To: Voyager Internal

From: G. S. Gordon Jr.

Subject: VGRANL LIBRARY MJS

Date: April 2, 1996

VGRANL

This is the main analysis program for Voyager production at MIT. VGRANL estimates the plasma parameters using a moment analysis, with possibly a full non-linear fit. The same analysis subroutines are used at GSFC for the production of the Summary tapes. Various printout options, (ANSPRT, VOYPRT etc.) and plotting options, (Day plots, engineering plots etc.) as well as input options, (EDR, SUMMARY, SPECTRAL) are available.

INPUT FORMATS

In the following tables, the order for each entry is mnemonic Fortran data type, initial or default value (if any), description, and subroutine where set (if present).

FT01F001
FORMAT (2(I5,I4,2I3),I5)

VARIABLE	TYPE	DESCRIPTION
IYST	I4	Year to start processing
IDST	I4	Day to start processing
IHST	I4	Hour to start processing
IMSP	I4	Min to start processing
IYSP	I4	Year to stop processing
IDSP	I4	Day to stop processing
IHSP	I4	Hour to stop processing
IMSP	I4	Min to stop processing
INEW	I4	code for time average of B field. (set by call to SETBFL) 1 48.00 sec averages 2 9.60 sec averages 3 1.92 sec averages

This card may be repeated as often as needed. If no card is present, all data is processed.

FT02F001

FORMAT &PLSNT . . . &END / &RUNNT . . . &END / 32L1

&PLSNT — Name list to control Plasma processing (MIT & GSFC)

IDSRN(15) — I4 Fortran I/O unit number for selective printing.
If set to 0, there is no printing. E.g. If IDSRN(11)=0, then PLSBEG detail is not written out. On the standard run, units 6, 8, and 9 are defined as output units.

variable	type	index	default	discription
IDSRN(15)	i4			Fortran unit number for output from
		1	6	Print on change of status
		2	0	KNTCUR detail
		3	0	MODCAL detail
		4	0	IDCANL detail
		5	0	CURCAL detail
		6	0	STDANL detail
		7	0	PRANAL detail
		8	0	ELANAL detail
		9	0	GETFLD detail
		10	0	BKGDCR detail
		11	6	PLSBEG detail
		12	6	VGRLOG detail
		13	0	ANSPRT after PLSANL is called.
				(a negative number indicates no format)
		14	0	ANSPRT before PLSANL is called
		15	6	ALL ERRORS

For IPR and IPQ:

First index is for cup number
Second index is 1 for low resolution (L mode)
2 for high resolution (M mode)

variable	type	default	description
IPR(4,2)	I2	(4*2,4*12)	# of channels above peak for proton moment estimate.
IPQ(4,2)	I2	(4*2,4*12)	# of channels below peak for proton moment estimate.
		For IPQF and IPRF:	
		First index is	1 for protons (fit only)
			2 for alphas (fit and moment)
		Second index is	1 for low resolution (L mode)
			2 for high resolution (M mode)
IPQF(2,2)	I2	(2,2,5,5)	# of channels above peak for fit estimates, For alphas moments estimates is same range as fits.
IPRF(2,2)	I2	(1,2,6,5)	# of channels below peak for fit estimates, For alphas moments estimates is same range as fits.

ALPHA	R4	0.01	N_α/N_p threshold to do alpha analysis
IEND	I2	4	Maximum of calls to FNCDRV
EPS	R4	0.01	Wanted fractional error in X^2
CSIG	R4	6.0	Factor to multiply CNOISE to get min current.
FSIG	R4	1.0	?
NS	I4	0	Number of spectra to be averaged together.
&END			terminates PLSNT namelist

&RUNNT Namelist to control MIT processing.

variable	type	index	default	discription
ICUNIT(10)	I2			Fortran I/O unit numbers for MIT-only functions
		1	1	Time Processing
		2	0	Input tape Dump NXTMOD
		3	6	VGRLOG Print
		4	0	VGRLOG Histograms
		5	9	OUTMOD Print (HA, DP, CN)
		6	3	GETFLD input
		7	14	CSEDR input (obsolete)
		8	15	CT or user tape output
		9	16	DP tape out
		10	17	HA tape out
		11	18	Calibration data tape

variable	type	default	description
TJUMP	R4	1.E+6	delete data if time gap exceeds time amount (in days)
FACT	R4	0.78740	
GAPSEC(20)	R4	(4*96., 4*192., 2*96., 192., 2*96., 192., 2*96., 192., 3*0)	expected time between data points for dayplot, by transmission type.
XENG ?	R4		X scale engineering plot in hr/inch.
FITMOM	A4		'MOM'
INB	I4		Number of entries in IB
IB(9)	I4		Indices of variables in DOCP VAR array that involve the B field.
NP(2)	I4		NP(ITLMOD) gives the number of entries in table IAP, IAPOFF, and ICP for mode ITLMOD
IAP(60,2)	I4		ANS(IAP(I, ITLMOD)) is the source of the data for DOCP. If IAP(I, ITLMOD) < 0 special processing is done.
ICP(60,2)	I4		VAR(ICP(I, ITLMOD)) is the destination for the data for DOCP

IAPOFF(60,2)	I4		Fill data is used by DOCP if ANS array does not have IAPOFF(I, ITLMOD) + IAP(I, ITLMOD) valid data values.
LANG(100)			True if corresponding value in VAR, proto HA array, is to be treated as an angle when taking hourly averages.
LTEST(100)			If TRUE then this value will not be averaged under certain data conditions.
NA	I4		Maximium used index in VAR array.
NUMDAY	I4		1 for day plots, ? for nday plots. Number of days on one panel.
NYRF	I4		First year to be plotted.
NDAYF	I4		First day to be plotted.
NEXD	I4		Number of days to overlap between panels.
F	I4		X axis scale factor, computed from FACT.
IDSRND	I4		
IUNIT	I4	18	Output unit for spectral tape. If greater than 20 long form is used. If .NOT.(LDMP(1) .OR. LDMP(2)) then IUNIT is set to 18 in DOCALT.
LDMP(2)	L1		Logical flags concerning dumping.
&END			terminates RUNNT namelist

For the LPLS switches, the description describes the action for the TRUE setting, even if the default is FALSE. LPLS(2)=.TRUE. implies that there will be no fit.

variable	type	default	description
LPLS(32)	L1		Logical plasma switches format(32L1)
	1	F	Overlay CR M modes (GSFC only)
	2	F	No fit (moment analysis will be done only if LPLS(4)=LPLS(31)=.FALSE.
	3	F	No transparency correction
	4	F	No analysis of data (KNTCUR, GETFLD, VOYPRT, and ANSPRT are available if LPLS(31)=LPLS(2)=.FALSE.)
	5	F	VOYPRT
	6	F	No log
	7	T	Hourly average tape
	8	F	ANSPRT only on every 31st mode (effective only if IDSRN(13) or IDSRN(14) > 0)
	9	F	No 1st Maxwellian Proton fit
	10	T	No 2nd Maxwellian Proton fit
	11	F	No 1st Maxwellian alpha fit
	12	T	No 2nd Maxwellian alpha fit
	13	T	1st proton fit anisotropic
	14	F	2nd proton fit anisotropic
	15	T	1st alpha fit anisotropic
	16	F	2nd proton fit anisotropic
	17	F	Accept Golay correction
	18	F	Accept bad data quality status word
	19	T	Do day plot
	20	F	Condensed tape (User defined tape)
	21	F	Do engineering plot
	22	F	Print engineering plot variables
	23	F	Calibration tape/Spectral tape
	24	F	Extended X^2
	25	F	Turns off the filter in KNTCUR.
	26	F	Do ODDPLT
	27	F	Reload PLCONS & logical switches from Summary tape
	28	F	SEDR tape mounted
	29	F	Transform data in main routine
	30	F	Transform data in PLSANL
	31	F	No PLSANL (as a result also turns off VOYPRT & ANSPRT from PLSANL.)
	32	F	Print digital data numbers (GSFC only)

FT03F001

FORMAT(I5, I4, 3I3, 3F10.2)

VARIABLE	TYPE	DESCRIPTION
IY	I4	Year
ID	I4	Day
IH	I4	Hour
IMIN	I4	Min
ISEC	I4	Sec
BX	R4	X component of magnetic field (γ)
BY	R4	Y component of magnetic field (γ)
BZ	R4	Z component of magnetic field (γ)

This file is to override the measured magnetic field. Normally this file is dummied out. If no card is present, field from tape is used. (for EDR 0.7, 0.0, 0.7)

SUBROUTINES

MAIN

The main routine for VGRANL. RUNBEG is called to initialize commons. It reads the time card from FT01F001 (see :hdref refid=FT01.). Only those times included on the time card are processed. If no time card is present, all times are processed. VGRANL loops using NXTMOD to read in the next data record, and then processes the data specified by the time cards in the subroutines.

ALTCP (IAP, I, ANS, VAR, ITYPE)

A dummy routine that allows for an alternate copying of the ANS array into the proto HA array.

ARG	DEFINITION
IAP	Source of ANS data, see :hdref refid=CDOCP..
I	Inxdex to IAP.
ANS	Answer array, see :hdref refid=STDCALL..
VAR	Proto HA array, see :hdref refid=HA..
ITYPE	Input data source, see :hdref refid=NXTMOD..

ANSPRT (ANS, JTB, JDAT, JNE, LSTAT, JTLMOD, JCLK, TEMP, IDSRN)

Prints out the answer array on Fortran unit IDSRN. If IDSRN > 0, a formatted output is given. If IDSRN < 0, the answer array is just printed in G format. ANSMAG is a version of ANSPRT for use with NXTMAG when the detailed magnetic field is wanted from SUMMARY tapes. Note that the ANS array is different in this case as is documented in the NXTMAG code.

ARG	DEFINITION	
ANS-TEMP	:hdref refid=STDCALL..	
IDSRN	I4	Control for printing.

BKGDCR (ANS, JTB, JDAT, JNE, LSTAT, JTLMOD, JCLK, TEMP, CURRNT)

Dummy routine that can process DC returns.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL..
CURRNT(512)	Currents in femtoamps.

CAVE (ANS, JTB, CUR, KSTAT, LSTAT, JTLMOD, NNS, FL, CURL)

Cave averages NNS spectra together. It keeps the four modes separate and will start a new average if it detects a change in the status word.

ARG	DEFINITION	
ANS(150)	R4	ANS array.
JTB(6)	I2	Time array
CUR(512)	R4	Curents in femptoamps to be averaged.
KSTAT	I2	Assumed status word.
LSTAT	L4	Official status word.
JTLMOD	I2	Type of mode.
NNS	I4	Number of spectra to be averaged.
FL	I4	Flag indicates if average is being returned.
		0 Use average.
		1 Do not use spectra.
CURL	R4	Current levels for 0, 128, 255 digital levels. RMARK in KNTCUR.

CORRCT (ANS, JTB, JDATA, JNE, LSTAT, JTLMOD, JCLK, TEMP, IEOD, TYPE)

CORRCT allows for correction to the data. As programmed, it corrects for known errors in the integration times. Both ANS and JCLK are corrected.

The method used is an array: JL(4,2,10,2) stores the start/stop time (first index), 1 or 2 (second index), number of error interval (third index), and spacecraft type (fourth index). If the time is in the known window and JCLK does not agree with the known integration time, then JCLK and ANS are corrected.

ARG	DEFINITION	
ANS-TEMP	See :hdref refid=STDCALL..	
IEOD	I4	End of file flag.
TYPE	A4	Type of input tape, e.g. SUM, EDR.

CURCAL (ANS, JTB, JDAT, JNE, LSTAT, JTLMOD, JCLK, TEMP, CURRNT)

Dummy routine to do the current calibration analysis. Does call VOYPRT.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL..
CURRNT	Current in femptoamps.

CURPLT (ANS, JTB, JDATA, JNE, LSTAT, JTLMOD, JCLK, TEMP, IKINDS, YDEC, XLG, YLG, NDEC, MINDEX CUF, CUR, KSTAT, IXCEL, CNOISE, CUR128)

Plots out oddplots, and spectral plots. See SPECTRAL PLOT write up.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL.

DOCALT (ANS, JTB, JDATA, JNE, LSTAT, JTLMOD, JCLK)

Puts out a calibration record, also known as a spectral tape. (See :hdref refid=SPECTRA.). Long or short form is determined by 'IUNIT' and 'LDMP' which can be set from the input deck. (See also :hdref refid=FT02.).

COMMON BLOCK	USE and reference.
CCA	GSFC control common :hdref refid=CCA..
CMODE	NXTMOD common :hdref refid=CMODE..

ARG	DEFINITION
ANS	ANS array.
JTB(6)	Time array.
JDATA(512)	Array of digital data.
JNE	Number of samples taken per cup for one mode.
LSTAT	Status word.
JTLMOD	Indicator of type of mode.
JCLK	Index showing integration time being used.

DOCP (ANS, VAR, ITYPE)

Copies the answer array into a proto Hourly Average array. :hdref refid=HA. describes the default. Copying can be controlled via input: cf. :hdref refid=FT02..

ARG	DEFINITION
ANS	ANS array, :hdref refid=ANSWER..
VAR	Proto Hourly Average array. :hdref refid=HA..
ITYPE	Type of input data.

DOCN (ANS, JTB, JDATA, JNE, LSTAT, IEOD)

Dummy routine to allow for a user defined tape.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL.. (not yet)

DODP (VAR, IEOD)

DODP produces the day plot or the N-day plots. It has its own writeup.

ARG	DEFINITION
VAR	Proto Hourly average array. See :hdref refid=HA..
IEOD	End of data flag.

DOHA (VAR, IEOD, ANS, IPTYPE)

DOHA computes the hourly averages, Average value, Standard deviation & Number of accepted points for each value in the proto Hourly Average array. For every change in the hour, the Hourly Average record is written out.

ARG	DEFINITION
VAR	Proto HA array.
IEOD	End of data flag.
ANS	ANS array.
IPTYPE	Type of input data.

ELANAL (ANS, JNE, JTLMOD, CURRNT, IXCEL, CNOISE, RMARK)

Processes normal electron data. Computes electron temperature (in degrees Kelvin) and the distribution function.

ARG	DEFINITION
ANS	ANS array. :hdref refid=STDCALL..
JNE	Number of energy levels.
JTLMOD	Type of Mode.
CURRNT	The measured currents in femptoamps. A negative value means that the current has been filtered out, or -1. suspect, or -2. not received.
KSTAT	Our best guess at the status word.
IXCEL	Quality flag. +1 = OK. Otherwise a count +1 of the number of suspect channels. (JDAT = -1). If negative, some channels are saturated.
CNOISE	The noise level for this instrument setting.
RMARK(3)	The current level for digital counts of 0, 128, 255.

FNCDRV (LX, Y, WEIGHT, NCOL, NTERMS, NCOMP, A, NFREE, VLIM, CHISQR, ALPHA, BETA)

Computes the current in each cup and channel for a given bimaxwellian. Also computes the derivatives.

ARG	DEFINITION
LX	!
Y	!
WEIGHT	!
NCOL	!
NTERMS	!
NCOMP	!
A	!
NFREE	!
VLIM	!
CHISQR	!
ALPHA	!
BETA	!

GETFLD (ANS, JTB)

Gets the Magnetic field and put it in the answer array. At GSFC this is a GSFC routine. At MIT this either picks it off the data tape, or puts in a dummy one (0.707, 0.0, 0.707). In either case it can be overwritten. See :hdref refid=FT03..

ARG	DEFINITION	
ANS	R4	ANS array.
JTB(6)	I2	Time array.

IDCANL (ANS, JTB, JDAT, JNE, LSTAT, JTLMOD, ICLK, TEMP, CURRNT, IMODON, IXCEL, CNOISE, RMARK)

Does a short moment analysis of the DC return. See "ANSWER ARRAY IDCANL" :hdref refid=ANSIDC..

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL..
CURRNT(512)	Current in femptoamps.
IMODON	!
IXCEL	!
CNOISE	!
RMARK	The currents associated with the 0, 128, 255 digital level in the cups.

JC (JNE, A, B, T, F)

Computes currents from fit parameters.

ARG.DEFINITION

JNE	Number of energy levels.
A(3)	X, Y, Z velocities.
B(3)	X, Y, Z B field.
T(4)	!
F( )	Current in femptoamps.

KNTCUR (ANS, JTB, JDAT, JNE, LSTAT, JTLMOD, JCLK, TEMP , CURRNT, KSTAT, IXCEL, CNOISE, RMARK)

Converts the digital currents into femptoamps. It is also able to average together many spectra using CAVE, and/or filter the spectra to decrease the effects of the noise.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL..
CURRNT	The measured currents in femptoamps. A negative value means that the current has been filtered out, or -1. suspect, or -2. not received.
KSTAT	Our best guess at the status word.
IXCEL	Quality flag. +1 = OK. Otherwise a count +1 of the number of suspect channels. (JDAT = -1). If negative, some channels are saturated.
CNOISE	The noise level for this instrument setting.
RMARK(3)	The current level for digital counts of 0, 128, 255.

If LPLS(25) is .FALSE. then a filter is used to pick the peak current in L & M modes.

VGRLOG (ANS, JTB, JDATA, JNE, LSTAT, JTLMOD, JCLK, TEMP, IEOD, ICU3, ICU4)

VGRLOG prints out a Log of the input tape. It can also produce a plot of the missing data.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL..
IEOD	End of data flag.
ICU3	Fortran unit number for log.
ICU4	Fortran unit number for Spectral histograms.

MJSFIT (LX, Y, WEIGHT, NCOL, NTERMS, NCOMP, ICHI, A, SIGMAA, FLAMDA, CHISQR, VLIM, ICALL, IQUAL, IPRT, EPS, IEND)

Does nonlinear fit for plasma parameters.

ARG	DEFINITION
LX	!
Y	!
WEIGHT	!
NCOL	!
NTERMS	!
NCOMP	!
A	!
SIGMAA	!
FLAMDA	!
CHISQR	!
VLIM	!
ICALL	!
IQUAL	!
IPRT	!
EPS	!
IEND	!

MJSINV (ARRAY, NORDER, DET)

Inverts a symmetric matrix, and computes its determinant.

ARG	DEFINITION
ARRAY	Matrix for both input and output.
NORDER	Order of determinant.
DETT	Determinant.

MODCAL (ANS, JTB, JDAT, JNE, LSTAT, JTLMOD, JCLK, TEMP, CURRNT)

Dummy routine to allow for analysis of voltage modulator calibrations. Calls VOYPRT.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL..
CURRNT(512)	Current in femtoamps.

MOMENT (L1, L2, V, R, RMM1, RM0, RM1, RM2, FM1, F0, F1, F2, XCRIT, IQUALY)

Computes the first three moments of the ion distribution.

ARG	DEFINITION
L1	Minium channel to be included.
L2	Maximum channel to be included.
V	Velocity of channel at middle of channel.
R	Current in fempto amps.
RMM1	Density in Cm**-3
RM0	Vel of plasma relative to cup normat in km/s.
RM1	Thermal speed in (km/Sec)**2
RM2	Third moment divided by density, Heat Flux (km/s)**3
FM1	!
F0	!
F1	!
F2	!
XCRIT	!
IQUALY	!

NXTMOD (ANS, JTB, JDATA, JNE, LSTAT, JTLMOD, JCLK, TEMP, IEOD, IL, IDTYPE)

NXTMOD exists in many forms to read the many different VGR data tapes. To the user there is a minimum of differences. These routines also return results that are almost the same as what we receive from GSFC through the standard calling sequence which is the first part of NXTMOD's calling sequence (see below). The common block CMODE (:hdref refid=CMODE.) is not available at GSFC and should be avoided if possible.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL..
IEOD	End of data flag.
	0 Normal return.
	-1 End of data.
	-2 Error.
IL	Fortran unit number for detailed printout (debugging).
IDTYPE	A4 Type of input medium being read: SUM, EDR, SPL. (Not always implemented)

Note that different versions may invoke different subroutines and common blocks.

SETBFL (IBLL)

Of use only in NXTMAG. It sets the integration time to be picked for the B field.

ARG	DEFINITION
IBLL	Flag for integration time. (default 1)
	1 48.00 seconds
	2 9.60 seconds
	3 1.92 seconds

ODDPLT (ANS, JTB, JDATA, JNE, LSTAT, JTLMOD, JCLK, TEMP, IEOD)

Picks out the 'oddest' reasonable plot in every given interval of data, and does a spectral plot of it along with its fit currents.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL..
IEOD	End of data flag.

ORDER (A, O, P, B, BMAG)

ARG	DEFINITION
A	!
O	!
P	!
B	!
BMAG	!

OUTMOD (ANS, JTB, JDATA, JNE, LSTAT, IEOD, IPTYPE, LUSE)

OUTMOD controls most of the output for VGRANL. Actual output is done in the called subroutines.

ARG	DEFINITION
ANS	ANS array.
JTB(6)	Time array.
JDATA(512)	Digital current array.
JNE	Number of measurement per cup.
LSTAT	Status word.
IEOD	End of data flag.
IPTYPE	Type of input tape.
LUSE	Use flag.

PARPER (A, B, C, PAR, PER, CHI2, DET)

Calculates the parallel and perpendicular components of the ellipse of the input data. Usually the cups thermal width.

PARPW (A, B, C, PAR, PER, CHI2, DET)

!

PARPQ (A, B, C, PAR, PER, CHI2, DET)

PERDIF (PDN, IH, ANS)

Computes histogram of percentage differences of fit and moment densities.

ARG	DEFINITION
PDF	percentage difference ρ_{mon} and ρ_{fit}
IH(10)	Histogram of differences.
ANS(150)	Answer array.

PLSANL (ANS, JTB, JDAT, JNE, LSTAT, JTLMOD, JCLK, TEMP)

Main plasma analysis routine used at GSFC. Mostly a big switch which decides what type of data it is and then calls the appropriate processing routines.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL..

PLSEDM (JTBH, IEODC)

PLSEDM functions differently according to its environment. For EDR tapes, it computes a state vector for the spacecraft and the coordinate conversion matrices by reading the SEDR tape. For Summary tapes, this data is read from the SUMMARY tape. At GSFC it is furnished by a subroutine call from GSFC's code before PLSANL is called.

ARG	TYPE	DEFINITION
JTBH(6)	I4	Time of the data.
IEODC	I4	End of data flag.

PLSBEG

PLSBEG initializes many of the variables used in the plasma analysis. Note that many of the variables can be changed using &PLSNT (:hdref refid=FT02.) which is read in by RUNBEG (:hdref refid=RUNBEG.). At GSFC, the GSFC code reads in &PLSNT in the same manner as RUNBEG. The block data associated with the plasma analysis is also loaded with PLSBEG. Still, PLSBEG must be executed before any plasma analysis is done.

PRANAL (ANS, JNE, JTLMOD, CURRNT, IXCEL, CNOISE, RMARK)

Processes normal electron data. Does both the moment and fit positive ion parameters.

ARG	DEFINITION
ANS	ANS array.
JNE	Number of energy levels.
JTLMOD	Type of Mode.
CURRNT	The measured currents in femptoamps. A negative value means that the current has been filtered out, or -1. suspect, or -2. not received.
KSTAT	Our best guess at the status word.
IXCEL	Quality flag. +1 = OK. Otherwise a count +1 of the number of suspect channels. (JDAT = -1). If negative, some channels are saturated.
CNOISE	The noise level for this instrument setting.
RMARK(3)	The current level for digital counts of 0, 128, 255.

RUNBEG

RUNBEG loads the BLOCK DATA for:

PLCONS	:hdref refid=PLCONS..
CDODP	:hdref refid=CDOCP..
PSTUFF	:hdref refid=PSTUFF..
NDYCOM	:hdref refid=NDYCOM..

Note that many of these are needed for the processing of subroutines that may be used independently of VGRANL. RUNBEG is also the approved way of loading and changing these variables. RUNBEG reads all of its input off FT02F001, &PLSNT, &RUNNT and LPLS. See :hdref refid=FT02.. RUNBEG should be called only once.

SELECT (ANS, JTB, JDATA, JNE, LSTAT, JTLMOD, JCLK, TEMP, LUSE)

SELECT is normally a dummy routine which is set to allow the user to select which data is to be processed. In the case of Summary tape production, there is a version SELSUM which does monitor the processing.

ARG	DEFINITION	
ANS-TEMP	:hdref refid=STDCALL..	
LUSE	L4	TRUE if the data is to be used, FALSE if the data is to be ignored.

SELPRT

Prints out a summary of the selection at the end of the job.

SETJTL (JTLMO, JTLOFF, KSTAT, JTB, JTLMOD, JCLK)

Set the offset for JTLMOD in GS-5. Must be called befort GETJTL. Uses special data from NXTMOD.

ARG	TYPE	DEFINITION
JTLMO	I2	Modified JTLMOD
	1	L , long in GS-5
	2	M
	3	E1, long in GS-5
	4	E2, long in GS-5
	5	L , short in GS-5
	6	M , not used
	7	E1, short in GS-5
	8	E2, short in GS-5
JTLOFF	I2	Offset for JTLMOD. JTLMO - JTLMOD
KSTAT	I2	Best guess at status word.
JTLMOD	I2	Type of mode.
	1	L
	2	M
	3	E1
	4	E2
JCLK	I2	Index for integration time of instrument.

GETJTL (JTLMO, JTLOFF, KSTAT)

Returns the arguments calculated by the last call to SETJTL.

SPLOT (KNS, KTB, KDATA, KNE, KSTAT, KTLMOD, KCLK, KEMP, KXCEL, KKINDS, KINDEX, KKSTAT, IH)

Write out Numbers on oddplots, and plots real and computed currents using CURPLT.

ARG	DEFINITION
KNS	!
KTB	!
KDATA	!
KNE	!
KSTAT	!
KTLMOD	!
KCLK	!
KEMP	!
KXEL	!
KKINDS	!
KINDEX	!
KKSTAT	!
IH	!

STDANL (ANS, JTB, JDAT, JNE, LSTAT, JTLMOD, JCLK, TEMP , CURRNT, IXCEL, CNOISE, RMARK)

STDANL processes all of the standard plasma measurements, using the subroutines PRANAL and ELANAL.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL..
CURRNT	The measured currents in femptoamps. A negative value means that the current has been filtered out, or -1. suspect, or -2. not received.
KSTAT	Our best guess at the status word.
IXCEL	Quality flag. +1 = OK. Otherwise a count +1 of the number of suspect channels. (JDAT = -1) If negative, some channels are saturated.
CNOISE	The noise level for this instrument setting.
RMARK(3)	The current level for digital counts of 0, 128, 255.

STEP (NUMCHN)

Computes the average velocity, and velocity width for each modulator step

ARG	DEFINITION
NUMCHN(2)	Number of channels in L, and M modes.

VOYPRT (ANS, JTB, JDAT, JNE, LSTAT, JTLMOD, JCLK, TEMP, IDSRN)

Voyprt prints out the digital currents.

ARG	DEFINITION
ANS-TEMP	:hdref refid=STDCALL..
IDSRN	Fortran unit number to print on. If 0, no print.

DUMMY ROUTINES

The following routines have dummy versions in the MJS libraries. The dummy version of each routine is in a module whose name is a concatenation of D and the routine's name.

DDODP	Dummies all plotting. Note that since only one type of plotting can be done, including ODDPLT, DODP, or ENGPLT will automatically exclude the other types of plots.
DPLSANL	Dummies out all normal plasma analysis.
DMJSFIT	Eliminates the non-linear fitting.

Note that loading a dummy routine will prevent the loading of the normal routine. Thus, even if the flags are set to do that type of processing, it will be dummied out. Loading a dummy routine both speeds the loading and decreases the required storage.

PROGRAM STRUCTURE

Following is a list of subroutines used by VGRANL. Subroutines that are called by a given routine are grouped together and indented. Occasionally, functions that are computed in line are listed as though they are a subroutine with a blank name.

Thus, some idea can be gotten of the flow of a routine by reading through the subroutine list.

VGRANL 0
Main program for Voyager plasma analysis.

RUNBEG 1
Reads in control information for analysis. GSFC uses same input format for FT02F001. See :hdref refid=FT02.. RUNBEG has the block data for the MIT only control variables.
(end of RUNBEG) 1

VGRANL loops reading time cards (see :hdref refid=ft01.) and in an inner loop reading and processing the requested data.

NXTMOD 1
Reads in the Plasma data.
(end of NXTMOD) 1

Actual module determines the media used.

NXTSUM 1
Reads off a SUMMARY tape. BAT7 must also be included when loading NXTSUM.

```
//GO.SUMMARYT     DD  UNIT=T1600,LABEL=(,BLP),
//  VOL=SER=PT0000
```

(end of NXTSUM) 1

NXTEDR 1
Reads in an EDR tape. BAT7 must also be included when loading NXTEDR.

```
//GO.PLSEDRIN     DD  UNIT=T800,LABEL=(,BLP),
//  DCB=(RECFM=VBS,LRECL=4224,BLKSIZE=18260),
//  VOL=SER=PT0000
```

(end of NXTEDR) 1

NXTSPL 1
Reads in a SPECTRAL tape

```
//GO.FT18F001     DD  DISP=OLD,
//  DSN=CSR.$380300.V2SPL.Y00.D000.DATA
```

(end of NXTSPL) 1

NXTFOR 1
Reads in a SUMMARY tape using Fortran I/O

```
//GO.FT12F001  DD  UNIT=T1600,LABEL=(,BLP),DISP=OLD,
//  DCB=(RECFM=VBS,LRECL=4224,BLKSIZE=18260),
//  VOL=SER=PT0000
```

(end of NXTFOR) 1

NXTMAG 1

Reads a SUMMARY tape. Returns Magnetic field data only. BAT7 must also be included when loading NXTMAG. Integration time is determined by SETBFL. See :hdref refid=ft01..

```
//GO.SUMMARYT    DD  UNIT=T1600,LABEL=(,BLP),VOL=SER=PT0000
```

(end of NXTMAG) 1

SELECT 1

Selects which modes are to be processed. Normally dummied except for production off SUMMARY tapes when SELSUM is used.

(end of SELECT) 1

CORRCT 1

Corrects data for known incorrect data transmissions. Only incorrect integration times are corrected as of now.

(end of CORRCT) 1

PLSEDM 1

Computes or reads rotation matrix for transforming results from spacecraft to RTN.

Merged SEDR. SEDR from JPL is T800.

```
//GO.SEDRIN   DD UNIT=T6250,LABEL=(,BLP),DCB=(RECFM=VBS,LRECL=7290,
//   BLKSIZE=7294,DEN=4),VOL=SER=PT0000
```

(end of PLSEDM) 1

ANSPRT 1

Prints out a formatted copy of the answer array. ANSMAG is needed if NXTMAG is used.

(end of ANSPRT) 1

SETBFL 1

Sets the integration time when NXTMAG is used. Otherwise not used.

(end of SETBFL) 1

PLSANL 1

The main MIT plasma analysis subroutine. PLSANL is also used at GSFC.

PLSBEG 2

Initializes the analysis variables that are used both at MIT and GSFC, i.e. those that are used by routines called from PLSANL. PLSBEG also has the block data subroutine for these variables. (Called only once)

(end of PLSBEG) 2

$DATE 2

Prints out list of PLSMA LIBRARY routines loaded.

(end of $DATE) 2

KNTCUR 2

Converts the digital counts to current values in femtoamps. Also finds the peaks in the distribution function in each cup. May do some filtering and/or other checking in finding the peaks. Module name will indicate this.

(end of KNTCUR) 2

CAVE 2

Averages currents together from several spectra.

(end of CAVE) 2

FILT 2

Filters the data for one spectrum to try and decrease the effects of noise. Also important in peak selection.

(end of FILT) 2

GETFLD 2

Puts the magnetic field in the answer array. Measured field can be overwritten by card input. See :hdref refid=FT03..

(end of GETFLD) 2

(in PLSANL) The next part is just a big switch to determine the type of processing that is to be done based on the value of the status word.

MODCAL 2

Modulator voltage calibration.

(end of MODCAL) 2

IDCANL 2

IDC analysis.

(end of IDCANL) 2

CURCAL 2

Current calibration.

(end of CURCAL) 2

STDANL 2

Normal plasma data

ELANAL 3

Electron analysis.

(end of ELANAL) 3

PRANAL 3

Proton (positive ion) analysis.

MOMENT 4

Calculates values of moments around peaks.

(end of MOMENT) 4

PARPW 4
Calculates parallel and perpendicular temperatures. (Module name is PARPER)
(end of PARPW) 4

PARPQ 4
Calculates parallel and perpendicular heat fluxes. (Module name is PARPER)
(end of PARPQ) 4

SCRTNB 4
PLSEDM must be called first to provide the rotation matrix.
(end of SCRTNB) 4

SCRTNV 4
PLSEDM must be called first to provide the rotation matrix.
(end of SCRTNV) 4

(in pranal) Computes transparency corrections for each cup.

ORDER 4
Fit routine. Orders arrays.
(end of ORDER) 4

MJSFIT 4

FNCDRV 5
Calculates derivatives.
(end of FNCDRV) 5

MJSINV 5
Inverts matrix.
(end of MJSINV) 5

(end of MJSFIT) 4

(end of PRANAL) 3

(end of STDANL) 2

BKGDCR 2
Plasma modulator off. :hp3.DUMMY ROUTINE:ehp3.
(end of BKGDCR) 2

(in STDANL) Analysis is completed, now to output the results.

VOYPRT 2
Prints out the digital values of the currents
(end of VOYPRT) 2

ANSPRT 2
Prints out a formatted copy of the answer array. Note that this is after the analysis whereas the call from VGRANL gives it before the analysis.
(end of ANSPRT) 2

(end of PLSANL) 1

DOCALT 1
Write out a spectral, or calibration tape.
(end of DOCALT) 1

OUTMOD 1
Most output is controlled through this subroutine.

SCRTNB 2
B field can be rotated to RTN from OUTMOD
(end of SCRTNB) 2

SCRTNV 2
Velocities can be rotated to RTN from OUTMOD
(end of SCRTNV) 2

ODDPLT 2
Plot out samples of the 'oddplots'.
Time jumps are checked. If they exist, data may be jumped.

PERDIF 3
Computes percentage difference in mon and fit densities alon with its histogram.
(end of PERDIF) 3

STEP 3
Computes average velocity, and velocity width for each modulator step.
(end of STEP) 3

SPLOT 3
Plots out measured and computed currents.
(end of SPLOT) 3

JC 3
Computes the currents given the fit parameters.
(end of JC) 3

KNTCUR 3
Converts digital current to femptoamps
(end of KNTCUR) 3

CURPLT 3
Plots out the currents.
(end of CURPLT) 3

(end of ODDPLT) 2

DOCN 2
A dummy routine to allow the user to make his own formatted tape.
(end of DOCN) 2

DOCP 2
Copy data into special array

ALTCP 3
Alternate processing for docp. Dummy routine.
(end of ALTCP) 3

(end of DOCP) 2

DOHA 2
Write out Hourly Average tape.
(end of DOHA) 2

DODP 2
Make a Day Plot
(end of DODP) 2

(end of OUTMOD) 1

VGRLOG 1
Print out a log of the data.

FLUSH 2
Also prints out histograms of size of good spectra.
(end of FLUSH) 2

PRTSC 2
Actually writes out the line with the start and stop time.
(end of PRTSC) 2

SPECBD 2
Saves up the data on the bad spectrum.
(end of SPECBD) 2

HPRNT 2
(end of HPRNT) 2

(end of VGRLOG) 1

DOCALT 1

Writes out Calibration(Spectral) Tape.

(end of DOCALT) 1

SELPRT 1

Print out a summary of the data that was SELECTed out.

(end of SELPRT) 1

(end of VGRANL) 0

DATA STRUCTURES

INTERNAL DATA STRUCTURES

STANDARD CALLING SEQUENCE

This calling sequence is used by most of the upper level routines. It is sometimes expanded by adding on to the end of it.

ANS(150)	R4	See :hdref refid=ANSWER..
JTB(6)	I2	Time array, Year, Day, Hour, Min, Sec, Millisec.
JATA(512)	I2	Digital currents. Close packed with channels sequential and cups in order. Data not telemetered -2, missing data -3.
JNE	I2	Number of channels per cup in measurement.
LSTAT(4)	L1	Status word. LSTAT(1) last good status word LSTAT(2) actual TLM status LSTAT(3-4) interpreted as I2 = 0 ok, = -1 status missing
JTLMOD	I2	GSFC mode word, 1-L, 2-M, 3-E1, 4-E2, At MIT other values are possible. 10-B 48 sec, 11-B 9.6 sec, 12-B 1.92 sec
JCLK	I2	Index to indicate integration time + seteling tim os 30 ms. 1-60, 2-240, 3-960 milliseconds.
TEMP(3)	R4	Instrument Temperature in degrees C TPMC, TPMOD, TCUP

CCA COMMON

This common is maintained by GSFC for their production.
The only variables controlled by MIT are the logical switches LPLS.

LSYS(32)	L1	system switching vector for GSFC.
LMAG(32)	L1	magswitching vector.
LPLS(32)	L1	Plasma switching vector used in MIT processing. (See :hdref refid=ft02.).
WORK(25-30)		**spares**
IBAD		# of 48 sec ave deleted from mag hourly average
IPCH	I4	# of mag hourly average cards punched
SCN1	I4	ID of spacecraft data in EDR1
SCN2	I4	ID of spacecraft data in EDR2
TIME2	R8	Time of record in EDR2
IY2		Year of data in EDR2
IDAY2		Day of data in EDR2
MSEC2		Millisecond of data in EDR2
TIME1	R8	Decimal day of data in EDR1
WORK(432-500)		**spares**

CDOCP COMMON

This common controls the creation of the proto HA array, and the averaging of the data to make the hourly average tape.
These variables can be changed by &RUNNT, see :hdref refid=FT02..

INB	I4	Number of entries in IB
IB(9)	I4	Indices of variables in DOCP VAR array that involve the B field.
NP(2)	I4	NP(ITLMOD) gives the number of entries in table IAP, IAPOFF, and ICP for mode ITLMOD
IAP(60,2)	I4	ANS(IAP(I, ITLMOD)) is the source of the data for DOCP, see :hdref refid=STDCALL.. If IAP(I, ITLMOD) < 0 special processing is done.
ICP(60,2)	I4	VAR(ICP(I, ITLMOD)) is the destination for the data for DOCP. ICP(I, ITLMOD) is th position in the Hourly Average Array, see :hdref refid=HA..
IAPOFF(60,2)	I4	Fill data is used by DOCP if ANS array does not have IAPOFF(I, ITLMOD) + IAP(I, ITLMOD) valid data values.
NA	I4	Maximium used index in VAR array.
LANG(100)	L4	True if corresponding value in VAR, proto HA array, is to be treated as an angle when taking hourly averages.
LTESTA(100)	L4	If TRUE then this value will not be averaged under certain data conditions.
NAR(2)	I4	Maximium used index in VAR array. First value for normal data, second for GS-5 data with short L Mode.

CMODE COMMON

CMODE is an MIT-only common and should be avoided if at all possible. It is loaded by most but not all versions of NXTMOD. The standard calling sequence (:hdref refid=STDCALL.) gives most of these variables in a more reliable manner.

VARIABLE	TYPE	DEFINITION
IYR	I4	Year of data.
IDOY	I4	Day of year.
IHR	I4	Hour of day.
IMIN	I4	Minute of hour.
SEC	R4	Second of minute including fraction.
ICLK	I4	Integration time flag.
		1 60 millisec
		2 240 millesec
		3 960 millisec
ISTAT	I4	Status word.
ICOMM	I4	Command word?
IDATAN(4,144)	I4	Digital currents.
ITLMOD	I4	Flag to indicate type of mode.
		1 L-mode
		2 M-mode
		3 E1-mode
		4 E2-mode
TEMP(3)	R4	Temperature of instrument in degrees C.
IENGDN(10)	I4	Engineering counts?
MODTAL	I4	Count of the mode.
IKINDS	A4	Spacecraft type?
MINDEX	I4	Minimum channel number returned for M-mode.

LPLS COMMON

This common is used by SELSUM, the SELECT for Summary tape production, and by DOCAL. In the former case it keeps a record of the number and reasons for rejecting spectra.
In both cases it controls the writing of the spectral tape.

IUNIT	I4	Fortran unit number that the spectal tape is written out on. If IUNIT > 20 then a long spectral record is written.
LDMP(2)	L4	Controls if the record is to be dumped.
LED(16)	L1	Indicates that the corresponding test failed.
LMAX(16)	L1	!

MITRUN COMMON

This common is only used in the MIT production. Set with namelist &RUNNT.
It controls the type of processing to be done.
For a more complete definition of the variables, see :hdref refid=ft02..

IUNIT(10)	I/O unit numbers for MIT processing.
TJUMP	Time data jump test
FACT	?
GAPSEC(20)	Expected time gap between data points
FITMOD	Fitmod
SKPODD	?

NDYCOM COMMON

This common is to support DODP. Read in on unit 5.

NYRF	Year of first data to be plotted.
NDAYF	Day of first data to be plotted.
NEXT	Number of days to be overlapped on Nday plots.

PLCONS COMMON

The block data for this common are loaded with PLSBEG. The variables that can be changed are changed by PLSNT and are marked *&PLSNT.*
See :hdref refid=ft02..

IDSRN(15)	I/O unit numbers for selective printing.	*&PLSNT*
ISC	!	
VJNE(16,2)	E mode voltage at middle of step	
DVDE(16,2)	E mode voltage across step	
CJN(16,2)	One dimensional distribution function = CURRNT*CJN/(VJNE**SN*DVDE)	
VOLTSC	Not used = 0.01	
J1E(2)	Min channel number used in calculating flux or distribution function	
J2E(2)	Max channel number used in calculation flux etc.	
FON(2)	Conversion factor for current in femto amps to	
flux in	/cm^2/sec.	
J3E(2)	Min channel number used in calculating temp	
J4E(2)	Max channel number used in calculating temp	
EN(2)	TEMP = EN*(VOLT(LOW)**2-VOLT(HI)**2)/ALOG10(DIST(HI)/DIST(LO))	
SN(2)	See CJN above (defaulted to 1., 1.)	
FAC(3)	Square root of ratio of integration times	
SIGNOI	Signal noise level	
DCRTN(256)	DC return current conversion table	
VJNL(16)	L Mode voltage at middle of step	
VJWL(17)	L Mode voltage at lower edge of step	
VJNM(128)	M Mode voltage at middle of step	
VJWM(129)	M Mode voltage at lower edge of step	
II	Spacecraft ID, 1 Voyager 1, 0 Voyager 2 from SUMMARYT	*&PLSNT*
IEND	Maximum # of calls to FNCDRV	*&PLSNT*
EPS	Wanted fractional error in χ^2	
FLAM	Normal starting value Λ for nonlinear fit	*&PLSNT*
QK(4,2)	!	
NK(4,2)	!	
SK(4,2)	!	
WK(4,2)	!	

VK(4,2)	!	
DELTAL(2)	!	
IPQF(2,2)	# channels up from peak for alphas	*&PLSNT*
IPRF(2,2)	# channels down form peak for alphas	*&PLSNT*
IPQ(4,2)	# channels up from peak for protons	*&PLSNT*
IPR(4,2)	# channels down from peak for protons	*&PLSNT*
CN(4,3)	Directional cosines of cups	
COSB(3)	Cosine of angle between cup and B field	
COS2B(3)	Square of cosine of angle between cup and B field	
SIN2B(3)	Square of sine of angle between cup and B field	
CALCUR(12)	!	
CLOCK(3)	Plasma cup integration time in sec.	
CAP(2)	Integration capacitance in microfarads	
GAIN(2)	Gain of amplifier	
VO	Voltage for first step of modulator. Set in PLSBEG	
ALPHA	N_α/N_p threshold for alpha analysis	*&PLSNT*
NQ(4)	!	
MASS(4)	!	
KEY(4)	!	
LANIS(4)	!	
NCOM(2)	!	
NVAR(2)	!	
FNOIS	!	
CSIG	Multiplier of CNOISE to get minimum current for analysis	*&PLSNT*
FSIG	!	*&PLSNT*
NS	Number of spectra to be averaged together	*&PLSNT*
xtras(243)	Spares	

PSTUFF COMMON

This common is used by DODP.
It is loaded by the namelist SCALE from unit 5.
For a description of DODP and its input see the DODP write up.

F	Horizontal scale factor
X12	Length of xaxis
SCNAME	Spacecraft name
IDSRN	Data set number
NUMDAY	Number of days per panel. One for a day plot.
NOROT	Print solar rotation number
TPTYPE	!

EXTERNAL DATA STRUCTURES

OUTPUT FILE DEFINITIONS

HA Hourly average

```
//GO.FT17F001     DD  UNIT=T6250,DISP=OLD,LABEL=(,BLP),
//  DCB=(RECFM=VBS,LRECL=17596,BLKSIZE=17600),
//  VOL=SER=PT1234
```

SP Spectral tape (short form)

```
//GO.FT18F001     DD  UNIT=T6250,DISP=OLD,LABEL=(,BLP),
//  DCB=(RECFM=VBS,LRECL=17596,BLKSIZE=17600),
//  VOL=SER=PT1234
```

SP Spectral tape (long form)

```
//GO.FT21F001     DD  UNIT=T6250,DISP=OLD,LABEL=(,BLP),
//  DCB=(RECFM=VBS,LRECL=17596,BLKSIZE=17600),
//  VOL=SER=PT1234
```

PLOT Calcomp file on disk

```
//GO.FT37F001     DD  UNIT=3350,DISP=OLD,
//   DCB=(RECFM=VS,LRECL=364,BLKSIZE=368),
//   DSN=CSR.$380340.ODDPLT.DATA
```

PLOT Calcomp file on tape

```
//GO.FT37F001     DD  UNIT=T800,DISP=(MOD,PASS),
//   DCB=(RECFM=VS,LRECL=364,BLKSIZE=368,DEN=2),
//   LABEL=(,BLP),
//   VOL=SER=PT0000
```

SUMMARY TAPE

The Summary tape is a labelled tape. The data section has many logical record, each logical record is made up of a header plus one or more subsections as diagrammed below.

```
/*COMMENT ALL TAPE REQUESTS FROM MIT (CSPR) CART
/*SETUP UNIT=T6250,ID=(GS5P03,NORING,SAVE,SL),                X
/*C='SLOT  PT0247'
//GO.FT12F001     DD  UNIT=(T6250),LABEL=(,SL),DISP=(OLD,PASS),
//   DCB=(RECFM=VBS,LRECL=4224,BLKSIZE=18260),
//   DSN=VOYAGER.CONJOINT.MAG.PLS,
//   VOL=SER=GS5P03
```

ENG - ENGINEERING	
Header 32 words	SELECTED ENGINEERING DATA 2-240 words

LFM - MAGNETOMETER		
Header 32 words	MAG DATA 496 words	SEDR 50 words

M - PROTON MODE			
Header 32 words	OUTPUT DATA 150 words	SEDR 50 words	RAW DATA 256 words

L - PROTON MODE			
Header 32 words	OUTPUT DATA 150 words	SEDR 50 words	RAW DATA 32 words

E1/E2 - ELECTRON MODE			
Header 32 words	OUTPUT DATA 80 words	SEDR 50 words	RAW DATA 8 words

Note that the records are of variable length and that there is a word in the HEADER that allows these records to be read by a Fortran read without error. Fortran can also read these records by reading into a large array and accepting the end of record error (this is usually faster).

This block is the first block in all SUMMARY tape records.

HEADER to SUMMARY TAPE RECORDS

WORD	**NAME**	**TYPE**	**MEANING**
1	ID	A4	Data identifier i.e. 'ENG ', 'LFM ', 'M ', 'L ', 'E1 ', E2 ', 'HDR1', 'HDR2', 'HDR3'
2	TELFMT	A4	Telemetry format
3	SCID	A4	Spacecraft ID, 'FLT1', 'FLT2'
4	IYR	I2	Year of data (time tag at beginning of data block)
	IDAY	I2	Day of year (Jan 1 = 1)
5	IHR	I2	Hour of day (0-23)
	MIN	I2	Minute of hour (0-59)
6	ISEC	I2	Second of minute (0-59)
	MSEC	I2	Millisecond (0-999)
7-8	DDAY	R8	Decimal day of year of data (Jan 1 = 0)
9-10	EPICDAY	R8	Decimal day count since 20 Aug. 1977
11	TYPE	A4	Type of time, SCET or ERT.
12	BLOCKTIM	R8	Time period of this data block in seconds.
13	COUNT16	I2	2**16 seq counter of data at time of telemetry readout (increments once in 48 min)
	MOD60		Modulo 60 seq counter of data readout (increments once in 48 sec)
14	LINECNT	I2	Line counter of data readout (1-800) (increments once in 60 ms)
			Spare
15	STATUS	Z4	Status word
16	COMMAND	Z4	Command
17	ID2	I2	Data identifier LFM=1, HFM=2, M=3, E1=4, L=5, E2=6, ENG=7, HDR1=8, HDR3=10
	MODE	I2	Data telemetry mode GS-3=0, CR-1=1, CR-2=2, CR-3=3, CR-4=4, CR-5A=5, CR-6A=6, CR-6B=7, CR-5B=8, CR-7S=9, CR-7L=10, GS-5S=11, GS-5L=12
18			SPARE
19-20	MEDDLE	A8	A character
21-22			SPARE
30-31			
32	NREC	I2	Record number on tape
	NWORD	I2	Number of words remaining in logical record.

ANSWER ARRAY M & L

DESCRIPTION OF ANSWER (ANS) ARRAY

WORD	QUANTITY	MNEMONIC	TYPE	DEFINITION	UNITS	SET BY
1 a)			I2	number of words in ANS array		many
b)		NTALLY		tally of the calls to PLSANL		PLSANL
2 a)		IPK (4)	I2	peak channel number sensor A		KNTCUR
b)			I2	B		
3 a)			I2	C		
b)			I2	D		
4			R4	delta time from start of mode to peak	sec	KNTCUR
5	Bx	BX	R4	components of B field in spacecraft coordinates (x,y,z)	q	GETFLD
6	By	BY				
7	Bz	BZ				
8		BMAG	R4	square root of sum of squared average components	q	GETFLD
9		F2	R4	average of $(B_x^2 + B_y^2 + B_z^2)^{1/2}$	q	GETFLD
10		RMS (3)	R4	vector RMS of B field, spacecraft coordinates	q	GETFLD
11						
12						
13		NA	I4	number of MAG samples in this average (0 if bad data)		GETFLD
14			R4	delta time from peak to mag field average	sec	GETFLD
15			R4	time period of field average	sec	GETFLD

------------------------ Moment Calculations ---------------------

Moments usually taken over 8 channels above peak and 12 below. Stopped at 3 times noise level or saturation see items 16 through 19.

DESCRIPTION OF ANSWER (ANS) ARRAY (cont)

WORD	QUANTITY	MNEMONIC	TYPE	DEFINITION	UNITS	SET BY
16	$J_{A_{mom}}$	JACUPMOM	R4	number of channels used in moment calculation, cup A		PRANAL
17	$J_{B_{mom}}$	JBCUPMOM		B		
18	$J_{C_{mom}}$	JCCUPMOM		C		
19	$J_{D_{mom}}$	JDCUPMOM		D		
20	ρ_A	NACUP	R4	density from moments, for each cup	#/cc	MPMENT
21	ρ_B	NBCUP				
22	ρ_C	NCCUP				
23	ρ_D	NDCUP				
24	V_{A_n}	VACUPN	R4	velocity component along normal of each cup	km/sec	PRANAL MOMENT
25	V_{B_n}	VBCUPN				
26	V_{C_n}	VCCUPN				
27	V_{D_n}	VDCUPN				
28	$V_{x_{mom}}$	VXMOM	R4	velocity from moments, spacecraft coordinates x,y,z (i.e. no aberration correction)	km/sec	PRANAL
29	$V_{y_{mom}}$	VYMOM				
30	$V_{z_{mom}}$	VZMOM				
31	V	VMAG	R4	velocity from moments, spacecraft R, r, d	km/sec	PRANAL
32	θ_{mom}	THETAMOM				
33	ϕ_{mom}	PHIMOM				
34	W_{A_n}	WACUPN	R4	thermal speed from moments, for each cup	km/sec	PRANAL MOMENT
35	W_{B_n}	WBCUPN				

36	W_{C_n}	WCCUPN				
37	W_{D_n}	WDCUPN				
38	δ_{mom}	NBARMOM	R4	average density from moments		
39	w_n	DN	R4	density criterion (no transparency correction)		
40	W_{mom}	WMOM	R4	thermal speed from moment (reconstructed using field)	km/sec	PRANAL MOMENT
41	A	A1P	R4	anisotropy of proton thermal speed (moments), Wpar/Wperp		PRANAL
42	X_w^2	CHI2W	R4	cost function (normalized square of residuals) for thermal speed fit by PARPER		PRANAL/ (PARPER)
43	q_A	QACUPMOM	R4	heat flux from moments for each cup	km/sec	PRANAL MOMENT
44	q_B	QBCUPMOM				
45	q_C	QCCUPMOM				
46	q_D	QDCUPMOM				
47	$Q_{\parallel}+5*Q_{\perp}$	QPAR	R4	Q parallel + 5*Q perpendicular again reconstructed and unreliable		PARPER/ PRANAL
48	X_q^2	CHI2Q	R4	normalized square residuals for heat flux		PRANAL

---------------------- Fit Calculations --------------------------

There are several fitting options; the default is an anisotropic proton and an isotropic alpha maxwellian. Items 49 through 63 summarize the results of the fitting procedure. The quantities are averages over the appropriate peaks weighted by the number density of the peaks.

DESCRIPTION OF ANSWER (ANS) ARRAY (cont)

WORD	QUANTITY	MNEMONIC	TYPE	DEFINITION	UNITS	SET BY
49	$V_{x_{fit}}$	VXBARPFT	R4	velocity of protons from fit routine spacecraft coordinates x,y,z	km/sec	PRANAL/ MJSFIT
50	$V_{y_{fit}}$	VYBARPFT				
51	$V_{z_{fit}}$	VZBARPFT				
52	ρ_{fit}	NBARPFT	R4	density of protons from fit		MJSFIT
53	W_{fit}	WBARPFT	R4	thermal width of protons from fit, averaged	km/sec	PRANAL/ MJSFIT
54	A_{fit}	ABARPFT	R4	anisotropy of protons from fit		PRANAL/ MJSFIT
55	q_{fit}	QBARPFT	R4	heat flux of protons from fit, normalized		PRANAL/ MJSFIT
56	$V_{x_{fit}}$	VXBARAFT	R4	velocity of alphas from fit, spacecraft x,y,z	km/sec	PRANAL/
57	$V_{y_{fit}}$	VYBARAFT				
58	$V_{z_{fit}}$	VZBARAFT				
59	n_{fit}	NBARAFT	R4	density of alphas from fit		MJSFIT
60	W_{fit}	WBARAFT	R4	thermal width of alphas from fit	km/sec	PRANAL/ MJSFIT
61	A_{fit}	ABARAFT	R4	anisotropy of alphas from fit		PRANAL/ MJSFIT
62	q_{fit}	QBARAFT	R4	heat flux of alphas from fit, normalized		PRANAL/ MJSFIT
63	V_{α}-V_p	DVAMPFT	R4	delta velocity between alphas and protons from fit	km/sec	PRANAL/ MJSFIT

-------------------- fit, information on first peak -------------------

DESCRIPTION OF ANSWER (ANS) ARRAY (cont)

WORD	QUANTITY	MNEMONIC	TYPE	DEFINITION	UNITS	SET BY
64	$V_{x_{1p}}$	VS1P	R4	velocity of first proton peak, spacecraft x,y,z	km/sec	PRANAL MJIT
65	$V_{y_{1p}}$	VY1P				
66	$V_{z_{1p}}$	VZ1P				
67	ρ_{1p}	N1P	R4	density of first proton peak		MJSFIT
68	$W_{\parallel 1p}$	WPAR1P	R4	thermal width parallel to B field for first proton bi-maxwellian	km/sec	PRANAL/ MJSFIT
69	$W_{\perp 1p}$	WPER1P	R4	thermal width perpendicular to B field for first proton bi-maxwellian	km/sec	PRANAL/ MJSFIT

------------------ fit, information on second peak --------------------

DESCRIPTION OF ANSWER (ANS) ARRAY (cont)

WORD	QUANTITY	MNEMONIC	TYPE	DEFINITION	UNITS	SET BY
70	V_{1p}-V_{2p}	DV2P	R4	difference in bulk velocity between first and second proton (along B required)	km/sec	PRANAL/ MJSFIT
71	ρ_{2p}	N2P	R4	density of second proton fit		MJSFIT
72	W_{2p}	WPAR2P	R4	thermal width of second proton maxwellian parallel to B field	km/sec	PRANAL/ MJSFIT
73	W_{2p}	WPER2P	R4	thermal width of second proton; maxwellian; perpendicular to B field	km/sec	PRANAL/ MJSFIT

-------------------- fit, information on first alpha peak -------------------

DESCRIPTION OF ANSWER (ANS) ARRAY (cont)

WORD	QUANTITY	MNEMONIC	TYPE	DEFINITION	UNITS	SET BY
74	$V_{1\alpha}$-V_{1p}	DV1A	R4	velocity difference between first proton and first alpha,	km/sec	PRANAL/ MJSFIT
75	$\rho_{1\alpha}$	N1A	R4	density of first alpha,		MJSFIT
76	$W_{\parallel 1\alpha}$	WPAR1A	R4	thermal width of first alpha, parallel to B	km/sec	PRANAL/ MJSFIT
77	$W_{\perp 1\alpha}$	WPER1A	R4	thermal width of first alpha, perpendicular to B	km/sec	PRANAL/ MJSFIT

---------------------fit information on second alpha peak -------------------

DESCRIPTION OF ANSWER (ANS) ARRAY (cont)

WORD	QUANTITY	MNEMONIC	TYPE	DEFINITION	UNITS	SET BY
78	$V_{2\alpha}$-V_{1p}	DV2A	R4	velocity difference between second alpha and first proton,	km/sec	PRANAL/ MJSFIT
79	$\rho_{2\alpha}$	N2A	R4	density of second alpha		MJSFIT
80	$W_{\parallel 2\alpha}$	W2a	R4	thermal width of second alpha parallel to B field	km/sec	PRANAL/ MJSFIT
81	$W_{\perp 2\alpha}$	WPER2A	R4	thermal width of second alpha perpendicular to B field	km/sec	
82	$Log_{10}X^2$	LOGHI2	R4	log10 of cost function (sum of squares of residuals)		

------------------------general information -----------------------

DESCRIPTION OF ANSWER (ANS) ARRAY (cont)

WORD	QUANTITY	MNEMONIC	TYPE	DEFINITION	UNITS	SET BY
83	$Log_{10}X^2$ ext	LOGCHI2E	R4	log10 of cost function (sum of squares of residuals over all data)		
84	ICALL	ICALL	R4	number of iterations performed by fit routine		
85	IQUAL	IQUAL	R4	related to reason for termination of fit procedure		
86	$J_{A_{fit}}$	JACUPFT	R4	number of channels from each cup used in fit		
87	$J_{B_{fit}}$	JBCUPFT				
88	$J_{C_{fit}}$	JCCUPFT				
89	IXCEL	IXCEL	R4	number of saturated channels		
90	t1	T1	R4	transparency correction (due to angle) for each main cup		PRANAL
91	t2	T2				
92	t3	T3				

-----------summary of analysis with aberration corrections made to velocities-----------

DESCRIPTION OF ANSWER (ANS) ARRAY (cont)

WORD	QUANTITY	MNEMONIC	TYPE	DEFINITION	UNITS	SET BY
93	$\rho_{1_{cor}}$	N1COR	R4	moment densities corrected for trasparencies		
94	$\rho_{2_{cor}}$	N2COR				
95	$\rho_{3_{cor}}$	N3COR				
96	B_R	BR	R4	B field in RTN coordinates	q	
97	B_T	BT				
98	B_N	BN				
99	$V_{R_{mom}}$	VRMOM	R4	moment proton velocities in RTN coordinates	km/sec	
100	$V_{T_{mom}}$	VTMOM				
101	$V_{N_{mom}}$	VNMOM				
102	V_{mom}	VMAGMOM	R4	moment proton speed	km/sec	
103	NS<)$_{mom}$	NSANMOM		North-South angle of flow = ATAN2 (VN/SQRT(VR2 + VT2))	degrees	
104	EW<)$_{mom}$	EWANMOM		East-West angle of flow = -ATAN2 (VT,VR)	degrees	
105	$V_{R_{fit}}$	VRPFT	R4	proton velocity in RTN coordinates, fit	km/sec	
106	$V_{T_{fit}}$	VTPFT				
107	$V_{N_{fit}}$	VNPFT				
108	fit	VMAGPFT	R4	proton speed, fit	km/sec	
109	NS<)$_{fit}$	NSANPFT		flow angles, fit (defined as above)	degrees	
110	EW<)$_{fit}$	EWANPFT				
111	$V_{R_{fit}}$	VRAFT	R4	alpha velocity in RTN coordinates, fit	degrees	
112	$V_{T_{fit}}$	VTAFT				
113	$V_{N_{fit}}$	VNAFT				

114	fit	VMAGAFT	R4	alpha speed, fit	km/sec
115	$NS<)_{fit}$	NSANAFT		alpha flow angles, fit	
116	$EW<)_{fit}$	EWANAFT			
117	$\rho_{\alpha_{mom}}$	NAMOM		alpha number density, moments	
118	$W_{\alpha_{mon}}$	WAMOM		alpha thermal speed, moments	km/sec
119	$V_{x_{\alpha_{mom}}}$	VXAMOM		alpha velocity, moments, s/c coord ¬ abberation correction)	km/sec
120	$V_{y_{\alpha_{mom}}}$	VYAMOM			
121	$V_{z_{\alpha_{mom}}}$	VZAMOM			
122	IPAa	IPACUPA		pk channel for alpha in each cup (estimated-not useful)	
123	IPBa	IPBCUPA			
124	IPCa	IPBCUPA			
125	NCHANp	NESTCHP		estimate of of channels from peak to 1/e of peak. derived from moment calculation	
126	NCHANa	NESTCHA		ditto for alphas	
127	$V_{\alpha}-V_{mom}$	VAMPMOM		speed difference, not necessarily along B, moments	km/sec
128	$<) (V_{\alpha}-V_{p},B)$	ANVAMPB		angle to B field	degrees
129	wna	DNA		density criterion for alphas	
130	cos(B:,n:A)	COSBACUP		cosines of angles between BT and cup normals	
131	cos(B:,n:B)	COSBBCUP			
132	cos(B:,n:C)	COSBCCUP			
133	$W_{p_{mom}}$	WBARPMOM		estimate of thermal speed	km/sec
				from moments: (WA2 + WB2 + WC2)1/2	

This is the answer array for all electron data.

ANSWER ARRAY Electron data.

WORD	NAME	TYPE	MEANING
1		I2	Number of words in this block
		I2	Tally of number of calls to PLSANL
2		I2	Peak channel number sensor cup A
		I2	" B
3		I2	" C
		I2	" D
4		R4	Δ time from mode start to peak.
5	XA	R4	B_x ambient field in spacecraft coordinates.
6	YA	R4	B_y
7	ZA	R4	B_z
8	F1	R4	$\sum_i^N \frac{\lvert\vec{B}_i\rvert}{N}$
9	F2	R4	$\sqrt{\bar{B}_x^2+\bar{B}_y^2+\bar{B}_z^2}$
10-12	RMS	R4	Vector rms of B field
13	NA	I4	Number of MAG samples in average
14		R4	Δ time from peak to MAG average.
15		R4	Time period of Mag average.
16		R4	Flux #/cm^2 /sec
17		R4	Temperature degrees Kelvin
18-33		R4	Distribution #/V^3/cm^3
23-80			SPARE

This is the answer array for protons using IDCANL.

ANSWER ARRAY IDCANL.

WORD	NAME	TYPE	MEANING
1		I2	Number of words in this block
		I2	Tally of number of calls to PLSANL
2		I2	Peak channel number sensor cup A
		I2	" B
3		I2	" C
		I2	" D
4		R4	Δ time from mode start to peak.
5	XA	R4	B_x ambient field in spacecraft coordinates.
6	YA	R4	B_y
7	ZA	R4	B_z
8	F1	R4	$\sum_i^N \frac{\lvert\vec{B}_i\rvert}{N}$
9	F2	R4	$\sqrt{\bar{B}_x^2+\bar{B}_y^2+\bar{B}_z^2}$
10-12	RMS	R4	Vector rms of B field
13	NA	I4	Number of MAG samples in average
14		R4	Δ time from peak to MAG average.
15		R4	Time period of Mag average.
16	DEN	R4	Density num/cc
17	VEL	R4	Velocity km/sec
18		R4	Thermal velocity km/sec
19		R4	Third monent km/sec
20	IQUAL	I4	number of channels above noise. If negative MOMENT failed

This is variable length block of engineering data

ENGINEERING DATA

WORD	NAME	TYPE	MEANING
1	IDECK	I2	Deck (ENG code) 620=672
	IENG	I2	Value of ENG
2	ITIME	R4	"Read out" time of data in sec last time in header.

* repeat for new set
*
*

This block gives the spacecraft state vector and rotation matrices for conversion between coordinate systems.
Note that the coordinate systems change with the type of tape.

SEDR DATA

WORD	NAME	TYPE	MEANING
1-2	TN	R8	EPIC day of navigation block.
3-4	TP	R8	EPIC day of pointing vector block.
5-10	SPV	R4	Spacecraft relative position vector and velocity vector in HG: Inertial Sun Equator System (AU, km/sec) S3: Jupiter System III Cartesian (Jupiter radii, Km/sec)
11	RANGE	R4	Spacecraft distance from HG: Sun in AU. S3: Jupiter in Jupiter radii.
12-13	ANG	R4	Spacecraft relative Longitude and Lattitude in radians HG: Inertial Sun Equatorial System. S3: Jupiter latitude and longitude :hp1.Note: :ehp1. $0 \leq$ longitude $< 2\pi$ $-\pi/2 <$ latitude $\leq +\pi/2$
14-22	TTB	R4	HG: Matrix to rotate data from Inertial Sum Equatorial System to Inertial Heliographic System. S3: Matrix to rotate data from Jupiter System III to Jupiter system III spherical
23-31	TTB5	R4	HG: Matrix to rotate data from Inertial Heliographic System to Earth-Orbit-True System. S3: Matrix to rotate data from payload to Jupiter System III Cartesian.
32-40	THG	R4	HG: Matrix to rotate data from payload to Inertial Heliographic System. S3: Matrix to rotate data from Payload to Jupiter System III spherical.
41-50			SPARE

SPECTRAL TAPE

SPECTRAL TAPE

WORD	VARIABLE	TYPE	DEFINITION
0	IMM	I4	Number of words following
1	IDSC	A4	Spacecraft ID
2-4	JTB(6)	I2	Data time: year, day, hour, minute, second, millisecond.
5	LSTAT	I4	Status word
6	JTLMOD	I2	Mode type. 1=L, 2=M, 3=E1, 4=E2
	JCLK	I2	Integration time for measurement
7-9	TEMP(3)	R4	Instrument temperature
10-18	IENGDM	I4	Engineering data digital values
19	MODTAL	I4	Spectral number from original run (negative if written by SUN)
20	IKINDS	A4	Telemetery format
21	MINDEX	I2	Index of first telemetered energy cell
22	KSTAT	I2	Assumed status work
	IM	I2	Number of data values
24-24+IM/2	IDATA(<513)	I2	Digital current

The following are only on long format tape

	ANS(<200)	R4	Answer array, length is indicated by first word
	LED(16)	L1	Logical flags showing which editing rules were violated (see SELSUM version of SELECT)
	LMAX(16)	L1	Logical flags showing which spectrum type tests failed

```
//FT18F001  DD  UNIT=T6250,LABEL=(,BLP),DISP=OLD,
//     DCB=(RECFM=VBS,LRECL=1000,BLKSIZE=19069)
//     VOL=SER=PT1234
```

HOURLY AVERAGE

Voyager hourly average tapes contain averages of all the currently available interplanetary data for an individual spacecraft. They are FORTRAN readable; the reading procedure is described in Appendix A. The tape contains data from L, M, E1, and E2 modes and also trajectory information.

The tape begins with a header section which is followed by data arranged in triplets. If q is the quantity measured, the triplet is q_{ave}, σ_q, and N_q,

$$q_{ave} = (\Sigma\, q_i)/N_q$$

$$\sigma = [\Sigma\, (q_i - q_{ave})^2/(N_q - 1)]^{1/2}$$

N_q = the number of data points contributing to q_{ave}.

Note carefully that any parameter may be filled (there is no unique fill value); if so, the value of N_q is set to 0. Be sure to check N_q before using an average. (The fill value is not predictable.)

The supplementary trajectory information on the G-tapes (word number 211 and greater) is not arranged in such triplets. A detailed description of the tape follows. The source of most of the parameters is the "ANSWER" array from the Voyager analysis program VGRANL. The position of any variable in the hourly average array is controled by the :hdref refid=CDOCP., and can be changed using the namlist &RUNNT, see :hdref refid=FT02. Changes should be made :hp3.only with extreme care.:ehp3. as mixing such files can result in an unreadable data set. The default values follow.

------------------------------ HEADER ------------------------------

WORD	MEANING		TYPE
0	The number of words following in record		I4
1,2	Source of data (tape label)		A8
3	Type of source: ('EDR ' or 'SUM ')		A4
4	Date the average was made		
5	Spare		
6	S/C ID: ('VOY1' or 'VOY2')	A8	
7	Time of data:	Year (e.g. 1977=77)	I4
8		Day (Jan 1 =1)	I4
9		Hour (0 - 23)	I4

Unless otherwise specified, the data triplet variables have the following types: q_{ave} and σ_q are R*4; N_q is I4.

Referances to ANS under SOURCE refer to the answer array, see :hdref refid=ANSWER..
The TRIPLET # also refers to the index of the proto HA array produced by DOCP, see :hdref refid=DO

WORD	MEANING	SOURCE	[TRIPLET #]
	--------------- M MODE VARIABLES moment protons -		
10-12	ρ #/cc	ANS(38)	[1]
13-15	|V| km/s	ANS(102)	[2]
16-18	W Thermal width km/s	ANS(40)	[3]
19-21	Anisotropy wpar/wperp	ANS(41)	[4]
22-24	V_r km/s	ANS(99)	[5]
25-27	V_t km/s	ANS(100)	[6]
28-30	V_n km/s	ANS(101)	[7]
	estimates		
31-33	ρ #/cc	ANS(38)	[8]
34-36	|V| km/s	ANS(102)	[9]
37-39	W Thermal width km/s	ANS(40)	[10]
	--------------- M MODE VARIABLES moment alphas --		
40-42	ρ #/cc	ANS(117)	[11]
43-45	|V| km/s	ANS( )	[12]
46-48	W Thermal width km/s	ANS(118)	[13]
49-51	Anisotropy wpar/wperp	ANS( )	[14]
52-54	V_r km/s	ANS( )	[15]
55-57	V_t km/s	ANS( )	[16]
58-60	V_n km/s	ANS( )	[17]
	estimates		
61-63	ρ #/cc	ANS( )	[18]
64-66	|V| km/s	ANS( )	[19]
67-69	W Thermal width km/s	ANS( )	[20]
	--------------- M MODE VARIABLES fit protons -		
70-72	ρ #/cc	ANS(52)	[21]
73-75	|V| km/s	ANS(108)	[22]
76-78	W Thermal width km/s	ANS(53)	[23]
79-81	Anisotropy wpar/wperp	ANS(54)	[24]
82-84	V_r km/s	ANS(105)	[25]
85-87	V_t km/s	ANS(106)	[26]
88-90	V_n km/s	ANS(107)	[27]
	estimates		
91-93	ρ #/cc	ANS( )	[28]
94-96	|V| km/s	ANS( )	[29]
97-99	W Thermal width km/s	ANS( )	[30]

--------------- M MODE VARIABLES fit alphas --

100-102	ρ #/cc	ANS(59)	[31]
103-105	$\|V\|$ km/s	ANS(114)	[32]
106-108	W Thermal width km/s	ANS(60)	[33]
109-111	Anisotropy wpar/wperp	ANS(61)	[34]
112-114	V_r km/s	ANS(111)	[35]
115-117	V_t km/s	ANS(112)	[36]
118-120	V_n km/s	ANS(113)	[37]
	estimates		
121-123	ρ #/cc	ANS( )	[38]
124-126	$\|V\|$ km/s	ANS( )	[39]
127-129	W Thermal width km/s	ANS( )	[40]

------------- MAGNETIC FIELD ------------------------------------

130-132	$F1 = \|\Sigma B_i\|/N$	ANS(8)	[41]
133-135	$F2 = \Sigma \|B_i\|/N$	ANS(9)	[42]
136-138	B_r γ	ANS(96)	[43]
139-141	B_t γ	ANS(97)	[44]
142-144	B_n γ	ANS(98)	[45]
145-147	Number of rejected spectra		[46]

-------------- E1 & E2 VARIABLES long integration time ------------

148-150	E1 Temperature °K	ANS(17)	[47]
151-153	E1 Flux one dimensional	ANS(16)	[48]
154-156	E2 Temperature °K	ANS(17)	[49]
157-159	E2 Flux one dimensional	ANS(16)	[50]

--------------- L-MODE VARIABLES moment, long integration ------

160-162	ρ #/cc	ANS(38)	[51]
163-165	|V| km/s	ANS(102)	[52]
166-168	W Thermal width km/s	ANS(40)	[53]
169-171	Anisotropy wpar/wperp	ANS(41)	[54]
172-174	V_r km/s	ANS(99)	[55]
175-177	V_t km/s	ANS(100)	[56]
178-180	V_n km/s	ANS(101)	[57]
	estimates		
181-183	ρ #/cc	ANS(38)	[58]
184-186	|V| km/s	ANS(102)	[59]
187-189	W Thermal width km/s	ANS(40)	[60]
	D cup		
190-192	Density #/cc	ANS(23)	[61]
193-195	Velocity km/s	ANS(27)	[62]
196-198	Thermal width km/s	ANS(37)	[63]

----------------- TRAJECTORY -------------------------------------

199-201	Range from Sun AU (using 1AU=1.495979x10^8 km)	ASEDR(11)	[64]
202-204	Longitude, Sun true Equinox and Equator, radians	ASEDR(12)	[65]
205-207	Latitude, Sun True Equinox and Equator, radians	ASEDR(13)	[66]

-------------- E1 & E2 VARIABLES short integration time ------------

208-210	E1 Temperature °K	ANS(17)	[67]
211-213	E1 Flux one dimensional	ANS(16)	[68]
214-216	E2 Temperature °K	ANS(17)	[69]
217-219	E2 Flux one dimensional	ANS(16)	[60]

--------------- L-MODE VARIABLES moment. short integration ------

220-222	ρ #/cc	ANS(38)	[61]
223-225	|V| km/s	ANS(102)	[62]
226-228	W Thermal width km/s	ANS(40)	[63]
229-231	Anisotropy wpar/wperp	ANS(41)	[64]
232-234	V_r km/s	ANS(99)	[65]
235-237	V_t km/s	ANS(100)	[66]
238-124	V_n km/s	ANS(101)	[67]
	estimates		
241-243	ρ #/cc	ANS(38)	[68]
244-246	|V| km/s	ANS(102)	[69]
247-249	W Thermal width km/s	ANS(40)	[70]
	D cup		
250-252	Density #/cc	ANS(23)	[71]
253-255	Velocity km/s	ANS(27)	[72]
256-258	Thermal width km/s	ANS(37)	[73]

The first word of each record (Header word O) indicates the number of words which follow. A FORTRAN READ statement might be of the form:

```
READ (XX) N, (A(I), I = 1,N)
```

with an EQUIVALENCE statement

```
EQUIVALENCE (A(1), IA(1))
```

With the DD card,

```
//FTXXF001 DD UNIT=T6250,LABEL=(,BLP),
// DCB=(RECFM=VBS,LRECL=17596,BLKSIZE=17600,
// VOL=SER=ABCD
```

CALLED

- $DATE
  - MAIN
- ALTCP
  - DOCP
- ANSPRT
  - MAIN
  - PLSANL
- AVEDIS
  - DODP
- AXISD
- AXISPT
- AXISST
- AXIST
- BKGDCR
  - PLSANL
- CAVE
  - KNTCUR
- CLRVAR
  - OUTMOD
- CORRCT
  - MAIN
- CURCAL
  - PLSANL
- CURNT
  - JC
- CURPLT
  - SPLOT
- DAYLAB
  - DODP
- DOCALT
  - MAIN
- DOCN
  - OUTMOD
- DOCP
- DODP
- DOHA
- DOYLAB
  - DODP
- ELANAL
  - STDANL
- ENDPLT
  - ODDPLT
- EXIT
  - DODP
- FRAME
- FRAMEC
- GAP
- GETFLD
  - PLSANL
- IDCANL
- JC
  - SPLOT
- KNTCUR
  - PLSANL
  - SPLOT
- LABP
  - DODP
- LINCOL
- MJSFIT
  - PRANAL
- MOMENT
  - IDCANL
  - PRANAL
- NEWPEN
  - DODP
- NUMBER
  - SPLOT
- NXTMOD
  - MAIN
- ODDPLT
  - OUTMOD
- ORDER
  - PRANAL
- OUTMOD
  - MAIN
- PARPQ
  - PRANAL
- PARPW
- PERDIF
  - ODDPLT
- PLOT
  - DODP
- PLSANL
  - MAIN
- PLSBEG
  - PLSANL
- PLSEDM
  - MAIN
- PRANAL
  - STDANL
- PRTVAR
  - DODP
- PTCRV2
- ROTATE
- RUNBEG
  - MAIN
- SCRTNB
  - OUTMOD
- SCRTNV
  - PRANAL
- SEDRB
  - DOCP
- SELECT
  - MAIN
- SELPRT
- SETBFL
- SETJTL
- SPLOT

- ODDPLT
STDANL
- PLSANL
STEP
- ODDPLT
VGRLOG
- MAIN
VOYPRT
- CURCAL
- KNTCUR
- MODCAL
- PLSANL
XAXALT
- DODP
XLAB
YDAT

CALLS

CURCAL
- VOYPRT
DOCP
- ALTCP
- SEDRB
DODP
- AVEDIS
- AXISD
- AXISPT
- AXISST
- AXIST
- DAYLAB
- DOYLAB
- EXIT
- FRAME
- FRAMEC
- GAP
- LABP
- LINCOL
- NEWPEN
- PLOT
- PRTVAR
- PTCRV2
- ROTATE
- XAXALT
- XLAB
- YDAT
IDCANL
- MOMENT
JC
- CURNT
KNTCUR
- CAVE
- VOYPRT
MAIN
- $DATE
- ANSPRT
- CORRCT
- DOCALT
- NXTMOD
- OUTMOD
- PLSANL
- PLSBEG
- PLSEDM
- RUNBEG
- SELECT
- SELPRT
- SETBFL
- SETJTL
- VGRLOG
MODCAL
- VOYPRT
ODDPLT

- ENDPLT
- PERDIF
- SPLOT
- STEP

OUTMOD
- CLRVAR
- DOCN
- DOCP
- DODP
- DOHA
- ODDPLT
- SCRTNB
- SCRTNV

PLSANL
- ANSPRT
- BKGDCR
- CURCAL
- GETFLD
- IDCANL
- KNTCUR
- PLSBEG
- STDANL
- VOYPRT

PRANAL
- MJSFIT
- MOMENT
- ORDER
- PARPQ
- PARPW
- SCRTNV

SPLOT
- CURPLT
- JC
- KNTCUR
- NUMBER

STDANL
- ELANAL
- PRANAL

COMMON LOADED BY

CCA
- RUNBEG

CDATA
- DODP

CDOCP
- RUNBEG

CGAP
- DODP

LPLS
- RUNBEG

MITRUN

MORLST
- DODP

MORRAY

NDYCOM
- RUNBEG

PLCONS
- PLSBEG

PSTUFF
- RUNBEG

COMMON USED BY

- CALSP
  - DOCALT
  - RUNBEG
- CCA
  - ANSPRT
  - CORRCT
  - DOCALT
  - DOCP
  - DODP
  - OUTMOD
  - PLSBEG
  - RUNBEG
- CDOCP
  - DOCP
  - RUNBEG
- CDODP
  - DODP
- CMODE
  - CORRCT
  - DOCALT
  - DODP
  - ODDPLT
- CMOE
  - OUTMOD
- LPLS
  - DOCP
- LVAR
  - SPLOT
- MITRUN
  - DODP
  - ODDPLT
  - OUTMOD
  - RUNBEG
- MORLST
  - DODP
- MORRAY
- NDYCOM
  - RUNBEG
- PLCONS
  - ANSPRT
  - DOCP
  - JC
  - PLSBEG
  - RUNBEG
- PSTUFF
  - DODP
  - RUNBEG
- VSTEP
  - STEP

COMMONS IN

- ANSPRT
  - CCA
  - PLCONS
- CORRCT
  - CCA
  - CMODE
- DOCALT
  - CALSP
  - CCA
  - CMODE
- DOCP
  - CCA
  - CDOCP
  - LPLS
  - PLCONS
- DODP
  - CCA
  - CDODP
  - CMODE
  - MITRUN
  - MORLST
  - MORRAY
  - NDYCOM
  - PSTUFF
- JC
  - PLCONS
- ODDPLT
  - CMODE
  - MITRUN
- OUTMOD
  - CCA
  - CMOE
  - MITRUN
- PLSBEG
  - CCA
  - PLCONS
- RUNBEG
  - CALSP
  - CCA
  - CDOCP
  - MITRUN
  - NDYCOM
  - PLCONS
  - PSTUFF
- SPLOT
  - LVAR
- STEP
  - VSTEP

ENTRIES

- DOENG
  - DODP
- GETJTL
  - SETJTL
- ODDPLT
  - DODP
- SELPRT
  - SELECT
- SETBFL
  - NXTMOD