COMPLETE
18.2
11: NODE RESTART
18.1
12: PERFORM POWER OFF
19.1
13: ALL SHUTDOWN
3.4

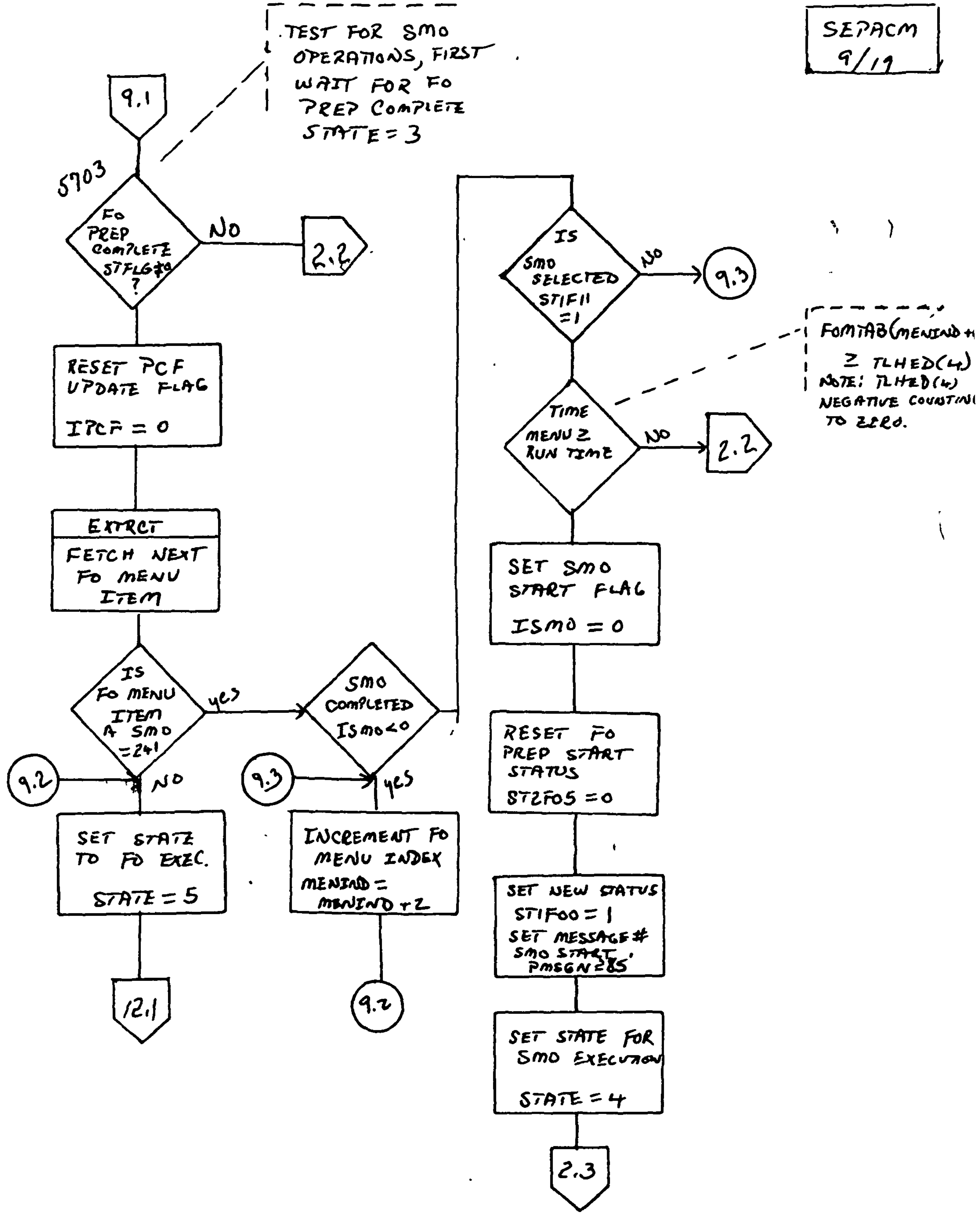
SEPACM
7/19


7.1
STATE 1
TEST FOR FO PREP START
SET AZ TO 229°
PCFBFR(79)=58
SET COEL TO 95°
PCFBFR(80)=213
7.4
IS SMO SELECTED CMIF11=8 OR PCFBFR(...)=1
yes
NO
IS SMO SELECT STATUS ON STIF11=1
yes
NO
RESET SMO SELECT COMMAND CMIF11=0
SET SMO SELECT STATUS STIF11=1
SET NEW STATUS STIF00=1
INITIALIZE STATE STATE =1
yes
2.2
A MFO START AMFO =0
NO
7.2
SELECT MOD START ROUTINE
FOSEL=37
MODSEP
SET ACTIVE SUBROUTINES FOR MOD START
7.3
7.2
SELECT FO PREP START FROM MENU
FOSEL = IAND (FOMTAB(MENIND), M...)
7.3
PASSK
BUILD CMD. SET
PROCEED STATUS ON STIF14 =1
yes
NO
PROCEED COMMAND ON CMIF14 =1
NO
2.2
yes
8.1
MFO? AMFO≠0
SELECT TIME FROM MENU
PTIME = FOMTAB (MENIND+1)
7.4
STATE 2
CGMT
TEST GMT FOR START
TIME PASS
NO
2.2
yes
8.1

SEPACM 8/19


8.1
IUGMT
MARK FO PREP START TIME
FOSTRT(1-3)
8.2
RESET PCF UPDATE FLAG
IPCF = Φ
SET FO PREP START STATUS
STZFOS = 1
SET NEW STATUS
STZFOO = 1
RESET NODE STATUS
STWRDZ(7...15) = 0
RESET PROCEED COMMAND
CMIFIN = 0
SET NEW STATUS
STIFOO = 1
RESET STATUS WORD # 1
STWRD1(2...11) = 0
STIF12 = 0
STIF13 = 0
STIF14 = 0
SET FO PREP START MESSAGE #
PMSGN = 4
SET STOP COMMAND FLAG
STFLG = 1
8.3
8.3
SET STATE TO TEST FOR SMO
STATE = 3
SELECT RELATIVE TIME
TIMEX = FOMTAB (MENIND+1)
MFO
AMFO≠0
yes
SELECT MFO RELATIVE TIME
TIMEX = ITX
RTDRV
START IU COMMANDS
2.3

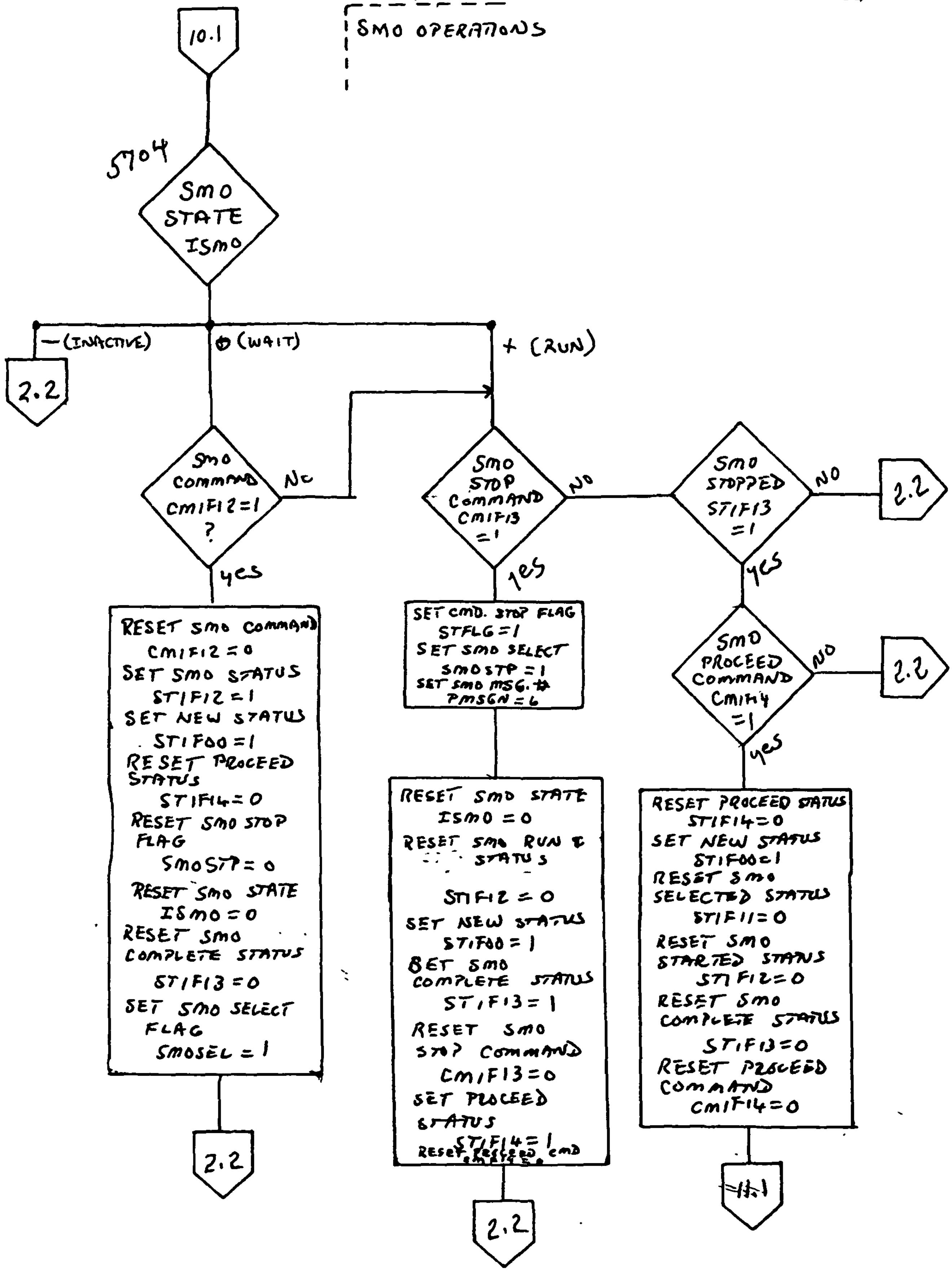
SEPACM 9/19

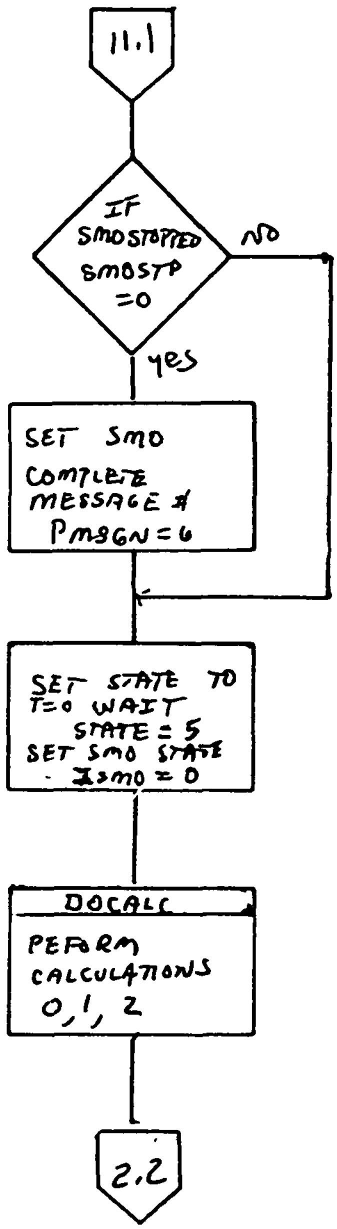

TEST FOR SMO OPERATIONS, FIRST WAIT FOR FO PREP COMPLETE STATE=3
9.1
5703
FO PREP COMPLETE STFLG≠0 ?
NO
2.2
RESET PCF UPDATE FLAG
IPCF = 0
EXTRCT
FETCH NEXT FO MENU ITEM
IS FO MENU ITEM A SMO =241
yes
NO
9.2
SET STATE TO FO EXEC.
STATE = 5
12.1
SMO COMPLETED ISMO<0
yes
9.3
INCREMENT FO MENU INDEX
MENIND = MENIND + 2
9.2
IS SMO SELECTED STIF11 =1
NO
9.3
FOMTAB(MENIND+1) ≥ TLHED(4)
NOTE: TLHED(4) NEGATIVE COUNTING TO ZERO.
TIME MENU ≥ RUN TIME
NO
2.2
SET SMO START FLAG
ISMO = 0
RESET FO PREP START STATUS
ST2FOS = 0
SET NEW STATUS
STIFOO = 1
SET MESSAGE # SMO START,
PMSGN=85
SET STATE FOR SMO EXECUTION
STATE = 4
2.3

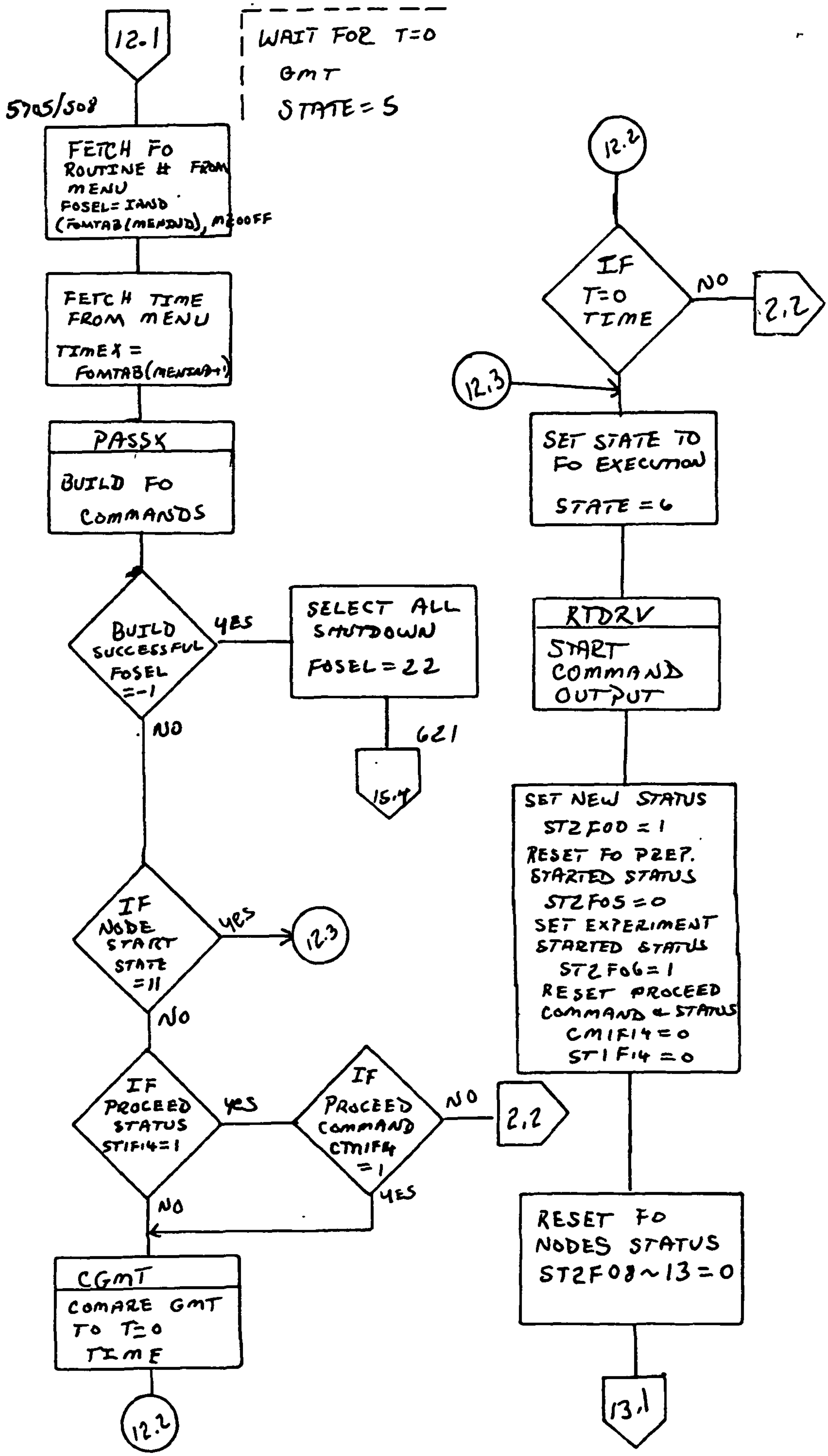
SEPACM
10/19

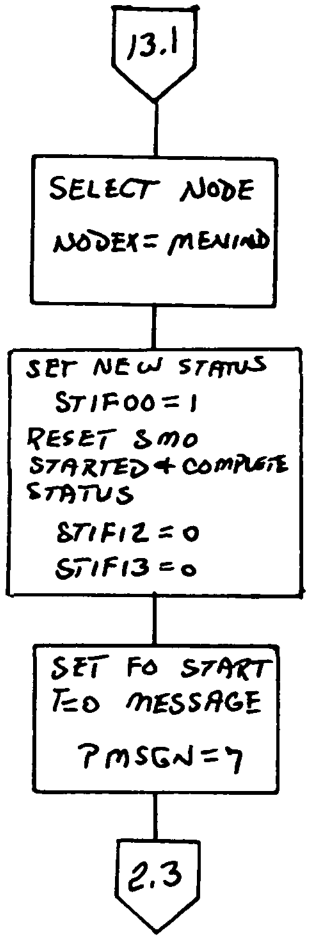
STATE 4

SMO OPERATIONS




11.1
IF SMOSTOPPED SMOSTP =0
NO
YES
SET SMO COMPLETE MESSAGE # PMSGN=6
SET STATE TO T=0 WAIT STATE = 5
SET SMO STATE ISMO = 0
DOCALC
PEFORM CALCULATIONS 0, 1, 2
2.2

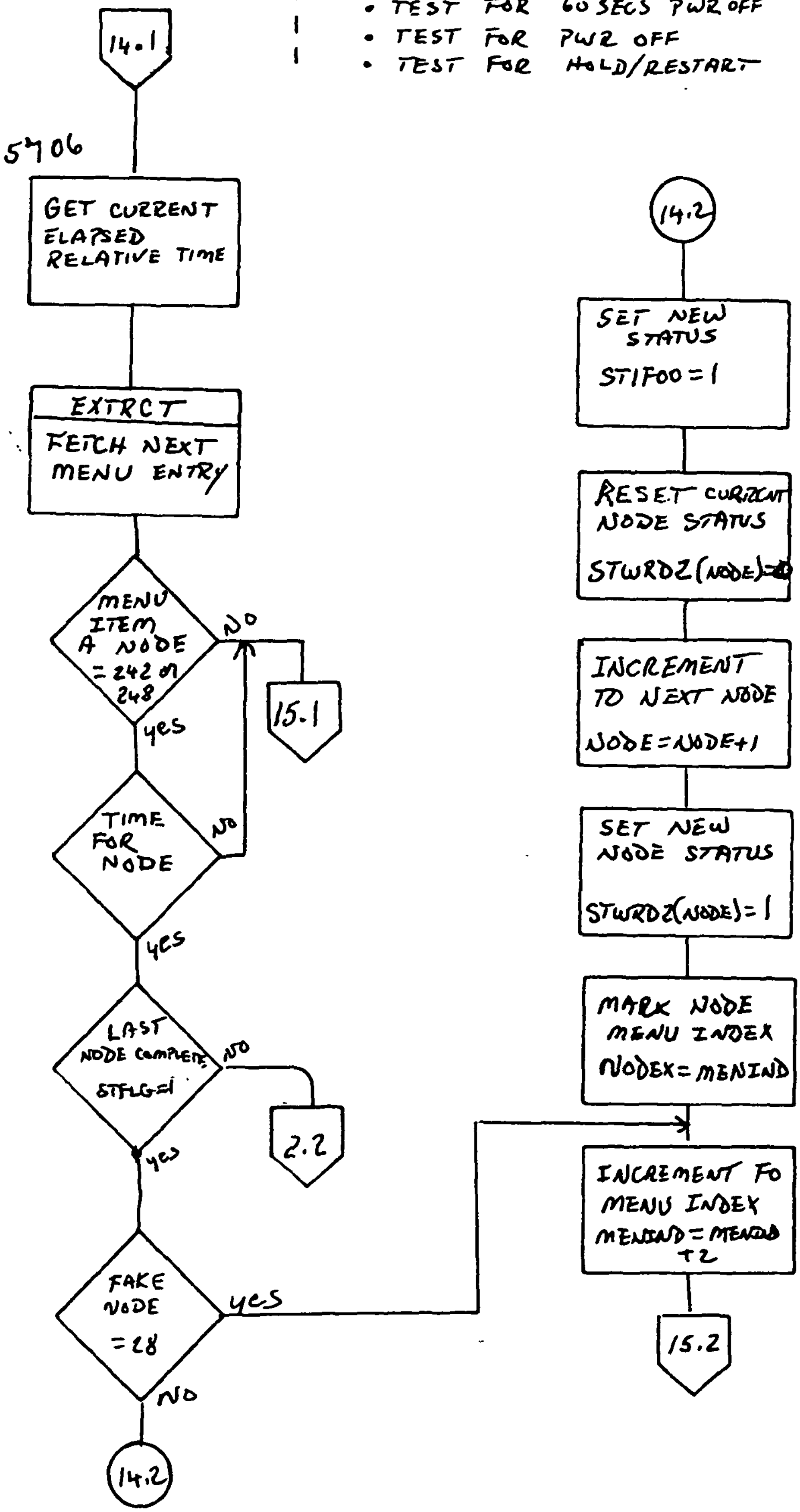

12.1
WAIT FOR T=0
GMT
STATE=5
5705/508
FETCH FO ROUTINE # FROM MENU
FOSEL= IAND (FOMTAB(MENIND), M200FF
FETCH TIME FROM MENU
TIMEX = FOMTAB(MENIND+1)
PASSX
BUILD FO COMMANDS
BUILD SUCCESSFUL FOSEL =-1
YES
NO
SELECT ALL SHUTDOWN
FOSEL=22
621
15.4
IF NODE START STATE =11
YES
12.3
NO
IF PROCEED STATUS STIF14=1
YES
IF PROCEED COMMAND CMIF14 =1
NO
2.2
YES
NO
CGMT
COMARE GMT TO T=0 TIME
12.2
12.2
IF T=0 TIME
NO
2.2
12.3
SET STATE TO FO EXECUTION
STATE=6
RTDRV
START COMMAND OUTPUT
SET NEW STATUS
ST2F00=1
RESET FO PREP. STARTED STATUS
ST2F05=0
SET EXPERIMENT STARTED STATUS
ST2F06=1
RESET PROCEED COMMAND & STATUS
CMIF14=0
ST1F14=0
RESET FO NODES STATUS
ST2F08~13=0
13.1

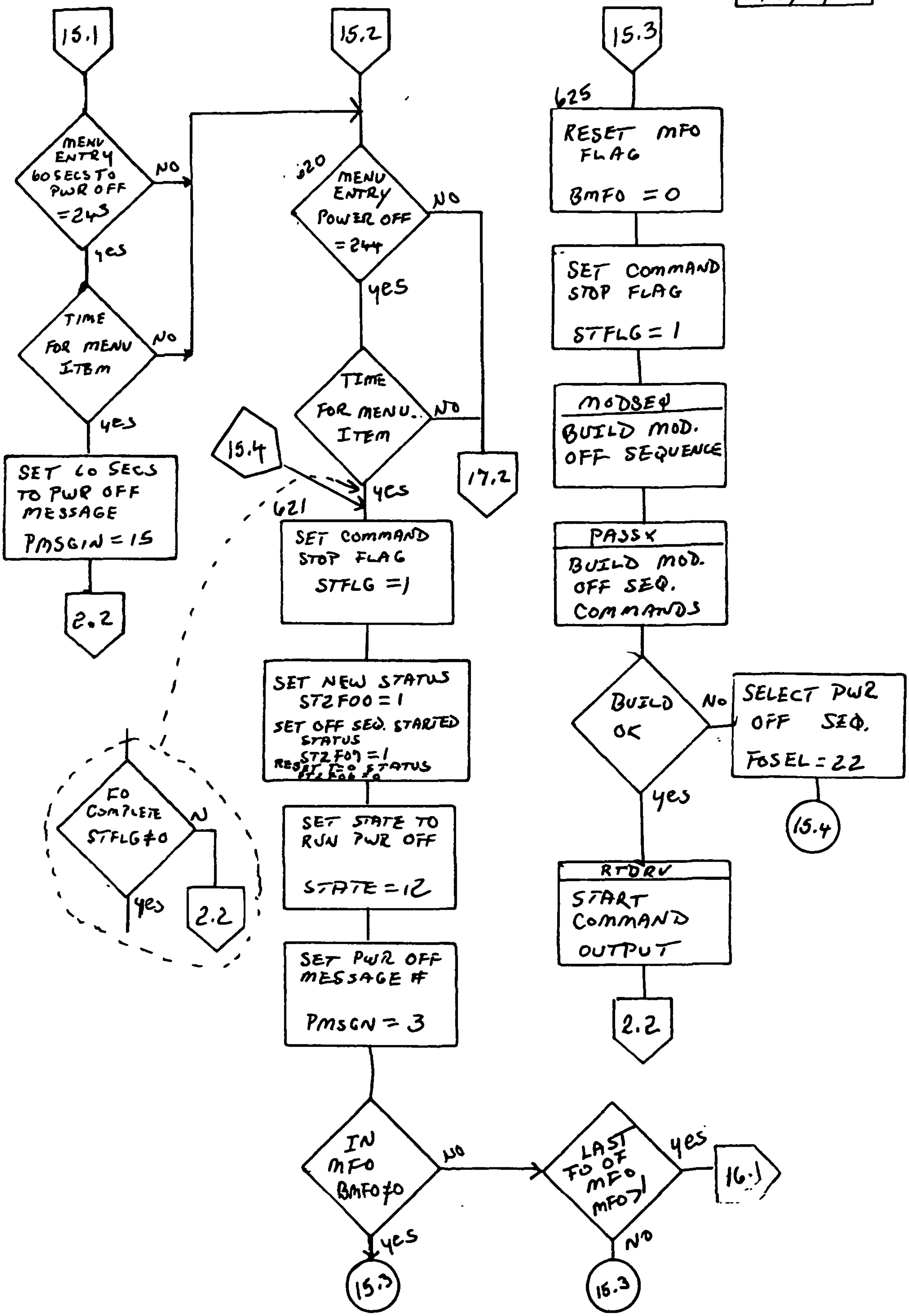

13.1
SELECT NODE
NODEX=MENIND
SET NEW STATUS
STIF00=1
RESET SMO
STARTED + COMPLETE
STATUS
STIF12=0
STIF13=0
SET FO START
T=0 MESSAGE
PMSGN=7
2.3

SEPACM
14/19

STATE 6

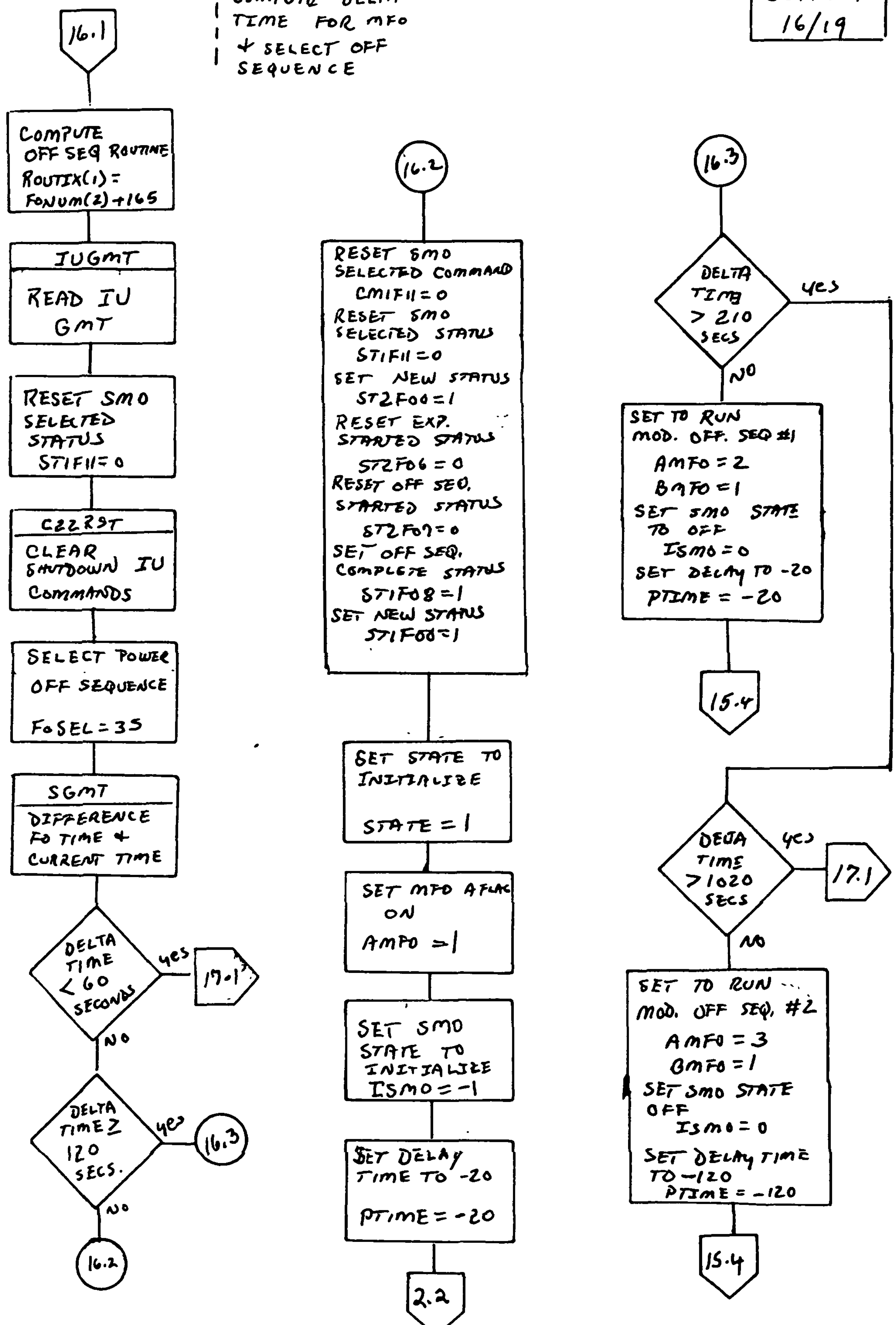
FO RUN STATE
- TEST FOR NODES
- TEST FOR 60 SECS PWR OFF
- TEST FOR PWR OFF
- TEST FOR HOLD/RESTART



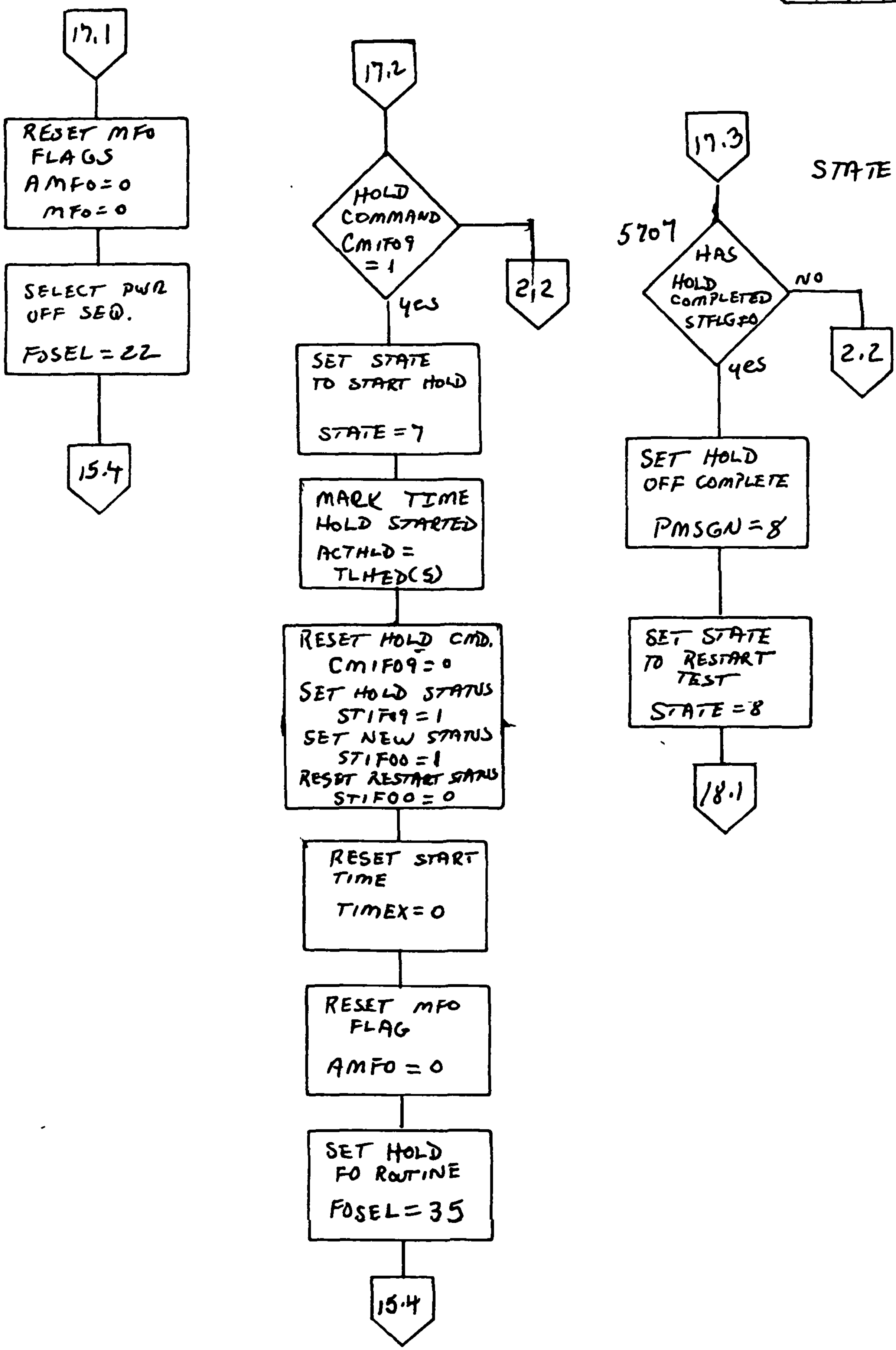

15.1
MENU ENTRY 60 SECS TO PWR OFF =243
NO
yes
TIME FOR MENU ITEM
NO
yes
SET 60 SECS TO PWR OFF MESSAGE
PMSGIN = 15
2.2
15.2
620
MENU ENTRY POWER OFF =244
NO
yes
TIME FOR MENU ITEM
NO
17.2
15.4
yes
621
SET COMMAND STOP FLAG
STFLG = 1
SET NEW STATUS
ST2F00 = 1
SET OFF SEQ. STARTED STATUS
ST2F09 = 1
SET STATE TO RUN PWR OFF
STATE = 12
SET PWR OFF MESSAGE #
PMSGN = 3
IN MFO BMFO≠0
NO
yes
15.3
LAST FO OF MFO MFO>1
yes
16.1
NO
15.3
FO COMPLETE STFLG≠0
N
yes
2.2
15.3
625
RESET MFO FLAG
BMFO = 0
SET COMMAND STOP FLAG
STFLG = 1
MODSEQ
BUILD MOD. OFF SEQUENCE
PASSX
BUILD MOD. OFF SEQ. COMMANDS
BUILD OK
No
SELECT PWR OFF SEQ.
FOSEL = 22
15.4
yes
RTDRV
START COMMAND OUTPUT
2.2

SEPACM 16/19

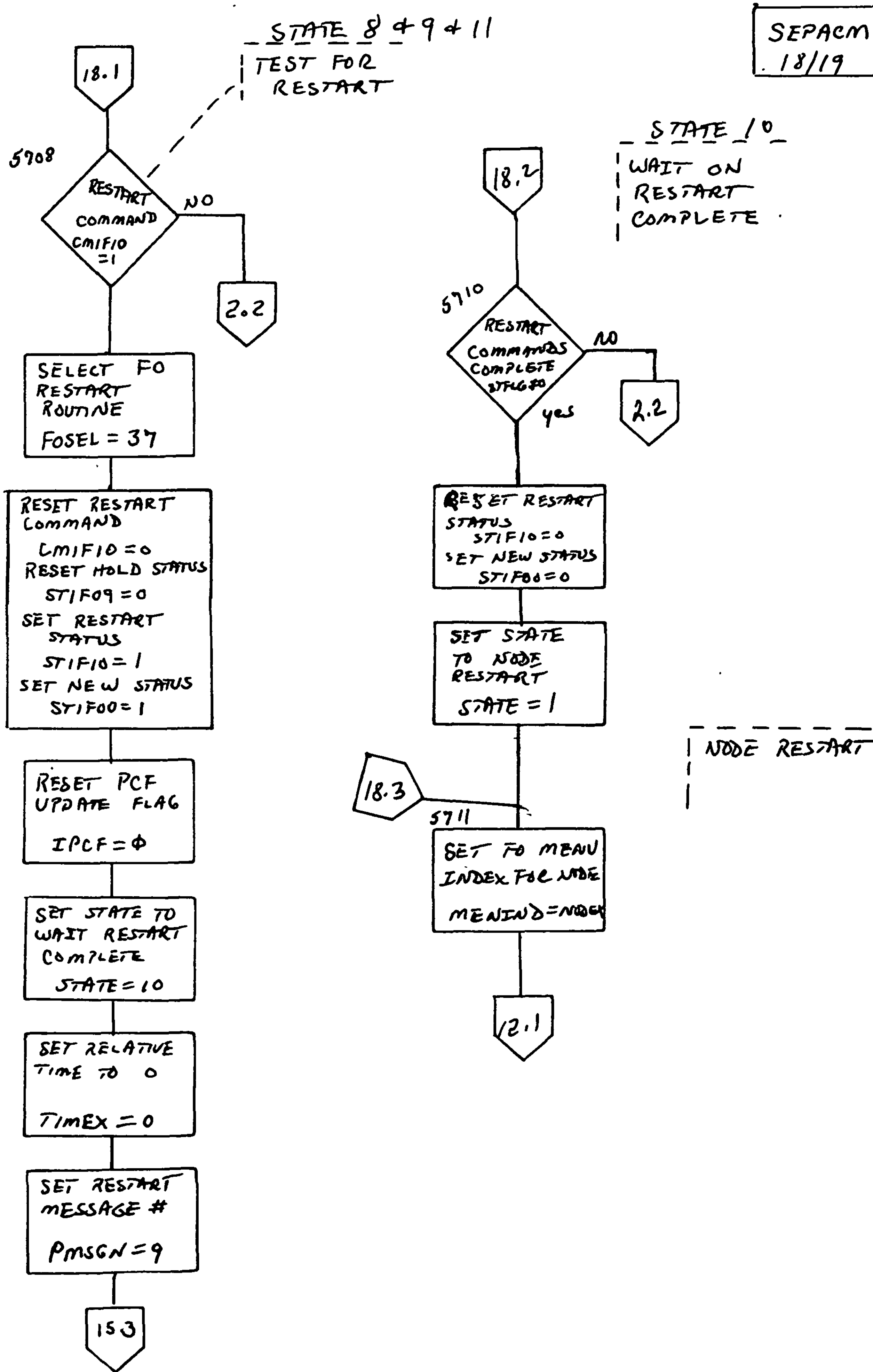
COMPUTE DELTA TIME FOR MFO + SELECT OFF SEQUENCE

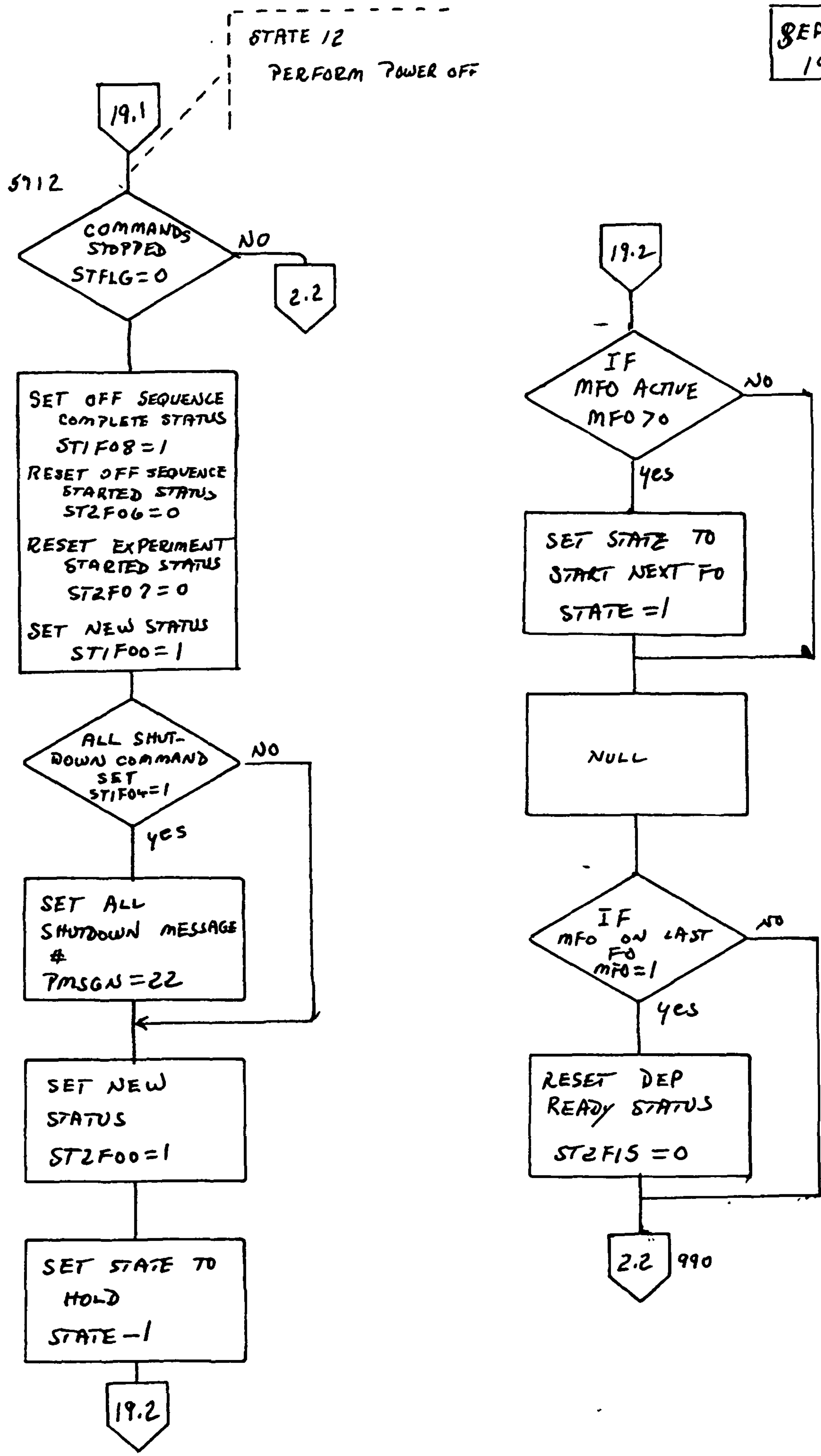


STATE 7


17.1
RESET MFO FLAGS
AMFO=0
MFO=0
SELECT PWR OFF SEQ.
FOSEL=22
15.4
17.2
HOLD COMMAND CMIF09 =1
2,2
yes
SET STATE TO START HOLD
STATE=7
MARK TIME HOLD STARTED
ACTHLD = TLHED(S)
RESET HOLD CMD.
CMIF09=0
SET HOLD STATUS
STIF09=1
SET NEW STATUS
STIF00=1
RESET RESTART STATUS
STIF00=0
RESET START TIME
TIMEX=0
RESET MFO FLAG
AMFO=0
SET HOLD FO ROUTINE
FOSEL=35
15.4
17.3
5707
HAS HOLD COMPLETED STFLGFO
NO
2.2
yes
SET HOLD OFF COMPLETE
PMSGN=8
SET STATE TO RESTART TEST
STATE=8
18.1

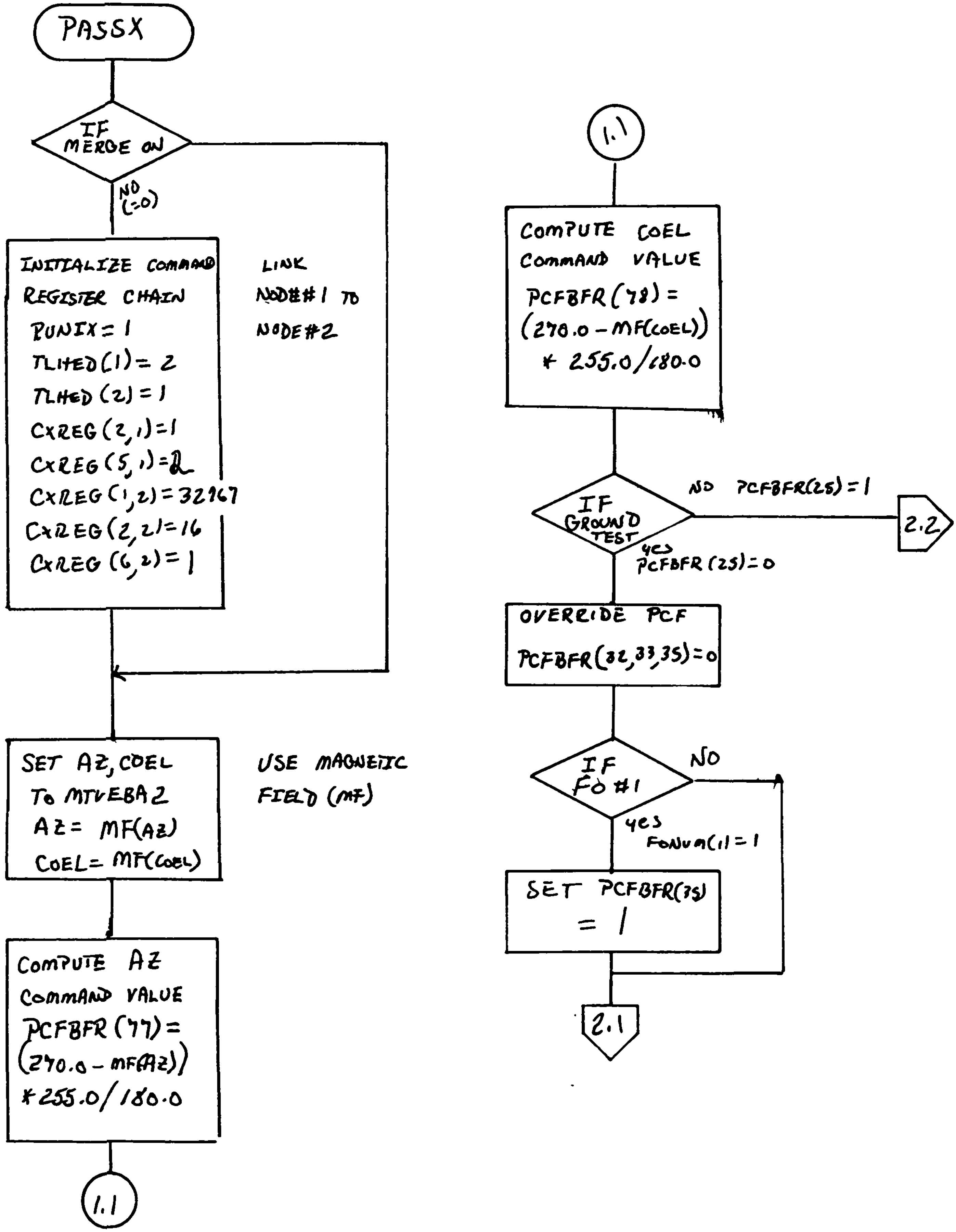
SEPACM 18/19

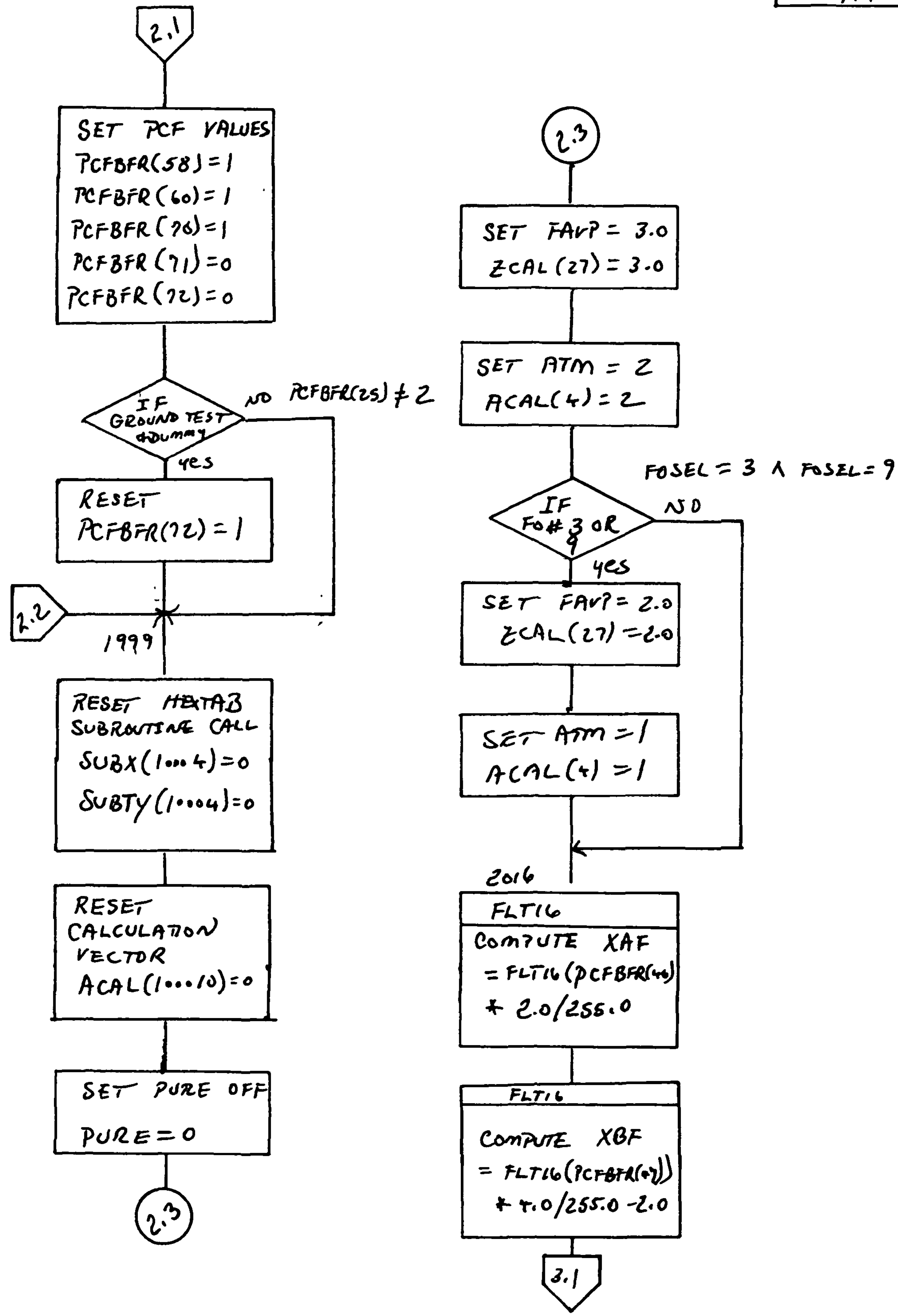

STATE 8 + 9 + 11
TEST FOR RESTART
18.1
5708
RESTART COMMAND CMIF10 =1
NO
2.2
SELECT FO RESTART ROUTINE FOSEL = 37
RESET RESTART COMMAND CMIF10=0 RESET HOLD STATUS STIF09=0 SET RESTART STATUS STIF10=1 SET NEW STATUS STIF00=1
RESET PCF UPDATE FLAG IPCF=Φ
SET STATE TO WAIT RESTART COMPLETE STATE=10
SET RELATIVE TIME TO 0 TIMEX=0
SET RESTART MESSAGE # PMSGN=9
15.3
STATE 10
WAIT ON RESTART COMPLETE
18.2
5710
RESTART COMMANDS COMPLETE STFLG#0
NO
yes
2.2
RESET RESTART STATUS STIF10=0 SET NEW STATUS STIF00=0
SET STATE TO NODE RESTART STATE=1
NODE RESTART
18.3
5711
SET FO MENU INDEX FOR NODE MENIND=NODE
12.1

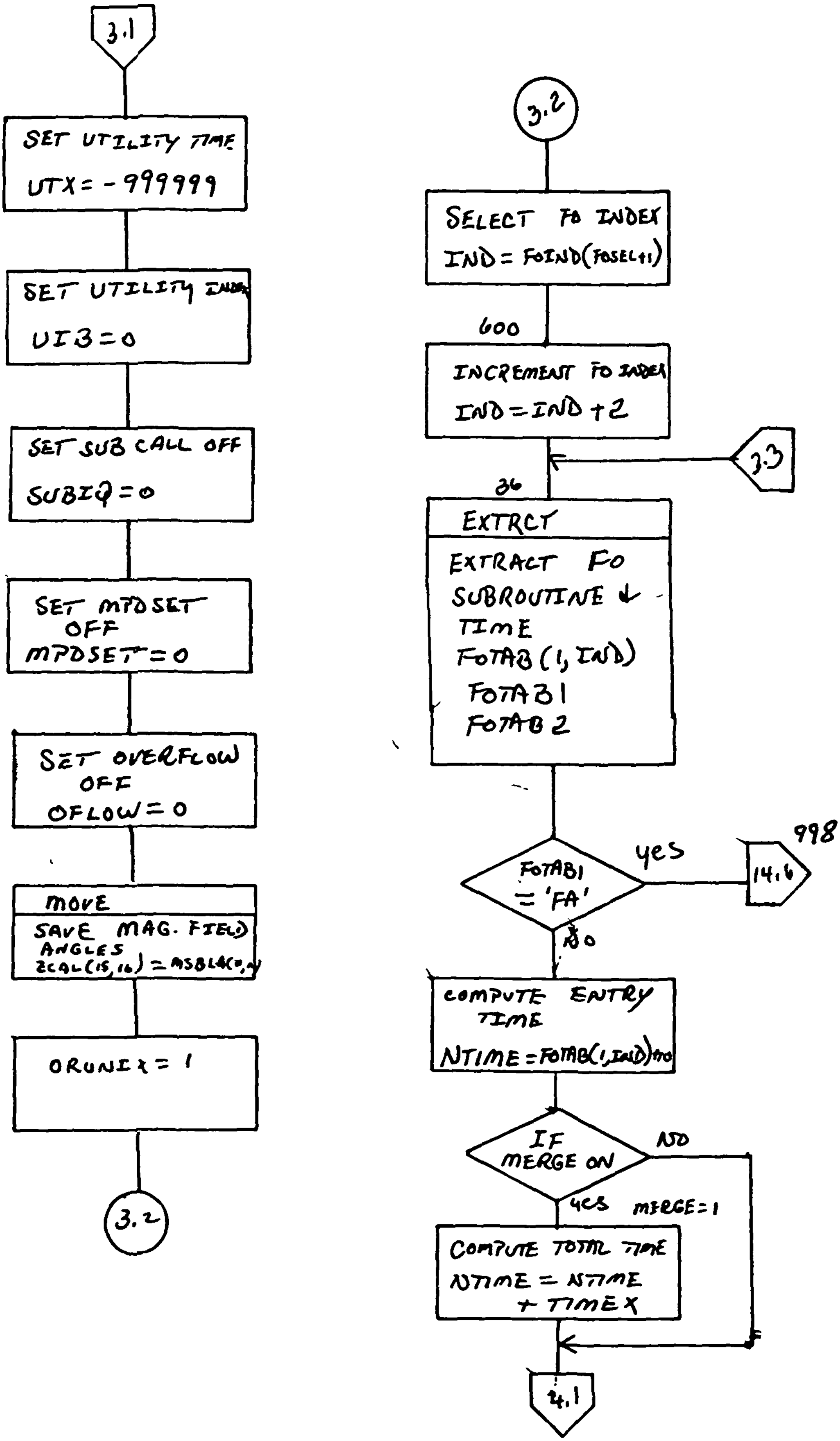

STATE 12
PERFORM POWER OFF
19.1
ST12
COMMANDS STOPPED
STFLG=0
NO
2.2
SET OFF SEQUENCE COMPLETE STATUS
ST1F08=1
RESET OFF SEQUENCE STARTED STATUS
ST2F06=0
RESET EXPERIMENT STARTED STATUS
ST2F07=0
SET NEW STATUS
ST1F00=1
ALL SHUT-DOWN COMMAND SET
ST1F04=1
NO
yes
SET ALL SHUTDOWN MESSAGE #
PMSGN=22
SET NEW STATUS
ST2F00=1
SET STATE TO HOLD
STATE-1
19.2
19.2
IF MFO ACTIVE
MFO>0
NO
yes
SET STATE TO START NEXT FO
STATE=1
NULL
IF MFO ON LAST FO
MFO=1
NO
yes
RESET DEP READY STATUS
ST2F15=0
2.2
990

FO COMMAND GENERATION PASS
EXECUTIVE

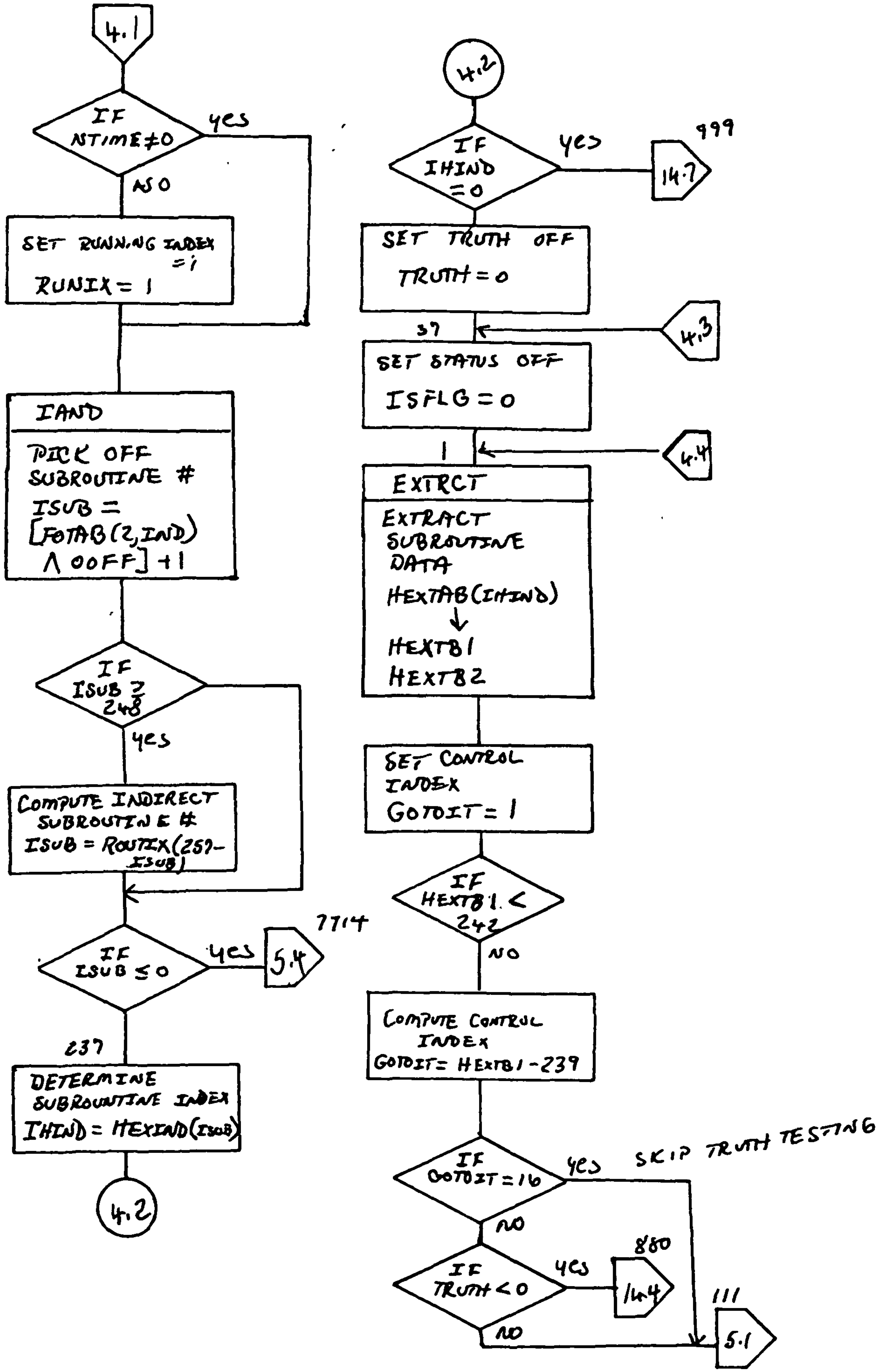
PASSX
1/14




2.1
SET PCF VALUES
PCFBFR(58)=1
PCFBFR(60)=1
PCFBFR(70)=1
PCFBFR(71)=0
PCFBFR(72)=0
IF GROUND TEST + DUMMY
NO PCFBFR(25) ≠ 2
yes
RESET
PCFBFR(72)=1
2.2
1999
RESET HEXTAB
SUBROUTINE CALL
SUBX(1...4)=0
SUBTY(1...4)=0
RESET
CALCULATION
VECTOR
ACAL(1...10)=0
SET PURE OFF
PURE=0
2.3
2.3
SET FAVP = 3.0
ZCAL(27) = 3.0
SET ATM = 2
ACAL(4) = 2
FOSEL = 3 ∧ FOSEL = 9
IF FO# 3 OR 9
NO
yes
SET FAVP = 2.0
ZCAL(27) = 2.0
SET ATM = 1
ACAL(4) = 1
2016
FLT16
COMPUTE XAF
= FLT16(PCFBFR(46))
* 2.0/255.0
FLT16
COMPUTE XBF
= FLT16(PCFBFR(47))
* 4.0/255.0 -2.0
3.1

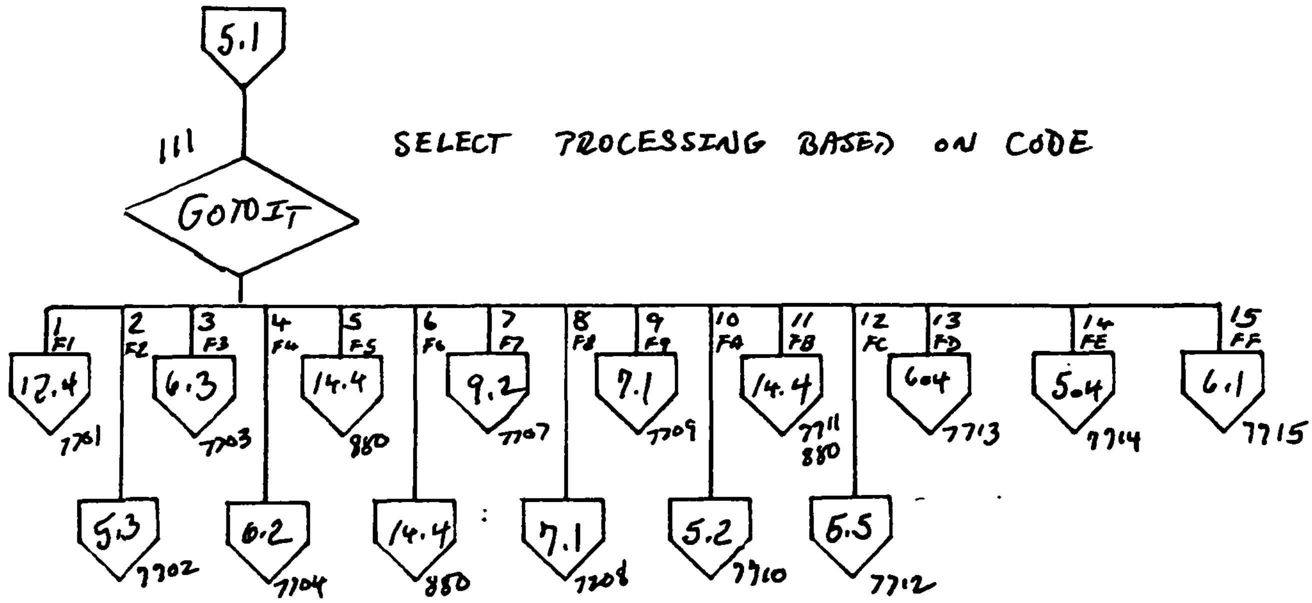

3.1
SET UTILITY TIME
UTX = -999999
SET UTILITY INDEX
UI3 = 0
SET SUB CALL OFF
SUBIQ = 0
SET MPDSET OFF
MPDSET = 0
SET OVERFLOW OFF
OFLOW = 0
MOVE
SAVE MAG. FIELD ANGLES
ZCAL(15,16) = ASBLK(9,4)
ORUNIX = 1
3.2
3.2
SELECT FO INDEX
IND = FOIND(FOSEL+1)
600
INCREMENT FO INDEX
IND = IND + 2
3.3
36
EXTRCT
EXTRACT FO
SUBROUTINE
TIME
FOTAB(1, IND)
FOTAB1
FOTAB2
FOTAB1 = 'FA'
yes
998
14.6
NO
COMPUTE ENTRY TIME
NTIME = FOTAB(1,IND)*10
IF MERGE ON
NO
yes
MERGE=1
COMPUTE TOTAL TIME
NTIME = NTIME + TIMEX
4.1

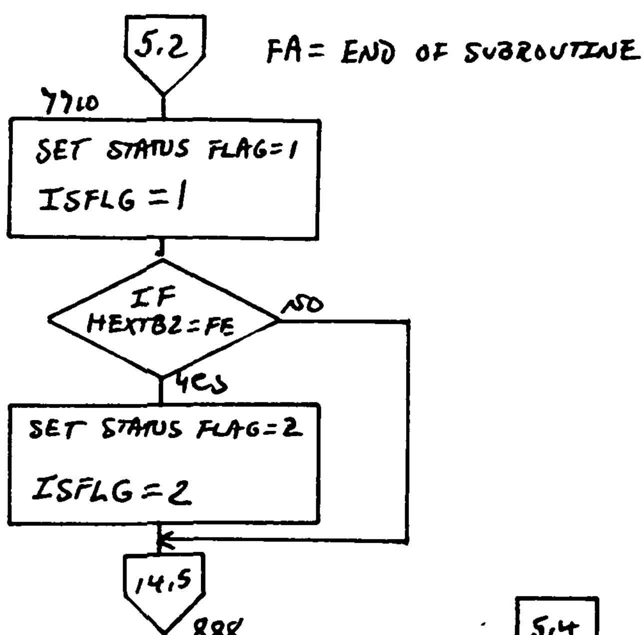
PASSX
4/14

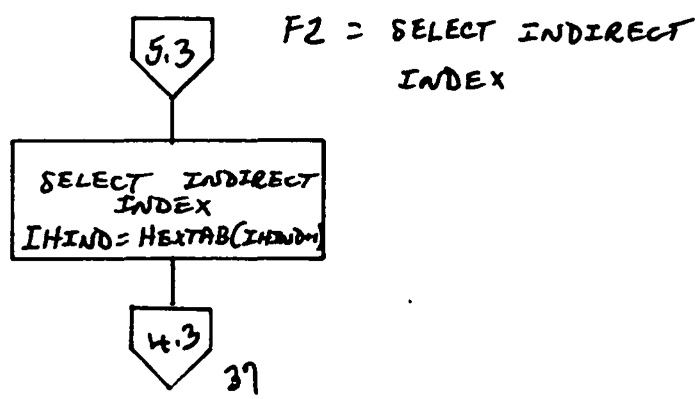


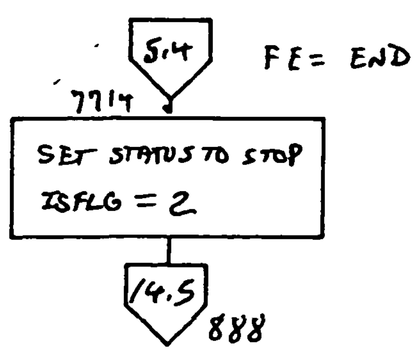
4.1
IF NTIME≠0
yes
NO
SET RUNNING INDEX =1
RUNIX = 1
IAND
PICK OFF SUBROUTINE #
ISUB = [FOTAB(2,IND) ∧ 00FF] +1
IF ISUB ≥ 248
yes
COMPUTE INDIRECT SUBROUTINE #
ISUB = ROUTIX(257-ISUB)
IF ISUB ≤ 0
yes
7714
5.4
237
DETERMINE SUBROUTINE INDEX
IHIND = HEXIND(ISUB)
4.2
4.2
IF IHIND =0
yes
999
14.7
SET TRUTH OFF
TRUTH = 0
37
4.3
SET STATUS OFF
ISFLG = 0
1
4.4
EXTRCT
EXTRACT SUBROUTINE DATA
HEXTAB(IHIND)
HEXTB1
HEXTB2
SET CONTROL INDEX
GOTOIT = 1
IF HEXTB1 < 242
NO
COMPUTE CONTROL INDEX
GOTOIT = HEXTB1 - 239
IF GOTOIT = 16
yes
SKIP TRUTH TESTING
NO
IF TRUTH < 0
yes
880
14.4
NO
111
5.1

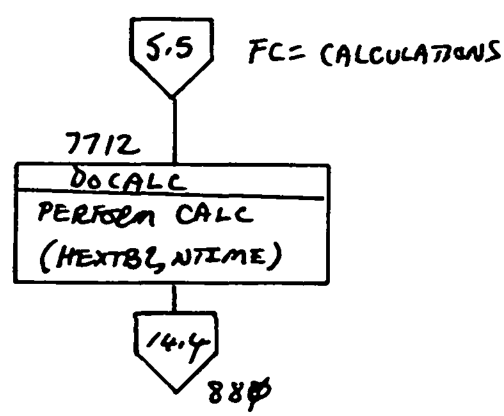
PASSX
5/14


5.1
111
SELECT PROCESSING BASED ON CODE
GOTOIT
1 F1 12.4 7701
2 F2 5.3 7702
3 F3 6.3 7703
4 F4 6.2 7704
5 F5 14.4 880
6 F6 14.4 880
7 F7 9.2 7707
8 F8 7.1 7708
9 F9 7.1 7709
10 FA 5.2 7710
11 FB 14.4 7711 880
12 FC 5.5 7712
13 FD 6.4 7713
14 FE 5.4 7714
15 FF 6.1 7715

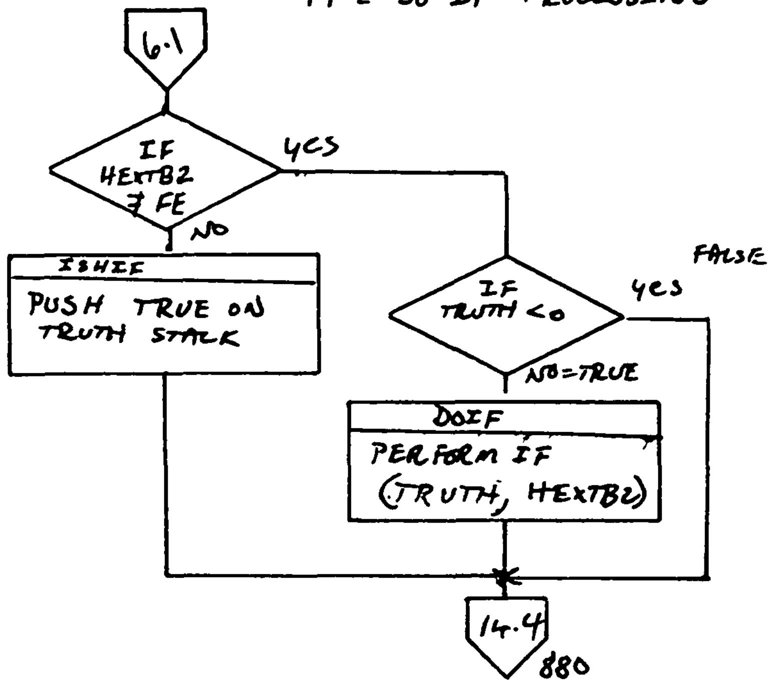

5.2
FA= END OF SUBROUTINE
7710
SET STATUS FLAG=1
ISFLG =1
IF HEXTB2=FE
NO
YES
SET STATUS FLAG=2
ISFLG=2
14.5
888


5.3
F2 = SELECT INDIRECT INDEX
SELECT INDIRECT INDEX
IHIND= HEXTAB(IHIND)
4.3
37

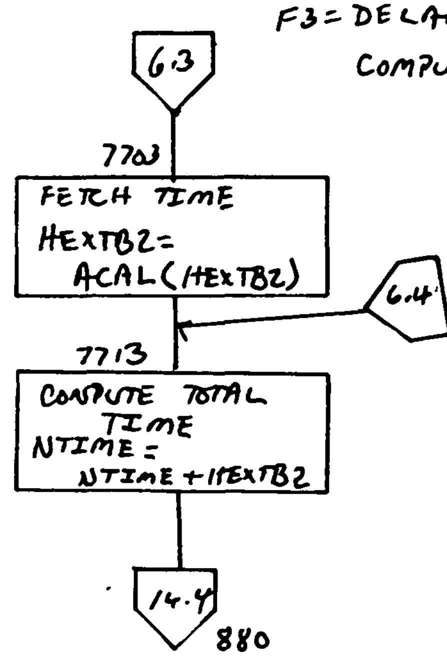

5.4
FE= END
7714
SET STATUS TO STOP
ISFLG = 2
14.5
888


5.5
FC= CALCULATIONS
7712
DOCALC
PERFORM CALC
(HEXTB2, NTIME)
14.4
880

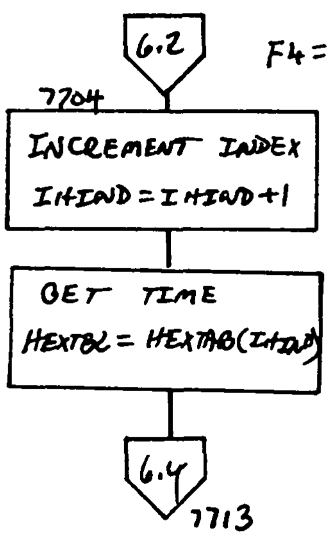
FF = DO IF PROCESSING



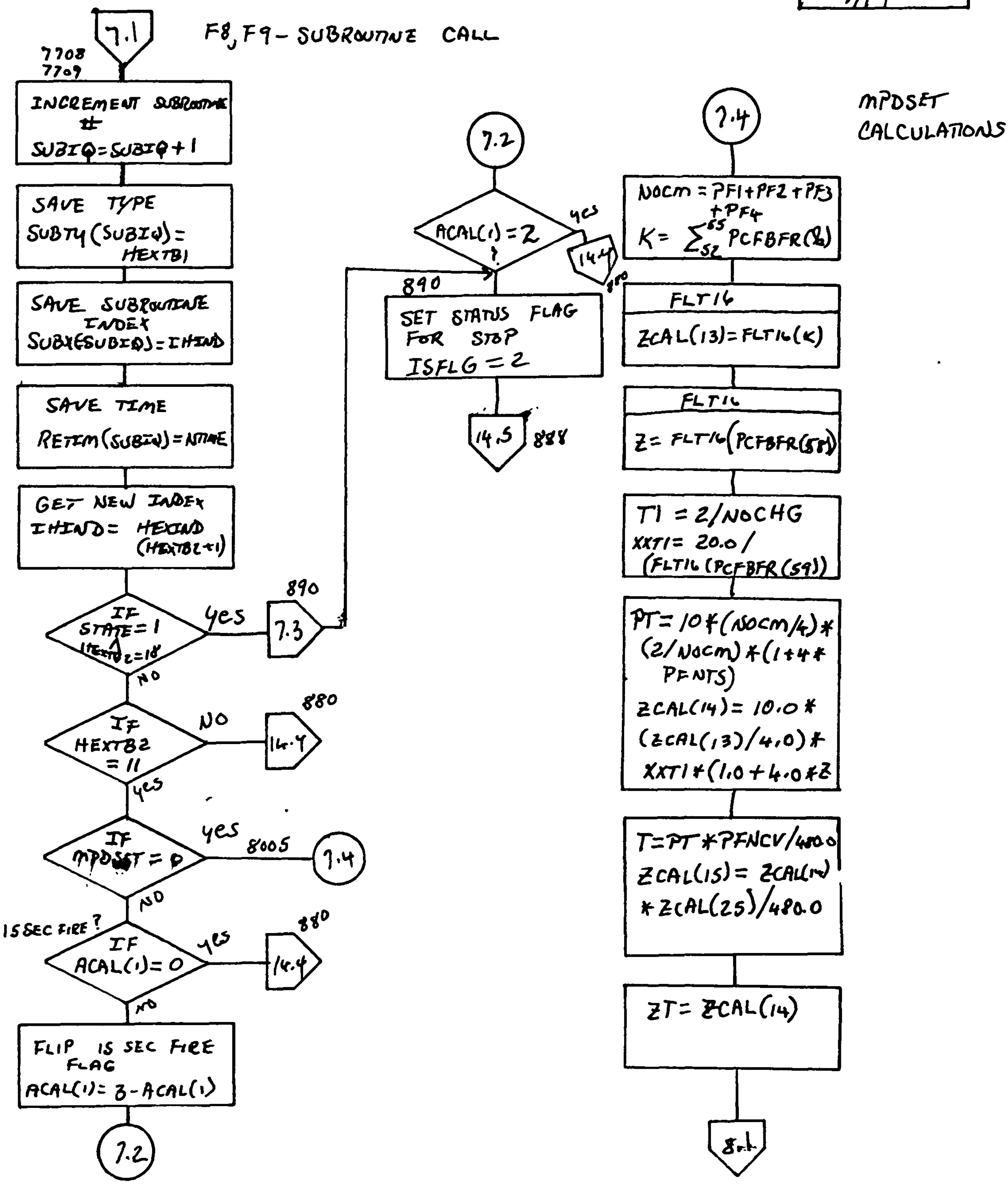
F3 = DELAY COMPUTED TIME



F4 = INDIRECT DELAY

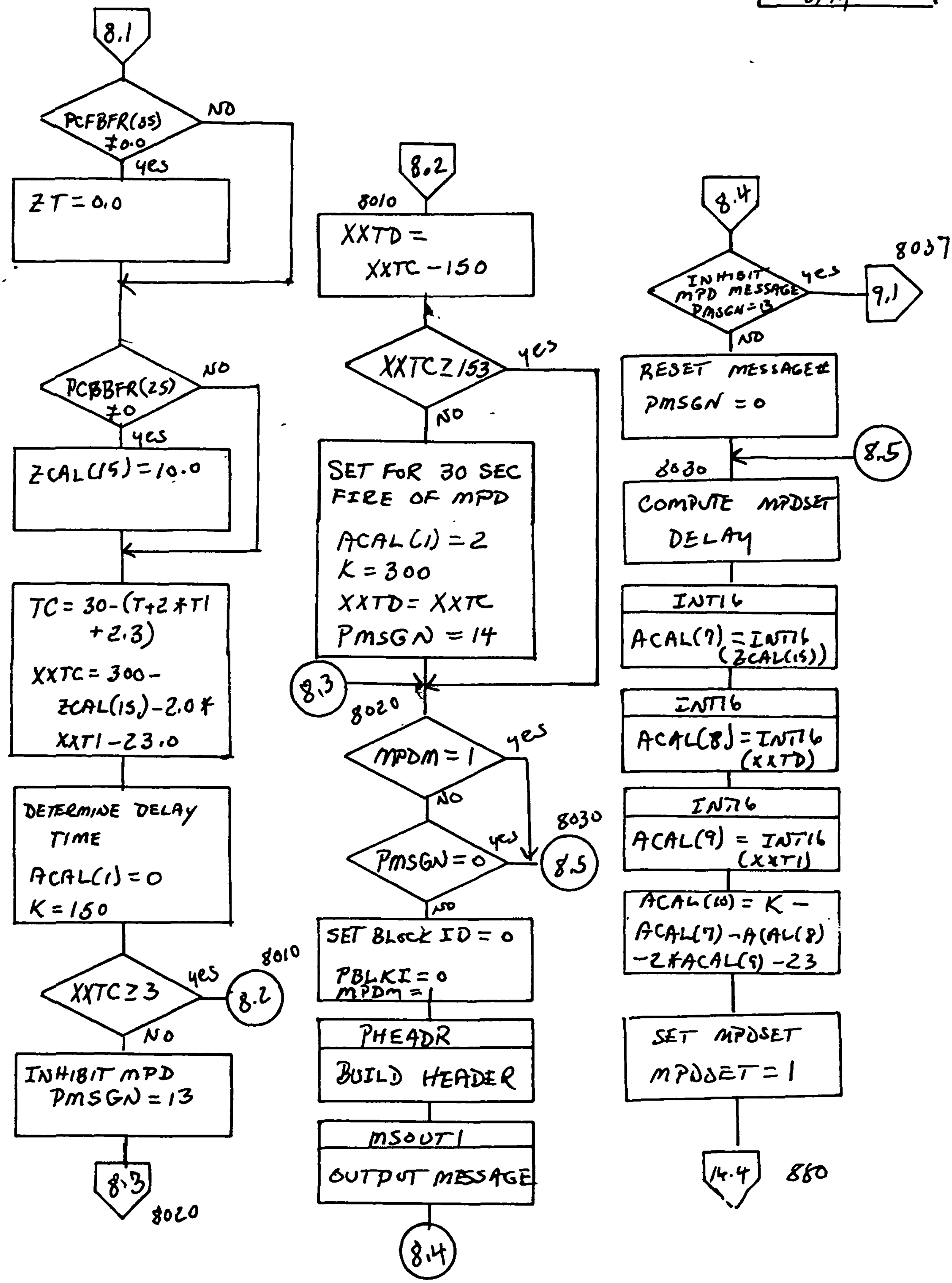


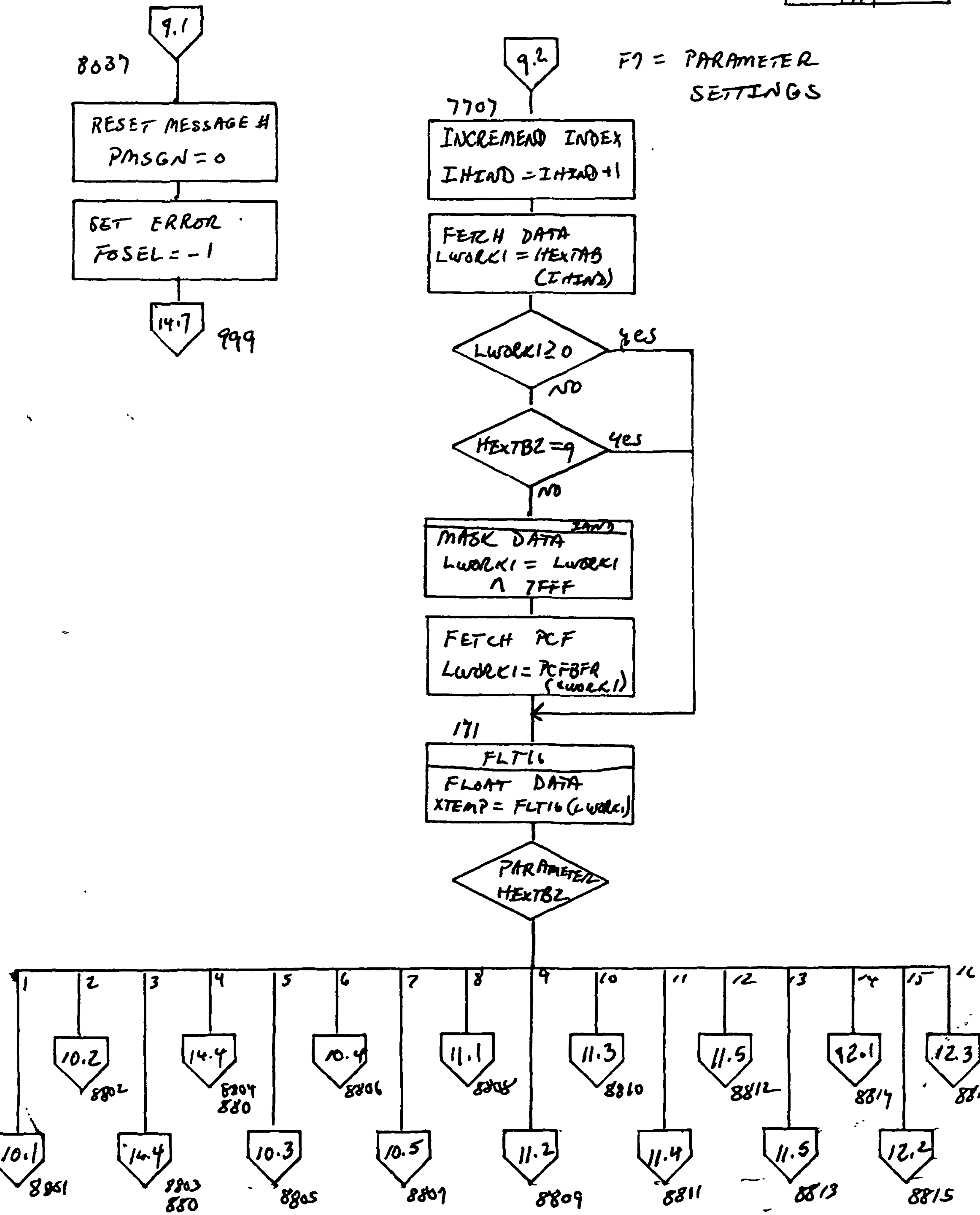
PASS X
7/14



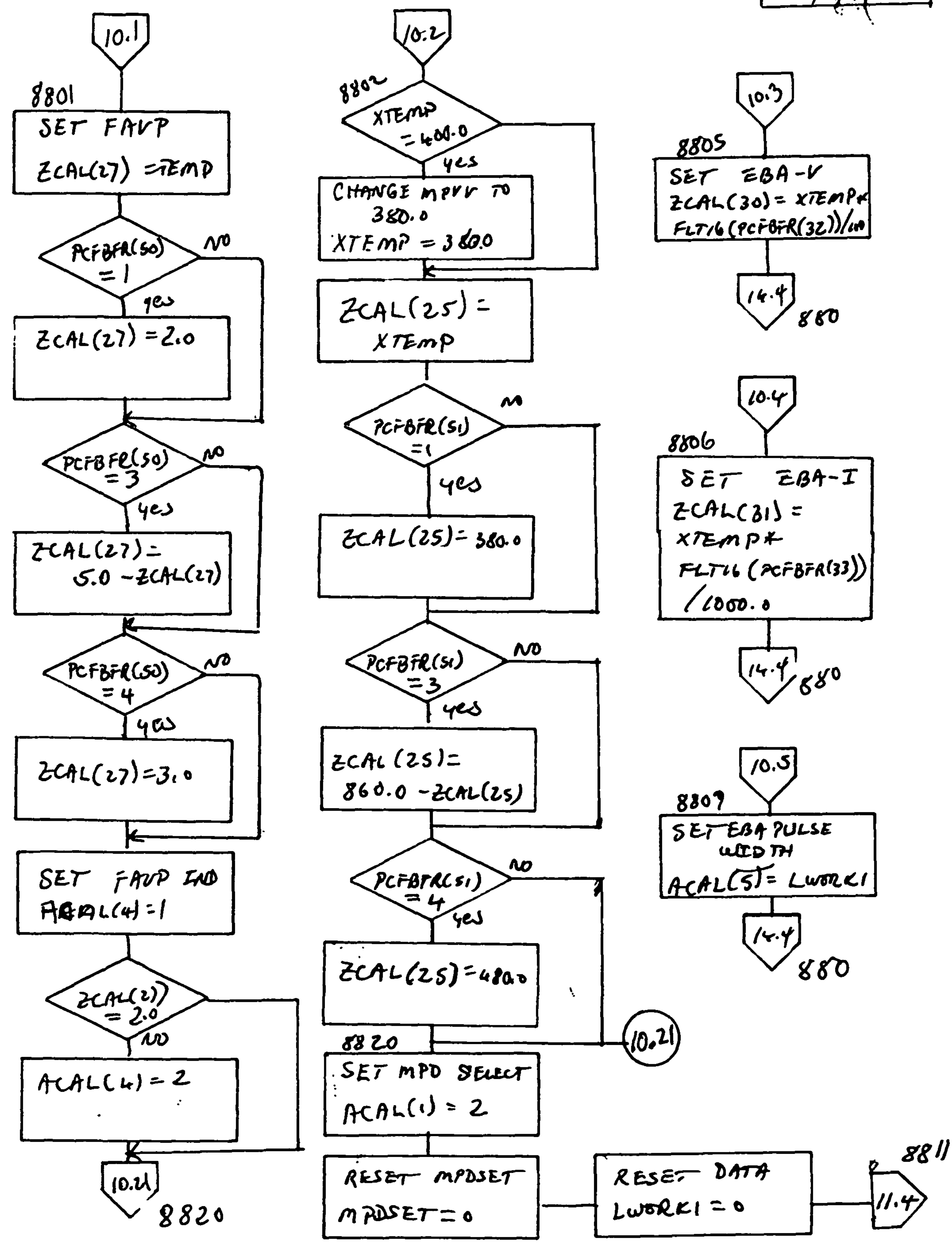
7.1
F8, F9 - SUBROUTINE CALL
7708
7709
INCREMENT SUBROUTINE #
SUBIQ = SUBIQ + 1
SAVE TYPE
SUBTY(SUBIQ) = HEXTB1
SAVE SUBROUTINE INDEX
SUBX(SUBIQ) = IHIND
SAVE TIME
RETIM(SUBIQ) = NTIME
GET NEW INDEX
IHIND = HEXIND (HEXTB2+1)
IF STATE = 1 HEXTB2 = 18
yes
890
7.3
NO
IF HEXTB2 = 11
NO
880
14.4
yes
IF MPDSET = 0
yes
8005
7.4
NO
15 SEC FIRE ?
IF ACAL(1) = 0
yes
880
14.4
NO
FLIP 15 SEC FIRE FLAG
ACAL(1) = 3 - ACAL(1)
7.2
7.2
ACAL(1) = 2
yes
14.4
880
890
SET STATUS FLAG FOR STOP
ISFLG = 2
14.5
888
7.4
MPDSET CALCULATIONS
NOCM = PF1 + PF2 + PF3 + PF4
K = Σ52 65 PCFBFR(Q)
FLT16
ZCAL(13) = FLT16(K)
FLT16
Z = FLT16(PCFBFR(58))
T1 = 2/NOCHG
XXT1 = 20.0 / (FLT16 (PCFBFR(59))
PT = 10*(NOCM/4)* (2/NOCM)*(1+4* PFNTS)
ZCAL(14) = 10.0 * (ZCAL(13)/4.0)* XXT1*(1.0+4.0*Z
T = PT * PFNCV/480.0
ZCAL(15) = ZCAL(14) * ZCAL(25)/480.0
ZT = ZCAL(14)
8.1

PASSX
8/14


8.1
PCFBFR(35) ≠ 0.0
NO
yes
ZT = 0.0
PCBBFR(25) ≠ 0
NO
yes
ZCAL(15) = 10.0
TC = 30-(T+2*T1 +2.3)
XXTC = 300 - ZCAL(15)-2.0* XXT1-23.0
DETERMINE DELAY TIME
ACAL(1) = 0
K = 150
XXTC ≥ 3
yes
8010
8.2
NO
INHIBIT MPD
PMSGN = 13
8.3
8020
8.2
8010
XXTD = XXTC - 150
XXTC ≥ 153
yes
NO
SET FOR 30 SEC FIRE OF MPD
ACAL(1) = 2
K = 300
XXTD = XXTC
PMSGN = 14
8.3
8020
MPDM = 1
yes
NO
PMSGN = 0
yes
8030
8.5
NO
SET BLOCK ID = 0
PBLKI = 0
MPDM = 1
PHEADR
BUILD HEADER
MSOUT1
OUTPUT MESSAGE
8.4
8.4
INHIBIT MPD MESSAGE PMSGN = 13
yes
8037
9.1
NO
RESET MESSAGE#
PMSGN = 0
8.5
8030
COMPUTE MPDSET DELAY
INT16
ACAL(7) = INT16 (ZCAL(15))
INT16
ACAL(8) = INT16 (XXTD)
INT16
ACAL(9) = INT16 (XXT1)
ACAL(10) = K - ACAL(7) - ACAL(8) - 2*ACAL(9) - 23
SET MPDSET
MPDSET = 1
14.4
880

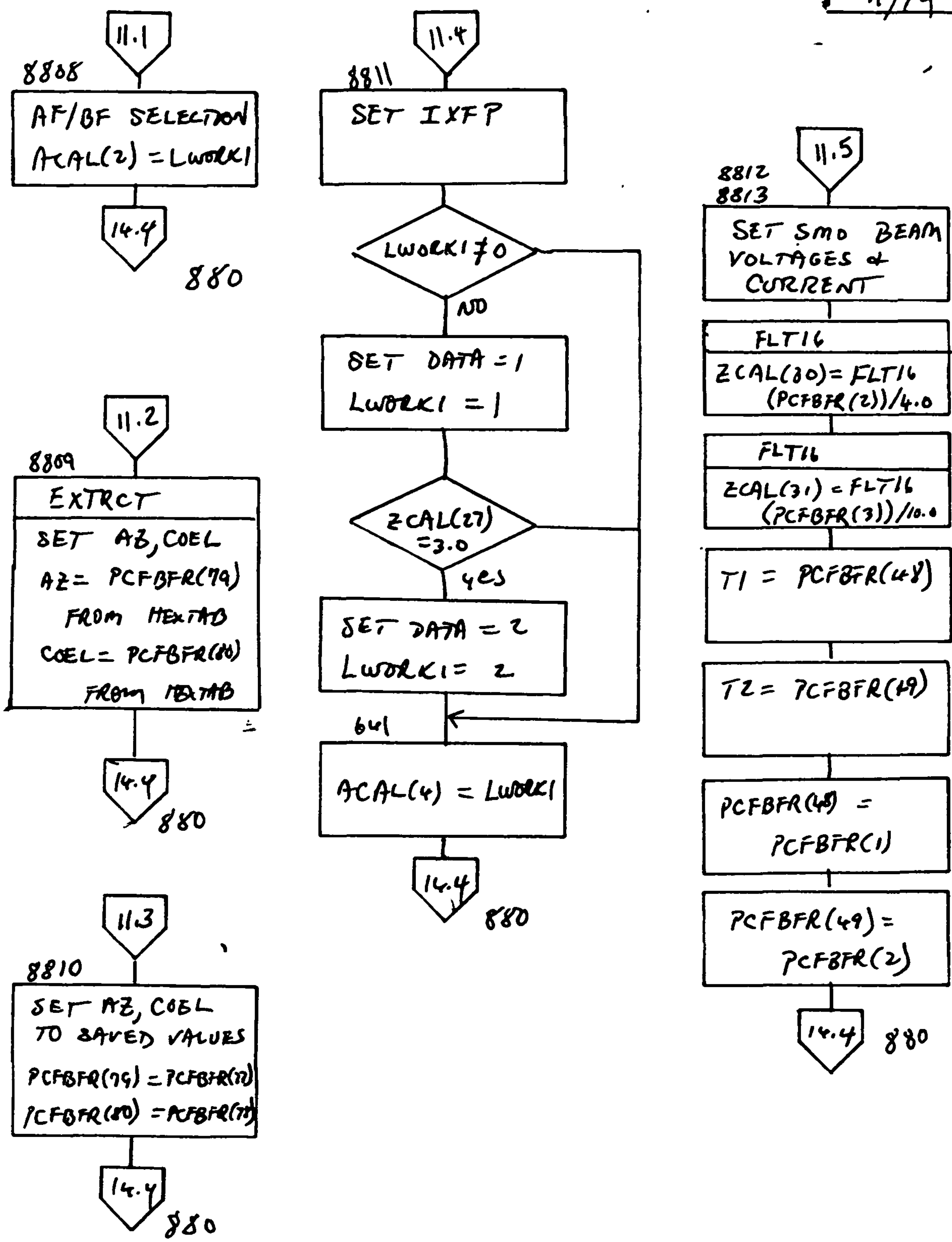

9.1
8037
RESET MESSAGE #
PMSGN = 0
SET ERROR
FOSEL = -1
14.7
999
9.2
F7 = PARAMETER SETTINGS
7707
INCREMENT INDEX
IHIND = IHIND + 1
FETCH DATA
LWORK1 = HEXTAB (IHIND)
LWORK1 ≥ 0
yes
NO
HEXTB2 = 9
yes
NO
MASK DATA
IAND
LWORK1 = LWORK1 ∧ 7FFF
FETCH PCF
LWORK1 = PCFBFR (LWORK1)
171
FLT16
FLOAT DATA
XTEMP = FLT16 (LWORK1)
PARAMETER HEXTB2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
10.1
8801
10.2
8802
14.4
8803
880
14.4
8804
880
10.3
8805
10.4
8806
10.5
8807
11.1
11.2
8809
11.3
8810
11.4
8811
11.5
8812
11.5
8813
12.1
8814
12.2
8815
12.3

PASSX
10/14

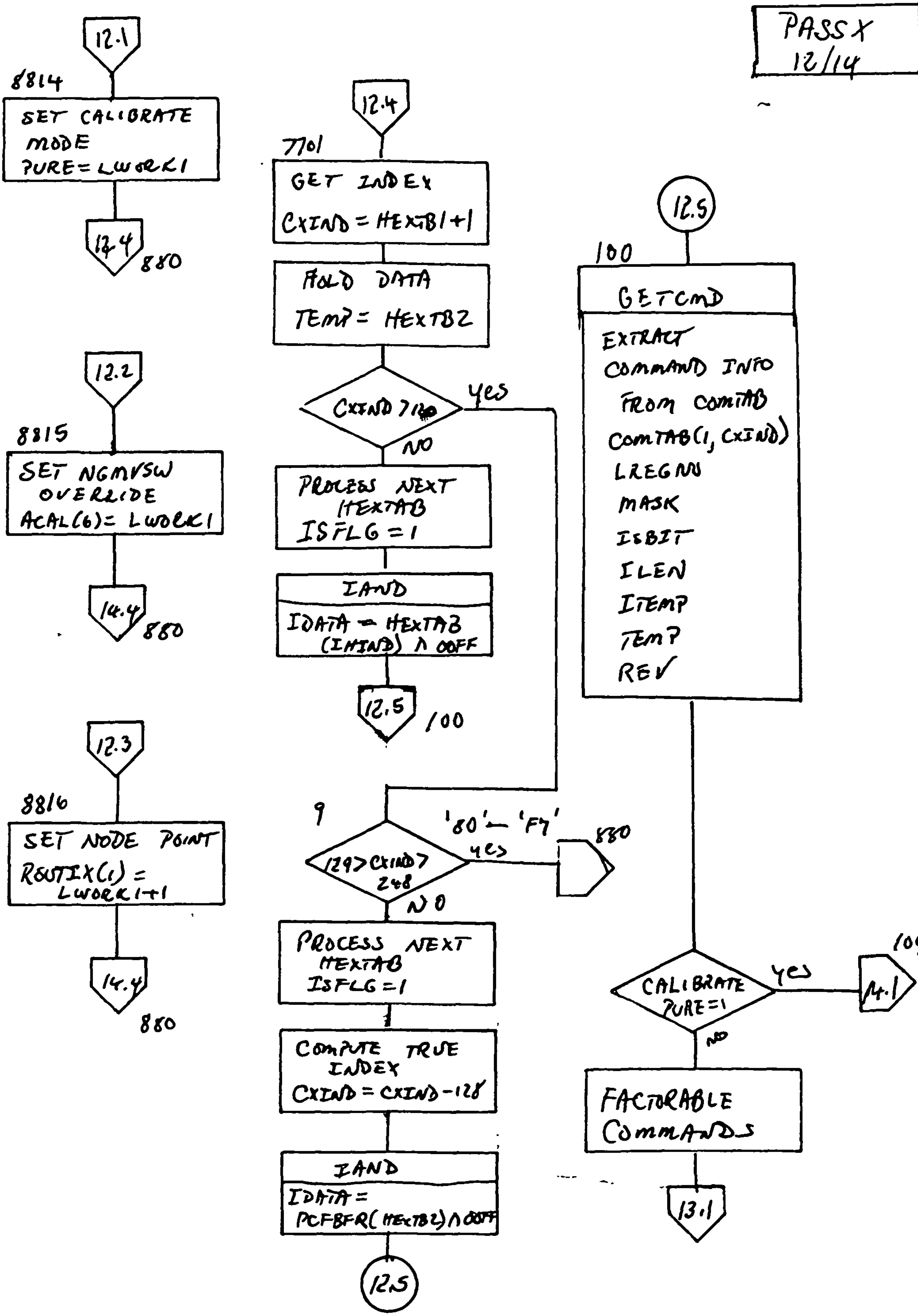


10.1
8801
SET FAVP
ZCAL(27) = TEMP
PCFBFR(50) = 1
NO
yes
ZCAL(27) = 2.0
PCFBFR(50) = 3
NO
yes
ZCAL(27) = 5.0 - ZCAL(27)
PCFBFR(50) = 4
NO
yes
ZCAL(27) = 3.0
SET FAVP IND
ACAL(4) = 1
ZCAL(27) = 2.0
NO
ACAL(4) = 2
10.21
8820
10.2
8802
XTEMP = 400.0
yes
CHANGE MPVV TO 380.0
XTEMP = 380.0
ZCAL(25) = XTEMP
NO
PCFBFR(51) = 1
yes
ZCAL(25) = 380.0
PCFBFR(51) = 3
NO
yes
ZCAL(25) = 860.0 - ZCAL(25)
PCFBFR(51) = 4
NO
yes
ZCAL(25) = 480.0
10.21
8820
SET MPD SELECT
ACAL(1) = 2
RESET MPDSET
MPDSET = 0
RESET DATA
LWORK1 = 0
8811
11.4
10.3
8805
SET EBA-V
ZCAL(30) = XTEMP*
FLT16(PCFBFR(32))/100
14.4
880
10.4
8806
SET EBA-I
ZCAL(31) =
XTEMP*
FLT16(PCFBFR(33))
/1000.0
14.4
880
10.5
8809
SET EBA PULSE WIDTH
ACAL(5) = LWORK1
14.4
880

PASS X
11/14

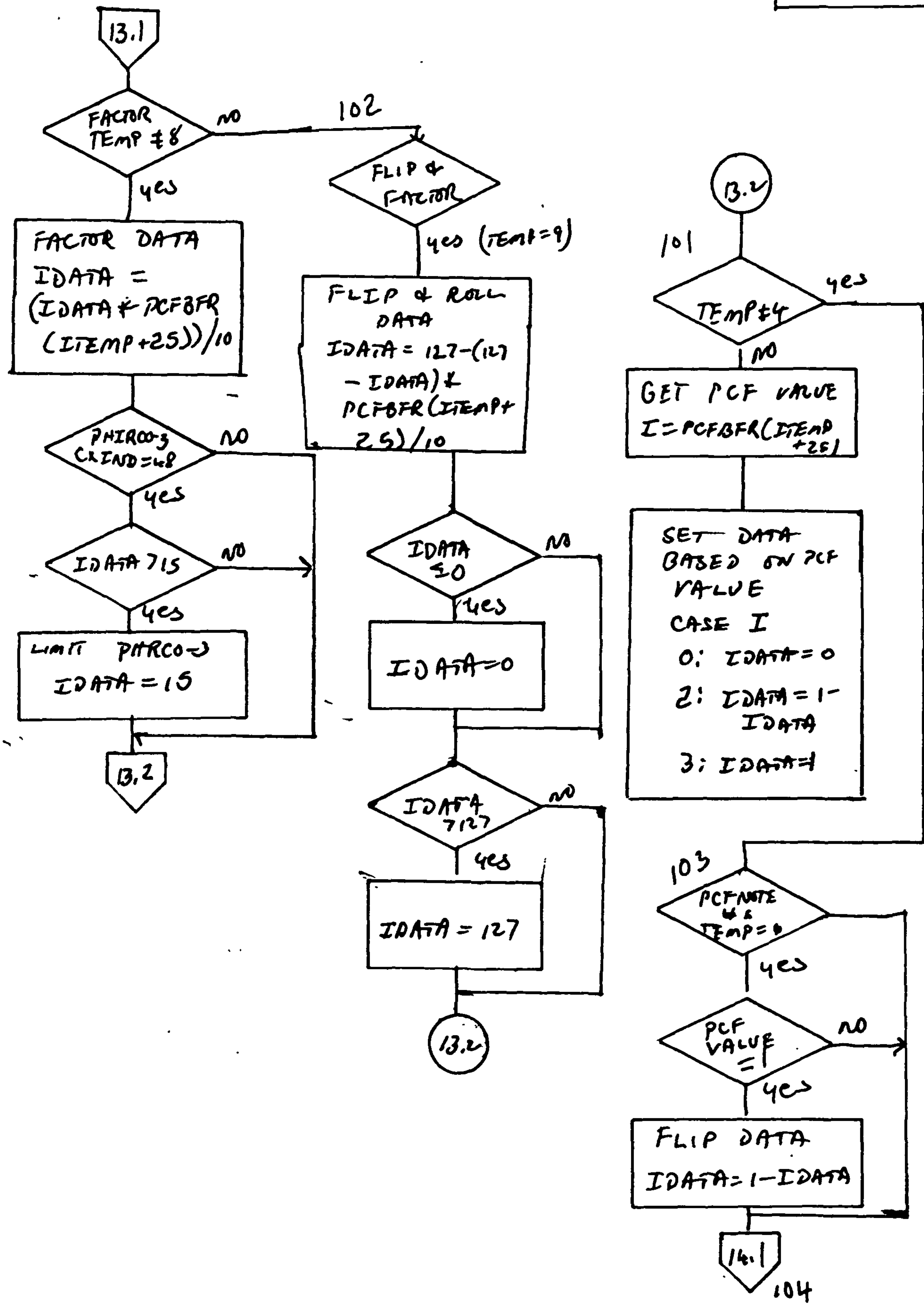

11.1
8808
AF/BF SELECTION
ACAL(2) = LWORK1
14.4
880
11.2
8809
EXTRCT
SET AZ, COEL
AZ = PCFBFR(79)
FROM HEXTAB
COEL = PCFBFR(80)
FROM HEXTAB
14.4
880
11.3
8810
SET AZ, COEL
TO SAVED VALUES
PCFBFR(79) = PCFBFR(77)
PCFBFR(80) = PCFBFR(78)
14.4
880
11.4
8811
SET IXFP
LWORK1 ≠ 0
NO
SET DATA = 1
LWORK1 = 1
ZCAL(27)
= 3.0
yes
SET DATA = 2
LWORK1 = 2
641
ACAL(4) = LWORK1
14.4
880
11.5
8812
8813
SET SMO BEAM
VOLTAGES &
CURRENT
FLT16
ZCAL(30) = FLT16
(PCFBFR(2))/4.0
FLT16
ZCAL(31) = FLT16
(PCFBFR(3))/10.0
T1 = PCFBFR(48)
T2 = PCFBFR(49)
PCFBFR(48) =
PCFBFR(1)
PCFBFR(49) =
PCFBFR(2)
14.4
880

PASSX
12/14



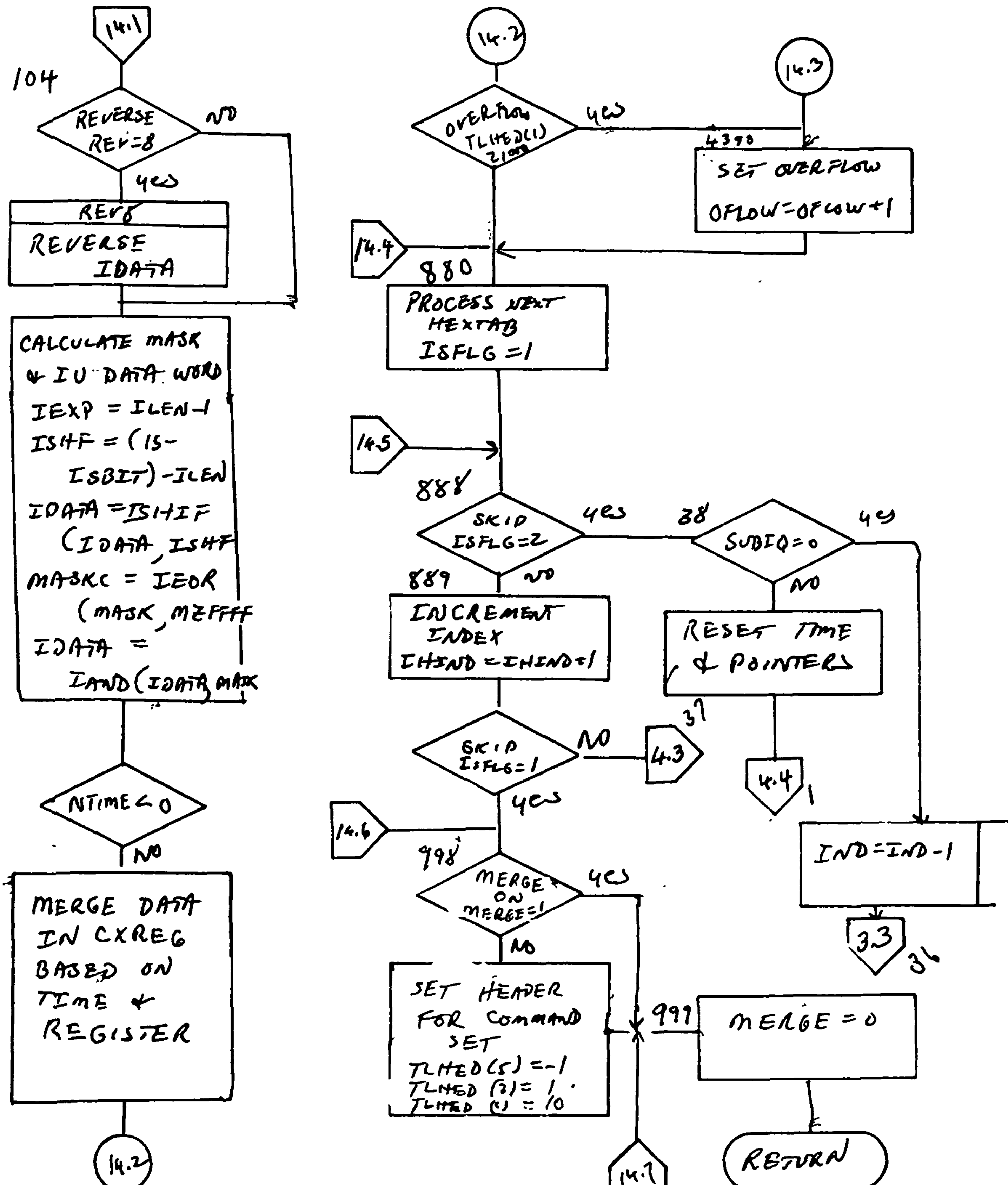
12.1
8814
SET CALIBRATE MODE
PURE=LWORK1
12.4
880
12.2
8815
SET NGMVSW OVERRIDE
ACAL(6)= LWORK1
14.4
880
12.3
8816
SET NODE POINT
ROUTIX(1) = LWORK1+1
14.4
880
12.4
7701
GET INDEX
CXIND = HEXTB1+1
HOLD DATA
TEMP = HEXTB2
CXIND 7 127
yes
NO
PROCESS NEXT HEXTAB
ISFLG = 1
IAND
IDATA = HEXTAB (IHIND) ∧ 00FF
12.5
100
9
'80' — 'F7'
yes
880
129 > CXIND 7 248
NO
PROCESS NEXT HEXTAB
ISFLG = 1
COMPUTE TRUE INDEX
CXIND = CXIND-128
IAND
IDATA = PCFBFR(HEXTB2) ∧ 00FF
12.5
12.5
100
GETCMD
EXTRACT COMMAND INFO FROM COMTAB
COMTAB(1, CXIND)
LREGNO
MASK
ISBIT
ILEN
ITEMP
TEMP
REV
CALIBRATE PURE=1
yes
104
14.1
NO
FACTORABLE COMMANDS
13.1

PASSX

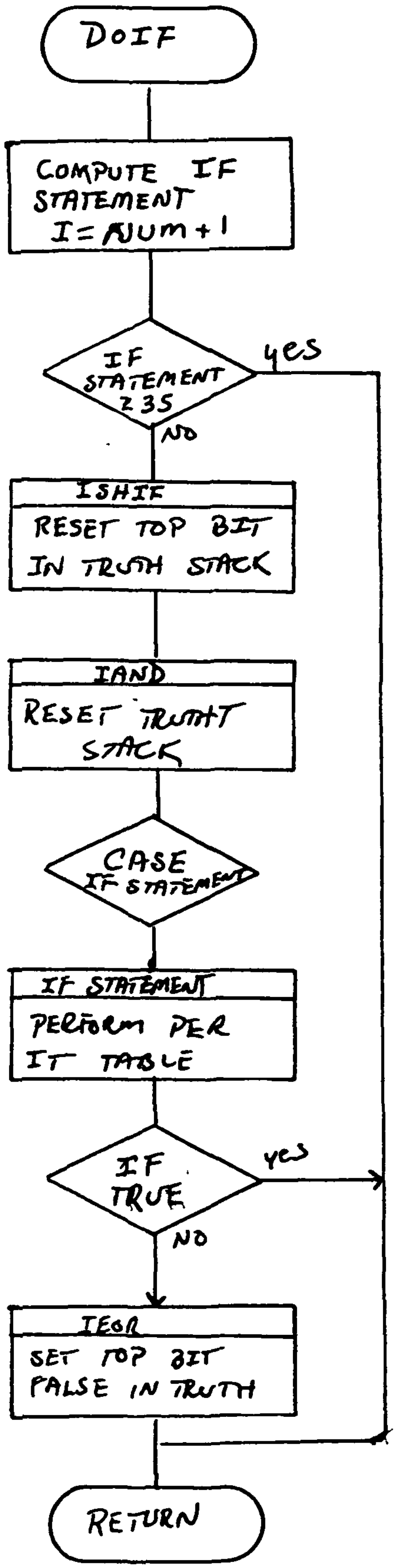


13.1
FACTOR TEMP ≠ 8
NO
102
YES
FACTOR DATA
IDATA = (IDATA * PCFBFR (ITEMP+25))/10
FLIP & FACTOR
YES (TEMP=9)
FLIP & ROLL DATA
IDATA = 127-(127 - IDATA) * PCFBFR(ITEMP+25)/10
PHIRCO-3 CKIND=48
NO
YES
IDATA > 15
NO
YES
LIMIT PHRCO-3
IDATA = 15
13.2
IDATA ≤ 0
NO
YES
IDATA = 0
IDATA > 127
NO
YES
IDATA = 127
13.2
13.2
101
TEMP ≠ 4
YES
NO
GET PCF VALUE
I = PCFBFR(ITEMP+25)
SET DATA BASED ON PCF VALUE
CASE I
0: IDATA = 0
2: IDATA = 1-IDATA
3: IDATA = 1
103
PCFNOTE ≠ 6 TEMP = 6
YES
PCF VALUE = 1
NO
YES
FLIP DATA
IDATA = 1-IDATA
14.1
104

PASSX


14.1
104
REVERSE REV=8
NO
YES
REV8
REVERSE IDATA
CALCULATE MASK & IU DATA WORD
IEXP = ILEN-1
ISHF = (15-ISBIT)-ILEN
IDATA = ISHIF (IDATA, ISHF
MASKC = IEOR (MASK, MZFFFF
IDATA = IAND(IDATA, MASK
NTIME < 0
NO
MERGE DATA IN CXREG BASED ON TIME & REGISTER
14.2
14.2
OVERFLOW TLHED(1) Z1000
YES
14.3
4390
SET OVERFLOW
OFLOW=OFLOW+1
14.4
880
PROCESS NEXT HEXTAB
ISFLG =1
14.5
888
SKIP ISFLG=2
YES
38
SUBIQ=0
YES
889
NO
NO
INCREMENT INDEX
IHIND =IHIND+1
RESET TIME & POINTERS
SKIP ISFLG=1
NO
4.3
37
4.4
YES
14.6
998
IND=IND-1
MERGE ON MERGE=1
YES
NO
33
36
SET HEADER FOR COMMAND SET
TLHED(5)=-1
TLHED (3)= 1
TLHED (1) = 10
999
MERGE = 0
14.7
RETURN

IF STATEMENT
PROCESSING



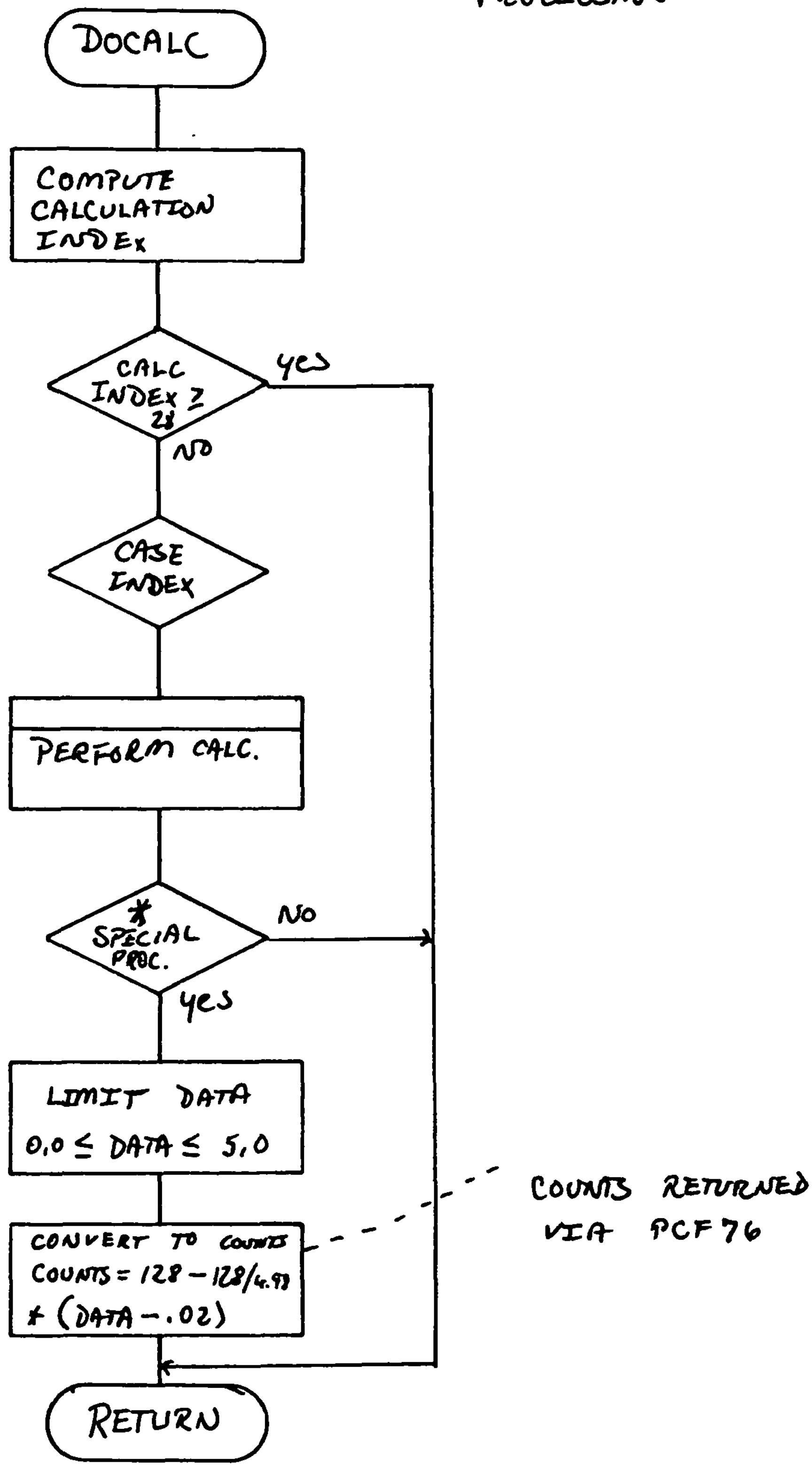
DOIF
2/3

IF	STATEMENT	COMMENTS
1	ICNT = 0	ICNT = PCF45
2	ICNT ≠ 0	ICNT = PCF45
3	IB ≥ IBO	IB = ZCAL31, IBO = ZCAL5
4	IB < IBO	IB = ZCAL31, IBO = ZCAL5
5	IB ≥ IBC	IB = ZCAL31, IBC = ZCAL6
6	IB < IBC	IB = ZCAL31, IBC = ZCAL6
7	THETA = 0	THETA = PCF 48 OR PCF49 PCF 48 & 49 ALTERNATED EVERY 1 MINUTE
8	THETA ≠ 0	Same as 8
9	THETXO ≥ 0	THETXO = ZCAL16
10	THETXO < 0	THETXO = ZCAL16
11	THETYO ≥ 0	THETYO = ZCAL17
12	THETYO < 0	THETYO = ZCAL17
13	PT > 25	PT = ZCAL14
14	ANGL = 0	ANGL = PCF 71
15	ANGL ≠ 0	ANGL = PCF71
16	EHVC = 1	EHVC = PCF70
17	EHVC ≠ 1	EHVC = PCF70

DOIF
3/3

IF	STATEMENT	COMMENTS
18	VFON = 1	VFON = PCF72
19	VFON ≠ 1	VFON = PCF72
20	IXFP = 1	IXFP = ACAL4
21	IXFP ≠ 1	IXFP = ACAL4
22	VB > VBMAX	VB= ZCAL30, VBMAX= ZCAL2
23	IB > IBMAX	IB = ZCAL31, IBMAX = ZCAL3
24	CNT = 1	CNT = PCF45
25	PWIDTH < 10	PWIDTH = ACAL5
26	FO # 2	FONUM(1) = FO#
27	PWIDTH ≥ 10	PWIDTH = ACAL5
28	TRGCFO = 0	TRGCFO = PCF60
29	TRGCFO ≠ 0	TRGCFO = PCF60
30	PWIDTH ≥ 1.0	PWIDTH = ACAL5
31	SMO THETA = 0	SMO THETA = PCF1
32	SMO THETA ≠ 0	SMO THETA = PCF1
33	NOT FO#2	FO# = FONUM(1)
34	NOT (NGMVSW & FO#4)	NGMVSW = ACAL6 FO# = FONUM(1)

CALCULATION STATEMENT PROCESSING



DOCALC
2/5

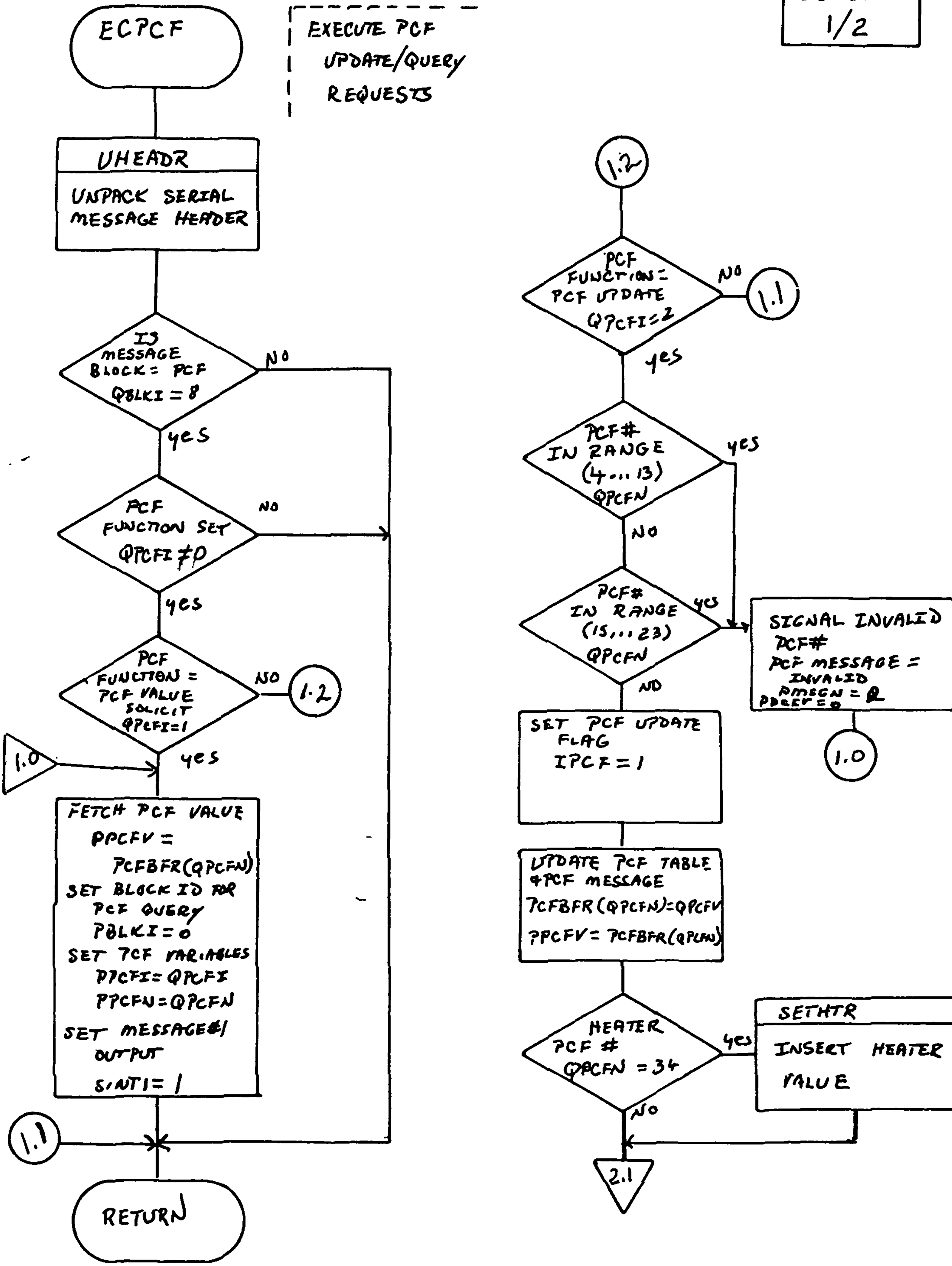
#	CALCULATION	COMMENTS	
1	$L = \sum_{i=1}^{6} HVCSW_i$	L = ZCAL 1 $HVCSW_{i_{1...6}}$ = PCF 39... 44	
2	VBMAX = 1.25 * L	VBMAX = ZCAL 2 L = ZCAL 1	
3	$IBMAX = 7.8E\text{-}2 * (VBMAX)^{1.5}$	IBMAX = ZCAL 3 VBMAX = ZCAL 2	
4	HTRADJ = AH * I + BH	HTRADJ = ZCAL 4 I = PCF 34	*
5	$IBO = 1.56E\text{-}2 * VB^{1.5}$	IBO = ZCAL 5 VB = ZCAL 30	
6	IBC = 5.1 E-3 * VB	IBC = ZCAL 6 VB = ZCAL 30	
7	$BMCADJ = (AIB * (IB + BIB * VB + CIB)^{2/3} + DIB) / VB$ IF VB = 0 THEN BMCADJ = 0.0	BMCADJ = ZCAL 7 VB = ZCAL 31	*
8	IF VB = 0 THEN BMCADJ = 0.0 ELSE $BMCADJ = \dfrac{(IB/IBC) * (AIB1 * (IBC + BIB * VB + CIB)^{2/3} + DIB}{VB}$	BMCADJ = ZCAL 8 IB = ZCAL 31 IBC = ZCAL 6 VB = ZCAL 30	*

DOCALC
3/5

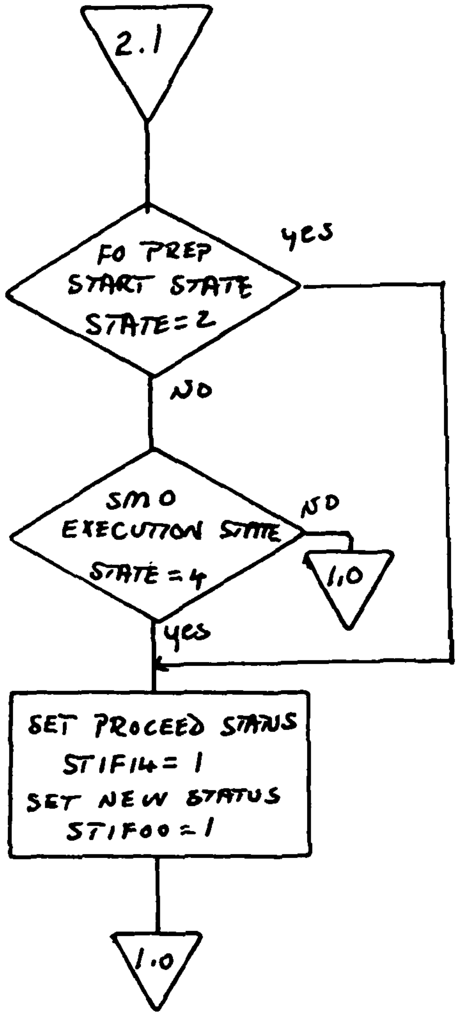
#	CALCULATION	COMMENTS	
9	$BMVADJ = AVB * VB + BVB$	BMVADJ = ZCAL9 VB = ZCAL30	*
10	$FOCCN = (AF * AF\emptyset) * VB^{1/8} * IB^{1/4} + BF$	FOCCN = ZCAL10 VB = ZCAL30 IB = ZCAL31 $AF, BF = \left\{\begin{matrix} 1.0, & 0.05 \\ 1.15, & 0.05 \\ .85, & 0.05 \\ 0.0, & 2.58 \\ 0.0, & 2.26 \end{matrix}\right\}$ SELECT BY ACAL2	*
11	$DEFCNX = AX * VB^{1/2} * \lvert THETXO \rvert + CX$	DEFCNX = ZCAL11 VB = ZCAL30 THETXO = ZCAL16	*
12	$DEFCNY = AY + VB^{1/2} * \lvert THETYO \rvert + CY$	DEFCNY = ZCAL12 VB = ZCAL30 THETYO = ZCAL17	*
13	$NOCM = \sum_{i=1}^{4} PF_i$	NOCM = ZCAL13 $PF_{i, 1 \ldots 6}$ = PCF52...55	

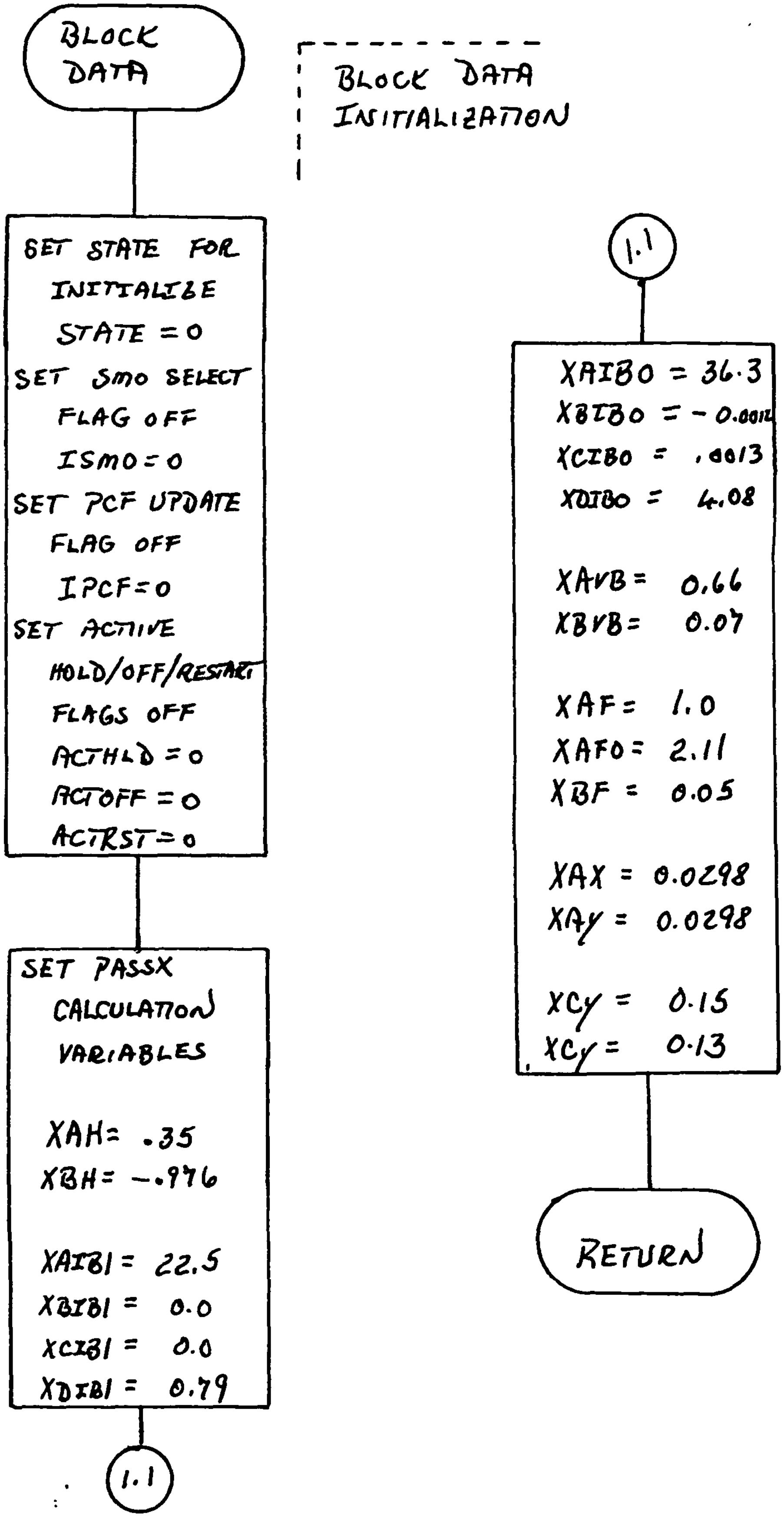
#	CALCULATION	COMMENTS
14	VB = VBMAX	VB = ZCAL30 VBMAX = ZCAL2
15	IB = IBMAX	IB = ZCAL31 IBMAX = ZCAL3
16	EDØ-3 = (TAUEM + 500)/100	EDØ-3 = PCF76 TAUEM = PCF 26
17	AIB1 = 22.5, BIB2 = 0.0, CIB1 = 0.0 DIB1 = 0.79	
18	AIB1 = 36.3, BIB1 = -1.2E-3, CIB1 = 1.3E-3 DIB1 = 4.08	
19	EBA AZ = ARCTAN (TAN (COEL - PITCH) * COS (AZ)) EBA COEL = ARCTAN (TAN (COEL - PITCH) * SIN (AZ))	EBA AZ = ZCAL16 EBA COEL = ZCAL17 PITCH = PCF48 OR 49 ALTERNATE 1 MIN COEL = MAG. FIELD BLOCK10 AZ = MAG. FIELD BLOCK10
20	$IB = .078 * VB^{1.5}$	IB = ZCAL31 VB = ZCAL30
21		NOT USED

#	CALCULATIONS	COMMENTS
22	POSITION AZ, COEL AZ = (270.0 − MFAZ)) * 255.0 / 180.0 COEL = (MFCOEL + 30.0) * 255.0 / 150.0	AZ = PCF 77 COEL = PCF 78
23	IF PWIDTH < .1 THEN EPW = PWIDTH * 100 ; EPWM = 1 IF PWIDTH < 1.0 THEN EPW = PWIDTH * 10 ; EPWM = 2 IF PWIDTH < 10.0 THEN EPW = PWIDTH ; EPWM = 3	PWIDTH = ACAL5 EPW = PCF 76 EPWM = PCF 77
24	EDMO-3 = PWIDTH	PWIDTH = ACAL 5 EDMO-3 = PCF 76
25	IF (PWIDTH .GE. 2.55) PWIDTH = 2.55	PWIDTH = ACAL 5
26	NOT USED	
27	SMOOTHED	


ECPCF
EXECUTE PCF UPDATE/QUERY REQUESTS
UHEADR
UNPACK SERIAL MESSAGE HEADER
IS MESSAGE BLOCK = PCF QBLKI = 8
NO
yes
PCF FUNCTION SET QPCFI ≠ 0
NO
yes
PCF FUNCTION = PCF VALUE SOLICIT QPCFI=1
NO
1.2
yes
1.0
FETCH PCF VALUE
PPCFV = PCFBFR(QPCFN)
SET BLOCK ID FOR PCF QUERY
PBLKI = 0
SET PCF VARIABLES
PPCFI = QPCFI
PPCFN = QPCFN
SET MESSAGE#1 OUTPUT
SINTI = 1
1.1
RETURN
1.2
PCF FUNCTION = PCF UPDATE QPCFI = 2
NO
1.1
yes
PCF# IN RANGE (4... 13) QPCFN
yes
NO
PCF# IN RANGE (15,... 23) QPCFN
yes
NO
SIGNAL INVALID PCF#
PCF MESSAGE = INVALID
PMSGN = R
PDCEF = 0
1.0
SET PCF UPDATE FLAG
IPCF = 1
UPDATE PCF TABLE & PCF MESSAGE
PCFBFR(QPCFN)=QPCFV
PPCFV = PCFBFR(QPCFN)
HEATER PCF # QPCFN = 34
yes
SETHTR
INSERT HEATER VALUE
NO
2.1

ECPCF
2/2


2.1
FO PREP
START STATE
STATE=2
yes
NO
SMO
EXECUTION STATE
STATE=4
NO
1,0
yes
SET PROCEED STATUS
STIF14=1
SET NEW STATUS
STIF00=1
1.0


BLOCK DATA
BLOCK DATA INITIALIZATION
SET STATE FOR INITIALIZE
STATE = 0
SET SMO SELECT FLAG OFF
ISMO = 0
SET PCF UPDATE FLAG OFF
IPCF = 0
SET ACTIVE HOLD/OFF/RESTART FLAGS OFF
ACTHLD = 0
ACTOFF = 0
ACTRST = 0
SET PASSX CALCULATION VARIABLES
XAH = .35
XBH = -.976
XAIBI = 22.5
XBIBI = 0.0
XCIBI = 0.0
XDIBI = 0.79
1.1
1.1
XAIBO = 36.3
XBIBO = -0.0012
XCIBO = .0013
XDIBO = 4.08
XAVB = 0.66
XBVB = 0.07
XAF = 1.0
XAFO = 2.11
XBF = 0.05
XAX = 0.0298
XAY = 0.0298
XCY = 0.15
XCY = 0.13
RETURN

APPENDIX B

PATCH LOG

SEPAC

FLIGHT SOFTWARE

VERSION 3

PATCH LOG

INTERMETRICS INCORPORATED • 3322 S MEMORIAL PKWY., HUNTSVILLE ALABAMA 35801 • (205) 883-6860
CORPORATE OFFICE 733 CONCORD AVENUE • CAMBRIDGE MASSACHUSETTS 02138 • (617) 661-1840

SEPAC SOFTWARE PATCH SHEET

DATE:

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ADDRESS	PATCH	MNEMONICS	COMMENTS
1CFØ	5010 DØØC	ST 1,12(13)	C22DWN:
2012	47EØ	BE —	ECSMO:
220C	47ØØ	NOP	MANUAL:
2B24	9Ø16	STM 1,6 -	MODSEQ
2B2C	1852 DØØC	LR 5,2 ?	
	B86Ø ØØØ9	LHI 6,9	
	928Ø 5ØØ2	MVI 2(5),'80'	
	BA5Ø ØØØ2	AHI 5,2	
	466Ø FØØE	BCT 6,14(15)	
954	F8A7		HEXTAB:
5ØC	ØØØ5		DRIVER:
8DA	92FF Ø64C	MVI A(64C),'FF'	
19Ø	ØØØØ ØØØØ		
			ECSMO:
2ØØ4	47FØ Ø194	B Q1	
Ø194	A8FØ D8A8	Q1 LSI 15,A(7CF3FR)	
Ø195	D2Ø3 FØ5E	MVC 64(4,15),A(19E)	
	Ø19Ø		
Ø19E	74FØ C1B8	LS 15,A(ECSMO)	
Ø1A2	47FØ CØ4Ø	B RETURN	

SEPAC SOFTWARE PATCH SHEET

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ADDRESS	PATCH	MNEMONICS	COMMENTS
8D96	47FØ Ø1A6	E2 B .Ø2	PASSX:
Ø1A6	A8FØ D8A8	.Ø2 LSI 15, A(PCFØFR)	
Ø1AA	D2Ø3 Ø19Ø	MVC Ø(4, A(15:)), 94(15)	
	FØ5E		
Ø1BØ	D2Ø1 FØ5E	MVC 94(2, 15), Ø(15)	
	FØØØ		
Ø1B6	D2Ø1 FØ6Ø	MVC 96(2, 15), Ø(15)	
	FØØØ		
Ø1BC	47FØ C43Ø	B .E2+4	
7D18	47FØ Ø1CØ	.E3 B .Ø3	HOLD, SETFOSEL=35
Ø1CØ	41ØØ ØØ23	.Ø3 LA Ø, 35	
Ø1C4	4ØØØ BØEØ	STH Ø, Ø(11)	
Ø1C8	47FØ DC6E	B .E3+4	
864	95FF ØØ54	CLI A(54), 'FF'	EXTINT
868	478Ø C416	BE	
	AE2Ø ØØØ3		DRIVER
	477Ø C144		

SEPAC SOFTWARE PATCH SHEET

DATE:

ADDRESS	PATCH	MNEMONICS	COMMENTS
			EARLY 1HZ RECOVERY
1DØ	D5Ø1 ØØ1E Ø246	CLC 30(2),EXHIGH	IGNORE 1HZ WHILE IN;
1D6	474Ø Ø22Ø	BL .L1	RTCMD F2Ø - 1ØB4
1DA	D5Ø1 ØØ1E Ø248	CLC 30(2),EXTLOW	AEPION-AEPIOF 219Ø - 21FØ
1EØ	474Ø Ø22E	BL RETRN	IUCMD 1E5Ø - 1F76
1E4	D5Ø1 ØØ1E Ø24A	CLC 30(2),RTLHIGH	EXTINT 86E - 8CE
1EA	474Ø Ø22Ø	BL .L1	
1EE	D5Ø1 ØØ1E Ø24C	CLC 30(2),RTLLOW	
1F4	474Ø Ø22E	BL RETRN	
1F8	D5Ø1 ØØ1E Ø24E	CLC 30(2),IULHIGH	
1FE	474Ø Ø22Ø	BL .L1	
2Ø2	D5Ø1 ØØ1E Ø25Ø	CLC 30(2),IULLOW	
2Ø8	474Ø Ø22E	BL RETRN	
2ØC	D5Ø1 ØØ1E Ø252	CLC 30(2),AEPHIGH	
212	474Ø Ø22Ø	BL .L1	
216	D5Ø1 ØØ1E Ø25A	CLC 30(2),AEPLOW	
21C	474Ø Ø22E	BL RETRN	
22Ø	D2Ø7 Ø26Ø ØC18	.L1 MVC (8,A(15)),A(16C)	
226	9ØØF ØØCØ	STM Ø,15,EXTINTSV	
22A	47FØ ØB54	B A(854)	
22E	5Ø3Ø Ø258	RTRN ST 3,SAVE3	
232	483Ø Ø256	LH 3,CT	
236	8A3Ø ØØØ1	AHI 3,1	
23A	4Ø3Ø Ø256	STH 3,CT	
23E	583Ø Ø258	L 3,SAVE3	
242	82ØØ ØØ18	EH77 LPSW 18	
246	Ø86E	EXTHIGH DC H'86E'	
248	Ø8CE	EXTLOW DC H'8CE'	
24A	ØF2Ø	RTLHIGH DC H'F2Ø'	
24C	10B4	RTLLOW DC H'1ØB4'	
24E	1E5Ø	IULHIGH DC H'1E5Ø'	
25Ø	1F76	IULLOW DC H'1F76'	
252	219Ø	AEPHIGH DC H'219Ø'	
254	21FØ	AEPLOW DC H'21FØ'	
256	ØØØØ	CT DC H'Ø'	
	cont		

SEPAC SOFTWARE PATCH SHEET

DATE:

ADDRESS	PATCH	MNEMONICS	COMMENTS
258		SAVE3 DS F	
26Ø		SPSW DS 2F	
268			
85Ø	47FØ Ø1DØ	B .1DØ	
8CC	Ø26Ø		
PATCH #9	DON'T RUN FAV	PON @ T=0 FOR	FO'S ON RESTART
887C	47FØ Ø268	B .P91	PASSX: (AØC)
268	48ØØ D328	.P91 LH Ø, HEXTB2	
26C	A9ØØ ØØ12	CSI Ø, 18	
27Ø	477Ø D9E8	BNE PASSX(A1Ø)	
274	5Ø3Ø Ø294	ST 3, S3	
278	1B33	SR 3, 3	
27A	A83Ø A6C8	LSI 3, A(DFPCOM)	
27E	483Ø 3ØØØ	LH 3, Ø(3)	STATE
282	A93Ø ØØØB	CSI 3, 11	
286	583Ø Ø294	L 3, S3	
28A	478Ø DA1E	BE P, +A(89Ø)	
28E	47FØ D9E8	B P+A(81Ø)	
294		S3 DS F	
298			
PATCH #5	SAVES 32 BITS	FROM 'DEPRTC' FOR	HVCCST
73B8	47ØØ	NOP	(+AE)
	ALLOW HOLD AF	TER '60 SECS TO PWR	OFF'
7B64	DDA2		A(C54)

SEPAC SOFTWARE PATCH SHEET

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ADDRESS	PATCH	MNEMONICS	COMMENTS
PATCH # 9,10	ALLOW OFF SEQ COMMAND		
72DE	40A0 7000	STH 10, STIF00	
72E2	40A0 7008	STH 10, STIF04	
72E6	1B00	SR 0, 0	
72E8	4000 9008	STH 0, CMIF04	
72EC	4000 7012	STH 0, STIF04	
72F0	4000 601E	STH 0, TIMEX	
72F4	4100 0016	LHI 0, 22	
72F8	4000 B000	STH 0, FOSEL	
72FC	4700 0000	NOP	
7300	1B00	SR 0, 0	
7302	1B00	SR 0, 0	
7306			
7318	0009		
PATCH # 13	MPDSET CHANGE		
43C0	F9D8		
43D0	F9D9		
697E	FAD8		
6980	6C01		
6982	CA3A		
6984	FAFE		
6986	FAD9		
6988	4200		
698A	4A00		
698C	FAFE		
6BD0	1478		
6BD2	147C		

SEPAC SOFTWARE PATCH SHEET

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ADDRESS	PATCH	MNEMONICS	COMMENTS
PATCH # 11	OFF SEQ		
1348	4100 0000	LA 0,0	(438)
	58F0 D21C	L 15,	
	4003 F000	ST 3, LMWRD1	
	47F0 0298	B .P11-1	
	40A3 F000	ST 10, STWRD1	
298	58F0 D20C	.P11-1 L 15, "D20C"	
29C	D930 0012	LSI 3, 12	
2A0	4770 02BA	BNE .P11-2	
2A4	5030 0294	ST 3, A(0294)	
2A8	1B33	SR 3, 3	
2AA	A830 A6C8	LSI 3, A(A6C8)	
2AE	4830 3000	LH 3, 0(3)	
2B2	A930 0008	CSI 3, 8	
2B6	4780 D3AE	BE "D3AE"	
2BA	47F0 D420	.P11-2 B "D420"	
2BE			
	CHANGE DEFAULT OF CNT FOR		FO's 4, 9a, 9b, 9c, 10, 11
			PCFTAB
3972	017F		(C2)
3B9E	017F		(1EE)
3BD0	017F		(220)
3C02	017F		(252)
3C34	017F		(284)
3C66	017F		(2B6)

SEPAC SOFTWARE PATCH SHEET

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ADDRESS	PATCH	MNEMONICS	COMMENTS
			ADJUST PREP START FOR MFO
PATCH #8			SEPAC M
7642	95∅∅ D1AB	CLI ∅, A(D1AB)	(732)
7646	477∅ D726	BNE .L1	
7652	58F∅ D1EC	L 15, A(D1EC)	(742)
7656	4133 F∅∅2	LA 3, F∅∅2	
765A	5∅3∅ D∅AC	ST 3, A(D∅AC)	
765E	41∅∅ B∅2∅	.L1 LA ∅, 2∅2∅	
7662	5∅∅∅ D∅A8	ST ∅, A(D∅A8)	
PATCH #14			
7C82	45E∅ ∅2BE	BAL A(2BE)	
2BE	4∅∅∅ 6∅∅2	STH ∅, 6∅∅2	
2C2	92∅2 D∅AE	MVI 2, A(D∅AE)	
2C6	92CC D∅AF	MVI 'CC', (D)+∅AF	
2CA	∅7FE	BR 14	
2CC	FFEC		
7C9E	45E∅ ∅2CE	BAL A(∅2CE)	(D8E)
2CE	40A∅ D1AC	STH 10, (D)+1AC	
2D2	47F∅ D2C2	B (D)+2C2	
2D6			
PATCH #20			
7CBA	45E∅ ∅2D6	BAL ∅2D6	(DAA)
2D6	40A∅ D1AC	ST 10, A(D1AC)	
2DA	92∅2 D∅AE	MVI '02', (D)+AE	
2DE	92E4 D∅AF	MVI 'E4', (D)+AF	
2E2	∅7FE	BR 14	
2E4	FF88		

SEPAC SOFTWARE PATCH SHEET

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ADDRESS	PATCH	MNEMONICS	COMMENTS
PATCH #21/22	FAKE MTV	OFF SEQ	OFFSEQ:
2B3E	4560 02E6	BAL 02E6	(2A6)
02E6	1B11	SR 1,1	
02E8	A810 A6C8	LSI 1,A(A6C8)'	
02EC	4810 1000	LH 1,0(1)	
02F0	B850 3907	LHI 5,'3907'	
02F4	922E 5000	MVI '2E',0(5)	
02F8	A910 0007	LSI 1,7	
02FC	4780 0304	BE 0304	
0300	92DA 5000	MVI 'DA',0(5)	
0304	1856	LR 5,6	
0306	4864 0000	LH 6,0(4)	
030A	07F5	BR 5	
030C			
68D4	1480		
698E	FADA		MTVOFF
	0C01		LENCS=1
	0B00		VIDEOA=0
	0901		LENISL=1
	077F		LENIS=0V
	0A01		SENSL=1
	077F		SENAD=0V
	0D01		TEST=1
	FD0A		DELAY 1.0
	0D00		TEST=0
6998	F9C5		CALL MTVX
699A	FAFE		

SEPAC SOFTWARE PATCH SHEET

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ADDRESS	PATCH	MNEMONICS	COMMENTS
	OVERRIDE MPD	INHIBIT IN GROUND	TEST MODE
895Ø	45EØ Ø3ØC		PASSX: (AEØ) BAL Ø3ØC
3ØC	7Ø2Ø 9ØD6	STE 2, ZCAL	
31Ø	95ØØ 9Ø33	CLI Ø, 31(9)	
314	Ø78E	BRE 14	
316	782Ø Ø32Ø	LE 2, K10.	
31A	7Ø2Ø 9ØD6	STE 2, ZCAL	
31E	Ø7FE	BR 14	
32Ø	41AØ ØØØØ	K1Ø DC E(10.0)	
896Ø	45EØ Ø324	BAL 14, 324	(AFØ)
324	7Ø2Ø 9ØDA	STE 2, ZCAL	
328	95ØØ 9Ø33	CLI Ø, 31(9)	
32C	Ø78E	BRE 14	
32E	782Ø Ø32Ø	LE 2, K1Ø	
332	7Ø2Ø 9ØDA	STE 2, ZCAL	
336	Ø7FE	BR 14	
	DISPLAY ONLY	ONE 'MPD 3Ø SECOND'	MESSAGE
89E8	45EØ Ø338	BAL Ø338	SEPACM: (A78)
338	93ØØ Ø34E	TS 34E	
33C	477Ø DBAC	BNE (D)+BAC	
34Ø	12ØØ	LTR Ø, Ø	
342	478Ø DBB8	BE (D)+BB8	
346	Ø7FE	BR 14	

SEPAC SOFTWARE PATCH SHEET

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ADDRESS	PATCH	MNEMONICS	COMMENTS
	MOVE SMO COMPLETE MESSAGE TO		SMO STOP
7872	45E0 035A	BAL 035A	SEPACM: (962)
035A	48A0 03CE	STH 10, X'3CE'	
35E	9E00 B006	MVI PMSGN, 'O'	
362	9206 B007	MVI PMSGN+1, '06'	
366	07FE	BR 14	
	FIX SMO READY MESSAGE		
78C6	9200 7017	MVI STIF11, 'R'	SEPACM
	MOVE FO START MESSAGE TO START OF MOD. ON.		
7D6C	45E0 0368	BAL 14, 368	SEPACM: (E5C)
0368	4000 601E	STH 0, 30(6)	
36C	9209 B007	MVI PMSGN+1, '09'	
370	07FE	BR 14	
7D96	4700	NOP	(E86)
	INSURE MESSAGE GETS OUT ON		HOLD/RESTART
7D22	45E0 - 0372	BAL 14, 0372	SEPACM: (E12)
372	4790 DEB4	BE (D)+EB4	
376	58F0 D1F4	L 15, OUTCOM	
37A	9501 F001	CLI SYNT1, 1	
37E	4780 DEB4	BE (D)+EB4	
382	07FE	BR 14	
7D7A	45E0 0372	BAL 14, 0372	(E6A)

SEPAC SOFTWARE PATCH SHEET

DATE:

ADDRESS	PATCH	MNEMONICS	COMMENTS
	CHANGE DEFAULT OF PFNCV FOR FO#11		
3C6C	Ø4Ø1		PCFCOM: (2BC)
TR-224	CHANGE MPD FIRING TIME FOR FO#12b		
634Ø	FD7D	DELAY 12.5	HEXTAB: (22BØ)
TR-224	CHANGE MPD FIRING TIME FOR FO#12A		
3598	ØØØ4	MPD @ 4.0	FOTAB: (538)
3954	ØØØ4	" " 4.0	(8F4)
	WAIT FOR MPD FIR INH MESSAGE TO BE SENT		
8ADA	45EØ Ø384	BAL 14, Ø384	PASSX: (C6A)
Ø384	4ØØØ FØØØ	STH Ø, Ø(15)	
388	58FØ Ø354	L 15, 0354	
38C	46FØ Ø38C	BCT 15, *	
390	07FE ØØØØ	BR 14	
394	ØØØ7 FFFF	WAIT CONST	
	IGNORE PROG. CHK. & MACH. CHK INTERRUPTS		
6E	Ø3EØ		
3EØ	82ØØ ØØ28		
76	Ø3E4		
3E4	82ØØ ØØ3Ø		
	EXTEND CAPACITOR DUMP TIME		
43CA	FD1A		(33A)
8A6A	BBØØ ØØØA		PASSX: (BFA)
8??C	ØØFØ ØØ21		

SEPAC SOFTWARE PATCH SHEET

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ADDRESS	PATCH	MNEMONICS	COMMENTS
	SECOND EBA	FIRE - SMO	
205E	45EØ Ø3E8	BAL 14,Ø3E8	ECSMO: (96)
3E8	478Ø CØ9A	BE ECS5Ø	
3EC	B92Ø ØØØ3	LHI 2,3	
3FØ	477Ø CØBA	BNE OUT	
3F4	Ø7FE	BR 14	
2Ø72	45EØ Ø3F6	BAL 14,Ø3F6	(AA)
Ø3F6	Ø78E	BRE 14	
3F8	B92Ø ØØØ3	LHI 2,3	
3FC	477Ø CØB4	BNE ECS13Ø	
4ØØ	D2Ø3 C1A6	MVC LOOPCT(4),	
	Ø4ØA	LOOPSEC	
4Ø6	47FØ CØB4	B ECS13Ø	
4ØA	ØØØ1 ØØØ1	DC X'ØØØ1ØØØ1'	
2ØA4	45EØ Ø4ØE	BAL 14,Ø4ØE	(DC)
4ØE	745Ø FØE2	LHI 2,3	
416	477Ø FØ1C	BNE EBA1Ø	
41A	A523 FØD6	SIO 2,3,RB3WØ	
41E	477Ø Ø41A	BNZ *-4	
422	B43Ø F3FF	NSI 3,X'F3FF'	
426	A63Ø Ø4ØØ	OSI 3,X'Ø4ØØ'	
42A	A532 FØD8	SIO 3,2,WB3WØ	
42E	477Ø Ø42A	BNZ *-4	
432	A532 FØDC	SIO 3,2,WOB3WØ	
436	477Ø Ø432	BNZ *-4	
43A	A421 ØA9Ø	TMRS 2,1,ZECO	
43E	A4Ø1 ØØØØ	.L1 TMRS Ø,1,Ø	
442	B51Ø 22AD	CLSI 1,X'22AD'	1SEC
446	477Ø Ø43E	BNE .L1	
44A	47FØ FØ48	B EBA4Ø	

SEPAC SOFTWARE PATCH SHEET

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ADDRESS	PATCH	MNEMONICS	COMMENTS
	GENERATE BML	GRAPHIC DATA	AT EBA FIRINGS
8B0	45E0 0398	BAL 14,0398	EXTINT
0398	5260 600A	LTS 6,10(6)	
39C	077E	BNER 14	
39E	95FF 03AE	CLI EBAFLG,X'FF'	
3A2	077E	BNER 14	
3A4	9500 03AF	CLI EBAFLG,X'0'	
3A8	A8F0 2558	LSI 15,X'DATA'	
3AC	07FF	BR 15	
3AE	0000	EBAFLG DC H'0'	
1EE4	45E0 03B0	BAL 14,03B0	RTCMD:(E4)
1792	45E0 044E	BAL 14,044E	ECBML: (1A)
044E	9500 1003	CLI EIB0,X'00'	
452	4770 C18E	BNE ECB01	
456	9500 1005	CLI 5(1),X'00'	
45A	4770 C18E	BNE ECB01	
45E	A8F0 A6C8	LSI 15,=A6C8	
462	74F0 F000	LS 15,STATE	
466	A9F0 0006	CSI 15,6	
46A	4770 C18E	BNE C18E	
46E	9201 1003	MVI 3(1),X'01'	
472	07FE	BR 14	
5E8	47F0 C144	B RUNS	DRIVER

SEPAC SOFTWARE PATCH SHEET

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ADDRESS	PATCH	MNEMONICS	COMMENTS
	ALLOW PROCEED ONLY IF SMO IN STOPPED STATE		
3CE	ØØØØ		SMOSTP DC H'Ø'
7854	400Ø Ø3CE	STH 0,Ø3CE	SEPACM; (944)
7872	45EØ Ø55A	BAL 14,Ø55A	(962)
788A	45FØ Ø474	BAL 14,Ø474	(97A)
Ø474	40AØ 7Ø1C	STH 10,28(7)	
Ø478	47FØ Ø3DC	B Ø3DC	
78CA	45EØ Ø47E	BAL Ø47E	(9BA)
Ø47E	523Ø Ø3CE	LTS 3,SMOSTP	
482	Ø77E	BNER 14	
484	9206 B0Ø7	MVI 6,PMSGN	
488	Ø7FE	BR 14	
78CE	9205 6001	MVI STATE,5	(9BE)
ECRo16	TURN OFF DEP READY YES		AT FO/MFO COMPLETION
7DC8	476Ø DE98	BL 6,3736(13)	SEPACM; (EB8)
7DCC	7216 B007	MVI PMSGNH,22	
7DDØ	40AD 800Ø	STH 10,ST2FØØ	
7DD4	130A	LCR Ø,10	
7DD6	52FØ 6Ø1C	LTS 15,MFO	
7DDA	478Ø DEBØ	BE .L1	
7DDE	130Ø	LCR Ø,Ø	
7DEØ	46FØ DEBØ	BCT 15,.L1	
7DE4	92CØ 8Ø1F	MVI ST2F15,Ø	
7DE8	400Ø 6ØØØ	.L1 STH Ø,STATE	
	CLEAN BLOCK ID 9 AFTER		FO SCHEDULE
143Ø	45EØ Ø48A	BAL 14,'48A'	MSGHAN; (10Ø)
48A	A94Ø ØØØ9	LSI 4,9	
48E	477Ø Ø494	BNE .L1	
492	1555	SR 5,5	
494	4Ø53 ØØØ8	STH 5,8(3)	
498	Ø7FE	BR 14	

SEPAC SOFTWARE PATCH SHEET

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ADDRESS	PATCH	MNEMONICS	COMMENTS
	SET LTV	BUFFER FOR AEPI,	AEPI SYNC
21DA	46E0 049A	BAL 049A	AEPION! (4A)
049A	A630 8000	OSI 3,X'8000'	
49E	B540 1EFA	LHI 4,X'1EFA'	
4A2	7608 4008	OI 8,0(4)	
4A6	07FE	BR 14	
	BML GRAPHIC	PATCH (CONT)	
2558	077E	BNER 14	
255A	9200 03AE	MVI EBAFLG,X'00'	
255E	92FF 03AF	MVI EB40FF,X'FF'	
2562	92FF 067C	MVI TECBML,X'AD'	
2566	07FE	BR 14	
3B0	5870 C1A0	L 7,AIUCR	RTCMD
3B4	9110 7014	TM 10(7),14	
3B8	47E0 0300	BNO .L1	
3BC	7440 200A	LS 4,10(2)	
3C0	A040 0004	LSI 4,4	
3C4	92FF 03AE	MVI EBAFLG,X'FF'	
3C8	7440 700A	.L2 LS 4,10(7)	
3CA	07FE	BR 14	
3D0	9200 03AF	.L1 MVI EB40FF,X'00'	
3D4	9200 03AE	MVI EBAFLG,X'00'	
3D8	47F0 03C8	B .L2	

ADDRESS	PATCH	MNEMONICS	COMMENTS
	OFF SEQ. COMPLETE PATCH		(CONT)
75C8	9200 7011	MVI STIF08,00	SEPACM: (6B8)
75CC	5200 D1AA	LTS 0, AMFO	
75D0	4790 D6BC	BE 3204	
75D4	9225 B001	MVI FOSEL, :37	
75D8	1200	LTR 0, 0	
	SMO PROCEED PATCH	(CONT)	
3DC	40A0 7O1A	STH 10, STIF13	
3E0	9200 9O1D	MVI CMF14, 0	
3E4	07FE	BR 14	
	AFPI - TOGGLE	CR, SET	
2196	B840 1EFA	LHI 4, X'1EFA'	AEPIOF: (6)
219A	94F7 4008	NI IUCREG, X'F7'	
219E	47F0 F01A	B F01A	
	RETRANSMIT		
966	B8F0 0654	LHI 15, TTiDUMBUF	IOINT:
11C6	1B22	SR 2, 2	MSOUT1: (9E)
	CLEAN OFF SEQ/PROCEED/LINE 19		
7B8C	9203 D007	MVI PMSGN, 3	SEPACM: (C7C)
7B90	9200 7O1D	MVI STIF14, 0	
7C68	9200 800F	MVI STIF07, 0	(D58)
7CCC	41C0 C085	LA 0, X'86'	(8F0)

SEPAC SOFTWARE PATCH SHEET

DATE:

ADDRESS	PATCH	MNEMONICS	COMMENTS
2758	A8FØ 2568	LSI 15, DA6A	PHEADP:(3Ø)
275C	05EF 18ØØ	BR 15	
2568	746Ø 2ØØ6	LS 6 8(2)	
256C	A76Ø 0080	XSI 6 X'80'	
2570	8C6Ø ØØØ8	SRDL 6,4	
2574	Ø7FE	BR 14	
	STOP OVERRIDING	COMMAND	TO IU
1ØØ4	92Ø1 1ØØ5	MVI STFLG,1	RTCMP: (144)
	CLEAN SMD	BETWEEN MFO'S	
7C3C	92ØØ 6ØØ3	MVI ISMO,Ø	SEPACM: (D2C)
7C1E	92ØØ 6ØØ2	MVI ISMO,Ø	(DØE)
7C12	9200 7017	MVI STIF11,Ø	(DØ2)
7C22	9223 BØØ1	MVI TOSEL,23	
7C24	92ØØ Ø34E	MVI 34E,ØØ	
	REMOVE	DEPDMP	
696	Ø972		DRIVER:

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ADDRESS	PATCH	MNEMONICS	COMMENTS
CR#25	- DGP+INTV TIME LINE FOR FO#8		
			FOTAB+384
33E4	ØØØØ ØØ45		MTVMS4 Ø.Ø
			FOTAB+394
33F4	ØØØØ ØØ9E		CALSET5 Ø.Ø
	ØØ96 ØØ97		T81SET 150.Ø
	ØØ96 ØØ5A		A4FIR 150.Ø
	FAFE FAFE		END FO#8
			HEXTAB + D26
4DB6	ØBØØ		VIDEOH = 0
	ØAØ1		SENSL = 1
	Ø86D		SLV = 1
	Ø9Ø1		LENISL = 1
	Ø766		ILV = 3
	FAFE		END
	Continued on page 19		
TR#E007	- BML GRAPHICS FOR MPD FIRING		
			EXTINT
872	A8FØ 2576		LSI 15, X'2576'
876	Ø5EF 18ØØ		BALR 14, 15 ; SR Ø, Ø
2576	1B66		SR 6, 6
2578	746Ø C422		LS 6, ATLBUF
257C	526Ø 6ØØA		LTS 6, 10(6)
258Ø	Ø77E		BNOR 14
2582	95FF Ø4A8		CLI MPDFLG, X'FF'
2586	Ø77E		BNER 14
2588	95ØØ Ø4AA		CLI MPDOFF, 0
258C	Ø77E		BNER 14
258E	92ØØ Ø4A8		MVI MPDFLG, 0
2592	92FF [illegible]AA		MVI MPDOFF, X'FF'
2596	92FF Ø67C		MVI TELBML, X'FF'
259A	Ø7FE		BR 14
259C	912Ø 7Ø14		TM 20(7), 13
25AØ	47EØ FØ12		BNO L1

SEPAC SOFTWARE PATCH SHEET

DATE:

ADDRESS	PATCH	MNEMONICS	COMMENTS
25A4	92FF Ø4A8	MVI MPDFLG, X'FF'	
25A8	744Ø 7ØØA	L2 LS 4, 1Ø(7)	
25AC	Ø7FE	BR 14	
25AE	92ØØ Ø4AA	L1 MVI MPDOFF, X'ØØ'	
25B2	92ØØ Ø4A8	MVI MPDFLG, X'ØØ'	
25B6	47FØ FØØC	B L2	
3C8	A8FØ 259C	LSI 15 X'2596'	
	Ø7FF	BR 15	
TR# E004	GROUND TEST	SETTINGS	
			PASSX + 574
3E4	4ØØØ 9Ø9C	STH 0, 151(9)	
	482Ø 9Ø32	LH 2, 5Ø(9)	
	A92Ø ØØØ2	CSI 2, 2	
	478Ø 1596	BF	
			PASSX + 5B6
842C	4ØØØ 9Ø8C	STH 0, '80'(9)	
			PASSX + 5BE
842E	92Ø1 9Ø75	MVI 1, '75'(9)	
CR#25	(CONT.)		
			HEXTAB + 2772
68Ø2	2EØ1		PHOFL = 1
			+2776
68Ø6	2DØF		PHØAG = 15
			+277A
68ØA	1CØ2		PLLB = 2
			+2788
6818	14Ø1		EPEFIX = 1

ADDRESS	PATCH	MNEMONICS	COMMENTS
M.G. + P.C. DUMP START ADDRESS			
7F6	ØØØØ		EXIT.IT
FLIP IU WATCHDOG DATA			
87A	B8FØ 25BA	LHI 15, X'25BA'	
	Ø5FF	BALR 14,15	
	18ØØ	LR Ø,Ø	
25BA	A536 Ø4AC	SIO 3,6,RDPM240	READ DPM(240)
25BE	4770 FØØØ	BNZ *-4	
25C2	A76Ø ØØFF	XSI 6, X'FF'	
25C6	A563 Ø4AE	SIO 6,3 WDPM240	WRITE DPM(240)
25CA	477Ø FØØC	BNZ *-4	
25CE	958Ø ØØ13	CLI EXPSWCLT+3, X'80'	
25D2	478Ø C3FA	BE EXT1	
25D6	Ø7FE	BR 14	
4AC	B8EØ		
4AE	BFEØ		
CORRECT RETRANSMIT			
A94	98EC		
91C	ØC54		

APPENDIX C

MEMORY DUMP

```
0000  0004 0000 0000 04B0 0000 0000 0000 0000 0000 0000 [illegible] 0000 0004 0000 4000 75A4
0020  0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0004 2065 9800 755E
0040  0000 0000 0000 0024 0000 0000 0000 0000 0000 2800 0000 0000 0004 0000 0800 0050
0060  0004 0000 0800 00D6 0000 0000 0800 07C0 0000 0000 0800 07C0 0004 0000 0800 00DA
0080  0000 A0B0 0000 7010 0000 00DA 0000 0096 0000 0000 0000 0001 0000 A6C8 0000 A790
00A0  0000 DB8B 0000 DA3B 0000 0001 0000 AB70 0000 7E6B 0000 6F38 6800 7BC4 0000 2B24
00C0  0000 0000 0000 06A0 0000 000A 0000 0001 0000 0001 0000 DA36 0000 A6C8 0000 A790
00E0  0000 DB0B 0000 DA3B 0000 0001 0000 A070 0000 7E6B 0000 6F3B 0000 7564 0000 0000
0100  0000 0000 0000 06A8 0000 0013 0000 064C 0000 A070 0000 0000 0000 0000 0000 0000
0120  FFFF F6FF FFFF FFFF 0000 F7FF 0000 FFFF 0000 04B0 0000 09BD 6800 0612 0000 0BE2
0140  0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0160  0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0180  0000 0000 0000 0000 0000 0000 0000 0000 001E 001E A0F0 D0A8 D203 F05E 0190 74F0
01A0  C1B8 47F0 C040 A0F0 D0AD D203 0190 F05E D201 F05E F000 D201 F060 F000 47F0 C430
01C0  4100 0023 4000 8000 47F0 DC6E 7777 7777 D501 001E 0246 4740 0220 D501 001E 0248
01E0  4740 022E D501 001E 024A 4740 0220 D501 001E 024C 4740 022E D501 001E 024E 4740
0200  0220 D501 001E 0250 4740 022E D501 001F 0252 4740 0220 D501 001E 0254 4740 022E
0220  D207 0260 0018 900F 00C0 47F0 0854 5030 0258 4030 0256 BA30 0001 4030 0256 5830
0240  0258 8200 0010 086E 08CE 0F20 10B4 1E50 1F76 2190 21F0 0000 0000 0000 0000 0000
0260  8004 0000 4800 75A4 4800 D328 A900 0012 4770 D9ED 5030 0294 1B33 A830 A6C8 4830
0280  3000 A930 000B 5030 0294 4780 DA1E 47F0 D9E8 0000 0000 0024 50F0 D20C A930 0012
02A0  4770 02BA 5030 0294 1B33 A830 A6C8 4030 3000 A930 0008 4780 D3AE 47F0 D420 4000
02C0  6002 9202 D0AE 92CC D0AF 07FE FFEC 40A0 D1AC 47F0 02C2 40A0 D1AC 9202 D0AE 92E4
02E0  D0AF 07FE FFB0 1B11 A810 A6C8 4810 1000 B850 3907 922E 5000 A910 0007 4780 0304
0300  92DA 5000 1856 4064 0000 07F5 7020 90D6 9500 9033 078E 7820 0320 7020 90D6 07FE
0320  4264 0000 7020 90DA 9500 9033 078E 7820 0320 7020 90DA 07FE 9300 034E 4770 DBAC
0340  1200 4780 DBB8 07FE 0000 0000 0000 0000 4000 B002 4000 034E 07FE 40A0 701A 9200
0360  7017 9206 B007 07FE 4000 601E 9209 B007 07FE 0000 0000 0000 0000 0000 0000 0000
0380  0000 0000 4000 F000 50F0 0394 46F0 038C 07FE 0000 0007 FFFF 5260 600A 077E 95FF
03A0  03AE 077E 9500 03AF A8F0 2558 07FF 0000 5070 C1A0 9110 7014 47E0 03D0 7440 200A
03C0  A940 0004 92FF 03AE A8F0 259C 07FF 0000 9200 03AF 9200 03AE 47F0 03C8 40A0 701A
03E0  9200 901D 07FE 7777 4780 C09A B920 0003 4770 C0BA 07FE 078E B920 0003 4770 C0B4
0400  D203 C1A6 040A 47F0 C0B4 0001 0001 7450 F0E2 B920 0003 4770 F01C A523 F0D6 4770
0420  041A B430 F3FF A630 0400 A532 F0D8 4770 042A A532 F0DC 4770 0432 A421 0A90 A401
0440  0000 B510 A065 4770 043E 47F0 F048 9500 1003 4770 C10E 9500 1005 4770 C10E A0F0
0460  A6C8 74F0 F000 A9F0 0006 4770 C10E 9201 1003 07FE 40A0 701C 47F0 03DC 07FE 5230
0480  03CE 077E 9206 B007 07FC A940 0009 4770 0494 1B55 4053 0008 07FE A630 0000 B846
04A0  1EFA 9600 4008 07FE 7777 7777 B8E0 BFE0 5BC0 0004 41D0 C500 A421 C5E0 4110 C41A
04C0  4010 005E 4110 C4C4 4010 007E A010 F00F A510 C1EE 4770 C020 1822 A020 D000 B010
04E0  0001 0812 BA20 0400 47B0 C032 2B22 7420 C1EA 4A32 0000 4620 C04A 4620 C042 4A30
0500  0000 A530 C1EE 4770 C052 B820 000A 4110 C076 4010 005E 4110 0001 45E0 C190 8000
0520  C1E8 47F0 C072 9500 001B 4780 C066 A520 C1F0 4770 C07E 4620 C066 0000 0000 4110
0540  0003 45E0 C190 D207 0070 C300 D207 0058 C308 1B44 B050 0013 41F0 C19C 9200 F000
0560  41FF 0004 4650 C0AC 92FF C1DB 92FF C1A0 9200 0000 D24E 0009 0000 7450 C4F2 4045
0580  0000 4110 C4F4 74F0 C500 05EF 7450 C2EE 92FF 5005 0000 C1E8 9500 0054 4780 C0FC
05A0  92FF C1DC 9500 0056 4780 C100 92FF C1D8 2B44 7440 C2EE 7454 0002 1255 4780 C11A
05C0  1B55 4054 0002 92FF C1C4 95FF 0000 4770 C140 1B33 7430 C424 7433 0000 A930 0006
05E0  4770 C144 7420 0046 47F0 C144 4770 C144 92FF C1CC 9200 0008 4120 0013 4130 C19C
0600  9500 3000 4780 C162 9200 3000 50F3 0000 05EF 4133 0004 4620 C150 9500 0051 4780
0620  C0E8 9200 0051 74F0 C1EC 4110 C1F8 05EF 47F0 C0EB 1BFF A5FF C1F4 4770 C186 07FE
0640  A510 C1F2 4770 C190 07FE 7777 0000 08F2 0000 06BA 0000 0A94 0000 0B10 0000 6800
0660  0000 0D50 0000 21FB 0000 A47B 0000 1600 0000 1670 0000 1FCB 0000 2E70 0000 1770
0680  0000 0C58 0000 224E 0000 6F10 0000 1330 0000 2369 0000 0972 8004 AFFE 1F00 2F00
06A0  AFA0 BFF1 BFFF 0000 0000 0044 0000 06B4 0000 06B6 0004 33B3 73C3 90EC D00C 1BC1
06C0  182D 41D0 C096 502D 0004 50D2 0008 74F0 C0F4 1B66 406F 0004 7460 C0DE 9200 6000
06E0  D21E 6001 6000 7460 C0E2 9200 6000 D21E 6001 6000 7460 C0E0 9200 6000 D21E 6001
0700  6000 2B8B 2B66 7460 C0F4 B050 002A 7470 C0E8 4087 000A 7470 C0EA B8B0 0001 0900
0720  0002 4057 D00A B050 0005 4056 0000 4110 C0FE 74F0 C0EC 05EF 74F0 C0E6 05EF 1BFF
0740  74F0 C2FC 05EF 50D0 C09A 90EC D00C 07FF 7777 7777 0000 0900 0000 106C 4800 0746
0760  0000 0F20 0000 0000 0000 07AB 0000 09FB 0000 0650 0000 A870 0000 0005 0000 A870
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0780   0000 3060 0000 027C 0000 0000 0000 F7FF 0000 FFFF 0000 06BA 1EFA 1E3A 1E1A A070
07A0   7E70 6980 3060 2A80 0000 07AC 0001 7777 0004 0000 0800 00DA 0004 0000 0800 0050
07C0   900F 0080 58C0 0004 41D0 C2A0 4100 0000 A500 C1F2 4770 C320 0000 C41F 74F0 C1FC
07E0   4110 C344 05EF B200 C390 900F 0000 B200 0020 0000 0000 0000 0000 0100 0000 0002
0800   0040 0080 40C0 20A0 60E0 1090 50D0 30B0 70F0 0404 44C4 24A4 64E4 1494 54D4 34B4
0820   74F4 0C8C 4CCC 2CAC 6CEC 1C9C 4CDC 3CBC 7CFC 0202 42C2 22A2 62E2 1292 42D2 32B2
0840   72F2 7777 7777 7777 0002 0000 0000 0000 47F0 01D0 A405 0000 92FF 0051 58C0 0004
0860   41D0 C550 95FF 0054 4780 C416 1BFF 0000 C41E ABF0 2576 05FF 1800 B0F0 25BA 05EF
0880   1800 A432 C420 5030 0044 BA30 0001 5030 0044 97FF 0050 95FF 0050 4770 C362 92FF
08A0   C1DC 92FF C1E0 92FF 000B 1B66 7460 C422 45E0 0390 A960 000B 4780 C410 A432 C420
08C0   74F0 C506 05EF 900F 00C0 0200 0260 8004 0377 A8D0 A6C0 8200 0020 92FF 064C 0200
08E0   0028 900F 0100 58C0 0004 41D0 C578 7410 003A 2BEE B020 000B 4130 C4C0 6513 0000
0900   4770 C460 1BFF 74F3 0002 7433 0004 07F3 4133 0006 4620 C44C 1BEE 50E0 000C 47F0
0920   C4BE 9620 004E 9200 000C 9200 000E 47F0 C4BE 9610 004E 9200 0000 9200 000F 47F0
0940   C4B6 9680 004E 9500 000E 4780 C476 92FF 000C 47F0 C4B6 9640 004E 9500 0001 4700
0960   C4B6 92FF 000D B0F0 0654 92FF F000 900F 0100 07FE B200 0030 2065 0650 096A 2001
0980   0670 096A 201F 0694 096A 6000 0000 0922 6001 0000 0932 6002 0000 0942 6003 0000
09A0   0956 A6CB 0000 A7B0 0000 09AC 0000 0060 2A52 0000 B0FF 0F20 0000 0000 0000 0000
09C0   0000 6F30 6800 0612 0000 6F10 0000 0000 0000 06A0 0000 0004 0000 0688 0000 A070
09E0   0000 0000 0000 0000 0000 0000 FFFF F6FF FFFF FFFF 0000 F7FF 0000 FFFF 0000 04B0
0A00   0000 0000 0000 0000 0000 106C 5800 0BC6 0000 0F20 0000 0000 0000 06A8 0000 0376
0A20   0000 0024 0000 0001 0006 A2BD 0000 0005 0000 A790 0000 DB0B 0000 DA3B 0000 0001
0A40   0000 A870 0000 04B0 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0A60   0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0A80   0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 90EC D00C 18CF 182D 41D0 C020
0AA0   502D 0004 50D2 000B 4110 C070 74F0 C070 05EF 58D0 C02C 98EC D00C 07FE 0000 0000
0AC0   0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0AE0   0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000
0B00   0000 0000 0000 0B08 0000 0000 1128 7777 90EC D00C 18CF 182D 41D0 C0AC 502D 0004
0B20   50D2 0000 74F0 C0F6 05EF 1B44 7440 C0F4 1B33 7430 4002 B430 F000 0B30 000C A930
0B40   000D 4720 C096 A930 0000 4740 C096 BB30 000B 8930 0002 48F3 C0F8 1B55 7453 C0FA
0B60   92FF F000 4144 0002 5040 C110 5040 C11C B950 0000 4780 C096 B950 000A 4700 C0B6
0B80   4110 C110 B950 000B 4780 C090 D23F 4040 4000 47F0 C090 D23F 4080 4000 4110 C11C
0BA0   74F0 C146 05EF 1B33 7440 C0F4 4030 4000 58D0 C0B0 98EC D00C 07FE 0000 0000 0000
0BC0   0000 09B0 0000 0000 6800 0B2A 0000 10C8 0000 0000 0000 06A0 0000 09B0 0000 0650
0BE0   0000 A070 0000 0000 0000 0000 0000 0000 FFFF F6FF FFFF FFFF 0000 F7FF 0000 FFFF
0C00   0000 0B10 D7C0 10C8 0668 000B 065C 0009 066C 000A 0680 0000 0664 0000 0660 0000
0C20   0000 D7C2 0000 0C3A 0000 0C3C 0000 D7C2 0000 0C38 0000 0C44 0011 0000 2DAD 6DED
0C40   1D9D 5DDD 41C1 21A1 61E1 1191 51D1 31B1 71F1 0989 4900 1F00 90EC D00C 18CF 182D
0C60   41D0 C0A4 502D 0004 50D2 000B 1B22 7420 C0F2 1B55 4152 000A 1B44 7435 0000 AE30
0C80   0700 47E0 C036 B430 F8FF 4140 0001 4030 C0F6 2B66 A567 C0F6 4770 C03C 1244 4770
0CA0   C060 4070 5004 4155 0006 D501 5000 C0F4 4780 C0B4 47F0 C020 4070 C0F6 7415 0002
0CC0   A710 FFFF C471 7415 0004 6415 0002 C617 A510 5000 4770 C070 47F0 C04E 5030 C0F0
0CE0   BA30 0002 5030 C0EC 4110 C0EC 74F0 C0F8 05EF 58D0 C0A0 98EC D00C 07FE 7777 7777
0D00   7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777
0D20   7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777
0D40   7777 7777 0000 0000 8000 D7C0 0000 0000 1128 7777 7777 7777 90EC D00C 18CF 1820
0D60   41D0 C0B4 502D 0004 50D2 000B 1B22 7420 C0CC 4122 0002 4150 000A 4B62 000B 1266
0D80   4700 C066 2B66 7462 5002 7472 5000 4155 0004 1266 4700 C05C 7442 5000 4047 0000
0DA0   4177 0002 4155 0002 4660 C040 A920 003A 4740 C02C 50D0 C0E0 90EC D00C 07FE 2B66
0DC0   7472 5000 D233 200C 7000 5020 C0D0 4110 C0D0 74F0 C0CE 05EF 47F0 C05C 7777 7777
0DE0   0000 09B0 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777
0E00   7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777 7777
0E20   7777 7777 D7C0 1128 0000 0000 7777 7777 90EC D00C 18CF 182D 4100 C094 502D 0004
0E40   50D2 000B 9500 0054 4770 C02C 92FF 0039 95FF 0000 4770 C020 9200 0039 2B22 7420
0E60   C0E6 5B11 0010 7431 0000 BB30 0001 4032 0006 B530 FFFF 4770 C054 1B33 7430 C0E4
0E80   9600 3000 B830 FFFF 4032 0008 B030 000A 4032 000A 1B33 7420 C0E0 4032 0004 9500
0EA0   0054 4700 C07E 92FF 0055 47F0 C0B4 74F0 C0E2 05EF 8000 C0CA 58D0 C090 90EC D00C
0EC0   07FE 0000 0000 0000 0000 6F38 0000 106C 4800 0EB4 0000 0F20 0000 0000 0000 A6E6
0EE0   0000 A870 0000 0000 0000 0001 0000 0001 0000 A6CB 0000 A790 0000 DB80 0000 DA38
```

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0F00  0000 0001 0000 A070 0000 0E30 0377 068C 7FFF 0F20 1EFA A0D0 A070 0104 7777 7777
0F20  70EC D00C 1BCF 102D 41D0 C14C 502D 0004 50D2 0008 1B44 4040 C19E 5020 C194 7442
0F40  000A BA40 0001 4042 000A A940 000A 4740 C050 1B44 4042 000A 7442 0000 BA40 0001
0F60  4042 0008 7442 0006 BA40 0001 4042 0006 1B44 1B11 7410 C19C 7410 1004 C211 4770
0F80  C12E 2B44 7442 0002 1244 4780 C140 7452 0008 BC50 000A 4A52 000A 4062 0004 BB60
0FA0  0001 BC60 000C 4956 200C 4740 C0DC 92FF C19F 5070 C1A0 2BED 74B6 200E BB80 0001
0FC0  0700 0001 7496 2010 A790 FFFF 6498 7000 4098 7000 7496 2010 6496 2012 6698 7000
0FE0  4098 7000 7446 2014 4042 0004 7442 0002 BB40 0001 4042 0002 47F0 C062 95FF C19F
1000  4770 C126 45E0 0380 AE40 0000 47E0 C102 B440 7FFF 4047 000A 74F0 C1A4 05EF 47F0
1020  C110 AE40 4000 47E0 C110 B440 BFFF 4047 000A 74F0 C1A6 05EF 9200 0010 92FF C19E
1040  58F0 C190 05EF 95FF C19E 4700 C136 9500 0010 4770 C0E4 58D0 C150 98EC D00C 07FE
1060  7410 C19C 9201 1005 47F0 C0DC 0000 0000 0000 0A00 0000 0000 4800 1046 0000 1E50
1080  0000 0000 0000 A070 0000 A8D0 0000 0650 0000 0000 0000 0000 0000 003C 0000 1EFA
10A0  0000 001E 0000 0000 0000 F7FF 0000 FFFF 0000 0F20 0000 A8D0 0000 1E50 A870 0000
10C0  0000 1EFA 2100 2190 90EC D00C 18CF 2022 A523 C058 4770 C008 B430 7FFF A523 C05A
10E0  4770 C014 7420 C05C 4122 0000 A830 B0C0 4160 001F 4030 C056 A545 C056 4770 C030
1100  4050 2002 4120 2002 4130 3001 4660 C02C 7440 C05C 4040 4000 90EC D00C 07FE D0DE
1120  B8FC BFFC D7C0 7777 90EC D00C 18CF 102D 4100 C118 502D 0004 5002 0000 98AB 1000
1140  9500 000E 4770 C034 12AA 4780 C034 9201 000F D239 C170 A000 47F0 C04C 9500 000F
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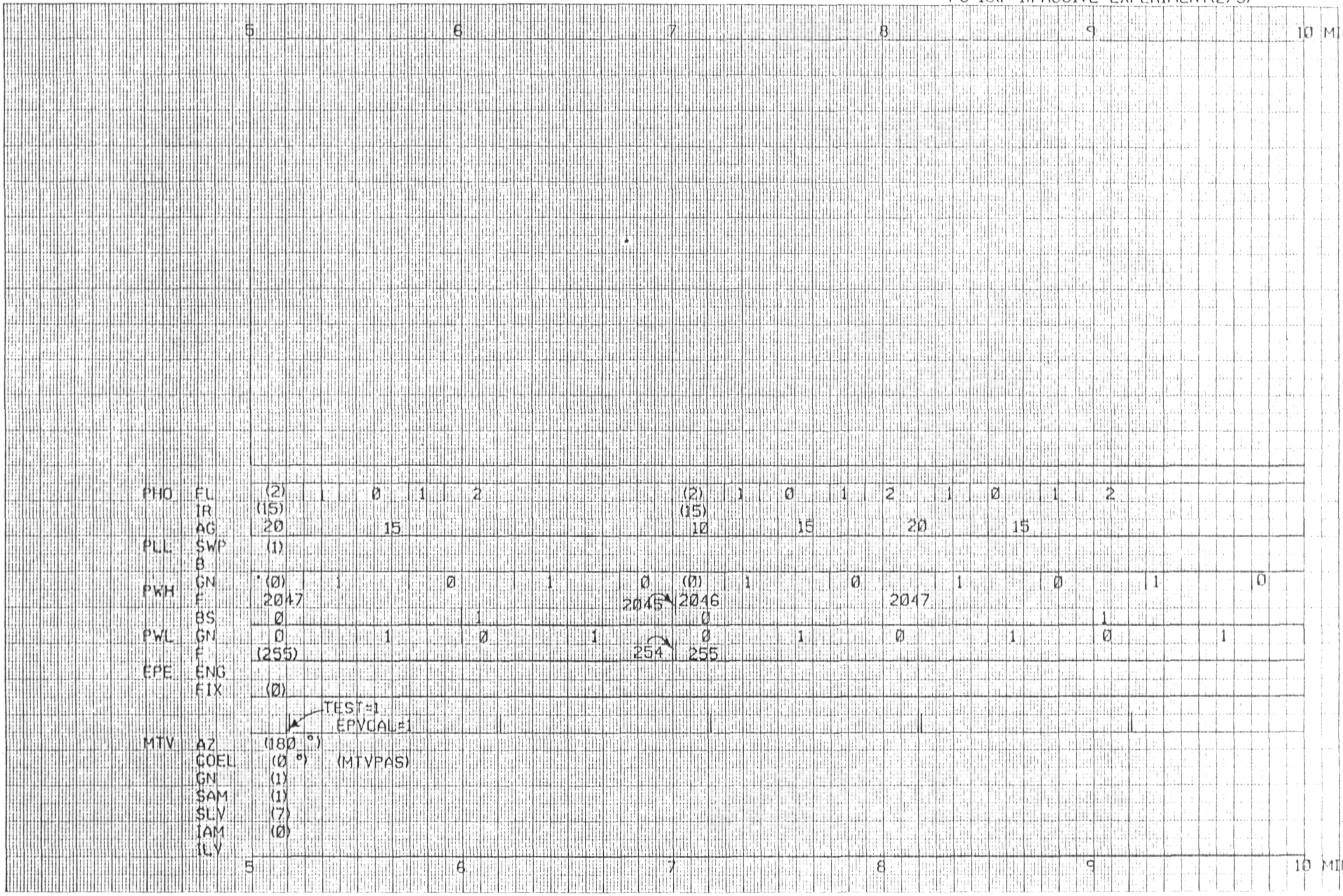
AE00	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AE20	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AE40	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AE60	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AE80	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AEA0	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AEC0	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AEE0	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AF00	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AF20	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AF40	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AF60	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AF80	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AFA0	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AFC0	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
AFE0	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000

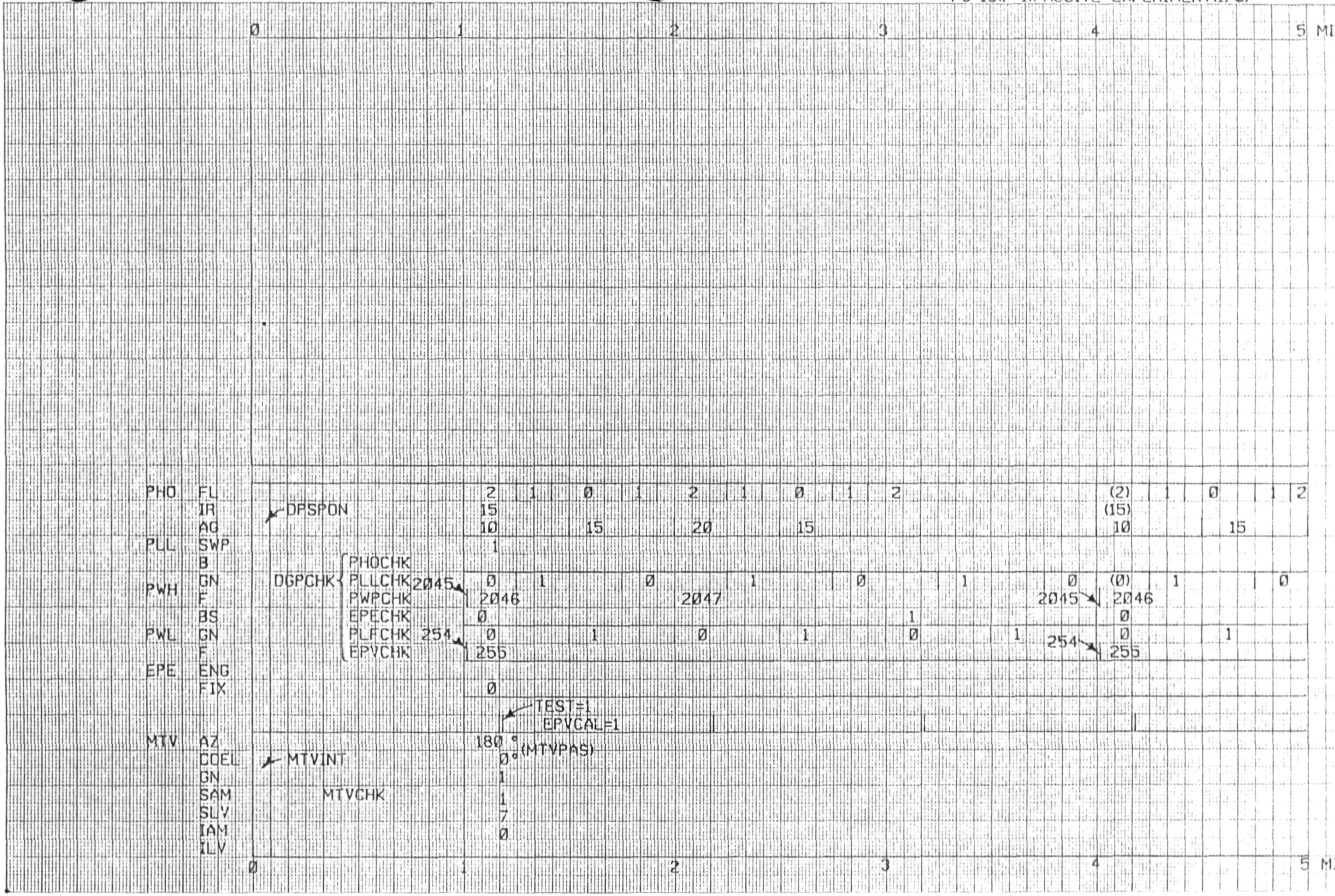
checksum: X'5137' = X'EB76' + X'114'

APPENDIX D

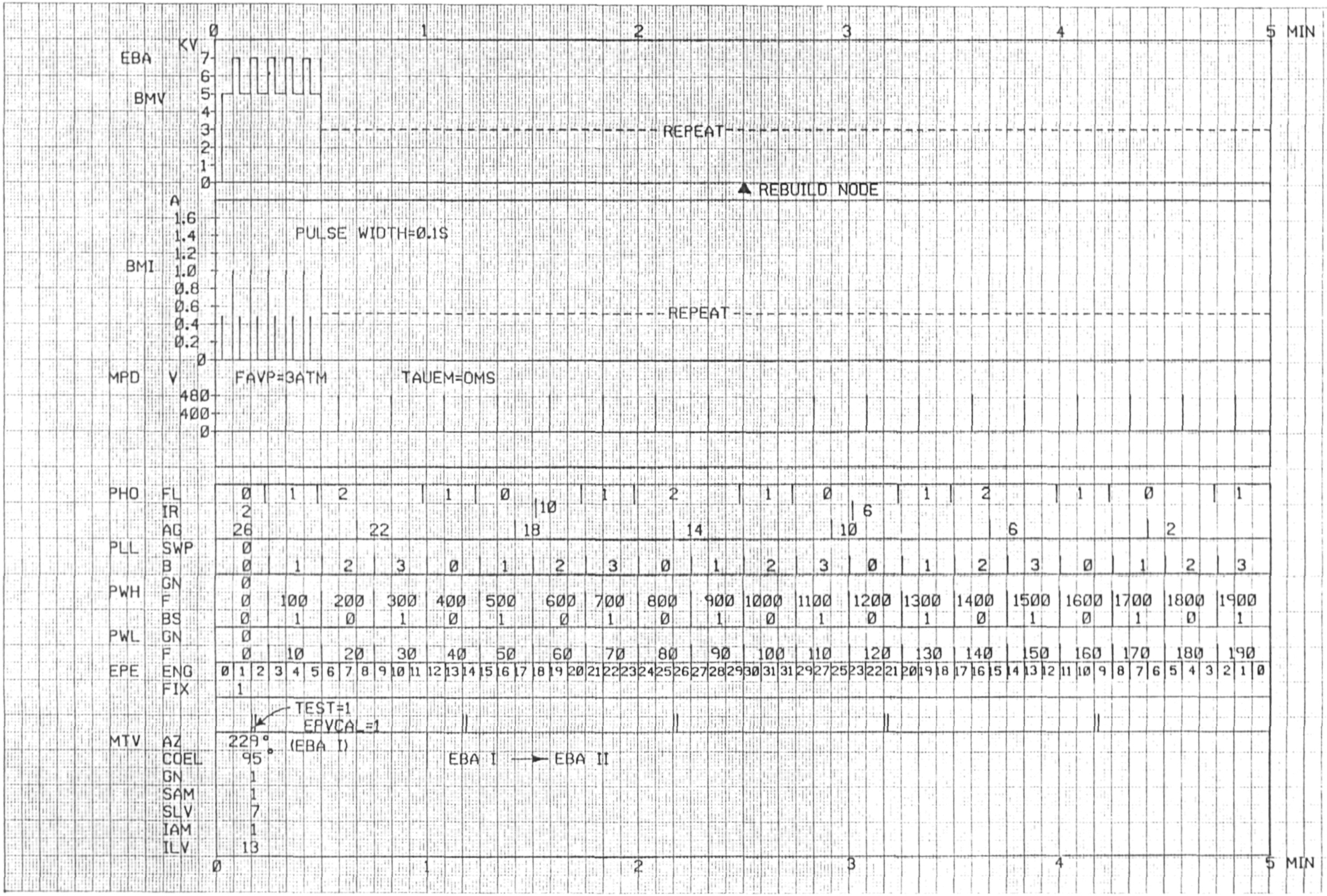
SEPAC FO SEQUENCE CHARTS


5
6
7
8
9
10 MIN
PHO FL (2) 1 0 1 2 (2) 1 0 1 2 1 0 1 2
IR (15) (15)
AG 20 15 10 15 20 15
PLL SWP (1)
B
PWH GN (0) 1 0 1 0 (0) 1 0 1 0 1 0
F 2047 2045 2046 2047
BS 0 1 0 1
PWL GN 0 1 0 1 0 1 0 1 0 1
F (255) 254 255
EPE ENG
FIX (0)
TEST=1
EPVCAL=1
MTV AZ (180 °)
COEL (0 °) (MTVPAS)
GN (1)
SAM (1)
SLV (7)
IAM (0)
ILV
5
6
7
8
9
10 MIN

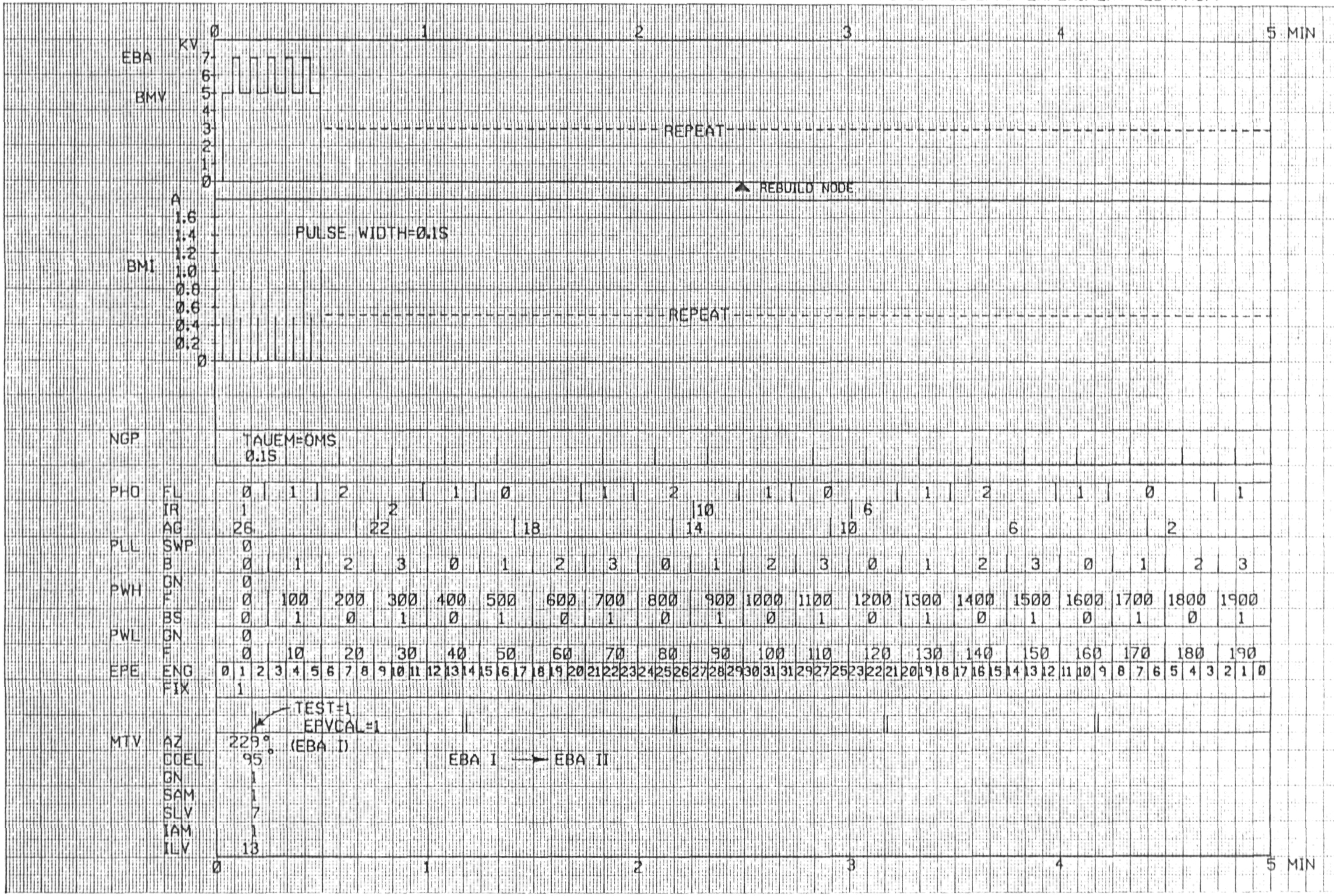
FO-13(P-1)PASSIVE EXPERIMENT(1/?)

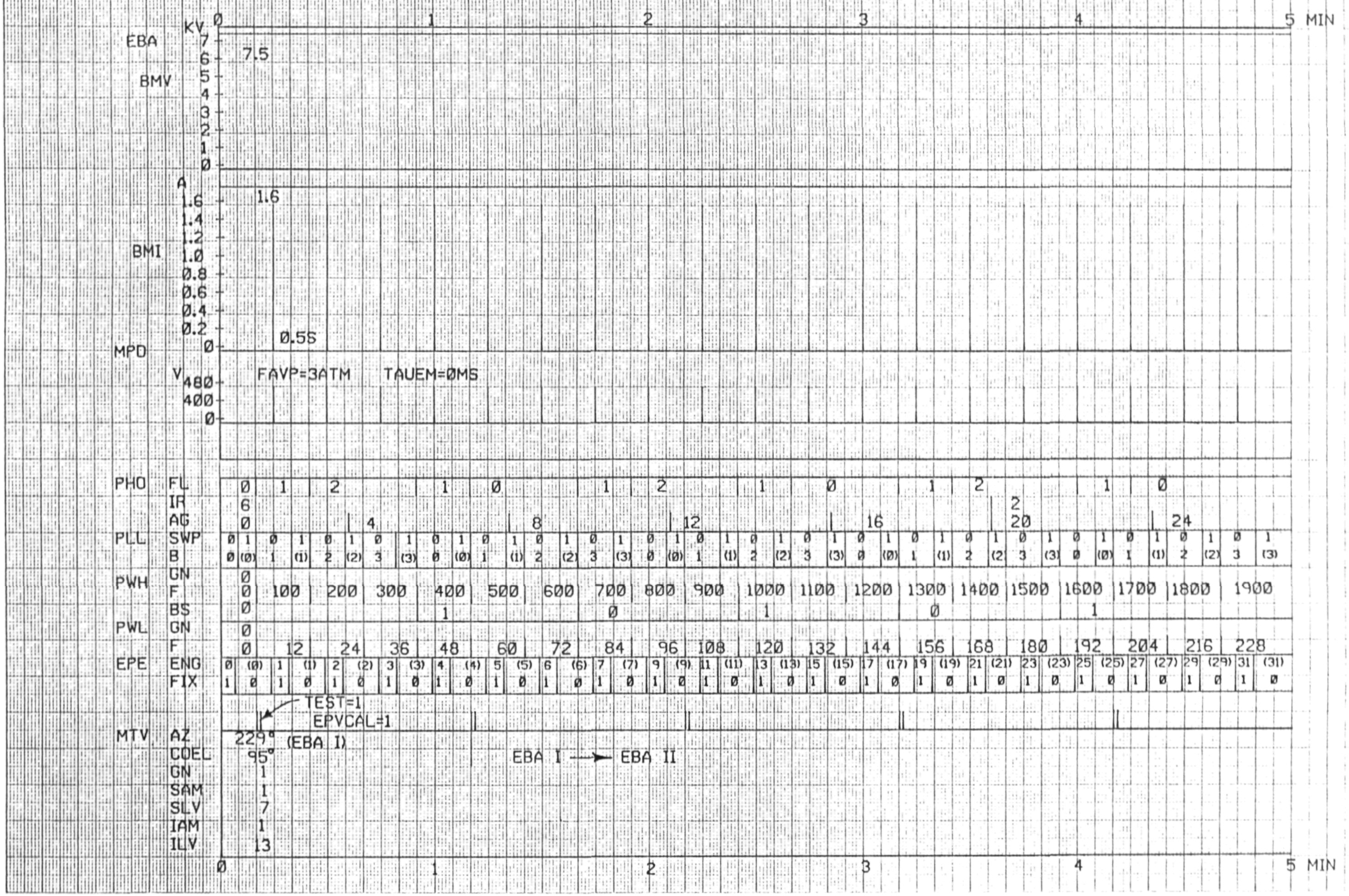


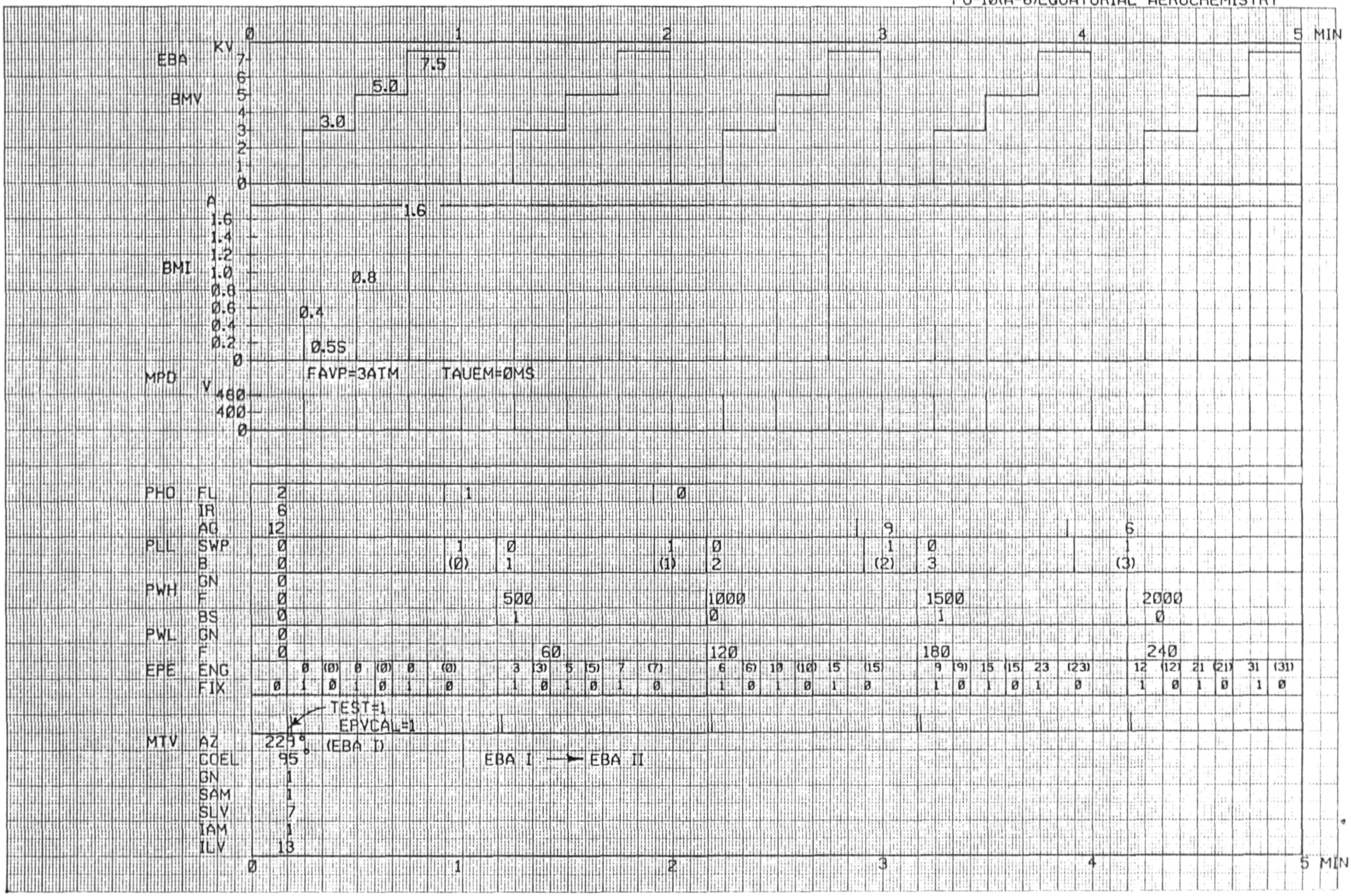
FO-12(A-8A) E//B EXPERIMENT (EBA/MPD)

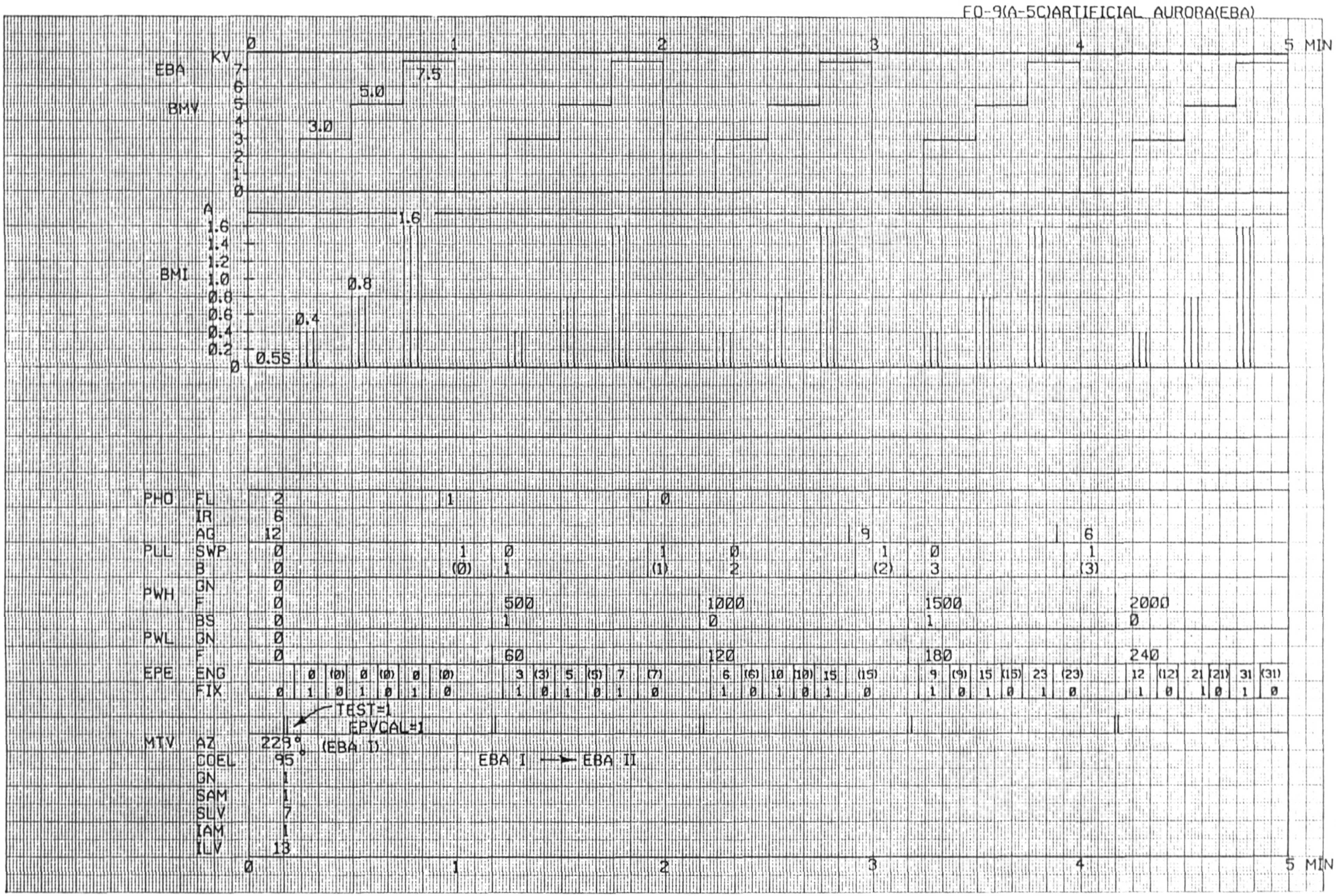


FO-12(A-8B)E//B EXPERIMENT (EBA/NGP)



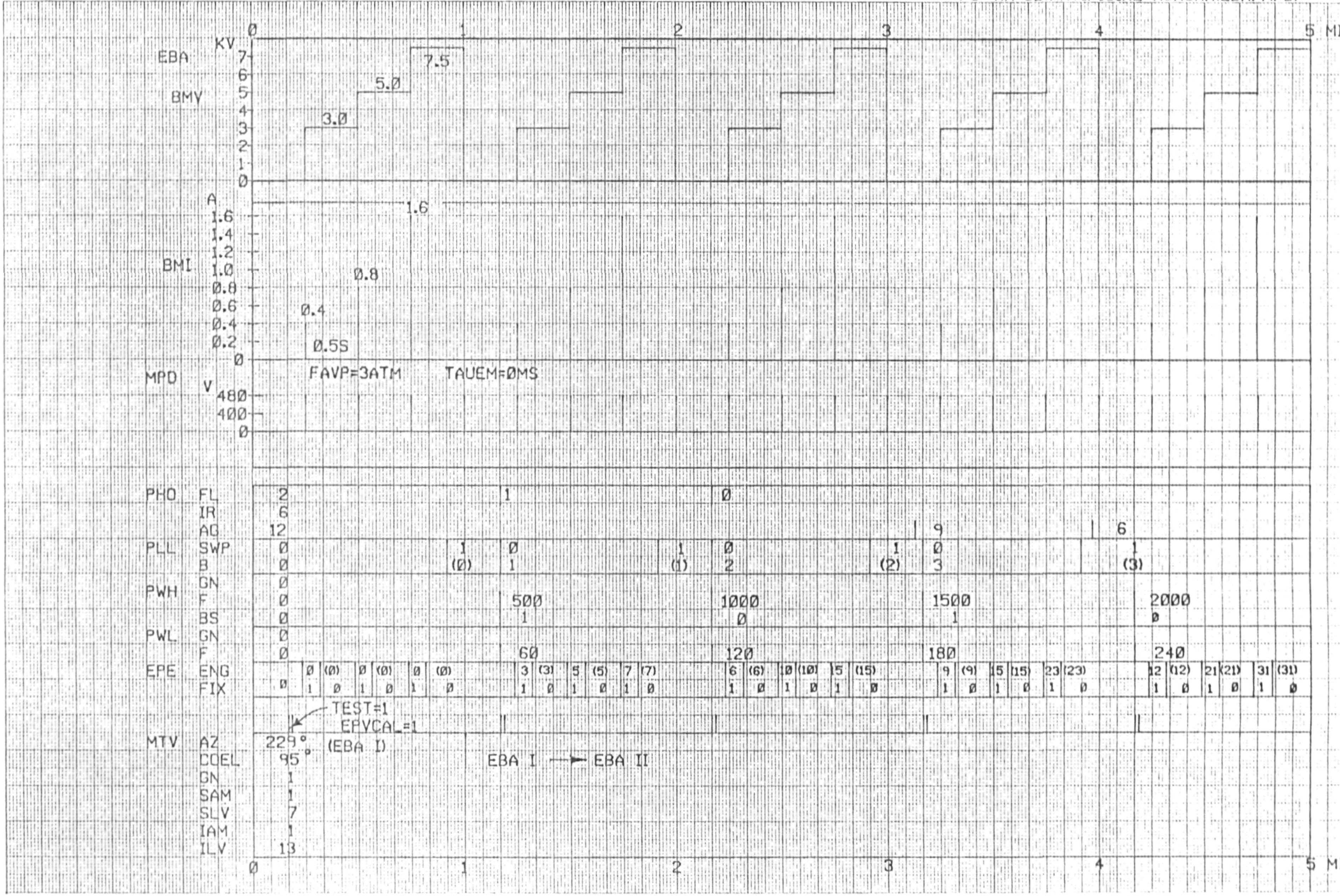

0 1 2 3 4 5 MIN
EBA
KV
7.5
BMV
BMI
A
1.6
MPD
0.5S
V
FAVP=3ATM TAUEM=ØMS
PHO FL
IR
AG
PLL SWP
B
PWH GN
F
BS
PWL GN
F
EPE ENG
FIX
TEST=1
EPVCAL=1
MTV AZ
COEL
GN
SAM
SLV
IAM
ILV
229° (EBA I)
95°
EBA I → EBA II
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900
12 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228


0 1 2 3 4 5 MIN
EBA KV
BMV
3.0
5.0
7.5
BMI A
1.6
0.8
0.4
0.55
MPD V
FAVP=3ATM
TAUEM=0MS
480
400
PHO FL IR AG
PLL SWP B
PWH GN F BS
PWL GN F
EPE ENG FIX
500
1000
1500
2000
60
120
180
240
TEST=1
EPVCAL=1
MTV AZ COEL GN SAM SLV IAM ILV
229°
(EBA I)
95
13
EBA I → EBA II

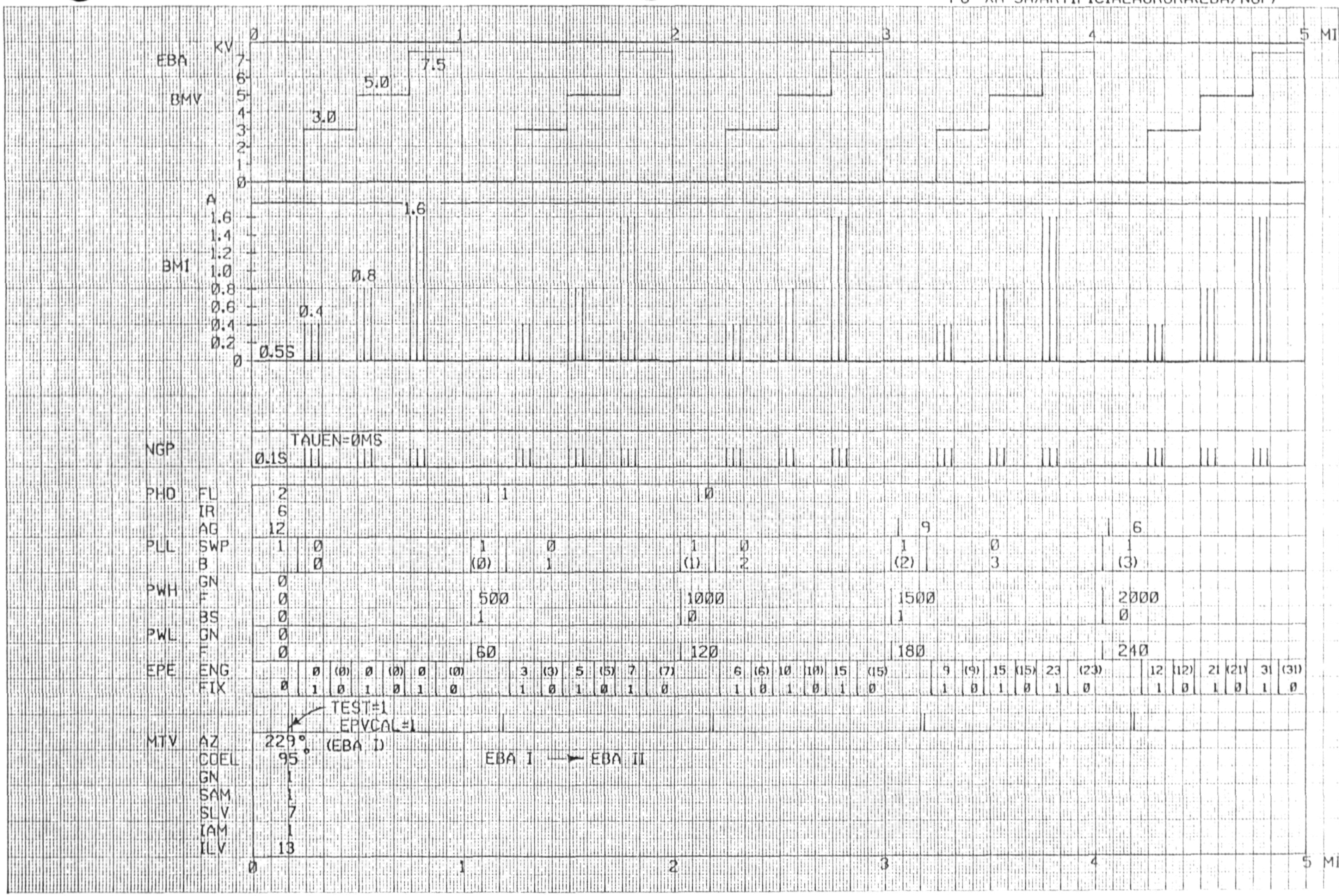


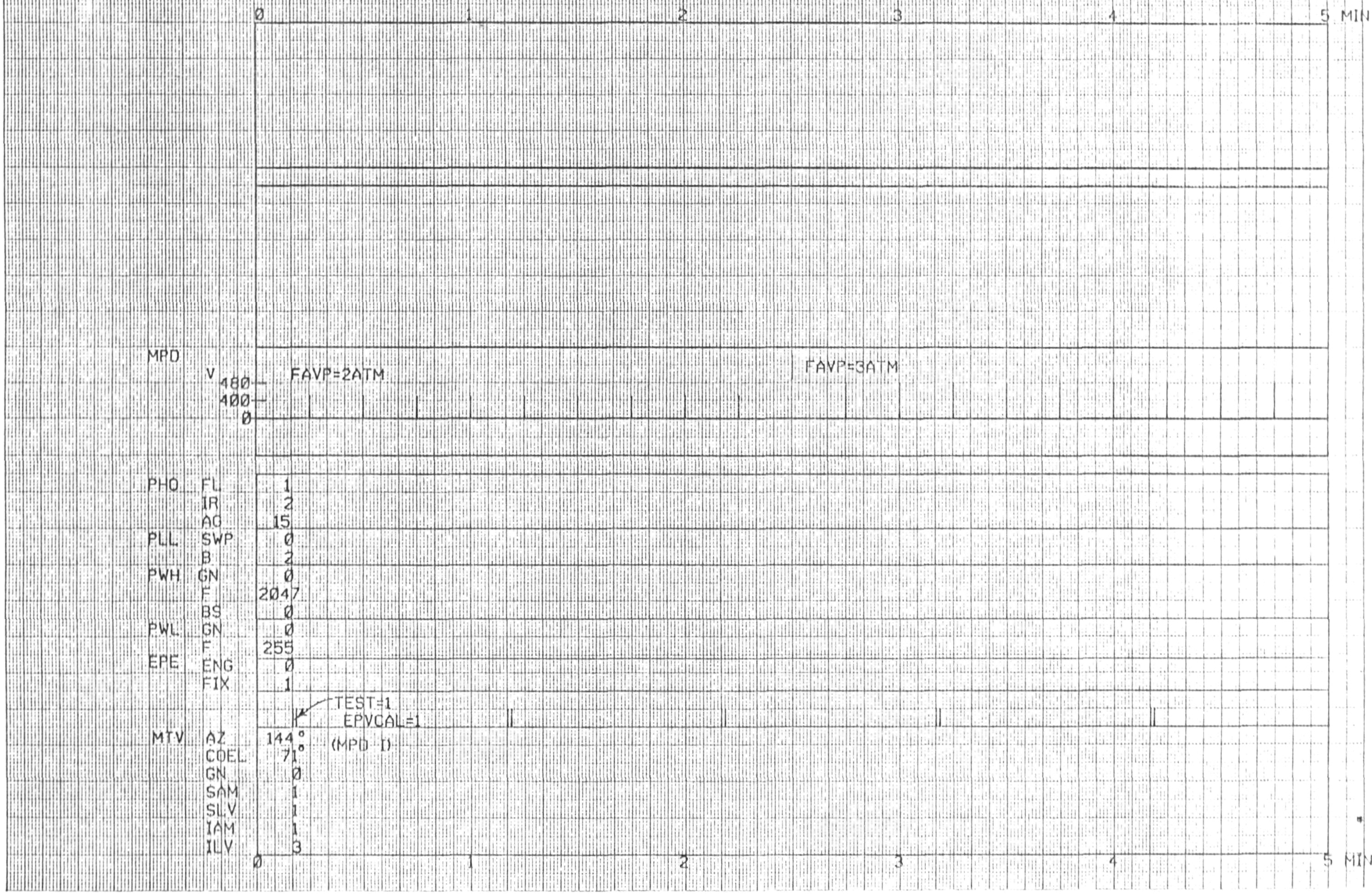
EO-9(A-5C)ARTIFICIAL AURORA(EBA)
0 1 2 3 4 5 MIN
EBA
KV
BMV
7.5
5.0
3.0
A
1.6
BMI
0.8
0.4
0.5S
PHO FL 2 1 0
IR 6
AG 12 9 6
PUL SWP 0 1 0 1 0 1 0 1
B 0 (0) 1 (1) 2 (2) 3 (3)
PWH GN 0
F 0 500 1000 1500 2000
BS 0 1 0 1 0
PWL GN 0
F 0 60 120 180 240
EPE ENG
FIX
TEST=1
EPVCAL=1
MTV AZ 229° (EBA I)
COEL 95°
GN 1
SAM 1
SLV 7
IAM 1
ILV 13
EBA I → EBA II

FO-9(A-5B)ARTIFICIAL AURORA(EBA/MPD)

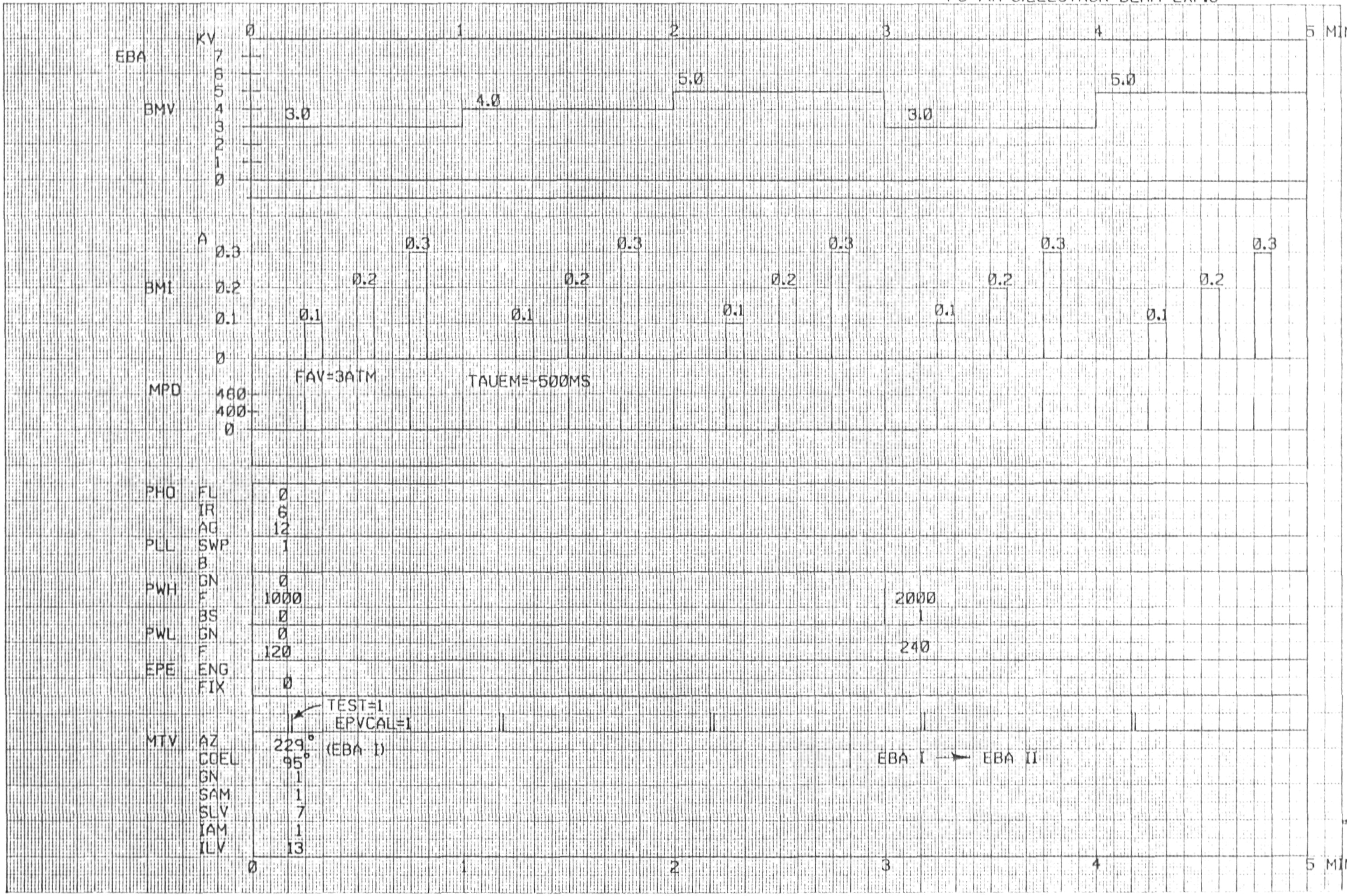


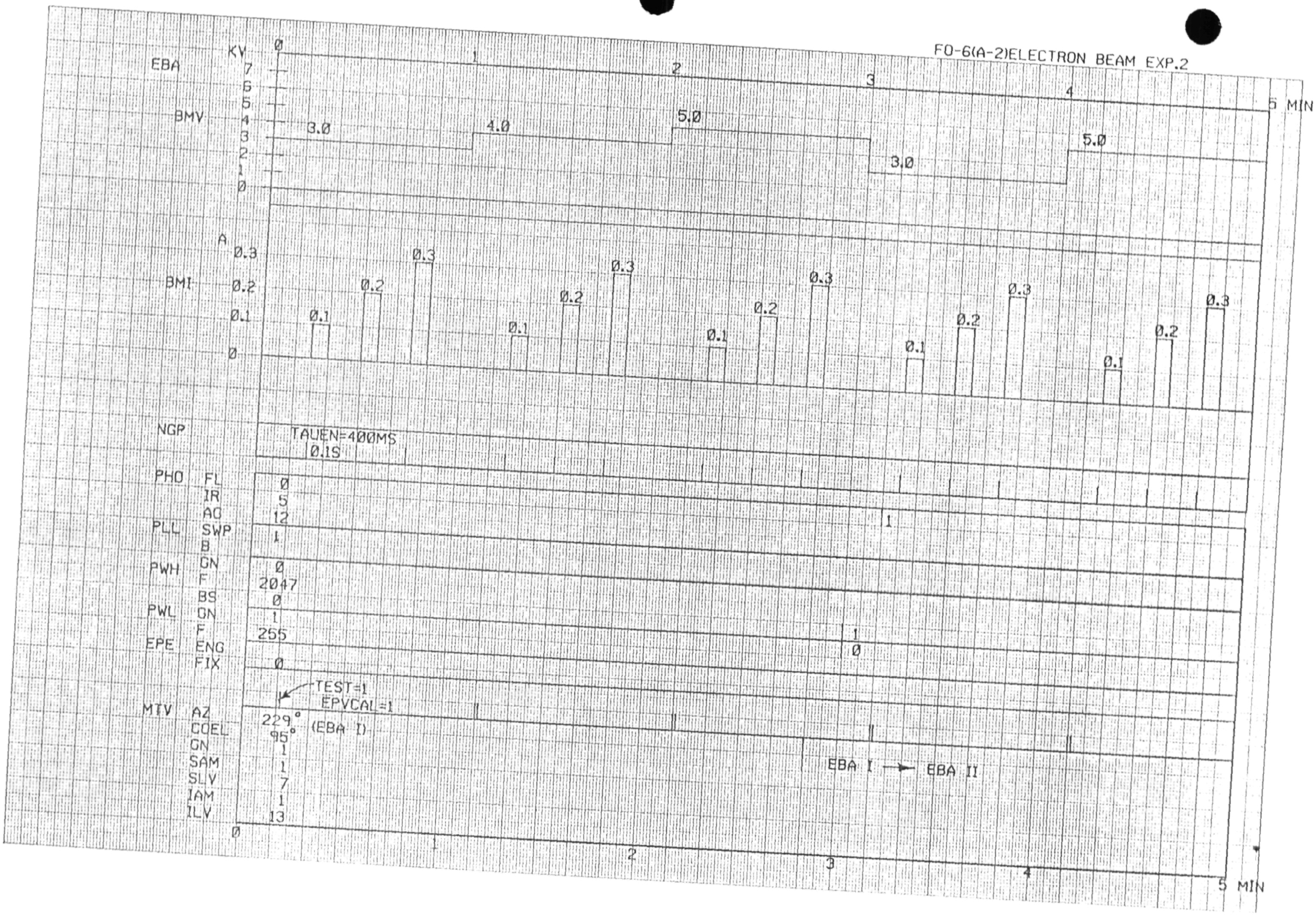
FO-9(A-5A)ARTIFICIAL AURORA(EBA/NGP)




0
1
2
3
4
5 MIN
MPD
V
480
400
0
FAVP=2ATM
FAVP=3ATM
PHO FL 1
IR 2
AG 15
PLL SWP 0
B 2
PWH GN 0
F 2047
BS 0
PWL GN 0
F 255
EPE ENG 0
FIX 1
TEST=1
EPVCAL=1
MTV AZ 144°
COEL 71°
(MPD I)
GN 0
SAM 1
SLV 1
IAM 1
ILV 3

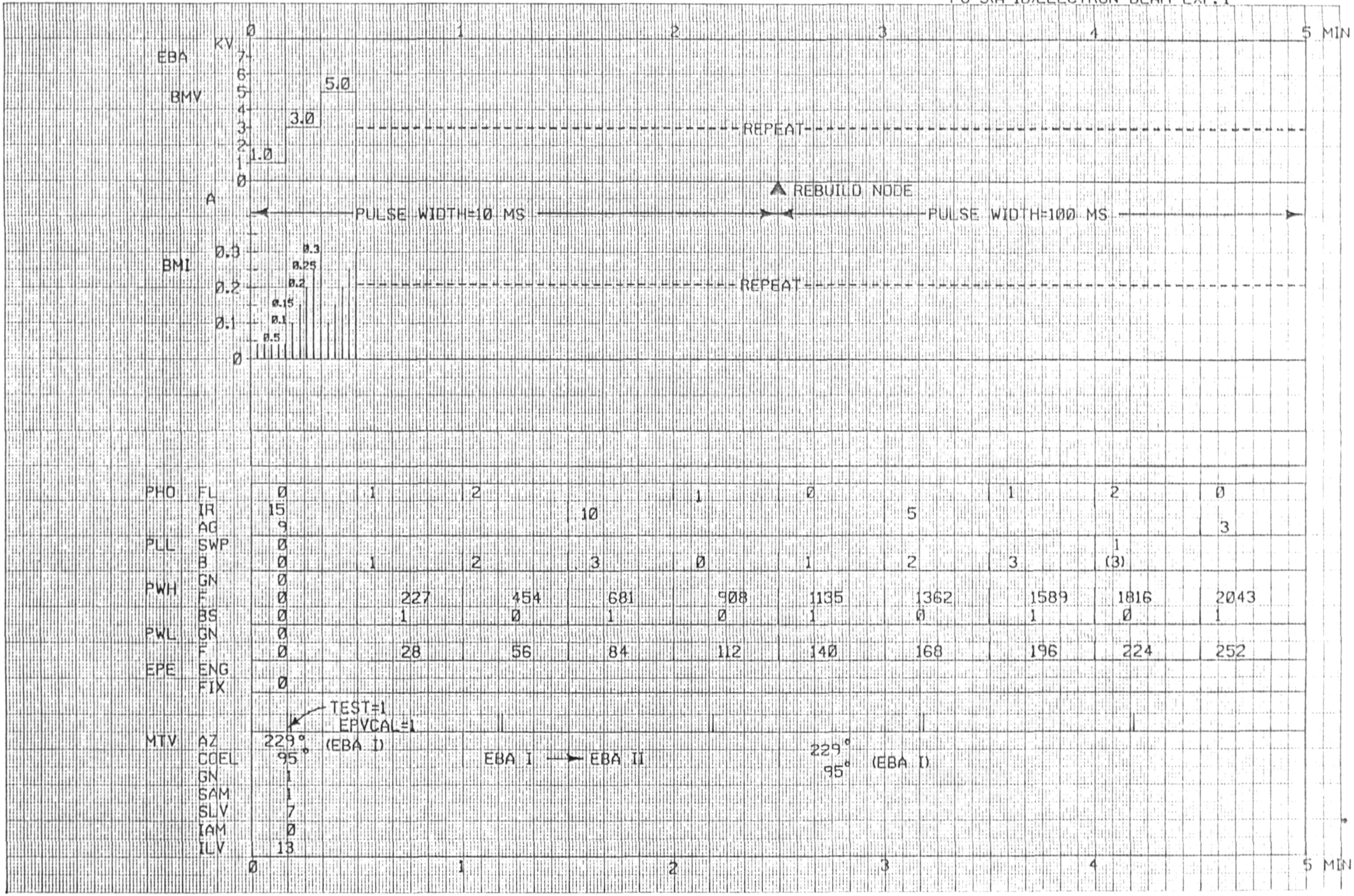
FO-7(A-3)ELECTRON BEAM EXP.3



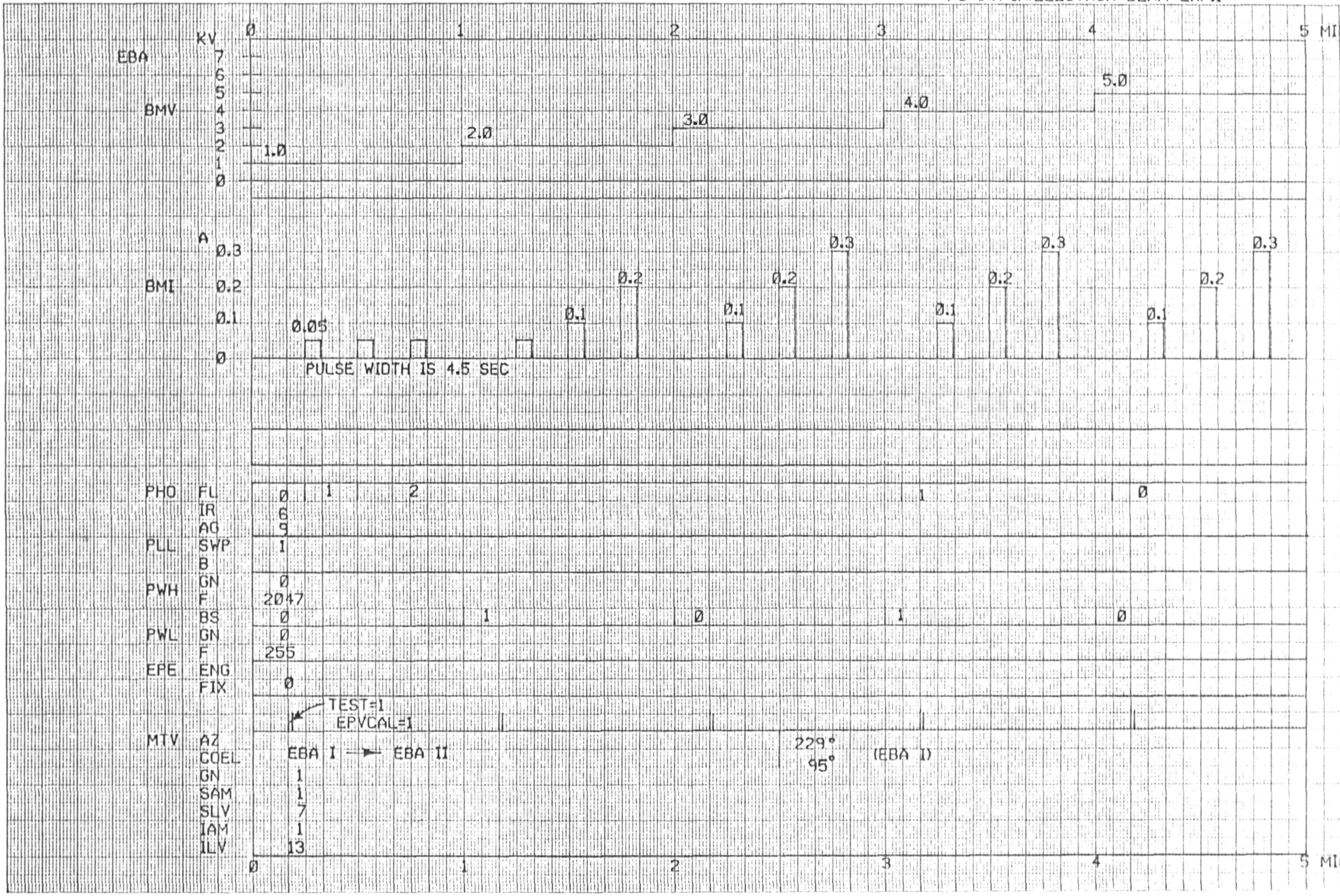


FO-6(A-2)ELECTRON BEAM EXP.2
EBA
KV
BMV
3.0
4.0
5.0
3.0
5.0
BMI
A
0.1
0.2
0.3
NGP
TAUEN=400MS
0.1S
PHO FL IR AC
PLL SWP B
PWH ON F BS
PWL ON F
EPE ENG FIX
TEST=1
EPVCAL=1
MTV AZ COEL ON SAM SLV IAM ILV
229°
95°
(EBA I)
EBA I → EBA II
0
2047
255
13
5 MIN

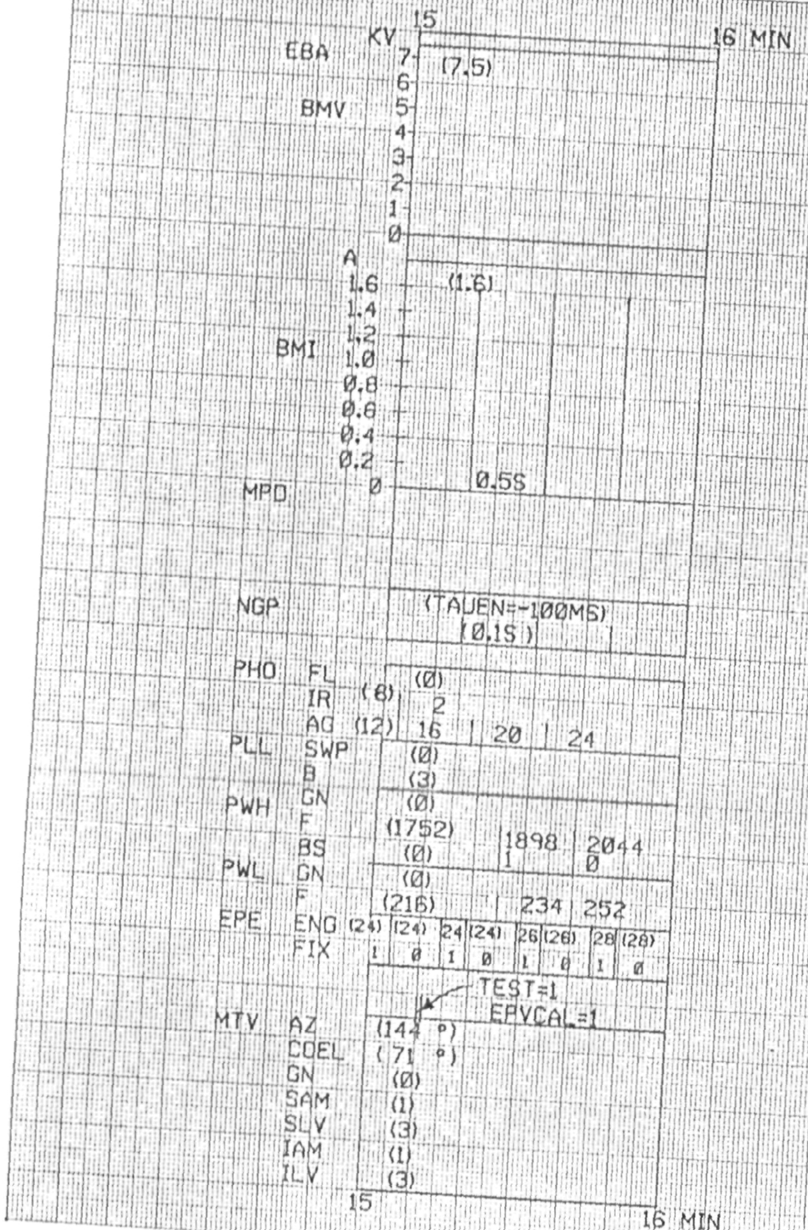
FO-5(A-1B)ELECTRON BEAM EXP.1



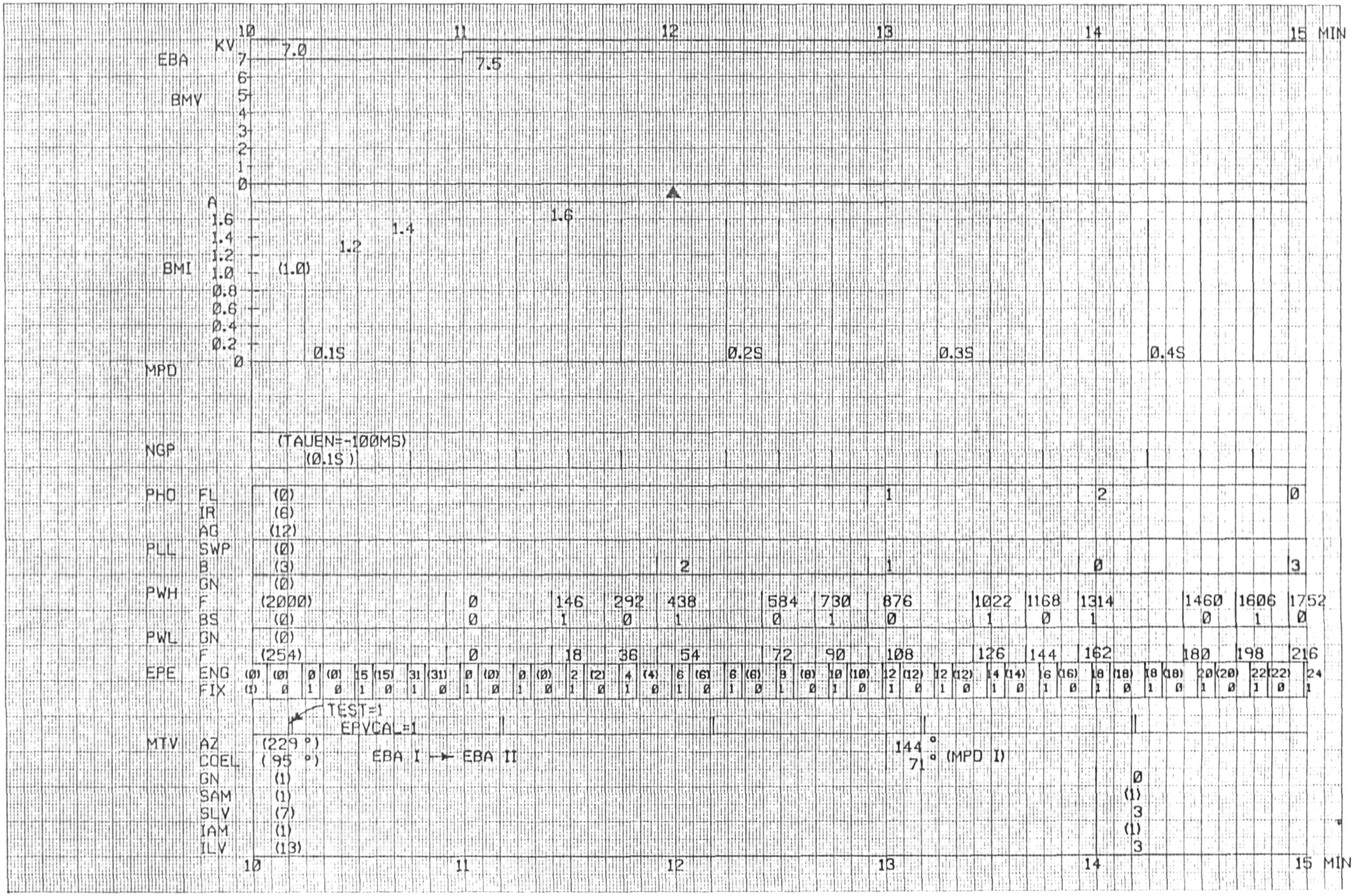
FO-5(A-1A)ELECTRON BEAM EXP.1

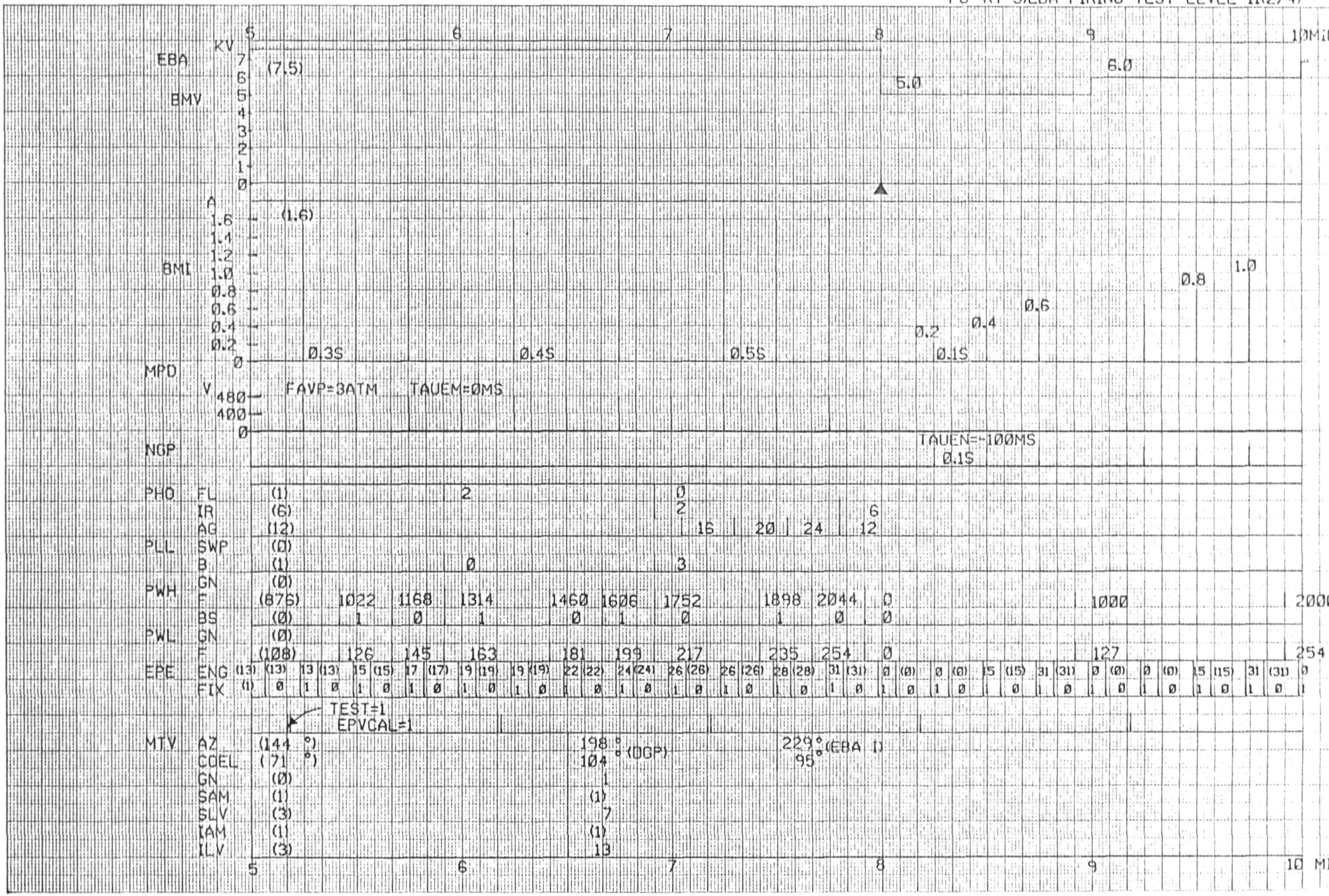


FO-4(T-3)EBA FIRING TEST LEVEL II(4/4)

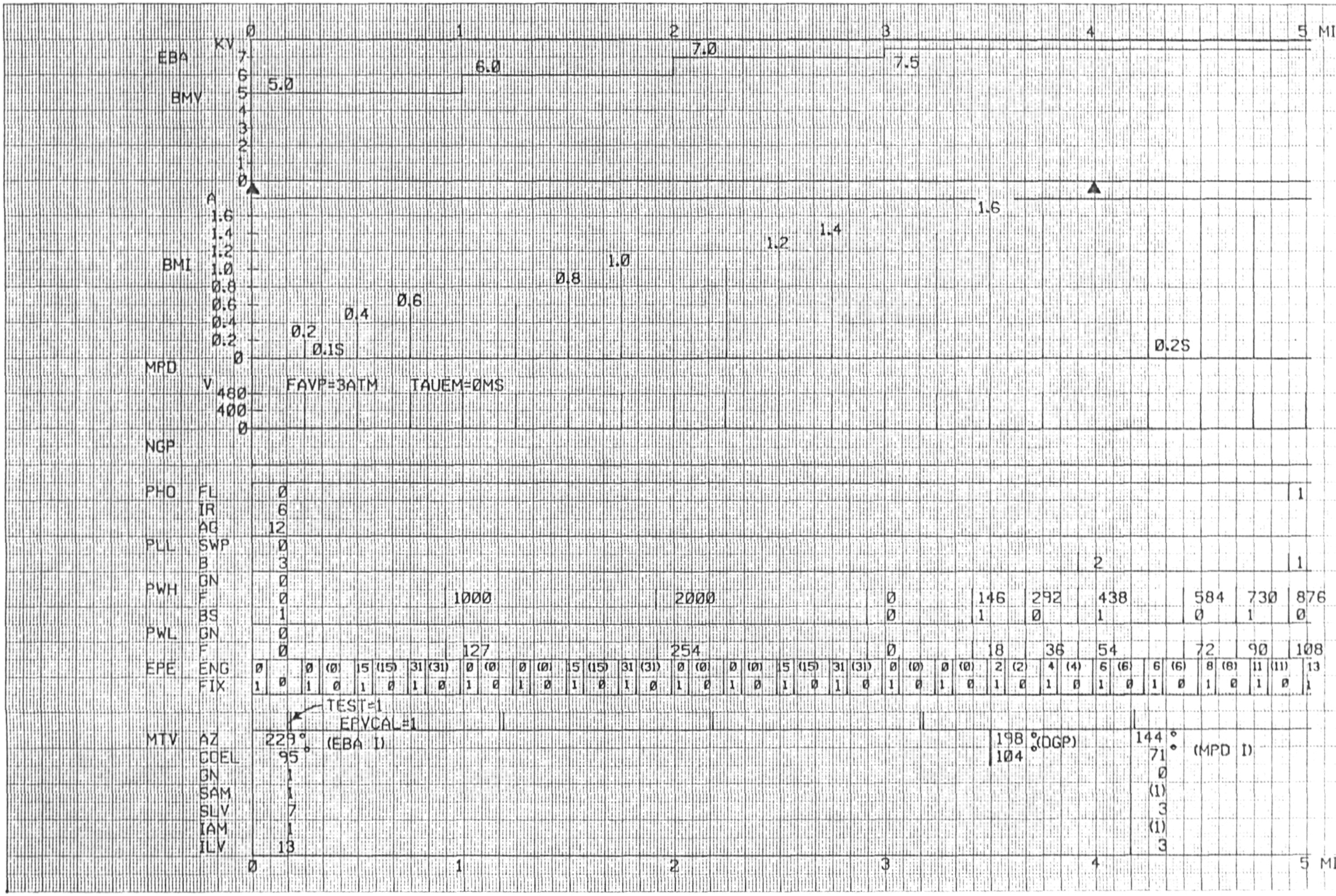


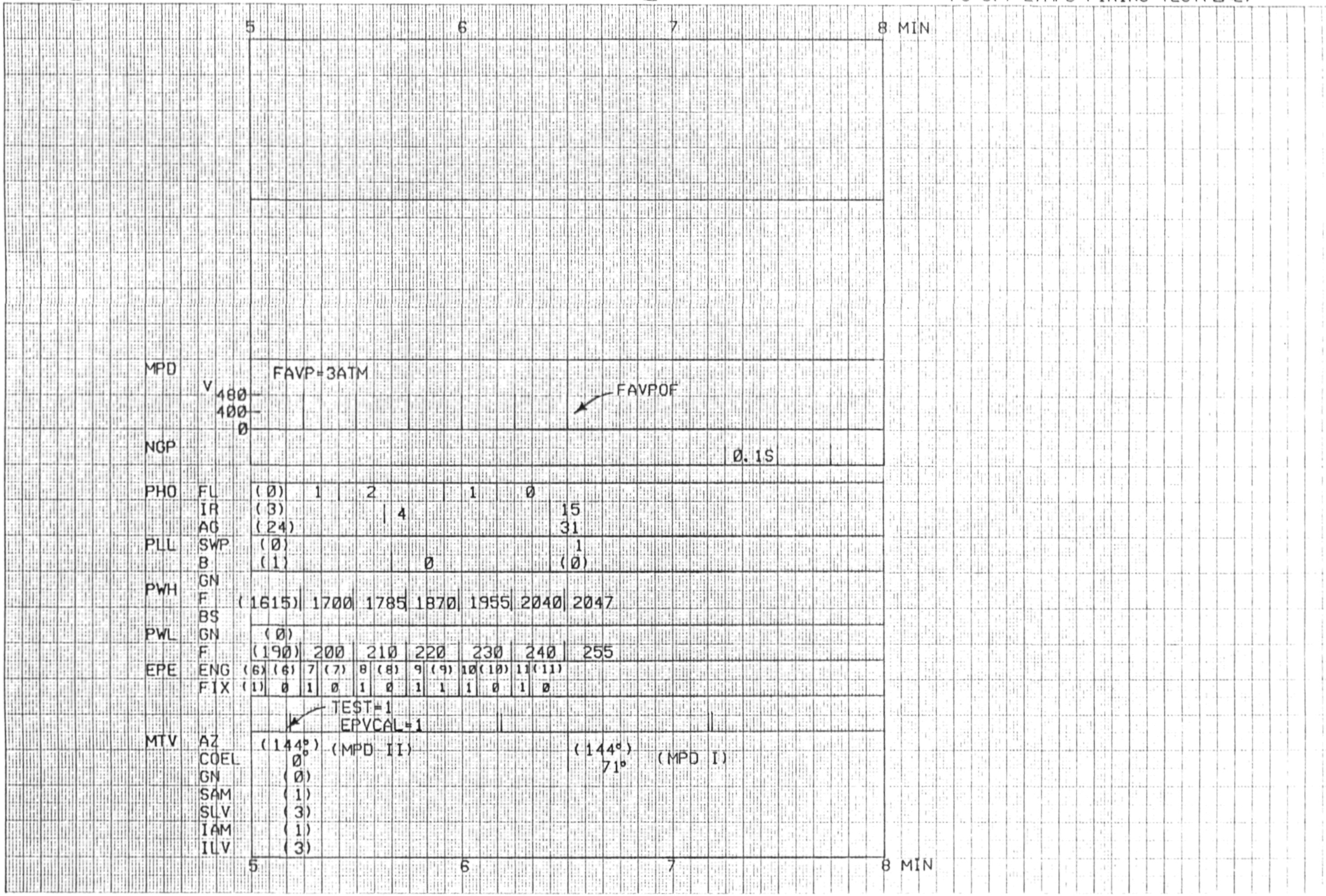
FO-4(T-3)EBA FIRING TEST LEVEL II(3/4)



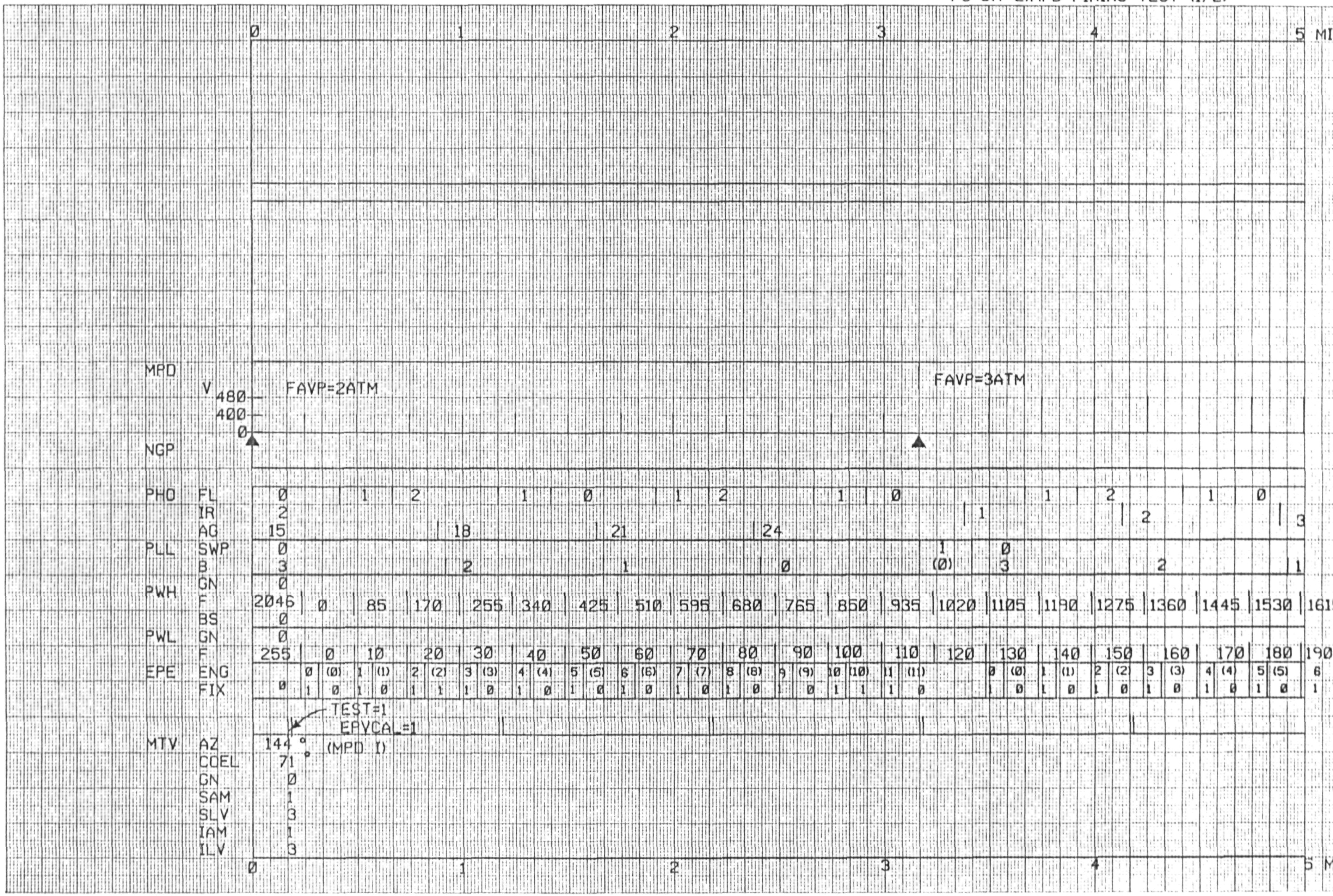

5
6
7
8
9
10MIN
EBA
KV
BMV
(7.5)
5.0
6.0
A
BMI
(1.6)
0.8
1.0
0.6
0.4
0.2
0.3S
0.4S
0.5S
0.1S
MPD
V
FAVP=3ATM
TAUEM=0MS
NGP
TAUEN=-100MS
0.1S
PHO FL
IR
AG
PLL SWP
B
PWH GN
F
BS
PWL GN
F
EPE ENG
FIX
TEST=1
EPVCAL=1
MTV AZ
COEL
GN
SAM
SLV
IAM
ILV
(144 °)
(71 °)
198 °
104 °
(DGP)
229 °
95 °
(EBA I)
10 MIN

FO-4(T-3)EBA FIRING TEST LEVEL II (1/4)

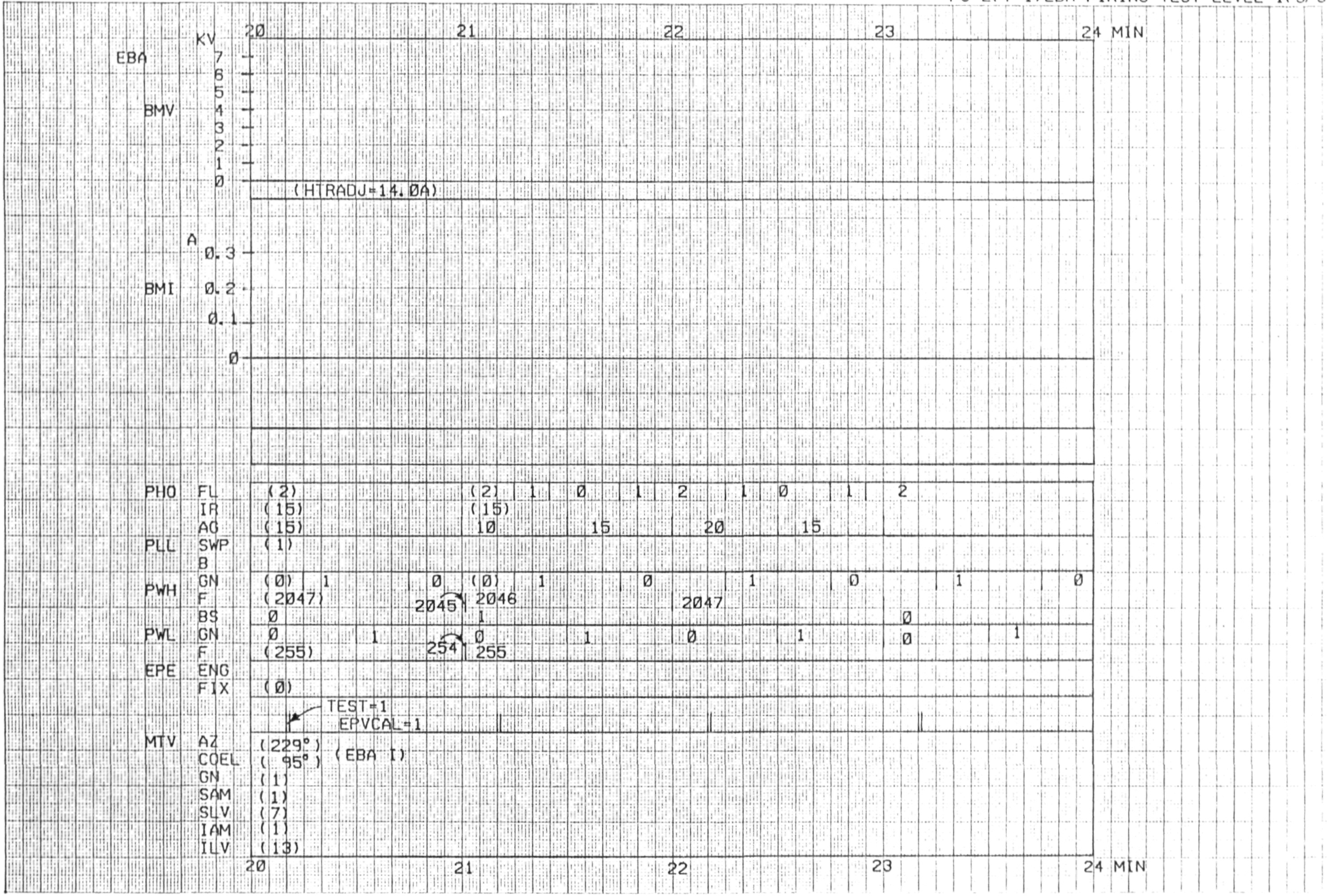



5
6
7
8 MIN
MPD
FAVP=3ATM
V
480
400
0
FAVPOF
NGP
0.1S
PHO FL (0) 1 2 1 0
IR (3) 4 15
AG (24) 31
PLL SWP (0) 1
B (1) 0 (0)
PWH GN
F (1615) 1700 1785 1870 1955 2040 2047
BS
PWL GN (0)
F (190) 200 210 220 230 240 255
EPE ENG (6) (6) 7 (7) 8 (8) 9 (9) 10 (10) 11 (11)
FIX (1) 0 1 0 1 0 1 1 1 0 1 0
TEST=1
EPVCAL=1
MTV AZ (144°) (MPD II) (144°) (MPD I)
COEL 0° 71°
GN (0)
SAM (1)
SLV (3)
IAM (1)
ILV (3)
5
6
7
8 MIN

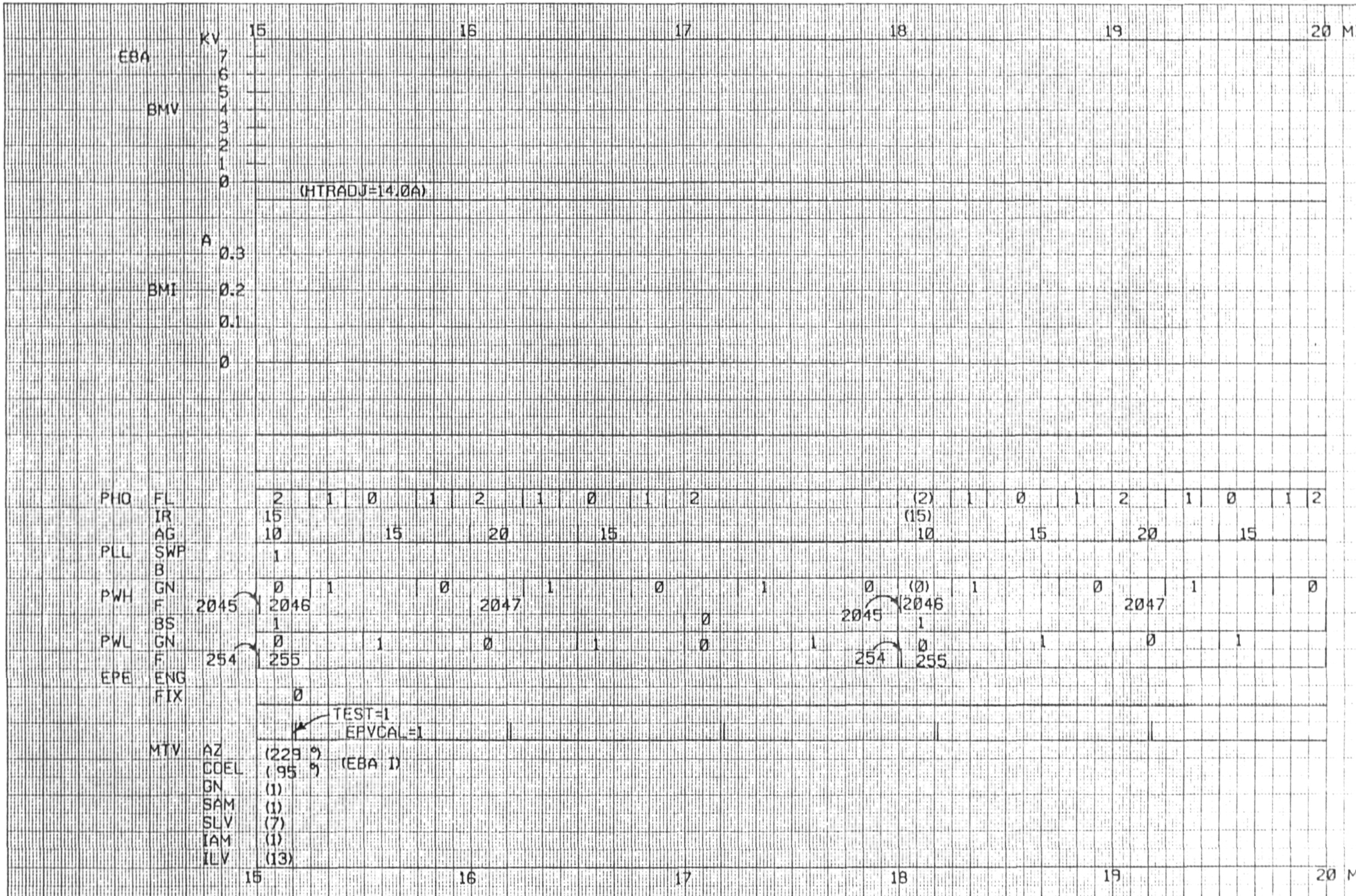
FO-3(T-2)MPD FIRING TEST (1/2)

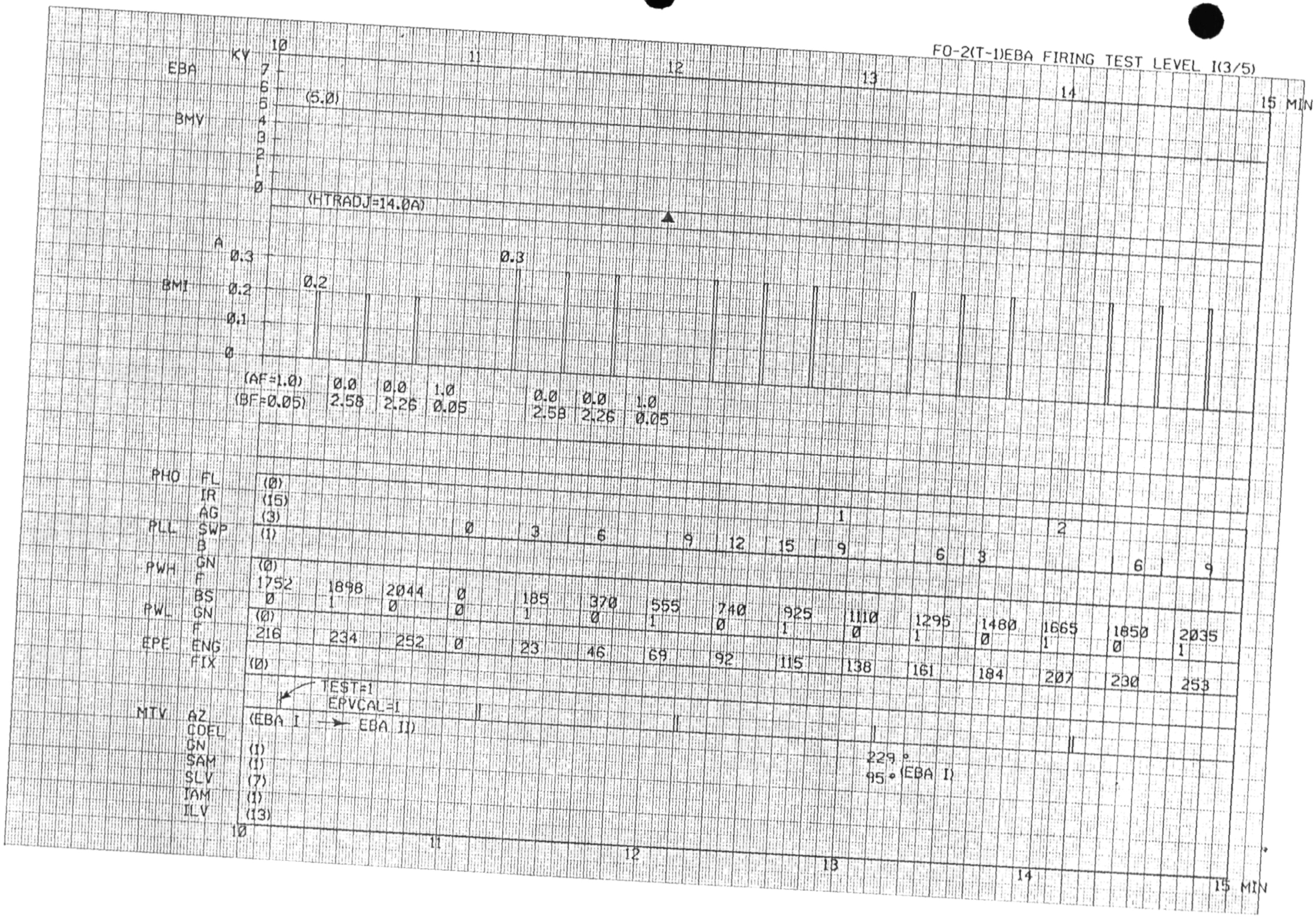


FO-2(T-1)EBA FIRING TEST LEVEL I(5/5)



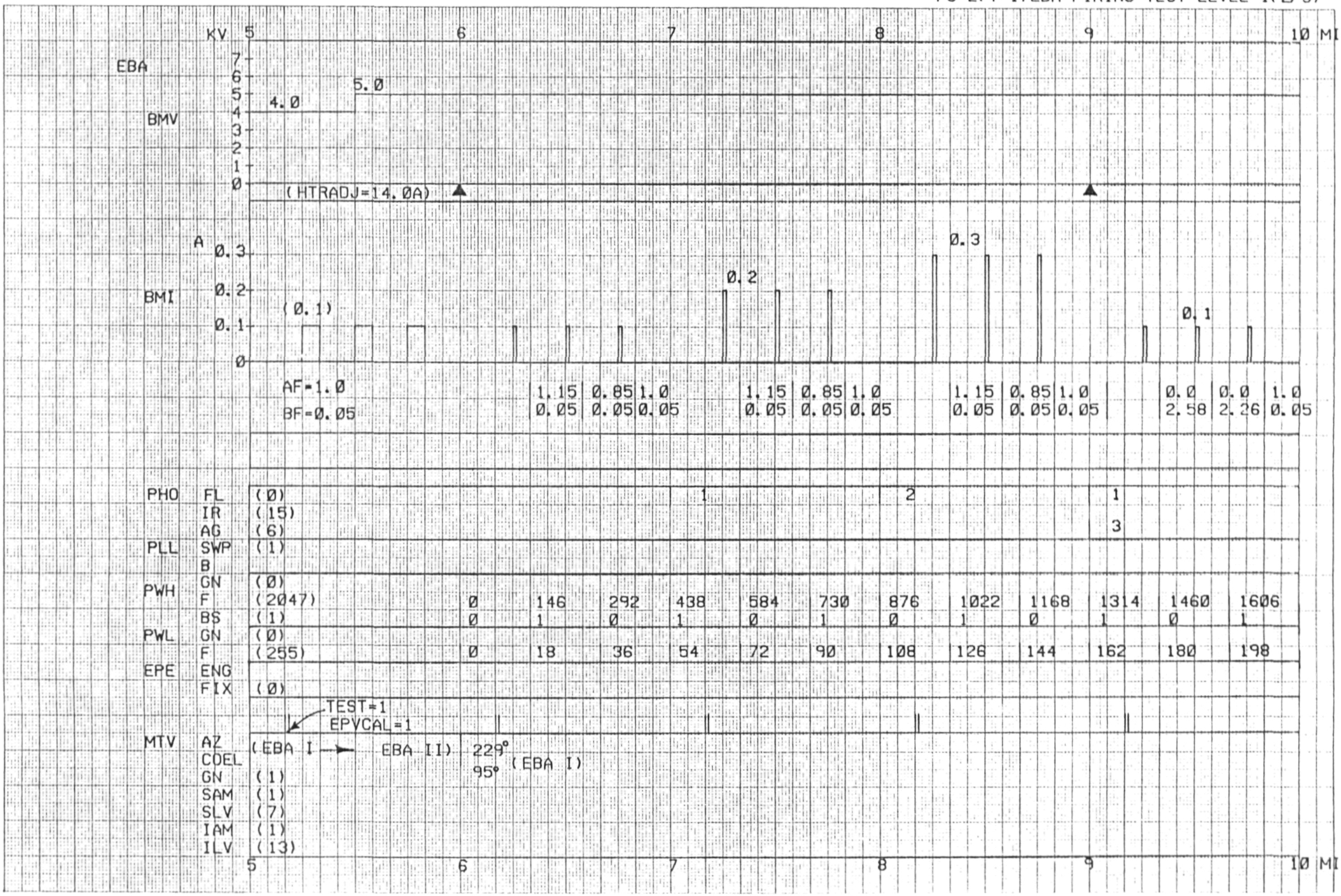
FO-2(T-1)EBA FIRING TEST LEVEL I(4/5)

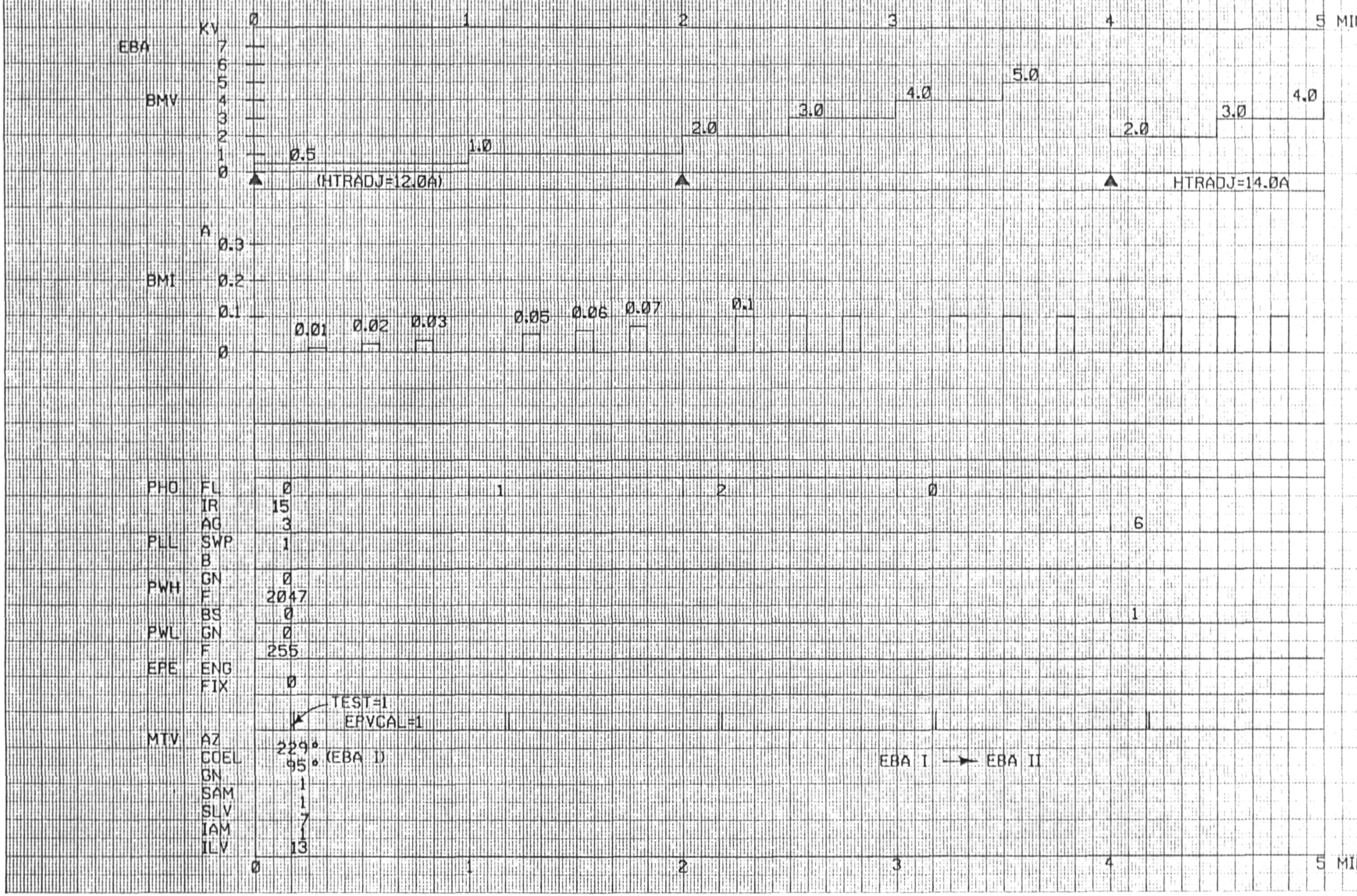




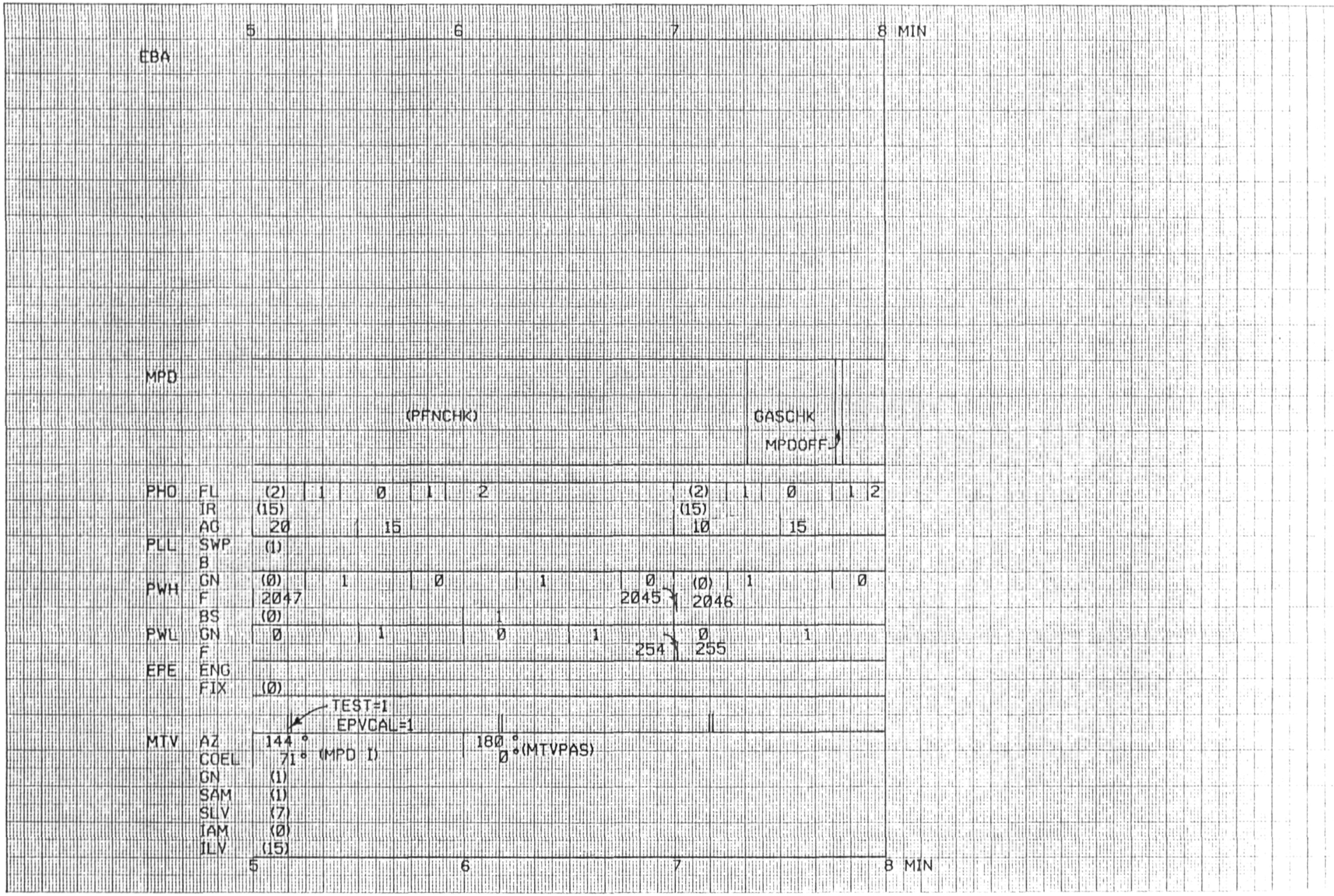
FO-2(T-1)EBA FIRING TEST LEVEL I(3/5)
EBA KV
BMV
(5.0)
(HTRADJ=14.0A)
BMI A
0.3
0.2
(AF=1.0) 0.0 0.0 1.0 0.0 0.0 1.0
(BF=0.05) 2.58 2.26 0.05 2.58 2.26 0.05
PHO FL (0)
IR (15)
AG (3)
PLL SWP (1)
B
PWH GN (0)
F 1752 1898 2044 0 185 370 555 740 925 1110 1295 1480 1665 1850 2035
BS
PWL GN (0)
F 216 234 252 0 23 46 69 92 115 138 161 184 207 230 253
EPE ENG
FIX (0)
TEST=1
EPVCAL=1
MTV AZ (EBA I → EBA II)
COEL
GN (1)
SAM (1)
SLV (7)
IAM (1)
ILV (13)
229°
95° (EBA I)
10 11 12 13 14 15 MIN

FO-2(T-1)EBA FIRING TEST LEVEL I(2/5)

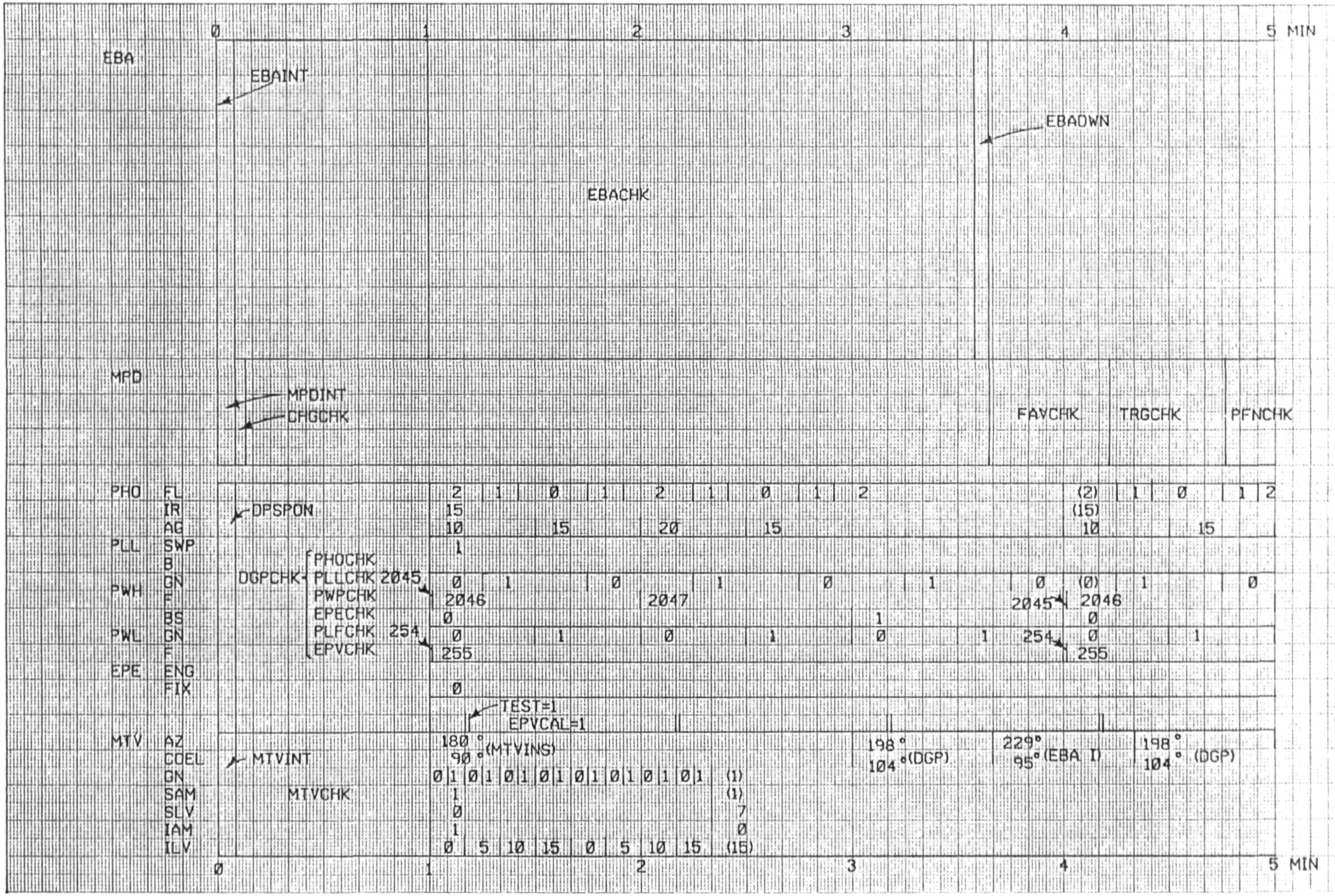



0 1 2 3 4 5 MIN
KV
EBA
7
6
5
BMV
4
3
2
1
0
0.5
1.0
2.0
3.0
4.0
5.0
2.0
3.0
4.0
(HTRADJ=12.0A)
HTRADJ=14.0A
A
0.3
BMI
0.2
0.1
0
0.01
0.02
0.03
0.05
0.06
0.07
0.1
PHO FL 0 1 2 0
IR 15
AG 3 6
PLL SWP 1
B
PWH GN 0
F 2047
BS 0 1
PWL GN 0
F 255
EPE ENG
FIX 0
TEST=1
EPVCAL=1
MTV AZ 229°
COEL 95° (EBA I)
GN 1
SAM 1
SLV 7
IAM 1
ILV 13
EBA I → EBA II
0 1 2 3 4 5 MIN

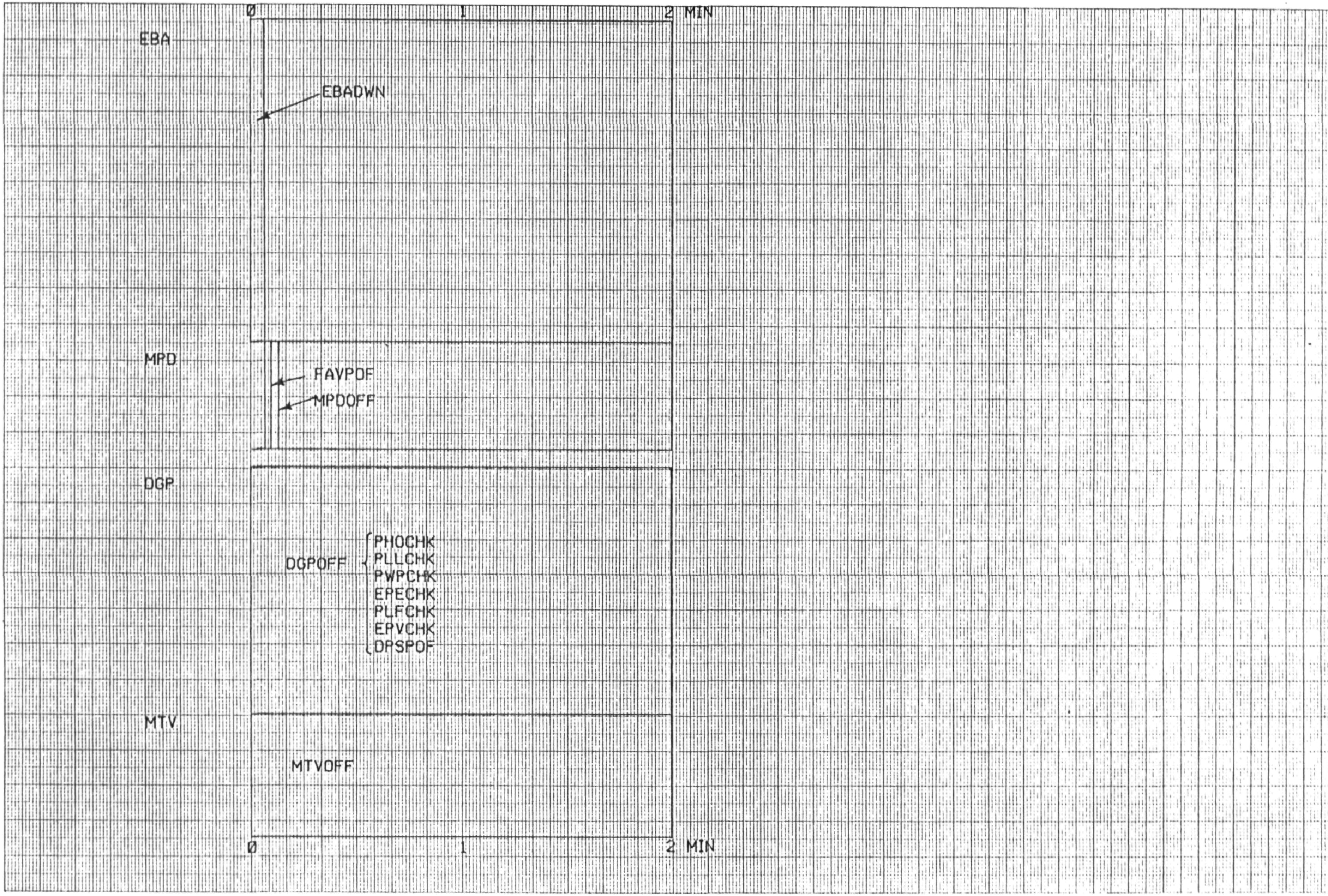
FO-1(CFO) SEPAC SYSTEM CHECKOUT (2/2)



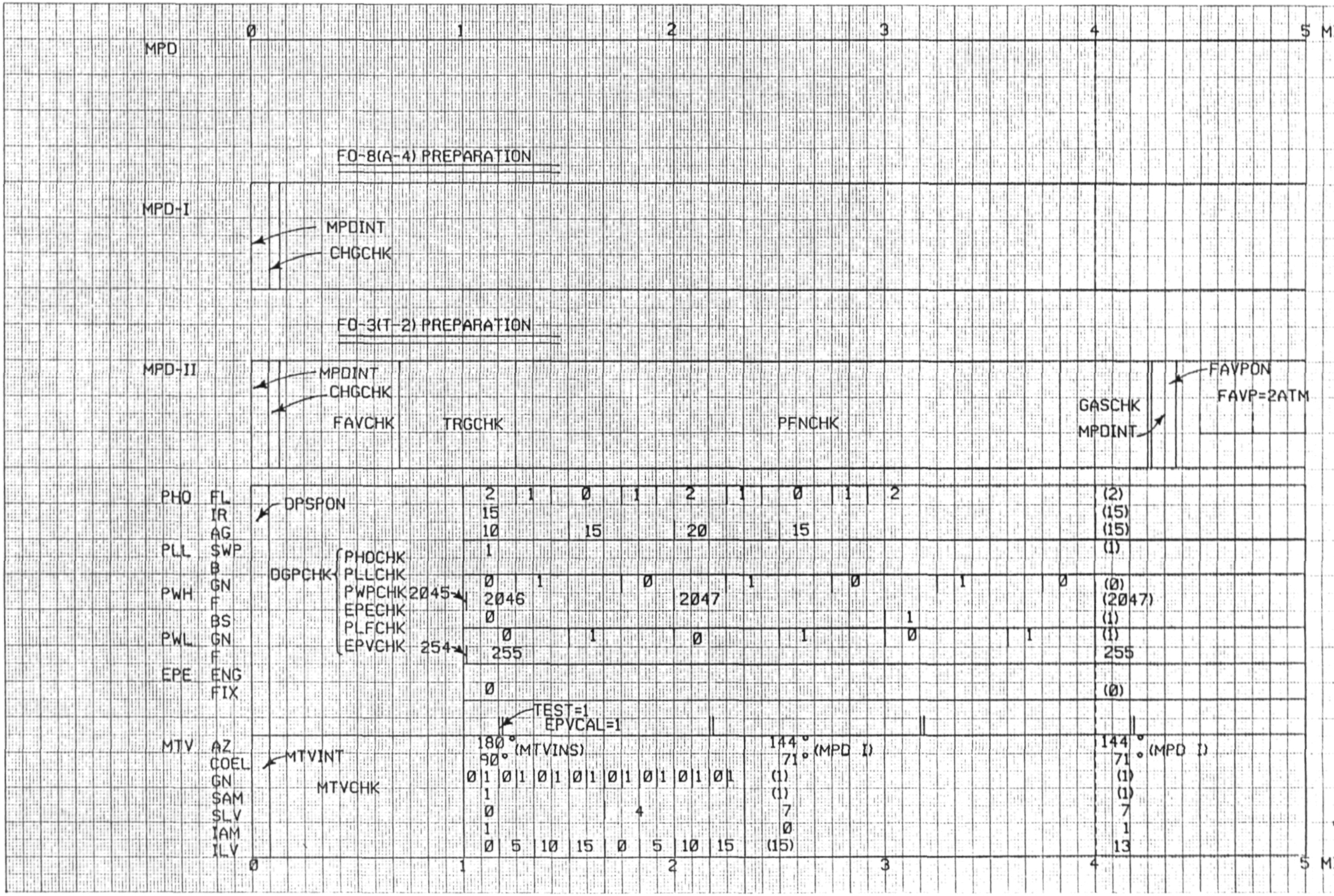
FO-1 (CFO) SEPAC SYSTEM CHECKOUT(1/2)

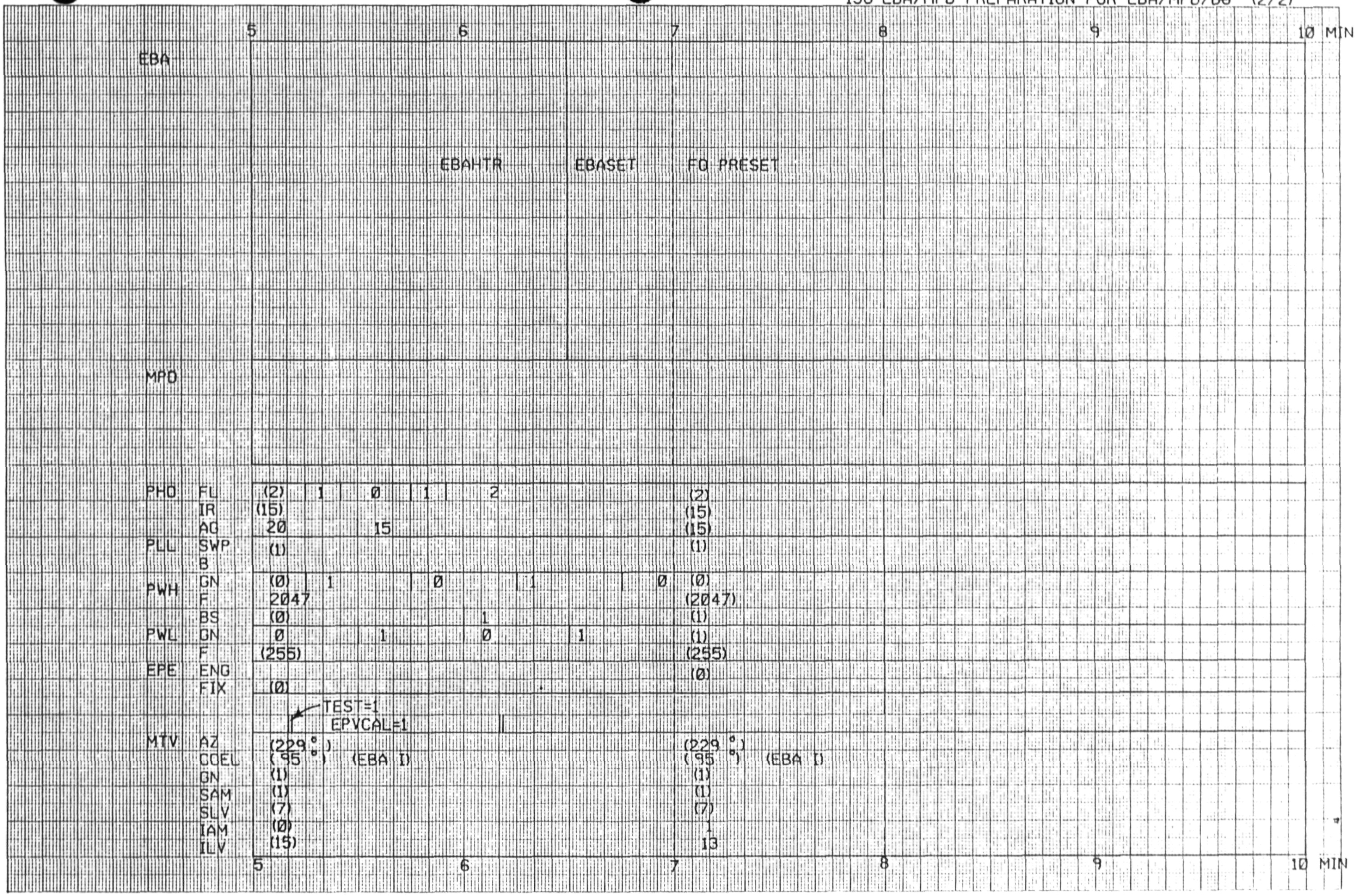


PWROFF SYSTEM TERMINATION

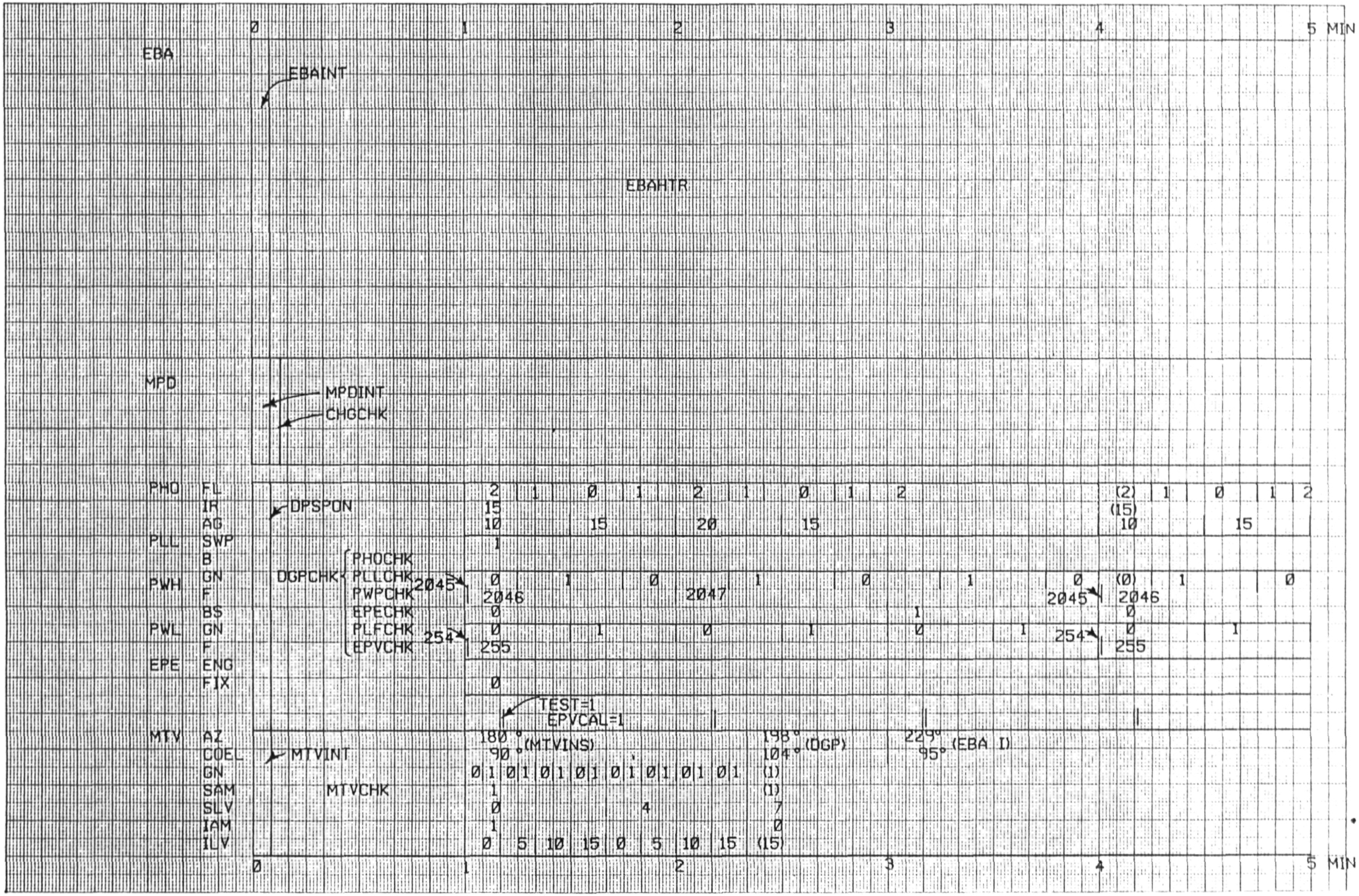


ISO-MPD PREPARATION FOR MPD/DG

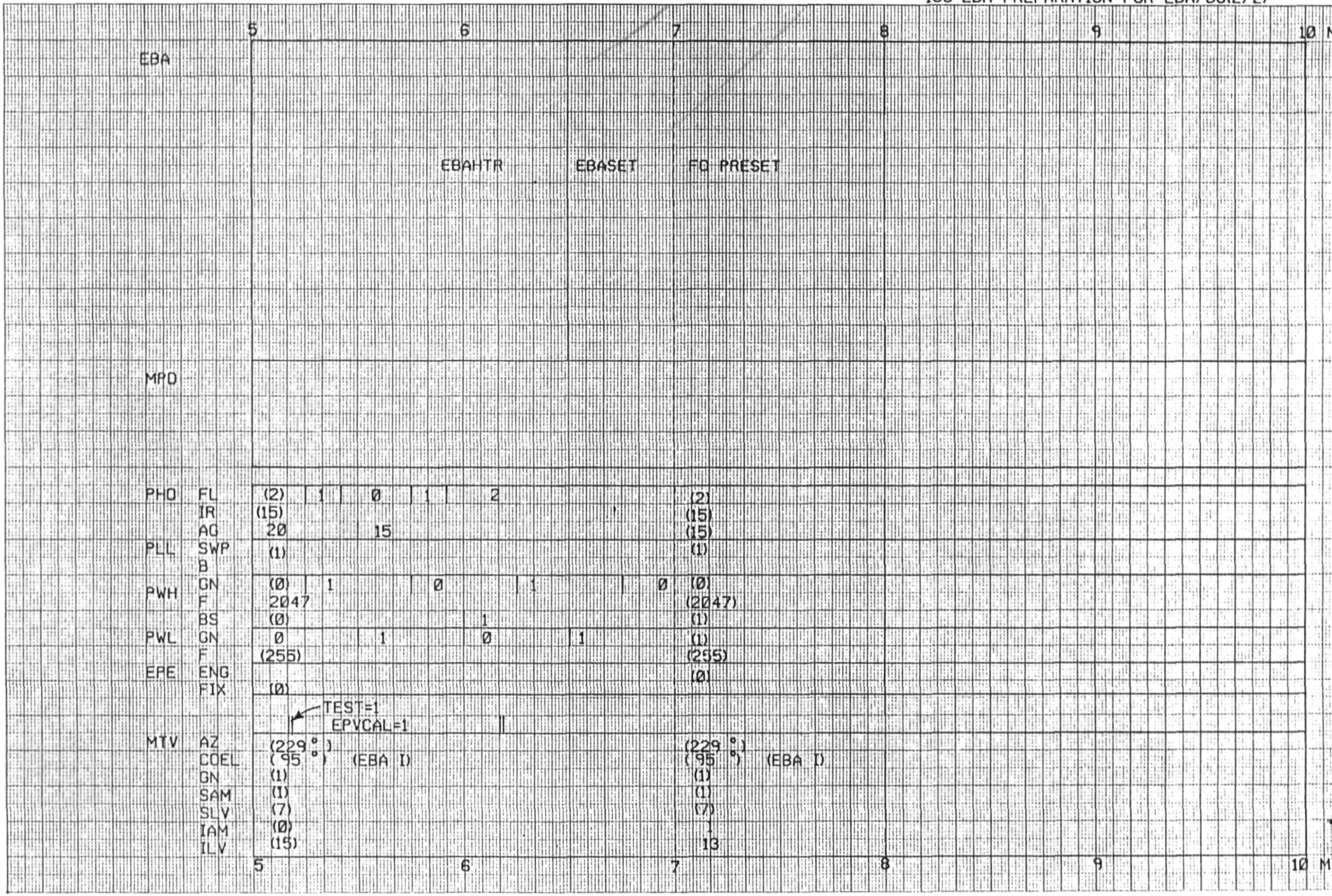


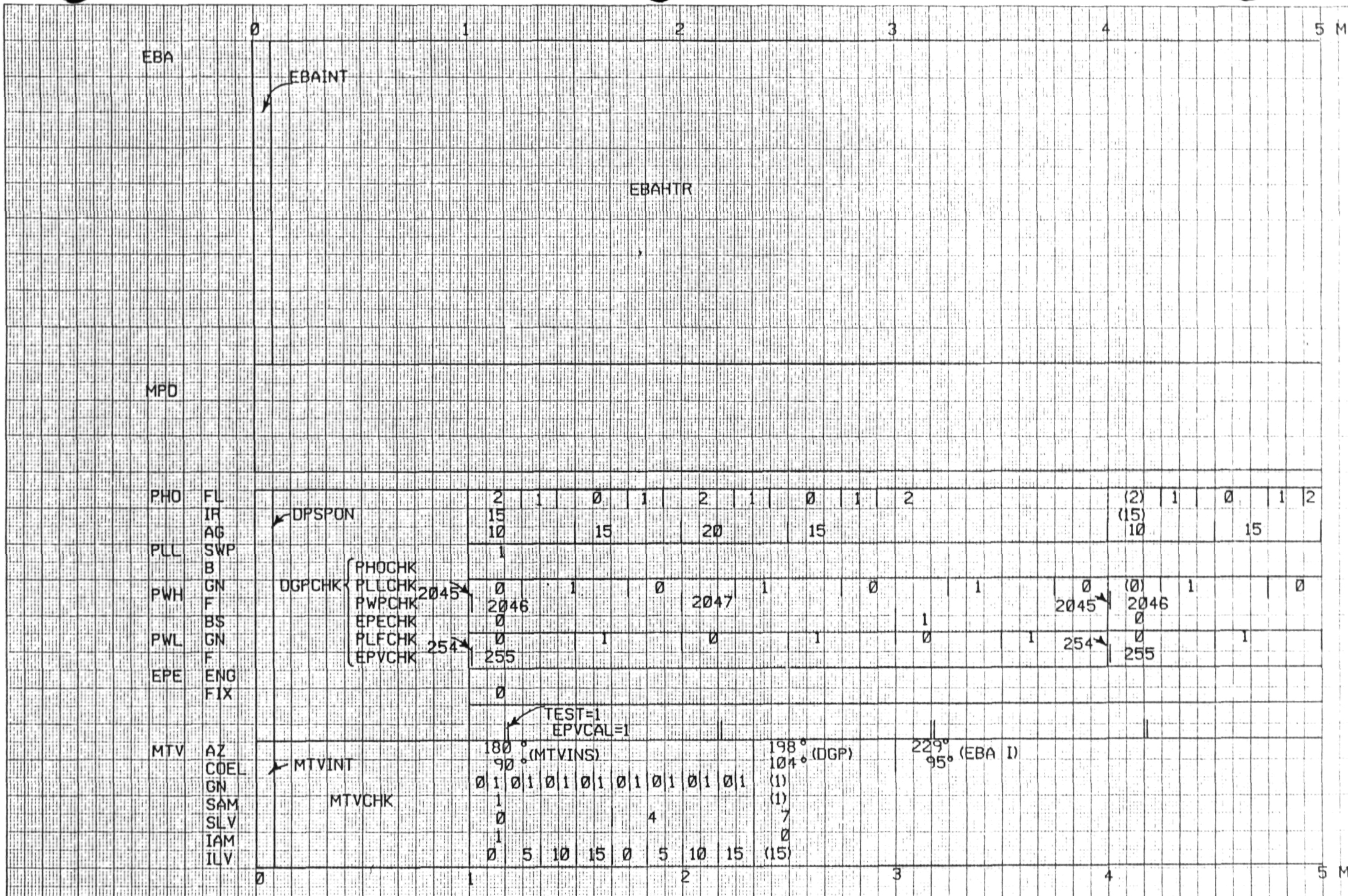

5
6
7
8
9
10 MIN
EBA
EBAHTR
EBASET
FO PRESET
MPD
PHO FL (2) 1 0 1 2 (2)
IR (15) (15)
AG 20 15 (15)
PLL SWP (1) (1)
B
PWH ON (0) 1 0 1 0 (0)
F 2047 (2047)
BS (0) 1 (1)
PWL ON 0 1 0 1 (1)
F (255) (255)
EPE ENG (0)
FIX (0)
TEST=1
EPVCAL=1
MTV AZ (229°) (229°)
COEL (95°) (EBA I) (95°) (EBA I)
ON (1) (1)
SAM (1) (1)
SLV (7) (7)
IAM (0) 1
ILV (15) 13
5
6
7
8
9
10 MIN

ISO-EBA/MPD PREPARATION FOR EBA/MPD/DG (1/2)



ISO-EBA PREPARATION FOR EBA/DG(2/2)





0 1 2 3 4 5 MIN
EBA
EBAINT
EBAHTR
MPD
PHO FL
IR
AG
PLL SWP
B
PWH GN
F
BS
PWL GN
F
EPE ENG
FIX
MTV AZ
COEL
GN
SAM
SLV
IAM
ILV
DPSPON
DGPCHK
PHOCHK
PLLCHK
PWPCHK
EPECHK
PLFCHK
EPVCHK
2045
2046
2047
254
255
TEST=1
EPVCAL=1
180° (MTVINS)
90°
198° (DGP)
104°
229° (EBA I)
95°
MTVINT
MTVCHK

FO-14(P-2)1ESØ20 EXPERIMENT SUPPORT