

## FTECS Galileo Deliverables

The *Mission-Wide Comprehensive Deliverable*: A single file that contains the entire EPD mission (all other deliverables are a subset of this product)

The following file comprises the entirety of the Galileo EPD mission, both RecordMode and Realtime, in a single file:

`galileo_epd_level2_comprehensive_ver-1.1.1-01.cdf`

*Filename 1: Galileo Mission Comprehensive*

The *Mission-Wide Magnetospheric Deliverable*: A single file that contains all of the magnetospheric records across the mission

The following file is a subset of Filename 1: Galileo Mission Comprehensive and includes only magnetospheric records (as opposed to lunar records). This includes the entirety of the RealTime mission, and a subset of the EPD RecordMode encounters (see the LunarOrMagnetospheric column in **Error! Reference source not found.** for which RecordMode files are included in this product, i.e., files where LunarOrMagnetospheric = "Magnetospheric").

`galileo_epd_level2_magnetospheric_ver-1.1.1-01.cdf`

*Filename 2: Galileo Mission Magnetospheric Product*

The following five files if concatenated would be exactly equal to the previous file (Filename 2: Galileo Mission Magnetospheric Product).

`galileo_epd_level2_magnetospheric_1996_ver-1.1.1-01.cdf`

*Filename 3: Galileo Magnetospheric Product (1996 only)*

`galileo_epd_level2_magnetospheric_1997_ver-1.1.1-01.cdf`

*Filename 4: Galileo Magnetospheric Product (1997 only)*

galileo\_epd\_level2\_magnetospheric\_1998\_ver-1.1.1-01.cdf

*Filename 5: Galileo Magnetospheric Product (1998 only)*

galileo\_epd\_level2\_magnetospheric\_1999\_ver-1.1.1-01.cdf

*Filename 6: Galileo Magnetospheric Product (1999 only)*

galileo\_epd\_level2\_magnetospheric\_2000\_through\_2003\_ver-1.1.1-01.cdf

*Filename 7: Galileo Magnetospheric Product (2000 through end of mission in 2003)*

The Lunar Deliverables: A single file for each moon (Target = Amalthea, Callisto, Europa, Ganymede, or Io).

The following five files are all the RecordMode records, across the entire mission, for each respective moon. See **Error! Reference source not found.** for which RecordMode encounters were included in each file. For example, the Europa file, Filename 10, contains all records drawn from the files where Target = “Europa”; namely, 96354.rat, 97051.rat, 97310.rat, 97350.rat, 98088.rat, 98151.rat, 99032.rat, and 00003.rat. Note that these products are composed entirely of RecordMode records and include no RealTime records at all.

galileo\_epd\_level2\_lunar\_amalthea\_ver-1.1.1-01.cdf

*Filename 8: All RecordMode records where Target = Amalthea*

galileo\_epd\_level2\_lunar\_callisto\_ver-1.1.1-01.cdf

*Filename 9: All RecordMode records where Target = Callisto*

galileo\_epd\_level2\_lunar\_europa\_ver-1.1.1-01.cdf

*Filename 10: All RecordMode records where Target = Europa*

galileo\_epd\_level2\_lunar\_ganymede\_ver-1.1.1-01.cdf

*Filename 11: All RecordMode records where Target = Ganymede*

galileo\_epd\_level2\_lunar\_io\_ver-1.1.1-01.cdf

*Filename 12: All RecordMode records where Target = Io*

## Uniform Record Structure

All records in all deliverables have the exact same format. In Table 1 we give the name and a brief description of each variable within the uniform Galileo CDF Record Structure. We then do a detailed analysis of each column variable, how it was derived, its possible contents, and the implications of those contents for other columns within the product.

*Table 1: Name and brief description of each variable within the Uniform Galileo CDF Record Structure.*

Name	Brief Description
Epoch	Start time of the accumulation period.
UTC	Start time of the accumulation period (UTC Format).
DecimalYear	Start time of the accumulation period (Decimal DOY format).
StartET	Start time of the accumulation period (Ephemeris Time format).
MidET	Midpoint ephemeris time of the accumulation period.
StopET	Stop time of the accumulation period (Ephemeris Time format).
DeltaT	Accumulation period (StopET - StartET).
RecordType	Binary record type that serves as the foundation of the current record: 1 --> HighResRecordMode, 2 --> MedResRecordMode, 3 --> LowResRecordMode, 11 --> HighResRealTime, 12 --> MedResRealTime, 13 --> LowResRealTime
LunarOrMagnetospheric	Indicates whether the Target is a Lunar (LunarOrMagnetospheric --> 1) or Magnetospheric (LunarOrMagnetospheric --> 2) target.
Target	Lunar (1 --> Amalthea, 2 --> Callisto, 3 --> Europa, 4 --> Ganymede, 5 --> Io), Magnetospheric (6 --> Inner Magnetosphere, 7 --> Middle Magnetosphere, 8 --> Magnetotail)
SubTarget	Lunar (1 --> Upstream, 2 --> Flank, 3 --> Wake, 4 --> Polar), Magnetospheric (5 --> Plasma Sheet Crossing, 6 --> Quarter Rotation Survey, 7 --> Dawnside, 8 --> Apojove, 9 --> Duskside, 10 --> Transauroral Region, 11 --> Magnetic Equator Crossing, 12 --> Perijove, 13 --> Io Plasma Torus, 14 --> Io Plasma Torus Ramp Region)
FileSpinNumber	Identifies the binary record or "spin" within the original EPD file (OriginalEpdFileName). One is the first spin of the day, two is the second spin, etc...
OriginalEpdFileName	The original binary EPD file from which the current record is drawn. RecordMode records will be of the form (yyddd.rat), whereas RealTime records will be of the form (yyddd.lga).
FIDU	Flux-Ion-Differential-Unidirectional: 10 EPD ion flux channels. Note: Fluxes are corrected for deadtime, background, anomalous instrument performance, and instrument degradation.
FIDU_Energy	Midpoint energy of the respective FIDU flux channel.

FIDU_Energy_Label	Midpoint energy as a string for the given FIDU flux channel for plot axis labeling purposes.
FIDU_EnergyRange	Start and Stop energy passbands for the respective FIDU flux channel.
FIDU_Quality	Data quality flag for the respective FIDU energy channel: -1 --> Data missing, 0 --> Highest Quality Data, 4 --> Questionable Data (for a variety of possible reasons), 10 --> Data Quality Flag currently unavailable
FeDU	Flux-Electron-Differential-Unidirectional: 8 EPD electron flux channels. Note: Fluxes are corrected for deadtime, background, anomalous instrument performance, and instrument degradation.
FeDU_Energy	Midpoint energy of the respective FeDU flux channel.
FeDU_Energy_Label	Midpoint energy as a string for the given FeDU flux channel for plot axis labeling purposes.
FeDU_EnergyRange	Start and Stop energy passbands for the respective FeDU flux channel.
FeDU_Quality	Data quality flag for the respective FeDU energy channel: -1 --> Data missing, 0 --> Highest Quality Data, 4 --> Questionable Data (for a variety of possible reasons), 10 --> Data Quality Flag currently unavailable
FepIU	Flux-Electron_and_Proton-Integral-Unidirectional: 4 EPD electron and proton integral flux channels. Note: Fluxes are corrected for deadtime, background, anomalous instrument performance, and instrument degradation.
FepIU_Energy	Midpoint energy of the respective FepIU flux channel. Note: this variable is set to the fill value because it is an integral channel.
FepIU_Energy_Label	Midpoint energy as a string for the given FepIU flux channel for plot axis labeling purposes. Note: this is set to the fill value since this is an integral channel.
FepIU_EnergyRange	Start and Stop energy passbands for the respective FepIU variable. Note: the Start energy passband is well defined, but the Stop energy pass band is set to the fill value since it would be infinity (because it is an integral channel).
FepIU_Quality	Data quality flag for the respective FepIU energy channel: -1 --> Data missing, 0 --> Highest Quality Data, 4 --> Questionable Data (for a variety of possible reasons), 10 --> Data Quality Flag currently unavailable
FHDU	Flux-Hydrogen-Differential-Unidirectional: 4 EPD hydrogen flux channels. Note: Fluxes are corrected for deadtime, background, anomalous instrument performance, and instrument degradation.
FHDU_Energy	Midpoint energy of the respective FHDU flux channel.
FHDU_Energy_Label	Midpoint energy as a string for the given FHDU flux channel for plot axis labeling purposes.
FHDU_EnergyRange	Start and Stop energy passbands for the respective FHDU flux channel.

FHDU_Quality	Data quality flag for the respective FHDU energy channel: -1 --> Data missing, 0 --> Highest Quality Data, 4 --> Questionable Data (for a variety of possible reasons), 10 --> Data Quality Flag currently unavailable
FHeDU	Flux-Alpha-Differential-Unidirectional: 5 EPD helium flux channels. Note: Fluxes are corrected for deadtime, background, anomalous instrument performance, and instrument degradation.
FHeDU_Energy	Midpoint energy of the respective FHeDU flux channel.
FHeDU_Energy_Label	Midpoint energy as a string for the given FHeDU flux channel for plot axis labeling purposes.
FHeDU_EnergyRange	Start and Stop energy passbands for the respective FHeDU flux channel.
FHeDU_Quality	Data quality flag for the respective FHeDU energy channel: -1 --> Data missing, 0 --> Highest Quality Data, 4 --> Questionable Data (for a variety of possible reasons), 10 --> Data Quality Flag currently unavailable
FODU	Flux-Oxygen-Differential-Unidirectional: 7 EPD oxygen flux channels. Note: Fluxes are corrected for deadtime, background, anomalous instrument performance, and instrument degradation.
FODU_Energy	Midpoint energy of the respective FODU flux channel.
FODU_Energy_Label	Midpoint energy as a string for the given FODU flux channel for plot axis labeling purposes.
FODU_EnergyRange	Start and Stop energy passbands for the respective FODU flux channel.
FODU_Quality	Data quality flag for the respective FODU energy channel: -1 --> Data missing, 0 --> Highest Quality Data, 4 --> Questionable Data (for a variety of possible reasons), 10 --> Data Quality Flag currently unavailable
FOSDU	Flux-OxygenSulphur-Differential-Unidirectional: 4 EPD oxygen-sulphur flux channels. Note: Fluxes are corrected for deadtime, background, anomalous instrument performance, and instrument degradation.
FOSDU_Energy	Midpoint energy of the respective FOSDU flux channel.
FOSDU_Energy_Label	Midpoint energy as a string for the given FOSDU flux channel for plot axis labeling purposes.
FOSDU_EnergyRange	Start and Stop energy passbands for the respective FOSDU flux channel.
FOSDU_Quality	Data quality flag for the respective FOSDU energy channel: -1 --> Data missing, 0 --> Highest Quality Data, 4 --> Questionable Data (for a variety of possible reasons), 10 --> Data Quality Flag currently unavailable

FSDU	Flux-Sulphur-Differential-Unidirectional: 7 EPD sulphur flux channels. Note: Fluxes are corrected for deadtime, background, anomalous instrument performance, and instrument degradation.
FSDU_Energy	Midpoint energy of the respective FOSDU flux channel.
FSDU_Energy_Label	Midpoint energy as a string for the given FSDU flux channel for plot axis labeling purposes.
FSDU_EnergyRange	Start and Stop energy passbands for the respective FSDU flux channel.
FSDU_Quality	Data quality flag for the respective FSDU energy channel: -1 --> Data missing, 0 --> Highest Quality Data, 4 --> Questionable Data (for a variety of possible reasons), 10 --> Data Quality Flag currently unavailable
FNaDU	Flux-Sodium-Differential-Unidirectional: 2 EPD sodium flux channels. Note: Fluxes are corrected for deadtime, background, anomalous instrument performance, and instrument degradation.
FNaDU_Energy	Midpoint energy of the respective FNaDU flux channel.
FNaDU_Energy_Label	Midpoint energy as a string for the given FNaDU flux channel for plot axis labeling purposes.
FNaDU_EnergyRange	Start and Stop energy passbands for the respective FNaDU flux channel.
FNaDU_Quality	Data quality flag for the respective FNaDU energy channel: -1 --> Data missing, 0 --> Highest Quality Data, 4 --> Questionable Data (for a variety of possible reasons), 10 --> Data Quality Flag currently unavailable
RawRates	Raw EPD rates (64 in total) from the original binary file.
RawRates_Quality	Data quality flag for the respective raw energy channel: -1 --> Data missing, 0 --> Highest Quality Data, 4 --> Questionable Data (for a variety of possible reasons), 10 --> Data Quality Flag currently unavailable
BackgroundRates	Background EPD rates (64 in total) from the original binary file (where available).
BackgroundRates_Quality	Data quality flag for the respective background energy channel: -1 --> Data missing, 0 --> Highest Quality Data, 4 --> Questionable Data (for a variety of possible reasons), 10 --> Data Quality Flag currently unavailable
ElectronSpectralParameters	Three forward-model parameters that can be used to calculate differential electron intensities from 0.7-20.0 MeV.
PitchAngle	Angle (in degrees) between the local magnetic field (using highest-quality magnetometer data) and the detector look direction.
PhaseAngle	Angle (in degrees) between the projection of the detector look direction onto the magnetic-xy plane. In this coordinate system the z-axis is parallel to the local magnetic field, the x-axis is coplanar with the corotation vector, and the y-axis completes the set.

SolidAngle	SolidAngle (in steradians) of the EPD detector sweep for the given measurement. This varies as a function of detector mode (RecordMode or RealTime), product resolution (High/Med/Low resolution), motor position, and sector.
LookDirection	x/y/z-axis components of the look direction vector of the zero-degree-end of the EPD detector in IAU_JUPITER coordinates.
MagneticField	x/y/z-axis components of the local magnetic field in IAU_JUPITER coordinates.
Lkhurana	The Khurana L-shell value for the current record.
Position	The position of the spacecraft, relative to Jupiter, at the midpoint ephemeris time of the accumulation period in the IAU_JUPITER reference frame.
Position_Amalthea	The position of Amalthea, relative to Jupiter, at the midpoint ephemeris time of the accumulation period in the IAU_JUPITER reference frame.
Position_Callisto	The position of Callisto, relative to Jupiter, at the midpoint ephemeris time of the accumulation period in the IAU_JUPITER reference frame.
Position_Europa	The position of Europa, relative to Jupiter, at the midpoint ephemeris time of the accumulation period in the IAU_JUPITER reference frame.
Position_Ganymede	The position of Ganymede, relative to Jupiter, at the midpoint ephemeris time of the accumulation period in the IAU_JUPITER reference frame.
Position_Io	The position of Io, relative to Jupiter, at the midpoint ephemeris time of the accumulation period in the IAU_JUPITER reference frame.
Transformation_Matrix	Elements of the 3x3 matrix used to transform from the IAU_JUPITER to the JUICE_JUPITER_BSM reference frame at the midpoint ephemeris time of the current accumulation period.
Ion_Channels	Bookkeeping variable used to iterate among the FIDU flux channels.
Electron_Channels	Bookkeeping variable used to iterate among the FeDU flux channels.
Integral_Channels	Bookkeeping variable used to iterate among the FeplU electron-proton integral flux channels.
Hydrogen_Channels	Bookkeeping variable used to iterate among the FH DU flux channels.
Helium_Channels	Bookkeeping variable used to iterate among the FHeDU flux channels.
Oxygen_Channels	Bookkeeping variable used to iterate among the FODU flux channels.
OxygenSulphur_Channels	Bookkeeping variable used to iterate among the FOSDU flux channels.
Sulphur_Channels	Bookkeeping variable used to iterate among the FSDU flux channels.
Sodium_Channels	Bookkeeping variable used to iterate among the FNaDU flux channels.
RawRates_Channels	Bookkeeping variable used to iterate among the RawRates rate channels.
MotorPos	The EPD stepper-motor position. Note: for RecordMode records this will vary between (0-7) though the mpos=0 records are not present since they are otherwise included as background rates in adjacent records. This variable is set to its fill value for RealTime records.
MotorPos_Label	The MotorPos represented as a string for plot axis-labeling purposes.
Sector	The EPD stepper-motor sector position. Note: the range and physical interpretation of this variable will vary by RecordType. HighResRecordMode: 1-64, MedResRecordMode 1-32, LowResRecordMode: 1-16, HighResRealTime: 1-16, MedResRealTime: 1-6, LowResRealTime: 1
Sector_Label	The Sector variable represented as a string for plot axis-labeling purposes.

AxisIterator	Bookkeeping variable for iterating between the components of vector and tensor variables.
AxisIterator_Label	The AxisIterator label represented as a string for plot axis-labeling purposes.
MinMaxRange	Bookkeeping variable used for iterating between the minimum and maximum energy values in the flux EnergyRange passbands.

## Input Data Products

The output data product is a Frankenstein composition of a variety of input data products.

## Detailed Variable Descriptions

What follows are detailed descriptions of the output product variables. We describe the CDF attributes for each variable, relevant input data products and field variables, as well as the mechanics and logic of the algorithms by which the output variables are calculated. We make every effort to connect these algorithms to archival algorithms and documentation; and, wherever these choices are unclear or arbitrary, we illustrate the rationale behind our choices and the resulting uncertainty in the associated output.

## Appendix A: Product Inventory Tables

<b>RecordMode Filename (yyddd.rat)</b>	<b>Encounter Orbit Designation</b>	<b>Year</b>	<b>Month</b>	<b>Day</b>	<b>LunarOrMagnetospheric</b>	<b>Target</b>
95341	J0	1995	12	7	Lunar	Io
96250	G2	1996	9	6	Lunar	Ganymede
96255	G2	1996	9	11	Magnetospheric	Middle Magnetosphere
96309	C3	1996	11	4	Lunar	Callisto
96310	C3	1996	11	5	Magnetospheric	Middle Magnetosphere
96354	E4	1996	12	19	Lunar	Europa



97051	E6	1997	2	20	Lunar	Europa
97089	G7	1997	3	30	Magnetospheric	Middle Magnetosphere
97095	G7	1997	4	5	Lunar	Ganymede
97126	G8	1997	5	6	Magnetospheric	Middle Magnetosphere
97127	G8	1997	5	7	Lunar	Ganymede
97176	C9	1997	6	25	Lunar	Callisto
97179	C9	1997	6	28	Magnetospheric	Middle Magnetosphere
97204	C9	1997	7	23	Magnetospheric	Magnetotail
97219	C9	1997	8	7	Magnetospheric	Magnetotail
97235	C9	1997	8	23	Magnetospheric	Magnetotail
97259	C10	1997	9	16	Lunar	Callisto
97260	C10	1997	9	17	Lunar	Callisto
97261	C10	1997	9	18	Magnetospheric	Inner Magnetosphere
97310	E11	1997	11	6	Lunar	Europa
97350	E12	1997	12	16	Lunar	Europa
98088	E14	1998	3	29	Lunar	Europa
98151	E15	1998	5	31	Lunar	Europa
99032	E19	1999	2	1	Lunar	Europa
99123	C20	1999	5	3	Magnetospheric	Inner Magnetosphere
99182	C21	1999	7	1	Magnetospheric	Inner Magnetosphere
99183	C21	1999	7	2	Magnetospheric	Inner Magnetosphere
99224	C22	1999	8	12	Magnetospheric	Inner Magnetosphere
99257	C23	1999	9	14	Magnetospheric	Inner Magnetosphere
99284	I24	1999	10	11	Lunar	Io
99329	I25	1999	11	25	Magnetospheric	Inner Magnetosphere
00003	E26	2000	1	3	Lunar	Europa
00053	I27	2000	2	22	Lunar	Io
00141	G28	2000	5	20	Lunar	Ganymede
00363	G29	2000	12	28	Lunar	Ganymede
01145	C30	2001	5	25	Lunar	Callisto
01218	I31	2001	8	6	Lunar	Io
01288	I32	2001	10	15	Magnetospheric	Inner Magnetosphere
01289	I32	2001	10	16	Lunar	Io
02309	A34	2002	11	5	Lunar	Amalthea