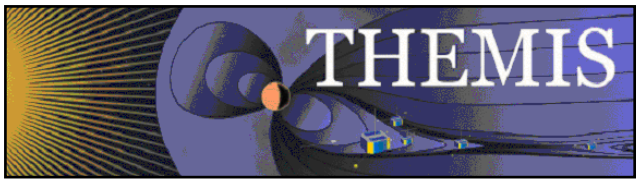

THEMIS
L2 File Definitions

THM-SOC-125
September 2011

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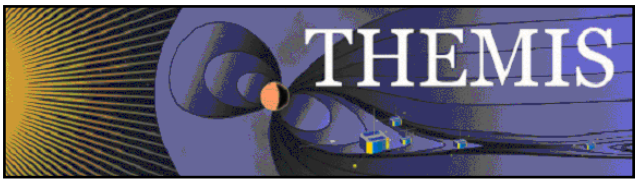

Document Revision Record

Rev.	Date	Description of Change	Approved By
-	Sep 2011	Initial Version	D. King

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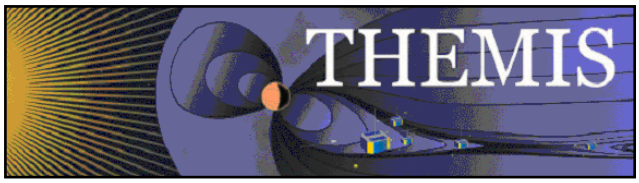

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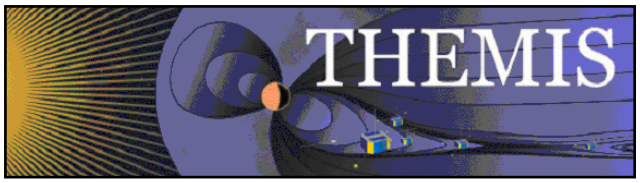


1. Introduction

1.1 Purpose and Scope

Three levels of THEMIS data products exist: “Level 0” (L0), “Level 1” (L1), and “Level 2” (L2). L0 data is in the form of raw packets. L1 data is time-tagged, uncalibrated data, stored in Common Data Format (CDF) files. L2 data, also stored as CDF files, consists of calibrated data in geophysically relevant coordinates. This document discusses the structure of the L2 CDF files, together with the processes involved in producing them. For a discussion of the L1 data files see the L1 File Definitions document. For a discussion of the L2 GMAG data files in particular, see the Ground Magnetometer L2 Data Files Variable Name Definition document.

1.2 Applicable Documents

1.	THM_SOC_124_L1_FILE_DEF	THEMIS L1 File Definitions
2.	THM_SOC_108_GMAG_L2_VARNAMES	THEMIS Ground Magnetometer L2 Data Files Variable Name Definition
3.	THM_SOC_110_COORDINATES	THEMIS Science Coordinate Systems Definition
4.	thm_l2gen_demo.txt	Detailed example of L1->L2 processing
5.	THM_SOC_101_TIME	THEMIS Science TIME Definition
6.	THM_SOC_135_TIME_CONVENTIONS	THEMIS/ARTEMIS timekeeping conventions

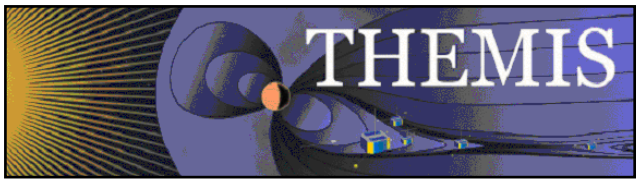
2. Common Data Format

CDF (Common Data Format) is a means of storing and manipulating multidimensional data sets and associated metadata. Full documentation, software, conversion tools, and so on, are available from NASA/GSFC at http://cdf.gsfc.nasa.gov/. CDF files are manipulated using the CDF library application programming interfaces (APIs) – users are isolated from the actual format in which the data is stored. The resulting files can be transported between any of the platforms supported by CDF.

CDF files contain “variables” (the data) and “attributes”. Variables are organized as multidimensional arrays, ranging from 0-dimensional arrays for scalar data, up to 10. Each variable is also assigned a data type, for example CDF_BYTE, CDF_CHAR, CDF_INT4. A “CDF record” is comprised of an array for each of the variables – CDFs can contain multiple records, but the array size for a variable cannot vary between records. CDFs can also contain ‘virtual’ variables. The values for virtual variables are not contained within the CDF, instead they can be calculated by some external code.

The attributes in a CDF are divided into global attributes (gAttributes), which include the metadata describing the CDF file, and variable attributes (vAttributes), which describe the properties of the variables. Global attributes include information such as the project and PI names; variable attributes include information such as the units for the data. THEMIS CDFs are designed to comply with ISTP/IACG guidelines, which can be found at http://spdf.gsfc.nasa.gov/istp_guide/istp_guide.html. These guidelines specify certain required attributes, variables, naming conventions for variables, etc. The compliance of a given CDF with ISTP guidelines can be checked with the ISTP Skeleton Editor: skteditor, available at http://sscweb.gsfc.nasa.gov/skteditor/.

For each L2 data type a mastercdf file exists that gives all the attribute and variable information but does not include any data, e.g. tha_l2_esa_00000000_v01.cdf gives the attribute and variable information for the L2 data from the THEMIS Probe A Electrostatic Analyzer. As will be discussed later in the document, these master CDFs are used in the creation of the L2 CDFs. Mastercdfs can be edited by converting them to skeleton table format (using, for example the SPDF skeletontable tool), editing the resulting text file and converting back to CDF (using, for example the SPDF skeletonCDF tool). See section



4 below for an example of a skeleton table. Note that you can also use the ISTP Skeleton Editor to edit a CDF or a skeleton table, while checking ISTP compliance.

Note that it is recommended that users download the NASA IDL CDF patch available at (as of July 2011) http://cdf.gsfc.nasa.gov/html/cdf_patch_for_idl6x_new3.html.

More details on THEMIS CDFs can be found in thm_soc_124_L1_file_def.doc

3. L1->L2 Processing

A detailed example of the L1->L2 processing can be found in thm_l2gen_demo.txt.
L2 files are generated automatically every day using a script create_probe_l2cdf.ksh. All L1 files created in the previous 36 hours are processed. In addition, if L1 state files have been created in the previous 36 hours, then the L2 files which use coordinate transformations (all but SST, FFT, and FBK) are processed, even if there is no new L1 data for those instruments. To generate L2 files, the TDAS software is used to first load, and then calibrate the corresponding L1 (or L0) data. The resulting tplot variables are then written to a CDF with the help of a mastercdf file. In the resulting L2 CDF all metadata comes from the mastercdf, and is not inherited from the L1 data or calibration process.
L2 files are reprocessed whenever there are changes in calibration files. This is reasonably infrequent, with the exception of FGM where calibration files are updated every few months.

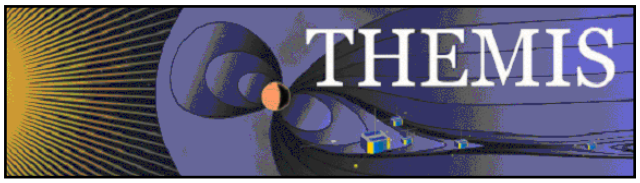
4. L2 CDFs

By convention THEMIS time is measured as the number of unleaped seconds since 1-Jan-1970 00:00:00 GMT. The time variables that appear in L2 CDFs will be discussed briefly below. For more detail see the L1 File Definitions document and the THEMIS Science Time document. For discussion on THEMIS time conventions and leap seconds see the THEMIS Time Conventions document (thm_soc_135_time_conventions).

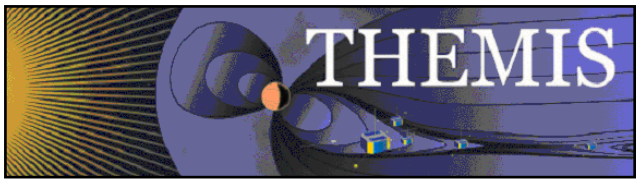
A data variable ‘varname’ has an associated time variable ‘varname_time’ e.g. tha_peif_time in table below, together with a variable of the type CDF_EPOCH, e.g. tha_peif_epoch0, that has a nonvarying value of 1-Jan-1970 00:00:00.000. Variables are linked to a time variable and an epoch variable through the attributes DEPEND_TIME and DEPEND_EPOCH0. For example, for the variable tha_peif_data_quality, DEPEND_TIME has the value ‘tha_peif_time’ and DEPEND_EPOCH0 has the value ‘tha_peif_epoch0’. In addition, each THEMIS variable has a *virtual* variable of the type CDF_EPOCH/CDF_EPOCH16 with the name ‘varname_epoch’, e.g. tha_peif_epoch. This virtual variable is for use by CDAWeb, and is calculated using functions ‘comp_themis_epoch’ and ‘comp_themis_epoch16’ provided by SPDF. The variable attribute DEPEND_0 points to the virtual epoch variable.

The final time variable encountered in the L2 CDFs is the range_epoch variable. This variable, of type CDF_EPOCH, contains the minimum and maximum times associated with any of the variables in the particular CDF.

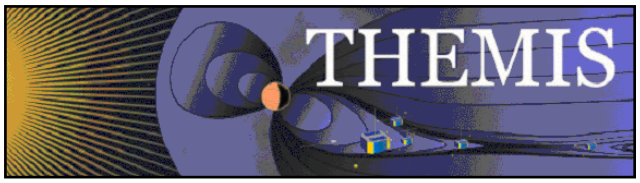
Below is an example skeleton table – in this case an excerpt from the L2 skeleton table for ESA. The global attributes are listed first, followed by the variable attribute names. Finally, for each variable the attributes, attribute types, and attribute values are given.



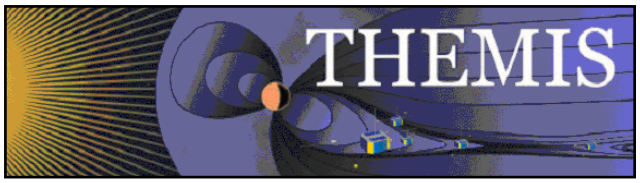

```
! Skeleton table for the "tha_l2_esa_00000000_v01" CDF.
! Generated: Friday, 19-Aug-2011 15:11:57
! CDF created/modified by CDF V3.1.1
! Skeleton table created by CDF V3.3.0

#header

                    CDF NAME: tha_l2_esa_00000000_v01
                DATA ENCODING: NETWORK
                    MAJORITY: ROW
                      FORMAT: SINGLE
! Variables                G.Attributes         V.Attributes  Records    Dims          Sizes
! ---------                ------------         ------------  -------    ----          -----
0/383                      35                   28            0/z        0

#GLOBALattributes

! Attribute                                Entry     Data
! Name                                     Number    Type     Value
 ---------                                ------    ----     -----
"Project"                                     1:   CDF_CHAR   { "THEMIS" } .

"Source_name"                                 1:   CDF_CHAR   { "THA>Themis Probe A" } .

"Discipline"                                  1:   CDF_CHAR   { "Space " -
                                                               "Physics>Magnetospheric " -
                                                               "Science" } .

"Data_type"                                   1:   CDF_CHAR   { "ESA" } .

"Descriptor"                                  1:   CDF_CHAR   { "L2>L2 DATA" } .

"Data_version"                                1:   CDF_CHAR   { "1" } .

"PI_name"                                     1:   CDF_CHAR   { "V. Angelopoulos, C.W. " -
                                                               "Carlson & J. McFadden" } .

"PI_affiliation"                              1:   CDF_CHAR   { "UCB, NASA NAS5-02099" } .

"TITLE"                                       1:   CDF_CHAR   { "Electrostatic Analyzer (ESA)" } .
```



"TEXT"	1:	CDF_CHAR	{ "THEMIS-A: Electrostatic " - "Analyzer (ESA): " - "Electron/Ion " - "Ground-Calculated Energy " - "Fluxes (ions: 5 eV to 25 " - "keV) electrons: 6 eV to 30" - " keV) and Moments " - "(density, velocity, " - "pressure, and " - "temperature). Includes " - "FULL, REDUCED and BURST " - "modes. FULL: high angular " - "resolution, low (few min) " - "time resolution. REDUCED: " - "degraded angular " - "resolution, high (approx. " - "3 sec) time resolution. " - "BURST: high angular " - "resolution, high time " - "resolution; only short " - "bursts of data. Note that " - "angular resolution affects" - " moments since they are " - "obtained integrating over " - "the mode-specific angular " - "distribution. Moment Data " - "Quality flags (0: good " - "data; non-zero flags are " - "totals of values; 1: " - "missing S/C potential, 2: " - "Counter saturation, 4: " - "Solar Wind not in Solar " - "Wind Mode, or Solar Wind " - "Mode, not in Solar Wind, " - "8: (Reduced Mode only) " - "slow survey mode+flows, " - "16: electron density Gt " - "2*ion density, 32: ion " - "density Gt 2*electron " - "density, 64: Spacecraft " - "Maneuver)." } .
"Instrument_type"	1:	CDF_CHAR	{ "Particles (space)" }
	2:	CDF_CHAR	{ "Plasma and Solar Wind" } .
"Mission_group"	1:	CDF_CHAR	{ "THEMIS" } .
"Logical_source"	1:	CDF_CHAR	{ "tha_l2_esa" } .
"Logical_file_id"	1:	CDF_CHAR	{ "tha_l2_esa_00000000_v01" } .
"Logical_source_description"	1:	CDF_CHAR	{ "THEMIS-A: Electrostatic " - "Analyzer (ESA): " - "Electron/Ion " - "Ground-Calculated Energy " - "Fluxes (ions: 5 eV to 25 " - "keV) electrons: 6 eV to 30" - " keV) and Moments " - "(density, velocity, " - "pressure, and " - "temperature). Includes " – "FULL, REDUCED and BURST " - "modes. FULL: high angular " - "resolution, low (few min) " - "time resolution. REDUCED: " - "degraded angular " - "resolution, high (approx. " -

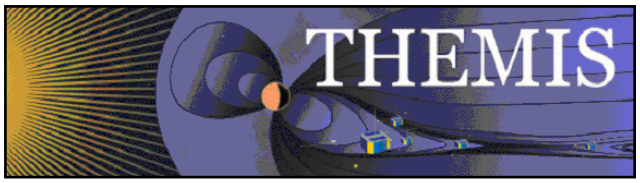


```
                                                    "3 sec) time resolution. " -
                                                    "BURST: high angular " -
                                                    "resolution, high time " -
                                                    "resolution; only short " –
                                                    "bursts of data. Note that " –
                                                    "angular resolution affects" -
                                                    " moments since they are " –
                                                    "obtained integrating over " -
                                                     "the mode-specific angular " -
                                                    "distribution." } .
"Time_resolution"                   1:  CDF_CHAR    { "???" } .

"Rules_of_use"                      1:  CDF_CHAR    { "Open Data for Scientific Use" } .

"Generated_by"                      1:  CDF_CHAR    { "THEMIS SOC" } .

"Generation_date"                   1:  CDF_CHAR    { "Thu Sep  4 15:07:27 2008" } .

"Acknowledgement"                   1:  CDF_CHAR    { "NASA Contract NAS5-02099" } .

"MODS"                              1:  CDF_CHAR    { "Rev- 2006-09-18" } .

"ADID_ref"                          1:  CDF_CHAR    { "NSSD0110" } .

"LINK_TEXT"                         1:  CDF_CHAR    { "THEMIS ESA " }
                                    2:  CDF_CHAR    { "Higher resolution data and" -
                                                    " analysis s/w from " }
                                    3:  CDF_CHAR    { "Detailed description of the " }
                                    4:  CDF_CHAR    { "Detailed explanation of the " } .

"LINK_TITLE"                        1:  CDF_CHAR    { "Processing History" }
                                    2:  CDF_CHAR    { "THEMIS mission website" }
                                    3:  CDF_CHAR    { "ESA Instrument" }
                                    4:  CDF_CHAR    { "ESA L2 Data Quality Flags" } .

"HTTP_LINK"                         1:  CDF_CHAR    { "http://themis.ssl.berkeley" -
                                                    ".edu/esa_proc_history.shtm" -
                                                    "l" }
                                    2:  CDF_CHAR    { "http://themis.ssl.berkeley" -
                                                    ".edu" }
                                    3:  CDF_CHAR    { "http://themis.ssl.berkeley" -
                                                    ".edu/instrument_esa.shtml" }
                                    4:  CDF_CHAR    { "http://themis.ssl.berkeley" -
                                                    ".edu/esa_flag.shtml" } .

"File_naming_convention"            1:  CDF_CHAR    { "source_descriptor_datatype" } .


"Caveats"                           1:  CDF_CHAR    { "See THEMIS website for " -
                                                    "caveats" } .


"Validity"                          1:  CDF_CHAR    { "to be validated" } .

"Validator"                         1:  CDF_CHAR    { "tbd" } .

"Validate"                          1:  CDF_CHAR    { "Compatible with the ISTP " -
                                                    "CDF Standards" } .
```



```
"Inst_mod"                                  1:  CDF_CHAR   { "THM>xxxx" } .

"Parents"                                   1:  CDF_CHAR   { "xxxx" } .

"Inst_settings"                             1:  CDF_CHAR   { "Not used" } .

"Software_version"                          1:  CDF_CHAR   { "xxxx" } .

"Sc_pot_source"                             1:  CDF_CHAR   { "None" } .

#VARIABLEattributes

  "DISPLAY_TYPE"
  "FILLVAL"
  "FORMAT"
  "UNITS"
  "DEPEND_TIME"
  "DEPEND_EPOCH0"
  "DEPEND_0"
  "VAR_TYPE"
  "PROPERTY"
  "SC_ID"
  "CATDESC"
  "FIELDNAM"
  "VALIDMIN"
  "VALIDMAX"
  "TENSOR_ORDER"
  "SI_CONVERSION"
  "LABLAXIS"
  "SCALETYP"
  "COORDINATE_SYSTEM"
  "DEPEND_1"
  "DICT_KEY"
  "REPRESENTATION_1"
  "VAR_NOTES"
  "LABL_PTR_1"
  "VIRTUAL"
  "FUNCT"
  "COMPONENT_0"
  "COMPONENT_1"

#variables

! No rVariables.

#zVariables
! Variable                      Data       Number                      Record        Dimension
! Name                          Type      Elements     Dims   Sizes   Variance       Variances
! --------                      ----      --------     ----   -----   --------       ---------
"tha_peif_data_quality"     CDF_INT4          1         0                T

! Attribute                 Data
! Name                      Type          Value
! --------                  ----          -----

"DISPLAY_TYPE"              CDF_CHAR      { "time_series" }
"FILLVAL"                   CDF_INT4      { -2147483648 }
"FORMAT"                    CDF_CHAR      { "i2" }
"DEPEND_TIME"               CDF_CHAR      { "tha_peif_time" }
```

```
"DEPEND_EPOCH0"             CDF_CHAR      { "tha_peif_epoch0" }
"DEPEND_0"                  CDF_CHAR      { "tha_peif_epoch" }
"VAR_TYPE"                  CDF_CHAR      { "data" }
"PROPERTY"                  CDF_CHAR      { "scalar" }
"SC_ID"                     CDF_CHAR      { "a" }
"CATDESC"                   CDF_CHAR      { "ESA Full Mode Ion Moment Data Quality " -
                                          "(0: Good data, non-zero: Data may not " -
                                          "be suitable, see: " -
                                          "http://themis.ssl.berkeley.edu/esa_fla" -
                                          "g.shtml.) " }
"FIELDNAM"                  CDF_CHAR      { "Data_Quality_Flag_ion Full ESA-A" }
"VALIDMIN"                  CDF_INT4      { 0 }
"VALIDMAX"                  CDF_INT4      { 112 }
"TENSOR_ORDER"              CDF_INT4      { 0 }
"LABLAXIS"                  CDF_CHAR      { "Data_Quality_Flag_ion Full ESA-A" }
"SCALETYP"                  CDF_CHAR      { "linear" } .
! RV values were not requested.

! Variable                      Data       Number                      Record        Dimension
! Name                          Type       Elements     Dims   Sizes   Variance      Variances
! --------                      ----       --------     ----   -----   --------      ---------
"tha_peif_densityQ"         CDF_DOUBLE         1         0                 T

! Attribute                   Data
! Name                        Type          Value
! --------                    ----          -----

"DISPLAY_TYPE"              CDF_CHAR      { "time_series" }
"FILLVAL"                   CDF_DOUBLE    { nan.0 }
"FORMAT"                    CDF_CHAR      { "E13.6" }
"UNITS"                     CDF_CHAR      { "cm^-3" }
"DEPEND_TIME"               CDF_CHAR      { "tha_peif_time" }
"DEPEND_EPOCH0"             CDF_CHAR      { "tha_peif_epoch0" }
"DEPEND_0"                  CDF_CHAR      { "tha_peif_epoch" }
"VAR_TYPE"                  CDF_CHAR      { "data" }
"PROPERTY"                  CDF_CHAR      { "scalar" }
"SC_ID"                     CDF_CHAR      { "a" }
"CATDESC"                   CDF_CHAR      { "(Good data only) ESA Full (High " –
                                            "Angular Resolution, few minute time " –
                                            "res.) Mode, Ion Density " }
"FIELDNAM"                  CDF_CHAR      { "N_ion Full ESA-A" }
"VALIDMIN"                  CDF_DOUBLE    { 0.0 }
"VALIDMAX"                  CDF_DOUBLE    { 1.0e+10 }
"TENSOR_ORDER"              CDF_INT4      { 0 }
"SI_CONVERSION"             CDF_CHAR      { "1.0e6>m^-3" }
"LABLAXIS"                  CDF_CHAR      { "N_ion Full ESA-A" }
```



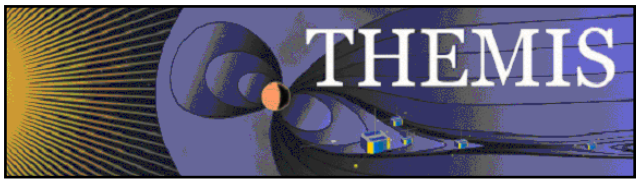
```
"SCALETYP"                  CDF_CHAR       { "log" }
"VIRTUAL"                   CDF_CHAR       { "TRUE" }
"FUNCT"                     CDF_CHAR       { "apply_esa_qflag" }
"COMPONENT_0"               CDF_CHAR       { "tha_peif_density" }
"COMPONENT_1"               CDF_CHAR       { "tha_peif_data_quality" } .
! RV values were not requested.
.
```

. *(other variables here)*

```
.
! Variable                     Data       Number                     Record        Dimension
! Name                         Type       Elements     Dims   Sizes  Variance      Variances
! --------                     ----       --------     ----   -----  --------      ---------
"tha_peif_t3_labl"          CDF_CHAR           20        1    3            F              T

! Attribute                  Data
! Name                       Type          Value
! --------                   ----          -----

"FORMAT"                    CDF_CHAR       { "a20" }
"VAR_TYPE"                  CDF_CHAR       { "metadata" }
"CATDESC"                   CDF_CHAR       { "tha_peif_t3_labl" }
"FIELDNAM"                  CDF_CHAR       { "tha_peif_t3_labl" }
"DICT_KEY"                  CDF_CHAR       { "label" } .

! NRV values follow...
[1] = { "Tprp1_ion Full ESA-A" }
[2] = { "Tprp2_ion Full ESA-A" }
[3] = { "Tpar_ion Full ESA-A " }

.
```

. *(other variables here)*

```
.
! Variable                     Data       Number                     Record        Dimension
! Name                         Type       Elements     Dims   Sizes  Variance      Variances
! --------                     ----       --------     ----   -----  --------      ---------
"tha_peif_time"             CDF_DOUBLE         1         0                T

! Attribute                  Data
! Name                       Type          Value
! --------                   ----          -----

"FILLVAL"                   CDF_DOUBLE     { nan.0 }
"FORMAT"                    CDF_CHAR       { "F12.8" }
"UNITS"                     CDF_CHAR       { "sec" }
"VAR_TYPE"                  CDF_CHAR       { "support_data" }
"CATDESC"                   CDF_CHAR       { "tha_peif_time, UTC, in seconds since " –
                                             "01-Jan-1970 00:00:00; marks center " –
```



```
                                          "time of data sample" }
"FIELDNAM"                  CDF_CHAR      { "tha_peif_time" }
"VALIDMIN"                  CDF_DOUBLE    { 0.0 }
"VALIDMAX"                  CDF_DOUBLE    { 5.0e+09 }
"LABLAXIS"                  CDF_CHAR      { "UT" }
"VAR_NOTES"                 CDF_CHAR      { "Unleaped seconds. Sample start and end" –
                                            " time can be calculated from  " –
                                            "tha_peif_delta_time (sample duration)." } .
  ! RV values were not requested.
.
```

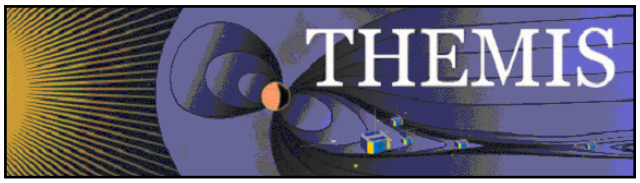
. *(other variables here)*

```
.
! Variable                    Data       Number                    Record        Dimension
! Name                        Type       Elements     Dims   Sizes  Variance      Variances
! --------                    ----       --------     ----   -----  --------      ---------
"tha_peif_epoch0"           CDF_EPOCH          1         0                F

! Attribute                 Data
! Name                      Type          Value
! --------                  ----          -----

"FILLVAL"                   CDF_DOUBLE    { -1.0e+31  }
"FORMAT"                    CDF_CHAR      { "E13.6"}
"UNITS"                     CDF_CHAR      {  "msec"}
"VAR_TYPE"                  CDF_CHAR      { "support_data" }
"CATDESC"                   CDF_CHAR      { "EPOCH0 of THEMIS time base"}
"FIELDNAM"                  CDF_CHAR      { "tha_peif_epoch0"}
"VALIDMIN"                  CDF_DOUBLE    { 5.99582e+13 }
"VALIDMAX"                  CDF_DOUBLE    { 6.63012e+13}
"LABLAXIS"                  CDF_CHAR      { "timebase"}
"VAR_NOTES"                 CDF_CHAR      { "EPOCH of 01-Jan-1970 00:00:00"} .
! NRV values follow...
[] = 01-Jan-1970 00:00:00.000
.
```

. *(other variables here)*

```
.
#end
```

The skeleton table excerpt shown here gives examples of the entries for three types of variable, data, metadata, and support data (identifiable by the “VAR_TYPE” attribute). Note that the metadata variable "tha_peif_t3_labl" has Record Variance = F, indicating that the values do not vary between CDF records. The values of this variable are also listed in the skeleton table. "tha_peif_densityQ" is an example of a virtual variable (“VIRTUAL” = “TRUE”). The attributes for the virtual variable include “FUNCT”, “COMPONENT_0”, and “COMPONENT_1”, which give the function and arguments used to calculate the values of the virtual variable.



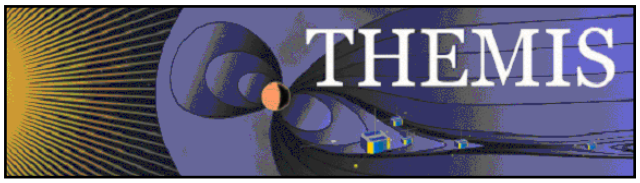
Note that the variable names in the skeleton table above begin with 'tha_'. It is the THEMIS convention that CDF variables begin 'th?_' where '?' is one of a-2, representing probes A-E. In the sections below variable names are listed for Probe A (with the exception, of course, of the ground based GMAG).
Coordinate systems in the following are abbreviated. GSE: Geocentric Solar Ecliptic, GSM: Geocentric Solar Magnetospheric, DSL: Despun Spacecraft, SSL: Spinning Spacecraft (see THEMIS Science Coordinate Systems Definition document for more details).
Descriptions of variables here are (for the most part) taken directly out of the master cdfs.

4.1 ESA (Electrostatic Analyzer)

During L2 processing a data quality variable is created that indicates which data may have problems (see table below for more details). ESA L2 CDFs also contain a number of virtual variables, denoted with a 'Q', used by NASA SPDF to screen out data that may have problems. The data quality flag is used to fill these 'Q' variables (the values for virtual variables do not appear within the CDF, but are instead calculated by some external code from non-virtual variables). Note that the TDAS software makes use of the data quality flag but does not use the 'Q' virtual variables.

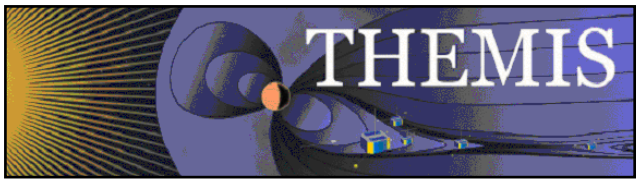
ESA L2 variables
Here '?' takes the values 'i' for ion or 'e' for electron
'*' takes the values 'f' for full (high angular resolution, low (few min) time resolution), 'r' for reduced (low angular resolution, high (approx 3 sec) time resolution), and 'b' for burst (high time and angular resolution) mode.
For example, there exist variables tha_peif_data_quality, tha_peef_data_quality, tha_peir_data_quality, tha_peer_data_quality, tha_peib_data_quality, and tha_peeb_data_quality.

tha_pe?*_data_quality	ESA Full/Reduced/Burst Mode Ion/Electron Moment Data Quality (0: Good data, non-zero: Data may not be suitable, see: http://themis.ssl.berkeley.edu/esa_flag.shtml.)
tha_pe?*_densityQ	(Virtual) ESA Full/Reduced/Burst Mode, Ion/Electron Density, good data only.
tha_pe?*_avgtempQ	(Virtual) Average temperature
tha_pe?*_vthermalQ	(Virtual) Thermal velocity
tha_pe?*_sc_potQ	(Virtual) Spacecraft potential
tha_pe?*_en_efluxQ	(Virtual) Energy flux spectrogram
tha_pe?*_t3Q	(Virtual) Diagonalized temperature
tha_pe?*_magt3Q	(Virtual) Temperature, field aligned
tha_pe?*_ptensQ	(Virtual) Pressure tensor
tha_pe?*_mftensQ	(Virtual) Momentum flux tensor
tha_pe?*_fluxQ	(Virtual) Particle flux vector
tha_pe?*_symmQ	(Virtual) Symmetry Vector (direction of pressure tensor symmetry (DSL))
tha_pe?*_symm_angQ	(Virtual) Symmetry Angle (between symmetry direction and B)
tha_pe?*_magfQ	(Virtual) Magnetic Field Vector in DSL
tha_pe?*_velocity_dslQ	(Virtual) Velocity vector in DSL
tha_pe?*_velocity_gseQ	(Virtual) Velocity vector in GSE
tha_pe?*_velocity_gsmQ	(Virtual) Velocity vector in GSM
tha_pe?*_modeQ	(Virtual) Survey mode, controls angle and energy binning, and time resolution, values 0 to 4 (peer, peib, peeb only?)
tha_pe?*_density	(All qualities data) ESA full/reduced/burst mode, ion/electron density
tha_pe?*_avgtemp	Average temperature
tha_pe?*_vthermal	Thermal velocity
tha_pe?*_sc_pot	Spacecraft potential



tha_pe?*_en_eflux	Energy flux spectrogram
tha_pe?*_en_eflux_yaxis	
tha_pe?*_t3	Diagonalized temperature Notes on diagonalized temperature:.The first eigenvalue and eigenvector are the distinguisheable eigenvalue and the major (symmetry) axis, respectively. The "degenerate" eigenvalues are sorted such that the 2nd eigenvalue is smaller than third one.
tha_pe?*_t3_labl	(Metadata) Label Value = {“Tprp1_^ * ESA-A”, “Tprp2_^ * ESA-A”, “Tpar_^ * ESA-A”}, ^ = ion, elec, * = Full, Rdcd, Brst
tha_pe?*_t3_compno	(Metadata) Component number Value = {1,2,3}
tha_pe?*_magt3	Temperature, field aligned 3d temperatures around magnetic axis (Z) and normal axes (X,Y), where Y is Z direction crossed into Sun direction and X completes orthogonal system.
tha_pe?*_magt3_labl	(Metadata) Label Value = {“Tprp1_^ FA * ESA-A”, “Tprp2_^ FA * ESA-A”, “Tpar_^ FA ^ ESA-A”}, ^ = ion, elec, * = Full, Rdcd, Brst
tha_pe?*_magt3_compno	(Metadata) Component number Value = {1,2,3}
tha_pe?*_ptens	Pressure tensor
tha_pe?*_ptens_labl	(Metadata) Label Value = {“Pxx_^ * ESA-A”, “Pyy_^ * ESA-A”, “Pzz_^ * ESA-A”, “Pxy_^ * ESA-A”, “Pxz_^ * ESA-A”, “Pyz_^ (ESA-A”}, ^ = ion, elec, * = Full, Rdcd, Brst
tha_pe?*_ptens_compno	(Metadata) Component number Value = {1,2,3,4,5,6}
tha_pe?*_mftens	Momentum flux tensor
tha_pe?*_mftens_labl	(Metadata) Label Value = {“MFxx_^ * ESA-A”, “MFyy_^ * ESA-A”, “MFzz_^ * ESA-A”, “MFxy_^ *ESA-A”, “MFxz_^ * ESA-A”, “MFyz_^ * ESA-A”}, ^ = ion, elec, * = Full, Rdcd, Brst
tha_pe?*_mftens_compno	(Metadata) Component number Value = {1,2,3,4,5,6}
tha_pe?*_flux	Particle flux vector
tha_pe?*_flux_labl	(Metadata) Label Value = {“Fx_^ DSL * ESA-A”, “Fy_^ DSL * ESA-A”, “Fz_^ DSL * ESA-A”}, ^ = ion, elec * = Full, Rdcd, Brst
tha_pe?*_flux_compno	(Metadata) Component number Value = {1,2,3}
tha_pe?*_symm	Symmetry Vector (direction of pressure tensor symmetry (DSL)) This is the direction vector of the principal axis of the pressure tensor in DSL coordinates.
tha_pe?*_symm_labl	(Metadata) Label Value = {“Symm_x^ * ESA-A”, “Symm_y^ * ESA-A”, “Symm_z^ * ESA-A”}, ^ = e, i,

	* = Full, Rdcd, Brst
tha_pe?*_symm_compno	(Metadata) Component number Value = {1, 2, 3}
tha_pe?*_symm_ang	Symmetry Angle (between symmetry direction and B)
tha_pe?*_magf	Magnetic Field Vector in DSL
tha_pe?*_magf_labl	(Metadata) Label Value = {“Bx_^ DSL * ESA-A”, “By_^ DSL * ESA-A”, “Bz_^ DSL *t ESA-A”}, ^ = elec, ion, * = Full, Rdcd, Brst
tha_pe?*_magf_compno	(Metadata) Component number Value = {1, 2, 3}
tha_pe?*_velocity_dsl	Velocity vector in DSL
tha_pe?*_velocity_dsl_labl	(Metadata) Label Value = {“Vx_^ DSL * ESA-A”, “Vy_^ DSL * ESA-A”, “Vz_^ DSL * ESA-A”}, ^ = elec, ion, * = Full, Rdcd, Brst
tha_pe?*_velocity_dsl_compno	(Metadata) Component number Value = {1, 2, 3}
tha_pe?*_velocity_gse	Velocity vector in GSE
tha_pe?*_velocity_gse_labl	(Metadata) Label Value = {“Vx_^ GSE * ESA-A”, “Vy_^ GSE * ESA-A”, “Vz_^ GSE * ESA-A”}, ^ = elec, ion, * = Full, Rdcd, Brst
tha_pe?*_velocity_gse_compno	(Metadata) Component number Value = {1, 2, 3}
tha_pe?*_velocity_gsm	Velocity vector in GSM
tha_pe?*_velocity_gsm_labl	(Metadata) Label Value = {“Vx_^ GSM * ESA-A”, “Vy_^ GSM * ESA-A”, “Vz_^ GSM * ESA-A”}, ^ = elec, ion, * = Full, Rdcd, Brst
tha_pe?*_velocity_gsm_compno	(Metadata) Component number Value = {1, 2, 3}
tha_pe?*_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_pe?*_delta_time	Duration in seconds of sample
tha_pe?*_mode	Survey mode, controls angle and energy binning, and time resolution, values of 0 to 8 (ion) or 4 (electron)
tha_pe?*_mode_labl	(Metadata) Label Value = {“cfg1_^ * ESA-A”, “cfg2_^ * ESA-A”, “mode_^ * ESA-A}, ^ = elec, ion, * = Full, Rdcd, Brst
tha_pe?*_mode_compno	(Metadata) Component number Value = {1, 2, 3}
tha_pe?*_epoch0	01-Jan-1970 00:00:00.000
tha_pe?*_epoch	(Virtual)
Rep_xyz_gse	(Metadata) Label representation Value = {“x”, “y”, “z”}
Rep_xyz_dsl	(Metadata) Label representation Value = {“x”, “y”, “z”}
Rep_xyz_gsm	(Metadata) Label representation Value = {“x”, “y”, “z”}



Rep_xyz_nfa	(Metadata) Label representation (NFA: Nominally Field Aligned) Value = {“xx”, “yy”, “zz”}
sc_pot_source	Source of the potential field used to obtain particle moments. If None, then the potential was set to 0. Else the potential was calculated using EFI data. Value = None
tha_?esa_solarwind_flag	ESA electron/ion solar wind mode flag; 0: Not in Solar Wind mode, 1: in Solar Wind mode
tha_?esa_solarwind_flag_time	Unleaped seconds
tha_?esa_solarwind_flag_epoch	(Virtual)
tha_?esa_solarwind_flag_epoch0	01-Jan-1970 00:00:00.000
range_epoch	

4.2 SST (Solid State Telescope)

SST L2 variables

Here ‘?’ takes the values ‘i’ for ion or ‘e’ for electron.

tha_ps?f_en_eflux	SST Ion/Electron energy spectrogram
tha_ps?f_en_eflux_yaxis	
tha_ps?f_en_eflux_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_ps?f_en_eflux_delta_time	Duration in seconds of sample.
tha_ps?f_en_eflux_mode	SST survey mode
tha_ps?f_en_eflux_epoch0	01-Jan-1970 00:00:00.000
tha_ps?f_en_eflux_epoch	(Virtual)
tha_?esa_solarwind_flag	ESA electron/ion solar wind mode flag; 0: Not in Solar Wind mode, 1: in Solar Wind mode
tha_?esa_solarwind_flag_time	Unleaped seconds
tha_?esa_solarwind_flag_epoch	(Virtual)
tha_?esa_solarwind_flag_epoch0	01-Jan-1970 00:00:00.000
range_epoch	

4.3 MOM (On board Moments)

Onboard moments are calculated from ESA and SST data. As with the ESA L2 cdfs, there is a data quality flag that indicates whether there are potential problems with the data. This data quality flag is used by NASA SPDF to fill the virtual ‘Q’ variables.

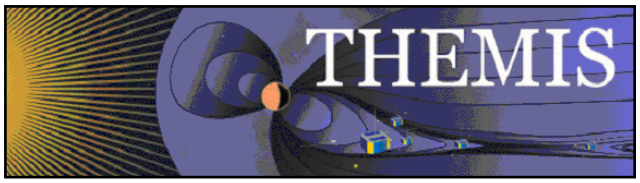
MOM L2 variables

Here ‘?’ takes the values ‘i’ for ion or ‘e’ for electron.

tha_pe?m_data_quality	Ion/Electron Moment Data Quality (0: good data, nonzero: data may not be suitable. See http://themis.ssl.berkeley.edu/mom_flag.shtml)
tha_pe?m_densityQ	(Virtual) ESA On Board Moment Ion/Electron Density (good data only)
tha_pe?m_ptotQ	(Virtual) Ion/Electron total pressure
tha_pe?m_fluxQ	(Virtual) Ion/Electron particle flux vector
tha_pe?m_mftensQ	(Virtual) Ion/Electron momentum flux tensor

tha_pe?m_efluxQ	(Virtual) Ion/Electron energy flux vector
tha_pe?m_velocity_dslQ	(Virtual) Ion/Electron velocity vector in DSL
tha_pe?m_velocity_gseQ	(Virtual) Ion/Electron velocity vector in GSE
tha_pe?m_velocity_gsmQ	(Virtual) Ion/Electron velocity vector in GSM
tha_pe?m_ptensQ	(Virtual) Ion/Electron pressure tensor
tha_pe?m_magQ	(Virtual) Magnetic field vector (DSL)
tha_pe?m_velocity_magQ	(Virtual) Ion/Electron velocity vector, field aligned
tha_pe?m_t3_magQ	(Virtual) Ion/Electron temperature, field aligned
tha_pe?m_ptens_magQ	(Virtual) Ion/Electron pressure tensor, field aligned
tha_pe?m_density	ESA On Board Moment Ion/Electron Density
tha_pe?m_ptot	Ion/Electron total pressure
tha_pe?m_flux	Ion/Electron particle flux vector
tha_pe?m_flux_labl	(Metadata) Label Value = {“Fx_* MOM ESA-A”, “Fy_* MOM ESA-A”, “Fz_* MOM ESA-A”}, * = ion, elec
tha_pe?m_flux_compno	(Metadata) Component number Value = {1,2,3}
tha_pe?m_mftens	Ion/Electron momentum flux tensor
tha_pe?m_mftens_labl	(Metadata) Label Value = {“Mfxx_* MOM ESA-A”, “Mfyy_* MOM ESA-A”, “Mfzz_* MOM ESA-A”, “Mfxy_* MOM ESA-A”, “Mfxz_* MOM ESA-A”, “Mfyz_* MOM ESA-A” }, * = ion, elec
tha_pe?m_mftens_compno	(Metadata) Component number Value = {1,2,3,4,5,6}
tha_pe?m_eflux	Ion/Electron energy flux vector
tha_pe?m_eflux_labl	(Metadata) Label Value = {“Efx_* MOM ESA-A”, “Efy_* MOM ESA-A”, “Efz_* MOM ESA-A”}, * = ion, elec
tha_pe?m_eflux_compno	(Metadata) Component number Value = {1,2,3}
tha_pe?m_velocity_dsl	Ion/Electron velocity vector in DSL
tha_pe?m_velocity_dsl_labl	(Metadata) Label Value = {“ Vx_* DSL MOM ESA-A”, “Vy_* DSL MOM ESA-A”, “Vz_* DSL MOM ESA-A”}, * = ion, elec
tha_pe?m_velocity_dsl_compno	(Metadata) Component number Value = {1,2,3}
tha_pe?m_velocity_gse	Ion/Electron velocity vector in GSE
tha_pe?m_velocity_gse_labl	(Metadata) Label Value = {“Vx_* GSE MOM ESA-A”, “Vy_* GSE MOM ESA-A”, “Vz_* GSE MOM ESA-A”}, * = ion, elec
tha_pe?m_velocity_gse_compno	(Metadata) Component number Value = {1,2,3}
tha_pe?m_velocity_gsm	Ion/Electron velocity vector in GSM
tha_pe?m_velocity_gsm_labl	(Metadata) Label Value = {“Vx_* GSM MOM ESA-A”, “Vy_* GSM MOM ESA-A”, “Vz_* GSM MOM ESA-A”}, * = ion, elec
tha_pe?m_velocity_gsm_compno	(Metadata) Component number

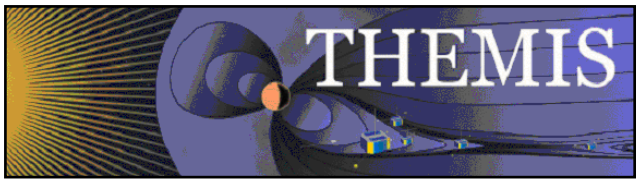
	Value = {1,2,3}
tha_pe?m_ptens	Ion/Electron pressure tensor
tha_pe?m_ptens_labl	(Metadata) Label Value = {“Pxx_* MOM ESA-A” , “Pyy_* MOM ESA-A”, “Pzz_* MOM ESA-A”, “Pxy_* MOM ESA-A”, “Pxz_* MOM ESA-A”, “Pyz_* MOM ESA-A”}, * = ion, elec
tha_pe?m_ptens_compno	(Metadata) Component number Value = {1,2,3,4,5,6}
tha_pe?m_mag	Magnetic field vector (DSL)
tha_pe?m_mag_labl	(Metadata) Label Value = { “Bx_* DSL MOM ESA-A”, “By_* DSL MOM ESA-A”, “Bz_* DSL MOM ESA-A”}, * = ion, elec
tha_pe?m_mag_compno	(Metadata) Component number Value = {1,2,3}
tha_pe?m_velocity_mag	Ion/Electron velocity vector, field aligned
tha_pe?m_velocity_mag_labl	(Metadata) Label Value = {“Vx_* FA MOM ESA-A”, “Vy_* FA MOM ESA-A”, “Vz_* FA MOM ESA-A”}, * = ion, elec
tha_pe?m_velocity_mag_compno	(Metadata) Component number Value = {1,2,3}
tha_pe?m_t3_mag	Ion/Electron temperature, field aligned 3d temperatures around magnetic axis (Z) and normal axes (X,Y), where Y is Z direction crossed into Sun direction, and X completes orthogonal system."
tha_pe?m_t3_mag_labl	(Metadata) Label Value = {“Tx_* FA MOM ESA-A”, “Ty_* FA MOM ESA-A”, “Tz_* FA MOM ESA-A”}, * = ion, elec
tha_pe?m_t3_mag_compno	(Metadata) Component number Value = {1,2,3}
tha_pe?m_ptens_mag	Ion/Electron pressure tensor, field aligned Pressure tensor around magnetic axis (Z) and normal axes (X,Y), where Y is direction crossed into Sun direction, and X completes orthogonal system.
tha_pe?m_ptens_mag_labl	(Metadata) Label Value = {“Pxx_* FA MOM ESA-A”, “Pyy_* FA MOM ESA-A”, “Pzz_* FA MOM ESA-A”, “Pxy_* FA MOM ESA-A”, “Pxz_* FA MOM ESA-A”, “Pyz_* FA MOM ESA-A”}, * = ion, elec
tha_pe?m_ptens_mag_compno	(Metadata) Component number Value = {1,2,3,4,5,6}
tha_pe?m_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_pe?m_epoch0	01-Jan-1970 00:00:00
tha_pe?m_epoch	(Virtual)
tha_pxxm_pot	Spacecraft potential
tha_pxxm_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_pxxm_epoch0	01-Jan-1970 00:00:00
tha_pxxm_epoch	(Virtual)
Rep_xyz_dsl	(Metadata) Label representation Value = {“x”, “y”, “z”}
Rep_xyz_gse	(Metadata) Label representation Value = {“x”, “y”, “z”}



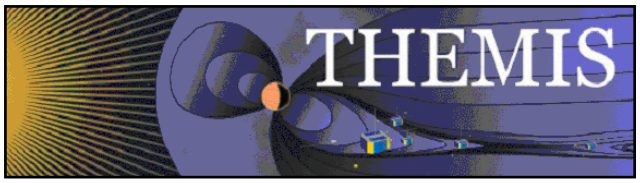
Rep_xyz_gsm	(Metadata) Label representation Value = {“x”, “y”, “z”}
Rep_xyz_nfa	(Metadata) Label representation Value = {“xx”, “yy”, “zz”}
tha_?esa_solarwind_flag	ESA electron/ion solar wind mode flag; 0: Not in Solar Wind mode, 1: in Solar Wind mode
tha_?esa_solarwind_flag_time	Unleaped seconds
tha_?esa_solarwind_flag_epoch	(Virtual)
tha_?esa_solarwind_flag_epoch0	01-Jan-1970 00:00:00
range_epoch	

4.4 EFI (Electric Field Instrument)

tha_efs_dot0_epoch	(Virtual)
tha_efs_dot0_gse	EFS_DOT0 (spin-fit, using E dot B=0) electric field vector in GSE coordinates
tha_efs_dot0_gse_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_dot0_gse_labl	(Metadata) Label Value = {“Ex GSE EFS_dot0-A”, “Ey GSE EFS_dot0-A”, Ez GSE EFS_dot0-A”}
tha_efs_dot0_gsm	EFS_DOT0 (spin-fit, using E dot B=0) electric field vector in GSM coordinates
tha_efs_dot0_gsm_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_dot0_gsm_labl	(Metadata) Label Value = {“Ex GSM EFS_dot0-A”, “Ey GSM EFS_dot0-A”, Ez GSM EFS_dot0-A”}
tha_efs_dot0_dsl	EFS_DOT0 (spin-fit, using E dot B=0) electric field vector in XYZ despun spacecraft coordinates (DSL)
tha_efs_dot0_dsl_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_dot0_dsl_labl	(Metadata) Label Value = {“Ex DSL EFS_dot0-A”, “Ey DSL EFS_dot0-A”, Ez DSL EFS_dot0-A”}
tha_efs_dot0_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_efs_q_mag	EFS_Q_MAG (Data Quality Parameter: set to NaN for EFS, as there is no good measure of data quality.)
tha_efs_q_mag_time	UTC in seconds since 01-Jan_1970 00:00:00
tha_efs_q_mag_epoch	(Virtual)
tha_efs_q_pha	EFS_Q_PHA (Data Quality Parameter: Set to NaN, as there is no good way to measure data quality for EFS data.)
tha_efs_q_pha_time	UTC in seconds since 01-Jan_1970 00:00:00
tha_efs_q_pha_epoch	(Virtual)
tha_efs_dot0_epoch0	01-Jan-1970 00:00:00.000
tha_eff_dot0_gse	EFF_DOT0 (fast-survey, 1/8 sec time resolution, using E dot B=0) electric field vector in GSE coordinates
tha_eff_dot0_gse_compno	(Metadata) Component number Value = {1, 2, 3}
tha_eff_dot0_gse_labl	(Metadata) Label Value = {“Ex GSE EFF_dot0-A”, “Ey GSE EFF_dot0-A”, Ez GSE EFF_dot0-A”}
tha_eff_dot0_gsm	EFF_DOT0 (fast-survey, 1/8 sec time resolution, using E dot

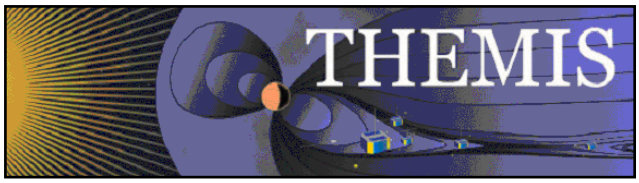


	B=0) electric field vector in GSM coordinates
tha_eff_dot0_gsm_compno	(Metadata) Component number Value = {1, 2, 3}
tha_eff_dot0_gsm_labl	(Metadata) Label Value = {“Ex GSM EFF_dot0-A”, “Ey GSE EFF_dot0-A”, Ez GSM EFF_dot0-A”}
tha_eff_dot0_dsl	EFF_DOT0 (fast-survey, 1/8 sec time resolution, , using E dot B=0) electric field vector in XYZ despun spacecraft coordinates (DSL)
tha_eff_dot0_dsl_compno	(Metadata) Component number Value = {1, 2, 3}
tha_eff_dot0_dsl_labl	(Metadata) Label Value = {“Ex DSL EFF_dot0-A”, “Ey DSL EFF_dot0-A”, Ez DSL EFF_dot0-A”}
tha_eff_dot0_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_eff_q_mag	EFF_Q_MAG (Data Quality Parameter: equal to the spin-fit E34 electric field magnitude divided by the spin-fit E12 electric field magnitude. Good values are near 1.0)
tha_eff_q_mag_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_eff_q_mag_epoch	(Virtual)
tha_eff_q_pha	EFF_Q_PHA (Data Quality Parameter: equal to the cosine of the angle between the spin-fit E34 electric field and the spin-fit E12 electric field. Good values are near 1.0)
tha_eff_q_pha_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_eff_q_pha_epoch	(Virtual)
tha_eff_e12_efs_epoch	(Virtual)
tha_eff_e12_efs	E12_EFS, Ground Spin-fit (using E12), spin plane electric field vector in XYZ despun spacecraft coordinates (DSL)
tha_eff_e12_efs_compno	(Metadata) Component number Value = {1, 2, 3}
tha_eff_e12_efs_labl	(Metadata) Label Value = {“Ex DSL EFF_E12_EFS-A”, “Ey DSL EFF_E12_EFS-A”, Ez DSL EFF_E12_EFS-A”}
tha_eff_e12_efs_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_eff_e34_efs_epoch	(Virtual)
tha_eff_e34_efs	E34_EFS, Ground Spin-fit (using E34), spin plane electric field vector in XYZ despun spacecraft coordinates (DSL)
tha_eff_e34_efs_compno	(Metadata) Component number Value = {1, 2, 3}
tha_eff_e34_efs_labl	(Metadata) Label Value = {“Ex DSL EFF_E34_EFS-A”, “Ey DSL EFF_E34_EFS-A”, Ez DSL EFF_E34_EFS-A”}
tha_eff_e34_efs_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_eff_dot0_epoch0	01-Jan-1970 00:00:00.000
Rep_xyz_dsl	(Metadata) Label representation Value = {“x”, “y”, “z”}
Rep_xyz_gse	(Metadata) Label representation Value = {“x”, “y”, “z”}
Rep_xyz_gsm	(Metadata) Label representation Value = {“x”, “y”, “z”}
range_epoch	



4.5 FBK (Filter Bank Data)

tha_fb_hff	High Frequency Filter peak and average values hf_peak and hf_avg are the peak and average values of the output of the High-Frequency Filter, a broadband filter covering the 100- to 400-kHz band used for AKR detection.
tha_fb_hff_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_hff_epoch	(Virtual)
tha_fb_hff_labl	(Metadata) Label Value = {"FBK-A HF Filter Peak Voltage", "FBK-A HF Filter Average Voltage"}
tha_fb_hff_compno	(Metadata) Component number Value = {1, 2}
tha_fb_v1	Spectrogram FBK Potential, Sensor 1
tha_fb_v1_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_v1_epoch	(Virtual)
tha_fb_v2	Spectrogram FBK Potential, Sensor 2
tha_fb_v2_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_v2_epoch	(Virtual)
tha_fb_v3	Spectrogram FBK Potential, Sensor 3
tha_fb_v3_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_v3_epoch	(Virtual)
tha_fb_v4	Spectrogram FBK Potential, Sensor 4
tha_fb_v4_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_v4_epoch	(Virtual)
tha_fb_v5	Spectrogram FBK Potential, Sensor 5
tha_fb_v5_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_v5_epoch	(Virtual)
tha_fb_v6	Spectrogram FBK Potential, Sensor 6
tha_fb_v6_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_v6_epoch	(Virtual)
tha_fb_edc12	Spectrogram FBK E Field DC Component, Sensors 1&2 (spin plane)
tha_fb_edc12_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_edc12_epoch	(Virtual)
tha_fb_edc34	Spectrogram FBK E Field DC Component, Sensors 3&4 (spin plane)
tha_fb_edc34_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_edc34_epoch	(Virtual)
tha_fb_edc56	Spectrogram FBK E Field DC Component, Sensors 5&6 (axial)
tha_fb_edc56_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_edc56_epoch	(Virtual)
tha_fb_scm1	Spectrogram FBK Search Coil Magnetometer (SCM) Axis 1
tha_fb_scm1_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_scm1_epoch	(Virtual)
tha_fb_scm2	Spectrogram FBK Search Coil Magnetometer (SCM) Axis 2
tha_fb_scm2_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_scm2_epoch	(Virtual)
tha_fb_scm3	Spectrogram FBK Search Coil Magnetometer (SCM) Axis 3
tha_fb_scm3_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_scm3_epoch	(Virtual)
tha_fb_eac12	Spectrogram FBK E Field AC Component, Sensors 1&2 (spin plane)
tha_fb_eac12_time	UTC in seconds since 01-Jan-1970 00:00:00

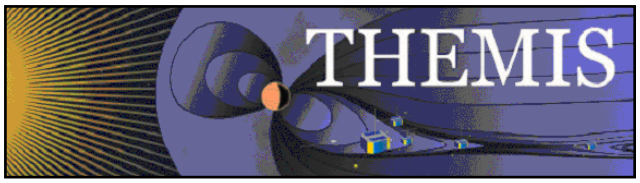


tha_fb_eac12_epoch	(Virtual)
tha_fb_eac34	Spectrogram FBK E Field AC Component, Sensors 3&4 (spin plane)
tha_fb_eac34_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_eac34_epoch	(Virtual)
tha_fb_eac56	Spectrogram FBK E Field AC Component, Sensors 5&6 (axial)
tha_fb_eac56_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fb_eac56_epoch	(Virtual)
tha_fb_yaxis	Value = {2.689e+03, 5.720e+02, 1.442e+02, 3.620e+01, 9.050e+00, 2.260e+00}
tha_fbk_labl	(Metadata) Label Value = {“2-kHz”, “512-Hz”, “128-Hz”, “32-Hz”, “8-Hz”, “2-Hz”}
tha_fbk_fcenter	center frequency (geometric mean) Value = {2.689e+03, 5.720e+02, 1.442e+02, 3.620e+01, 9.050e+00, 2.260e+00}
tha_fbk_fband	frequency bandwidths Value = {4.604e+03, 5.880e+02, 1.472e+02, 3.690e+01, 9.220e+00, 2.310e+00}
tha_fbk_freqno	(Metadata) Frequency Number Value = {1, 2, 3, 4, 5, 6}
tha_fbk_epoch0	01-Jan-1970 00:00:00.000
range_epoch	

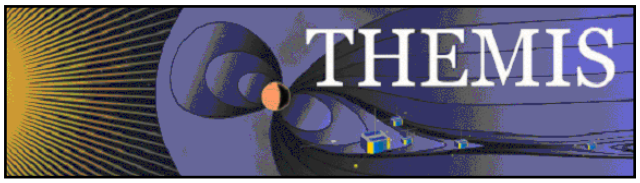
4.6 FFT (On Board Fast Fourier Transform)

On Board Fast Fourier Transform (FFT) power spectra of Electric (EFI) and Magnetic (SCM) field, for particle and wave burst survey modes.
Here ‘?’ can take the value ‘f’ for Fast Survey, ‘p’ for Particle Burst, ‘w’ for Wave Burst.

tha_ff?_16_dbpara	FFT Power Spectrum, 16 frequencies for SCM delta-B (parallel to B)
tha_ff?_16_dbperp	FFT Power Spectrum, 16 frequencies for SCM delta-B (perpendicular to B)
tha_ff?_16_eac12	FFT Power Spectrum, 16 frequencies for E Field AC Component, Sensors 1&2 (spin plane)
tha_ff?_16_eac34	FFT Power Spectrum, 16 frequencies for E Field AC Component, Sensors 3&4 (spin plane)
tha_ff?_16_eac56	FFT Power Spectrum, 16 frequencies for E Field AC Component, Sensors 5&6 (axial)
tha_ff?_16_edc12	FFT Power Spectrum, 16 frequencies for E Field DC Component, Sensors 1&2 (spin plane)
tha_ff?_16_edc34	FFT Power Spectrum, 16 frequencies for E Field DC Component, Sensors 3&4 (spin plane)
tha_ff?_16_edc56	FFT Power Spectrum, 16 frequencies for E Field DC Component, Sensors 5&6 (axial)
tha_ff?_16_epara	FFT Power Spectrum, 16 frequencies for EFI E (parallel to B)
tha_ff?_16_eperp	FFT Power Spectrum, 16 frequencies for EFI E (perp to B)
tha_ff?_16_scm1	FFT Power Spectrum, 16 frequencies for SCM, Axis 1
tha_ff?_16_scm2	FFT Power Spectrum, 16 frequencies for SCM, Axis 2
tha_ff?_16_scm3	FFT Power Spectrum, 16 frequencies for SCM, Axis 3
tha_ff?_16_v1	FFT Power Spectrum , 16 frequencies for EFI Potential, Sensor 1
tha_ff?_16_v2	FFT Power Spectrum , 16 frequencies for EFI Potential, Sensor 2



tha_ff?_16_v3	FFT Power Spectrum , 16 frequencies for EFI Potential, Sensor 3
tha_ff?_16_v4	FFT Power Spectrum , 16 frequencies for EFI Potential, Sensor 4
tha_ff?_16_v5	FFT Power Spectrum , 16 frequencies for EFI Potential, Sensor 5
tha_ff?_16_v6	FFT Power Spectrum , 16 frequencies for EFI Potential, Sensor 6
tha_ff?_16_yaxis	*no values*
tha_ff?_16_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_ff?_16_epoch0	01-Jan-1970 00:00:00.000
tha_ff?_16_epoch	(Virtual)
tha_ff?_32_dbpara	FFT Power Spectrum, 32 frequencies for SCM delta-B (parallel to B)
tha_ff?_32_dbperp	FFT Power Spectrum, 32 frequencies for SCM delta-B (perpendicular to B)
tha_ff?_32_eac12	FFT Power Spectrum, 32 frequencies for E Field AC Component, Sensors 1&2 (spin plane)
tha_ff?_32_eac34	FFT Power Spectrum, 32 frequencies for E Field AC Component, Sensors 3&4 (spin plane)
tha_ff?_32_eac56	FFT Power Spectrum, 32 frequencies for E Field AC Component, Sensors 5&6 (axial)
tha_ff?_32_edc12	FFT Power Spectrum, 32 frequencies for E Field DC Component, Sensors 1&2 (spin plane)
tha_ff?_32_edc34	FFT Power Spectrum, 32 frequencies for E Field DC Component, Sensors 3&4 (spin plane)
tha_ff?_32_edc56	FFT Power Spectrum, 32 frequencies for E Field DC Component, Sensors 5&6 (axial)
tha_ff?_32_epara	FFT Power Spectrum, 32 frequencies for EFI E (parallel to B)
tha_ff?_32_eperp	FFT Power Spectrum, 32 frequencies for EFI E (perp to B)
tha_ff?_32_scm1	FFT Power Spectrum, 32 frequencies for SCM, Axis 1
tha_ff?_32_scm2	FFT Power Spectrum, 32 frequencies for SCM, Axis 2
tha_ff?_32_scm3	FFT Power Spectrum, 32 frequencies for SCM, Axis 3
tha_ff?_32_v1	FFT Power Spectrum , 32 frequencies for EFI Potential, Sensor 1
tha_ff?_32_v2	FFT Power Spectrum , 32 frequencies for EFI Potential, Sensor 2
tha_ff?_32_v3	FFT Power Spectrum , 32 frequencies for EFI Potential, Sensor 3
tha_ff?_32_v4	FFT Power Spectrum , 32 frequencies for EFI Potential, Sensor 4
tha_ff?_32_v5	FFT Power Spectrum , 32 frequencies for EFI Potential, Sensor 5
tha_ff?_32_v6	FFT Power Spectrum , 32 frequencies for EFI Potential, Sensor 6
tha_ff?_32_yaxis	*no values*
tha_ff?_32_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_ff?_32_epoch0	01-Jan-1970 00:00:00.000
tha_ff?_32_epoch	(Virtual)
tha_ff?_64_dbpara	FFT Power Spectrum, 64 frequencies for SCM delta-B (parallel to B)
tha_ff?_64_dbperp	FFT Power Spectrum, 64 frequencies for SCM delta-B (perpendicular to B)
tha_ff?_64_eac12	FFT Power Spectrum, 64 frequencies for E Field AC Component, Sensors 1&2 (spin plane)
tha_ff?_64_eac34	FFT Power Spectrum, 64 frequencies for E Field AC Component, Sensors 3&4 (spin plane)
tha_ff?_64_eac56	FFT Power Spectrum, 64 frequencies for E Field AC Component, Sensors 5&6 (axial)
tha_ff?_64_edc12	FFT Power Spectrum, 64 frequencies for E Field DC Component,



	Sensors 1&2 (spin plane)
tha_ff?_64_edc34	FFT Power Spectrum, 64 frequencies for E Field DC Component, Sensors 3&4 (spin plane)
tha_ff?_64_edc56	FFT Power Spectrum, 64 frequencies for E Field DC Component, Sensors 5&6 (axial)
tha_ff?_64_epara	FFT Power Spectrum, 64 frequencies for EFI E (parallel to B)
tha_ff?_64_eperp	FFT Power Spectrum, 64 frequencies for EFI E (perp to B)
tha_ff?_64_scm1	FFT Power Spectrum, 64 frequencies for SCM, Axis 1
tha_ff?_64_scm2	FFT Power Spectrum, 64 frequencies for SCM, Axis 2
tha_ff?_64_scm3	FFT Power Spectrum, 64 frequencies for SCM, Axis 3
tha_ff?_64_v1	FFT Power Spectrum , 64 frequencies for EFI Potential, Sensor 1
tha_ff?_64_v2	FFT Power Spectrum , 64 frequencies for EFI Potential, Sensor 2
tha_ff?_64_v3	FFT Power Spectrum , 64 frequencies for EFI Potential, Sensor 3
tha_ff?_64_v4	FFT Power Spectrum , 64 frequencies for EFI Potential, Sensor 4
tha_ff?_64_v5	FFT Power Spectrum , 64 frequencies for EFI Potential, Sensor 5
tha_ff?_64_v6	FFT Power Spectrum , 64 frequencies for EFI Potential, Sensor 6
tha_ff?_64_yaxis	*no values*
tha_ff?_64_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_ff?_64_epoch0	01-Jan-1970 00:00:00.000
tha_ff?_64_epoch	(Virtual)
range_epoch	

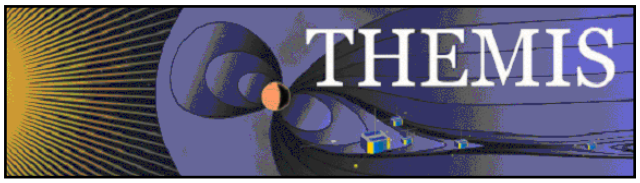
4.7 FGM (Fluxgate Magnetometer)

tha_fgs_btotal	Spin resolution (FGS) magnetic field magnitude
tha_fgs_gse	FGS (spin-resolution/~3 sec) magnetic field in GSE coordinates
tha_fgs_gsm	FGS magnetic field in GSM coordinates
tha_fgs_dsl	FGS magnetic field in DSL coordinates
tha_fgs_compno	(Metadata) Component number Value = {1, 2, 3}
tha_fgs_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fgs_epoch0	01-Jan-1970 00:00:00.000
tha_fgs_epoch	(Virtual)
tha_fgs_labl	(Metadata) Label Value = {“Bx FGS-A”, “By FGS-A”, “Bz FGS-A”}
tha_fgl_btotal	Low time resolution/~0.25sec (FGL) magnetic field magnitude
tha_fgl_gse	FGL magnetic field in GSE coordinates
tha_fgl_gsm	FGL magnetic field in GSM coordinates
tha_fgl_dsl	FGL magnetic field in DSL coordinates
tha_fgl_ssl	FGL magnetic field in SSL coordinates
tha_fgl_compno	(Metadata) Component number Value = {1, 2, 3}
tha_fgl_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fgl_epoch0	01-Jan-1970 00:00:00.000
tha_fgl_epoch16	(Virtual)
tha_fgl_labl	(Metadata) Label Value = {“Bx FGL-A”, “By FGL-A”, “Bz FGL-A”}
tha_fgh_btotal	High time resolution/~0.008 sec (FGH) magnetic field magnitude

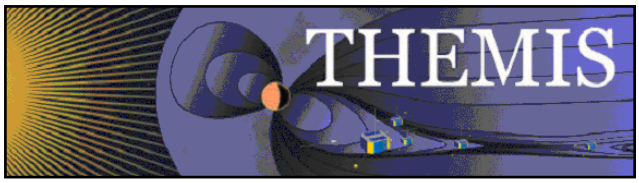
tha_fgh_gse	FGH magnetic field in GSE coordinates
tha_fgh_gsm	FGH magnetic field in GSM coordinates
tha_fgh_dsl	FGH magnetic field in DSL coordinates
tha_fgh_ssl	FGH magnetic field in SSL coordinates
tha_fgh_compno	(Metadata) Component number Value = {1, 2, 3}
tha_fgh_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fgh_epoch0	01-Jan-1970 00:00:00.000
tha_fgh_epoch16	(Virtual)
tha_fgh_labl	(Metadata) Label Value = {“Bx FGH-A”, “By FGH-A”, “Bz FGH-A”}
tha_fge_btotal	Engineering mode (FGE) magnetic field magnitude
tha_fge_gse	FGE magnetic field in GSE coordinates
tha_fge_gsm	FGE magnetic field in GSM coordinates
tha_fge_dsl	FGE magnetic field in DSL coordinates
tha_fge_ssl	FGE magnetic field in SSL coordinates
tha_fge_compno	(Metadata) Component number Value = {1, 2, 3}
tha_fge_labl	(Metadata) Label Value = {“Bx FGE-A”, “By FGE-A”, “Bz FGE-A”}
tha_fge_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fge_epoch0	01-Jan-1970 00:00:00.000
tha_fge_epoch16	(Virtual)
Rep_xyz	(Metadata) Representation for xyz vector/tensor dimension Value = {“x”, “y”, “z”}
range_epoch	

4.8 FIT (On Board Spin-Fit Electric and Magnetic Field Data)

tha_fgs_sigma	Standard deviation of the onboard magnetic field spin-fit (FGS)
tha_fgs_dsl	FGS magnetic field vector in DSL coordinates
tha_fgs_dsl_compno	(Metadata) Component number Value = {1, 2, 3}
tha_fgs_dsl_labl	(Metadata) Label Value = {“Bx DSL FGS-A”, “By DSL FGS-A”, “Bz DSL FGS-A”}
tha_fgs_gse	FGS magnetic field vector in GSE coordinates
tha_fgs_gse_compno	(Metadata) Component number Value = {1, 2, 3}
tha_fgs_gse_labl	(Metadata) Label Value = {“Bx GSE FGS-A”, “By GSE FGS-A”, “Bz GSE FGS-A”}
tha_fgs_gsm	FGS magnetic field vector in GSM coordinates
tha_fgs_gsm_compno	(Metadata) Component number Value = {1, 2, 3}
tha_fgs_gsm_labl	(Metadata) Label Value = {“Bx GSM FGS-A”, “By GSM FGS-A”, “Bz GSM FGS-A”}
tha_fgs_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fgs_epoch0	01-Jan-1970 00:00:00.000
tha_fgs_epoch	(Virtual)
tha_efs_sigma	Standard deviation of the onboard electric field spin-fit (EFS)
tha_efs_dsl	EFS electric field vector in DSL coordinates



tha_efs_dsl_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_dsl_labl	(Metadata) Label Value = {“Bx DSL EFS-A”, “By DSL EFS-A”, “Bz DSL EFS-A”}
tha_efs_0_dsl	EFS_0 (spin-fit, using E_z=0) electric field in DSL coordinates
tha_efs_0_dsl_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_0_dsl_labl	(Metadata) Label Value = {“Ex DSL EFS_0-A”, “Ey DSL EFS_0-A”, “Ez DSL EFS_0-A”}
tha_efs_dot0_dsl	EFS_DOT0 (spin-fit, using E dot B = 0) electric field vector in DSL coordinates
tha_efs_dot0_dsl_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_dot0_dsl_labl	(Metadata) Label Value = {“Ex DSL EFS_dot0-A”, “Ey DSL EFS_dot0-A”, “Ez DSL EFS_d0t0-A”}
tha_efs_gse	EFS electric field vector in GSE coordinates
tha_efs_gse_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_gse_labl	(Metadata) Label Value = {“Ex GSE EFS-A”, “Ey GSE EFS-A”, “Ez GSE EFS-A”}
tha_efs_0_gse	EFS_0 (spin-fit, using E_z=0) electric field in GSE coordinates
tha_efs_0_gse_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_0_gse_labl	(Metadata) Label Value = {“Ex GSE EFS_0-A”, “Ey GSE EFS_0-A”, “Ez GSE EFS_0-A”}
tha_efs_dot0_gse	EFS_DOT0 (spin-fit, using E dot B = 0) electric field vector in GSE coordinates
tha_efs_dot0_gse_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_dot0_gse_labl	(Metadata) Label Value = {“Ex GSE EFS_dot0-A”, “Ey GSE EFS_dot0-A”, “Ez GSE EFS_dot0-A”}
tha_efs_gsm	EFS electric field vector in GSM coordinates
tha_efs_gsm_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_gsm_labl	(Metadata) Label Value = {“Ex GSM EFS-A”, “Ey GSM EFS-A”, “Ez GSM EFS-A”}
tha_efs_0_gsm	EFS_0 (spin-fit, using E_z=0) electric field in GSM coordinates
tha_efs_0_gsm_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_0_gsm_labl	(Metadata) Label Value = {“Ex GSM EFS_0-A”, “Ey GSM EFS_0-A”, “Ez GSM EFS_0-A”}
tha_efs_dot0_gsm	EFS_DOT0 (spin-fit, using E dot B = 0) electric field vector in GSM coordinates
tha_efs_dot0_gsm_compno	(Metadata) Component number Value = {1, 2, 3}
tha_efs_dot0_gsm_labl	(Metadata) Label Value = {“Ex GSM EFS_dot0-A”, “Ey GSM EFS_dot0-A”, “Ez GSM EFS_dot0-A”}
tha_efs_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_efs_epoch0	01-Jan-1970 00:00:00.000

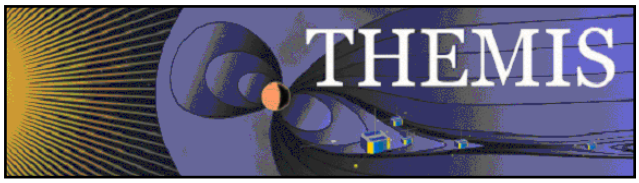


tha_efs_epoch	(Virtual)
tha_fit_bfit	FIT_BFIT spin-fit calibrated model data A, B, C, sigma, avg. (DSL)
tha_fit_bfit_compno	(Metadata) Component number Value = {1, 2, 3, 4, 5}
tha_fit_bfit_labl	(Metadata) Label Value = {“A FIT_BFIT FGM-A”, “B FIT_BFIT FGM-A”, “C FIT_BFIT FGM-A”, “Sigma FIT_BFIT FGM-A”, “Avg. FIT_BFIT FGM-A”}
tha_fit_bfit_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fit_bfit_epoch0	01-Jan-1970 00:00:00.000
tha_fit_bfit_epoch	(Virtual)
tha_fit_efit	FIT_EFIT spin-fit calibrated model data A, B, C, sigma, avg. (DSL)
tha_fit_efit_compno	(Metadata) Component number Value = {1, 2, 3,4 ,5}
tha_fit_efit_labl	(Metadata) Label Value = {“A FIT_EFIT FGM-A”, “B FIT_EFIT FGM-A”, “ C FIT_EFIT FGM-A”, “Sigma FIT_EFIT FGM-A”, “Avg. FIT_EFIT FGM-A”}
tha_fit_efit_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_fit_efit_epoch0	01-Jan-1970 00:00:00.000
tha_fit_efit_epoch	(Virtual)
Rep_xyz_dsl	(Metadata) Label representation Value = {“x”, “y”, “z”}
Rep_xyz_gse	(Metadata) Label representation Value = {“x”, “y”, “z”}
Rep_xyz_gsm	(Metadata) Label representation Value = {“x”, “y”, “z”}
range_epoch	

4.9 GMAG (Ground Magnetometer)

For additional information on the L2 GMAG CDFs see the Ground Magnetometer L2 Data Files Variable Name Definition document.
Data from external sites (that is not THEMIS GBO or EPO) are processed to conform to the same file definitions.
The L2 GMAG CDFs contain the following variables (here ???? represents the four (or three) letter code for the GMAG site):

thg_mag_????	Magnetic field B in HDZ vector components
thg_mag_????_unit	(Metadata) Magnetic field units Value = {“nT”, “nT”, “nT”}
thg_mag_????_labl	(Metadata) Label Value = {“Magnetic North, local”, “Magnetic East, local”, “Vertical Down, local”}
thg_mag_????_compno	(Metadata) HDZ component number Value = {1, 2, 3}
thg_mag_????_time	UTC in seconds since 01-Jan-1970 00:00:00
thg_mag_????_epoch	(Virtual)
thg_mag_????_epoch0	01-Jan-1970 00:00:00.000
range_epoch	



4.10 SCM (Search Coil Magnetometer)

tha_scf_epoch	(Virtual)
tha_scf_btotal	Search Coil Fast-survey, 1/8 sec time resolution, magnetic field B magnitude
tha_scf_gse	SCF magnetic field in XYZ GSE coordinates
tha_scf_gsm	SCF magnetic field in XYZ GSM Coordinates
tha_scf_dsl	SCF magnetic field in XYZ DSL Coordinates
tha_scf_compno	(Metadata) XYZ component number Value = {1, 2, 3}
tha_scf_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_scf_epoch0	01-Jan-1970 00:00:00.000
tha_scf_labl	(Metadata) Label Value = {“Bx SCF-A”, “By SCF-A”, “Bz SCF-A”}
tha_scp_epoch16	(Virtual) Search Coil Particle-burst epoch variable
tha_scp_btotal	SCP (Particle burst, 1/128 sec time resolution) magnetic field magnitude
tha_scp_gse	SCP magnetic field in XYZ GSE coordinates
tha_scp_gsm	SCP magnetic field in XYZ GSM Coordinates
tha_scp_dsl	SCP magnetic field in XYZ DSL Coordinates
tha_scp_compno	(Metadata) XYZ component number Value = {1, 2, 3}
tha_scp_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_scp_epoch0	01-Jan-1970 00:00:00.000
tha_scp_labl	(Metadata) Label Value = {“Bx SCP-A”, “By SCP-A”, “Bz SCP-A”}
tha_scw_epoch16	(Virtual) Search Coil Wave-burst epoch variable
tha_scw_btotal	SCW (Wave burst, 1/8192 sec time resolution) magnetic field magnitude
tha_scw_gse	SCW magnetic field in XYZ GSE coordinates
tha_scw_gsm	SCW magnetic field in XYZ GSM Coordinates
tha_scw_dsl	SCW magnetic field in XYZ DSL Coordinates
tha_scw_compno	(Metadata) XYZ component number Value = {1, 2, 3}
tha_scw_time	UTC in seconds since 01-Jan-1970 00:00:00
tha_scw_epoch0	01-Jan-1970 00:00:00.000
tha_scw_labl	(Metadata) Label Value = {“Bx SCW-A”, “By SCW-A”, “Bz SCW-A”}
Rep_xyz	(Metadata) Representation for xyz vector/tensor dimension Value = {“x”, “y”, “z”}
range_epoch	