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 Index 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 Currents 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 :href 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 :href 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 :htref 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 :htref 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. :hhref 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" :refid=ANSIDC..

ARG DEFINITION

ANS-TEMP :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 :href 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 :href 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 Minimum channel to be included.
L2 Maximum channel to be included.
V Velocity of channel at middle of channel.
R Current in femtoamps.
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 (:htdref refid=CMODE.) is not available at GSFC and should be avoided if possible.

ARG DEFINITION

ANS-TEMP :htdref 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 :htdref 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 $\rho_{\text{mon}}$ and $\rho_{\text{fit}}$

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 :stdcall...

**PLSEDMD (JTBH, IEODC)**

PLSEDMD 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 (:stdcall=FT02.) which is read in by RUNBEG (:stdcall=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 before GETJTL. Uses special data from NXTMOD.

<table>
<thead>
<tr>
<th>ARG</th>
<th>TYPE</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>JTLMO</td>
<td>I2</td>
<td>Modified JTLMOD</td>
</tr>
<tr>
<td>JTLOFF</td>
<td>I2</td>
<td>Offset for JTLMOD. JTLMO - JTLMOD</td>
</tr>
<tr>
<td>KSTAT</td>
<td>I2</td>
<td>Best guess at status word.</td>
</tr>
<tr>
<td>JTLMOD</td>
<td>I2</td>
<td>Type of mode.</td>
</tr>
<tr>
<td>JCLK</td>
<td>I2</td>
<td>Index for integration time of instrument.</td>
</tr>
</tbody>
</table>

**GETJTL ( JTLMO, JTLOFF, KSTAT)**

Returns the arguments calculated by the last call to SETJTL.
**SPL**OT (KNS, KTB, KDATA, KNE, KSTAT, KTLMOD, KCLK, KEMP, XXCEL, KKINDS, KINDEX, KKSTAT, IH)

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

<table>
<thead>
<tr>
<th>ARG</th>
<th>DEFINITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>KNS</td>
<td>!</td>
</tr>
<tr>
<td>KTB</td>
<td>!</td>
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<tr>
<td>KDATA</td>
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<td>KINDEX</td>
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</tr>
<tr>
<td>KKSTAT</td>
<td>!</td>
</tr>
<tr>
<td>IH</td>
<td>!</td>
</tr>
</tbody>
</table>
STDANL (ANS, JTB, JDAT, JNE, LSTAT, JTLMOD, JCLK, TEMP, CURRNT, IXCEL, CNOISE, RMARK)

STDANL processes all of the standard plasma measurements, using the subroutines PRA-NAL 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.