UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Earthquake Processing on the Eclipse: A Beginner's Manual

By

C. McHugh

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Introduction

The package of programs on the Eclipse computer is designed to facilitate processing of earthquake data from dubbed library tapes. These programs make possible the selection of up to several hundred seismograms and permit their digitization and display. The data are quickly processed, accessible, accurate, and easily archived for later use or transfer to other computers. The package contains eight programs: SELECT2, NPCON, DMUX3, PICKER, HYPO, SISDS, BTRANS and RESTB. The first three programs enable the selection and digitization of seismograms. These three programs set up the file structure utilized during processing and must be used in the order listed for any given earthquake. The next three programs, PICKER, HYPO and SISDS, allow the actual display and analysis of the seismograms. (It is recommended that use of PICKER precede use of SISDS.) The last two programs, BTRANS and RESTB, are magnetic tape archiving programs. (These also must be used in the order listed.)

Setting Up

The Eclipse is a 16-bit mini-computer accessed by two terminals (see Appendix 2 for more information on Eclipse hardware). These two terminals have corresponding grounds (operating system partitions). The background is used primarily for system work; the foreground is used for plotting and other processing. Most work is done on the foreground terminal (the Tektronix 4014).

At the beginning of a session it is wise to type

RLA

INFO

on the background terminal. This releases all unessential disks and gives the operating system, directory, C.P.U. memory allocation, date and time, and whether the computer can execute commands typed on the foreground terminal. If the operating system is not XSYSA, (or XSYSB if on Eclipse B), terminate the foreground with

ctrl-F

Then type

INIT DPØF

BOOT DPØF:XSYSA

and answer the questions about the date and time. Follow this with

SMEM 45

EXFG/E CLI

Now commands typed on the foreground terminal will be executed. At this point load the small (portable) disk pack containing the working directory. DO NOT touch the keyboard of either terminal until the

disk ready light is on. (The system will crash if given commands before the disk housing the operating system (DPØF) is ready; see Appendix 2 for more information on Eclipse hardware.) On the foreground terminal, get into the working directory:

DIR DPØ:DIRNAME

(DIRNAME is the name of the working directory.)

Then type

STARTUP

This routine sets the links from the working directory to that in which the programs reside. One additional link may have to be set manually, that which allows access to a dub catalog file (DCAT) during selection. (The name of the DCAT file is of the form MONYR, where MON stands for the first three letters of the month and YR for the last two digits of the year. There is one for each month.) This link need be set only once for each DCAT file.

To set it, type

LINK MONYR W:MONYR

Event selection is now possible.

Station Selecting

The SELECT2 program is the first program in the package. Successful use of this program determines the success in processing. SELECT2 can be thought of as the foundation program in that it sets up the files necessary for digitization and subsequent processing. This program is oriented toward routine earthquake processing. Under

normal operation the program chooses those stations which fall within an imaginary circle of given radius and centered at the station listed in the DCAT. The program will automatically extend this radius when seeking stations to fill the station coverage gap it finds after drawing the first circle. To use this program, type

SELECT2

It will ask three questions; the first is for a name, the second, for the name of the DCAT file to be used. Responses are

OPERATORNAME

MONYR

The third question concerns a control file, the file actually used to guide the digitizing program. Generally the answer to "new control file?" is YES. (It is not YES when a selection session is started at one time and completed at another; see Appendix 3.) SELECT2 requires that the proper station history files also be accessed. (There are two station history files, the "IN" or index file and the "ML" or master list file. Names are of the form CALYR.IN and CALYR.ML, where CAL stands for Calnet and YR stands for the last two digits of the year. The year given here should match that of the DCAT file.) To access them, type

ST

The computer will then list out the current station history files and ask for the names of the ones to be used, with verification required after each one:

index file? CALYR.IN

CR to verify

master list? CALYR.ML

CR to verify

The computer will then repeat "new control file?"; answer YES as before. SELECT2 then keys into the DCAT through a series of unique ID's (hereafter also referred to as UID), each of which consists of a year, month, date, and event sequence number. To find these unique ID's type

PC

for "print contents of the dub catalog". Then type

DAY

The computer will ask for which day of the month. Enter the date in response to the prompt. This will bring all events for that particular day into a temporary buffer for screening. Type

PR

to initiate the screening process, and for each successive page give a carriage return. It is recommended that all unique ID's, (and the corresponding tape ID's) for a particular day be retrieved at the same time (see Appendix 3). To exit the screening process, type

FIN

It is not necessary to screen all entries for a day; FIN can be typed after any page. Now call in another day or type FIN again to totally exit this part of the program.

To begin event selection, type

SE

and answer the prompt with the unique ID of the event to be selected. Verify with a carriage return. After a time the computer will print out the number of stations found within a default radius. At this point type in a different radius or give a carriage return to continue. The computer prints out the number of stations selected. Now type

PS

to list the stations selected. Modifications, either additions or deletions, are made with

MS

A XXXV add the station XXXV

D XXXV delete the station XXXV

Exit the modification routine with a carriage return. Print the station list again; if satisfied with it, complete the processing with

CP

The next event can be selected in the same manner (see Appendix 4 for more information on SELECT2). SELECT2 is left gracefully with

EX

SELECT2, or any other program, is left ungracefully with ctrl-A. If SELECT2 is left in this way a program called UNLOCK must be invoked to enable future use of the DCAT file. To use it, type

UNLOCK

The program will prompt for the name of the file to be unlocked; type the name of the DCAT in response:

MONYR

Exit UNLOCK with a carriage return.

Digitizing

To digitize, the system must be booted to an unmapped operating system, a system that does not recognize the existence of Eclipse B. At this point make sure DZØ is not initialized on Eclipse B. (Ask its user or type RELEASE DZØ on its background terminal.) Then mount the proper 1-inch library tape and set up the transport (see Appendix 2). Boot to the unmapped system: on the terminal where working, type

RELEASE DZØ

RELEASE DPØ

On the background terminal type

ctrl-F

INIT DPØF:DIG

BOOT DPØF:DIG:USMALL

and answer the questions concerning the date and time. Get into the working directory:

DIR DPØ:DIRNAME

Now begin digitizing:

NPCON

This program will ask several questions on the foreground terminal. The first one asks where to put the digitized data. The proper response is

DZØ:X

or

DZØ:Y

(This is the EVDAT file, a large contiguous file to which data is digitized.) The next question asks whether the tape is dubbed (Ø = yes); type

Ø

in response to this question. The last two questions deal with events that may already be in the EVDAT file. The first of these questions asks for the number of the next event. To this answer

1

The second asks to delete the last events. To this also answer

1

(Note that responding with a "1" to both questions will cause NPCON to overwrite all events already in the EVDAT file. If this is not desired, answer the first question with the next available event number. There will no second question. If the event(s) in the EVDAT file belong(s) to another user, assume processing has been completed and respond with "1" to each question.) The program then takes over and finishes by itself. Upon completion, boot back to a mapped operating system; type

RELEASE DPØ

RELEASE DZØ

INIT DPØF

BOOT DPØF:XSYSA

and answer the date and time questions. Then type

SMEM 45

EXFG/E CLI

On the foreground terminal get into the working directory and set the links:

DIR DPØ:DIRNAME

STARTUP

Demultiplexing

The data must now be demultiplexed. This moves it into the working directory and prepares it for analysis. To demultiplex type

DMUX3

The computer will ask for the name of the directory digitized to; respond with

DZØ:X

or

DZØ:Y

(depending upon which EVDAT file was used).

The computer will print out a list of the unique ID's of events digitized to the EVDAT file, and ask for the number of the event

to demultiplex. Answer with the event number (not the unique ID) or take one of the options listed, a "Ø" to exit or a "-1" to demultiplex all events in the EVDAT file. (It is recommended that events be digitized and demultiplexed in the same session. This will prevent inadvertant deletions by other users.) When demultiplexing is completed, the data are ready for screening and processing on the Eclipse or for transfer to other computers.

Automatic Picking

At this point the data can be screened and manually picked or it can be automatically picked. To use the automatic picker, type

PICKER

UID

CR to verify

The computer will print the phase data on the screen as it picks. (Note: The picker approximates all coda lengths; these should be used with caution.) Any number of events may be picked in succession without leaving the program; it will prompt for each unique ID. A carriage return in response to the prompt will exit this program.

Event Locating

A preliminary location can be obtained by the use of HYP079. To get a location, type

HYPO

UID

CR to verify

The program will funnel the results into a screening routine whose prompt is "filename?". The answer to this query is

OUTPUT

Carriage returns prompt new pages. At the end of the file will be another "filename?". Answer this with

ctrl-Z

to exit HYPO.

Trace Plotting

The plotting routine is called SISDS. It will plot trace data, picks from the automatic picker, and residuals from the locating program. To use it, type

SISDS

and answer prompt with the unique ID of the event to be screened. At this point, decide how much trace data will be seen at one time and at which point in the data the screening process will start. Any reasonable values may be used (recommended values for length of window and seconds into data are 10. and 8. respectively). If no values are set, the default values are used (i.e., the entire digitization length is plotted without offset). A routine called in will ask for these values in turn:

DE

length of window? 10.

seconds into data? X 8.

Traces can be displayed in an orderly fashion, or called individually by name or trace number. To display traces in an orderly fashion, or step through the traces, as it is called, decide how many traces per step and with which to begin. (Recommended values for number of traces per step and beginning trace number are 4 (or 2) and 1 respectively.) Then type

STSE

number of traces per step? 4

beginning trace number? 1

The computer will plot according to the numbers entered here. To plot the next group of traces, type

ST

and repeat as often as necessary to plot all the digitized traces. To display picks on each plot, enter the picking mode; type

PI brings up cross-hairs

L displays picks

Picks from the automatic picker and residuals from the locating program will be superimposed on the traces. It is possible to correct or make picks in this mode as well. To do this, it is necessary to put crosshairs were pick is to be made and type in what the pick is.

Some options are

;IPUØ	p-waves
;EP 2	
;ISD2	S-waves
;ES+1	
F	coda
A CR CR	amplitude (first carriage return after crosshairs positioned on one peak, second carriage return after crosshairs positioned on trough one-half cycle later).
XP	delete picks corresponding to letter
XF	

Exit the PI mode with

.	(a period)

If more of the trace should be seen, the size of the window can be changed (use DE option, p. 13), or the window may be moved forward or backward in time. To slide the window, type

SL+	move window forward in time
SL-	move window backward in time

Individual traces may be called into the plotting buffer by the name or by the number of the trace. To call traces, type

```
TR
SE:XXXV
```

or

```
SE:NN
EX
```

where XXXV is the station name or NN is the trace number. More than one station may be called at once (examples: SE:XXXV XXXV or SE:NN NN). To plot those traces just called type

PL

To exit SISDS and preserve corrections and new picks, type

REWR

EX

(See Appendix 5 for more information on SISDS.)

Now HYPO can be used as before

HYPO

UID

CR to verify

filename? OUTPUT

ctrl-Z to exit

Tape Writing and Reading

When an event is completed, it is saved on magnetic tape. Tape writing and reading are handled by companion programs, BTRANS and RESTB. At this time mount a tape on one of the drives and set the tape drive selector on Ø. The other tape drive should be selected differently. BTRANS requires that a double file mark (normally marking the end of the last file on the tape) be put on a new tape at the beginning. To do this, type

INIT/F MTØ

RELEASE MTØ

This is done only once per tape, before it is ever written by BTRANS. Now write the event(s) to tape:

BTRANS

UID

CR to verify

The event is then written into the next available tape file. Files are numbered by the program. Events can be written one after another without leaving the program; BTRANS will prompt after writing each one. Answer the prompt with a carriage return to exit the program. (See Appendix 6 for information on BTRANS tape structure.)

To read an event back to the disk for further manipulation, mount the tape and put the tape drive selector on 1 (the other tape drive should be selected differently). Then type

RESTB

This program will ask for the tape file number of the event to be restored, not the unique ID. Furthermore this number must be right justified. Once the file number is given the computer spins the tape to that file, prints out the unique ID, and asks if it is correct. Answer the questions with YES or NO. A YES response will initiate restoration of the event; a NO response will cause the computer to prompt for another file number. RESTB will restore a series of events on one tape without leaving the program. Exit the program with "-1" when it asks for a file number.

Sending Phase Data to UNIX (the PDP 11/70)

The phase data and station list used by the Eclipse are in the so-called "EQ" file for the event. (The name is of the form UID.EQ; see Appendix 3 for more information on the file structure.) The phase data is not formatted such that HYPO71 can use it. A routine called CONVERT transforms the data to HYPO71 format. To use it type

CONVERT

UID

CR to verify

The program will ask for another unique ID when finished. A carriage return at this point will exit the program. The phase data in HYPO71 format is now in a file called the "71" file (the name of this file is of the form UID.71; see Appendix 3 for HYPO71 phase reading format).

HYPO71 is not available on the Eclipse. It is available on the PDP 11/70 (also referred to as UNIX), however, and further locations are executed there. Phase data is moved to UNIX with the aid of a tape writing program called WRITEU. The program expects a file of the names of the files to be written to tape. To create this file, type

XFER/A $TTI1 FILENAMES

UID.71 (There will be no
UID.71 response from the
UID.71 terminal in this mode;
everything typed will be
ctrl-Z in this file).

where FILENAMES can be any file name not already in use. Print this new file back on the terminal to check it:

TYPE FILENAMES

The computer will list the contents of this file. Mount a tape on one of the drives, and set the tape drive selector at Ø. (The other tape drive should be selected differently). Then begin writing the tape:

WRITEU

This program asks three questions. The first concerns lower case conversion; type a "1" in response to it. The second concerns the beginning tape file number: type a "Ø" in response to it. The third concerns the file name; respond with the name of the file just created. The computer will write the tape. When it is finished, it will ask for another filename. Respond with a carriage return to exit the program. The tape drive must now be released:

RELEASE MTØ

The tape is now ready for UNIX.

Finishing Up

To delete all files pertaining to an event and free disk space for future processing, type

DELETE/V UID.-

DELETE/V FILENAMES

Now it is possible to process a second event or group of events. Start with the selection program and proceed as above.

At the end of an Eclipse session release all disks in the system and leave the computer status listed on the background terminal. On both terminals, type

RELEASE DPØ

RELEASE DZØ

and in addition on the background terminal, type

INFO

Remove the small (portable) disk pack and replace it with the one originally in the drive. (Remember not to touch the terminal keyboards until the disk ready light is on.)

Acknowledgments

I thank Pete Stevenson for his continued support during the writing of this manual and Jerry Eaton, Bill Ellsworth, Rob Cockerham, and Alan Rite for their editorial comments.

Appendix 1

Useful Eclipse Commands

Below is a listing of some useful system commands and conventions:

-	(dash) used with LIST, DELETE, etc., to avoid repetitive typing. (It is much like the star convention on some computers.)
rub out	on foreground terminal (Tektronix); delete a single character.
del	on background terminal; delete a single character.
\	(backslash) delete entire line.
ctrl-A	manual interrupt.
DELETE/V	delete file(s) and verify deletion; command must have argument(s) following it.
GDIR	print name of current working directory (does not include other directories accessed).
GMEM	print current C.P.U. memory allocation.
GSYS	print current operating system.
GTOD	print time of day.
LIST/S	list files and sort according to number and alphabet; command can have argument(s) following it.
PRINT	(B-Eclipse only) line print file; command must have argument(s) following it.
TYPE	print file on terminal; command must have an argument following it.
UNLINK	delete a link to a file in another directory; command must have an argument following it. Never delete a link with the DELETE command; the computer will delete the file and leave the link.

Appendix 2

Eclipe Hardware
Physical Devices

The following devices are recognized by either Eclipse computer:

DPØF — fixed single platter disk; it houses the operating systems.

DPØ — portable single platter disk; it houses the user's working directory.

DZØ — 1Ø-platter disk; this disk is divided into three partitions and houses the programs, DCAT files, station history files, and EVDAT files used in processing.

IPB — interprocessing bus; it allows both computers to access DZØ at the same time.

A/D — analog/digitial converter used in digitizing.

MTØ, MT1 — magnetic tape drives Ø and 1.

In addition, Eclipse B recognizes:

DP1F — fixed single platter disk.

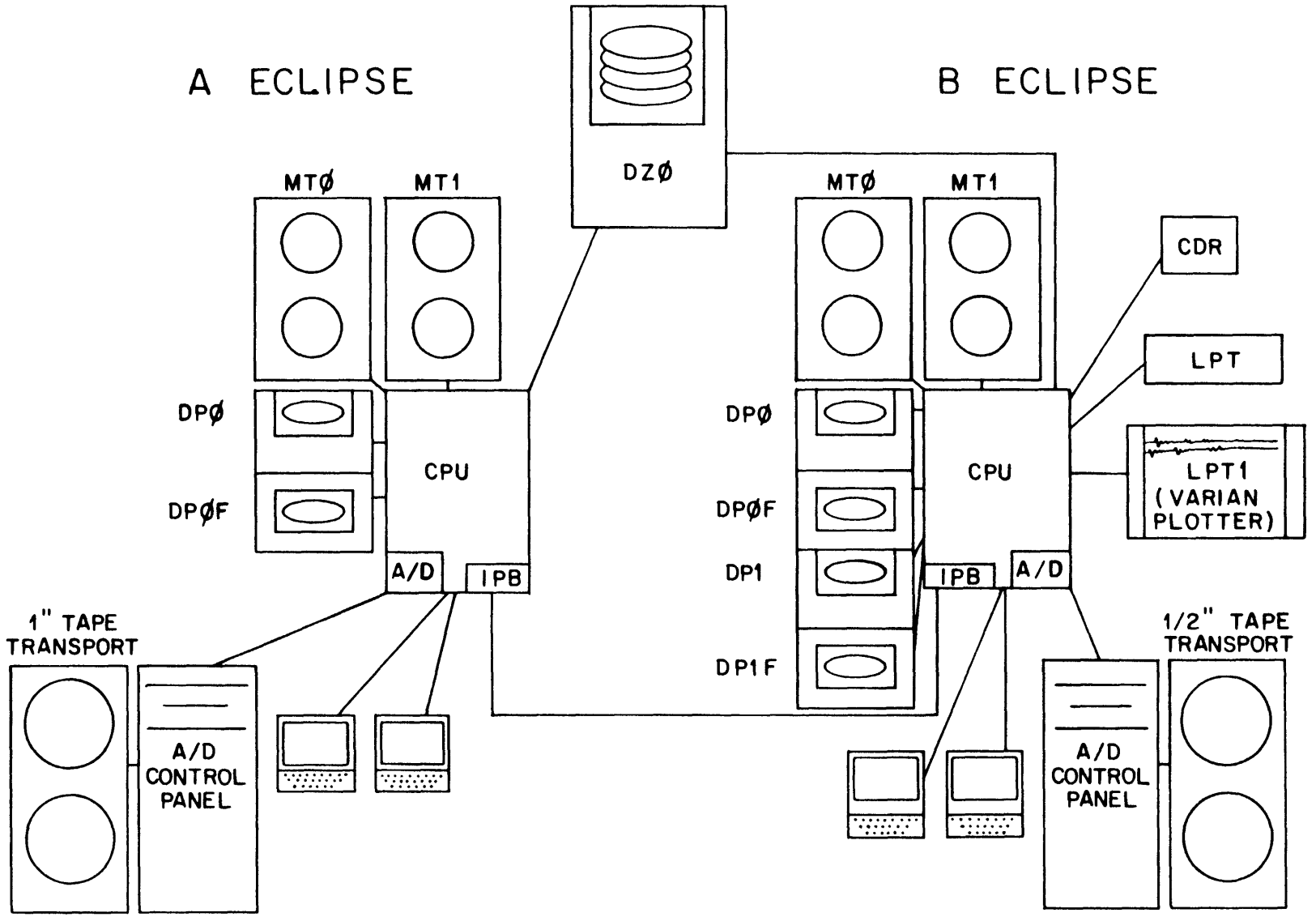
DP1 — portable single platter disk; it may be used instead of DPØ.

LPT — line printer.

CDR — card reader.

LPT1 — Varian plotter.

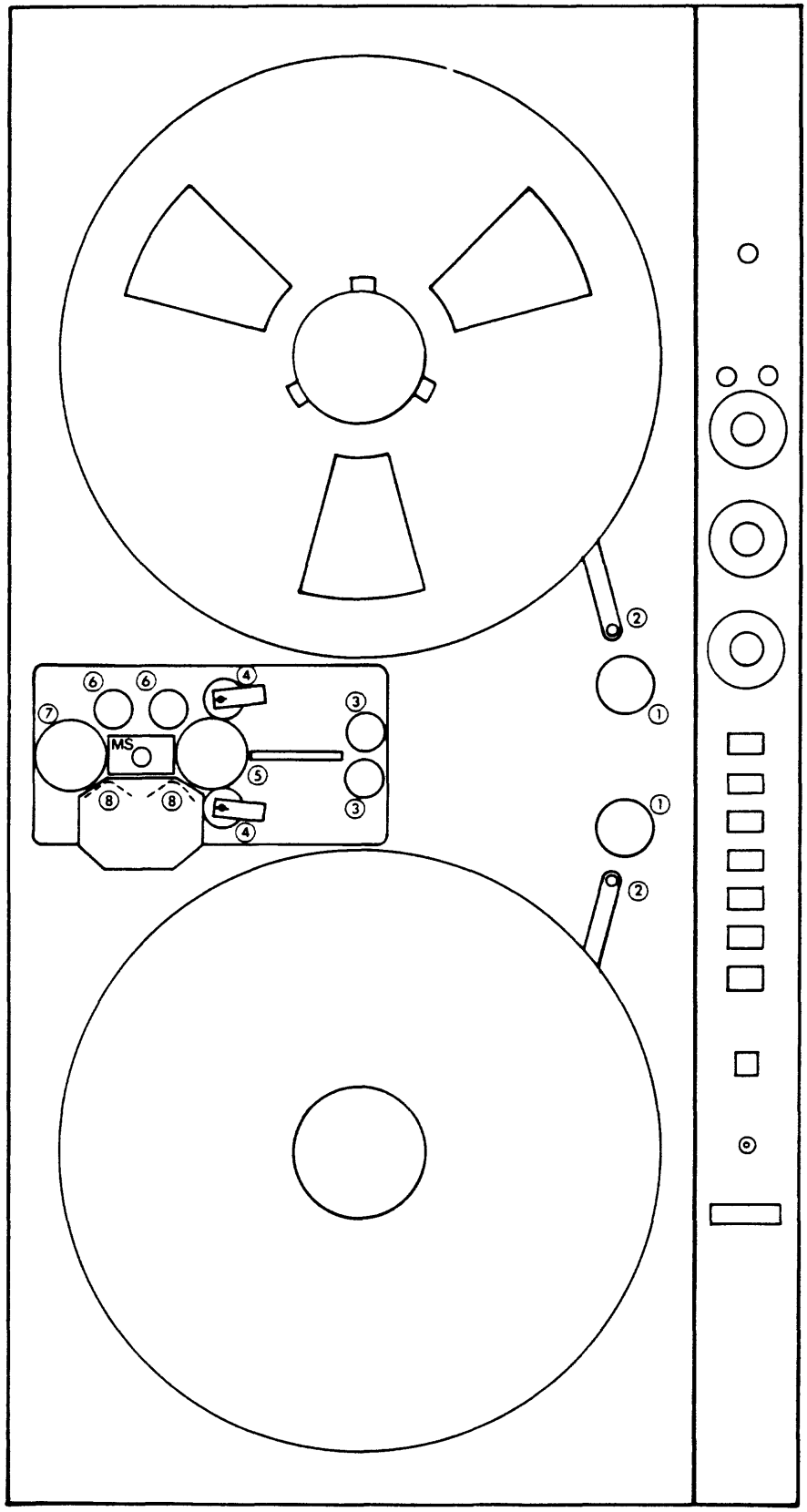
SCHEMATIC OF ECLIPSE HARDWARE



Tape Transport and A/D Panel

The 1-inch tape transport should always be cleaned before digitizing. Clean it with freon according to the diagram on the next page. Prepare the tape transport according to the diagram, p. 26, and check the transport to be sure all settings are correct. The time code translater and A/D control panel must be properly set as well. The last two diagrams (p. 27-28) have the settings on them; be sure the settings on these devices are correct.

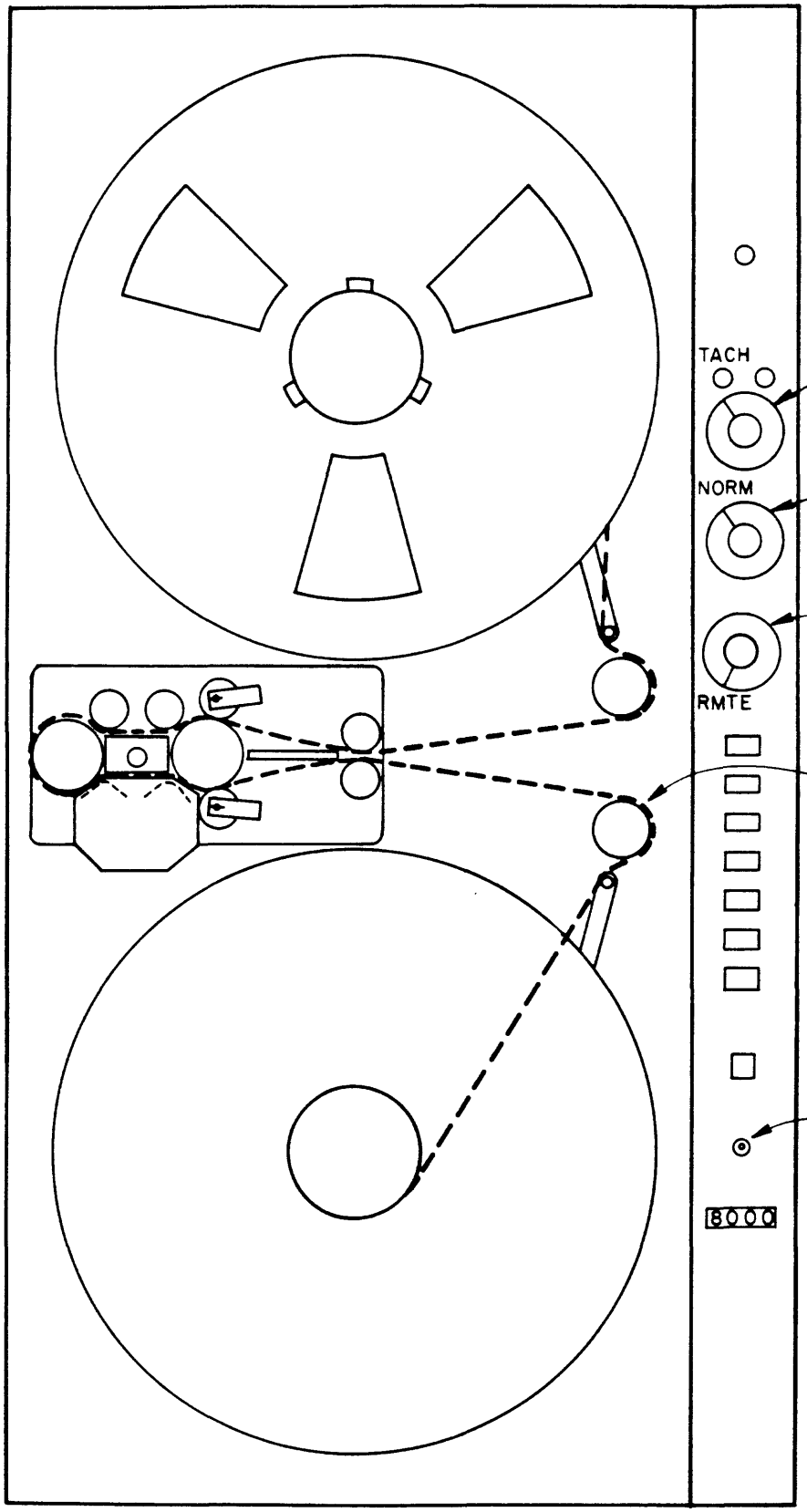
TAPE TRANSPORT CLEANING



ALL SURFACES TOUCHED BY THE TAPE SHOULD BE CLEANED:

① GUIDE ROLLERS
② CUTOFF ARMS
③ GUIDE PINS
④ PINCH ROLLERS
⑤ CAPSTAN
⑥ POSTS
⑦ TOP ROLLER
⑧ HEADS
(TO CLEAN REMOVE MAGNETIC SHIELD (MS))

TAPE TRANSPORT PREPARATION



MOUNT TAPE ON UPPER HUB TURN HUB UNTIL TIGHT

THREAD TAPE ACCORDING TO DIAGRAM

TURN PHASE LOCK SELECTOR TO "TACH"

TURN RECORD TEST SELECTOR TO "NORM"

TURN TAPE SPEED SELECTOR TO 7 1/2 IPS AND RUN FORWARD TO FIND FOIL MARKER

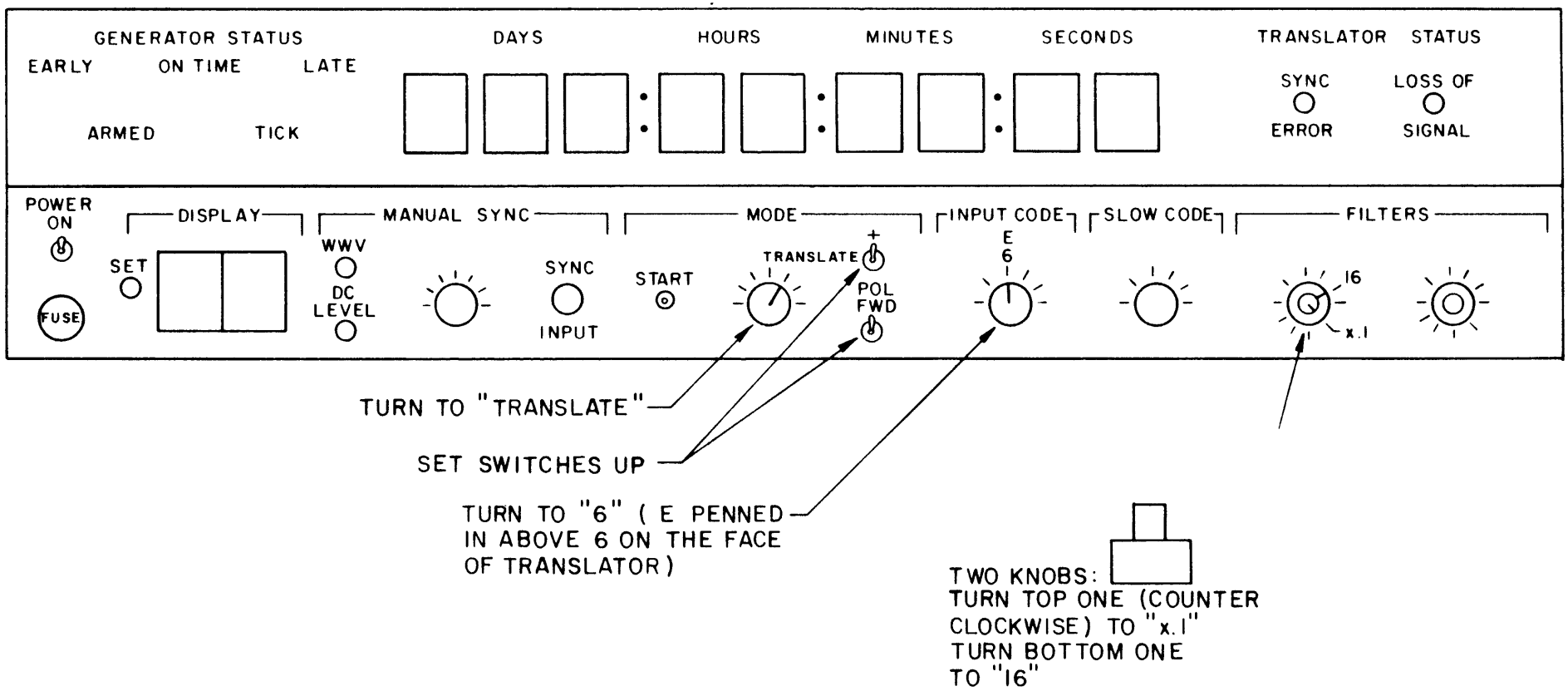
POSITION FOIL MARKER HERE

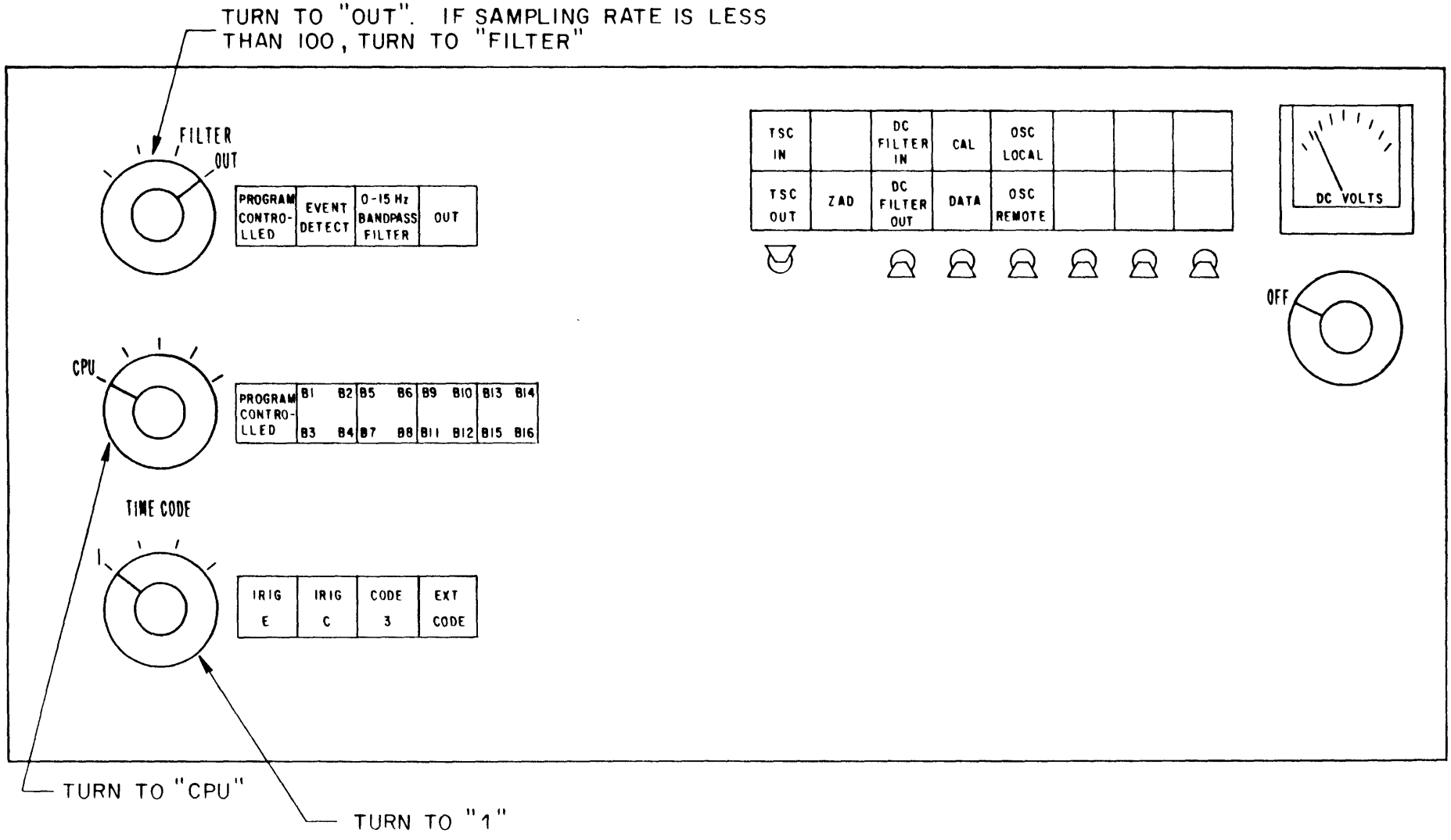
PUSH TO SET HEX FOOTAGE AT 8000

THEN TURN TAPE SPEED SELECTOR TO "RMTE"

TIME CODE TRANSLATOR:

BEFORE DIGITIZING BE SURE OF THESE SETTINGS (FAILURE TO DO SO WILL RESULT IN NON-READING OF TIME CODE AND ABORT NPCON)




TURN TO "OUT". IF SAMPLING RATE IS LESS THAN 100, TURN TO "FILTER"
FILTER
OUT
PROGRAM CONTRO-LLED
EVENT DETECT
0-15 Hz BANDPASS FILTER
OUT
CPU
PROGRAM CONTRO-LLED
B1 B2 B5 B6 B9 B10 B13 B14
B3 B4 B7 B8 B11 B12 B15 B16
TIME CODE
IRIG E
IRIG C
CODE 3
EXT CODE
TSC IN
TSC OUT
ZAD
DC FILTER IN
DC FILTER OUT
CAL
DATA
OSC LOCAL
OSC REMOTE
DC VOLTS
OFF
TURN TO "CPU"
TURN TO "1"

Appendix 3

File Structure

Five files are created in the working directory for each event. These are listed below along with other pertinent information:

File Name	Type	Description	Content	Creating Program	Using Programs
UID.EQ or "EQ"	ascii	earthquake data	station list analog tape assignments, phase data	SELECT2	PICKER, HYPO SISDS, BTRANS
UID.PL or "PL"	ascii	pointer list	station names analog tape assignments	SELECT2	not currently in use
UID.DL or "DL"	ascii	dialog	date, time to begin digitizing, digitizing length, passes to be digitized	SELECT2	NPCON
UID.TR or "TR"	binary	trace	actual traces	DMUX3	PICKER, SISDS, BTRANS
UID.TD or "TD"	binary	trace directory	trace names and locations in TR file	DMUX3	PICKER, SISDS, BTRANS

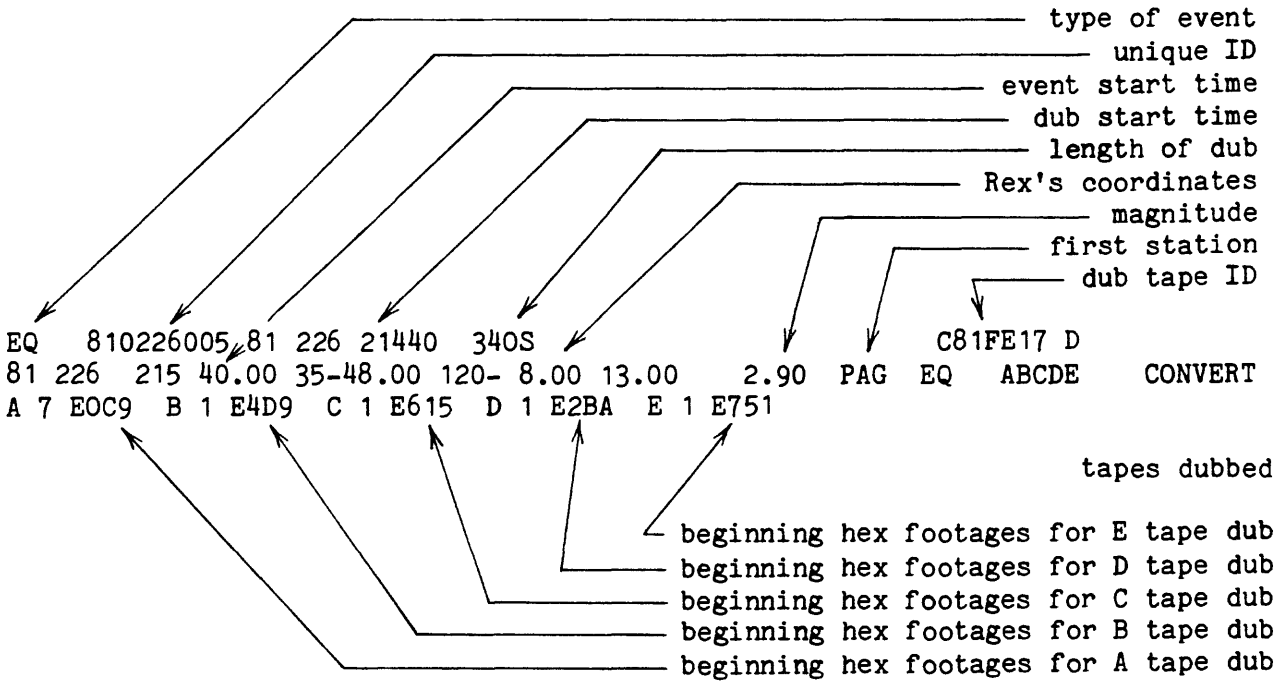
The formats of the "EQ" file are presented on pages 35-37. (The formats for HYPO71 phase input are on p. 38). There are three other important files used in processing. These three reside on the big disk, are linked to the working directory, and are used by SELECT2. One is the DCAT (dub catalog) file. Each DCAT file contains a listing of dubbed events for a month. The entries contain information about the events:

(unique ID's), estimated origin times, dub lengths, estimated first stations, coordinates from the real time picker if available, estimated magnitudes, types of events (regional, local, teleseism, etc.), dub tape numbers, and hex footages of the events on the dub tapes. An annotated example of a typical DCAT entry is on the following page. The other two files are the station history files, or index and master list files. They are cross-referenced listings of the stations and contain information about them: coordinates, elevations, dates in operation, delays, if any, and analog tape assignments. These files allow SELECT2 to compose a station list containing all information pertinent to the stations at any given time.

The DCAT File

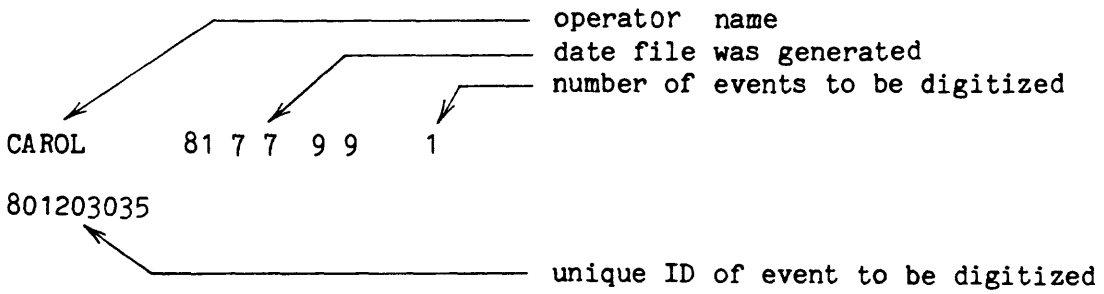
The DCAT file is a list of events dubbed on the library tapes.

Below is an annotated DCAT entry:



The CONTROL1 File

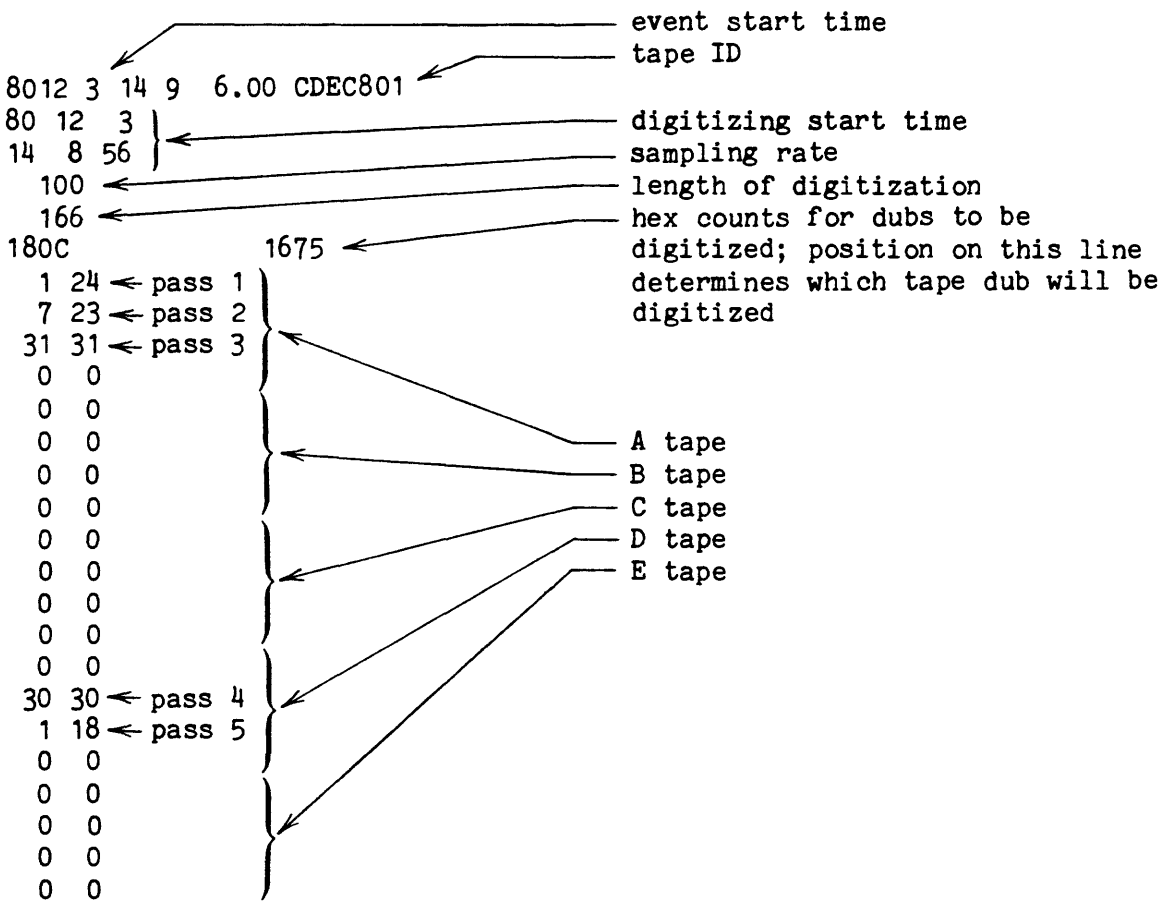
There are two files governing the digitization process directly; these are CONTROL1 and the "DL" file. CONTROL1 is written by SELECT2. This is the file that is recreated with each selection process when the query "new control file?" is answered positively. An annotated example of the control file follows.



The number of events to be digitized must match the number of unique ID's listed.

The "DL" File

NPCON reads the unique ID's from CONTROL1 and uses the appropriate "DL" file to digitize. An annotated example of the "DL" file follows.



NPCON is capable of digitizing 20 passes, 4 for each tape. Each pass contains a maximum of 4 tracks; each track has 8 channels. A maximum of 32 channels may be digitized during any one pass. Channels are numbered sequentially beginning with the first channel on the first track of a particular pass. The first channel on the second track receives number

9, the first channel on the third track, number 17, etc. The vertical positions of the numbers in the sequence in the "DL" file dictate which tapes and passes will be digitized; the numbers themselves dictate which channels (these numbers are referred to as the range).

Thus, in the above example, pass 1 would see channels 1 through 24 on the A tape dub digitized. This is equivalent to digitizing the first three tracks on the A tape dub. The second pass would see channels 7 through 23 digitized; this is equivalent to digitizing the last two channels on track 5, all of track 6, and channels 1 through 7 on track 7. The third pass would see only the thirty-first channel digitized; this is equivalent to digitizing channel 7 on track 12. Pass 4 would see only channel 30 digitized from the D tape dub; this is equivalent to digitizing channel 6 on track 8. Pass 5 would see channels 1 through 18 digitized. This is equivalent to digitizing all of tracks 9 and 10 and channels 1 and 2 on track 11 on the D tape dub. Note that null range values indicate nonexistance of a pass. NPCON assigns pass numbers only where range values differ from 0. Note also that all channels within a given range are digitized regardless of whether the corresponding station names are in the station listing generated by SELECT2. The unlisted stations are eliminated in the demultiplexing process.

HYPO 79 SUMMARY, STATION AND PHASE FORMATS

The summary card format is:

Item	Columns	Format	Description
1	1-6	3i2	year, month, day
2	7	1x	blank
3	8-11	2i2	hour, minute
4	12-17	f6.2	origin time, seconds
5	18-20	i3	latitude, degrees
6	21	a1	+ or N or - or S, if blank assume +
7	22-26	f5.2	latitude, minutes
8	27-30	i4	longitude, degrees
9	31	a1	+ or E or - or W, if blank assume +
10	32-36	f5.2	longitude, minutes
11	37	1x	blank
12	38-43	f6.2	depth, kilometers
13	44	1x	blank
14	45-50	f6.2	magnitude
15	51-53	i3	number of P phases
16	54-57	i4	gaps
17	58-60	i3	minimum distance, kilometers
18	61-62	i2	number of S phases
19	63-67	f5.2	RMS
20	68-72	f5.1	ERH
21	73-77	f5.1	ERZ
22	78	a1	"q" if an explosion or quarry
23	79	a1	quality
24	80	a1	rank of the inverse matrix for the hypocenter program (usually 4)

The station card format is:

Item	Columns	Format	Description
1	1-4	a4	name
2	5	a1	station weight
3	6	1x	blank
4	7-8	i2	latitude, degrees
5	9	a1	+ or N, - or S
6	10-14	f5.2	latitude, minutes
7	15	1x	blank
8	16-18	i3	longitude, degrees
9	19	a1	+ or E, - or W
10	20-24	f5.2	longitude, minutes
11	25-29	i5	elevation, meters
12	30-31	i2	instrument class
13	32-34	i3	attenuation (db)
14	35-37	i3	velocity model number
15	38-42	f5.2	P delay, seconds
16	43	1x	blank
17	44-45	a2	x phase (S or PN)
18	46-48	i3	x model number
19	49-53	f5.2	x delays, seconds
20	54-59	6x	blanks
21	60-65	f6.2	dt, clock correction, seconds
22	66	a1	"R" if first motion reversed
23	67-70	a4	analog tape name, track, and vco
24	71-74	a4	remark
25	75-80	i6	year, month, day of the entry in the instrument history file

The phase card format is:

Item	Columns	Format	Description
1	1-4	a4	station name
2	5	1x	blank
3	6	a1	first motion descriptor E or I
4	7-8	a2	name of the phase (e.g. P phase)
5	9	a1	first motion
6	10	i1	arrival reading weight
7	11-12	2x	blanks
8	13-14	i2	year
9	15-16	i2	month
10	17-18	i2	day
11	19	1x	blank
12	20-21	i2	hour
13	22-23	i2	minute
14	24	1x	blank
15	25-29	f5.2	second
16	30	1x	blank
17	31-35	f5.2	travel-time residual, seconds
18	36-40	f5.0	maximum amplitude (peak-to-peak)
19	41	1x	blank
20	42-45	f4.2	period of maximum amplitude
21	46	1x	blank
22	47-53	f6.2	epicentral distance, kilometers
23	53	1x	blank
24	54-56	i3	azimuth to station, clockwise from north in degrees
25	57	1x	blank
26	58-60	i3	angle of incidence, degrees
27	61-65	f5.0	coda length in seconds
28	66	1x	blank
29	67-70	f4.1	coda magnitude
30	71-73	i3	amplitude of first half cycle in digital counts
31	74-76	i3	pulse time in digital counts (usually hundredths of seconds)
32	77-80	2a2	remark

HYP071 Phase Format

The phase card format is:

Item	Columns	Format	Description
1	1-4	a4	name
2	5	a1	first motion descriptor E or I
3	6	a1	P-arrival denotation
4	7	a1	first motion
5	8	f1.0	arrival reading weight
6	9	1x	blank
7	10-11	i2	year
8	12-13	i2	month
9	14-15	i2	day
10	16-17	i2	hour
11	18-19	i2	minute
12	20-24	f5.2	seconds
13	25-31	i7	blanks
14	32-36	f5.2	S-seconds
15	37	a1	first motion descriptor E or I
16	38	a1	S-arrival denotation
17	39	a1	first motion
18	40	f1.0	arrival reading weight
19	41-43	3x	blanks
20	44-47	f4.0	maximum amplitude (peak-to-peak)
21	48-50	f3.2	period of maximum amplitude
22	51-62	2f4.1	on-site calibration information (not currently in use)
23	63-65	a3	remark
24	66-70	f5.2	time correction in seconds
25	71-75	f5.0	coda length in seconds
26	76-80	5x	blanks

Appendix 4

Advanced Selecting

The selection program has options other than those presented in the main text of this paper. SELECT2 is very flexible and will permit tailoring the digitization requests to exact specifications. The program can be thought of as having many levels, each with a different set of capabilities and all contingent upon user interaction. Level 1 was presented in the main text. It is very simple. Level N would involve specifying every parameter for the selection and digitization processes. Presented here is a discussion of all options in the program and tips on their usage.

Background on SELECT2: The Idea of Rings

Event selection is based upon the idea of rings, each with a different radius and centered at the station listed in DCAT. These radii are designated R1, R2, R3, and R4, and together determine whether a station is selected. R1 has an initial value of 40 km. All stations within 40 km are selected and termed primary. If there are less than fifteen stations within this ring, another value based on magnitude is used. (It is found from the calculation 40.0 + 10.0 * EMAG, where EMAG is the magnitude given in the DCAT.) This is the R3 radius and any stations found are also termed primary. The station coverage (i.e., distribution of stations around the central one) is then analyzed, the

gap found, and the area within the angle is searched for more stations out to a radius of R2 (also based on magnitude: R2 = 40.0 + 20.0 * EMAG). Any stations found are termed secondary. Until now all stations selected are high-gain vertical. R4 determines the selection of horizontal and low-gain vertical stations and is also based on magnitude (R4 = 20.0 + 10.0 * EMAG). These stations are loosely termed horizontals.

Selecting: Many Ways to Tailor

Begin station selection:

SELECT2

OPERATERNAME

MONYR

new control file? YES

Enter the appropriate station history files:

ST

CALYR.IN

CR to verify

CALYR.ML

CR to verify

new control file? YES

For a listing of the options available at this point, type

ME

The following command list will appear:

```
ME  print this menu
ST  enter new master list and index
SE  select stations for one event
MC  modify selection control parameters
PC  print contents of dub catalog
NC  open new dub catalog
EX  exit from program
```

Most of the options here are asking for specific information or do specific things. (Note the use of ST, PC, and SE in the main text and of ST above.) Three of the possibilities, SE, MC, and PC, have additional listings of commands available. These listings of commands are also called with ME. Find the unique ID of the event to be selected:

PC

List the commands with

ME

The following list will appear:

```
MC      print this menu
PR      print catalog entries
DAY     search catalog contents for one day
UID     print one unique ID entry
RANGE   search contents by range of indices
STATUS  search contents by processing status class
TYPE    search entries by event classification
FIN     return
```

The unique ID may be found using the DAY, RANGE, or TYPE options. (The STATUS option is not currently in use.) Each asks for specific information and searches the DCAT according to the data given. Once the unique ID is known, the UID option may be used. The actual selection control parameters may also be changed. To invoke the option and list the commands, type

MC

ME

The following list will appear:

```
ME   print modify commands
R1   modify R1 parameters
R2    "    R2     "
R3    "    R3     "
R4    "    R4     "
D1    "    digitization length formula
NS    "    A/D sample rate
GAP  modify gap closure parameters
FIN  return
```

Modifications made in R1, R2, R3, R4 and GAP affect the selection process. Changes in R1, R2, and R3 affect the search for primary and secondary high-gain vertical stations and may increase or decrease their numbers dramatically. Changes in R4 affect the number of low-gain vertical and horizontal stations selected. Changes in GAP alter the angular gap in the network that the program will try to close.

Modifications in D1 and NS affect the digitizing process. Changes made in either of these should be directly related to the future use of the data. It must be noted that any modifications made at this point will be in effect for all events selected during the session unless further modifications are made.

Now select the event and print the list of options:

SE

UID

ME

The following list will appear:

ME	print select menu
CP	complete processing of current event
EV	enter unique ID
GAP	print out gap
AB	abort selection
UNQ	enter unique ID only
PS	print list of stations selected for digitizing
PU	print list of stations not selected
ID	print current unique ID
MC	modify selection control parameters
PC	print contents of dub catalog
MS	modify list of selected stations
MD	modify length of digitization
RE	re-define event origin time, epicenter and magnitude
RS	re-select stations for current event

The options GAP, PS, PU, ID, and MS refer to the selection process that has just taken place. PU requires a radius out to which all unselected stations are found and then listed. GAP prints the gap in station coverage (it is not the same as the GAP discussed above.) MC and PC have the same sets of options here as above. The MC command, when used here, restricts the selection process for the current event only; restrictions must be reset for other events. RS must follow this command so that the stations selected reflect the changes in parameters. EV requests a new unique ID and starts a new selection process, whereas UNQ asks for a unique ID but does not initiate any processing. RS must also follow this command. Use of the RE command is not recommended. It makes changes in the DCAT and whether or not damage occurs is unknown at this time. MD allows for the lenthening or shortening of actual digitizing time. AB aborts the selection now in progress. Now complete the processing of the current event and leave the program:

CP

EX

Selecting Teleseisms

Selecting teleseisms depends to a large degree upon the future use of the data. Usually a large number of stations covering considerable area is desired, but the length of digitization need not be based on magnitude (or upon the maximum allowable length of digitization). When selecting a teleseism, extend the R1 radius to

maximize the number of stations selected. Print the list of stations selected to be sure all required ones are present. Now change the length of digitization to a reasonable value. (The value based on magnitude will be very large, and will be reduced to 320 seconds by NPCON during digitization.) If the length of digitization is not reduced, the amount of data to be digitized may be much larger than the EVDAT file. Another possible change is the sampling rate. It is set at 100 samples/second. It can be set at less using the MC command discussed above. If the sampling rate is less than 100 samples per second, manually set the 0-15 hz band pass filter on the A/D control panel (see Appendix 2) before digitizing, and note that the trace polarities are reversed. A sampling rate greater than 100 samples/second is not currently successful.

Appendix 5

Advanced Trace Plotting

Like SELECT2, SISDS also has a range of options not discussed in the above text. There are two different lists of options in SISDS; one list contains plotting instructions and the other list contains picking instructions. Begin trace plotting

SISDS

UID

For a listing of the plotting instructions, type

ME

The following command list will appear:

EV	select event
TR	select traces
DE	define time window
SL-	slide time window left
SL+	slide time window right
PL	plot traces
ST	step through traces
STSE	select step size then step
BU	back-step one step
SESC	select scale units option
PLDE	plot decimated
SC	scale traces
PI	pick traces
REWR	rewrite phases to earthquake data file
REPI	read all picks from earthquake data file
SA	save all picks as phase cards
SH	allign traces on P-times
SH-S	allign traces on S-times
ZERO	remove DC level
ME	print menu
UNZE	do not remove DC level
LDCO	load commands from remote file
UNCO	disable remote (LDCO) option
COPY	make hard copy
PAUSE	temporarily return to manual control

RESU	resume control with remote file
?	print pick menu
EX	exit program

This set of commands may be further subdivided into two groups, plotting instructions and program instructions. The plotting instructions are BU, SH, SH-S, PLDE, SESC, SC, ZERO, and UNZE. These commands are discussed here. The BU command is used while stepping through the traces; it plots the traces in the previous step. SH shifts the traces such that all energy appears to be arrive at the same time regardless of station location. SH-S shifts the traces such that all S-wave energy appears to arrive at the same time regardless of station location. These commands require P- and S-picks respectively. STSH can be used to step through the traces and shift them as well. The command also requires the presence of P-picks. (The command is not in the above listing.) PLDE plots requested traces in less than 40 seconds real time; a decimation factor is calculated so that plotting is in accordance with the 40-second real-time limit. This factor is printed on the screen above the plot. Traces cannot be shifted with this command. SESC lists three scaling options, digital counts, volts out, and equivalent develocorder millimeters, and prompts for the selection of one. (The default is equivalent develocorder millimeters.) All plots are labelled according to the selection made here. SC permits changes in the vertical scaling factor (the vertical scale is 200. mm. and the default scaling factor is 1). This command can be used to scale stations directly. This usage requires that the pass (i.e., traces 1-32 or traces 33-64, etc.) containing these

stations be in the plotting buffer (use the TR command: SE:1-32). This command may also be used with the TR command (see p. 15) to scale all traces called there. Examples of these usages are displayed when SC is typed. It must be remembered that scaled traces remain scaled until SISDS is left or until they are rescaled. ZERO calculates the average vertical offset of a trace in volts (maximum offset is $\pm$ 2.5 volts). This offset is then used to translate the trace(s) to a "centered" position (at 0 volts). All traces are plotted with an offset until this option is disabled with the UNZE command.

The following discussion pertains to commands in the second group, those which control the program. These include the EV, REPI, SA, LDCO, UNCO, COPY, PAUSE, and RESU commands. The EV command asks for a unique ID and calls that event into SISDS, thereby enabling analysis of a second event without leaving the program. REPI reads the picks into SISDS from the "EQ" file and prints out the same information as is printed upon program entry; phase or station data are not displayed. SA writes the phase data in HYP071 format to a new file whose name is requested; the data is written once per event and SISDS must be left before this option may be used a second time. Unfortunately not all picks in the "EQ" file are written to this new file; use of this command is not recommended. LDCO allows use of an external file of commands to control SISDS (see p. 18, for the XFER command used to construct this file). UNCO is used within the external file to disable it and return control to the terminal. Once this option is used, one of these two commands must be within the external plotting file to provide a path to a new external

plotting file or to channel control back to the terminal. (If neither command is used the program will terminate without preserving any picks.) COPY and PAUSE are also used within the external plotting file. COPY stops the automatic plotting process long enough to make Tektronix copies of the plots. PAUSE temporarily returns control of the program to the terminal; RESU returns plotting to remote control and executes the next available command.

The last command in the listing is

? (a question mark)

This, when typed, lists all the options available in the picker mode:

P	pick P-time
S	pick S-time
F	pick end of coda
C	pick P-rise amplitude and zero-crossing
A	measure P-amplitude and period (peak to peak, use space bar to measure peaks)
Q	measure S-amplitude (peak to peak, use space bar to measure peaks)
X	rezero P, S, F
R	enter 3 char. remark
*	enter 1 char. station remark (col. 71)
0-4	grade of P-pick
5-9	grade (+5) of S-pick
E, I	emergent or impulsive P-arrival
+, U	up first motion
-, D	down first motion
T	enter clock correction
	enter fmp value (cursor selects stations)
J, K	emergent or impulsive S-arrival
(followed by)	print data between cross-hair hits
L	list picked values
G	get automatic picks or calnet phases
Y	get phase list
H	get hypout file
;	speedy pick option; enter 4 char. string (prmk or srmk) cross-hair determines position of P or S picks
.	exit pick routine

This listing may only be printed at command level and not in the picker mode. Get into the picker mode:

PI

The P and S options assign times to the corresponding picks but do not allow entry of first motions or weights. The ; convention requires four characters describing the arrival be entered after it. In this program the 0-4 weighting scheme is used for P-arrivals and the 5-9 weighting scheme is used for S-arrivals. It is common practice, however, to use the 0-4 scheme for both P- and S-arrivals. Likewise the first motion descriptor is E or I for P-arrivals, while that for S-arrivals is J or K. It is also common practice to use E or I as the first motion descriptor for both P- and S-arrivals. A and Q measure P- and S-amplitudes respectively. If an amplitude is measured and its phase unknown, the A convention is used. Both P- and S-amplitudes cannot be read on the same trace and retained as P- and S-amplitudes. Both types are written to the same place in the "EQ" file and are indistinguishable. The individual user decides which amplitude, if one is preferred, will be consistently measured throughout the data set. There are two ways to enter a remark. The R convention allows entry of a three-character remark. The three-character remark is written into the "EQ" file, but not read by CONVERT; it does not appear on the screen when the phase data is listed. The * convention allows entry of a single-character remark. This remark is not written into the "EQ" file, but does appear on the screen when the phase data is listed. Codas are usually read with the F convention, where the cursor marks the coda and

the computer reads it. Codas can be entered with the > convention, where codas read elsewhere are manually entered and the cursor marks the appropriate station. T permits manual entry of a clock correction; this correction is used for the entire event. The G, Y, and H commands prompt for external files. These three conventions are not currently in use (none of the appropriate external files exist.) The pair of parentheses allows for the generation of sprint files; these files are created by successive entry of the parenthesis with the cross-hairs being relocated from their original positions in between. The data to be written to the sprint file must be on the screen. All data is associated with the P-arrival and is written to an external file named SPRINT. Finish the use of SISDS and exit the program:

REWR

EX

Appendix 6

BTRANS Tape Writing

BTRANS writes three of the five disk files to a single magnetic tape file. These files are the "EQ", the "TD" and the "TR". On the disk the files are stored in blocks, each consisting of 256 words or 512 bytes. All pointers within these files are in units of blocks. On magnetic tape the files are stored in "long" blocks; these are 2048 words or 4096 bytes. Events are in 16-bit binary on both disk and tape. All tapes are written at 800 bits per inch.

Each disk file has a corresponding number of tape blocks within the tape file. The following table summarizes the structure of the tape file:

Tape Block	Number of Tape Blocks	Disk File	Disk Blocks	Contents
0 to i-1	i	.EQ	not applicable	station list, analog tape assignments, phase data, hypocenter solution information
i to i+j-1	j	.TD	0	event information
			1	information on traces 1-51
			2	information on traces 52-102
			3	information on traces 103-etc.
i+j+k-1	k	.TR	0	256 digital words of seismic data are in each block.
			1	
			2	
			etc.	

Each block that is not completely filled by disk file data is padded with zeros.