



Science Operations Center Data Product Conventions

Document: ICON Data Product Conventions (Recommended)

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ICON Mission

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Abstract: The Ionospheric Connection Explorer (ICON) produces many data products (level 0 through level 4) which are made publicly available to the science community and to the Space Physics Data Facility. The data variable naming, format and metadata *recommended* conventions described in this document are provided to ensure ease of use. The higher level data products (level 4 models) may deviate slightly (the products have existed prior to the ICON project).

I. DOCUMENT REVISION RECORD

Rev.	Date	Description of Change
0.1	23 Nov 2015	Initial draft (Tori Fae).
0.2	1 Dec 2015	Added samples, chapter 4 and modifications from Scott England.
0.3	19 Dec 2015	Adjusted for conversation with team and SPDF.
0.4	1 Feb 2016	Modified date / time information per SPDF and updated examples.
0.5	28 Feb 2017	Fixed “-“ inconsistency in variable names and updated version information..
0.6	9 April 2019	Detail in Filename Convention Detail in Variable Names including required variables Detail in discussion of Epoch
0.7	2 May 2019	Deleted Table 2.0 reference

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1 Introduction

1.1 *Purpose and Scope*

The Ionospheric Connection Explorer (ICON) produces level 0 through level 4 data products made publicly available to the science community and Space Physics Data Facility. The variable naming, format and metadata recommended convention are described in this document to ensure ease of use and aid the science team in keeping data format consistency. This document should be followed except where impossible.

1.2 *Overview*

A number of standard conventions have been used with CDF and NetCDF data formats. The most notable in the NetCDF community are CF (climate & forecast), NODS (National Oceanographic Data Center) and COARDS (Cooperative Ocean/Atmosphere Research Data Service). None of these are particularly suitable for ICON data products. The CDF community is more developed in this arena, notably the ISTP / IACG (International Solar Terrestrial Physics / Inter-Agency Consultative Group from the Space Physics Data Facility).

NetCDF and CDF data formats are inherently different and so some modifications to the ISTP standard (designed for CDF) are required to ensure compatibility with NetCDF files and will be detailed in this document. It should be noted that this document is a strongly recommended best practice for ICON data products levels 0-3. The ICON modeling data products should still try to follow the global attribute recommendations and are otherwise left unchecked for historical reasons.

See [Appendix](#) for a listing of links to each of the formats and conventions.

1.3 *Document Layout*

Section 1: Overview

Presents a general overview of this document and its purpose.

Section 2: Convention Recommendations

List of all recommended conventions used in summary and detail format.

Section 3: CDL Files / Example

Presents an example CDL file with ICON data headers and explains the CDL format.

Section 4: NetCDF Format

Described the version of NetCDF used and why it was chosen.

Section 5: Appendix

Contains document references, list of terms and a list of website references.

2 Convention Recommendations

The following conventions are summarized and then each discussed in detail. It is recommended that ICON attempt to keep with the ISTEP/IACG conventions for CDF, only deviating where there are conflicts in the native NetCDF expectations. Note that all of the data shown below are recommendations (an item indicating “required” is a strong recommendation). Each section should contain a summary of the data.

In general, the global attributes need to be set, the Epoch time variable(s) need to be set first, then other variables and their associated attributes and dimensions. File names should follow the conventions below. Examples can be seen in the [CDL chapter](#).

2.1 Global Attributes

NetCDF uses global attributes to describe the file and purpose of the data. The attributes shown below should be followed. There may be other attributes added to any NetCDF file which are not specified here. The expected attributes are summarized here.

** Note: Except where mentioned, all values are character strings.*

Acknowledgement	< Acknowledgement Text >
ADID_Ref	“NASA Contract > NNG12FA45C”
Calibration_File	< Calibration File Name >
Conventions	“SPDF ISTEP/IACG Modified for NetCDF”
Data_Level	< Data Product Level >
Data_Revision	< Data File Version >
Data_Type	< Data Product Short & Long Name >
Data_Version	< Data File Version >
Data_VersionMajor	< Data File Version >
Date_End	< UTC Data End Time >
Date_Start	< UTC Data Start Time >
Description	< Description of Data Set >
Descriptor	< Instrument Descriptor >
Discipline	“Space Physics > Ionospheric Science”
File	< Full File Name >
File_Date	< File Generation Date - UTC >
Generated_By	< Generator Data Center / Group >
Generation_Date	< Date File Generated >
History	< History Information >
HTTP_LINK	< See LINK Section >
Instrument	< Instrument Name >
Instrument_Type	< ISTEP Instrument Type >
Link_Text	< See LINK Section >
Link_Title	< See LINK Section >
Logical_File_ID	< ISTEP Logical File Name >
Logical_Source	< ISTEP Logical Source Header >
Logical_Source_Description	< ISTEP Logical Source Descriptions >
Mission_Group	“Ionospheric Investigations”
MODS	< History Information >
Parents	< Parent Documents >
PI_Affiliation	“UC Berkeley > SSL”

PI_Name	"T. J. Immel"
Project	"NASA > ICON"
Rules_of_Use	"Public Data for Scientific Use"
Software_Version	< Software Version >
Source_Name	"ICON > Ionospheric Connection Explorer"
Spacecraft_ID	"NASA > ICON - 493"
Text	< See TEXT Section >
Text_Supplement	< Extra Descriptive Text >
Time_Resolution	< Data Time Resolution >
Title	< ICON Data Product Title >

2.1.1 Acknowledgement

This is an ISTP recommended designed for the PI to give citable acknowledgements. This will be fixed for ICON, with the same acknowledgement text used for all data products. Updates to this acknowledgement are maintained first at a password-protected site as follows:

sftp://icon-science.ssl.berkeley.edu:36868/Drop/Acknowledgement.TXT

- **Name:** "Acknowledgement"
- **Value:**

This is a data product from the NASA Ionospheric Connection Explorer mission, an Explorer launched in June 2018. Guidelines for the use of this product are described in the ICON Rules of the Road (<https://http://icon.ssl.berkeley.edu/Data>).

Responsibility for the mission science falls to the Principal Investigator, Dr. Thomas Immel at UC Berkeley:
Immel, T.J., England, S.L., Mende, S.B. et al. Space Sci Rev (2018) 214: 13.
<https://doi.org/10.1007/s11214-017-0449-2>

Responsibility for the validation of the L1 data products falls to the instrument lead investigators/scientists.

* EUV: Dr. Eric Korpela : <https://doi.org/10.1007/s11214-017-0384-2>

* FUV: Dr. Harald Frey : <https://doi.org/10.1007/s11214-017-0386-0>

* MIGHTI: Dr. Christoph Englert : <https://doi.org/10.1007/s11214-017-0358-4>,
and <https://doi.org/10.1007/s11214-017-0374-4>

* IVM: Dr. Roderick Heelis : <https://doi.org/10.1007/s11214-017-0383-3>

Responsibility for the validation of the L2 data products falls to those scientists responsible for those products.

* Daytime O and N2 profiles: Dr. Andrew Stephan :
<https://doi.org/10.1007/s11214-018-0477-6>

* Daytime (EUV) O+ profiles: Dr. Andrew Stephan :
<https://doi.org/10.1007/s11214-017-0385-1>

* Nighttime (FUV) O+ profiles: Dr. Farzad Kamalabadi :
<https://doi.org/10.1007/s11214-018-0502-9>

* Neutral Wind profiles: Dr. Jonathan Makela :
<https://doi.org/10.1007/s11214-017-0359-3>

* Neutral Temperature profiles: Dr. Christoph Englert :
<https://doi.org/10.1007/s11214-017-0434-9>

* Ion Velocity Measurements : Dr. Russell Stoneback :
<https://doi.org/10.1007/s11214-017-0383-3>

Responsibility for Level 4 products falls to those scientists responsible for those products.

* Hough Modes : Dr. Chihoko Yamashita : <https://doi.org/10.1007/s11214-017-0401-5>

* TIEGCM : Dr. Astrid Maute : <https://doi.org/10.1007/s11214-017-0330-3>

* SAMI3 : Dr. Joseph Huba : <https://doi.org/10.1007/s11214-017-0415-z>

Pre-production versions of all above papers are available on the ICON website.

Overall validation of the products is overseen by the ICON Project Scientist, Dr. Scott England.

NASA oversight for all products is provided by the Mission Scientist, Dr. Jeffrey Klenzing.

Users of these data should contact and acknowledge the Principal Investigator Dr. Immel and the party directly responsible for the data product (noted above) and acknowledge NASA funding for the collection of the data used in the research with the following statement : "ICON is supported by NASA's Explorers Program through contracts NNG12FA45C and NNG12FA42I".

These data are openly available as described in the ICON Data Management Plan available on the ICON website (<http://icon.ssl.berkeley.edu/Data>).

- **Comment:** Required and fixed.

2.1.2 Authority Control Identifier (ADID Reference)

This is the control authority identifier (currently somewhat defunct in CDF). ICON uses it for the NASA contract number and it should be included with every file.

- **Name:** "ADID_Ref"
- **Value:** "NASA Contract > NNG12FA45C"
- **Comment:** Required and fixed.

2.1.3 Calibration File

This is the name of the calibration file used when generating this data. If there is no file, leave it blank. The name is similar to the [logical source name](#) global attribute but includes the extension. Note the [file name conventions](#) section for file naming.

- **Name:** "Calibration_File"
- **Value Example:** "ICON_L1_EUV_Calibration_v0001.NC"
- **Comment:** Required though may be empty if no calibration file was used.

2.1.4 Conventions

This is standard for NetCDF files and is required for ICON.

- **Name:** "Conventions"
- **Value:** "SPDF ISTEP/IACG Modified for NetCDF"
- **Comment:** Required and fixed.

2.1.5 Data Level

The data product level as specified in the DPID. This is required and should follow the format “L#.##”. If there is no data product then leave blank.

- **Name:** “Data_Level”
- **Value Example:** “L2.0”
- **Comment:** Required.

2.1.6 Data Type

The identifier for the data set within this NetCDF data file. The short name and long name are included. For the short name we will go with the data product as specified in the DPID. The long name should also be from the DPID and be descriptive. Data product 2.2 would be represented as in the example below. If a name is not provided in the DPID then the science team should be consulted.

- **Name:** “Data_Type”
- **Value Example:** “DP22 > Data Product 2.2: MIGHTI Cardinal Vector Winds”
- **Comment:** Required.

2.1.7 Data Version

The version of this NetCDF file. The first version should always be 1.0 and increment as the file is updated later with new or updated data. The revision normally gets incremented during reprocessing. The major version normally only changes for a software change significant enough to alter the data format produced. The major version should be between 1 and 99 while the revision should be between 0 and 999 as shown below. The actual version is computed by adding the major version to the revision divided by 1000.

- **Name:** “Data_Revision”
- **Value Example:** 2 (unsigned short) (limit 0 through 999).
- **Comment:** Recommended.

- **Name:** “Data_Version”
- **Value Example:** 1.002 (float) (limit 1.0 through 99.999).
- **Comment:** Required.

- **Name:** “Data_VersionMajor”
- **Value Example:** 1 (unsigned byte) (limit 1 through 99).
- **Comment:** Recommended.

2.1.8 Dates / End / Start / Generation

The three dates here are in UTC time. One is the time of the first data point, one is the time of the last data point and the last is the time the file was generated. All are in UTC time and follow the same format. A fourth date used for ISTP compliance that does not follow the same format but does contain the same generation date. Note that the last part of the date format uses the ISO 8601 standard. The two formats are shown below.

- **Format 1:** “ddd, DD MMM YYYY, YYYY-MM-DDTHH:mm:ss.xxx UTC”
- **Format 2:** “YYYYMMDD” in UTC time

- **Name:** "Date_End"
- **Value Example:** "Fri, 18 Sep 2015, 2015-09-18T15:24:07.000 UTC"
- **Comment:** Recommended date of last data point in file. Use first time if single data point.
- **Name:** "Date_Start"
- **Value Example:** "Fri, 18 Sep 2015, 2015-09-18T15:24:07.000 UTC"
- **Comment:** Recommended date of first data point in file.
- **Name:** "File_Date"
- **Value Example:** "Sun, 20 Sep 2015, 2015-09-20T10:00:00.000 UTC"
- **Comment:** Recommended date of file creation.
- **Name:** "Generation_Date"
- **Value Example:** "20151014" (format is YYYYMMDD in UTC)
- **Comment:** Strongly recommended.

2.1.9 Description

This contains a description of the data set which may be the same as the title attribute or contain extra information.

- **Name:** "Description"
- **Value Example:** "ICON Level 0 Nominal EUV Daily Downlink"
- **Comment:** Strongly recommended.

2.1.10 Descriptor

This is a required ISTP value describing the instrument long and short name. The short name should be kept between 3 and 8 characters. The short names for the instruments are "EUV", "FUV", "IVM-A", "IVM-B", "MIGHTI-A" and "MIGHTI-B". The models should use the DPID names for their short name.

- **Name:** "Descriptor"
- **Value Example:** "FUV > Intensified Far Ultraviolet Imager"
- **Comment:** Required.

2.1.11 Discipline

This is a required ISTP value indicating the discipline and sub-discipline (fixed for ICON).

- **Name:** "Discipline"
- **Value:** "Space Physics > Ionospheric Science"
- **Comment:** Required and fixed.

2.1.12 File

This is supplementary data indicating the expected full file name similar to the [logical source name](#) global attribute but including the extension. Note the [file name conventions](#) sections for file naming.

- **Name:** "File"
- **Value Example:** "ICON_L0P_EUV_Nominal_20150117_v0001.NC"
- **Comment:** Recommended.

2.1.13 Generated By

This value contains the data center generating this file and the group that wrote the software. It should include the processor and version as well as the software author.

- **Name:** "Generated_By"
- **Value Example:** "ICON SDC > ICON SSL FUV Processor v1.1, H. U. Frey"
- **Comment:** Strongly recommended.

2.1.14 History & Modifications (MODS)

Recommended global attribute for NSSDC indicating file modification state. This should be duplicated in the NetCDF history. When a modification is made, then it should be appended to the attribute as another string in the vector. The initial version should be labeled as such. Modifications should contain the date, time, user name, data version, software name, software version and software command line.

- **Name:** "History"
- **Value Example:** "Version 1, H. Frey, 2015-10-22T10:00:00, FUV L1 Processor v1."
- **Comment:** Recommended by NetCDF.
- **Name:** "MODS"
- **Value Example:** "Version 1, H. Frey, 2015-10-22T10:00:00, FUV L1 Processor v1."
- **Comment:** Recommended by ISTP.

2.1.15 Instrument

This should exist for all data associated with a single instrument. The names should be one of the following. The models use their 6-8 character abbreviation.

- **Name:** "Instrument"
- **Value Options:** "EUV", "FUV", "IVM-A", "IVM-B", "MIGHTI-A", or "MIGHTI-B"
- **Comment:** Recommended setting for any data file related to one specific instrument.

2.1.16 Instrument Type

This value is used by CDA web and should likely be limited to the values below.

- **Name:** "Instrument_Type"
- **Value Options:** "Imagers (space)"
"Particles (space)"
- **Comment:** Required by ISTP (for CDA Web compatibility).

2.1.17 Link (Website Link Information / HTTP Link)

This is a combination of three values which are used by different software to show information that has "<LINK_TEXT> <LINK_TITLE>" as text with a hyperlink at <LINK_TITLE> pointing to the <HTTP_LINK>. All three values must be included or excluded together. All links should go to a subsection of the ICON website. Links can be made from there to point to specific institutions should that be desired.

- **Name:** "HTTP_LINK"
- **Value Example:** "http://icon.ssl.berkeley.edu/Observatory/Instruments/FUV"
- **Comment:** Strongly recommended – coupled with LINK_TEXT and LINK_TITLE.
- **Name:** "Link_Text"
- **Value Example:** "12-second FUV SW altitude profiles"
- **Comment:** Strongly recommended – coupled with LINK_TITLE and HTTP_LINK.
- **Name:** "Link_Title"
- **Value Example:** "ICON FUV"
- **Comment:** Strongly recommended – coupled with LINK_TEXT and HTTP_LINK.

2.1.18 Logical Source / Logical File ID

These values are required by ISTP to support CDA Web. They describe the name of the file as a header prefix, date and version. See the [file naming section](#) of the conventions for file naming. That is used here as an example. The three values below are coupled.

- **Name:** "Logical_File_ID"
- **Value Example:** "ICON_L1_FUV_SWP_2015-01-17_v0001"
(format follows file name conventions)
- **Comment:** Required setting for any data file. Note the file name conventions are followed.
- **Name:** "Logical_Source"
- **Value Example:** "ICON_L1_FUV_SWP_"
(format follows file name conventions)
- **Comment:** Same as "Logical_file_id" except the date and version.
- **Name:** "Logical_Source_Description"
- **Value Example:** "FUV Short Wavelength Channel - 135.6 Altitude Profiles"
- **Comment:** Describes the file from the corresponding file ID and source.

2.1.19 Mission Group

This is a required ISTP value indicating the mission data group for CDA Web (fixed for ICON).

- **Name:** "Mission_Group"
- **Value:** "Ionospheric Investigations"
- **Comment:** Required and fixed.

2.1.20 Parents

List the parent NetCDF files used to generate this file. This should be a comma-separated list. The name is not the name of this file but does follow the same pattern as the [logical source](#) attribute.

- **Name:** "Parents"
- **Value Example:** "NC > ICON_L1_FUV_SWP_2015-01-17.v0001"
- **Comment:** Optional. Note the "NC >" indicates that the parent is a NetCDF file.

2.1.21 PI Affiliation

This is a required ISTP value indicating the primary investigators affiliation (fixed for ICON).

- **Name:** "PI_Affiliation"
- **Value:** "UC Berkeley > SSL"
- **Comment:** Required and fixed.

2.1.22 PI Name

This is a required ISTP value indicating the primary investigators name (fixed for ICON).

- **Name:** "PI_Name"
- **Value:** "T. J. Immel"
- **Comment:** Required and fixed.

2.1.23 Project

This must exist for all data files. It has a fixed setting as shown below.

- **Name:** "Project"
- **Value:** "NASA > ICON"
- **Comment:** Required and fixed.

2.1.24 Rules of Use

This should be set and if set should be the fixed value shown below.

- **Name:** "Rules_of_Use"
- **Value:** "Public Data for Scientific Use"
- **Comment:** Recommended and fixed.

2.1.25 Software Version

This should be set and if set should be the version string and name of the processing software.

- **Name:** "Software_Version"
- **Value Example:** "ICON SDC > IVM Prime Generator v1.0.0"
- **Comment:** Recommended value should include the processor's source group.

2.1.26 Source Name

This ISTP required value has the short and long names of the mission sensor suite (fixed).

- **Name:** "Source_Name"
- **Value Example:** "ICON > Ionospheric Connection Explorer"
- **Comment:** Required and fixed.

2.1.27 Spacecraft ID

This must exist for all data files and is fixed for ICON (note spacecraft ID 493 = ICON).

- **Name:** "Spacecraft_ID"
- **Value:** "NASA > ICON - 493"
- **Comment:** Required and fixed.

2.1.28 TEXT (Description)

This ISTP required value has a description of the experiment (including a minimum of one journal or web link reference) whose data is included in the NetCDF file. The text here is set unless a specific file requires different text.

- **Name:** "Text"
- **Value:** "ICON explores the boundary between Earth and space – the ionosphere – to understand the physical connection between our world and the immediate space environment around us. Visit 'http://icon.ssl.berkeley.edu' for more details."
- **Comment:** Required and fixed (note – this may change per data set if approved by PI).
- **Name:** "Text_Supplement"
- **Value:** <Extra String Text if Needed>
- **Comment:** Optional – only use if more description is required.

2.1.29 Time Resolution

This ISTP recommended value indicates the data frequency of data in the file.

- **Name:** "Time_Resolution"
- **Value Example:** "30 seconds"
- **Comment:** Strongly recommended where applicable.

2.1.30 Title

This ISTP and NetCDF optional value should be provided which indicates the title of the NetCDF data contained (use the DPID for guidance).

- **Name:** "Title"
- **Value Example:** "ICON FUV Altitude Profiles (DP 1.3)"
- **Comment:** Strongly recommended value (should correlate strongly to the DPID).

2.2 *Epoch Variable / Dimension*

The ISTP standard assumes that the first variable(s) in the data set will be the "Epoch" variable (different names can be used if there are more than one but the first should be "Epoch"). This is an array of times that match to each other time-related variable with a "DEPEND" linkage (described in variable attributes). If there is no time related data then there should still be an "Epoch" variable with a zero dimension.

Note that more than one Epoch may be included. For example, Epoch_1, Epoch_2 and Epoch_3 variables may be included or used though the numbering should leave the one most often used named "Epoch". Note that the dimension is named the same as the variable. Not all time series need to have the same dimension but they normally do.

Things to note:

- Epoch (variable) has a corresponding Epoch dimension.
- ICON uses Epoch defined as UTC milliseconds since 01 January 1970 (Unix Style UTC Time) as a *signed* 64-bit integer number. This time should usually be the center time of the measurements represented in the variables.

2.3 Variables

Variables in ICON are diverse and specific to individual instruments (Level 1) or retrieved products (Level 2). They should follow naming conventions delineated here, be completely described in variable attributes (var_notes), have specific dimensions and follow ICON conventions that are to be used across all data files when possible.

2.3.1 Required Variables

It must be noted that for ISTP standard compliance the [Epoch](#) variables must be the first variables declared in the data file. Following that, and possibly unique to ICON, is a human-readable UTC_Time variable containing the ISO 8601 standard time at the center time for all of the measurements represented in variables. This will be identical to the EPOCH variable in dimension.

UTC Time Format: "YYYY-MM-DD HH:mm:ss.xxxZ"

These two variables representing time are required in both Level 1 and Level 2 data products. At Level 2, several additional variables are required, which are tabulated below, as their expected variable name.

Required Variable	Detail
Epoch	UTC Epoch, msec from Jan 1, 1970*
UTC_Time	String format of same dimension and value as Epoch
Latitude	Geolocation of retrieved science parameter WGS84 -90°-90 °
Longitude	Geolocation of retrieved science parameter WGS84 in 0-360°E**
Altitude	Geolocation of retrieved science parameter WGS84 km
Solar Zenith Angle	0-180° at location of retrieved science parameter
Local_Solar_Time	0-24 hours (decimal) at location of retrieved science parameter
<Science Parameter>	Vn, Un, Tn, ON2, Ne, Oplus, etc.

* Method of combinations of time and other parameters for MIGHTI A-B Level 2.1 products to retrieve Level 2.2 vector wind is described in MIGHTI Level 2.2 Epoch Var_Notes

**Note the selected range of longitudes for variables departs from the IDL default that is -180 to + 180 degrees.

2.3.2 Recommended Variables

In addition to the required variables listed above, the variables in the following list provide several other important parameters that support analysis of the Level 2 data, those being primarily a magnetic coordinate reference for the retrieved products. Further, the locale of the observatory is recommended so that other observational parameters may be calculated as necessary for future analyses.

Recommended Variable	Detail
----------------------	--------

GPS_Epoch	GPS time corresponding to the epoch variable
Magnetic_Latitude Magnetic_Latitude_120 Magnetic_Latitude_300	Magnetic Latitude in quasi-dipole coords for the derived parameter or profile. Actual altitude, 120, and/or 300 km selected to best match the retrieved science parameter. -90°-90 °
Magnetic_Longitude Magnetic_Longitude_120 Magnetic_Longitude_300	Magnetic Longitude in quasi-dipole coords for the derived parameter or profile. Actual altitude, 120, and/or 300 km selected to best match the retrieved science parameter. 0-360°E
Magnetic_Zonal_Wind	(2.2 Only) Wind in local magnetic zonal direction
Magnetic_Meridional_Wind	(2.2 Only) Wind in local magnetic meridional direction
SC_Latitude SC_Longitude SC_Altitude	Observatory locale (except 2.2) in WGS84

Additional parameters for future consideration. These are already reported in the IVM product. Adding them to the derived parameters could be done in the future.

Additional Variables	Detail
Apex_Height	Height of magnetic field line connected to science parameter
Footpoint_Latitude_North (South)	Magnetic footpoint of the observatory to the north of the orbit plane
Footpoint_Longitude_North (South)	Magnetic footpoint of the observatory to the south of the orbit plane

2.3.3 Variable Names

Because many software packages may use the different NetCDF files and in doing so import variables from multiple files caution needs to be taken to avoid name overlap between files and between computing language keywords. This reasoning along with the need for easy use drives the convention recommended here. Every variable name stemming from ICON observatory data has a simple and unique construction:

(Preamble)_(Parameter Name)

The **preamble** is a unique identifier constructed as follows:

1. Variables start with “ICON”.
2. Level 1 variables should then include a reference to the instrument such as “FUV”
3. As derived products, Level 2 variables do not need to identify the originating instrument, but should follow with the exact product identifying abbreviation such as “L25” for “Level 2.5 FUV Nighttime Retrieval”.
4. Separation between descriptive elements, including this preamble and the parameter name should be done with underscores (“_”)

The ICON Level 2 preamble is simply ICON_LXX, where XX=21, 22, ..., 27, uniquely identifying the 7 L2 products of ICON.

The **parameter name** that follows the preamble should be descriptive, and follow the parameter name conventions described in Sections 2.3.1 and 2.3.2

A resulting Level 1 variable name may look like “**ICON_L1_FUV_Turret_Angle**”

A resulting Level 2 variable name may look like “**ICON_L25_Oplus_Density**”

2.3.4 Variable Dimensions

If a new dimension is required and is self referential to the variable, then it is common to name the dimension the same name as the variable (as in the case of [EPOCH](#)). Otherwise a name that is descriptive is preferred.

The “UNLIMITED” dimension of a variable should always be the last dimension and every effort should be made to keep only one unlimited dimension per variable. This avoids compatibility issues with older formats.

2.3.5 Variable Attributes

There are conventions that should be maintained for ISTP standards and others for NetCDF format reasons. A notable example is the “**_FillValue**” which ISTP requires being named “**FillValue**” while NetCDF uses the same name with an underscore to actually perform the fill. For this reason both must be maintained. A summary and examples are below of the recommended attributes. Other required ISTP attributes can be found on the [ISTP guide](http://spdf.sci.gsfc.nasa.gov/istp_guide/vattributes.html) (http://spdf.sci.gsfc.nasa.gov/istp_guide/vattributes.html).

Bin_Location	<ISTP : Time Descriptor Attribute >
CatDesc	<ISTP : Catalog Description >
Depend_#	<ISTP : Dependency Tracking 0 through # >
Display_Type	<ISTP : Variable Display Type >
FieldNam	<ISTP : Name of Variable on Plots >
FillVal	<ISTP : Value for Unspecified Data >
Format	<ISTP : Data Formatting String >
LablAxis	<ISTP : Data Charting Axis Label >
Labl_Ptr_#	<ISTP : Data Charting Axis Label >
Long_Name	<NetCDF : Variable Description >
MonoTon	<ISTP : Monotonic Indicator >
ScaleTyp	<ISTP : Linear or Log Scale >
Time_Base	<ISTP : Time Descriptor Attribute >
Time_Scale	<ISTP : Time Descriptor Attribute >
Units	<ISTP : Variable Units >
ValidMax	<ISTP : Maximum Value >
ValidMin	<ISTP : Minimum Value >
Valid_Max	<NetCDF : Maximum Value >
Valid_Min	<NetCDF : Minimum Value >
Valid_Range	<NetCDF : Minimum – Maximum Range >
Var_Notes	<ISTP : Notes >
Var_Type	<ISTP : Type of Variable >
_ChunkingSizes	<NetCDF : Compression Related >
_DeflateLevel	<NetCDF : Compression Related >
_FillValue	<NetCDF : Same as FillVal from ISTP >
_Shuffle	<NetCDF : Compression Related >

2.3.5.1 Catalog Description / Long Name

- **Name:** “CatDesc”
 - **Requirement:** ISTP Required
 - **Type:** String (80 Character Maximum)
 - **Value Example:** “ICON FUV turret angle (degrees) at center time.”
 - **Notes:** A description of the data item and dependencies in string format (80 characters or less).
-
- **Name:** “Long_Name”
 - **Requirement:** NetCDF Recommended
 - **Type:** String
 - **Value Example:** “ICON FUV turret angle (degrees) at center time.”
 - **Notes:** A description of the data item in string format similar to the ISTP CatDesc.

2.3.5.2 Compression Settings

These three settings control the NetCDF byte layout and compression. They are described in the [NetCDF Compression](#) section. “_ChunkingSizes” is the most complicated one. The others should be fixed for ICON.

- **Name:** “_ChunkingSizes”
 - **Requirement:** NetCDF Required / Used
 - **Type:** Integer (INT)
 - **Value Example:** 1
 - **Notes:** NetCDF attribute which controls the data arrangement. See [NetCDF compression](#).
-
- **Name:** “_DeflateLevel”
 - **Requirement:** NetCDF Required
 - **Type:** Integer (INT)
 - **Value:** 6
 - **Notes:** ZLIB compression level from 0 to 9. ICON uses deflate level 6 by default.
-
- **Name:** “_Shuffle”
 - **Requirement:** NetCDF Required
 - **Type:** String
 - **Value:** “true”
 - **Notes:** Enables byte shuffling in NetCDF data set for optimized compression performance.

2.3.5.3 Dependency

These indicate dimensional dependencies and should follow their dimension settings. Any time a variable is time dependent, the first dependency (“Depend_0”) should be the correct Epoch. ICON suggests that the dependency is on the UTC time of the center of the associated measurement.

- **Name:** “Depend_0”, “Depend_1”, ...
- **Requirement:** ISTP Required (Conditionally)
- **Type:** String (80 Character Maximum)
- **Value Example:** “Epoch”

- **Notes:** Depend_0 should always be the corresponding time variable ([Epoch](#)) if there is time variability. Otherwise there should be a number of dependencies pointing to other variables as needed (used for dimensional references). The value is set to the variable name.

2.3.5.4 Display Type

- **Name:** "Display_Type"
- **Requirement:** ISTP Required
- **Type:** String
- **Value Examples:** "time_series", "image", "spectrogram", ...
- **Notes:** Indicates to automated software how to display this data. See ISTP site for details.

2.3.5.5 Field Name

- **Name:** "FieldNam"
- **Requirement:** ISTP Required
- **Type:** String (30 Character Limit)
- **Value Example:** "FUV Turret Angle (Degrees)"
- **Notes:** Used to plot or display data in charts so should be written with formatting in mind.

2.3.5.6 Fill Values

Fill values are used to fill in data that is not explicitly set. NetCDF will automatically fill out data with this value and thus compress it efficiently later. Fill values should normally be a value that is out of the valid range (see valid maximum/minimums). If no such range exists then it should be set to zero. For floating point values, NaN (not a number) should be set (*note that in C and similar languages NaN cannot explicitly be declared but can be defined as 0.0/0.0*).

The two values indicated here must both be set. One is for ISTP compliance and the other is for NetCDF internal functionality.

- **Name:** "_FillValue"
- **Requirement:** NetCDF Required
- **Type:** as Variable
- **Value Examples:** "NaN", "0", "-1"
- **Notes:** Used by NetCDF to fill in data that was not explicitly set. This is typed data.

- **Name:** "FillVal"
- **Requirement:** ISTP Required
- **Type:** as Variable
- **Value Examples:** "NaN", "0", "-1"
- **Notes:** Used by ISTP to recognize the fill value. This is typed data.

2.3.5.7 Format / Format Pointer

- **Name:** "Format"
- **Requirement:** ISTP Required
- **Type:** String (30 Character Maximum)
- **Value Example:** "I3"

- **Notes:** Used by CDFlist to format output data. This is a “Fortran” style formatting string.

2.3.5.8 Labels for Axes

- **Name:** “LablAxis”
- **Requirement:** ISTP Required (only if Labl_Ptr_1 not specified)
- **Type:** String (10 Character Maximum)
- **Value Example:** “Quality”
- **Notes:** Used by CDF utilities to label the axis. Do not set this if Labl_Ptr_1 is used.
- **Name:** “Labl_Ptr_1”, “Labl_Ptr_2”, ...
- **Requirement:** ISTP Required (only if LablAxis not specified)
- **Type:** String
- **Value Examples:** “Time_Axis”
- **Notes:** Used by CDF utilities to label the n^{th} dimensional axis (the first axis being Labl_Ptr_1). The string here is a reference to another variable in the NetCDF data set that is a string following the same rules as LablAxis above.

2.3.5.9 Monotonic Indicator

- **Name:** “MonoTon”
- **Requirement:** ISTP Optional
- **Type:** String
- **Value Options:** “Decrease” or “Increase”
- **Notes:** Only used if variable is known to be monotonically decreasing or increasing.

2.3.5.10 Scale Type

- **Name:** “ScaleTyp”
- **Requirement:** ISTP Recommended
- **Type:** String
- **Value Options:** “Linear” or “Log”
- **Notes:** Linear is assumed if not specified. This indicates the default scale used when plotting.

2.3.5.11 Time Assisting Attributes

Several attributes may be used optionally to enhance the understanding of the specific time measurement. SPDF uses these so they are strongly recommended. They can be added to an individual measurement or to an Epoch variable if they apply to the overall data.

- **Name:** “Bin_Location”
- **Requirement:** ISTP Recommended
- **Type:** Float (range from 0.0 to 1.0)
- **Value Example:** 0.5
- **Notes:** Range fraction from start of measurement being 0.0 to end of measurement being 1.0 and middle of measurement being 0.5.
- **Name:** “Time_Base”
- **Requirement:** ISTP Required for Time Varying Variables
- **Type:** String
- **Value Examples:** “FIXED: 1970 (POSIX)”, “FIXED: 1980-01-06 (GPS)”, ...

- **Notes:** Indicator about the base (ICON normally uses a fixed base of GPS or UTC).
- **Name:** "Time_Scale"
- **Requirement:** ISTP Recommended for Time Varying Variables
- **Type:** String
- **Value Examples:** "UTC", "GPS", ...
- **Notes:** Indicator about the scale type of time.

2.3.5.12 Units

- **Name:** "Units"
- **Requirement:** ISTP Required & NetCDF Required
- **Type:** String (20 Character Maximum – Smaller Preferred)
- **Value Examples:** "ms", "s", "days", "photon count", ...
- **Notes:** Note that the ISTP Unit_PTR variable is not used because NetCDF also requires the use of "Units". This should be a small character string describing the units of the variable. Leave an empty string if there are no units.

2.3.5.13 Valid Maximum & Minimum

Both NetCDF and ISTP have requirements here and both are used even though there is duplication. They should be set to the same values. The NetCDF version can opt for a range instead of using the minimum and maximum.

- **Name:** "ValidMax"
 - **Requirement:** ISTP Required (Conditionally excepted for strings & unlimited floating point)
 - **Type:** Typed by Variable
 - **Value Example:** "10000.0"
 - **Notes:** The ISTP maximum valid value which is of the same type as the variable. Skip this for strings or double/floats that are unlimited.
-
- **Name:** "ValidMin"
 - **Requirement:** ISTP Required (Conditionally excepted for strings & unlimited floating point)
 - **Type:** Typed by Variable
 - **Value Example:** "-10000.0"
 - **Notes:** The ISTP minimum valid value which is of the same type as the variable. Skip this for strings or double/floats that are unlimited.
-
- **Name:** "Valid_Max"
 - **Requirement:** NetCDF Required (Conditionally excepted for strings & unlimited floating point)
 - **Type:** Typed by Variable
 - **Value Example:** "10000.0"
 - **Notes:** The NetCDF maximum valid value which is of the same type as the variable. Skip this for strings or double/floats that are unlimited. Note: Do not use if using "Valid_Range".
-
- **Name:** "Valid_Min"
 - **Requirement:** NetCDF Required (Conditionally excepted for strings & unlimited floating point)
 - **Type:** Typed by Variable
 - **Value Example:** "-10000.0"
 - **Notes:** The NetCDF minimum valid value which is of the same type as the variable. Skip this for strings or double/floats that are unlimited. Note: Do not use if using "Valid_Range".

- **Name:** “Valid_Range”
- **Requirement:** NetCDF Required (Conditionally excepted for strings & unlimited floating point)
- **Type:** Typed by Variable
- **Value Example:** “-10000.0”, “10000.0”
- **Notes:** The NetCDF two length vector containing the minimum and maximum valid values. Skip this for strings or double/floats that are unlimited. Note: Do not use if using “Valid_Max” and/or “Valid_Min”.

2.3.5.14 Variable Notes

- **Name:** “Var_Notes”
- **Requirement:** ISTP Optional
- **Type:** String
- **Value Example:** “A string of any length describing optional ancillary information.”
- **Notes:** The ISTP optional field allows adding notes about this variable. This is required for every ICON variable. It can be an array of strings with valuable information to help understand what the data is intended to be. With correct data descriptions included in ICON’s variable notes, the ICON products are self documenting.

2.3.5.15 Variable Type

- **Name:** “Var_Type”
- **Requirement:** ISTP Required
- **Type:** String
- **Value Options:** “data”, “support_data”, “metadata”, or “ignore_data”
- **Notes:** The ISTP required field indicates if the data is plottable (data), attached variables (support), labels/strings (metadata) or placeholders (ignore).

2.4 File Naming Conventions

ICON will be using a file naming convention similar to that of ISTP. Note that some fields are optional. The general format is shown here.

“ICON_<LEVEL>_<INSTRUMENT>[_<DESCRIPTION>]T<DATE>[_<TOD>]_v<VERSION>r<REVISION>.NC”

Where the values in <> are replaced as shown below and values in [] are optional.

- **DATE** = Date used to show the file content UTC date in YYYY-MM-DD format (where “2015-12-11” is 11 December 2015 UTC).
- **DESCRIPTION** = Optional, short text allowed to give further indication of the file content.
- **INSTRUMENT** = “FUV”, “IVM-A” as per the “Instrument” setting (may be model acronym).
- **LEVEL** = “L0”, “L0P”, “L1”, “L1_5”, “L2”, “L3”, “L4” and so on indicating the data product level.
- **REVISION** = Data file revision number (starting at 0 and incrementing) formatted as “r####” such that “r000” is the first file and “r001” would be the first revision or second file and so on. The revision represents the number of times the file has been updated due to new data, data corrections or calculation corrections and changes for each data change though resets to 0 if a new version is deployed.
- **TOD** = Optional UTC time of day used if needed in “HH.MM.SS” format (“15.10.00” is 3:10 PM UTC).
- **VERSION** = Data file version number (starting at 1 and incrementing up to 99) formatted as “v##” such that “v01” is version 1 and so on. The version represents the data format and code generation and should change infrequently.

So a level 0 file from the IVM-A instrument might look like any of these:

```
ICON_L0_IVM-A_NOMINAL_2015-10-13T140000_v01r003.NC  
ICON_L0_IVM-A_2015-10-13_v02r000.NC  
ICON_L0_IVM-A_CALIBRATE_2015-10-13T270000_v01r000.NC
```

2.4.1 Level 2 Filenames

Level 2 filenames are uniquely defined here to provide a uniform representation of those products. Though instrument specific information is not present in the file, the instrument responsible for the data is noted. Where an instrument has multiple product files or heads, or day/night products, those are separated. Examples for January 1, 2019 files are noted here:

```
ICON_L2-1_MIGHTI-X_LOS-Wind-Red_2019-01-01_v01r00.NC  
ICON_L2-1_MIGHTI-X_LOS-Wind-Green_2019-01-01_v01r00.NC  
ICON_L2-2_MIGHTI_VEC-Wind-Green_2019-01-01_v01r00.NC  
ICON_L2-2_MIGHTI_VEC-Wind-Red_2019-01-01_v01r00.NC  
ICON_L2-3_MIGHTI-X_Temps_2019-01-01_v01r00.NC  
ICON_L2-4_FUV_Day_2019-01-01_v01r00.NC  
ICON_L2-5_FUV_Night_2019-01-01_v01r00.NC  
ICON_L2-6_EUV_2019-01-01_v01r00.NC  
ICON_L2-7_IVM-X_2019-01-01_v01r00.NC
```

2.5 *Time Conventions*

ICON typically uses two time conventions. Other may be used though are discouraged. This deviates from the ISTEP standard as it is required by the ICON project. The two time conventions are described below and are the GPS EPOCH and the UTC EPOCH.

The GPS Epoch is used because the observatory reports this time in all ICON level zero files, and it is a widely used time convention in data products from other missions. The UTC time is preferred by Harald and should be the first Epoch variable in the data set. There may be multiple UTC Epochs needed (center time, start time, end time and so on) though it is recommended that the first variable is the center time. If an offset is to be used then one of the EPOCHs listed here should be used (which is the most common case). See the [time example](#).

2.5.1 GPS Epoch

The ICON observatory normally has readings from the GPS sensor and thus the time in GPS time. The GPS Epoch does not have leap seconds (meaning time is continuous and no adjustment for leap seconds have been made). The starting point is **6 January 1980 00:00:00.000 UTC** time and is referenced as continuous seconds since that time. See the [EPOCH](#) section for an example.

It is strongly recommended that a *signed 64-bit integer* be used. While a double can hold this data, floating point math often causes significant rounding errors when small values are manipulated with large values.

2.5.2 UTC Epoch

The ICON data products are to reference the UTC Epoch when possible. The time should be represented in milliseconds since **1 January 1970 00:00:00.000Z** (standard UNIX time). Note that this time DOES include leap seconds (there are 17 leap seconds from GPS to UTC as of January 2016). See the [EPOCH](#) section for an example.

It is strongly recommended that a *signed 64-bit integer* be used. While a double can hold this data, floating point math often causes significant rounding errors when small values are manipulated with large values.

3 CDL Files & Examples

CDL files are the text format typically used to represent human readable versions of NetCDF files. There are several tools that can convert NetCDF files to CDL files and back again. Comments in CDL are not carried over to the NetCDF file.

3.1 Tools

The following tools are provided by the SDC to manipulate CDL and NetCDF files.

3.1.1 Setup ICON Tools

These tools can be setup by sourcing the setup script in the ICON tool directory. You must have access to the ICON tools directory in order to perform this.

```
source /disks/data/icon/Tools/ICON/Binary/setup
```

3.1.2 Generate CDL Files

CDL files can be written manually in a text editor. The format is defined by UNIDATA and is best if following the conventions used by **ncgen** as indicated on the following websites:

- Examples: <https://www.unidata.ucar.edu/software/netcdf/examples/files.html>
- ncgen Specification: <https://www.unidata.ucar.edu/software/netcdf/docs/ncgen-man-1.html>

Generating a CDL file from a NC file is normally done with **ncdump**. This tool outputs text which should be piped to the new CDL file. This tool can also just tell the type. Exploring the command line options is a good idea. The two typical export commands are shown below. One offers the internal NetCDF attributes (`_FillValue`, `_DeflateLevel` and so on) while the other skips these values.

```
ncdump ICON_Sample_Epoch_2015-11-25_v01r002.NC > ICON_Sample_Epoch_2015-11-25_v01r002.CDL  
ncdump -s ICON_Sample_Epoch_2015-11-25_v01r002.NC > ICON_Sample_Epoch_2015-11-25_v01r002.CDL
```

3.1.3 Creating NC Files from CDL Files

NC files can be created using a CDL file with the ICON toolset using **ncgen**. The conventions that ncgen expects are indicated on the [UNIDATA website](#).

```
ncgen -b ICON_Sample_Epoch_2015-11-25_v01r002.CDL
```

Note that the `-k` command can be used to specify the output NC file type ("`-k 3`" means NetCDF 4 for example). This will override any `_Format` attribute used in the CDL file.

3.2 Examples

Examples here are in CDL format. The actual CDL files can be found in the repository under examples or on the SDC [confluence website](https://ops-wiki.ssl.berkeley.edu/display/GROUP/NetCDF) (<https://ops-wiki.ssl.berkeley.edu/display/GROUP/NetCDF>).

3.2.1 MIGHTI L0 Prime Example

This example shows a simple (non-real) MIGHTI instrument level zero prime file. This should represent how the ICON pipeline will take RAW MIGHTI data and offer it to the following processors. This includes samples of how time will look (when using integer values for time and not floats or doubles). Note that the image data is left out here though is in the actual CDL file.

```
netcdf ICON_L0P_MIGHTI-A_NOMINAL_2016-01-16_184544_v02r000 {

    // Dimension List
    dimensions:
        Epoch                                     = UNLIMITED ; // (1 currently)
        ICON_L0_MIGHTI_A_Image_ROI_Columns       = 128      ;
        ICON_L0_MIGHTI_A_Image_ROW_Rows          = 1026     ;

    // Variable Definitions:
    variables:
        int64 Epoch(Epoch) ;
        Epoch:Bin_Location = 0.5f ;
        string Epoch:CatDesc =
            "Milliseconds since 1970-01-01 00:00:00 UTC at middle of image integration." ;
        string Epoch:Display_Type = "Time_Series" ;
        string Epoch:FieldNam = "UTC Time" ;
        Epoch:FillVal = -999999999999999L ;
        string Epoch:Format = "I13" ;
        string Epoch:LablAxis = "UTC Time" ;
        string Epoch:Long_Name =
            "Milliseconds since 1970-01-01 00:00:00 UTC at middle of image integration." ;
        string Epoch:MonoTon = "Increase" ;
        string Epoch:ScaleTyp = "Linear" ;
        string Epoch:Time_Base = "1970-01-01 00:00:00.000 UTC" ;
        string Epoch:Time_Scale = "UTC" ;
        string Epoch:Units = "milliseconds" ;
        Epoch:ValidMax = 600000000000L ;
        Epoch:ValidMin = 0L ;
        Epoch:Valid_Range = 0L, 600000000000L ;
        string Epoch:Var_Notes =
            "Milliseconds since 1970-01-01 00:00:00 UTC at middle of image integration.",
            "Derived from original GPS values reported from spacecraft (Time_GPS_Seconds and Time_GPS_Subseconds).",
            "Time calculation is offset by 615ms (flush time) for the first image in the series and for all other images are",
            "adjusted by subtracting (integration time + 308 milliseconds) from the reported GPS time then adding the",
            "difference between the readout FRT and the header FRT.",
            "Time may be delayed by up to 10 ms due to FSW polling delay.",
            "Maximum time is ~2150 UTC and minimum time is ~1970 UTC." ;
        string Epoch:Var_Type = "Support_Data" ;
        Epoch:_ChunkSizes = 262144 ;
        Epoch:_DeflateLevel = 6 ;
        Epoch:_Endianness = "little" ;
        Epoch:_FillValue = -999999999999999L ;
        Epoch:_Shuffle = "true" ;
        Epoch:_Storage = "chunked" ;

        string ICON_L0_MIGHTI_A_Time_UTC(Epoch) ;
        ICON_L0_MIGHTI_A_Time_UTC:Bin_Location = 0.5f ;
        string ICON_L0_MIGHTI_A_Time_UTC:CatDesc =
            "ISO 9601 formatted UTC timestamp (at middle of image integration)." ;
        string ICON_L0_MIGHTI_A_Time_UTC:Depend_0 = "Epoch" ;
        string ICON_L0_MIGHTI_A_Time_UTC:Display_Type = "Time_Series" ;
        string ICON_L0_MIGHTI_A_Time_UTC:FieldNam = "UTC Time" ;
        string ICON_L0_MIGHTI_A_Time_UTC:FillVal = "" ;
        string ICON_L0_MIGHTI_A_Time_UTC:Format = "A27" ;
        string ICON_L0_MIGHTI_A_Time_UTC:LablAxis = "UTC Time" ;
        string ICON_L0_MIGHTI_A_Time_UTC:Long_Name =
            "ISO 9601 formatted UTC timestamp (at middle of image integration)." ;
        string ICON_L0_MIGHTI_A_Time_UTC:MonoTon = "Increase" ;
```

```

string ICON_L0_MIGHTI_A_Time.UTC:ScaleTyp          = "Linear" ;
string ICON_L0_MIGHTI_A_Time.UTC:Time_Base         = "1970-01-01 00:00:00.000 UTC" ;
string ICON_L0_MIGHTI_A_Time.UTC:Time_Scale        = "UTC" ;
string ICON_L0_MIGHTI_A_Time.UTC:Units              = "" ;
string ICON_L0_MIGHTI_A_Time.UTC:ValidMax           = "2150-01-01 00:00:00 UTC" ;
string ICON_L0_MIGHTI_A_Time.UTC:ValidMin           = "1970-01-01 00:00:00 UTC" ;
string ICON_L0_MIGHTI_A_Time.UTC:Valid_Range        =
    "1970-01-01 00:00:00 UTC",
    "2150-01-01 00:00:00 UTC" ;
string ICON_L0_MIGHTI_A_Time.UTC:Var_Notes          =
    "ISO 9601 formatted UTC timestamp (at middle of image integration).",
    "Derived from original GPS values reported from spacecraft (Time_GPS_Seconds and Time_GPS_Subseconds).",
    "Time calculation is offset by 615ms (flush time) for the first image in the series and for all other images are
    adjusted by subtracting (integration time + 308 milliseconds) from the reported GPS time then adding the
    difference between the readout FRT and the header FRT.",
    "Time may be delayed by up to 10 ms due to FSW polling delay.",
    "Maximum time is ~2150 UTC and minimum time is ~1970 UTC.",
    "All character arrays are NULL terminated (size includes NULL)." ;
string ICON_L0_MIGHTI_A_Time.UTC:Var_Type           = "Support_Data" ;
string ICON_L0_MIGHTI_A_Time.UTC:_ChunkSizes        = 1 ;
string ICON_L0_MIGHTI_A_Time.UTC:_DeflateLevel       = 6 ;
string ICON_L0_MIGHTI_A_Time.UTC:_FillValue         = "" ;
string ICON_L0_MIGHTI_A_Time.UTC:_Shuffle           = "true" ;
string ICON_L0_MIGHTI_A_Time.UTC:_Storage           = "chunked" ;

int64 ICON_L0_MIGHTI_A_Time_GPS(Epoch) ;
string ICON_L0_MIGHTI_A_Time_GPS:Bin_Location        = 0.5f ;
string ICON_L0_MIGHTI_A_Time_GPS:CatDesc            =
    "Milliseconds since 1980-01-06 00:00:00 TAI (coincident with UTC) at middle of image integration." ;
string ICON_L0_MIGHTI_A_Time_GPS:Depend_0           = "Epoch" ;
string ICON_L0_MIGHTI_A_Time_GPS:Display_Type       = "Time_Series" ;
string ICON_L0_MIGHTI_A_Time_GPS:FieldNam           = "GPS Time" ;
string ICON_L0_MIGHTI_A_Time_GPS:FillVal            = -999999999999999L ;
string ICON_L0_MIGHTI_A_Time_GPS:Format             = "I13" ;
string ICON_L0_MIGHTI_A_Time_GPS:LablAxis           = "GPS Time" ;
string ICON_L0_MIGHTI_A_Time_GPS:Long_Name          =
    "Milliseconds since 1980-01-06 00:00:00 TAI (coincident with UTC) at middle of image integration." ;
string ICON_L0_MIGHTI_A_Time_GPS:MonoTon            = "Increase" ;
string ICON_L0_MIGHTI_A_Time_GPS:ScaleTyp           = "Linear" ;
string ICON_L0_MIGHTI_A_Time_GPS:Time_Base         = "1980-01-06 00:00:00.000 UTC" ;
string ICON_L0_MIGHTI_A_Time_GPS:Time_Scale        = "GPS" ;
string ICON_L0_MIGHTI_A_Time_GPS:Units              = "milliseconds" ;
string ICON_L0_MIGHTI_A_Time_GPS:ValidMax           = 5500000000000L ;
string ICON_L0_MIGHTI_A_Time_GPS:ValidMin           = 0L ;
string ICON_L0_MIGHTI_A_Time_GPS:Valid_Range        = 0L, 5500000000000L ;
string ICON_L0_MIGHTI_A_Time_GPS:Var_Notes          =
    "Milliseconds since 1980-01-06 00:00:00 TAI (coincident with UTC) at middle of image integration.",
    "Derived from original GPS values reported from spacecraft (Time_GPS_Seconds and Time_GPS_Subseconds).",
    "Time calculation is offset by 615ms (flush time) for the first image in the series and for all other images are
    adjusted by subtracting (integration time + 308 milliseconds) from the reported GPS time then adding the
    difference between the readout FRT and the header FRT.",
    "Time may be delayed by up to 10 ms due to FSW polling delay.",
    "Maximum time is ~2150 UTC and minimum time is ~1970 UTC." ;
string ICON_L0_MIGHTI_A_Time_GPS:Var_Type           = "Support_Data" ;
string ICON_L0_MIGHTI_A_Time_GPS:_ChunkSizes        = 262144 ;
string ICON_L0_MIGHTI_A_Time_GPS:_DeflateLevel       = 6 ;
string ICON_L0_MIGHTI_A_Time_GPS:_Endianness        = "little" ;
string ICON_L0_MIGHTI_A_Time_GPS:_FillValue         = -999999999999999L ;
string ICON_L0_MIGHTI_A_Time_GPS:_Shuffle           = "true" ;
string ICON_L0_MIGHTI_A_Time_GPS:_Storage           = "chunked" ;

int64 ICON_L0_MIGHTI_A_Time.UTC_Begin(Epoch) ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:Bin_Location = 0.f ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:CatDesc      =
    "Milliseconds since 1970-01-01 00:00:00 UTC at start of image integration." ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:Depend_0     = "Epoch" ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:Display_Type = "Time_Series" ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:FieldNam     = "UTC Time" ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:FillVal      = -999999999999999L ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:Format       = "I13" ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:LablAxis     = "UTC Time" ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:Long_Name    =
    "Milliseconds since 1970-01-01 00:00:00 UTC at start of image integration." ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:MonoTon      = "Increase" ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:ScaleTyp     = "Linear" ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:Time_Base   = "1970-01-01 00:00:00.000 UTC" ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:Time_Scale  = "UTC" ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:Units       = "milliseconds" ;
string ICON_L0_MIGHTI_A_Time.UTC_Begin:ValidMax     = 6000000000000L ;

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        ICON_L0_MIGHTI_A_Time.UTC.Begin:ValidMin                = 0L ;
        ICON_L0_MIGHTI_A_Time.UTC.Begin:Valid_Range            = 0L, 600000000000L ;
string ICON_L0_MIGHTI_A_Time.UTC.Begin:Var_Notes              =
    "Milliseconds since 1970-01-01 00:00:00 UTC at start of image integration.",
    "Derived from original GPS values reported from spacecraft (Time_GPS_Seconds and Time_GPS_Subseconds).",
    "Time calculation is offset by 615ms (flush time) for the first image in the series and for all other images are
    adjusted by subtracting (integration time + 308 milliseconds) from the reported GPS time then adding the
    difference between the readout FRT and the header FRT.",
    "Time may be delayed by up to 10 ms due to FSW polling delay.",
    "Maximum time is ~2150 UTC and minimum time is ~1970 UTC." ;
string ICON_L0_MIGHTI_A_Time.UTC.Begin:Var_Type              = "Support_Data" ;
        ICON_L0_MIGHTI_A_Time.UTC.Begin:_ChunkSizes            = 262144 ;
        ICON_L0_MIGHTI_A_Time.UTC.Begin:_DeflateLevel          = 6 ;
        ICON_L0_MIGHTI_A_Time.UTC.Begin:_Endianness            = "little" ;
        ICON_L0_MIGHTI_A_Time.UTC.Begin:_FillValue             = -999999999999999L ;
        ICON_L0_MIGHTI_A_Time.UTC.Begin:_Shuffle               = "true" ;
        ICON_L0_MIGHTI_A_Time.UTC.Begin:_Storage               = "chunked" ;

int64 ICON_L0_MIGHTI_A_Time.UTC.End(Epoch) ;
        ICON_L0_MIGHTI_A_Time.UTC.End:Bin_Location            = 1.f ;
string ICON_L0_MIGHTI_A_Time.UTC.End:CatDesc                  =
    "Milliseconds since 1970-01-01 00:00:00 UTC at end of image integration." ;
string ICON_L0_MIGHTI_A_Time.UTC.End:Depend_0                 = "Epoch" ;
string ICON_L0_MIGHTI_A_Time.UTC.End:Display_Type            = "Time_Series" ;
string ICON_L0_MIGHTI_A_Time.UTC.End:FieldNam                 = "UTC Time" ;
        ICON_L0_MIGHTI_A_Time.UTC.End:_FillVal                = -999999999999999L ;
string ICON_L0_MIGHTI_A_Time.UTC.End:Format                  = "I13" ;
string ICON_L0_MIGHTI_A_Time.UTC.End:LablAxis                 = "UTC Time" ;
string ICON_L0_MIGHTI_A_Time.UTC.End:Long_Name                =
    "Milliseconds since 1970-01-01 00:00:00 UTC at end of image integration." ;
string ICON_L0_MIGHTI_A_Time.UTC.End:_MonoTon                 = "Increase" ;
string ICON_L0_MIGHTI_A_Time.UTC.End:_ScaleTyp                = "Linear" ;
string ICON_L0_MIGHTI_A_Time.UTC.End:_Time_Base              = "1970-01-01 00:00:00.000 UTC" ;
string ICON_L0_MIGHTI_A_Time.UTC.End:_Time_Scale             = "UTC" ;
string ICON_L0_MIGHTI_A_Time.UTC.End:_Units                   = "milliseconds" ;
        ICON_L0_MIGHTI_A_Time.UTC.End:_ValidMax                = 60000000000000L ;
        ICON_L0_MIGHTI_A_Time.UTC.End:_ValidMin                = 0L ;
        ICON_L0_MIGHTI_A_Time.UTC.End:_Valid_Range            = 0L, 60000000000000L ;
string ICON_L0_MIGHTI_A_Time.UTC.End:Var_Notes                =
    "Milliseconds since 1970-01-01 00:00:00 UTC at end of image integration.",
    "Derived from original GPS values reported from spacecraft (Time_GPS_Seconds and Time_GPS_Subseconds).",
    "Time calculation is offset by 615ms (flush time) for the first image in the series and for all other images are
    adjusted by subtracting (integration time + 308 milliseconds) from the reported GPS time then adding the
    difference between the readout FRT and the header FRT.",
    "Time may be delayed by up to 10 ms due to FSW polling delay.",
    "Maximum time is ~2150 UTC and minimum time is ~1970 UTC." ;
string ICON_L0_MIGHTI_A_Time.UTC.End:Var_Type                = "Support_Data" ;
        ICON_L0_MIGHTI_A_Time.UTC.End:_ChunkSizes            = 262144 ;
        ICON_L0_MIGHTI_A_Time.UTC.End:_DeflateLevel          = 6 ;
        ICON_L0_MIGHTI_A_Time.UTC.End:_Endianness            = "little" ;
        ICON_L0_MIGHTI_A_Time.UTC.End:_FillValue             = -999999999999999L ;
        ICON_L0_MIGHTI_A_Time.UTC.End:_Shuffle               = "true" ;
        ICON_L0_MIGHTI_A_Time.UTC.End:_Storage               = "chunked" ;

uint ICON_L0_MIGHTI_A_Time_GPS_Seconds(Epoch) ;
        ICON_L0_MIGHTI_A_Time_GPS_Seconds:Bin_Location        = 0.2f ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:CatDesc              =
    "GPS seconds count when FSW received image packet header." ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:Depend_0             = "Epoch" ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:Display_Type         = "Time_Series" ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:FieldNam             = "GPS Time" ;
        ICON_L0_MIGHTI_A_Time_GPS_Seconds:_FillVal            = 4294967295U ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:Format              = "I10" ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:LablAxis             = "GPS Time" ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:Long_Name            =
    "GPS seconds count when FSW received image packet header." ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:_MonoTon             = "Increase" ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:_ScaleTyp            = "Linear" ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:_Time_Base          = "1980-01-06 00:00:00.000 UTC" ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:_Time_Scale          = "GPS" ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:_Units               = "Seconds" ;
        ICON_L0_MIGHTI_A_Time_GPS_Seconds:_ValidMax            = 4294967294U ;
        ICON_L0_MIGHTI_A_Time_GPS_Seconds:_ValidMin            = 0U ;
        ICON_L0_MIGHTI_A_Time_GPS_Seconds:_Valid_Range        = 0U, 4294967294U ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:Var_Notes            =
    "GPS seconds count when FSW received image packet header.",
    "The FSW received the header of the first image in a series 615ms after start of image processing. Following
    headers are adjusted by subtracting (integration time + 308 milliseconds) from the reported GPS time then adding
    the difference between the readout FRT and the header FRT.",

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        "Time may be delayed by up to 10 ms due to FSW polling delay." ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:Var_Type           = "Support_Data" ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:ChunkSizes        = 524288 ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:DeflateLevel       = 6 ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:Endianness        = "little" ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:FillValue         = 4294967295U ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:Shuffle           = "true" ;
string ICON_L0_MIGHTI_A_Time_GPS_Seconds:Storage           = "chunked" ;

uint ICON_L0_MIGHTI_A_Time_GPS_Subseconds(Epoch) ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:Bin_Location   = 0.2f ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:CatDesc        =
    "FSW 20MHz clock (50 nanosecond) offset from GPS seconds." ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:Depend_0       = "Epoch" ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:Display_Type   = "Time_Series" ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:FieldNam       = "FSW Clock GPS Time Offset" ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:FillVal        = 999999999U ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:Format         = "I9" ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:LablAxis       = "Clk Offset" ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:Long_Name      =
    "FSW 20MHz clock (50 nanosecond) offset from GPS seconds." ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:ScaleTyp       = "Linear" ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:Units          = "50 Nanoseconds" ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:ValidMax       = 100000000U ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:ValidMin       = 0U ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:ValidRange     = 0U, 100000000U ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:Var_Notes      =
    "FSW 20MHz clock (50 nanosecond) offset from GPS seconds.",
    "The FSW received the header of the first image in a series 615ms after start of image processing. Following headers are adjusted by subtracting (integration time + 308 milliseconds) from the reported GPS time then adding the difference between the readout FRT and the header FRT.",
    "The offset may be more than 1 second but never 2 or more seconds.",
    "Time may be delayed by up to 10 ms due to FSW polling delay." ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:Var_Type       = "Support_Data" ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:ChunkSizes     = 524288 ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:DeflateLevel   = 6 ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:Endianness     = "little" ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:FillValue      = 999999999U ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:Shuffle        = "true" ;
string ICON_L0_MIGHTI_A_Time_GPS_Subseconds:Storage        = "chunked" ;

uint ICON_L0_MIGHTI_A_Time_Integration(Epoch) ;
string ICON_L0_MIGHTI_A_Time_Integration:Bin_Location     = 1.f ;
string ICON_L0_MIGHTI_A_Time_Integration:CatDesc          =
    "Time to integrate MIGHTI-A region of interest (ROI) image." ;
string ICON_L0_MIGHTI_A_Time_Integration:Depend_0         = "Epoch" ;
string ICON_L0_MIGHTI_A_Time_Integration:Display_Type     = "Time_Series" ;
string ICON_L0_MIGHTI_A_Time_Integration:FieldNam         = "GPS Time" ;
string ICON_L0_MIGHTI_A_Time_Integration:FillVal          = 4294967295U ;
string ICON_L0_MIGHTI_A_Time_Integration:Format          = "I10" ;
string ICON_L0_MIGHTI_A_Time_Integration:LablAxis         = "GPS Time" ;
string ICON_L0_MIGHTI_A_Time_Integration:Long_Name        =
    "Time to integrate MIGHTI-A region of interest (ROI) image." ;
string ICON_L0_MIGHTI_A_Time_Integration:ScaleTyp         = "Linear" ;
string ICON_L0_MIGHTI_A_Time_Integration:Units            = "milliseconds" ;
string ICON_L0_MIGHTI_A_Time_Integration:ValidMax         = 4294967294U ;
string ICON_L0_MIGHTI_A_Time_Integration:ValidMin         = 0U ;
string ICON_L0_MIGHTI_A_Time_Integration:ValidRange       = 0U, 4294967294U ;
string ICON_L0_MIGHTI_A_Time_Integration:Var_Notes        = "" ;
string ICON_L0_MIGHTI_A_Time_Integration:Var_Type         = "Support_Data" ;
string ICON_L0_MIGHTI_A_Time_Integration:ChunkSizes       = 524288 ;
string ICON_L0_MIGHTI_A_Time_Integration:DeflateLevel     = 6 ;
string ICON_L0_MIGHTI_A_Time_Integration:Endianness       = "little" ;
string ICON_L0_MIGHTI_A_Time_Integration:FillValue        = 4294967295U ;
string ICON_L0_MIGHTI_A_Time_Integration:Shuffle          = "true" ;
string ICON_L0_MIGHTI_A_Time_Integration:Storage          = "chunked" ;

ushort ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer(Epoch) ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:Bin_Location = 0.2f ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:CatDesc      =
    "Free running timer reading for MIGHTI image header." ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:Depend_0     = "Epoch" ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:Display_Type  = "Time_Series" ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:FieldNam     = "Image Header FRT" ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:FillVal      = 0U ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:Format       = "I5" ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:LablAxis     = "FRT Header" ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:Long_Name    =
    "Free running timer reading for MIGHTI image header." ;

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string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:ScaleTyp      = "Linear" ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:Units         = "milliseconds" ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:ValidMax      = 65535US ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:ValidMin      = 0US ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:ValidRange    = 0US, 65535US ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:Var_Notes     =
    "The FRTs are millisecond free running timers used to calculate the time offset for this image\'s integration
    from the observatory GPS time tag. This is only used when it is not the first image in the integration sequence.
    When the prior image FRT is not known a timing error is generated as a calculation cannot be performed. The base
    GPS time is used as the start time." ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:Var_Type       = "Support_Data" ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:_ChunkSizes    = 1048576 ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:_DeflateLevel   = 6 ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:_Endianness     = "little" ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:_FillValue      = 0US ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:_Shuffle        = "true" ;
string ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer:_Storage        = "chunked" ;

ushort ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer(Epoch) ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:Bin_Location   = 1.f ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:CatDesc        =
    "Free running timer reading for MIGHTI image data readout start." ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:Depend_0       = "Epoch" ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:Display_Type    = "Time_Series" ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:FieldNam       = "Image Data Readout FRT" ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:FillVal        = 0US ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:Format         = "I5" ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:LablAxis       = "FRTReadOut" ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:Long_Name      =
    "Free running timer reading for MIGHTI image data readout start." ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:ScaleTyp       = "Linear" ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:Units          = "milliseconds" ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:ValidMax       = 65535US ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:ValidMin       = 0US ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:ValidRange     = 0US, 65535US ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:Var_Notes     =
    "The FRTs are millisecond free running timers used to calculate the time offset for this image\'s integration
    from the observatory GPS time tag. This is only used when it is not the first image in the integration sequence.
    When the prior image FRT is not known a timing error is generated as a calculation cannot be performed. The base
    GPS time is used as the start time." ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:Var_Type       = "Support_Data" ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:_ChunkSizes    = 1048576 ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:_DeflateLevel   = 6 ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:_Endianness     = "little" ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:_FillValue      = 0US ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:_Shuffle        = "true" ;
string ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer:_Storage        = "chunked" ;

ushort ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer(Epoch) ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:CatDesc  =
    "Free running timer reading for MIGHTI prior image data readout start." ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:Depend_0  = "Epoch" ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:Display_Type = "Time_Series" ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:FieldNam    = "Prior Image Data Readout FRT" ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:FillVal    = 0US ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:Format      = "I5" ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:LablAxis    = "FRTPriorRO" ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:Long_Name   =
    "Free running timer reading for MIGHTI prior image data readout start." ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:ScaleTyp    = "Linear" ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:Units       = "milliseconds" ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:ValidMax    = 65535US ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:ValidMin    = 0US ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:ValidRange  = 0US, 65535US ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:Var_Notes  =
    "The FRTs are millisecond free running timers used to calculate the time offset for this image\'s integration
    from the observatory GPS time tag. This is only used when it is not the first image in the integration sequence.
    When the prior image FRT is not known a timing error is generated as a calculation cannot be performed. The base
    GPS time is used as the start time." ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:Var_Type    = "Support_Data" ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:_ChunkSizes = 1048576 ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:_DeflateLevel = 6 ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:_Endianness = "little" ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:_FillValue   = 0US ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:_Shuffle     = "true" ;
string ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer:_Storage     = "chunked" ;

ubyte ICON_L0_MIGHTI_A_Time_Prior_Known(Epoch) ;
string ICON_L0_MIGHTI_A_Time_Prior_Known:CatDesc =

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        "Flag indicating prior image\'s free running timer known." ;
string ICON_L0_MIGHTI_A_Time_Prior_Known:Depend_0
string ICON_L0_MIGHTI_A_Time_Prior_Known:Display_Type
string ICON_L0_MIGHTI_A_Time_Prior_Known:FieldNam
        ICON_L0_MIGHTI_A_Time_Prior_Known:FillVal
string ICON_L0_MIGHTI_A_Time_Prior_Known:Format
string ICON_L0_MIGHTI_A_Time_Prior_Known:LablAxis
string ICON_L0_MIGHTI_A_Time_Prior_Known:Long_Name
        "Flag indicating prior image\'s free running timer known." ;
string ICON_L0_MIGHTI_A_Time_Prior_Known:ScaleTyp
string ICON_L0_MIGHTI_A_Time_Prior_Known:Units
        ICON_L0_MIGHTI_A_Time_Prior_Known:ValidMax
        ICON_L0_MIGHTI_A_Time_Prior_Known:ValidMin
        ICON_L0_MIGHTI_A_Time_Prior_Known:Valid_Range
string ICON_L0_MIGHTI_A_Time_Prior_Known:Var_Notes
        "The FRTs are millisecond free running timers used to calculate the time offset for this image\'s integration
        from the observatory GPS time tag. This is only used when it is not the first image in the integration sequence.
        When the prior image FRT is not known a timing error is generated as a calculation cannot be performed. The base
        GPS time is used as the start time." ;
string ICON_L0_MIGHTI_A_Time_Prior_Known:Var_Type
        ICON_L0_MIGHTI_A_Time_Prior_Known:_ChunkSizes
        ICON_L0_MIGHTI_A_Time_Prior_Known:_DeflateLevel
        ICON_L0_MIGHTI_A_Time_Prior_Known:_FillValue
        ICON_L0_MIGHTI_A_Time_Prior_Known:_Shuffle
        ICON_L0_MIGHTI_A_Time_Prior_Known:_Storage

ubyte ICON_L0_MIGHTI_A_MT_Device_ID ;
string ICON_L0_MIGHTI_A_MT_Device_ID:CatDesc
        "MIGHTI camera instrument ID (0=MIGHTI-A, 1=MIGHT-B)." ;
        ICON_L0_MIGHTI_A_MT_Device_ID:Bin_Location
string ICON_L0_MIGHTI_A_MT_Device_ID:FieldNam
        ICON_L0_MIGHTI_A_MT_Device_ID:FillVal
string ICON_L0_MIGHTI_A_MT_Device_ID:Format
string ICON_L0_MIGHTI_A_MT_Device_ID:LablAxis
string ICON_L0_MIGHTI_A_MT_Device_ID:Long_Name
        "MIGHTI camera instrument ID (0=MIGHTI-A, 1=MIGHT-B)." ;
string ICON_L0_MIGHTI_A_MT_Device_ID:Units
        ICON_L0_MIGHTI_A_MT_Device_ID:ValidMax
        ICON_L0_MIGHTI_A_MT_Device_ID:ValidMin
        ICON_L0_MIGHTI_A_MT_Device_ID:Valid_Range
string ICON_L0_MIGHTI_A_MT_Device_ID:Var_Notes
string ICON_L0_MIGHTI_A_MT_Device_ID:Var_Type
        ICON_L0_MIGHTI_A_MT_Device_ID:_FillValue

short ICON_L0_MIGHTI_A_MT_Device_Current_Sense(Epoch) ;
        ICON_L0_MIGHTI_A_MT_Device_Current_Sense:Bin_Location
string ICON_L0_MIGHTI_A_MT_Device_Current_Sense:CatDesc
        "MIGHTI camera current (power) monitor count." ;
string ICON_L0_MIGHTI_A_MT_Device_Current_Sense:Depend_0
string ICON_L0_MIGHTI_A_MT_Device_Current_Sense:Display_Type
string ICON_L0_MIGHTI_A_MT_Device_Current_Sense:FieldNam
        ICON_L0_MIGHTI_A_MT_Device_Current_Sense:FillVal
string ICON_L0_MIGHTI_A_MT_Device_Current_Sense:Format
string ICON_L0_MIGHTI_A_MT_Device_Current_Sense:LablAxis
string ICON_L0_MIGHTI_A_MT_Device_Current_Sense:Long_Name
        "MIGHTI camera current (power) monitor count." ;
string ICON_L0_MIGHTI_A_MT_Device_Current_Sense:Units
        ICON_L0_MIGHTI_A_MT_Device_Current_Sense:ValidMax
        ICON_L0_MIGHTI_A_MT_Device_Current_Sense:ValidMin
        ICON_L0_MIGHTI_A_MT_Device_Current_Sense:Valid_Range
string ICON_L0_MIGHTI_A_MT_Device_Current_Sense:Var_Notes
string ICON_L0_MIGHTI_A_MT_Device_Current_Sense:Var_Type
        ICON_L0_MIGHTI_A_MT_Device_Current_Sense:_ChunkSizes
        ICON_L0_MIGHTI_A_MT_Device_Current_Sense:_DeflateLevel
        ICON_L0_MIGHTI_A_MT_Device_Current_Sense:_Endianness
        ICON_L0_MIGHTI_A_MT_Device_Current_Sense:_FillValue
        ICON_L0_MIGHTI_A_MT_Device_Current_Sense:_Shuffle
        ICON_L0_MIGHTI_A_MT_Device_Current_Sense:_Storage

ubyte ICON_L0_MIGHTI_A_Calibration_Lamp_1(Epoch) ;
        ICON_L0_MIGHTI_A_Calibration_Lamp_1:Bin_Location
string ICON_L0_MIGHTI_A_Calibration_Lamp_1:CatDesc
        "MIGHTI camera calibration lamp 1 setting (0=OFF, 1=ON)." ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_1:Depend_0
string ICON_L0_MIGHTI_A_Calibration_Lamp_1:Display_Type
string ICON_L0_MIGHTI_A_Calibration_Lamp_1:FieldNam
        ICON_L0_MIGHTI_A_Calibration_Lamp_1:FillVal
string ICON_L0_MIGHTI_A_Calibration_Lamp_1:Format
string ICON_L0_MIGHTI_A_Calibration_Lamp_1:LablAxis

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string ICON_L0_MIGHTI_A_Calibration_Lamp_1:Long_Name           =
    "MIGHTI camera calibration lamp 1 setting (0=OFF, 1=ON).";
string ICON_L0_MIGHTI_A_Calibration_Lamp_1:Units              = "Flag" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_1:ValidMax              = 1UB ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_1:ValidMin              = 0UB ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_1:Valid_Range           = 0UB, 1UB ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_1:Var_Notes          = "" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_1:Var_Type            = "Support_Data" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_1:_ChunkSizes           = 2097152 ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_1:_DeflateLevel          = 6 ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_1:_FillValue            = 99UB ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_1:_Shuffle              = "true" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_1:_Storage               = "chunked" ;

ubyte ICON_L0_MIGHTI_A_Calibration_Lamp_2(Epoch) ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_2:Bin_Location           = 1.f ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_2:CatDesc            =
    "MIGHTI camera calibration lamp 2 setting (0=OFF, 1=ON).";
string ICON_L0_MIGHTI_A_Calibration_Lamp_2:Depend_0           = "Epoch" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_2:Display_Type        = "Time_Series" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_2:FieldNam           = "MIGHTI Cal. Lamp 2 Setting" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_2:FillVal               = 99UB ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_2:Format             = "I1" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_2:LablAxis            = "MTCallamp2" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_2:Long_Name          =
    "MIGHTI camera calibration lamp 2 setting (0=OFF, 1=ON).";
string ICON_L0_MIGHTI_A_Calibration_Lamp_2:Units              = "Flag" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_2:ValidMax              = 1UB ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_2:ValidMin              = 0UB ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_2:Valid_Range           = 0UB, 1UB ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_2:Var_Notes          = "" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_2:Var_Type            = "Support_Data" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_2:_ChunkSizes           = 2097152 ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_2:_DeflateLevel          = 6 ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_2:_FillValue            = 99UB ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_2:_Shuffle              = "true" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_2:_Storage               = "chunked" ;

short ICON_L0_MIGHTI_A_Calibration_Lamp_Current(Epoch) ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Current:Bin_Location     = 1.f ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Current:CatDesc      =
    "MIGHTI camera calibration lamp combined current monitor sense count.";
string ICON_L0_MIGHTI_A_Calibration_Lamp_Current:Depend_0     = "Epoch" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Current:Display_Type  = "Time_Series" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Current:FieldNam      = "MT Cal. Lamp Current Sense" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Current:FillVal         = 0s ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Current:Format        = "I6" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Current:LablAxis      = "CallmpCur" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Current:Long_Name    =
    "MIGHTI camera calibration lamp combined current monitor sense count.";
string ICON_L0_MIGHTI_A_Calibration_Lamp_Current:Units         = "Count" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Current:ValidMax         = 32767s ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Current:ValidMin         = -32768s ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Current:Valid_Range      = -32768s, 32767s ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Current:Var_Notes     = "" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Current:Var_Type      = "Support_Data" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Current:_ChunkSizes      = 1048576 ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Current:_DeflateLevel     = 6 ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Current:_Endianness      = "little" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Current:_FillValue       = 0s ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Current:_Shuffle         = "true" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Current:_Storage          = "chunked" ;

short ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature(Epoch) ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:Bin_Location = 1.f ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:CatDesc  =
    "MIGHTI camera calibration lamp combined temperature monitor sense count.";
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:Depend_0 = "Epoch" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:Display_Type = "Time_Series" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:FieldNam  = "MT Cal. Lamp Temperature Sense" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:FillVal     = 0s ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:Format    = "I6" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:LablAxis   = "CallmpTemp" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:Long_Name =
    "MIGHTI camera calibration lamp combined temperature monitor sense count.";
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:Units     = "Count" ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:ValidMax     = 32767s ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:ValidMin     = -32768s ;
    ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:Valid_Range  = -32768s, 32767s ;

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string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:Var_Notes      = "" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:Var_Type      = "Support_Data" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:_ChunkSizes   = 1048576 ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:_DeflateLevel = 6 ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:_Endianness   = "little" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:_FillValue    = 0s ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:_Shuffle      = "true" ;
string ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature:_Storage      = "chunked" ;

short ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense(Epoch) ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:Bin_Location = 1.f ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:CatDesc      =
    "MIGHTI interferometer 1 fine temperature sense count." ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:Depend_0     = "Epoch" ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:Display_Type = "Time_Series" ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:FieldNam     = "MIGHTI Interferometer 1 Temp." ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:FillVal      = 0s ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:Format       = "I6" ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:LablAxis      = "Intf1Temp" ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:Long_Name    =
    "MIGHTI interferometer 1 fine temperature sense count." ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:Units        = "Count" ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:ValidMax      = 32767s ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:ValidMin      = -32768s ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:Valid_Range  = -32768s, 32767s ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:Var_Notes     = "" ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:Var_Type      = "Support_Data" ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:_ChunkSizes   = 1048576 ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:_DeflateLevel = 6 ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:_Endianness   = "little" ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:_FillValue    = 0s ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:_Shuffle      = "true" ;
string ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense:_Storage      = "chunked" ;

short ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense(Epoch) ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:Bin_Location = 1.f ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:CatDesc      =
    "MIGHTI interferometer 2 fine temperature sense count." ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:Depend_0     = "Epoch" ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:Display_Type = "Time_Series" ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:FieldNam     = "MIGHTI Interferometer 2 Temp." ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:FillVal      = 0s ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:Format       = "I6" ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:LablAxis      = "Intf2Temp" ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:Long_Name    =
    "MIGHTI interferometer 2 fine temperature sense count." ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:Units        = "Count" ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:ValidMax      = 32767s ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:ValidMin      = -32768s ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:Valid_Range  = -32768s, 32767s ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:Var_Notes     = "" ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:Var_Type      = "Support_Data" ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:_ChunkSizes   = 1048576 ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:_DeflateLevel = 6 ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:_Endianness   = "little" ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:_FillValue    = 0s ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:_Shuffle      = "true" ;
string ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense:_Storage      = "chunked" ;

short ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward(Epoch) ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Bin_Location = 1.f ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:CatDesc      =
    "MIGHTI optics bench forward temperature sense count." ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Depend_0     = "Epoch" ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Display_Type = "Time_Series" ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:FieldNam     = "Optics Bench Fore Temp. Sense" ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:FillVal      = 0s ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Format       = "I6" ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:LablAxis      = "OpBchTFore" ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Long_Name    =
    "MIGHTI optics bench forward temperature sense count." ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Units        = "Count" ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:ValidMax      = 32767s ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:ValidMin      = -32768s ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Valid_Range  = -32768s, 32767s ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Var_Notes     = "" ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Var_Type      = "Support_Data" ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:_ChunkSizes   = 1048576 ;
string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:_DeflateLevel = 6 ;

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    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Endianness      = "little" ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:FillValue      = 0s ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Shuffle        = "true" ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward:Storage        = "chunked" ;

short ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear(Epoch) ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:Bin_Location      = 1.f ;
    string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:CatDesc    =
        "MIGHTI optics bench rear temperature sense count." ;
    string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:Depend_0    = "Epoch" ;
    string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:Display_Type = "Time_Series" ;
    string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:FieldNam    = "Optics Bench Rear Temp. Sense" ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:FillVal          = 0s ;
    string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:Format      = "I6" ;
    string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:LablAxis    = "OpBnchTAft" ;
    string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:Long_Name  =
        "MIGHTI optics bench rear temperature sense count." ;
    string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:Units      = "Count" ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:ValidMax          = 32767s ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:ValidMin          = -32768s ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:Valid_Range      = -32768s, 32767s ;
    string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:Var_Notes  = "" ;
    string ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:Var_Type    = "Support_Data" ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:_ChunkSizes      = 1048576 ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:_DeflateLevel    = 6 ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:_Endianness      = "little" ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:_FillValue      = 0s ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:_Shuffle        = "true" ;
    ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear:_Storage        = "chunked" ;

short ICON_L0_MIGHTI_A_Optics_Temperature_Aft(Epoch) ;
    ICON_L0_MIGHTI_A_Optics_Temperature_Aft:Bin_Location            = 1.f ;
    string ICON_L0_MIGHTI_A_Optics_Temperature_Aft:CatDesc          =
        "MIGHTI optics aft temperature sense count." ;
    string ICON_L0_MIGHTI_A_Optics_Temperature_Aft:Depend_0          = "Epoch" ;
    string ICON_L0_MIGHTI_A_Optics_Temperature_Aft:Display_Type      = "Time_Series" ;
    string ICON_L0_MIGHTI_A_Optics_Temperature_Aft:FieldNam          = "Optics Aft Temperature Sense" ;
    ICON_L0_MIGHTI_A_Optics_Temperature_Aft:FillVal                = 0s ;
    string ICON_L0_MIGHTI_A_Optics_Temperature_Aft:Format            = "I6" ;
    string ICON_L0_MIGHTI_A_Optics_Temperature_Aft:LablAxis          = "OptTempAft" ;
    string ICON_L0_MIGHTI_A_Optics_Temperature_Aft:Long_Name        =
        "MIGHTI optics aft temperature sense count." ;
    string ICON_L0_MIGHTI_A_Optics_Temperature_Aft:Units            = "Count" ;
    ICON_L0_MIGHTI_A_Optics_Temperature_Aft:ValidMax                = 32767s ;
    ICON_L0_MIGHTI_A_Optics_Temperature_Aft:ValidMin                = -32768s ;
    ICON_L0_MIGHTI_A_Optics_Temperature_Aft:Valid_Range            = -32768s, 32767s ;
    string ICON_L0_MIGHTI_A_Optics_Temperature_Aft:Var_Notes        = "" ;
    string ICON_L0_MIGHTI_A_Optics_Temperature_Aft:Var_Type          = "Support_Data" ;
    ICON_L0_MIGHTI_A_Optics_Temperature_Aft:_ChunkSizes            = 1048576 ;
    ICON_L0_MIGHTI_A_Optics_Temperature_Aft:_DeflateLevel          = 6 ;
    ICON_L0_MIGHTI_A_Optics_Temperature_Aft:_Endianness            = "little" ;
    ICON_L0_MIGHTI_A_Optics_Temperature_Aft:_FillValue            = 0s ;
    ICON_L0_MIGHTI_A_Optics_Temperature_Aft:_Shuffle              = "true" ;
    ICON_L0_MIGHTI_A_Optics_Temperature_Aft:_Storage              = "chunked" ;

short ICON_L0_MIGHTI_A_TEC_Current_Input_Count(Epoch) ;
    ICON_L0_MIGHTI_A_TEC_Current_Input_Count:Bin_Location          = 1.f ;
    string ICON_L0_MIGHTI_A_TEC_Current_Input_Count:CatDesc        =
        "MIGHTI thermo-electric cooler combined (TEC-A + TEC-B) input current count." ;
    string ICON_L0_MIGHTI_A_TEC_Current_Input_Count:Depend_0        = "Epoch" ;
    string ICON_L0_MIGHTI_A_TEC_Current_Input_Count:Display_Type    = "Time_Series" ;
    string ICON_L0_MIGHTI_A_TEC_Current_Input_Count:FieldNam        = "MT TEC Input Current Count" ;
    ICON_L0_MIGHTI_A_TEC_Current_Input_Count:FillVal              = 0s ;
    string ICON_L0_MIGHTI_A_TEC_Current_Input_Count:Format          = "I6" ;
    string ICON_L0_MIGHTI_A_TEC_Current_Input_Count:LablAxis        = "TEC Cur In" ;
    string ICON_L0_MIGHTI_A_TEC_Current_Input_Count:Long_Name      =
        "MIGHTI thermo-electric cooler combined (TEC-A + TEC-B) input current count." ;
    string ICON_L0_MIGHTI_A_TEC_Current_Input_Count:Units          = "Count" ;
    ICON_L0_MIGHTI_A_TEC_Current_Input_Count:ValidMax              = 32767s ;
    ICON_L0_MIGHTI_A_TEC_Current_Input_Count:ValidMin              = -32768s ;
    ICON_L0_MIGHTI_A_TEC_Current_Input_Count:Valid_Range          = -32768s, 32767s ;
    string ICON_L0_MIGHTI_A_TEC_Current_Input_Count:Var_Notes      = "" ;
    string ICON_L0_MIGHTI_A_TEC_Current_Input_Count:Var_Type        = "Support_Data" ;
    ICON_L0_MIGHTI_A_TEC_Current_Input_Count:_ChunkSizes          = 1048576 ;
    ICON_L0_MIGHTI_A_TEC_Current_Input_Count:_DeflateLevel        = 6 ;
    ICON_L0_MIGHTI_A_TEC_Current_Input_Count:_Endianness          = "little" ;
    ICON_L0_MIGHTI_A_TEC_Current_Input_Count:_FillValue          = 0s ;
    ICON_L0_MIGHTI_A_TEC_Current_Input_Count:_Shuffle            = "true" ;
    ICON_L0_MIGHTI_A_TEC_Current_Input_Count:_Storage            = "chunked" ;

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short ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count(Epoch) ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:Bin_Location      = 1.f ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:CatDesc    =
        "MIGHTI thermo-electric cooler cold-side temperature sense count." ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:Depend_0    = "Epoch" ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:Display_Type = "Time_Series" ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:FieldNam     = "MT TEC Cold-Side Temp. Count" ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:FillVal           = 0s ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:Format      = "I6" ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:LablAxis    = "TECColdTmp" ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:Long_Name   =
        "MIGHTI thermo-electric cooler cold-side temperature sense count." ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:Units       = "Count" ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:ValidMax           = 32767s ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:ValidMin           = -32768s ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:Valid_Range       = -32768s, 32767s ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:Var_Notes   = "" ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:Var_Type    = "Support_Data" ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:_ChunkSizes        = 1048576 ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:_DeflateLevel      = 6 ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:_Endianness       = "little" ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:_FillValue         = 0s ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:_Storage           = "chunked" ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count:_Shuffle           = "true" ;

short ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count(Epoch) ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:Bin_Location      = 1.f ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:CatDesc    =
        "MIGHTI thermo-electric cooler hot-side temperature sense count." ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:Depend_0    = "Epoch" ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:Display_Type = "Time_Series" ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:FieldNam     = "MT TEC Hot-Side Temp. Count" ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:FillVal           = 0s ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:Format      = "I6" ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:LablAxis    = "TECHotTemp" ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:Long_Name   =
        "MIGHTI thermo-electric cooler hot-side temperature sense count." ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:Units       = "Count" ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:ValidMax           = 32767s ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:ValidMin           = -32768s ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:Valid_Range       = -32768s, 32767s ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:Var_Notes   = "" ;
    string ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:Var_Type    = "Support_Data" ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:_ChunkSizes        = 1048576 ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:_DeflateLevel      = 6 ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:_Endianness       = "little" ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:_FillValue         = 0s ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:_Shuffle           = "true" ;
    ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count:_Storage           = "chunked" ;

ubyte ICON_L0_MIGHTI_A_MTA_Aperture1_Position(Epoch) ;
    ICON_L0_MIGHTI_A_MTA_Aperture1_Position:Bin_Location      = 1.f ;
    string ICON_L0_MIGHTI_A_MTA_Aperture1_Position:CatDesc    =
        "MIGHTI-A camera aperture 1 position sense flag." ;
    string ICON_L0_MIGHTI_A_MTA_Aperture1_Position:Depend_0    = "Epoch" ;
    string ICON_L0_MIGHTI_A_MTA_Aperture1_Position:Display_Type = "Time_Series" ;
    string ICON_L0_MIGHTI_A_MTA_Aperture1_Position:FieldNam     = "MIGHTI-A Aperture Position 1" ;
    ICON_L0_MIGHTI_A_MTA_Aperture1_Position:FillVal           = 255UB ;
    string ICON_L0_MIGHTI_A_MTA_Aperture1_Position:Format      = "I1" ;
    string ICON_L0_MIGHTI_A_MTA_Aperture1_Position:LablAxis    = "MTAAppPos1" ;
    string ICON_L0_MIGHTI_A_MTA_Aperture1_Position:Long_Name   =
        "MIGHTI-A camera aperture 1 position sense flag." ;
    string ICON_L0_MIGHTI_A_MTA_Aperture1_Position:Units       = "Flag" ;
    ICON_L0_MIGHTI_A_MTA_Aperture1_Position:ValidMax           = 3UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture1_Position:ValidMin           = 0UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture1_Position:Valid_Range       = 0UB, 3UB ;
    string ICON_L0_MIGHTI_A_MTA_Aperture1_Position:Var_Notes   = "0=OPEN, 1=CLOSED, 2=15% OPEN, 3=UNKNOWN" ;
    string ICON_L0_MIGHTI_A_MTA_Aperture1_Position:Var_Type    = "Support_Data" ;
    ICON_L0_MIGHTI_A_MTA_Aperture1_Position:_ChunkSizes        = 2097152 ;
    ICON_L0_MIGHTI_A_MTA_Aperture1_Position:_DeflateLevel      = 6 ;
    ICON_L0_MIGHTI_A_MTA_Aperture1_Position:_FillValue         = 255UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture1_Position:_Shuffle           = "true" ;
    ICON_L0_MIGHTI_A_MTA_Aperture1_Position:_Storage           = "chunked" ;

ubyte ICON_L0_MIGHTI_A_MTA_Aperture2_Position(Epoch) ;
    ICON_L0_MIGHTI_A_MTA_Aperture2_Position:Bin_Location      = 1.f ;
    string ICON_L0_MIGHTI_A_MTA_Aperture2_Position:CatDesc

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    "MIGHTI-A camera aperture 2 position sense flag." ;
string ICON_L0_MIGHTI_A_MTA_Aperture2_Position:Depend_0      = "Epoch" ;
string ICON_L0_MIGHTI_A_MTA_Aperture2_Position:Display_Type  = "Time_Series" ;
string ICON_L0_MIGHTI_A_MTA_Aperture2_Position:FieldNam      = "MIGHTI-A Aperture Position 2" ;
    ICON_L0_MIGHTI_A_MTA_Aperture2_Position:FillVal          = 255UB ;
string ICON_L0_MIGHTI_A_MTA_Aperture2_Position:Format         = "I1" ;
string ICON_L0_MIGHTI_A_MTA_Aperture2_Position:LablAxis       = "MTAAppPos2" ;
string ICON_L0_MIGHTI_A_MTA_Aperture2_Position:Long_Name      =
    "MIGHTI-A camera aperture 2 position sense flag." ;
string ICON_L0_MIGHTI_A_MTA_Aperture2_Position:Units          = "Flag" ;
    ICON_L0_MIGHTI_A_MTA_Aperture2_Position:ValidMax          = 3UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture2_Position:ValidMin           = 0UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture2_Position:Valid_Range        = 0UB, 3UB ;
string ICON_L0_MIGHTI_A_MTA_Aperture2_Position:Var_Notes      = "0=OPEN, 1=CLOSED, 2=15% OPEN,
3=UNKNOWN" ;
string ICON_L0_MIGHTI_A_MTA_Aperture2_Position:Var_Type        = "Support_Data" ;
    ICON_L0_MIGHTI_A_MTA_Aperture2_Position:_ChunkSizes        = 2097152 ;
    ICON_L0_MIGHTI_A_MTA_Aperture2_Position:_DeflateLevel       = 6 ;
    ICON_L0_MIGHTI_A_MTA_Aperture2_Position:_FillValue         = 255UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture2_Position:_Shuffle           = "true" ;
    ICON_L0_MIGHTI_A_MTA_Aperture2_Position:_Storage            = "chunked" ;

ubyte ICON_L0_MIGHTI_A_MTA_Aperture1(Epoch) ;
    ICON_L0_MIGHTI_A_MTA_Aperture1:Bin_Location                = 1.f ;
string ICON_L0_MIGHTI_A_MTA_Aperture1:CatDesc                  =
    "MIGHTI-A camera aperture 1 switch setting (0=OPEN, 1=CLOSED)." ;
string ICON_L0_MIGHTI_A_MTA_Aperture1:Depend_0                  = "Epoch" ;
string ICON_L0_MIGHTI_A_MTA_Aperture1:Display_Type              = "Time_Series" ;
string ICON_L0_MIGHTI_A_MTA_Aperture1:FieldNam                  = "MIGHTI-A Aperture Switch 1" ;
    ICON_L0_MIGHTI_A_MTA_Aperture1:FillVal                      = 255UB ;
string ICON_L0_MIGHTI_A_MTA_Aperture1:Format                    = "I1" ;
string ICON_L0_MIGHTI_A_MTA_Aperture1:LablAxis                  = "MTAAppSw1" ;
string ICON_L0_MIGHTI_A_MTA_Aperture1:Long_Name                  =
    "MIGHTI-A camera aperture 1 switch setting (0=OPEN, 1=CLOSED)." ;
string ICON_L0_MIGHTI_A_MTA_Aperture1:Units                      = "Flag" ;
    ICON_L0_MIGHTI_A_MTA_Aperture1:ValidMax                      = 1UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture1:ValidMin                       = 0UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture1:Valid_Range                   = 0UB, 1UB ;
string ICON_L0_MIGHTI_A_MTA_Aperture1:Var_Notes                  = "" ;
string ICON_L0_MIGHTI_A_MTA_Aperture1:Var_Type                  = "Support_Data" ;
    ICON_L0_MIGHTI_A_MTA_Aperture1:_ChunkSizes                    = 2097152 ;
    ICON_L0_MIGHTI_A_MTA_Aperture1:_DeflateLevel                  = 6 ;
    ICON_L0_MIGHTI_A_MTA_Aperture1:_FillValue                    = 255UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture1:_Shuffle                      = "true" ;
    ICON_L0_MIGHTI_A_MTA_Aperture1:_Storage                      = "chunked" ;

ubyte ICON_L0_MIGHTI_A_MTA_Aperture2(Epoch) ;
    ICON_L0_MIGHTI_A_MTA_Aperture2:Bin_Location                = 1.f ;
string ICON_L0_MIGHTI_A_MTA_Aperture2:CatDesc                  =
    "MIGHTI-A camera aperture 2 switch setting (0=OPEN, 1=CLOSED)." ;
string ICON_L0_MIGHTI_A_MTA_Aperture2:Depend_0                  = "Epoch" ;
string ICON_L0_MIGHTI_A_MTA_Aperture2:Display_Type              = "Time_Series" ;
string ICON_L0_MIGHTI_A_MTA_Aperture2:FieldNam                  = "MIGHTI-A Aperture Switch 2" ;
    ICON_L0_MIGHTI_A_MTA_Aperture2:FillVal                      = 255UB ;
string ICON_L0_MIGHTI_A_MTA_Aperture2:Format                    = "I1" ;
string ICON_L0_MIGHTI_A_MTA_Aperture2:LablAxis                  = "MTAAppSw2" ;
string ICON_L0_MIGHTI_A_MTA_Aperture2:Long_Name                  =
    "MIGHTI-A camera aperture 2 switch setting (0=OPEN, 1=CLOSED)." ;
string ICON_L0_MIGHTI_A_MTA_Aperture2:Units                      = "Flag" ;
    ICON_L0_MIGHTI_A_MTA_Aperture2:ValidMax                      = 1UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture2:ValidMin                       = 0UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture2:Valid_Range                   = 0UB, 1UB ;
string ICON_L0_MIGHTI_A_MTA_Aperture2:Var_Notes                  = "" ;
string ICON_L0_MIGHTI_A_MTA_Aperture2:Var_Type                  = "Support_Data" ;
    ICON_L0_MIGHTI_A_MTA_Aperture2:_ChunkSizes                    = 2097152 ;
    ICON_L0_MIGHTI_A_MTA_Aperture2:_DeflateLevel                  = 6 ;
    ICON_L0_MIGHTI_A_MTA_Aperture2:_FillValue                    = 255UB ;
    ICON_L0_MIGHTI_A_MTA_Aperture2:_Shuffle                      = "true" ;
    ICON_L0_MIGHTI_A_MTA_Aperture2:_Storage                      = "chunked" ;

ubyte ICON_L0_MIGHTI_A_MTB_Aperture1_Position(Epoch) ;
    ICON_L0_MIGHTI_A_MTB_Aperture1_Position:Bin_Location        = 1.f ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:CatDesc          =
    "MIGHTI-B camera aperture 1 position sense flag." ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:Depend_0          = "Epoch" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:Display_Type      = "Time_Series" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:FieldNam          =
    "MIGHTI-B Aperture Position 1" ;
    ICON_L0_MIGHTI_A_MTB_Aperture1_Position:FillVal              = 255UB ;

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string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:Format          = "I1" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:LablAxis        = "MTBAppPos1" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:Long_Name       =
    "MIGHTI-B camera aperture 1 position sense flag." ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:Units           = "Flag" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:ValidMax         = 3UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:ValidMin         = 0UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:ValidRange       = 0UB, 3UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:Var_Notes        =
    "0=OPEN, 1=CLOSED, 2=15% OPEN, 3=UNKNOWN" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:Var_Type         = "Support_Data" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:ChunkSizes       = 2097152 ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:DeflateLevel     = 6 ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:FillValue        = 255UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:Shuffle          = "true" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1_Position:Storage          = "chunked" ;

ubyte ICON_L0_MIGHTI_A_MTB_Aperture2_Position(Epoch) ;
    ICON_L0_MIGHTI_A_MTB_Aperture2_Position:Bin_Location        = 1.f ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:CatDesc          =
    "MIGHTI-B camera aperture 2 position sense flag." ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:Depend_0         = "Epoch" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:Display_Type     = "Time_Series" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:FieldNam         = "MIGHTI-B Aperture Position 2" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:FillVal          = 255UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:Format           = "I1" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:LablAxis         = "MTBAppPos2" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:Long_Name        =
    "MIGHTI-B camera aperture 2 position sense flag." ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:Units           = "Flag" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:ValidMax         = 3UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:ValidMin         = 0UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:ValidRange       = 0UB, 3UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:Var_Notes        =
    "0=OPEN, 1=CLOSED, 2=15% OPEN, 3=UNKNOWN" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:Var_Type         = "Support_Data" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:ChunkSizes       = 2097152 ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:DeflateLevel     = 6 ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:FillValue        = 255UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:Shuffle          = "true" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2_Position:Storage          = "chunked" ;

ubyte ICON_L0_MIGHTI_A_MTB_Aperture1(Epoch) ;
    ICON_L0_MIGHTI_A_MTB_Aperture1:Bin_Location                = 1.f ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:CatDesc                  =
    "MIGHTI-B camera aperture 1 switch setting (0=OPEN, 1=CLOSED)." ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:Depend_0                 = "Epoch" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:Display_Type             = "Time_Series" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:FieldNam                 = "MIGHTI-B Aperture Switch 1" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:FillVal                  = 255UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:Format                   = "I1" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:LablAxis                 = "MTBAppSw1" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:Long_Name                =
    "MIGHTI-B camera aperture 1 switch setting (0=OPEN, 1=CLOSED)." ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:Units                    = "Flag" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:ValidMax                 = 1UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:ValidMin                 = 0UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:ValidRange               = 0UB, 1UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:Var_Notes                = "" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:Var_Type                 = "Support_Data" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:ChunkSizes               = 2097152 ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:DeflateLevel             = 6 ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:FillValue                = 255UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:Shuffle                  = "true" ;
string ICON_L0_MIGHTI_A_MTB_Aperture1:Storage                  = "chunked" ;

ubyte ICON_L0_MIGHTI_A_MTB_Aperture2(Epoch) ;
    ICON_L0_MIGHTI_A_MTB_Aperture2:Bin_Location                = 1.f ;
string ICON_L0_MIGHTI_A_MTB_Aperture2:CatDesc                  =
    "MIGHTI-B camera aperture 2 switch setting (0=OPEN, 1=CLOSED)." ;
string ICON_L0_MIGHTI_A_MTB_Aperture2:Depend_0                 = "Epoch" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2:Display_Type             = "Time_Series" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2:FieldNam                 = "MIGHTI-B Aperture Switch 2" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2:FillVal                  = 255UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture2:Format                   = "I1" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2:LablAxis                 = "MTBAppSw2" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2:Long_Name                =
    "MIGHTI-B camera aperture 2 switch setting (0=OPEN, 1=CLOSED)." ;
string ICON_L0_MIGHTI_A_MTB_Aperture2:Units                    = "Flag" ;

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        ICON_L0_MIGHTI_A_MTB_Aperture2:ValidMax           = 1UB ;
        ICON_L0_MIGHTI_A_MTB_Aperture2:ValidMin           = 0UB ;
        ICON_L0_MIGHTI_A_MTB_Aperture2:Valid_Range        = 0UB, 1UB ;
string ICON_L0_MIGHTI_A_MTB_Aperture2:Var_Notes          = "" ;
string ICON_L0_MIGHTI_A_MTB_Aperture2:Var_Type           = "Support_Data" ;
        ICON_L0_MIGHTI_A_MTB_Aperture2:_ChunkSizes        = 2097152 ;
        ICON_L0_MIGHTI_A_MTB_Aperture2:_DeflateLevel       = 6 ;
        ICON_L0_MIGHTI_A_MTB_Aperture2:_FillValue         = 255UB ;
        ICON_L0_MIGHTI_A_MTB_Aperture2:_Shuffle           = "true" ;
        ICON_L0_MIGHTI_A_MTB_Aperture2:_Storage           = "chunked" ;

ushort ICON_L0_MIGHTI_A_Error_Compression(Epoch) ;
        ICON_L0_MIGHTI_A_Error_Compression:Bin_Location   = 1.f ;
string ICON_L0_MIGHTI_A_Error_Compression:CatDesc        =
        "Error count during compression (per packet)." ;
string ICON_L0_MIGHTI_A_Error_Compression:Depend_0       = "Epoch" ;
string ICON_L0_MIGHTI_A_Error_Compression:Display_Type   = "Time_Series" ;
string ICON_L0_MIGHTI_A_Error_Compression:FieldNam       = "Compression Error Packet Count" ;
        ICON_L0_MIGHTI_A_Error_Compression:FillVal       = 65535US ;
string ICON_L0_MIGHTI_A_Error_Compression:Format         = "I5" ;
string ICON_L0_MIGHTI_A_Error_Compression:LablAxis       = "ErrorComp" ;
string ICON_L0_MIGHTI_A_Error_Compression:Long_Name      =
        "Error count during compression (per packet)." ;
string ICON_L0_MIGHTI_A_Error_Compression:Units          = "Count" ;
        ICON_L0_MIGHTI_A_Error_Compression:ValidMax      = 65535US ;
        ICON_L0_MIGHTI_A_Error_Compression:ValidMin      = 0US ;
        ICON_L0_MIGHTI_A_Error_Compression:Valid_Range   = 0US, 65535US ;
string ICON_L0_MIGHTI_A_Error_Compression:Var_Notes      =
        "Error count during compression (per packet).",
        "Should be zero (for no error) but if it is a non-zero number then the number indicates the number of packets
        that contained an overflow in the delta bit field during compression." ;
string ICON_L0_MIGHTI_A_Error_Compression:Var_Type       = "Support_Data" ;
        ICON_L0_MIGHTI_A_Error_Compression:_ChunkSizes   = 1048576 ;
        ICON_L0_MIGHTI_A_Error_Compression:_DeflateLevel = 6 ;
        ICON_L0_MIGHTI_A_Error_Compression:_Endianness   = "little" ;
        ICON_L0_MIGHTI_A_Error_Compression:_FillValue    = 65535US ;
        ICON_L0_MIGHTI_A_Error_Compression:_Shuffle      = "true" ;
        ICON_L0_MIGHTI_A_Error_Compression:_Storage      = "chunked" ;

ubyte ICON_L0_MIGHTI_A_Error_Time(Epoch) ;
        ICON_L0_MIGHTI_A_Error_Time:Bin_Location         = 1.f ;
string ICON_L0_MIGHTI_A_Error_Time:CatDesc              =
        "Error finding prior image readout FRT (0=GOOD, 1=ERROR)." ;
string ICON_L0_MIGHTI_A_Error_Time:Depend_0             = "Epoch" ;
string ICON_L0_MIGHTI_A_Error_Time:Display_Type         = "Time_Series" ;
string ICON_L0_MIGHTI_A_Error_Time:FieldNam             = "Time Calculation Error Flag" ;
        ICON_L0_MIGHTI_A_Error_Time:FillVal             = 255UB ;
string ICON_L0_MIGHTI_A_Error_Time:Format               = "I1" ;
string ICON_L0_MIGHTI_A_Error_Time:LablAxis             = "ErrorTime" ;
string ICON_L0_MIGHTI_A_Error_Time:Long_Name            =
        "Error finding prior image readout FRT (0=GOOD, 1=ERROR)." ;
string ICON_L0_MIGHTI_A_Error_Time:Units                = "Flag" ;
        ICON_L0_MIGHTI_A_Error_Time:ValidMax             = 1UB ;
        ICON_L0_MIGHTI_A_Error_Time:ValidMin             = 0UB ;
        ICON_L0_MIGHTI_A_Error_Time:Valid_Range         = 0UB, 1UB ;
string ICON_L0_MIGHTI_A_Error_Time:Var_Notes            =
        "Error finding prior image readout FRT (0=GOOD, 1=ERROR).",
        "The prior image read out FRT was missing so proper time offset couldn't be calculated correctly. The time will
        indicate later then the actual time. This only occurs when not the first image of the series." ;
string ICON_L0_MIGHTI_A_Error_Time:Var_Type            = "Support_Data" ;
        ICON_L0_MIGHTI_A_Error_Time:_ChunkSizes          = 2097152 ;
        ICON_L0_MIGHTI_A_Error_Time:_DeflateLevel        = 6 ;
        ICON_L0_MIGHTI_A_Error_Time:_FillValue          = 255UB ;
        ICON_L0_MIGHTI_A_Error_Time:_Shuffle            = "true" ;
        ICON_L0_MIGHTI_A_Error_Time:_Storage            = "chunked" ;

ushort ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count(Epoch) ;
        ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:Bin_Location = 1.f ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:CatDesc =
        "Horizontal charge transfer efficiency register count indicating the horizontal overscan pixel configuration per
        MIGHTI ICD." ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:Depend_0 = "Epoch" ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:Display_Type = "Time_Series" ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:FieldNam = "MT Horiz Charge Tsfr Eff Cnt" ;
        ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:FillVal = 65535US ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:Format = "I5" ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:LablAxis = "HCTE Cnt" ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:Long_Name =

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    "Horizontal charge transfer efficiency register count indicating the horizontal overscan pixel configuration per
    MIGHTI ICD." ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:Units          = "Count" ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:ValidMax      = 65535US ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:ValidMin      = 0US ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:Valid_Range   = 0US, 65535US ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:Var_Notes     =
    "Horizontal charge transfer efficiency register count indicating the horizontal overscan pixel configuration per
    MIGHTI ICD.",
    "See ICN-ICD-002 (MIGHTI) for more details on this parameter." ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:Var_Type      = "Support_Data" ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:_ChunkSizes    = 1048576 ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:_DeflateLevel  = 6 ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:_Endianness    = "little" ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:_FillValue     = 65535US ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:_Shuffle       = "true" ;
string ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count:_Storage       = "chunked" ;

ushort ICON_L0_MIGHTI_A_Image_BIN_Parameters(Epoch) ;
    ICON_L0_MIGHTI_A_Image_BIN_Parameters:Bin_Location                          = 0.f ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:CatDesc                          =
    "MIGHTI binning parameters (BINCOUNTS)." ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:Depend_0                          = "Epoch" ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:Display_Type                      = "Time_Series" ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:FieldNam                         = "BINCOUNTS" ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:FillVal                         = 65535US ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:Format                          = "I5" ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:LablAxis                        = "BINCOUNTS" ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:Long_Name                       =
    "MIGHTI binning parameters (BINCOUNTS)." ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:Units                          = "Flag" ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:ValidMax                        = 65535US ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:ValidMin                        = 0US ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:Valid_Range                     = 0US, 65535US ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:Var_Notes                       =
    "MIGHTI binning parameters (BINCOUNTS).",
    "See ICN-ICD-002 (MIGHTI) for more details on this parameter." ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:Var_Type                       = "Support_Data" ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:_ChunkSizes                     = 1048576 ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:_DeflateLevel                   = 6 ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:_Endianness                     = "little" ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:_FillValue                     = 65535US ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:_Shuffle                       = "true" ;
string ICON_L0_MIGHTI_A_Image_BIN_Parameters:_Storage                       = "chunked" ;

ubyte ICON_L0_MIGHTI_A_Image_First(Epoch) ;
    ICON_L0_MIGHTI_A_Image_First:Bin_Location                              = 0.f ;
string ICON_L0_MIGHTI_A_Image_First:CatDesc                              =
    "First image in MIGHTI integration sequence (0=NOT FIRST, 1=FIRST)." ;
string ICON_L0_MIGHTI_A_Image_First:Depend_0                              = "Epoch" ;
string ICON_L0_MIGHTI_A_Image_First:Display_Type                        = "Time_Series" ;
string ICON_L0_MIGHTI_A_Image_First:FieldNam                          = "First Image Flag" ;
string ICON_L0_MIGHTI_A_Image_First:FillVal                          = 255UB ;
string ICON_L0_MIGHTI_A_Image_First:Format                          = "I1" ;
string ICON_L0_MIGHTI_A_Image_First:LablAxis                          = "FirstImage" ;
string ICON_L0_MIGHTI_A_Image_First:Long_Name                        =
    "First image in MIGHTI integration sequence (0=NOT FIRST, 1=FIRST)." ;
string ICON_L0_MIGHTI_A_Image_First:Units                              = "Flag" ;
string ICON_L0_MIGHTI_A_Image_First:ValidMax                          = 1UB ;
string ICON_L0_MIGHTI_A_Image_First:ValidMin                          = 0UB ;
string ICON_L0_MIGHTI_A_Image_First:Valid_Range                      = 0UB, 1UB ;
string ICON_L0_MIGHTI_A_Image_First:Var_Notes                        = "" ;
string ICON_L0_MIGHTI_A_Image_First:Var_Type                        = "Support_Data" ;
string ICON_L0_MIGHTI_A_Image_First:_ChunkSizes                      = 2097152 ;
string ICON_L0_MIGHTI_A_Image_First:_DeflateLevel                    = 6 ;
string ICON_L0_MIGHTI_A_Image_First:_FillValue                      = 255UB ;
string ICON_L0_MIGHTI_A_Image_First:_Shuffle                        = "true" ;
string ICON_L0_MIGHTI_A_Image_First:_Storage                        = "chunked" ;

ushort ICON_L0_MIGHTI_A_Image_ROI_Column_Count(Epoch) ;
    ICON_L0_MIGHTI_A_Image_ROI_Column_Count:Bin_Location                = 0.f ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:CatDesc                =
    "MIGHTI region of interest (ROI) pixel column count." ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:Depend_0                = "Epoch" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:Display_Type            = "Time_Series" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:FieldNam                = "Image ROI Pixel Column Count" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:FillVal                = 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:Format                = "I5" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:LablAxis                = "ROIColCnt" ;
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string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:Long_Name           =
    "MIGHTI region of interest (ROI) pixel column count." ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:Units               = "Count" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:ValidMax             = 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:ValidMin            = 0US ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:ValidRange          = 0US, 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:Var_Notes           = "" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:Var_Type            = "Support_Data" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:_ChunkSizes         = 1048576 ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:_DeflateLevel       = 6 ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:_Endianness         = "little" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:_FillValue          = 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:_Shuffle            = "true" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Count:_Storage            = "chunked" ;

ushort ICON_L0_MIGHTI_A_Image_ROI_Column_Start(Epoch) ;
    ICON_L0_MIGHTI_A_Image_ROI_Column_Start:Bin_Location           = 0.f ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:CatDesc             =
    "MIGHTI region of interest (ROI) pixel starting column." ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:Depend_0            = "Epoch" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:Display_Type        = "Time_Series" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:FieldNam            = "Image ROI Start Pixel Column" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:FillVal            = 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:Format              = "I5" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:LablAxis            = "ROIColStrt" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:Long_Name           =
    "MIGHTI region of interest (ROI) pixel starting column." ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:Units               = "Count" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:ValidMax             = 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:ValidMin            = 0US ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:ValidRange          = 0US, 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:Var_Notes           = "" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:Var_Type            = "Support_Data" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:_ChunkSizes         = 1048576 ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:_DeflateLevel       = 6 ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:_Endianness         = "little" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:_FillValue          = 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:_Shuffle            = "true" ;
string ICON_L0_MIGHTI_A_Image_ROI_Column_Start:_Storage            = "chunked" ;

ushort ICON_L0_MIGHTI_A_Image_ROI_Row_Count(Epoch) ;
    ICON_L0_MIGHTI_A_Image_ROI_Row_Count:Bin_Location             = 0.f ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:CatDesc               =
    "MIGHTI region of interest (ROI) pixel row count." ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:Depend_0              = "Epoch" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:Display_Type          = "Time_Series" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:FieldNam              = "Image ROI Pixel Row Count" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:FillVal              = 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:Format                = "I5" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:LablAxis              = "ROIRowCnt" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:Long_Name             =
    "MIGHTI region of interest (ROI) pixel row count." ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:Units                 = "Count" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:ValidMax              = 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:ValidMin              = 0US ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:ValidRange            = 0US, 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:Var_Notes             = "" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:Var_Type              = "Support_Data" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:_ChunkSizes           = 1048576 ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:_DeflateLevel         = 6 ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:_Endianness           = "little" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:_FillValue            = 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:_Shuffle              = "true" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Count:_Storage              = "chunked" ;

ushort ICON_L0_MIGHTI_A_Image_ROI_Row_Start(Epoch) ;
    ICON_L0_MIGHTI_A_Image_ROI_Row_Start:Bin_Location             = 0.f ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:CatDesc               =
    "MIGHTI region of interest (ROI) pixel starting row." ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:Depend_0              = "Epoch" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:Display_Type          = "Time_Series" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:FieldNam              = "Image ROI Start Pixel Row" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:FillVal              = 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:Format                = "I5" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:LablAxis              = "ROIRowStrt" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:Long_Name             =
    "MIGHTI region of interest (ROI) pixel starting row." ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:Units                 = "Count" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:ValidMax              = 65535US ;

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        ICON_L0_MIGHTI_A_Image_ROI_Row_Start:ValidMin           = 0US ;
        ICON_L0_MIGHTI_A_Image_ROI_Row_Start:Valid_Range       = 0US, 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:Var_Notes         = "" ;
string ICON_L0_MIGHTI_A_Image_ROI_Row_Start:Var_Type          = "Support_Data" ;
        ICON_L0_MIGHTI_A_Image_ROI_Row_Start:_ChunkSizes       = 1048576 ;
        ICON_L0_MIGHTI_A_Image_ROI_Row_Start:_DeflateLevel     = 6 ;
        ICON_L0_MIGHTI_A_Image_ROI_Row_Start:_Endianness       = "little" ;
        ICON_L0_MIGHTI_A_Image_ROI_Row_Start:_FillValue        = 65535US ;
        ICON_L0_MIGHTI_A_Image_ROI_Row_Start:_Shuffle          = "true" ;
        ICON_L0_MIGHTI_A_Image_ROI_Row_Start:_Storage          = "chunked" ;

ushort ICON_L0_MIGHTI_A_Image_ROI_Pixels(Epoch, ICON_L0_MIGHTI_A_Image_ROW_Rows, ICON_L0_MIGHTI_A_Image_ROI_Columns) ;
        ICON_L0_MIGHTI_A_Image_ROI_Pixels:Bin_Location         = 1.f ;
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:CatDesc              =
        "MIGHTI region of interest pixel values layed out [ROWS]x[COLUMNS].";
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:Depend_0              = "Epoch" ;
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:Depend_1              = "Image_ROW_Rows" ;
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:Depend_2              = "Image_ROI_Columns" ;
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:Display_Type         = "Image" ;
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:FieldNam              = "Image ROI Pixels ROWSxCOLUMNS" ;
        ICON_L0_MIGHTI_A_Image_ROI_Pixels:FillVal              = 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:Format               = "I5" ;
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:LablAxis              = "ROI Pixels" ;
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:Long_Name             =
        "MIGHTI region of interest pixel values layed out [ROWS]x[COLUMNS].";
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:Units                 = "Count" ;
        ICON_L0_MIGHTI_A_Image_ROI_Pixels:ValidMax              = 65535US ;
        ICON_L0_MIGHTI_A_Image_ROI_Pixels:ValidMin              = 0US ;
        ICON_L0_MIGHTI_A_Image_ROI_Pixels:Valid_Range          = 0US, 65535US ;
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:Var_Notes             = "" ;
string ICON_L0_MIGHTI_A_Image_ROI_Pixels:Var_Type              = "Data" ;
        ICON_L0_MIGHTI_A_Image_ROI_Pixels:_ChunkSizes           = 7, 1026, 128 ;
        ICON_L0_MIGHTI_A_Image_ROI_Pixels:_DeflateLevel         = 6 ;
        ICON_L0_MIGHTI_A_Image_ROI_Pixels:_Endianness           = "little" ;
        ICON_L0_MIGHTI_A_Image_ROI_Pixels:_FillValue            = 65535US ;
        ICON_L0_MIGHTI_A_Image_ROI_Pixels:_Shuffle              = "true" ;
        ICON_L0_MIGHTI_A_Image_ROI_Pixels:_Storage              = "chunked" ;

// Global Attributes:
string :Acknowledgement =
        "This is a data product from the NASA Ionospheric Connection Explorer mission, an Explorer launched in June
        2017.\n\nResponsibility of the mission science falls to the Principal Investigator, Dr. Thomas Immel at UC
        Berkeley.\n\nValidation of the L1 data products falls to the instrument lead investigators/scientists.\n * EUV
        - Dr. Eric Korpela\n * FUV - Dr. Harald Frey\n * MIGHTI - Dr. Chris Englert\n * IVM - Dr. Roderick
        Heelis\n\nValidation of the L2 data products falls to those responsible for those products.\n * O/N2 - Dr.
        Andrew Stephan\n * Daytime (EUV) O+ profiles - Dr. Andrew Stephan\n * Nighttime (FUV) O+ profiles - Dr. Farzad
        Kamalabadi\n * Neutral Wind profiles - Dr. Jon Makela\n * Neutral Temperature profiles - Dr. Chris
        Englert\n\nResponsibility for Level 4 products are detailed on the ICON website
        (http://icon.ssl.berkeley.edu).\n\nOverall validation of the products is overseen by the ICON Project Scientist
        Dr. Scott England.\n\nNASA oversight for all products is provided by the Mission Scientist Dr. Douglas
        Rowland.\n\nUsers of these data should contact and acknowledge the Principal Investigator Dr. Immel and the
        party directly responsible for the data product and the NASA Contract Number NNG12FA45C from the Explorers
        Project Office." ;
string :ADID_Ref = "NASA Contract > NNG12FA45C" ;
string :Calibration_File = "" ;
string :Conventions = "SPDF ISTP/IACF Modified for NetCDF" ;
string :Data_Level = "L0.5" ;
string :Data_Type =
        "APIDxE8 > ICON Application ID 0xE8: MIGHTI-A Level 0.5 Data" ;
string :Data_Revision = 0 US ;
string :Data_Version = 2.F ;
string :Data_VersionMajor = 2 UB ;
string :Date_End =
        "Sat, 16 Jan 2016, 2016-01-16 18:45:44.883 UTC" ;
string :Date_Start =
        "Sat, 16 Jan 2016, 2016-01-16 18:45:44.783 UTC" ;
string :Description =
        "ICON MIGHTI-A Level 0.5 Nominal Image File" ;
string :Descriptor =
        "MIGHTI-A > ICON MIGHTI-A L0.5 Nominal Image File" ;
string :Discipline =
        "Space Physics > Ionospheric Science" ;
string :File =
        "ICON_L0P_MIGHTI-A_NOMINAL_2016-01-16_184544_v02r000.NC" ;
string :File_Date =
        "Thu, 4 Feb 2016, 2016-02-04 17:52:46.639 UTC" ;
string :Generated_By =
        "ICON SDC > ICON MIGHTI L0 Processor v1.0.0, Tori Fae (tfae@paradigm.ssl.berkeley.edu)" ;

```

```

string :Generation_Date           = "20160204" ;
string :History
    "Version 1, Created by ICON MIGHTI L0 Processor v1.0.0 on Tue, 2 Feb 2016, 2016-02-02 11:21:15.222 UTC.",
    "Version 2, Created by ICON MIGHTI L0 Processor v1.0.0 on Thu, 4 Feb 2016, 2016-02-04 17:52:46.639 UTC to fix attributes." ;
string :HTTP_LINK                 = "http://icon.ssl.berkeley.edu" ;
string :Instrument                 = "MIGHTI-A" ;
string :Instrument_Type            = "Imagers (Space)" ;
string :Link_Text                  =
    "All ICON information and data can be found at the " ;
string :Link_Title                 = "ICON Website" ;
string :Logical_File_ID           =
    "ICON_L0P_MIGHTI-A_NOMINAL_2016-01-16_184544_v02r000" ;
string :Logical_Source             =
    "ICON_L0P_MIGHTI-A_NOMINAL_2016-01-16_184544" ;
string :Logical_Source_Description =
    "ICON MIGHTI-A Level 0.5 Nominal Image File" ;
string :Mission_Group             = "Ionospheric Investigations" ;
string :MODS
    "Version 1, Created by ICON MIGHTI L0 Processor v1.0.0 on Tue, 2 Feb 2016, 2016-02-02 11:21:15.222 UTC.",
    "Version 2, Created by ICON MIGHTI L0 Processor v1.0.0 on Thu, 4 Feb 2016, 2016-02-04 17:52:46.639 UTC to fix attributes." ;
string :Parents
    "DAT > ICON_2016-01-16_L0_MIGHTI_DATA_v0001" ;
string :PI_Affiliation             = "UC Berkeley > SSL" ;
string :PI_Name                   = "T. J. Immel" ;
string :Project                   = "NASA > ICON" ;
string :Rules_of_Use              = "Public Data for Scientific Use" ;
string :Software_Version          =
    "ICON SDC > ICON MIGHTI L0 Processor v1.0.0, Tori Fae (tfae@paradigm.ssl.berkeley.edu)" ;
string :Source_Name               =
    "ICON > Ionospheric Connection Explorer" ;
string :Spacecraft_ID             = "NASA > ICON - 493" ;
string :Text
    "ICON explores the boundary between Earth and space - the ionosphere - to understand the physical connection between our
    world and the immediate space environment around us. Visit 'http://icon.ssl.berkeley.edu\' for more details." ;
string :Time_Resolution           = "100 milliseconds" ;
string :Title                     =
    "MIGHTI-A Level 0.5 Nominal Image File" ;
:_Format                         = "netCDF-4" ;

// Data Values
data:
Epoch
ICON_L0_MIGHTI_A_Time_UTC         = 1452969944833 ;
ICON_L0_MIGHTI_A_Time_GPS         = "2016-01-16 18:45:44.833 UTC" ;
ICON_L0_MIGHTI_A_Time_UTC_Begin   = 1137005161833 ;
ICON_L0_MIGHTI_A_Time_UTC_End     = 1452969944783 ;
ICON_L0_MIGHTI_A_Time_GPS_Seconds = 1452969944883 ;
ICON_L0_MIGHTI_A_Time_GPS_Subseconds = 1137005161 ;
ICON_L0_MIGHTI_A_Time_Integration = 3356853 ;
ICON_L0_MIGHTI_A_Time_Integration = 100 ;
ICON_L0_MIGHTI_A_Time_Header_Free_Running_Timer = 30242 ;
ICON_L0_MIGHTI_A_Time_Readout_Free_Running_Timer = 31271 ;
ICON_L0_MIGHTI_A_Time_Prior_Readout_Free_Running_Timer = _ ;
ICON_L0_MIGHTI_A_Time_Prior_Known = 0 ;
ICON_L0_MIGHTI_A_MT_Device_ID     = 0 ;
ICON_L0_MIGHTI_A_MT_Device_Current_Sense = -27590 ;
ICON_L0_MIGHTI_A_Calibration_Lamp_1 = 0 ;
ICON_L0_MIGHTI_A_Calibration_Lamp_2 = 0 ;
ICON_L0_MIGHTI_A_Calibration_Lamp_Current = -32263 ;
ICON_L0_MIGHTI_A_Calibration_Lamp_Temperature = 22842 ;
ICON_L0_MIGHTI_A_Interferometer_1_Temperature_Sense = -5045 ;
ICON_L0_MIGHTI_A_Interferometer_2_Temperature_Sense = -3124 ;
ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Forward = -844 ;
ICON_L0_MIGHTI_A_Optics_Bench_Temperature_Rear = -2533 ;
ICON_L0_MIGHTI_A_Optics_Temperature_Aft = -2743 ;
ICON_L0_MIGHTI_A_TEC_Current_Input_Count = -31669 ;
ICON_L0_MIGHTI_A_TEC_Temperature_Cold_Count = 25274 ;
ICON_L0_MIGHTI_A_TEC_Temperature_Hot_Count = 25149 ;
ICON_L0_MIGHTI_A_MTA_Aperture1_Position = 3 ;
ICON_L0_MIGHTI_A_MTA_Aperture2_Position = 3 ;
ICON_L0_MIGHTI_A_MTA_Aperture1 = 0 ;
ICON_L0_MIGHTI_A_MTA_Aperture2 = 0 ;
ICON_L0_MIGHTI_A_MTB_Aperture1_Position = 3 ;
ICON_L0_MIGHTI_A_MTB_Aperture2_Position = 3 ;
ICON_L0_MIGHTI_A_MTB_Aperture1 = 0 ;
ICON_L0_MIGHTI_A_MTB_Aperture2 = 0 ;
ICON_L0_MIGHTI_A_Error_Compression = 0 ;
ICON_L0_MIGHTI_A_Error_Time = 0 ;
ICON_L0_MIGHTI_A_Horizontal_Charge_Transfer_Efficiency_Count = 50 ;

```

```
ICON_L0_MIGHTI_A_Image_BIN_Parameters      = 528 ;  
ICON_L0_MIGHTI_A_Image_First                = 1 ;  
ICON_L0_MIGHTI_A_Image_ROI_Column_Count    = 128 ;  
ICON_L0_MIGHTI_A_Image_ROI_Column_Start    = 0 ;  
ICON_L0_MIGHTI_A_Image_ROI_Row_Count       = 1026 ;  
ICON_L0_MIGHTI_A_Image_ROI_Row_Start       = 0 ;  
}
```

4 NetCDF Format

There are a number of NetCDF standards (listed below). For the ICON mission we are using NetCDF 4 in order to take advantage of the fast access, large size disc access provided by the addition of HDF5 to the NetCDF file system. The table below summarizes the benefits and restraints of the different formats.

NetCDF Format Comparison

	NETCDF 3 (CLASSIC)	NETCDF 4 (CLASSIC)	NETCDF 4	NETCDF 4 (RECOMMENDED)
COMPATIBILITY	MOST	~MOST	LEAST	COMPROMISE
COMPRESSION	POST PROCESSING	IN-PROCESS	IN-PROCESS	IN-PROCESS
INTEGERS: 64-BIT	NO	NO	YES	YES
INTEGERS: UNSIGNED	NO	NO	YES	YES
SIZE: FILE	FILE SYSTEM	FILE SYSTEM	FILE SYSTEM	FILE SYSTEM
SIZE: STRUCTURE	~ 2 GB	~ 2 GB	UNLIMITED	UNLIMITED
STRINGS	NO	NO	YES	YES
STRUCTURES	NO	NO	YES	NO
UNLIMITED DIMENSIONS	LAST *	LAST *	MANY *	LAST *

* Note: Unlimited dimensions may either be a single dimension which is the last of a multi-dimensional array (Classic Mode) or contain many dimensions in unlimited mode (NetCDF 4 [non-classic] and beyond).

4.1 NetCDF Classic (NetCDF 3)

NetCDF Classic (also known as NetCDF Version 3) is the most widely used version (though that is changing). This variant is not suitable for ICON because it has a limitation of 2 GB (which may be too small for some Level 4 Model Data Products) and a maximum array size less than one billion.

- **Compatibility:** Most widely used with the most tools existing to manipulate data.
- **Compression:** No inherent compression in routines. However secondary steps can be taken to re-write data in a compressed format at the expense of extra processing time (and space during processing).
- **Structures:** Has signed integers and double capabilities though is notably lacking 64-bit integers, unsigned integers and character strings. The lack of unsigned numbers and 64-bit support being the most problematic. These limitations can be worked around as strings can be written in two parts with a size and an array of characters, tags can be added to the numbers to indicate they are unsigned, and two 32-bit numbers or a double can be used to express most 64 bit numbers.
- **Size Limitations:** File sizes can be as large as the underlying file system supports (note that older file systems are limited to 2 GB [$2 * 2^{30}$ bytes]). Only the last dimension of an array is allowed to be unlimited/unbounded in classic. Further, the largest size of the total data in a multiple dimension array cannot exceed ~2 GB (precisely $2^{31} - 4$ bytes). This limitation can be somewhat alleviated by making the “unlimited” variable break at intervals less than this limitation.

4.2 *NetCDF 4 Classic*

NetCDF version 4 can be set to classic mode in order to make [NetCDF 4](#) data in a format that mirrors the classic format but with the faster file system and compression capabilities. This is still a very compatible option and if compatibility is the highest priority then this is the best option. It still has many of the limitations of [NetCDF 3](#). The primary difference between NetCDF 4 Classic and NetCDF Classic is that newer code is used during writing allowing for compression and performance enhancements during write.

- **Compatibility:** Very widely used and most existing tools support this format.
- **Compression:** Allows for in-process compression, which may be tailored per data set.
- **Structures:** Limited precisely as NetCDF Classic. This includes the lack of 64-bit integers and unsigned numbers which are often desired in ICON Data Products.
- **Size Limitations:** Limitations are nearly the same as NetCDF Classic with the exception that record sizes are increased from ~2 GB to ~4 GB (precisely 2^{32} - 4 bytes).

4.3 *NetCDF 4*

NetCDF version 4 is a newer format that uses the HDF5 data model and file format. This format alleviates the file size issues and has handlers for inline compression. It also allows for enhanced data structures which can be quite complicated. This format is very suitable for ICON though it is recommended that the advanced data structures not be used (multiple variables can be used instead) in order to continue using as many pre-existing tools as possible.

- **Compatibility:** Least widely used though adoption is growing.
- **Compression:** Allows for in-process compression, which may be tailored per data set.
- **Structures:** Supports strings, unsigned integers and 64-bit integers. Also supports advanced data structures though these are recommended against since reader applications are limited at this stage of adoption.
- **Size Limitations:** File sizes can be as large as the underlying file system supports (note that older file systems are limited to 2 GB [$2 * 2^{30}$ bytes]). Any dimension may be set to unlimited though this may expand the uncompressed size of the file greatly and it is recommended to still keep only the last dimension unlimited. The data per record can be of any size (that can be held in a 64-bit number).

4.4 *NetCDF Format Recommendations*

It is recommended that ICON use the [NetCDF 4](#) format but with some restrictions in order to encourage adoption and support as many readers and existing support software. The limitations are enumerated below.

- **Data Structures:** Avoid custom data structures and just use the basic types (integers, unsigned integers, 64-bit, double, float, and string).
- **Unlimited Dimensions:** Stick to the classic model restriction on unlimited dimensions (only the last dimension allowed as unlimited) where possible.

- **Compression:** Unless performance is an issue, enable compression at level 6. See the [compression section](#) for more details.
- **Groups:** Do not use the NetCDF-4 grouping mechanism.
- **Unsigned Numbers:** It is recommended to use unsigned numbers where needed or logically sound. The one exception is 64-bit numbers should never be unsigned in order to remain compatible with JAVA based software.
- **64-Bit Numbers:** Use 64-bit numbers (particularly for time offsets) though always used signed variant in order to remain JAVA compatible.

4.5 *NetCDF Tools*

There are a number of basic tools provided by NetCDF (other provided by third parties are not discussed here). These tools are available in the ICON SDC Pipeline. When accessing the pipeline tools one should first source the ICON setup file. The documentation for these tools can also be found on the UCAR website:

<https://www.unidata.ucar.edu/software/netcdf/docs/netcdf.html>

ICON Setup:

```
source /disks/data/icon/Tools/ICON/bin/setup
```

NetCDF Tools Pipeline Location:

```
/disks/data/icon/Tools/NetCDF/bin
```

Tools:

- **ncgen / ncgen3:** Convert a CDL file into an NC (NetCDF) file. The “3” variant only creates classic files while the other allows creation of NetCDF 4 files.
- **ncdump:** Convert a CDL file from an NC file. There are many options to this program determining what extra data to output. This can also be used to determine the type of the NetCDF file, compression, chunking and so forth.
- **nccopy:** Copies data from one NC file to another. Conversions can take place and compression can be used to compress a “Classic” file if need be. This is how one can post process a NetCDF 3 file to gain fairly significant compression.

4.6 *NetCDF Compression*

Compression for NetCDF 4 is quite fast. A compression level of 5-6 usually gets 80-90% of the maximum compression (level 9). For this reason ICON recommends using compression level 6. There are three main attributes per variable that control data layout and compression. A summary of how this works together can be seen on the UNIDATA site (http://www.unidata.ucar.edu/blogs/developer/en/entry/netcdf_compression).

_DeflateLevel

The “_DeflateLevel” is the ZLIB compression level which can be set between 0 (no compression) and 9 (maximum compression). For performance reasons and size concerns, ICON recommends setting this to 6 for all variables and files.

_Shuffle

The “_Shuffle” attribute allows the library to move chunks and bytes around to fit in empty spaces and generally helps compression. It can be set to “false” (off) or “true” (on). ICON recommends leaving this on for all variables.

_ChunkSizes

The “_ChunkSizes” attribute indicates how much data per chunk is compressed and kept together. Larger chunk sizes mean better compression but slower subset access. ICON recommends that either use the default chunk size and see the compressed result. If the compression is poor then try the smallest data chunk size per variable (one unit of the last dimension). This means for a single vector the unit would be 1. For an array which is dimensioned (time x 100 x 1000) the _ChunkSizes would be set with 1 for time and the maximum for the other dimensions as shown below.

```
dimensions:
  Epoch                = Unlimited ;
  Image_Column_Count = 100      ;
  Image_Row_Count    = 1000     ;
variables:
  ushort Image_Pixels(Epoch,Image_Column_Count,Image_Row_Count) ;
  Image_Pixels:_ChunkSizes = 1, 100, 1000 ;
  Image_Pixels:_DeflateLevel = 6 ;
  Image_Pixels:_Shuffle = "true" ;
```

5 Appendix

5.1 Key Definitions

Confluence – A free form documentation center created by Atlassian Software that allows the storage and versioning of documents and update by authorized people. Notifications can also be sent to interested parties when documents are updated. Details can be found at <https://www.atlassian.com/software/confluence>.

CDA - Coordinated Data Analysis

CDL - Network Common Data Form Description Language (NetCDF Text Format)

CF - Climate & Forecast

COARDS - Cooperative Ocean / Atmosphere Research Data Service

GIT - A source code control system which is free and publicly available that allows branching and versioning of software (<http://git-scm.com>).

IACG - Inter-Agency Consultative Group

ISTP - International Solar Terrestrial Physics

MB - Mega-Bytes (1,048,576 bytes or 0x0010 0000 bytes)

MOC - Mission Operations Center

MOS - Mission Operations System

NC - Net CDF File Format Extension

NOAA- National Oceanic and Atmospheric Administration

NODC- National Oceanic Data Center

SC - Space Craft

SDC - Science Data Center

SOC - Science Operations Center

SOS - Science Operations System often used interchangeably with ICON Science Team.

SPDF - Space Physics Data Facility (<http://spdf.gsfc.nasa.gov>)

SSL - Berkeley Space Sciences Laboratory

SSL - Secure Socket Layer

TBD - To Be Determined: an attribute or parameter value unknown at the time of writing.

5.2 Related Documents

This document summarizes and refers readers to information contained in several other documents. The information contained in this document is intended to be accurate; however, some documents referred to by this document are evolving works, and those documents supersede this document in case of a conflict.

Related Documents:

- ICON MOS ICD V2 – MOC to SOC (ICN-ICD-008V2)
- ICON MOS ICD V4 – SOC to Science Team (ICN-ICD-008V4)
- ICON MOS ICD V5 – SOC to Space Physics Data Facility (ICN-ICD-008V5)
- ICON MOS ICD V6 –SOC to ICON Public Website (ICN-ICD-008V6)
- ICON SOC Level 4 Requirements Document (ICN-OPS-003)

- ICON Science Data Management Plan (SDMP) (ICON-SCI-001)
- ICON Data Product Information Document (DPID) (ICON-SCI-004)

5.3 *Standard Convention Reference Links*

File Formats:

CDF – *Common Data Format*

<http://cdf.gsfc.nasa.gov>

NetCDF – *Network Common Data Form*

<http://www.unidata.ucar.edu/software/netcdf>

Conventions:

CDA Web

<http://cdaweb.gsfc.nasa.gov>

CF

<http://cfconventions.org>

COARDS

http://ferret.wrc.noaa.gov/noaa_coop/coop_cdf_profile.html

ISTP/IACG

http://spdf.sci.gsfc.nasa.gov/istp_guide

NOAA/NODC

<http://www.nodc.noaa.gov/data/formats/netcdf>

Others – *Other Common Conventions*

<http://www.unidata.ucar.edu/software/netcdf/conventions.html>