U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

KEY ANALYSIS SYSTEM

Volume 1 - User's Guide

Robert P. Massé

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INTRODUCTION

The KEY analysis system has been developed with the objective of making it easy to process broadband digital data from the United States National Seismograph Network (USNSN). The KEY system is designed to work in an interactive mode on any modern scientific workstation.

The KEY system greatly reduces the degree of difficulty encountered in accessing raw seismic data, in transforming these data into usable form, and in performing time domain and frequency domain operations on these data.

In the course of developing the KEY system, many options were included that make the system very versatile. Among the capabilities of the KEY system are the following:

1. The system is very modular and is easily expanded to perform additional functions. All input, output, and data handling operations already exist within the system and do not need to be provided when adding new data analysis functions.

2. The entire system is written in a higher level language (FORTRAN) and is extensively documented both internally (with comment statements) and externally.

3. The input parameters have been kept to a minimum.

4. Wherever reasonable, default values are assigned to the input parameters of most options for ease of operation.

5. Many provisions are available for checking and correcting the raw seismic data.

6. The seismic data can easily be despiked, corrected for instrument response, filtered, and decimated.

7. A very flexible plot option is available. Axis parameters can be specified by the user or determined by the system. Linear, semi-log, or log plots may be obtained. The user may provide plot axes titles and the main title for the plot.

8. The spectra option includes provisions for calculating real and imaginary components, amplitude spectra, phase spectra, and power spectra. Spectral information can be printed or plotted. The spectra may be smoothed and the frequency or period range specified.

9. The mean and trend can be removed from any data channel.

10. Any data channel can be tapered.

11. Horizontal components can be rotated to any azimuth.

12. A FORTRAN readable file of the calibrated and processed data can be written.

13. A complete body wave travel time computation option is available for most body wave phases.

14. A complete distance-azimuth computation option is available.

15. Data channels can be crosscorrelated and matched filtered.

16. Record sections can be obtained from broadband network data.

17. A beamforming option is available.

18. Moving window analysis can be performed to determine signal group velocity dispersion.

19. Theoretical Love and Rayleigh wave phase and group velocity dispersion can be calculated.

System Design

The KEY system consists of more than 160 subroutines that have all been integrated into one system by use of a common design logic, nomenclature, storage, and data flow. Moreover, the level of documentation is sufficient to allow additional analysis subroutines to be added easily to the KEY system. All input and output parameters for subroutine calls are clearly identified and defined so that existing subroutines can be incorporated into new analysis techniques. The linkage of all current subroutines are given in a section of this User's Guide.

Operation of the KEY analysis system is initiated by giving the UNIX command keyrun.

System Data Storage

The main data storage for the KEY system is the DATA array. Although this is a single array with a dimension of IDEM, it is treated by the KEY system as many data channels (see figure 1):

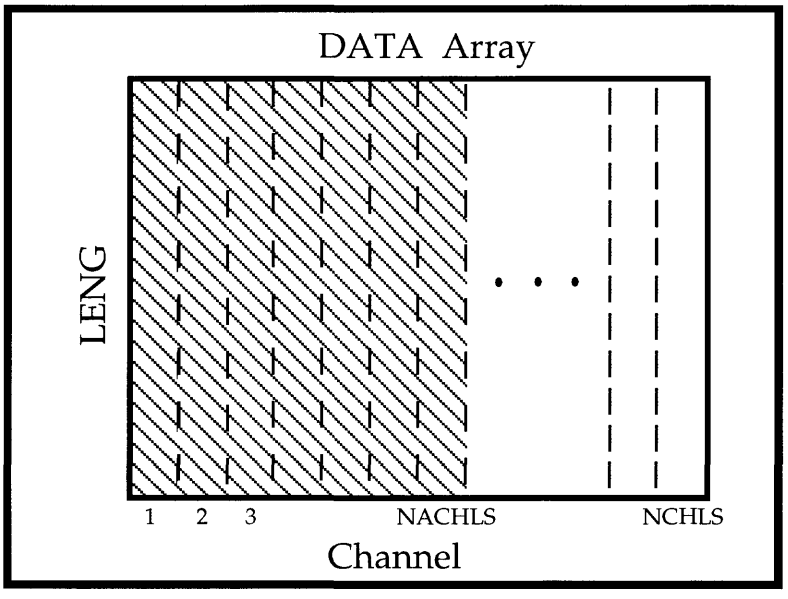

Figure 1

Data storage for KEY system.

The storage can be visualized as an area having a value IDEM. The area is divided into NCHLS channels each having a length of LENG. Therefore, we have:

$$IDEM = LENG*NCHLS$$

The number of channels that have data or that are assumed to possibly receive data under a current process is NACHLS where NACHLS < or = NCHLS.

The storage allocation is dynamic, in that the number of channels can be changed at any time while the KEY system is in operation. No data is saved from previous channels if the channel allocation is changed.

Another data storage array is BX which has a dimension of IDEM1. The array BX is used as a temporary working area for many different routines such as the spectral transformation routines. The BX array is available for use by new subroutines, but should be considered only as temporary storage.

Definition of Storage Parameters

IDEM	Dimension of storage array DATA. = 200000
IDEM1	Dimension of storage array BX. = 60000
NCHLS	Total number of data channels that DATA array is divided into.
LENG	Length of each DATA channel.
NACHLS	Number of DATA channels that may possibly contain data at current time.

COMMON Storage

All COMMON parameters of the KEY analysis system are defined in a section of this User's Guide. A mapping of the use of all COMMON parameters by sub-routines is also given. Some of the more important COMMON are:

COMMON/ARR/	This contains all the channel or station information from the channel headers.
COMMON/EVT/	This contains all the event information associated with the channel data.
COMMON/INOUT/	This contains the logical units for standard input from the keyboard and output to the screen.
COMMON/MUCHO/	This defines data storage parameters.
COMMON/XDATA/	This contains the actual data channels.

Processing Output

The standard output from the KEY analysis system is on logical units IWR2 = 6 and IWR = 7. Output to IWR2 goes to the screen. This unit is used for all prompts for new command instructions, for all error messages, and for most system output. Output to IWR is reserved for most system output and is a duplicate of the system output to IWR2. The output to IWR goes to the file keyout and can be saved for later analysis or printing.

KEYS Format

A special FORTRAN readable format is used to output data processed by the KEY analysis system for the purpose of additional later processing. This format, known as the KEYS format, is defined in the WRFIL subroutine and by the descriptions of the variables in COMMON/ARR/ and COMMON/EVT/.

External Subroutines

The only calls from the KEY system to subroutines that are not internal to the system are calls to plotting subroutines. These external subroutines are the part of the KEY system that may possibly be hardware dependent. The external subroutines called by the KEY system are: ADVPLT, ENDPLT, FACTOR, HLDPLT, NUMBER, OPNPLT, PLOT, SYMBOL.

Error Messages

The error message which will occur most often is "error in input parameters." To determine the exact nature of the error when this message occurs, the option description in this User's Guide should be referred to.

When the error description in this User's Guide indicates that the selected channel "contains no data," it means that the selected channel number is greater than NACHLS when this is not allowed for the given option. Similarly, when the error description indicates that the selected channel "does not exist," it means that the selected channel is greater than NCHLS, and this is usually not allowed.

Disclaimer

The procedures and programs included in the KEY system are not guaranteed to be free from error and so should be used with appropriate caution and at the user's own risk. The author appreciates being notified of all errors discovered by users so that future versions of the KEY system can be suitably corrected. Please send all corrections to:

Robert P. Masse
U. S. Geological Survey
National Earthquake Information Center
Box 25046, DFC, MS-967
Denver, CO. 80225 USA

bmasse@gldfs.cr.usgs.gov

SYSTEM OPTIONS --- BRIEF DESCRIPTION

KEY ANALYSIS SYSTEM OPTIONS

OPTION	BRIEF DESCRIPTION
apvl	calculate apparent velocity of a seismic phase based on current channels
beam	form a beam from summation of time-delayed data
bwtt	list body wave travel times for designated phases, distance ranges, and depth ranges
clos	close a file
copy	copy data from one channel to several other channels
cros	crosscorrelate two data channels
daad	add data channels
dasu	subtract data channels
deci	decimate a data channel
dele	delete a data channel
desp	despike a data channel
dist	compute distance-azimuth
endp	terminate all plotting functions
filt	filter a time series
firs	return to beginning of KEY system
grou	determine signal group velocity by moving window analysis
inst	remove/add instrument response
jday	determine the Julian day
last	exit KEY system
lsda	list data points from any channel
lsdp	list current data storage parameters
lsds	list distance-azimuth information for current channels
lsev	list event information
lshd	list data channel headers
lsrp	list instrument response poles and zeros

lssa	list number of samples for a data channel
lstt	list travel times for current stations and event
lwds	calculate theoretical Love wave dispersion
matc	matched filter a time series in a data channel
mean	remove mean from a data channel
mnmx	determine the minimum and maximum values of a data channel
move	move data from one channel to another
next	continue KEY run after unrecognized option has been read
nsnr	set up a file of station-times for use in retrieving USNSN or other data
plot	plot any time series in a data channel
pola	reverse polarity of a data channel
prpl	make a printer plot of x-y data
prpt	make a printer plot of time series data
rdda	read data points from the keyboard
rddp	read new data storage parameters from the keyboard
rdev	read event information from the keyboard
rdhd	read new data channel header information from the keyboard
rdsa	read the number of samples for a data channel from the keyboard
rdst	read new start time of a data channel from the keyboard
read	read a data file in RETRV or KEYS format
reco	plot a record section
rect	rectify a time series
reor	reorder data channels
resp	compute instrument response and list or plot it
rewi	rewind a file
rota	rotate two horizontal data channels

rwds	calculate theoretical Rayleigh wave dispersion
scal	scale a data channel
shif	shift a time series in a data channel
sign	form a synthetic test signal
spec	compute Fourier spectra and print or plot it
strp	set instrument response poles and zeros for a channel from the master file or from the keyboard
tape	taper a data channel
test	activate user test routine
tren	remove linear trend of a data channel
wrfl	write a data channel to a file in KEYS format
xypl	make a x-y plot of data
zend	zero unused part of data channels
zero	zero part of a data channel

SYSTEM OPTIONS --- DETAILED DESCRIPTION

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apvl The option 'apvl' computes the apparent velocity of a specified seismic phase across the current array of channels using the current epicenter information.

This option uses station location information in each channel header and the event location information to calculate theoretical travel times for the specified phase for each channel (station). From the travel times to the minimum and maximum distant stations of the network, a theoretical apparent velocity across the network for the phase is computed.

Event information must be provided previous to selecting this option. This information may be provided either directly by the user or indirectly in certain data input format headers (eg. KEYS format).

An error occurs if no event information is available for this option.

Option parameters:

NPHAS - PHASE NAME TO COMPUTE APPARENT VELOCITY FOR

	Distance Range for Phase
Pg	0 - 15
ScP	0 - 70
PcP	0 - 150
pP	0.3 - 180
sP	0.3 - 180
PP	0.3 - 180
P	0 - 180
PPP	0 - 180
SP	0 - 140
SPP	0 - 180
SKP1	70 - 180
SKP2	70 - 180
PKP	100 - 180
PKP2	100 - 180
PKKP	130 - 180
PKK2	150 - 180
PKK3	150 - 180
PKPP	0 - 180
PcS	0 - 70
ScS	0 - 100
SKS	60 - 180
SKS2	60 - 180
S	0 - 180
pS	0 - 180
sS	0 - 180
PS	0 - 140
PPS	0 - 180
SS	0 - 180
SSS	0 - 180

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beam The option 'beam' forms a beam from a specified number of DATA channels.

This option time aligns channels 1 through NCH and sums these channels to form a beam. The beam can then be stored in a specified DATA channel or left in the BX array.

A beam can be formed for any specified phase velocity, ray parameter, or calculated phase arrival time.

Time anomalies for each channel can be input and applied if desired.

An error occurs if the sampling rate for all channels beamed is not the same; if channel NCH does not contain data; if channel ICHAN does not exist; or if the calculated travel time for phase NPHAS is zero.

Option parameters:

NCH - NUMBER OF CHANNELS TO INCLUDE IN THE BEAM
(BEAM CHANNELS 1 THROUGH NCH)
= 0 SET TO NACHLS
ICHAN - CHANNEL NUMBER TO STORE FINAL BEAM
(MAY BE LARGER THAN NACHLS)
= 0 LEAVE IN BX
KSAMP - NUMBER OF SAMPLES TO INCLUDE IN BEAM
= 0 USE SMALLEST NUMBER OF SAMPLES OF ALL CHANNELS IN BEAM

IDL - TIME DELAY FLAG
= 0 NO TIME ANOMALIES
= 1 READ IN ADDITIONAL TIME ANOMALIES
IDIR - DIRECTION TO PHASE ARRAY
= 0 TOWARDS SHORTEST DISTANCE TO EVENT
= 1 TOWARDS LONGEST DISTANCE TO EVENT
FNOISE - NOISE TO INCLUDE BEFORE SIGNAL IN BEAM (IN SECONDS)
= 0 SET TO 10.0

ANOM - TIME ANOMALIES FOR EACH CHANNEL (IN SECONDS)

VEL - BEAMING PHASE VELOCITY (IN KILOMETERS/S)
- BEAMING RAY PARAMETER (IN S/DEGREE)
= 0 USE APPARENT VELOCITY BASED UPON PREDICTED ARRIVAL TIMES FOR SPECIFIED PHASE
IVP - VELOCITY FLAG
= 0 VEL IS PHASE VELOCITY
= 1 VEL IS RAY PARAMETER

VEL - BEAMING PHASE VELOCITY (IN KILOMETERS/S)
- BEAMING RAY PARAMETER (IN S/DEGREE)
DV - INCREMENT IN PHASE VELOCITY OR RAY PARAMETER
= 0 SET TO 0.02
IVP - VELOCITY FLAG
= 0 VEL IS PHASE VELOCITY

= 1 VEL IS RAY PARAMETER

NPHAS - PHASE NAME

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bwtt The option 'bwtt' lists body wave travel times for designated phases, distance ranges, and depth ranges.

This option produces a listing of travel times for any of the phases given below. The travel times correspond to those of the 1991 IASPEI tables. The range of distance values for which travel times can be computed for each phase are also given below. For distances outside these ranges, a travel time value of 0.0 is returned.

Care must be taken to use the appropriate upper case or lower case letter for the phase name. The desired distance and depth ranges are input parameters. Only four depth values will be used to compute travel times for each NPHAS parameter input. The maximum depth that can be used is 700 km.

Option parameters:

NPHAS - PHASE NAME
= 'last' NO MORE DATA

Distance Range for Phase

Pg	0	- 15
ScP	0	- 70
PcP	0	- 150
pP	0.3	- 180
sP	0.3	- 180
PP	0.3	- 180
P	0	- 180
PPP	0	- 180
SP	0	- 140
SPP	0	- 180
SKP1	70	- 180
SKP2	70	- 180
PKP	100	- 180
PKP2	100	- 180
PKKP	130	- 180
PKK2	150	- 180
PKK3	150	- 180
PKPP	0	- 180
PcS	0	- 70
ScS	0	- 100
SKS	60	- 180
SKS2	60	- 180
S	0	- 180
pS	0	- 180
sS	0	- 180
PS	0	- 140
PPS	0	- 180
SS	0	- 180
SSS	0	- 180

Distance Range Parameters

DI - INITIAL DISTANCE VALUE (IN DEGREES)
DF - FINAL DISTANCE VALUE (IN DEGREES)
DINC - INCREMENT IN DISTANCE VALUE (IN DEGREES)

Depth Range Parameters

DPI - INITIAL HYPOCENTER DEPTH VALUE (IN KILOMETERS)
DPINC - INCREMENT IN HYPOCENTER DEPTH VALUE (IN KILOMETERS)
(4 DEPTH VALUES LISTED)

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clos The option 'clos' closes a logical unit. The number of the logical unit to close is input.

This option assumes that the logical unit LUNX is open and tries to close it.

Option parameters:

LUNX - LOGICAL UNIT NUMBER TO CLOSE

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copy        The option 'copy' copies data from one DATA channel to
            several other DATA channels. Header information is also
            copied.

            This option copies data from DATA channel ICHAN1 to DATA
            channels ICHAN2 through ICHAN3. Header information is also
            copied.

            An error occurs if ICHAN1 contains no data or if channels
            ICHAN2 or ICHAN3 do not exist.


            Option parameters:

            ICHAN1 - CHANNEL TO MAKE COPIES OF
                     = 0 SET TO 1
            ICHAN2 - FIRST CHANNEL TO STORE COPY OF ICHAN1
                     = 0 SET TO NACHLS+1
            ICHAN3 - LAST CHANNEL TO STORE COPY OF ICHAN1
                     (IF ICHAN2 = 0 SET ICHAN3 = NACHLS+ICHAN3)

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cros The option 'cros' crosscorrelates two DATA channels containing time series.

This option crosscorrelates the data in DATA channel ICHAN1 with the data in DATA channel ICHAN2 and places the resulting correlogram in DATA channel ICHAN2. Therefore the original data in DATA channel ICHAN2 is not retained. To avoid losing data, the 'move' option can be used first to double store the channel ICHAN2 data.

Option parameters:

ICHAN1 - CHANNEL NUMBER FOR FIRST TIME SERIES
= 0 SET TO 1
ICHAN2 - CHANNEL NUMBER FOR SECOND TIME SERIES
(CORRELOGRAM PLACED IN THIS CHANNEL AFTER CROSSCORRELATION)

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daad The option 'daad' adds the data of one DATA channel to another DATA channel.

This option adds the data points in DATA channel ICHAN2 to the corresponding data points in DATA channel ICHAN1. The result is stored in DATA channel ICHAN1.

An error occurs if either channel ICHAN1 or channel ICHAN2 contains no data.

Option parameters:

ICHAN1 - DATA CHANNEL TO BE MODIFIED
ICHAN2 - DATA CHANNEL TO BE ADDED TO ICHAN1

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dasu The option 'dasu' subtracts the data of one DATA channel from another DATA channel.

This option subtracts the data points in DATA channel ICHAN2 from the corresponding data points in DATA channel ICHAN1. The result is stored in DATA channel ICHAN1.

An error occurs if either channel ICHAN1 or channel ICHAN2 contains no data.

Option parameters:

ICHAN1 - DATA CHANNEL TO BE MODIFIED
ICHAN2 - DATA CHANNEL TO BE SUBTRACTED FROM ICHAN1

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deci The option 'deci' decimates a designated DATA channel using a decimation factor that is input.

This option decimates the data in DATA channel ICHAN by the decimation factor IFACT. If ICHAN = 0, all DATA channels are decimated by the factor IFACT. If the parameter SAMR > 0, then any DATA channels having a sampling rate equal to SAMR will not be decimated. This makes it possible to easily reduce all DATA channels to the same sampling rate.

An error occurs if the selected channel ICHAN contains no data or if the decimation factor is zero.

Option parameters:

ICHAN - DESIRED CHANNEL
= 0 DECIMATE ALL CHANNELS
IFACT - DECIMATION FACTOR
SAMR - SAMPLING RATE (IN SAMPLES/S)
> 0 DECIMATE ONLY THOSE CHANNELS HAVING THIS SAMPLING RATE
= 0 DECIMATE ALL CHANNELS DESIGNATED BY ICHAN

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dele The option 'dele' deletes a designated DATA channel.

This option deletes DATA channel ICHAN and reduces the number of DATA channels (NACHLS) by one.

An error occurs if the selected channel ICHAN contains no data or is < or = 0.

Option parameters:

ICHAN - CHANNEL TO BE DELETED

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desp The option 'desp' checks a data trace and removes all spikes exceeding the threshold value.

This option despikes the data in DATA channel ICHAN. If ICHAN = 0, all DATA channels are despiked. The despike algorithm compares the ratio of the difference of two adjacent data points to the difference of two data points that are separated by one data point. If this ratio is equal to or greater than 10, a spike is assumed to exist between the two separated data points forming the denominator of the ratio.

Spikes are replaced by an average of the two data points on either side of the spike. All single point spikes (or data dropouts) are effectively treated by this method.

Option parameters:

ICHAN - CHANNEL NUMBER TO DESPIKE
= 0 DESPIKE ALL CHANNELS

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dist The option 'dist' computes the distance and azimuth for coordinates that are input.

This option calculates the distance and azimuths between epicenter and station locations that are input via the keyboard.

The epicenter and station coordinates can be in either decimal or degree-minute-seconds form. The data can be input in a sequence of one epicenter and many stations or one station and many epicenters. Up to 100 stations (IES = 0) or 100 epicenters (IES = 1) can be input at one time.

To exit this option, it is necessary to input 'last' twice in succession.

Option parameters:

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IFME - FORMAT FLAG FOR EPICENTER INPUT
       = 0 COORDINATES IN DECIMAL
       = 1 COORDINATES IN DEG, MIN, SEC
IFMS - FORMAT FLAG FOR STATION INPUT
       = 0 COORDINATES IN DECIMAL
       = 1 COORDINATES IN DEG, MIN, SEC
IES - DATA INPUT SEQUENCE FLAG
      = 0 ALL STATION DATA
          'last'
          EPICENTER DATA - COMPUTE FOR ALL STATIONS
          'last'
      = 1 ALL EPICENTER DATA
          'last'
          STATION DATA - COMPUTE FOR ALL EPICENTERS
          'last'

For IFMS = 0:

ISTA - STATION NAME
SLAT - STATION GEOGRAPHIC LATITUDE (IN DEGREES)
       - = S
SLON - STATION GEOGRAPHIC LONGITUDE (IN DEGREES)
       - = W

For IFMS = 1:

ISTA - STATION NAME
SDEG - STATION GEOGRAPHIC LATITUDE (IN DEGREES)
       - = S
SDEM - STATION GEOGRAPHIC LATITUDE (IN MINUTES)
SDES - STATION GEOGRAPHIC LATITUDE (IN SECONDS)
SLOD - STATION GEOGRAPHIC LONGITUDE (IN DEGREES)
       - = W
SLOM - STATION GEOGRAPHIC LONGITUDE (IN MINUTES)
SLOS - STATION GEOGRAPHIC LONGITUDE (IN SECONDS)
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      For IFME = 0:

      IEPT - EPICENTER ID
      ELAT - EVENT GEOGRAPHIC LATITUDE (IN DEGREES)
             - = S
      ELON - EVENT GEOGRAPHIC LONGITUDE (IN DEGREES)
             - = W

      For IFME = 1:

      IEPI - EPICENTER ID
      EDEG - EVENT GEOGRAPHIC LATITUDE (IN DEGREES)
             - = S
      EDEM - EVENT GEOGRAPHIC LATITUDE (IN MINUTES)
      EDES - EVENT GEOGRAPHIC LATITUDE (IN SECONDS)
      ELOD - EVENT GEOGRAPHIC LONGITUDE (IN DEGREES)
             - = W
      ELOM - EVENT GEOGRAPHIC LONGITUDE (IN MINUTES)
      ELOS - EVENT GEOGRAPHIC LONGITUDE (IN SECONDS)

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endp The option 'endp' terminates all plotting functions.

This option closes the basic plotting utility program that interprets FORTRAN plot commands from the KEY analysis system and generates corresponding graphic instructions to hardware output devices.

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filt The option 'filt' filters a time series.

This option designs a bandpass filter and then filters the data in DATA channel ICHAN. If ICHAN = 0, data in all DATA channels are filtered. The filter can be either a Butterworth bandpass filter or a filter designed in the frequency domain by specifying beginning and 6 db down points for the low and high ends of the bandpass filter.

All filtering is done in the time domain by convolving the data with the time domain representation of the filter.

An error occurs if the number of samples in the DATA channel to be filtered are greater than 16400 (if IFL=1), or if the selected channel ICHAN contains no data. Also FLOW must be greater than SAMR/3001 if IFL=1.

Option parameters:

IFL - FILTER FLAG
= 0 USE BUTTERWORTH BANDPASS FILTER IN TIME DOMAIN
= 1 DESIGN BANDPASS FILTER IN FREQUENCY DOMAIN
(NEED AT LEAST 256 SAMPLES IN TIME SERIES)

ICHAN - CHANNEL TO FILTER
= 0 FILTER ALL CHANNELS

FLOW - LOW FREQUENCY CUTOFF (6 DB DOWN)
FHIGH - HIGH FREQUENCY CUTOFF (6 DB DOWN)
(MUST BE LESS THAN SAMR/2)
> OR = SAMR/2 THEN 0.9*SAMR/2 USED

FLBGIN - LOW FREQUENCY BEGIN TAPER (> FLOW)
FHBGIN - HIGH FREQUENCY BEGIN TAPER (< FHIGH)

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firs The option 'firs' causes the KEY analysis system to return to the beginning of the system and continue execution.

This option is primarily used to reset the option flags IOPS and to distinguish outputs in the same run.

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grou The option 'grou' determines signal group velocity by performing moving window analysis.

This option filters the Fourier transformed signal for a given center period and computes the inverse transform. Amplitude or phase angle as a function of period and group velocity is then calculated. From this information the actual group velocity dispersion can be obtained.

The maximum signal length processed at one time is 16384 samples. The mean and linear trend of the data are removed.

Event information must be available in the KEY system before this option is selected.

A maximum of 300 values of group velocity and 133 values of period can be used for any given calculation.

An error occurs if: the selected channel ICHAN contains no data; TMIN = 0; TMAX = 0; UMIN = 0; UMAX = 0; or IFIR > ISAMP. An error also occurs if NACHLS * LENG > 164000 since the upper part of the DATA array is used for scratch storage.

Option parameters:

UMIN - MINIMUM GROUP VELOCITY (IN KM/S)
UMAX - MAXIMUM GROUP VELOCITY (IN KM/S)
DELU - INCREMENT IN GROUP VELOCITY (IN KM/S)
= 0 SET TO 0.01

TMIN - MINIMUM PERIOD (IN SECONDS)
TMAX - MAXIMUM PERIOD (IN SECONDS)
NPERV - NUMBER OF PERIODS TO CALCULATE GROUP VELOCITY
= 0 SET TO 133
> 133 SET TO 133

ALPHA - DEFINES SLOPE OF FILTER
= 0 SET TO 3.1
BAND - DEFINES BANDWIDTH OF FILTER
= 0 SET TO 0.4
> 1 SET TO 0.9

ICHAN - DESIRED CHANNEL TO COMPUTE DISPERSION FOR
= 0 SET TO 1
IFIR - FIRST SAMPLE TO PROCESS
= 0 SET TO 1

IAPH - SPECTRA OPTION FLAG
= 0 COMPUTE AMPLITUDE SPECTRA
= 1 COMPUTE PHASE SPECTRA

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inst The option 'inst' removes or adds the instrument response to a channel of data.

The data in DATA channel ICHAN are corrected for their instrument response. If ICHAN = 0, data in all DATA channels are corrected for instrument response. The response is calculated from the poles and zeros obtained from the DATA channel header or from a master file of responses selected by the user.

Correction can be made for displacement, velocity, and acceleration response (these responses can be removed or added to any DATA channel). The mean can be removed from the data and the data tapered with a 2 percent taper before making a correction for instrument response.

An error occurs if the selected channel ICHAN contains no data.

Option parameters:

ICHAN - CHANNEL TO CORRECT FOR INSTRUMENT RESPONSE
= 0 CORRECT ALL CHANNELS

IFL - RESPONSE OUTPUT FLAG
= 0 SET TO -1
=-1 REMOVE DISPLACEMENT RESPONSE
=-2 REMOVE VELOCITY RESPONSE
=-3 REMOVE ACCELERATION RESPONSE
= 1 ADD DISPLACEMENT RESPONSE
= 2 ADD VELOCITY RESPONSE
= 3 ADD ACCELERATION RESPONSE

IRX - RESPONSE FLAG
= 0 USE RESPONSE IN CHANNEL HEADER
= 1 USE RESPONSE FROM MASTER FILE

IMT - MEAN/TAPER FLAG
= 0 DO NOT REMOVE MEAN AND DO NOT TAPER
= 1 REMOVE MEAN AND TAPER DATA (2 PERCENT TAPER)

Master Response Parameters

IRP - SELECT MASTER RESPONSE FLAG
= 0 READ RESPONSE POLES AND ZEROS
= 1 SET UP RESPONSE FROM STORED INFORMATION
(REQUIRES 'response' FILE)

ICODE - DESIRED STATION FROM 'response' FILE

ICOMP - DESIRED COMPONENT FROM 'response' FILE

IYR - DESIRED YEAR
IMO - DESIRED MONTH (NUMBER)
IDY - DESIRED DAY

SA0 - CONSTANT RESPONSE TERM

KNP - NUMBER OF COMPLEX POLES

SPOLES - COMPLEX POLES

KNZ - NUMBER OF COMPLEX ZEROS

SZEROS - COMPLEX ZEROS

KFLAG - SPECIAL DATA FLAG

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jday      The option 'jday' determines the Julian day corresponding
          to an input date.


          Option parameters:

          IYR - YEAR
          IMO - MONTH (NUMBER)
          IDY - DAY

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last The option 'last' terminates the KEY analysis run and causes an exit from the KEY system.

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lsda      The option 'lsda' lists a selected sequential set of 200
          data points from any designated DATA channel.


          Option parameters:

          ICHAN - DESIRED CHANNEL FROM WHICH TO LIST DATA
                  = 0 LIST DATA FROM BX
          IPT - FIRST POINT TO LIST
                = 0 SET TO 1

**************************************************************************
```

```
*************************************************************************

lsdp      The option 'lsdp' lists current DATA storage parameters.

          This option lists the current values for the DATA storage
          parameters NCHLS, LENG, NACHLS, IDEM, and IDEM1.

*************************************************************************
```

****

lsds The option 'lsds' lists distance-azimuth values for the current epicenter and stations.

This option computes and lists the distances and azimuths from the current epicenter location to the current station locations as given in the data channel headers.

****

****

lsev The option 'lsev' lists event information.

This option lists the name, hypocenter, origin time, magnitude, and any associated comments for the current event.

****

****

lshd The option 'lshd' lists channel headers for all DATA channels.

This option lists the station name, component, location, elevation, channel start time, and sampling rate.

****

****

lsrp The option 'lsrp' lists instrument response poles and zeros for a designated DATA channel.

This option lists all the header information including the instrument response poles and zeros for DATA channel ICHAN. If ICHAN = 0, the header information and instrument response of all DATA channels are listed.

An error occurs if the selected channel ICHAN contains no data.

****

****

lssa The option 'lssa' lists the number of samples and the sampling rate for all DATA channels.

****

****

lstt The option 'lstt' lists the travel times for the current stations and event.

This option computes the travel times for a specified phase for all stations having channel data in the DATA array and for the current event.

Option parameters:

NPHAS - NAME OF DESIRED PHASE FOR TT COMPUTATION

UVEL - GROUP VELOCITY FOR RAYLEIGH OR LOVE WAVES (IN KM/S)
= 0 SET TO 4.0

****

****

lwds The option 'lwds' calculates theoretical Love wave dispersion using an earth model.

This option is designed to calculate Love wave dispersion (phase velocity 'c' and group velocity 'U' as a function of period 'T') for any specified earth model consisting of homogeneous flat layers. Calculations are made for the fundamental and higher modes.

If desired, this option will also list the ratio of particle motion in the m'th layer of the model to the particle motion at the surface of the model 'Vm/Vo'.

Phase and group velocity, kinetic energy, potential energy, and medium response are all standard results which are listed as a function of period.

Parameters of the homogeneous flat layers of the specified model earth are input data for this option. These parameters consist of the layer thicknesses, compressional velocities, shear velocities, and densities. If an intermediate layer has a shear velocity equal to zero, it will be chosen as the fluid half-space. This option is designed to work with models having as many as 1000 homogeneous layers, including the half-space.

In addition to the 1000 homogeneous layers, this option will automatically subdivide each layer into a number of layers when loss of precision seems possible due to large terms in the Haskell matrices.

For a given value of period T, this option will find a value of phase velocity c such that the period equation for Love waves is satisfied. Trial values of c are found by beginning with a given value of c and a given increment in c, dc, (which should be positive). Thereafter new increments in c are computed by the phase velocity curve follower. If a new increment is less than some small root accuracy value, then a solution of the period equation is judged to have been found.

If the values of kinetic energy and potential energy are not approximately equal, then the group velocity values determined may not be correct.

Experience has shown that dT values should not be greater than 1/5 of the smallest value of T for which calculations are to be made.

Option parameters:

FILENM - FILE NAME FOR INPUT MODEL

MODENO - MODE FLAG
= 0 FUNDAMENTAL MODE

= 1 FIRST HIGHER MODE
= 2 SECOND HIGHER MODE
= n N'TH HIGHER MODE

Period Parameters

TFIR - FIRST PERIOD VALUE (IN SECONDS)
(OR FIRST FREQUENCY VALUE)
TLAS - LAST PERIOD VALUE (IN SECONDS)
(OR LAST FREQUENCY VALUE)
DT - INCREMENT IN PERIOD VALUES (IN SECONDS)
(OR INCREMENT IN FREQUENCY VALUES)
= 0 SET TO 1.0
ITOP - PERIOD FLAG
= 0 INCREMENT PERIOD BY +DT
= 1 INCREMENT PERIOD BY *DT
= 2 INCREMENT FREQUENCY BY +DT AND FORM PERIOD=1/FREQ
= 3 READ PERIOD VALUES FROM KEYBOARD

Phase Velocity Parameters

CFIR - STARTING PHASE VELOCITY FOR SEARCH (IN KM/S)
= 0 SET TO 2.0
DC - INCREMENT IN PHASE VELOCITY FOR INITIAL SEARCH (IN KM/S)
= 0 SET TO 0.01

Search and Listing Parameters

MODPR - MODEL LISTING FLAG
= 0 NO LISTING MADE
= 1 LISTING MADE
KCDS - ROOT ACCURACY FLAG
= 0 ACCURACY = 1E-7
= 1 ACCURACY = 1E-6
= 2 ACCURACY = 1E-8
= 3 ACCURACY = 1E-9
= 4 ACCURACY = 1E-5
= 5 ACCURACY = 1E-10
= 6 ACCURACY = 1E-4
KWRITE - DEBUG LISTING FLAG
= 0 NO LISTING MADE
= 1 LISTING MADE OF ROOT SEARCH
= 2 LISTING MADE OF ROOT SEARCH AND LAYER DIVISION

IPARMO - LIST PARTICLE MOTION FLAG
= 0 DON'T LIST
= 1 LIST

****

****

matc The option 'matc' matched filters the time series data in one DATA channel with the matched filter in another DATA channel.

This option applies the matched filter in DATA channel ICHAN2 to the time series in DATA channel ICHAN1. The sampling rate for both the ICHAN1 data and ICHAN2 filter must be equal.

The resulting correlogram is stored in DATA channel ICHAN2. To avoid destroying the matched filter, the 'move' option can be used to double store the filter before selecting the 'matc' option.

An error occurs if either channel ICHAN1 or ICHAN2 contains no data (or filter), or if the sampling rates for the data and matched filter are not equal.

Option parameters:

ICHAN1 - CHANNEL NUMBER FOR DATA TIME SERIES
= 0 SET TO 1
ICHAN2 - CHANNEL NUMBER FOR MATCHED FILTER
(CORRELOGRAM PLACED IN THIS CHANNEL AFTER FILTERING)

****

****

mean

The option 'mean' removes the mean from a designated DATA channel.

This option computes and removes the mean for DATA channel ICHAN. If ICHAN = 0, the mean is computed and removed for all DATA channels.

A check is made for leading and trailing zeros, and these zero value points are not included in determining the mean or removing it.

An error occurs if the selected channel ICHAN contains no data.

Option parameters:

ICHAN - DESIRED CHANNEL TO REMOVE MEAN FROM
= 0 REMOVE MEAN FROM ALL CHANNELS

****

****

mnmx The option 'mnmx' determines the minimum and maximum of a specified DATA channel.

This option computes the positive minimum and maximum and the negative minimum and maximum of the DATA channel ICHAN.

An error occurs if the selected channel ICHAN contains no data.

Option parameters:

ICHAN - DESIRED CHANNEL TO EXAMINE
= 0 SET TO 1

****

****

move The option 'move' transfers selected data from one channel to a designated place in another channel.

This option transfers data between channels of the DATA array, or between the BX and DATA arrays. Moving data from a channel ICHAN1 to another channel ICHAN2 will cause the original data in channel ICHAN2 to be deleted. The channel ICHAN1 remains unchanged. If desired, only the data and not the channel header can be moved. To exchange data channels use the option 'reor'.

The first and last point of the data to be moved can be specified. The first point in the channel where data are to be moved can also be specified.

An error occurs if the selected channel ICHAN1 contains no data or if the selected channel ICHAN2 does not exist.

Option parameters:

IFL - FLAG FOR DATA TRANSFER
= 0 DATA ARRAY TO DATA ARRAY
= 1 DATA ARRAY TO BX ARRAY
= 2 BX ARRAY TO DATA ARRAY
IHF - MOVE HEADER FLAG
= 0 MOVE DATA AND MOVE HEADER IF IFL = 0
= 1 MOVE DATA BUT DO NOT MOVE HEADER IF IFL = 0

ICHAN1 - CHANNEL OF DATA TO BE MOVED
= 0 SET TO 1
IFIR1 - FIRST POINT OF DATA TO MOVE
= 0 SET TO 1
ILAS1 - LAST POINT OF DATA TO MOVE
= 0 SET TO JSAMP

ICHAN2 - CHANNEL TO STORE DATA
= 0 SET TO NACHLS+1 (CURRENT NUMBER OF DATA CHANNELS + 1)
IFIR2 - FIRST POINT IN CHANNEL TO STORE DATA
= 0 SET TO 1

****

****

next The option 'next' continues the KEY run after an unrecognized option has been read. A new option is then requested.

****

****

nsnr The option 'nsnr' sets up a file of station-times for use in retrieving USNSN data as well as data from other stations.

This option reads a master file containing station data for all stations of interest (see example below). The station data include geographic coordinates (in degrees) and the elevation (in kilometers). Stations may be deleted from the master station file for a particular data request using the parameters NDEL and NDEL2.

The event origin time and the desired phase are input parameters that are used in computing arrival time windows for all stations. An output file is created consisting of station name, instrument component, and predicted arrival time window for the desired phase. This file can then be used by programs that access the raw data archives (such as ipreq) to obtain the desired seismic data.

Option parameters:

FILENM - FILE NAME FOR INPUT STATION LIST

Example Station File

```
ALQ    34.9425 -106.4575   0.564
BINY   42.1993  -75.9861   0.152
CBM    46.9325  -68.1208   0.076
CCM    38.0557  -91.2446   0.068
CEH    35.8908  -79.0928   0.046
COL    64.9000 -147.7933   0.098
DUG    40.1950 -112.8133   0.450
GOL    39.7003 -105.3711   0.719
ISA    35.6633 -118.4733   0.255
STOP
```

NDEL - NUMBERS OF THE STATIONS TO DELETE
(MUST BE IN INCREASING ORDER)
< 0 OR end-of-file STOP
NDEL2 - DELETE THROUGH THIS NUMBER
= 0 JUST DELETE NDEL

EELAT - EPICENTER GEOGRAPHIC LATITUDE (IN DEGREES)
- = S
EELONG - EPICENTER GEOGRAPHIC LONGITUDE (IN DEGREES)
- = W
DEPTH - HYPOCENTER DEPTH (IN KILOMETERS)

IYR - EVENT YEAR
IMO - EVENT MONTH (NUMBER)
IDY - EVENT DAY
IHR - EVENT HOUR
IMIN - EVENT MINUTE

SEC - EVENT SECONDS

NPHAS - DESIRED PHASE NAME

Distance Range for Phase

Pg	0	- 15
ScP	0	- 70
PcP	0	- 150
pP	0.3	- 180
sP	0.3	- 180
PP	0.3	- 180
P	0	- 180
PPP	0	- 180
SP	0	- 140
SPP	0	- 180
SKP1	70	- 180
SKP2	70	- 180
PKP	100	- 180
PKP2	100	- 180
PKKP	130	- 180
PKK2	150	- 180
PKK3	150	- 180
PKPP	0	- 180
PcS	0	- 70
ScS	0	- 100
SKS	60	- 180
SKS2	60	- 180
S	0	- 180
pS	0	- 180
sS	0	- 180
PS	0	- 140
PPS	0	- 180
SS	0	- 180
SSS	0	- 180
L	0	- 360
R	0	- 360

UVEL - GROUP VELOCITY FOR RAYLEIGH OR LOVE WAVES (IN KM/S)
= 0 SET TO 4.0

FILENM2 - FILE NAME FOR OUTPUT LIST OF STATION-TIMES

KC1 - COMPONENT S, L, I, OR B (FORMAT 3A1 FOR COMPONENTS)
= A IF BHZ, BHN, AND BHE DESIRED
KC2 - COMPONENT H, L, G, OR M
KC3 - COMPONENT Z, N, OR E

SECLEN - AMOUNT OF DATA TO ACQUIRE (IN SECONDS)
= 0 SET TO 400.0

****

****

plot The option 'plot' plots any time series in a DATA channel.

This option plots any designated single DATA channel or any designated consecutive sequence of DATA channels. There are default settings for most plot parameters. These default settings produce a plot of the DATA channels on preset axes.

It is also possible to specify all plot axes parameters, such as axis range, tick mark spacing, and spacing of labeled tick marks. Axes title and the main plot title can also be provided as input parameters.

Option parameters:

IAUTO - PLOT DEFAULT OPTION FLAG
= 0 READ IN PLOT PARAMETERS
= 1 PLOT ALL CHANNELS ON PRESET AXES

NCH - TOTAL NUMBER OF CHANNELS TO PLOT
= 0 SET TO NACHLS
ICHAN1 - FIRST CHANNEL TO PLOT
= 0 SET TO 1

IFL - PLOT FLAG
= 0 PLOT ALL DATA IN NCH CHANNELS ON PRESET AXES
= 1 INPUT PLOT PARAMETERS FOR AXIS AND DATA
IHEAD - HEADER FILE
= 0 DON'T READ HEADER
= 1 READ HEADER

Plot Mode and Scaling Parameters

MODEP - MODE FOR OPENING PLOT SYSTEM
= 0 SET TO 3
= 1 IMMEDIATE MODE
= 2 DEFERRED MODE
= 3 EDIT MODE
FAC - PLOT SCALE FACTOR
= 0 SET T0 1.0

Plot Time Axis Parameters

TI - INCREMENT IN TIME VALUE FOR TICKS (IN SECONDS)
= 0 SET TO 20.0
TTI - INCREMENT IN TIME VALUE FOR LABELED TICKS (IN SECONDS)
(MUST BE INTEGER MULTIPLE OF TI)
= 0 SET TO 80
TMAX - MAXIMUM RELATIVE TIME VALUE TO BE PLOTTED
(IN SECONDS)
= 0 SET TO 200.0
TDIZ - TRACE PLOTTING INCREMENT (IN SECONDS/CM)
= 0 SET TO 10.0

Plot Distance Axis Parameters

ZLT - TOTAL PLOT DISTANCE DIMENSION (IN INCHES)
= 0 SET TO 9.5

Plot Title Parameters

AXTIT - TIME AXIS TITLE (20 CHARACTERS MAXIMUM)
AYTIT - DISTANCE AXIS TITLE (20 CHARACTERS MAXIMUM)
AMTIT - MAIN PLOT TITLE (20 CHARACTERS MAXIMUM)

****

****

pola The option 'pola' reverses the polarity of a designated DATA channel.

This option reverses the polarity of the data in the DATA channel ICHAN. If ICHAN = 0, the polarity of all DATA channels is reversed. An error occurs if the selected channel ICHAN contains no data.

Option parameters:

ICHAN - DESIRED CHANNEL TO REVERSE POLARITY OF
= 0 REVERSE ALL CHANNELS

****

****

prpl The option 'prpl' makes a printer plot of x-y data in one or two DATA channels.

This option plots one DATA channel versus another or versus an ordered sequence of increasing integers.

The first and last point of the data to be plotted can be specified, as well as the increment in points selected to be plotted. The range of values to be plotted along each axis and the length of the plot in printer lines can also be specified.

An error occurs if either of the selected channels, ICHAN1 or ICHAN2, contain no data when the parameters ICHAN1 and ICHAN2 are not zero.

Option parameters:

ICHAN1 - CHANNEL OF X DATA ARRAY
= 0 SET TO 1
ICHAN2 - CHANNEL OF Y DATA ARRAY
= 0 CREATE SEQUENTIAL INDEX ARRAY IN BX AS Y

IFIR - FIRST POINT TO PLOT
= 0 SET TO 1
ILAS - LAST POINT TO PLOT
= 0 SET TO CHANNEL VALUE
INC - INCREMENT FOR SELECTING DATA POINTS TO PLOT
= 0 SET TO 1

IYMAX - MAXIMUM NUMBER OF LINES IN Y FIELD
KMAX - MAX/MIN PLOT FLAG
= 0 PLOT ALL VALUES
= 1 READ IN MAXIMUM/MINIMUM VALUES

XS - SMALLEST X VALUE TO PLOT
XL - LARGEST X VALUE TO PLOT
YS - SMALLEST Y VALUE TO PLOT
YL - LARGEST Y VALUE TO PLOT

****

```
**************************************************************************

prpt      The option 'prpt' makes a printer plot of time series data
          from one or two DATA channels.


          Option parameters:

          ICHAN1 - CHANNEL OF X DATA ARRAY
                   = 0 USE BX ARRAY
          ICHAN2 - CHANNEL OF Y DATA ARRAY
                   = 0 PLOT ONLY X ARRAY

          IFIR - FIRST POINT TO PLOT
                 = 0 SET TO 1
          ILAS - LAST POINT TO PLOT
                 = 0 SET TO CHANNEL VALUE
          INC - INCREMENT FOR SELECTING DATA POINTS TO PLOT
                = 0 SET TO 1

**************************************************************************
```

```
**************************************************************************

rdda      The option 'rdda' reads data points into a DATA channel
          from the keyboard.

          The sampling rate of the input data can be specified.

          An error occurs if the selected channel ICHAN does not exist.


          Option parameters:

          ICHAN - CHANNEL NUMBER TO STORE DATA
                  = 0 SET TO 1
          SAMR - SAMPLING RATE (IN SAMPLES/S)
                 = 0 SET TO 40.0

          X - TIME SERIES VALUES
                 = end-of-file NO MORE DATA VALUES

**************************************************************************
```

****

rddp The option 'rddp' reads new DATA storage parameters from the keyboard.

This option changes all or some of the following DATA parameters: NCHLS (the total number of channels that the DATA array has been divided into), LENG (the length of each channel in samples), and NACHLS (the subset of NCHLS that actually contain data).

If NCHLS*LENG > IDEM where IDEM is the total dimension of the DATA array, a warning will be given.

Option parameters:

NC - NEW NUMBER OF CHANNELS AVAILABLE FOR DATA (NCHLS)
= 0 DO NOT CHANGE NCHLS
LE - NEW TOTAL STORAGE RESERVED FOR EACH CHANNEL (LENG)
= 0 DO NOT CHANGE LENG
NAC - NEW NUMBER OF ACTUAL CHANNELS WITH DATA (NACHLS)
= 0 DO NOT CHANGE NACHLS

****

****

rdev The option 'rdev' reads event information from the keyboard.

This option reads the event name, hypocenter, origin time, two magnitudes (eg. body wave and surface wave) and various event comments and flags from the keyboard.

This information is all stored in COMMON/EVT/ where it is accessible by many different subroutines and is included with all data files written in KEYS format.

Option parameters:

EXNAME - EVENT NAME (20 CHARACTERS MAXIMUM)

EXLAT - EVENT GEOGRAPHIC LATITUDE (IN DEGREES)
- = S
EXLON - EVENT GEOGRAPHIC LONGITUDE (IN DEGREES)
- = W
EXDEPH - EVENT HYPOCENTER DEPTH (IN KILOMETERS)

IEXYR - EVENT ORIGIN TIME - YEAR
IEXMO - EVENT ORIGIN TIME - MONTH (NUMBER)
IEXDY - EVENT ORIGIN TIME - DAY
IEXHR - EVENT ORIGIN TIME - HOUR
IEXMN - EVENT ORIGIN TIME - MINUTE
EXSEC - EVENT ORIGIN TIME - SECONDS

EXMAG1 - MAGNITUDE FOR EVENT
EXMAG2 - MAGNITUDE FOR EVENT

IEXM1 - MAGNITUDE EXMAG1 NAME - (format(2A4) for
IEXM2 - MAGNITUDE EXMAG2 NAME both magnitudes)

EXCOMT - COMMENTS (20 CHARACTERS MAXIMUM)

IFL - READ EXFLAG FLAG
= 0 DO NOT READ 10 EVENT FLAGS

EXFLAG - 10 EVENT FLAGS

****

****

rdhd The option 'rdhd' reads new header information for a designated DATA channel from the keyboard.

This option specifies a new station code, channel identification, station location, and data sampling rate for DATA channel ICHAN.

An error occurs if the selected channel ICHAN does not exist.

Option parameters:

ICHAN - DESIRED CHANNEL TO CHANGE HEADER
= 0 SET TO 1

JCODE - STATION CODE

JCHN1 - STATION CHANNEL IDENTIFICATION (format 4A1 for
JCHN2 - STATION CHANNEL IDENTIFICATION all channel ids.)
JCHN3 - STATION CHANNEL IDENTIFICATION
JCHN4 - STATION CHANNEL IDENTIFICATION

RLAT - STATION GEOGRAPHIC LATITUDE (IN DEGREES)
- = W
= 0 USE OLD LATITUDE
RLON - STATION GEOGRAPHIC LONGITUDE (IN DEGREES)
- = S
= 0 USE OLD LONGITUDE
RELEV - STATION ELEVATION (IN KILOMETERS)
= 0 USE OLD ELEVATION

RSAMR - DATA SAMPLING RATE (IN SAMPLES/S)
= 0 USE OLD SAMPLING RATE

****

****

rdsa The option 'rdsa' reads the number of samples in a DATA channel from the keyboard. The number of samples are then listed for all DATA channels.

This option specifies the number of samples (ISAMP) in DATA channel ICHAN. If ICHAN = 0, the number of samples for all DATA channels are set to ISAMP.

It is possible to set the number of samples for a given DATA channel to be larger than the number of data samples actually in the channel, and so care should be taken when using this option.

If the input parameter SEC > 0, then the number of samples for DATA channel ICHAN is set equal to those required to equal the time (in seconds) of the parameter SEC.

An error occurs if the selected channel ICHAN does not exist.

Option parameters:

ICHAN - CHANNEL NUMBER
= 0 CHANGE SAMPLE NUMBER FOR ALL CHANNELS TO ISAMP
ISAMP - NUMBER OF SAMPLES TO CHANGE TO
ISAMP > LENG SET ISAMP=LENG
SEC - AMOUNT OF TIME TO CHANGE TO (IN SECONDS)
> 0 USE SEC RATHER THAN ISAMP
= 0 USE ISAMP RATHER THAN SEC

****

****

rdst The option 'rdst' reads a new start time for a designated DATA channel from the keyboard.

An error occurs if the selected channel ICHAN does not exist.

Option parameters:

ICHAN - DESIRED CHANNEL TO CHANGE HEADER
= 0 SET TO 1

JDOFY - NEW START DAY
JHOUR - NEW START HOUR
JMIN - NEW START MINUTE
RSEC - NEW START SECOND

****

****

read The option 'read' reads a data file written either in RETRV or KEYS format.

This option reads data from a specified file and stores the data in a designated DATA channel ICHAN. The files can be either RETRV or KEYS files.

The station and component corresponding to each data set is listed and a decision can be made to store the data or to skip the data set. The beginning time to start storing each data set can be chosen.

DATA storage parameters can be set at the start of the read operation. Setting new DATA storage parameters will eliminate access to any data previously existing in DATA storage. If only one of the DATA storage parameters (NC or LE) is changed, the other one is automatically recomputed.

An error occurs if the storage parameters set exceed the overall storage available.

Option parameters:

NC - NEW NUMBER OF CHANNELS (NCHLS)
= 0 DO NOT CHANGE
LE - NEW TOTAL STORAGE RESERVED FOR EACH CHANNEL (LENG)
= 0 DO NOT CHANGE

ITYPE - NEXT FILE TYPE
CHOICES: retr, keys, last

LUN - FILE UNIT NUMBER FOR INPUT
(MUST BE GREATER THAN 14)

FILENM - FILE NAME FOR INPUT

ICHAN - DESIRED CHANNEL NUMBER TO FILL
= 0 FOR NEXT CHANNEL

IBDY - DESIRED START TIME - DAY
= 0 ASSUME SAME BEGIN TIME AS FILE
IBHR - DESIRED START TIME - HOUR
IBMIN - DESIRED START TIME - MINUTE
BSEC - DESIRED START TIME - SECOND

IOPT - 'more' OR 'last' OPTION

****

****

reco The option 'reco' plots a record section.

This option plots the first NCH DATA channels in the form of a record section. The reduction velocity for the record section is an input parameter. Each channel can be scaled individually or one common scaling factor can be used to preserve the relative amplitudes of all channels to each other.

All plotting parameters for the record section can be provided as input parameters. There are default values for almost all plotting parameters, so most input values can be zero.

The desired seismic phase for use in calculating the first point of each data channel to be plotted is an input parameter (NPHAS). It is necessary that event information be previously provided before selecting the option 'reco'.

Option parameters:

NCH - NUMBER OF CHANNELS TO INCLUDE IN RECORD SECTION
(INCLUDE FROM CHANNEL 1 TO NCH)
= 0 INCLUDE ALL CHANNELS
RVEL - REDUCTION VELOCITY (IN KILOMETERS/S)
= 0 REDUCED TIME NOT USED
FNOISE - SECONDS OF NOISE TO INCLUDE BEFORE SIGNAL
= 0 SET TO 10.0

ISC - TRACE SCALING OPTION FLAG
= 0 SCALE INDIVIDUALLY
= 1 SCALE ALL TOGETHER
= 2 DON'T SCALE
SF - MAXIMUM TRACE AMPLITUDE (IN CM)
= 0 SET TO 1.0

Plot Time Axis Parameters

TDIZ - SECONDS/CM TRACE PLOTTING INCREMENT
= 0 SET TO 5.0
TMAX - MAXIMUM RELATIVE TIME VALUE TO BE PLOTTED
(IN SECONDS)
= 0 SET TO 60.0
TI - INCREMENT IN TIME VALUE FOR TICKS (IN SECONDS)
= 0 SET TO 10.0
TTI - INCREMENT IN TIME VALUE FOR LABELED TICKS (IN SECONDS)
(MUST BE INTEGER MULTIPLE OF TI)
= 0 SET TO 20

Plot Distance Axis Parameters

FSDIST - PLOT ORIGIN FOR DISTANCE
DDIZ - KILOMETERS/CM DISTANCE PLOTTING INCREMENT

= 0 SET TO 100.0
DMAX - MAXIMUM IN DISTANCE VALUE FOR TICKS
= 0 SET TO MAXIMUM FOR 9.0 INCHES
DI - INCREMENT IN DISTANCE VALUE FOR TICKS
= 0 SET TO 100
DDI - INCREMENT IN DISTANCE VALUE FOR LABELED TICKS
= 0 SET TO 500

Plot Mode and Scaling Parameters

MODEP - MODE FOR OPENING PLOT SYSTEM
= 0 SET TO 3
= 1 IMMEDIATE MODE
= 2 DEFERRED MODE
= 3 EDIT MODE
FAC - PLOT SCALE FACTOR
= 0 SET TO 1.0

Plot Title Parameters

AXTIT - TIME AXIS TITLE (20 CHARACTERS MAXIMUM)
AYTIT - DISTANCE AXIS TITLE (20 CHARACTERS MAXIMUM)
AMTIT - MAIN PLOT TITLE (20 CHARACTERS MAXIMUM)

NPHAS - NAME OF DESIRED PHASE FOR TT COMPUTATION

Distance Range for Phase

Pg	0	- 15
ScP	0	- 70
PcP	0	- 150
pP	0.3	- 180
sP	0.3	- 180
PP	0.3	- 180
P	0	- 180
PPP	0	- 180
SP	0	- 140
SPP	0	- 180
SKP1	70	- 180
SKP2	70	- 180
PKP	100	- 180
PKP2	100	- 180
PKKP	130	- 180
PKK2	150	- 180
PKK3	150	- 180
PKPP	0	- 180
PcS	0	- 70
ScS	0	- 100
SKS	60	- 180
SKS2	60	- 180
S	0	- 180
pS	0	- 180
sS	0	- 180
PS	0	- 140
PPS	0	- 180
SS	0	- 180

SSS	0	- 180
R	0	- 360
L	0	- 360

UVEL - GROUP VELOCITY FOR RAYLEIGH OR LOVE WAVES (IN KM/S)
= 0 SET TO 4.0

****

****

rect The option 'rect' rectifies a DATA channel, making all amplitudes positive.

This option changes the sign of all negative data samples in DATA channel ICHAN. If ICHAN = 0, all DATA channels are rectified.

An error occurs if the selected channel ICHAN contains no data.

Option parameters:

ICHAN - DESIRED CHANNEL
= 0 RECTIFY ALL CHANNELS

****

```
**************************************************************************

reor      The option 'reor' reorders DATA channels according to the
          options input.

          This option will exchange two DATA array channels (ICHAN1
          and ICHAN2) or wil move BX to a DATA channel ICHAN2 or DATA
          channel ICHAN1 to BX.

          An error occurs if either ICHAN1 or ICHAN2 is greater than
          NACHLS or if the DATA array LENG is greater than IDEM1.

          Option parameters:

          ICHAN1 - DESIRED CHANNEL TO EXCHANGE WITH ICHAN2
                   = 0 NO EXCHANGE, BX TO ICHAN2
          ICHAN2 - DESIRED CHANNEL TO EXCHANGE WITH ICHAN1
                   = 0 NO EXCHANGE, ICHAN1 TO BX

**************************************************************************
```

****

resp The option 'resp' calculates the instrument response for a specified DATA channel and lists and/or plots the response.

This option uses the instrument poles and zeros from either: the header for selected DATA channel ICHAN, the master file, or the keyboard, to compute the instrument response.

A displacement, velocity, or acceleration response can be calculated. The instrument response can be listed and/or plotted.

An error occurs if the selected channel ICHAN contains no data, or if SAMR = 0.0 when NL2 > 0, or if FMN = 0.0 or FMX = 0.0 when NL2 = 0, or if FMN > FMX.

Option parameters:

ICHAN - CHANNEL NUMBER TO DETERMINE INSTRUMENT RESPONSE
= 0 SET TO 1

IFL - RESPONSE OUTPUT FLAG
= 0 SET TO 1
= 1 DISPLACEMENT RESPONSE
= 2 VELOCITY RESPONSE
= 3 ACCELERATION RESPONSE

IRX - RESPONSE FLAG
= 0 USE INSTRUMENT POLES AND ZEROS IN CHANNEL HEADER
= 1 USE INSTRUMENT POLES AND ZEROS FROM MASTER FILE

Master Response Parameters

IRP - SELECT MASTER RESPONSE FLAG
= 0 READ RESPONSE POLES AND ZEROS
= 1 SET UP RESPONSE FROM STORED INFORMATION
(REQUIRES 'response' FILE)

ICODE - DESIRED STATION FROM 'response' FILE

ICOMP - DESIRED COMPONENT FROM 'response' FILE

IYR - DESIRED YEAR
IMO - DESIRED MONTH (NUMBER)
IDY - DESIRED DAY

SA0 - CONSTANT RESPONSE TERM

KNP - NUMBER OF COMPLEX POLES

SPOLES - COMPLEX POLES

KNZ - NUMBER OF COMPLEX ZEROS

SZEROS - COMPLEX ZEROS

KFLAG - SPECIAL DATA FLAG

Frequency Parameters

FMN - MINIMUM FREQUENCY TO COMPUTE RESPONSE FOR
FMX - MAXIMUM FREQUENCY TO COMPUTE RESPONSE FOR
DF - INCREMENT IN FREQUENCY FOR COMPUTATIONS
(NUMBER OF FREQUENCY VALUES LIMITED TO 10000)
= 0 SET TO FMN
NL2 - LENGTH OF TIME SERIES THAT FMN AND FMX WILL
CORRESPOND TO
(MUST BE A POWER OF 2)
= 0 USE PARAMETERS FMN,FMX,DF
> 0 USE NL2 AND SAMR TO COMPUTE FMN,FMX,DF
SAMR - SAMPLING RATE (SAMPLES/S)
= 0 USE VALUE FROM CHANNEL HEADER

Print/Plot Parameters

IPRT - LIST RESPONSE FLAG
> 0 LIST RESPONSE
IPLOT - PLOT RESPONSE FLAG
> 0 PLOT RESPONSE
IFFT - FREQUENCY/PERIOD FLAG
= 0 PLOT FREQUENCY VALUES
= 1 PLOT PERIOD VALUES

Plot Option Parameters

LGF - FLAG FOR LOG PLOT
= 1 LOG PLOT ON X AXIS
= 3 LOG PLOT ON X AND Y AXIS
IHEAD - FLAG FOR HEADER PLOT
= 0 DON'T PLOT HEADER
= 1 PLOT HEADER
IPF1 - PLOT FLAG FOR NUMBERS ON X AXIS
= 0 PLOT NUMBERS
= 1 OMIT NUMBERS
IPF2 - PLOT FLAG FOR NUMBERS ON Y AXIS
= 0 PLOT NUMBERS
= 1 OMIT NUMBERS

Plot Range Parameters

ISF - FLAG FOR SPECTRAL AMPLITUDE RANGE TO PLOT
= 0 LOG PLOT OF ENTIRE RANGE
(LGF CANNOT BE 0 OR 2)
= 1 LOG PLOT OF MAXIMUM VALUE AND NCY CYCLES DOWN
= 2 READ IN RANGE TO PLOT
NCY - NUMBER OF CYCLES TO PLOT
= 0 SET TO 1 IF ISF = 1

Plot Axis Parameters

(Range Automatically Computed)

XDIZ - TRACE PLOTTING INCREMENT (IN X VALUE/CM)
- LINEAR PLOT (CM/X VALUE)
= 0 SET TO XI
- LOG PLOT (TOTAL X CM FOR ALL CYCLES)
= 0 SET TO 6 INCHES

YI - INCREMENT IN Y VALUE FOR TICKS
= 0 SET TO (YMAX-YF)/10.0 FOR LINEAR PLOT
= 0 SET TO YF*10**CYCLE FOR LOG PLOT

YYI - INCREMENT IN Y VALUE FOR LABELED TICKS
(MUST BE INTEGER MULTIPLE OF YI)
= 0 SET TO 2 YI FOR LINEAR PLOT
= 0 SET TO 10 YI FOR LOG PLOT

YDIZ - TRACE PLOTTING INCREMENT (IN Y VALUE/CM)
- LINEAR PLOT (CM/Y VALUE)
= 0 SET TO YI
- LOG PLOT (TOTAL Y CM FOR ALL CYCLES)
< 1 SET TO 6 INCHES

Plot X-Axis Parameters

XF - X AXIS PLOT ORIGIN VALUE (SMALLEST VALUE)

XMAX - MAXIMUM X VALUE TO BE PLOTTED

XI - INCREMENT IN X VALUE FOR TICKS
= 0 SET TO (XMAX-XF)/10.0 FOR LINEAR PLOT
= 0 SET TO XF*10**CYCLE FOR LOG PLOT

XXI - INCREMENT IN X VALUE FOR LABELED TICKS
(MUST BE INTEGER MULTIPLE OF XI)
= 0 SET TO 2 XI FOR LINEAR PLOT
= 0 SET TO 10 XI FOR LOG PLOT

XDIZ - TRACE PLOTTING INCREMENT (IN X VALUE/CM)
- LINEAR PLOT (CM/X VALUE)
= 0 SET TO XI
- LOG PLOT (TOTAL X CM FOR ALL CYCLES)
< 1 SET TO 6 INCHES

Plot Y-Axis Parameters

YF - Y AXIS PLOT ORIGIN VALUE (SMALLEST VALUE)

YMAX - MAXIMUM Y VALUE TO BE PLOTTED

YI - INCREMENT IN Y VALUE FOR TICKS
= 0 SET TO (YMAX-YF)/10.0 FOR LINEAR PLOT
= 0 SET TO YF*10**CYCLE FOR LOG PLOT

YYI - INCREMENT IN Y VALUE FOR LABELED TICKS
(MUST BE INTEGER MULTIPLE OF YI)
= 0 SET TO 2 YI FOR LINEAR PLOT
= 0 SET TO 10 YI FOR LOG PLOT

YDIZ - TRACE PLOTTING INCREMENT (IN Y VALUE/CM)
- LINEAR PLOT (CM/Y VALUE)
= 0 SET TO YI
- LOG PLOT (TOTAL Y CM FOR ALL CYCLES)
< 1 SET TO 6 INCHES

Plot Mode and Scaling Parameters

```
MODEP - MODE FOR OPENING PLOT SYSTEM
        = 0 SET TO 3
        = 1 IMMEDIATE MODE
        = 2 DEFERRED MODE
        = 3 EDIT MODE
FAC - PLOT SCALE FACTOR
      = 0 SET TO 1.0
SIZ1 - NUMBER SIZE FOR X AND Y AXES (IN INCHES)
       = 0 SET T0 0.14
SIZ2 - TITLE SIZE FOR X AND Y AXES (IN INCHES)
       = 0 SET TO 0.28
SIZ3 - SIZE FOR MAIN TITLE (IN INCHES)
       = 0 SET TO 0.28


                Plot Title Parameters

AXTIT - X AXIS TITLE (20 CHARACTERS MAXIMUM)
AYTIT - Y AXIS TITLE (20 CHARACTERS MAXIMUM)
AMTIT - MAIN PLOT TITLE (20 CHARACTERS MAXIMUM)


                Plot Line and Symbol Parameters

LINE - FLAG FOR CONTINUOUS LINE
       = 0 NO LINE JOINING POINTS
       = 1 LINE JOINING POINTS
MARK - SYMBOL CODE USED FOR DATA POINTS
       = 0 DON'T PLOT SYMBOL
       = 1 PLOT X
       = 2 PLOT O
       = 3 PLOT *
       = 4 PLOT +
```

****

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**************************************************************************

rewi        The option 'rewi' rewinds a logical file. The file number
            to rewind is an input parameter.


            Option parameters:

            LUN - LOGICAL UNIT NUMBER

**************************************************************************
```

****

rota The option 'rota' rotates two horizontal DATA channels.

This option rotates two horizontal components so that one component (radial) is aligned with a specified azimuthal direction and the other component (transverse) is aligned perpendicular to this direction. The azimuthal direction (station-to-epicenter azimuth) and the installed instrument azimuth are input parameters.

If any option that calculates distance-azimuth values has previously been executed, the station-to-epicenter azimuth then stored in COMMON/DTAZ/ may be used rather than entering a value by the keyboard.

An error occurs if the number of samples or the sampling rates of the two horizontal channels are not equal. An error also occurs if either of the channels selected for rotation contains no data.

Option parameters:

IR - CHANNEL NUMBER OF RADIAL (N-S) COMPONENT
IT - CHANNEL NUMBER OF TRANSVERSE (E-W) COMPONENT

GAM - STATION-TO-EPICENTER AZIMUTH (IN DEGREES)
< 0 USE COMPUTED BACK AZIMUTH IN COMMON/DTAZ/
BETA - ANGLE OF INSTALLED RADIAL (NORTH) COMPONENT WITH
RESPECT TO TRUE NORTH (IN DEGREES)
= 0 FOR INSTALLED N-S AND E-W COMPONENTS

****

****

rwds The option 'rwds' calculates theoretical Rayleigh wave dispersion using an Earth model.

This option is designed to calculate Rayleigh wave dispersion (phase velocity 'c' and group velocity 'U' as a function of period 'T') for any specified earth model consisting of homogeneous flat layers. Calculations are made for the fundamental and higher modes.

Phase and group velocity are listed as a function of period. This option will also list ratios of horizontal-to-vertical particle motion at the surface of the earth 'Uo/Wo' as a function of period.

Parameters of the homogeneous flat layers of the specified model earth are input data for this option. These parameters consist of the layer thicknesses, compressional velocities, shear velocities, and densities. If an intermediate layer has a shear velocity equal to zero, it will be chosen as the fluid half-space. This option is designed to work with models having as many as 1000 homogeneous layers, including the half-space.

In addition to the 1000 homogeneous layers, this option will automatically subdivide each layer into a number of layers when loss of precision seems possible due to large terms in the Duncan submatrices.

For a given value of period T, this option will find a value of phase velocity c such that the period equation for Rayleigh waves is satisfied. Trial values of c are found by beginning with a given value of c and a given increment in c, dc, (which should be positive). Thereafter new increments in c are computed by the phase velocity curve follower. If a new increment is less than some small root accuracy value, then a solution of the period equation is judged to have been found.

Experience has shown that dT values should not be greater than 1/5 of the smallest value of T for which calculations are to be made.

Option Parameters:

FILENM - FILE NAME FOR INPUT MODEL

MODENO - MODE FLAG
= 0 FUNDAMENTAL MODE
= 1 FIRST HIGHER MODE
= 2 SECOND HIGHER MODE
= n N'TH HIGHER MODE

Period Parameters

```
TFIR - FIRST PERIOD VALUE (IN SECONDS)
       (OR FIRST FREQUENCY VALUE)
TLAS - LAST PERIOD VALUE (IN SECONDS)
       (OR LAST FREQUENCY VALUE)
DT - INCREMENT IN PERIOD VALUES (IN SECONDS)
     (OR INCREMENT IN FREQUENCY VALUES)
     = 0 SET TO 1.0
ITOP - PERIOD FLAG
       = 0 INCREMENT PERIOD BY +DT
       = 1 INCREMENT PERIOD BY *DT
       = 2 INCREMENT FREQUENCY BY +DT AND FORM PERIOD=1/FREQ
       = 3 READ PERIOD VALUES FROM KEYBOARD


                Phase Velocity Parameters

CFIR - STARTING PHASE VELOCITY FOR SEARCH (IN KM/S)
       = 0 SET TO 2.0
DC - INCREMENT IN PHASE VELOCITY FOR INITIAL SEARCH (IN KM/S)
     = 0 SET TO 0.01


                Search and Listing Parameters

MODPR - MODEL LISTING FLAG
        = 0 NO LISTING MADE
        = 1 LISTING MADE
KCDS - ROOT ACCURACY FLAG
       = 0 ACCURACY = 1E-7
       = 1 ACCURACY = 1E-6
       = 2 ACCURACY = 1E-8
       = 3 ACCURACY = 1E-9
       = 4 ACCURACY = 1E-5
       = 5 ACCURACY = 1E-10
       = 6 ACCURACY = 1E-4
KWRITE - DEBUG LISTING FLAG
         = 0 NO LISTING MADE
         = 1 LISTING MADE OF ROOT SEARCH
         = 2 LISTING MADE OF ROOT SEARCH AND LAYER DIVISION

**********************************************************************
```

```
**************************************************************************

scal      The option 'scal' scales a designated DATA channel using
          a scaling factor that is an input parameter.

          This option multiplies each data point of DATA channel ICHAN
          by the input scale factor XXCAL. If ICHAN = 0, all DATA
          channels are scaled using the factor XXCAL.

          An error occurs if the selected channel ICHAN contains no
          data.


          Option parameters:

          ICHAN - DESIRED CHANNEL
                  = 0 SCALE ALL DATA CHANNELS
          XXCAL - SCALING FACTOR

**************************************************************************
```

****

shif The option 'shif' shifts a time series in a DATA channel.

This option shifts DATA channel ICHAN by the number of seconds specified by the parameter DELAY.

An error occurs if the selected channel ICHAN contains no data or if ICHAN < or = 0. An error also occurs if DELAY is negative and corresponds to a number of samples > the number of samples in channel ICHAN.

Option parameters:

ICHAN - DESIRED CHANNEL TO SHIFT
DELAY - DELAY TIME (IN SECONDS)
> 0 INCREASE DELAY
< 0 DELETE FIRST PART OF TRACE TO ADVANCE TRACE

****

****

sign The option 'sign' forms a synthetic test signal.

This option generates a synthetic test signal in DATA channel ICHAN. The test signal can be a composite of several signals summed together.

The test signal is added to channel ICHAN without first setting this DATA channel to zero. Therefore it is possible to create composites of real and synthetic signals.

Several different synthetic signal types are available for use individually or in combination to form the synthetic test signal.

The test signal length, sampling rate, and starting sample number can all be specified. The test signal can also be scaled and exponentially weighted.

Option parameters:

ICHAN - CHANNEL TO ADD SYNTHETIC SIGNAL
= 0 SET TO 1
***** CAUTION SIGNALS ARE ADDED TO CHANNEL AS IS;
CHANNEL IS NOT SET TO ZERO *****
SAMR - SAMPLING RATE (IN SAMPLES/S)
= 0 SET TO 40.0
NSIG - NUMBER OF DIFFERENT SIGNALS TO COMPUTE AND ADD TO ICHAN
= 0 SET TO 1
KSAMP - NUMBER OF SAMPLES TO SET FOR DATA CHANNEL
= 0 USE PRE-EXISTING NUMBER

Signal Selection

ISNX - SIGNAL TYPE
= 0 SET TO 1
= 1 SINE/COSINE SIGNAL
= 2 DELTA FUNCTION
= 3 SPECIAL FUNCTION # 1
f(t)=(t**2)*exp(2-2t)*sin(2pift)

Sample Parameters

ISAMP - NUMBER OF SAMPLES TO GENERATE
= 0 SET TO LENG
IFIR - FIRST SAMPLE TO ADD GENERATED SIGNAL TO
= 0 SET TO 1

Weighting and Scaling Parameters

ALPHA - EXPONENTIAL DECAY CONSTANT exp(-alpha*t)
= 0 NO EXPONENTIAL WEIGHTING

SCALE - SCALE FACTOR FOR SIGNAL
(MAXIMUM VALUE FOR SIGNAL)
= 0 SET TO 1.0

Sine/Cosine Parameters

T - PERIOD OF SINE/COSINE COMPONENT
A - COSINE COEFFICIENT
B - SINE COEFFICIENT
A0 - DC OFFSET

Delta Function Parameters

AMP - AMPLITUDE OF DELTA FUNCTION
IS - SAMPLE NUMBER TO PLACE DELTA FUNCTION

Special Function # 1 Parameters

T - PERIOD OF SINE COMPONENT

****

****

spec The option 'spec' calculates the Fourier spectra of data in a DATA channel or in BX.

This option calculates the Fourier spectra of a specified time series. Direct transforms can be performed to obtain real and imaginary components, power spectra, or amplitude and phase spectra. Indirect transforms can also be performed.

The data are first moved to the BX array before the data are transformed (unless the data are already in the BX array).

The data length must be a power of 2 or zeros will be added to obtain a power of 2. It is necessary that LENG > or = (total power-of-2-length + 2) of the data. If LENG is not large enough, only part of the data will be transformed.

A slow direct transform can also be calculated for test purposes, but this transform cannot be inverse transformed. The slow transform spectral results are automatically listed. Data in the DATA array are not first moved to the BX array before taking a slow direct transform. Also the sample length need not be a power of 2.

An error occurs if channel ICHAN contains no data, or if either ISAMP = 0 or SAMR = 0.0 when the data to be transformed are already in BX, or if ISAMP = 0 or SAMR = 0.0 in the DATA channel header and these values are not changed.

Option parameters:

IPOW - SPECTRA OPTION
- = 0 DIRECT TRANSFORM TO REAL AND IMAGINARY COMPONENTS
- = 1 INDIRECT TRANSFORM TO TIME DOMAIN
- = 2 DIRECT TRANSFORM TO POWER SPECTRA (LIMITED TO 10000 POINTS)
- = 3 DIRECT TRANSFORM TO AMPLITUDE AND PHASE SPECTRA (LIMITED TO 10000 POINTS)
- = 4 SLOW TEST TRANSFORM (LIMITED TO 10000 POINTS)

ICHAN - CHANNEL NUMBER TO COMPUTE SPECTRA OF
- > 0 MOVE ICHAN TO BX AND COMPUTE FOR BX
- = 0 COMPUTE FOR BX

Sample Parameters

ISAMP - NUMBER OF SAMPLES TO MOVE TO BX
- = 0 MOVE ALL SAMPLES

IFIR - FIRST SAMPLE TO MOVE
- = 0 SET TO 1

SAMR - SAMPLING RATE (IN SAMPLES/S)
- = 0 USE VALUE FOR CHANNEL

Smoothing Parameters

NSM - NUMBER OF POINTS TO SMOOTH SPECTRA OVER
(MUST BE BETWEEN 5 AND 25)
= 0 NO SMOOTHING

Print/Plot Parameters

IPRT - LIST OPTION
> 0 THEN LIST
IPLOT - PLOT OPTION
> 0 THEN PLOT

Period Parameters

TMN - SHORTEST PERIOD TO PRINT AND PLOT
= 0 USE DEFAULT FROM SPECTRA
TMX - LONGEST PERIOD TO PRINT AND PLOT
= 0 USE DEFAULT FROM SPECTRA

IFFT - FREQUENCY/PERIOD FLAG
= 0 PLOT FREQUENCY VALUES
= 1 PLOT PERIOD VALUES

Plot Option Parameters

LGF - FLAG FOR LOG PLOT
= 1 LOG PLOT ON X AXIS
= 3 LOG PLOT ON X AND Y AXIS
IHEAD - FLAG FOR HEADER PLOT
= 0 DON'T PLOT HEADER
= 1 PLOT HEADER
IPF1 - PLOT FLAG FOR NUMBERS ON X AXIS
= 0 PLOT NUMBERS
= 1 OMIT NUMBERS
IPF2 - PLOT FLAG FOR NUMBERS ON Y AXIS
= 0 PLOT NUMBERS
= 1 OMIT NUMBERS

Plot Range Parameters

ISF - FLAG FOR SPECTRAL AMPLITUDE RANGE TO PLOT
= 0 LOG PLOT OF ENTIRE RANGE
(LGF CANNOT BE 0 OR 2)
= 1 LOG PLOT OF MAXIMUM VALUE AND NCY CYCLES DOWN
= 2 READ IN RANGE TO PLOT
NCY - NUMBER OF CYCLES TO PLOT
= 0 SET TO 1 IF ISF = 1

Plot Axis Parameters
(Range Automatically Computed)

```
XDIZ - TRACE PLOTTING INCREMENT (IN X VALUE/CM)
     - LINEAR PLOT (CM/X VALUE)
       = 0 SET TO XI
     - LOG PLOT (TOTAL X CM FOR ALL CYCLES)
       = 0 SET TO 6 INCHES
YI - INCREMENT IN Y VALUE FOR TICKS
     = 0 SET TO (YMAX-YF)/10.0 FOR LINEAR PLOT
     = 0 SET TO YF*10**CYCLE FOR LOG PLOT
YYI - INCREMENT IN Y VALUE FOR LABELED TICKS
      (MUST BE INTEGER MULTIPLE OF YI)
      = 0 SET TO 2 YI FOR LINEAR PLOT
      = 0 SET TO 10 YI FOR LOG PLOT
YDIZ - TRACE PLOTTING INCREMENT (IN Y VALUE/CM)
     - LINEAR PLOT (CM/Y VALUE)
       = 0 SET TO YI
     - LOG PLOT (TOTAL Y CM FOR ALL CYCLES)
       < 1 SET TO 6 INCHES
```

Plot X-Axis Parameters

```
XF - X AXIS PLOT ORIGIN VALUE (SMALLEST VALUE)
XMAX - MAXIMUM X VALUE TO BE PLOTTED
XI - INCREMENT IN X VALUE FOR TICKS
     = 0 SET TO (XMAX-XF)/10.0 FOR LINEAR PLOT
     = 0 SET TO XF*10**CYCLE FOR LOG PLOT
XXI - INCREMENT IN X VALUE FOR LABELED TICKS
      (MUST BE INTEGER MULTIPLE OF XI)
      = 0 SET TO 2 XI FOR LINEAR PLOT
      = 0 SET TO 10 XI FOR LOG PLOT
XDIZ - TRACE PLOTTING INCREMENT (IN X VALUE/CM)
     - LINEAR PLOT (CM/X VALUE)
       = 0 SET TO XI
     - LOG PLOT (TOTAL X CM FOR ALL CYCLES)
       < 1 SET TO 6 INCHES
```

Plot Y-Axis Parameters

```
YF - Y AXIS PLOT ORIGIN VALUE (SMALLEST VALUE)
YMAX - MAXIMUM Y VALUE TO BE PLOTTED
YI - INCREMENT IN Y VALUE FOR TICKS
     = 0 SET TO (YMAX-YF)/10.0 FOR LINEAR PLOT
     = 0 SET TO YF*10**CYCLE FOR LOG PLOT
YYI - INCREMENT IN Y VALUE FOR LABELED TICKS
      (MUST BE INTEGER MULTIPLE OF YI)
      = 0 SET TO 2 YI FOR LINEAR PLOT
      = 0 SET TO 10 YI FOR LOG PLOT
YDIZ - TRACE PLOTTING INCREMENT (IN Y VALUE/CM)
     - LINEAR PLOT (CM/Y VALUE)
       = 0 SET TO YI
     - LOG PLOT (TOTAL Y CM FOR ALL CYCLES)
       < 1 SET TO 6 INCHES
```

Plot Mode and Scaling Parameters

```
MODEP - MODE FOR OPENING PLOT SYSTEM
```

```
          = 0 SET TO 3
          = 1 IMMEDIATE MODE
          = 2 DEFERRED MODE
          = 3 EDIT MODE
     FAC - PLOT SCALE FACTOR
         = 0 SET TO 1.0
     SIZ1 - NUMBER SIZE FOR X AND Y AXES (IN INCHES)
          = 0 SET T0 0.14
     SIZ2 - TITLE SIZE FOR X AND Y AXES (IN INCHES)
          = 0 SET TO 0.28
     SIZ3 - SIZE FOR MAIN TITLE (IN INCHES)
          = 0 SET TO 0.28


                    Plot Title Parameters

     AXTIT - X AXIS TITLE (20 CHARACTERS MAXIMUM)
     AYTIT - Y AXIS TITLE (20 CHARACTERS MAXIMUM)
     AMTIT - MAIN PLOT TITLE (20 CHARACTERS MAXIMUM)


                    Plot Line and Symbol Parameters

     LINE - FLAG FOR CONTINUOUS LINE
          = 0 NO LINE JOINING POINTS
          = 1 LINE JOINING POINTS
     MARK - SYMBOL CODE USED FOR DATA POINTS
          = 0 DON'T PLOT SYMBOL
          = 1 PLOT X
          = 2 PLOT O
          = 3 PLOT *
          = 4 PLOT +

*************************************************************************
```

****

strp The option 'strp' sets up instrument response poles and zeros for a designated channel.

This option sets up the instrument response poles and zeros for a selected channel ICHAN from the master file of response poles and zeros or from the keyboard. Some of the stations and components available in the master file are listed below. The actual poles and zeros are given in a later section of this User's Guide.

If this option is selected, a new response is established in the header of DATA channel ICHAN and the master response file need not be used again for this channel.

An error occurs if the selected channel ICHAN does not exist or if the station - component requested from the master file of response poles and zeros does not exist in the master file.

Station	Component
alq	bhz,bhn,bhe
biny	bhz,bhn,bhe
bks	bhz,bhn,bhe
bw06	bhz,bhn,bhe
cbm	bhz,bhn,bhe
ccm	bhz,bhn,bhe
ceh	bhz,bhn,bhe
cmb	bhz,bhn,bhe
col	bhz,bhn,bhe
cor	bhz,bhn,bhe
dpc	bhz,bhn,bhe
dug	bhz,bhn,bhe
goga	bhz,bhn,bhe
gol	bhz,bhn,bhe
hrv	bhz,bhn,bhe
isa	lhz,lhn,lhe
jfws	bhz,bhn,bhe
lbnh	bhz,bhn,bhe
lsct	bhz,bhn,bhe
ltx	bhz,bhn,bhe
mcwv	bhz,bhn,bhe
miar	bhz,bhn,bhe
mync	bhz,bhn,bhe
new	lhz,lhn,lhe
oxf	bhz,bhn,bhe
pas	bhz,bhn,bhe
rsny	mhz,mhn,mhe
rssd	mhz,mhn,mhe
sao	lhz,lhn,lhe
sjg	bhz,bhn,bhe
sspa	bhz,bhn,bhe
tpnv	lhz,lhn,lhe
tuc	lhz,lhn,lhe
wala	bhz,bhn,bhe
wdc	lhz,lhn,lhe
wmok	bhz,bhn,bhe

ysny bhz,bhn,bhe

Option parameters:

ICHAN - DESIRED CHANNEL TO SET RESPONSE FROM MASTER FILE
= 0 SET TO 1

Master Response Parameters

IRP - SELECT MASTER RESPONSE FLAG
= 0 READ RESPONSE POLES AND ZEROS
= 1 SET UP RESPONSE FROM STORED INFORMATION
(REQUIRES 'response' FILE)

ICODE - DESIRED STATION FROM 'response' FILE

ICOMP - DESIRED COMPONENT FROM 'response' FILE

IYR - DESIRED YEAR
IMO - DESIRED MONTH (NUMBER)
IDY - DESIRED DAY

SA0 - CONSTANT RESPONSE TERM

KNP - NUMBER OF COMPLEX POLES

SPOLES - COMPLEX POLES

KNZ - NUMBER OF COMPLEX ZEROS

SZEROS - COMPLEX ZEROS

KFLAG - SPECIAL DATA FLAG

****

****

tape The option 'tape' tapers a designated DATA channel using a percent value that is input.

This option tapers the data in the DATA channel ICHAN. If ICHAN = 0, the data in all DATA channels are tapered. Both ends of the data in DATA channel ICHAN are tapered.

The amount of data tapered is specified as a percent of the total length of the data in the channel. A check is made for leading and trailing zeros, and these zero value points are excluded from processing when the data in channel ICHAN are tapered.

An error occurs if the selected channel ICHAN contains no data or if the percent value PERCNT is zero.

Option parameters:

ICHAN - DESIRED CHANNEL
= 0 TAPER ALL CHANNELS
PERCNT - PERCNT OF TIME SERIES TO TAPER

****

****

test The option 'test' activates any routine supplied by the user and named testf.

This option is provided to make it possible to easily test new algorithms without having to develop all the input, quality control, and output routines usually required. By adding appropriate FORTRAN code to the existing subroutine TESTF, new algorithms can be quickly tested. The option 'test' will call the subroutine TESTF.

Before selecting the option 'test', all necessary input and data preparation options can be executed. After the option 'test' is selected, appropriate output or plotting options can be selected.

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****

tren The option 'tren' removes the linear trend from a designated DATA channel.

This option computes and removes the linear trend for DATA channel ICHAN. If ICHAN = 0, the linear trend is computed and removed for all DATA channels. A check is made for leading and trailing zeros, and these zero value points are not included in determining the linear trend or removing it.

An error occurs if the selected channel ICHAN contains no data.

Option parameters:

ICHAN - DESIRED CHANNEL
= 0 REMOVE TREND FROM ALL CHANNELS

****

****

wrfl The option 'wrfl' writes a designated DATA channel to a file in KEYS format.

This option writes data from DATA channel ICHAN to file LUN2. If ICHAN = 0, all DATA channels are written to file LUN2. The format used in writing file LUN2 is the KEYS format which is a FORTRAN binary format (see introduction in this User's Guide).

An error occurs if LUN2 < or = 0, or if channel ICHAN contains no data.

Option parameters:

ICHAN - DESIRED CHANNEL TO WRITE TO FILE
= 0 WRITE ALL CHANNELS

FILENM - NAME OF FILE TO CREATE FOR DATA

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xypl The option 'xypl' plots x-y data from specified DATA channels in linear, semi-log, or log plots.

This option provides a versatile plotting capability for x versus y data, where the x data are in DATA channel ICHAN1 and the y data are in DATA channel ICHAN2. For linear plots on either the x or y axis, the data may be negative. The most negative value desired on the axis is input as XF or YF.

There are many parameters available to define the plot. Most plotting parameters have default values.

An error occurs if the parameter LGF < 0 or LGF > 3. An error also occurs if XF > or = XMAX, YF > or = YMAX, IFIR > ILAS, or if the selected channel ICHAN1 or ICHAN2 contains no data. Values of XMAX and YMAX must be provided.

Option parameters:

LGF - FLAG FOR LOG PLOT
= 0 LINEAR PLOT
= 1 LOG PLOT ON X AXIS
= 2 LOG PLOT ON Y AXIS
= 3 LOG PLOT ON X AND Y AXIS
IHEAD - FLAG FOR HEADER PLOT
= 0 DON'T PLOT HEADER
= 1 PLOT HEADER
IPF1 - PLOT FLAG FOR NUMBERS ON X AXIS
= 0 PLOT NUMBERS
= 1 OMIT NUMBERS
IPF2 - PLOT FLAG FOR NUMBERS ON Y AXIS
= 0 PLOT NUMBERS
= 1 OMIT NUMBERS

Plot X-Axis Parameters

XF - X AXIS PLOT ORIGIN VALUE (SMALLEST OR MOST NEGATIVE VALUE)
XMAX - MAXIMUM X VALUE TO BE PLOTTED
XI - INCREMENT IN X VALUE FOR TICKS
= 0 SET TO (XMAX-XF)/10.0 FOR LINEAR PLOT
= 0 SET TO XF*10**CYCLE FOR LOG PLOT
XXI - INCREMENT IN X VALUE FOR LABELED TICKS
(MUST BE INTEGER MULTIPLE OF XI)
= 0 SET TO 2 XI FOR LINEAR PLOT
= 0 SET TO 10 XI FOR LOG PLOT
XDIZ - TRACE PLOTTING INCREMENT (IN X VALUE/CM)
- LINEAR PLOT (CM/X VALUE)
= 0 SET TO XI
- LOG PLOT (TOTAL X CM FOR ALL CYCLES)
< 1 SET TO 6 INCHES

Plot Y-Axis Parameters

```
YF - Y AXIS PLOT ORIGIN VALUE (SMALLEST OR MOST NEGATIVE
     VALUE)
YMAX - MAXIMUM Y VALUE TO BE PLOTTED
YI - INCREMENT IN Y VALUE FOR TICKS
     = 0 SET TO (YMAX-YF)/10.0 FOR LINEAR PLOT
     = 0 SET TO YF*10**CYCLE FOR LOG PLOT
YYI - INCREMENT IN Y VALUE FOR LABELED TICKS
      (MUST BE INTEGER MULTIPLE OF YI)
      = 0 SET TO 2 YI FOR LINEAR PLOT
      = 0 SET TO 10 YI FOR LOG PLOT
YDIZ - TRACE PLOTTING INCREMENT (IN Y VALUE/CM)
     - LINEAR PLOT (CM/Y VALUE)
       = 0 SET TO YI
     - LOG PLOT (TOTAL Y CM FOR ALL CYCLES)
       < 1 SET TO 6 INCHES
```

Plot Mode and Scaling Parameters

```
MODEP - MODE FOR OPENING PLOT SYSTEM
        = 0 SET TO 3
        = 1 IMMEDIATE MODE
        = 2 DEFERRED MODE
        = 3 EDIT MODE
FAC - PLOT SCALE FACTOR
      = 0 SET TO 1.0
SIZ1 - NUMBER SIZE FOR X AND Y AXES (IN INCHES)
       = 0 SET T0 0.14
SIZ2 - TITLE SIZE FOR X AND Y AXES (IN INCHES)
       = 0 SET TO 0.28
SIZ3 - SIZE FOR MAIN TITLE (IN INCHES)
       = 0 SET TO 0.28
```

Plot Title Parameters

```
AXTIT - X AXIS TITLE (20 CHARACTERS)
AYTIT - Y AXIS TITLE (20 CHARACTERS)
AMTIT - MAIN PLOT TITLE (20 CHARACTERS)
```

Data Channel Parameters

```
ICHAN1 - DATA CHANNEL NUMBER FOR X DATA
         = 0 SET TO 1
ICHAN2 - DATA CHANNEL NUMBER FOR Y DATA
         = 0 SET TO 2

IFIR - FIRST DATA POINT TO PLOT
       = 0 SET TO 1
ILAS - LAST DATA POINT TO PLOT
       = 0 SET TO NUMBER OF SAMPLES IN CHANNEL
```

Plot Line and Symbol Parameters

```
LINE - FLAG FOR CONTINUOUS LINE
```

```
            = 0 NO LINE JOINING POINTS
            = 1 LINE JOINING POINTS
      MARK - SYMBOL CODE USED FOR DATA POINTS
            = 0 DON'T PLOT SYMBOL
            = 1 PLOT X
            = 2 PLOT O
            = 3 PLOT *
            = 4 PLOT +

**********************************************************************
```

****

zend The option 'zend' zeros the end of all DATA channels.

This option zeros each DATA channel beyond the data in the channel as specified by the JSAMP parameter (see COMMON/ARR/). Therefore data points from JSAMP + 1 to LENG are set to zero for all DATA channels.

****

```
**************************************************************************

zero      The option 'zero' zeros part of a designated DATA channel.

          This option zeros the DATA channel ICHAN or the BX array.
          If ICHAN = 0, all DATA channels are zeroed. The first and
          last point to be zeroed can be specified.

          An error occurs if the channel ICHAN does not exist.


          Option parameters:

          IFL - FLAG FOR DATA ARRAY TO ZERO
                = 0 ZERO PART OF DATA ARRAY
                = 1 ZERO PART OF BX ARRAY
          ICHAN - CHANNEL TO ZERO
                  = 0 ZERO ALL CHANNELS IF DATA ARRAY SELECTED
          IFIR - FIRST POINT TO ZERO
                 = 0 SET TO 1
          ILAS - LAST POINT TO ZERO
                 = 0 SET TO LENG FOR DATA OR IDEM1 FOR BX

**************************************************************************
```

SUBROUTINE LINKAGE

KEY ANALYSIS SYSTEM

SUBROUTINE LINKAGE

AASEL
CALLS ADAZE,APVELX,BEAMX,CALEX,CALROT,CLOSEX,COPYF,DATAL,
DAZEX,DECIX,DESPIK,DPARA,ENDPF,EVTRD,INSTX,JULDY,
KEYBRD,LISTTX,LSRESX,LSTTX,MATCHX,METX,MNMXEX,MOVEX,
NSNFIL,PREVT,PRHEAD,READG,RECSEC,RECTIF,REORX,RESPX,
REVPOL,REWD,SDISP,SEIPLT,SETHD,SETST,SHIFTX,SIGNAL,
SPECTR,STORLT,TAP,TAPEX,TESTF,UDISPX,WRDATX,XSAMP,
ZEROX
CALLED BY KEY

ADAZE
CALLS CONVRT,DIAZ,PREVT
CALLED BY AASEL,BEAMX,UDISPX

ADDTIM
CALLS ITIMC,JUL,TIMC
CALLED BY NSNFIL

ADVPLT
CALLS ---
CALLED BY RAXEPL,XYAX

AMPPH1
CALLS PHASOR
CALLED BY SPECTR

APVEL
CALLS TTCOMP
CALLED BY APVELX

APVELX
CALLS APVEL
CALLED BY AASEL

BEAM
CALLS METR
CALLED BY BEAMX

BEAMX
CALLS ADAZE,BEAM,DELTT,TIMC,TTCOMP
CALLED BY AASEL

BNDPAS
CALLS ---
CALLED BY FILTX

CALB
CALLS ---
CALLED BY CALEX,UDISPX

CALEX
CALLS CALB
CALLED BY AASEL

```
CALROT
     CALLS        REVOLV
     CALLED BY    AASEL

CLFORM
     CALLS        ---
     CALLED BY    CLTWO,RCOOL

CLOSEX
     CALLS        ---
     CALLED BY    AASEL

CLTWO
     CALLS        CLFORM
     CALLED BY    MATCH

COMPAS
     CALLS        ---
     CALLED BY    CONVRT,DAZEX

CONVRT
     CALLS        COMPAS,COORD1
     CALLED BY    ADAZE,TTCOMP

COORD1
     CALLS        ---
     CALLED BY    CONVRT,DAZEX

COPYF
     CALLS        MOVE
     CALLED BY    AASEL

CROSSX
     CALLS        MATCH,POWER2
     CALLED BY    AASEL

CYCLES
     CALLS        ---
     CALLED BY    PLSPEC,XYAX,XYPSPC

DAAS
     CALLS        ---
     CALLED BY    AASEL

DATAL
     CALLS        ---
     CALLED BY    AASEL

DAZEX
     CALLS        COMPAS,COORD1,DIAZ,DZCON
     CALLED BY    AASEL

DECI
     CALLS        ---
     CALLED BY    DECIX

DECIX
```

```
     CALLS       DECI
     CALLED BY   AASEL

DELTT
     CALLS       TIMC
     CALLED BY   BEAMX

DELEX
     CALLS       MOVE
     CALLED BY   AASEL

DESP
     CALLS       ---
     CALLED BY   DESPIK

DESPIK
     CALLS       DESP
     CALLED BY   AASEL

DIAZ
     CALLS       SARCOS
     CALLED BY   ADAZE,DAZEX,TTCOMP

DPARA
     CALLS       ---
     CALLED BY   AASEL

DZCON
     CALLS       ---
     CALLED BY   DAZEX,KEY,TTCOMP

EETIME
     CALLS       JUL,TIMC
     CALLED BY   UDISPX

ENDPF
     CALLS       ENDPLT,HLDSET
     CALLED BY   AASEL,KEY

ENDPLT
     CALLS       ---
     CALLED BY   ENDPF

ENGL
     CALLS       ---
     CALLED BY   TEQUL

EVTRD
     CALLS       PREVT
     CALLED BY   AASEL

EXPWF
     CALLS       ---
     CALLED BY   SIGNAL

FACTOR
     CALLS       ---
     CALLED BY   RAXEPL,SPLDAT,XYAX,XYDAPL
```

```
FELIP
     CALLS       ---
     CALLED BY   READG

FILLCH
     CALLS       ITIMC,PRHEAD,TIMC
     CALLED BY   READG

FILTT
     CALLS       ---
     CALLED BY   FILTX

FILTX
     CALLS       BNDPAS,FILTT,PHILTR
     CALLED BY   AASEL

FOURT
     CALLS       PHASOR
     CALLED BY   TTOF3

FUNC
     CALLS       ---
     CALLED BY   TRVLTM

GPVEL
     CALLS       ---
     CALLED BY   SDISP

HELIP
     CALLS       ---
     CALLED BY   TELIP

HLDPLT
     CALLS       ---
     CALLED BY   ENDPF,RECSEC,SEIPLT,XYPSPC

INITFL
     CALLS       ---
     CALLED BY   READG

INSTR
     CALLS       RESP,RESP2
     CALLED BY   INSTX

INSTX
     CALLS       INSTR,METR,SETRES,TAP
     CALLED BY   AASEL

IRDDAT
     CALLS       RDDATA
     CALLED BY   IRDHD,ISTBIT,RERETR

IRDHD
     CALLS       IRDDAT,RDHEAD
     CALLED BY   RERETR

ISTBIT
```

```
     CALLS        IRDDAT,STABIT
     CALLED BY    RERETR

ITIMC
     CALLS        ---
     CALLED BY    ADDTIM,FILLCH

ITYR
     CALLS        ---
     CALLED BY    JUL

JUL
     CALLS        ITYR
     CALLED BY    ADDTIM,EETIME,SETRES

JULDY
     CALLS        JUL
     CALLED BY    AASEL

KEY
     CALLS        AASEL,ENDPF
     CALLED BY    ---

KEYBRD
     CALLS        ---
     CALLED BY    AASEL

LAGRAN
     CALLS        ---
     CALLED BY    PASTIM

LISTTT
     CALLS        ITIMC,TRVLTM
     CALLED BY    LISTTX

LISTTX
     CALLS        LISTTT
     CALLED BY    AASEL

LOVAIJ
     CALLS        ---
     CALLED BY    TEQUL

LSRESX
     CALLS        PRHEAD
     CALLED BY    AASEL

LSTTX
     CALLS        TTCOMP
     CALLED BY    AASEL

MATCH
     CALLS        CLTWO
     CALLED BY    CROSSX,MATCHX

MATCHX
     CALLS        MATCH,POWER2
     CALLED BY    AASEL
```

```
METR
     CALLS       ---
     CALLED BY   BEAM,INSTX,METX,PHILTR,UDISPX

METX
     CALLS       METR
     CALLED BY   AASEL

MNMX
     CALLS       ---
     CALLED BY   MNMXEX,PLSPEC

MNMXEX
     CALLS       MNMX
     CALLED BY   AASEL

MOVE
     CALLS       MOVHD
     CALLED BY   COPYF,DELEX,MOVEX,SPECTR,UDISPX

MOVEX
     CALLS       MOVE
     CALLED BY   AASEL

MOVHD
     CALLS       ---
     CALLED BY   MOVEX

NSNFIL
     CALLS       ADDTIM,TTCOMP
     CALLED BY   AASEL

NUMBER
     CALLS       ---
     CALLED BY   RAXEPL,XYAX

OPNPLT
     CALLS       ---
     CALLED BY   RECSEC,SEIPLT,XYPSPC

PASTIM
     CALLS       ---
     CALLED BY   TIMLPP,TRVLTM

PHASOR
     CALLS       ---
     CALLED BY   AMPPH2,FOURT,RESPC

PHILTR
     CALLS       METR
     CALLED BY   FILTX

PLOT
     CALLS       ---
     CALLED BY   RAXEPL,SPLDAT,XYAX,XYDAPL

PLSPEC
```

```
     CALLS       CYCLES,MNMX,XYPSPC
     CALLED BY   RESPX,SPECTR

POW
     CALLS       ---
     CALLED BY   SPECTR

POWBEM
     CALLS       ---
     CALLED BY   RECTIF

POWER2
     CALLS       ---
     CALLED BY   CROSSX,MATCHX,TTOF1,TTOF2,UDISPX

PREVT
     CALLS       ---
     CALLED BY   ADAZE,EVTRD

PRHEAD
     CALLS       ---
     CALLED BY   AASEL,FILLCH

PRPLT
     CALLS       ---
     CALLED BY   PRPLTX

PRPLTX
     CALLS       PRPLT
     CALLED BY   AASEL

PRSPC1
     CALLS       ---
     CALLED BY   SPECTR

PRSPC3
     CALLS       ---
     CALLED BY   SPECTR

RAVAGE
     CALLS       ---
     CALLED BY   SPECTR

RAXEPL
     CALLS       ADVPLT,FACTOR,NUMBER,PLOT,SYMBOL
     CALLED BY   RECSEC,SEIPLT

RAYGIJ
     CALLS       ---
     CALLED BY   TEQUR

RCOOL
     CALLS       CLFORM
     CALLED BY   TTOF1,UDISPX

RDDATA
     CALLS       ---
     CALLED BY   IRDDAT
```

```
RDFIL
     CALLS       ---
     CALLED BY   READG

RDHEAD
     CALLS       ---
     CALLED BY   IRDHD,LSRESX

READG
     CALLS       FILLCH,INITFL,RDFIL,RERETR
     CALLED BY   AASEL

RECSEC
     CALLS       HLDPLT,OPNPLT,RAXEPL,SFS,SPLDAT,TIMC,TTCOMP
     CALLED BY   AASEL

RECTIF
     CALLS       POWBEM
     CALLED BY   AASEL

REOR
     CALLS       ---
     CALLED BY   REORX

REORX
     CALLS       REOR
     CALLED BY   AASEL

RERETR
     CALLS       IRDDAT,IRDHD,ISTBIT
     CALLED BY   READG

RESP
     CALLS       ---
     CALLED BY   INSTR,RESPC

RESP2
     CALLS       ---
     CALLED BY   INSTR,RESPC

RESPC
     CALLS       RESP,RESP2
     CALLED BY   RESPX

RESPX
     CALLS       PLSPEC,RESPC,SETRES
     CALLED BY   AASEL

REVOLV
     CALLS       ---
     CALLED BY   CALROT

REVPOL
     CALLS       ---
     CALLED BY   AASEL

REWD
```

```
     CALLS       ---
     CALLED BY   AASEL

SARCOS
     CALLS       ---
     CALLED BY   DIAZ

SCALTS
     CALLS       ---
     CALLED BY   SIGNAL

SDISP
     CALLS       GPVEL,SROOT
     CALLED BY   AASEL

SEIPLT
     CALLS       HLDPLT,OPNPLT,RAXEPL,SFS,SPLDAT
     CALLED BY   AASEL

SETHD
     CALLS       ---
     CALLED BY   AASEL

SETRES
     CALLS       JUL
     CALLED BY   INSTX,RESPX,STRPX

SETST
     CALLS       ---
     CALLED BY   AASEL

SFS
     CALLS       ---
     CALLED BY   RECSEC,SEIPLT,UDISPX

SHIFT
     CALLS       ---
     CALLED BY   SHIFTX

SHIFTX
     CALLS       SHIFT
     CALLED BY   AASEL

SIG1
     CALLS       ---
     CALLED BY   SIGNAL

SIG2
     CALLS       ---
     CALLED BY   SIGNAL

SIG3
     CALLS       ---
     CALLED BY   SIGNAL

SIGNAL
     CALLS       EXPWF,SCALTS,SIG1,SIG2,SIG3
     CALLED BY   AASEL
```

```
SPECTR
     CALLS        AMPPH2,MOVE,PLSPEC,POW,PRSPC2,PRSPC3,RAVAGE,
                  TTOF1,TTOF3
     CALLED BY    AASEL

SPLDAT
     CALLS        FACTOR,PLOT
     CALLED BY    RECSEC,SEIPLT

SPLOT
     CALLS        ---
     CALLED BY    SPLOTX

SPLOTX
     CALLS        SPLOT
     CALLED BY    AASEL

SROOT
     CALLS        TEQUL,TEQUR
     CALLED BY    SDISP

STABIT
     CALLS        ---
     CALLED BY    ISTBIT

STORLT
     CALLS        ---
     CALLED BY    AASEL

STRAV
     CALLS        ---
     CALLED BY    TTCOMP

STRPX
     CALLS        SETRES
     CALLED BY    AASEL

SYMBOL
     CALLS        ---
     CALLED BY    RAXEPL,XYAX,XYDAPL

TAP
     CALLS        ---
     CALLED BY    INSTX,TAPEX

TAPEX
     CALLS        TAP
     CALLED BY    AASEL

TELIP
     CALLS        FELIP,HELIP
     CALLED BY    TRVLTM

TEQUL
     CALLS        LOVAIJ
     CALLED BY    SROOT
```

```
TEQUR
     CALLS       RAYGIJ
     CALLED BY   SROOT

TESTF
     CALLS       ---
     CALLED BY   AASEL

TIMC
     CALLS       ---
     CALLED BY   ADDTIM,BEAMX,DELTT,EETIME,FILLCH,RECSEC

TIMLPP
     CALLS       PASTIM
     CALLED BY   TRVLTM

TRVLTM
     CALLS       FUNC,PASTIM,TELIP,TIMLPP
     CALLED BY   LISTTT,TTCOMP

TTCOMP
     CALLS       CONVRT,DIAZ,DZCON,TRVLTM
     CALLED BY   APVEL,LSTTX,NSNFIL,RECSEC

TTOF1
     CALLS       POWER2,RCOOL
     CALLED BY   SPECTR

TTOF3
     CALLS       FOURT
     CALLED BY   SPECTR

UDISPX
     CALLS       ADAZE,CALB,EETIME,METR,MOVE,POWER2,RCOOL,SFS
     CALLED BY   AASEL

WRDATX
     CALLS       WRFIL
     CALLED BY   AASEL

WRFIL
     CALLS       ---
     CALLED BY   WRDATX

XSAMP
     CALLS       ---
     CALLED BY   AASEL

XSAMP2
     CALLS       ---
     CALLED BY   AASEL

XYAX
     CALLS       ADVPLT,CYCLES,FACTOR,NUMBER,PLOT,SYMBOL
     CALLED BY   XYPLT,XYPSPC

XYDAPL
     CALLS       FACTOR,PLOT,SYMBOL
```

```
     CALLED BY   XYPSPC

XYPLT
     CALLS       XYAX
     CALLED BY   AASEL

XYPSPC
     CALLS       CYCLES,HLDPLT,OPNPLT,XYAX
     CALLED BY   PLSPEC

ZER
     CALLS       ---
     CALLED BY   ZEROED,ZEROX

ZEROED
     CALLS       ZER
     CALLED BY   AASEL

ZEROX
     CALLS       ZER
     CALLED BY   AASEL
```

SUBROUTINES CONTAINING COMMON

KEY ANALYSIS SYSTEM

COMMON	SUBROUTINES CONTAINING COMMON
COMMON/ARR/	ADAZE,APVEL,BEAM,BEAMX,CALEX,CALROT,COPYF,CROSSX,DAAS, DATAL,DECIX,DELEX,DELTT,EETIME,FILLCH,FILTX,INSTX, LSRESX,LSTTX,MATCHX,METX,MNMXEX,MOVE,MOVEX,MOVHD, PRHEAD,PRPLTX,RECTIF,RDFIL,RECSEC,REORX,RESP,RESPX, REVPOL,SEIPLT,SETHD,SETST,SHIFTX,SIGNAL,SPECTR,SPLOTX, STRPX,TAPEX,UDISPX,WRDATX,WRFIL,XSAMP,XSAMP2,XYPLT, ZEROED
COMMON/CAL/	CALEX
COMMON/DAZCON/	BEAMX,BNDPAS,COMPAS,COORD1,COORD2,DIAZ,DZCON,FOURT, HELIP,INSTR,PHASOR,PHILTR,REVOLV,SARCOS,SIG1,SIGNAL, SPECTR
COMMON/DEM/	AASEL,BEAM,DPARA,KEY,READG,REORX,RERETR,SIGNAL, STORLT,UDISPX,ZEROX
COMMON/DTAZ/	ADAZE,APVEL,BEAMX,CALROT,UDISPX
COMMON/EVT/	ADAZE,APVEL,BEAMX,EETIME,EVTRD,KEY,LSTTX,PREVT,RDFIL, RECSEC,UDISPX,WRFIL
COMMON/FLAGS/	INITFL,IRDDAT,IRDHD,ISTBIT
COMMON/HEAD/	FILLCH,IRDHD,RDHEAD,RERETR
COMMON/IN/	AASEL,BEAM,BEAMX,KEY,DATAL,DAZEX,ENGL,FILLCH,FILTX, LOVAIJ,MOVE,PHILTR,PLSPEC,PRPLTX,RAYGIJ,RDFIL,RECSEC, REORX,RERETR,RESPX,SDISP,SIGNAL,SPECTR,SPLOTX,SROOT, TEQUL,TEQUR,UDISPX,ZER
COMMON/INOUT/	AASEL,ADAZE,APVELX,BEAM,BEAMX,CALEX,CALROT,CLOSEX, COPYF,CROSSX,DAAS,DATAL,DAZEX,DECIX,DELEX,DPARA,ENGL,

```
                EVTRD,FILLCH,FILTX,INSTX,JUL,JULDY,KEY,LISTTX,LOVAIJ,
                LSRESX,LSTTX,MATCHX,METX,MNMXEX,MOVEX,NSNFIL,PLSPEC,
                PREVT,PRHEAD,PRPLT,PRPLTX,PRSPC2,PRSPC3,RAYGIJ,RDFIL,
                READG,RECSEC,RECTIF,REORX,RERETR,RESP,RESPX,REVPOL,
                REWD,SDISP,SEIPLT,SETHD,SETRES,SETST,SHIFT,SHIFTX,
                SIGNAL,SPECTR,SPLOT,SPLOTX,SROOT,STORLT,STRPX,TAPEX,
                TRVLTM,UDISPX,WRDATX,XSAMP,XSAMP2,ZEROED,ZEROX

COMMON/IO/
                AASEL,CLOSEX,KEY,READG,SDISP,WRDATX,WRFIL

COMMON/METD/
                METR,METX

COMMON/MUCHO/
                AASEL,ADAZE,APVEL,BEAM,CALEX,CALROT,COPYF,CROSSX,
                DAAS,DATAL,DECIX,DELEX,DPARA,EETIME,FILLCH,FILTX,
                INSTX,KEY,LSRESX,LSTTX,MATCHX,METX,MNMXEX,MOVE,
                MOVEX,PRHEAD,PRPLTX,RDFIL,READG,RECSEC,RECTIF,
                REORX,RESP,RESPX,REVPOL,SEIPLT,SETHD,SHIFTX,SIGNAL,
                SPECTR,SPLOTX,STORLT,STRPX,TAPEX,UDISPX,WRDATX,
                XSAMP,XSAMP2,ZER,XYPLT,XYPSPC,ZEROED,ZEROX

COMMON/OPTION/
                AASEL,CALEX,CLOSEX,KEY,READG,WRFIL

COMMON/PCKF/
                AASEL,DPARA,ENDPF,RAXEPL,RECSEC,SEIPLT,XYAX

COMMON/RESPON/
                RESP2,SETRES,STRPX

COMMON/STAT/
                READG,FILLCH

COMMON/TRDATA/
                INITFL,IRDDAT,ISTBIT,RDDATA

COMMON/XDATA/
                ADAZE,BEAM,CALEX,CALROT,CROSSX,DAAS,DATAL,DECIX,
                FILLCH,MNMXEX,FILTX,INSTX,KEY,MATCHX,METX,MNMXEX,MOVE,
                PRPLTX,RECSEC,RECTIF,RDFIL,RECTIF,REORX,REVPOL,SEIPLT,
                SHIFTX,SIGNAL,SPECTR,SPLOTX,TAPEX,UDISPX,WRDATX,XYPLT,
                ZER
```

DEFINITION OF COMMON VARIABLES

KEY ANALYSIS SYSTEM

DEFINITION OF COMMON VARIABLES

```
COMMON/ARR/JCODE,JCHN,RLAT,RLON,RELEV,JYEAR,JDOFY,JHOUR,JMIN,
        * RSEC,RSAMR,RA0,JNP,RPOLES,JNZ,RZEROS,JSAMP,JFLAG

    DIMENSION JCODE(100),JCHN(4,100),RLAT(100),RLON(100),
    * RELEV(100),JYEAR(100),JDOFY(100),JHOUR(100),JMIN(100),
    * RSEC(100),RSAMR(100),RA0(100),JNP(100),RPOLES(30,100),
    * JNZ(100),RZEROS(20,100),JSAMP(100),JFLAG(100)

    COMPLEX RPOLES,RZEROS
```

JCODE - STATION CODE
JCHN - CHANNEL IDENTIFICATION
RLAT - STATION GEOGRAPHIC LATITUDE (IN DEGREES)
- = S
RLON - STATION GEOGRAPHIC LONGITUDE (IN DEGREES)
- = W
RELEV - STATION ELEVATION (IN KILOMETERS)
JYEAR - START TIME - YEAR
JDOFY - START TIME - DAY
JHOUR - START TIME - HOUR
JMIN - START TIME - MINUTE
RSEC - START TIME - SECONDS
RSAMR - SAMPLING RATE (IN SAMPLES/S)
RA0 - CONSTANT RESPONSE TERM
JNP - NUMBER OF COMPLEX POLES
RPOLES - COMPLEX POLES
JNZ - NUMBER OF COMPLEX ZEROS
RZEROS - COMPLEX ZEROS
JFLAG - SPECIAL DATA FLAG
JSAMP - TOTAL NUMBER OF DATA SAMPLES IN THE CHANNEL

```
COMMON/CAL/XXCAL
```

XXCAL - CALIBRATION FACTOR - COUNTS/MILLIMICRON

```
COMMON/DAZCON/PI,RD2DG,DG2RD,DG2KM,GEOCO1,GEOCO2,TWOPI,KNN,KSS,
            * KEE,KWW
```

PI - PI CONSTANT
RD2DG - RADIAN TO DEGREE CONVERSION FACTOR
DG2KM - DEGREE TO KILOMETER CONVERSION FACTOR
GEOCO1 - GEOGRAPHIC TO GEOCENTRIC CONVERSION TERM
GEOCO2 - GEOGRAPHIC TO GEOCENTRIC CONVERSION TERM
TWOPI - 2*PI
KNN - "n"
KSS - "s"
KEE - "e"
KWW - "w"

```
COMMON/DEM/IDEM,IDEM1

      IDEM - DIMENSION OF DATA ARRAY
      IDEM1 - DIMENSION OF READ BUFFER BX


COMMON/DTAZ/DELTA,DISKM,AZSE,AZES,CTT,ATT,DTT

      DELTA - DISTANCE (IN DEGREES)
      DISKM - DISTANCE (IN KILOMETERS)
      AZSE - AZIMUTH FROM STATION TO EPICENTER (IN DEGREES)
      AZSE - AZIMUTH FROM EPICENTER TO STATION (IN DEGREES)
      CTT - CALCULATED TRAVEL TIME (IN SECONDS)
      ATT - ACTUAL TRAVEL TIME (IN SECONDS)
      DTT - TRAVEL TIME DELAY (IN SECONDS)

    DIMENSION DELTA(100),DISKM(100),AZSE(100),AZES(100),CTT(100),
    * ATT(100),DTT(100)


COMMON/EVT/EXNAME,EXLAT,EXLON,EXDEPH,IEXYR,IEXMO,IEXDY,IEXHR,
         * IEXMN,EXSEC,EXMAG1,IEXM1,EXMAG2,IEXM2,EXCOMT,EXFLAG

    DIMENSION EXFLAG(10)

    CHARACTER*4 IEXM1,IEXM2
    CHARACTER*20 EXNAME,EXCOMT

      EXNAME - EVENT NAME (20 CHARACTERS)
      EXLAT - EVENT GEOGRAPHIC LATITUDE (IN DEGREES)
              - = S
      EXLON - EVENT GEOGRAPHIC LONGITUDE (IN DEGREES)
              - = W
      EXDEPH - EVENT HYPOCENTER DEPTH (IN KILOMETERS)
      IEXYR - EVENT ORIGIN TIME - YEAR
      IEXMO - EVENT ORIGIN TIME - MONTH
      IEXDY - EVENT ORIGIN TIME - DAY
      IEXHR - EVENT ORIGIN TIME - HOUR
      IEXMN - EVENT ORIGIN TIME - MINUTE
      EXSEC - EVENT ORIGIN TIME - SECONDS
      EXMAG1 - MAGNITUDE FOR EVENT
      IEXM1 - MAGNITUDE EXMAG1 NAME
      EXMAG2 - MAGNITUDE FOR EVENT
      IEXM2 - MAGNITUDE EXMAG2 NAME
      EXCOMT - COMMENTS (20 CHARACTERS)
      EXFLAG - 10 EVENT FLAGS


COMMON/FLAGS/HFLG,DFLG,NPTS

    INTEGER*4 HFLG,DFLG

      HFLG - RETRV HEADER FLAG
      DFLG - RETRV DATA FLAG
      NPS - NUMBER OF POINTS READ


COMMON/HEAD/CODE,CHN,LAT,LON,ELEV,SYEAR,SDOFY,SHOUR,SMIN,
```

```
     * SSECS,RATE,A0,NP,POLES,NZ,ZEROES,NFLAG

     DIMENSION CODE(4),CHN(4),POLES(30),ZEROES(20),NFLAG(3),XB(1),
     * ISTAT(11),JJ(11)

     COMPLEX POLES,ZEROES
     REAL*4 LAT,LON
     INTEGER*4 CODE,CHN,SYEAR,SDOFY,SHOUR,SMIN

       CODE - STATION CODE
       CHN - CHANNEL IDENTIFICATION
       LAT - STATION GEOGRAPHIC LATITUDE (IN DEGREES)
             - = S
       LON - STATION GEOGRAPHIC LONGITUDE (IN DEGREES)
             - = W
       ELEV - STATION ELEVATION (IN FEET)
       SYEAR - START TIME - YEAR
       SDOFY - START TIME - DAY
       SHOUR - START TIME HOUR
       SMIN - START TIME - MINUTE
       SSECS - START TIME - SECONDS
       RATE - SAMPLING RATE (IN SAMPLES/S)
       A0 - CONSTANT RESPONSE TERM
       NP - NUMBER OF COMPLEX POLES
       POLES - COMPLEX POLES
       NZ - NUMBER OF COMPLEX ZEROS
       ZEROES - COMPLEX ZEROS
       NFLAG - SPECIAL DATA FLAG


COMMON/IN/BX

     DIMENSION BX(1)

       BX - SINGLE LARGE DATA INPUT ARRAY


COMMON/INOUT/IRE,IWR,IWR2

       IRE - INPUT UNIT - KEYBOARD = 5
       IWR - OUTPUT UNIT - SAVE FILE = 7
       IWR2 - OUTPUT UNIT - SCREEN = 6


COMMON/IO/LUN,LUN2,LUN3,LUN4,LUN5,LUN6,LUN7,LUN8

       LUN - UNIT NUMBER FOR TIME SERIES INPUT
       LUN2 - UNIT NUMBER FOR TIME SERIES OUTPUT IN KEYS FORMAT = 10
       LUN3 - UNIT NUMBER FOR VARIOUS FILE INPUTS = 8
              EG.  STATION LIST, EARTH MODELS, RESPONSE MASTER FILE
       LUN4 - UNIT NUMBER FOR STATION LIST OUTPUT FOR ipreq = 9
       LUN5 - NOT ASSIGNED
       LUN6 - NOT ASSIGNED
       LUN7 - NOT ASSIGNED
       LUN8 - NOT ASSIGNED


COMMON/METD/TM1,TM2,IFP,ILP
```

```
      TM1 - LINEAR TREND COEFFICIENT
      TM2 - MEAN
      IFP - FIRST POINT AFTER LEADING ZEROS
      ILP - LAST POINT BEFORE TRAILING ZEROS


COMMON/MUCHO/NCHLS,LENG,NACHLS

      NCHLS - NUMBER OF CHANNELS DATA ARRAY DIVIDED INTO
      LENG - LENGTH OF INDIVIDUAL CHANNEL IN DATA ARRAY
      NACHLS - NUMBER OF CHANNELS OCCUPIED BY DATA


COMMON/OPTION/IOPS

    DIMENSION IOPS(1)

      IOPS - OPTION FLAGS


COMMON/PCKF/ICHECK,IPLFL

      ICHECK - ERROR FLAG
      IPLFL - PLOT FLAG


COMMON/RESPON/SA0,KNP,SPOLES,KNZ,SZEROS,KFLAG

    DIMENSION SPOLES(30),SZEROS(20)

    COMPLEX SPOLES,SZEROS

      SA0 - CONSTANT RESPONSE TERM
      KNP - NUMBER OF COMPLEX POLES
      SPOLES - COMPLEX POLES
      KNZ - NUMBER OF COMPLEX ZEROS
      SZEROS - COMPLEX ZEROS
      NFLAG - SPECIAL DATA FLAG


COMMON/STAT/ISTAT

      ISTAT - STATUS BITS FROM RETRV FILES

    DIMENSION ISTAT(11)


COMMON/TRDATA/PTS,BUFF

    DIMENSION BUFF(500)

    INTEGER*4 PTS

      PTS - NUMBER OF POINTS IN FILE BUFFER
      BUFF - TEMPORARY READ BUFFER
```

```
COMMON/XDATA/DATA

    DIMENSION DATA(1)

      DATA - MAIN DATA ARRAY
```

SYSTEM FLAGS

KEY ANALYSIS SYSTEM

SYSTEM FLAGS

OPTION FLAGS

IOPS(2)	DAZEX OPTION SELECTED
IOPS(23)	CALIBRATION APPLIED TO SOME CHANNEL
IOPS(50)	DATA READ FROM FILE LUN - NEED TO CLOSE
IOPS(51)	DATA WRITTEN TO FILE LUN2 - NEED TO CLOSE

GENERAL FLAGS

ICHECK	ERROR DETECTED
IPLFL	PLOTTING DONE - NEED TO TERMINATE

READ RETRV FORMAT FLAGS

HFLG = 0	NEXT RECORD IS NOT HEADER
= 1	NEXT RECORD IS HEADER
DFLG = 0	NEXT RECORD IS NOT DATA
= 1	NEXT RECORD IS DATA
IRDDAT = 0	END OF DATA READ
= 1	DATA READ
=-1	ERROR OR END-OF-FILE READ
IRDHD = 0	END ENCOUNTERED
= 1	HEADER READ
=-1	END-OF-FILE READ
TF = 0	DATA READ
= 1	END CODE READ FOR HEADER
=-1	END-OF-FILE READ
TD = 0	DATA READ
=-1	END-OF-FILE READ
ISTBIT = 1	OBTAINED STATUS BITS
=-1	NOT ABLE TO OBTAIN STATUS BITS

MASTER FILE OF POLES AND ZEROS

alq	bhz	1	1	1990	1	1	2010	0.402E+07	4	3	0	R1
alq	bhn	1	1	1990	1	1	2010	0.362E+07	4	3	0	R1
alq	bhe	1	1	1990	1	1	2010	0.375E+07	4	3	0	R1
cbm	bhz	1	1	1990	1	1	2010	0.788E+14	6	3	0	R2
cbm	bhn	1	1	1990	1	1	2010	0.784E+14	6	3	0	R2
cbm	bhe	1	1	1990	1	1	2010	0.780E+14	6	3	0	R2
ccm	bhz	1	1	1990	1	1	2010	0.961E+06	4	3	0	R6
ccm	bhn	1	1	1990	1	1	2010	0.964E+06	4	3	0	R6
ccm	bhe	1	1	1990	1	1	2010	0.993E+06	4	3	0	R6
ceh	bhz	1	1	1990	1	1	2010	0.746E+14	6	3	0	R2
ceh	bhn	1	1	1990	1	1	2010	0.778E+14	6	3	0	R2
ceh	bhe	1	1	1990	1	1	2010	0.792E+14	6	3	0	R2
cmb	bhz	1	1	1990	1	1	2010	0.359E+07	4	3	0	R1
cmb	bhn	1	1	1990	1	1	2010	0.373E+07	4	3	0	R1
cmb	bhe	1	1	1990	1	1	2010	0.401E+07	4	3	0	R1
col	bhz	1	1	1990	1	1	2010	0.407E+07	4	3	0	R1
col	bhn	1	1	1990	1	1	2010	0.376E+07	4	3	0	R1
col	bhe	1	1	1990	1	1	2010	0.388E+07	4	3	0	R1
dug	bhz	1	1	1990	1	1	2010	0.791E+14	6	3	0	R2
dug	bhn	1	1	1990	1	1	2010	0.785E+14	6	3	0	R2
dug	bhe	1	1	1990	1	1	2010	0.794E+14	6	3	0	R2
goga	bhz	1	1	1990	1	1	2010	0.779E+14	6	3	0	R2
goga	bhn	1	1	1990	1	1	2010	0.775E+14	6	3	0	R2
goga	bhe	1	1	1990	1	1	2010	0.771E+14	6	3	0	R2
gol	bhz	1	1	1990	1	1	2010	0.848E+08	4	3	0	R3
gol	bhn	1	1	1990	1	1	2010	0.930E+08	4	3	0	R3
gol	bhe	1	1	1990	1	1	2010	0.947E+08	4	3	0	R3
hrv	bhz	1	1	1990	1	1	2010	0.465E+07	4	3	0	R1
hrv	bhn	1	1	1990	1	1	2010	0.331E+05	3	3	0	R7
hrv	bhe	1	1	1990	1	1	2010	0.331E+05	3	3	0	R7
isa	lhz	1	1	1990	1	1	2010	0.156E+08	4	3	0	R1
isa	lhn	1	1	1990	1	1	2010	0.152E+08	4	3	0	R1
isa	lhe	1	1	1990	1	1	2010	0.124E+06	4	3	0	R1
lbnh	bhz	1	1	1990	1	1	2010	0.793E+14	6	3	0	R2
lbnh	bhn	1	1	1990	1	1	2010	0.799E+14	6	3	0	R2
lbnh	bhe	1	1	1990	1	1	2010	0.792E+14	6	3	0	R2
lsct	bhz	1	1	1990	1	1	2010	0.304E+11	5	3	0	R4
lsct	bhn	1	1	1990	1	1	2010	0.311E+11	5	3	0	R4
lsct	bhe	1	1	1990	1	1	2010	0.288E+11	5	3	0	R4
mcwv	bhz	1	1	1990	1	1	2010	0.705E+14	6	3	0	R2
mcwv	bhn	1	1	1990	1	1	2010	0.798E+14	6	3	0	R2
mcwv	bhe	1	1	1990	1	1	2010	0.809E+14	6	3	0	R2
miar	bhz	1	1	1990	1	1	2010	0.776E+14	6	3	0	R2
miar	bhn	1	1	1990	1	1	2010	0.780E+14	6	3	0	R2
miar	bhe	1	1	1990	1	1	2010	0.745E+14	6	3	0	R2
mync	bhz	1	1	1990	1	1	2010	0.775E+14	6	3	0	R2
mync	bhn	1	1	1990	1	1	2010	0.771E+14	6	3	0	R2
mync	bhe	1	1	1990	1	1	2010	0.799E+14	6	3	0	R2
new	lhz	1	1	1990	1	1	2010	0.752E+14	6	3	0	R2
new	lhn	1	1	1990	1	1	2010	0.776E+14	6	3	0	R2
new	lhe	1	1	1990	1	1	2010	0.796E+14	6	3	0	R2
oxf	bhz	1	1	1990	1	1	2010	0.789E+14	6	3	0	R2
oxf	bhn	1	1	1990	1	1	2010	0.805E+14	6	3	0	R2
oxf	bhe	1	1	1990	1	1	2010	0.802E+14	6	3	0	R2
sao	lhz	1	1	1990	1	1	2010	0.101E+07	4	3	0	R6
sao	lhn	1	1	1990	1	1	2010	0.981E+06	4	3	0	R6
sao	lhe	1	1	1990	1	1	2010	0.958E+06	4	3	0	R6
tpnv	lhz	1	1	1990	1	1	2010	0.313E+09	3	2	0	R5

```
tpnv lhn    1   1 1990   1   1 2010   0.285E+09   3   2     0 R5
tpnv lhe    1   1 1990   1   1 2010   0.327E+09   3   2     0 R5
tuc  lhz    1   1 1990   1   1 2010   0.140E+08   4   3     0 R1
tuc  lhn    1   1 1990   1   1 2010   0.141E+08   4   3     0 R1
tuc  lhe    1   1 1990   1   1 2010   0.137E+08   4   3     0 R1
wdc  lhz    1   1 1990   1   1 2010   0.293E+11   5   3     0 R4
wdc  lhn    1   1 1990   1   1 2010   0.308E+11   5   3     0 R4
wdc  lhe    1   1 1990   1   1 2010   0.288E+11   5   3     0 R4
wmok bhz    1   1 1990   1   1 2010   0.649E+14   6   3     0 R2
wmok bhn    1   1 1990   1   1 2010   0.640E+14   6   3     0 R2
wmok bhe    1   1 1990   1   1 2010   0.691E+14   6   3     0 R2
ysny bhz    1   1 1990   1   1 2010   0.777E+14   6   3     0 R2
ysny bhn    1   1 1990   1   1 2010   0.784E+14   6   3     0 R2
ysny bhe    1   1 1990   1   1 2010   0.795E+14   6   3     0 R2
     stop
R1
-0.123E-01 +0.123E-01 -0.123E-01 -0.123E-01
-0.392E+02 +0.491E+02 -0.392E+02 -0.491E+02
ZERO1
+0.000E+00 +0.000E+00 +0.000E+00 +0.000E+00
+0.000E+00 +0.000E+00
R2
-0.314E-01 +0.000E+00 -0.198E+00 +0.000E+00
-0.201E+03 +0.000E+00 -0.697E+03 +0.000E+00
-0.754E+03 +0.000E+00 -0.106E+04 +0.000E+00
ZERO2
+0.000E+00 +0.000E+00 +0.000E+00 +0.000E+00
+0.000E+00 +0.000E+00
R3
-0.130E+00 +0.135E+00 -0.130E+00 -0.135E+00
-0.444E+02 +0.444E+02 -0.444E+02 -0.444E+02
ZERO3
+0.000E+00 +0.000E+00 +0.000E+00 +0.000E+00
+0.000E+00 +0.000E+00
R4
-0.370E-01 +0.370E-01 -0.370E-01 -0.370E-01
-0.251E+03 +0.000E+00 -0.119E+03 +0.423E+03
-0.119E+03 -0.423E+03
ZERO4
+0.000E+00 +0.000E+00 +0.000E+00 +0.000E+00
+0.000E+00 +0.000E+00
R5
-0.220E+03 +0.327E+03 -0.220E+03 -0.327E+03
-0.490E+03 +0.000E+00
ZERO5
+0.000E+00 +0.000E+00 +0.000E+00 +0.000E+00
R6
-0.123E-01 +0.123E-01 -0.123E-01 -0.123E-01
-0.196E+02 +0.246E+02 -0.196E+02 -0.246E+02
ZERO6
+0.000E+00 +0.000E+00 +0.000E+00 +0.000E+00
+0.000E+00 +0.000E+00
R7
-0.139E-01 +0.100E-01 -0.139E-01 -0.100E-01
-0.314E+02 +0.000E+00
ZERO7
+0.000E+00 +0.000E+00 +0.000E+00 +0.000E+00
+0.000E+00 +0.000E+00
```

EXAMPLE DATA FILES

```
model1
0.1830 2.7430 1.5360 2.3000
1.3710 4.7200 2.6430 2.5000
0.0000 6.3000 3.5300 2.7000
0.0    0.0    0.0    0.0
```

MAKEFILE

```
#                          KEY ANALYSIS SYSTEM
#
#
#                                MAKEFILE
#
#
keyrun:key.o aasel.o readg.o initfl.o reretr.o fillch.o irdhd.o\
       irddat.o istbit.o rdhead.o rddata.o prhead.o timc.o testf.o\
       dazex.o diaz.o coord1.o dzcon.o sarcos.o compas.o itimc.o\
       metx.o calb.o calex.o tap.o revpol.o movex.o zerox.o dpara.o\
       tapex.o metr.o decix.o deci.o rewd.o datal.o wrfil.o reor.o\
       wrdatx.o reorx.o rdfil.o storlt.o setst.o sethd.o movhd.o\
       xsamp.o closex.o juldy.o ityr.o sfs.o spldat.o raxepl.o\
       recsec.o endpf.o seiplt.o trvltm.o jul.o felip.o helip.o\
       timlpp.o func.o pastim.o lagran.o telip.o zer.o ttcomp.o\
       listtt.o listtx.o nsnfil.o addtim.o keybrd.o evtrd.o\
       prevt.o calrot.o revolv.o desp.o despik.o ravage.o\
       respc.o resp.o power2.o signal.o sig1.o sig2.o sig3.o\
       scalts.o expwf.o ttof1.o rcool.o clform.o spectr.o\
       move.o fourt.o phasor.o instr.o ttof3.o prspc3.o\
       respx.o pow.o ravage.o instx.o splot.o splotx.o prplt.o\
       prpltx.o filtx.o bndpas.o filtt.o philtr.o cltwo.o\
       matchx.o match.o crossx.o powbem.o rectif.o shiftx.o\
       shift.o daas.o adaze.o apvel.o apvelx.o convrt.o\
       deltt.o beamx.o beam.o xyplt.o xyax.o xydapl.o strav.o\
       xypspc.o udispx.o cycles.o mnmxex.o mnmx.o plspec.o xsamp2.o\
       delex.o lsresx.o setres.o resp2.o copyf.o zeroed.o strpx.o\
       sdisp.o raygij.o lovaij.o tequr.o tequl.o engl.o sroot.o\
       gpvel.o prspc1.o ampph1.o eetime.o lsttx.o stabit.o
#
      f77 -o keyrun key.o aasel.o readg.o initfl.o reretr.o\
       fillch.o irdhd.o irddat.o istbit.o rdhead.o rddata.o stabit.o\
       prhead.o timc.o testf.o dazex.o diaz.o coord1.o dzcon.o\
       sarcos.o compas.o itimc.o metx.o calb.o calex.o tap.o\
       revpol.o movex.o zerox.o dpara.o tapex.o metr.o decix.o deci.o\
       rewd.o datal.o wrfil.o reor.o wrdatx.o reorx.o rdfil.o\
       storlt.o setst.o sethd.o movhd.o xsamp.o closex.o juldy.o\
       ityr.o sfs.o spldat.o raxepl.o recsec.o endpf.o seiplt.o\
       trvltm.o jul.o felip.o helip.o timlpp.o func.o pastim.o\
       lagran.o telip.o zer.o ttcomp.o listtt.o listtx.o nsnfil.o\
       addtim.o keybrd.o evtrd.o prevt.o calrot.o revolv.o\
       desp.o despik.o ravage.o respc.o resp.o power2.o\
       signal.o sig1.o sig2.o sig3.o scalts.o expwf.o ttof1.o\
       rcool.o clform.o move.o spectr.o fourt.o phasor.o\
       instr.o ttof3.o prspc3.o respx.o pow.o instx.o splot.o\
       splotx.o prplt.o prpltx.o filtx.o bndpas.o filtt.o\
       philtr.o cltwo.o matchx.o match.o crossx.o\
       powbem.o rectif.o shiftx.o shift.o daas.o adaze.o\
       apvel.o apvelx.o convrt.o deltt.o beamx.o beam.o strav.o\
       xyplt.o xyax.o xydapl.o xypspc.o udispx.o cycles.o mnmxex.o\
       mnmx.o plspec.o xsamp2.o delex.o lsresx.o setres.o resp2.o\
       copyf.o zeroed.o strpx.o sdisp.o raygij.o lovaij.o tequr.o\
       tequl.o engl.o sroot.o gpvel.o prspc1.o ampph1.o eetime.o\
       lsttx.o\
       -lbuplot
key.o:key.f
      f77 -c key.f
aasel.o:aasel.f
```

```
	f77 -c aasel.f
adaze.o:adaze.f
	f77 -c adaze.f
addtim.o:addtim.f
	f77 -c addtim.f
ampph1.o:ampph1.f
	f77 -c ampph1.f
apvel.o:apvel.f
	f77 -c apvel.f
apvelx.o:apvelx.f
	f77 -c apvelx.f
beam.o:beam.f
	f77 -c beam.f
beamx.o:beamx.f
	f77 -c beamx.f
bndpas.o:bndpas.f
	f77 -c bndpas.f
calb.o:calb.f
	f77 -c calb.f
calex.o:calex.f
	f77 -c calex.f
calrot.o:calrot.f
	f77 -c calrot.f
clform.o:clform.f
	f77 -c clform.f
closex.o:closex.f
	f77 -c closex.f
cltwo.o:cltwo.f
	f77 -c cltwo.f
compas.o:compas.f
	f77 -c compas.f
convrt.o:convrt.f
	f77 -c convrt.f
coord1.o:coord1.f
	f77 -c coord1.f
copyf.o:copyf.f
	f77 -c copyf.f
crossx.o:crossx.f
	f77 -c crossx.f
cycles.o:cycles.f
	f77 -c cycles.f
daas.o:daas.f
	f77 -c daas.f
datal.o:datal.f
	f77 -c datal.f
dazex.o:dazex.f
	f77 -c dazex.f
deci.o:deci.f
	f77 -c deci.f
decix.o:decix.f
	f77 -c decix.f
delex.o:delex.f
	f77 -c delex.f
deltt.o:deltt.f
	f77 -c deltt.f
desp.o:desp.f
	f77 -c desp.f
despik.o:despik.f
```

```
	f77 -c despik.f
diaz.o:diaz.f
	f77 -c diaz.f
dpara.o:dpara.f
	f77 -c dpara.f
dzcon.o:dzcon.f
	f77 -c dzcon.f
eetime.o:eetime.f
	f77 -c eetime.f
endpf.o:endpf.f
	f77 -c endpf.f
engl.o:engl.f
	f77 -c engl.f
evtrd.o:evtrd.f
	f77 -c evtrd.f
expwf.o:expwf.f
	f77 -c expwf.f
felip.o:felip.f
	f77 -c felip.f
fillch.o:fillch.f
	f77 -c fillch.f
filtt.o:filtt.f
	f77 -c filtt.f
filtx.o:filtx.f
	f77 -c filtx.f
fourt.o:fourt.f
	f77 -c fourt.f
func.o:func.f
	f77 -c func.f
gpvel.o:gpvel.f
	f77 -c gpvel.f
helip.o:helip.f
	f77 -c helip.f
initfl.o:initfl.f
	f77 -c initfl.f
instr.o:instr.f
	f77 -c instr.f
instx.o:instx.f
	f77 -c instx.f
irddat.o:irddat.f
	f77 -c irddat.f
irdhd.o:irdhd.f
	f77 -c irdhd.f
istbit.o:istbit.f
	f77 -c istbit.f
itimc.o:itimc.f
	f77 -c itimc.f
ityr.o:ityr.f
	f77 -c ityr.f
jul.o:jul.f
	f77 -c jul.f
juldy.o:juldy.f
	f77 -c juldy.f
keybrd.o:keybrd.f
	f77 -c keybrd.f
lagran.o:lagran.f
	f77 -c lagran.f
lsresx.o:lsresx.f
```

```
	f77 -c lsresx.f
listtt.o:listtt.f
	f77 -c listtt.f
listtx.o:listtx.f
	f77 -c listtx.f
lovaij.o:lovaij.f
	f77 -c lovaij.f
lsttx.o:lsttx.f
	f77 -c lsttx.f
match.o:match.f
	f77 -c match.f
matchx.o:matchx.f
	f77 -c matchx.f
metr.o:metr.f
	f77 -c metr.f
metx.o:metx.f
	f77 -c metx.f
mnmx.o:mnmx.f
	f77 -c mnmx.f
mnmxex.o:mnmxex.f
	f77 -c mnmxex.f
move.o:move.f
	f77 -c move.f
movex.o:movex.f
	f77 -c movex.f
movhd.o:movhd.f
	f77 -c movhd.f
nsnfil.o:nsnfil.f
	f77 -c nsnfil.f
pastim.o:pastim.f
	f77 -c pastim.f
phasor.o:phasor.f
	f77 -c phasor.f
philtr.o:philtr.f
	f77 -c philtr.f
plspec.o:plspec.f
	f77 -c plspec.f
pow.o:pow.f
	f77 -c pow.f
powbem.o:powbem.f
	f77 -c powbem.f
power2.o:power2.f
	f77 -c power2.f
prevt.o:prevt.f
	f77 -c prevt.f
prhead.o:prhead.f
	f77 -c prhead.f
prplt.o:prplt.f
	f77 -c prplt.f
prpltx.o:prpltx.f
	f77 -c prpltx.f
prspc1.o:prspc1.f
	f77 -c prspc1.f
prspc3.o:prspc3.f
	f77 -c prspc3.f
ravage.o:ravage.f
	f77 -c ravage.f
raxepl.o:raxepl.f
```

```
	f77 -c raxepl.f
raygij.o:raygij.f
	f77 -c raygij.f
rcool.o:rcool.f
	f77 -c rcool.f
rddata.o:rddata.f
	f77 -c rddata.f
rdfil.o:rdfil.f
	f77 -c rdfil.f
rdhead.o:rdhead.f
	f77 -c rdhead.f
readg.o:readg.f
	f77 -c readg.f
recsec.o:recsec.f
	f77 -c recsec.f
rectif.o:rectif.f
	f77 -c rectif.f
reor.o:reor.f
	f77 -c reor.f
reorx.o:reorx.f
	f77 -c reorx.f
reretr.o:reretr.f
	f77 -c reretr.f
resp.o:resp.f
	f77 -c resp.f
resp2.o:resp2.f
	f77 -c resp2.f
respc.o:respc.f
	f77 -c respc.f
respx.o:respx.f
	f77 -c respx.f
revolv.o:revolv.f
	f77 -c revolv.f
revpol.o:revpol.f
	f77 -c revpol.f
rewd.o:rewd.f
	f77 -c rewd.f
sarcos.o:sarcos.f
	f77 -c sarcos.f
scalts.o:scalts.f
	f77 -c scalts.f
sdisp.o:sdisp.f
	f77 -c sdisp.f
seiplt.o:seiplt.f
	f77 -c seiplt.f
sethd.o:sethd.f
	f77 -c sethd.f
setres.o:setres.f
	f77 -c setres.f
setst.o:setst.f
	f77 -c setst.f
sfs.o:sfs.f
	f77 -c sfs.f
shift.o:shift.f
	f77 -c shift.f
shiftx.o:shiftx.f
	f77 -c shiftx.f
sig1.o:sig1.f
```

```
	f77 -c sig1.f
sig2.o:sig2.f
	f77 -c sig2.f
sig3.o:sig3.f
	f77 -c sig3.f
signal.o:signal.f
	f77 -c signal.f
spectr.o:spectr.f
	f77 -c spectr.f
spldat.o:spldat.f
	f77 -c spldat.f
splot.o:splot.f
	f77 -c splot.f
splotx.o:splotx.f
	f77 -c splotx.f
sroot.o:sroot.f
	f77 -c sroot.f
stabit.o:stabit.f
	f77 -c stabit.f
storlt.o:storlt.f
	f77 -c storlt.f
strav.o:strav.f
	f77 -c strav.f
strpx.o:strpx.f
	f77 -c strpx.f
tap.o:tap.f
	f77 -c tap.f
tapex.o:tapex.f
	f77 -c tapex.f
telip.o:telip.f
	f77 -c telip.f
tequl.o:tequl.f
	f77 -c tequl.f
tequr.o:tequr.f
	f77 -c tequr.f
testf.o:testf.f
	f77 -c testf.f
timc.o:timc.f
	f77 -c timc.f
timlpp.0:timlpp.f
	f77 -c timlpp.f
trvltm.o:trvltm.f
	f77 -c trvltm.f
ttcomp.o:ttcomp.f
	f77 -c ttcomp.f
ttof1.o:ttof1.f
	f77 -c ttof1.f
ttof3.o:ttof3.f
	f77 -c ttof3.f
udispx.o:udispx.f
	f77 -c udispx.f
wrdatx.o:wrdatx.f
	f77 -c wrdatx.f
wrfil.o:wrfil.f
	f77 -c wrfil.f
xsamp.o:xsamp.f
	f77 -c xsamp.f
xsamp2.o:xsamp2.f
```

```
	f77 -c xsamp2.f
xyax.o:xyax.f
	f77 -c xyax.f
xydapl.o:xydapl.f
	f77 -c xydapl.f
xyplt.o:xyplt.f
	f77 -c xyplt.f
xypspc.o:xypspc.f
	f77 -c xypspc.f
zer.o:zer.f
	f77 -c zer.f
zeroed.o:zeroed.f
	f77 -c zeroed.f
zerox.o:zerox.f
	f77 -c zerox.f
```