

HPDE.io

Data Access

- [FTPS from the MMS SDC \(not with most browsers\)](#)
- [HTTPS from the MMS SDC](#)
- [FTPS from SPDF \(not with most browsers\)](#)
- [HTTPS from SPDF](#)
- [CDAWeb](#)
- [HAPI: CDAWeb HAPI Server](#)

MMS 1 Digital Signal Processor (DSP) Double Probe (ADP, SDP), Electric Field Power Spectral Density, Level 2 (L2), Fast Mode, 2 s Data

Ergun, R.E., Lindqvist, P., Torbert, R.B., Ahmadi, N., Graham, D.B., and Burch, J.L. (2022). MMS 1 Digital Signal Processor (DSP) Double Probe (ADP, SDP), Electric Field Power Spectral Density, Level 2 (L2), Fast Mode, 2 s Data [Data set]. NASA Space Physics Data Facility. <https://doi.org/10.48322/n5ky-bm34>. Accessed on 2023-April-5.

ResourceID

spase://NASA/NumericalData/MMS/1/FIELDS/DSP/Fast/Level2/ElectricFieldPowerSpectralDensity/P

Description

The MMS electric field power spectral density (EPSD) is computed onboard by the Digital Signal Processor (DSP). The fast Fourier transform (FFT) calculation is performed on a digitized version of analog signals from the Axial Double Probe (ADP) and Spin-Plane Double Probe (SDP). This data product is computed in space from individual components that are not synchronized to the 1 second pulse. Therefore, the timing between channels can be inaccurate by a fraction of a second. The samples times are interval start times taken from the x component. The spectra are calculated via a 1024-point FFT algorithm on piecewise continuous sets of waveform data. Nine signals can be processed simultaneously. Six of the twelve DC-coupled E, DC-coupled V, or SCM signals (16384 samples/s) are selected for spectral processing at 100% duty cycle. In addition, the three AC-coupled signals (262,144 kS/s) each can be processed at 6.25% duty cycle. Each of the nine signals has 16, 1024-point FFT operations every second; the field-programmable gate array (FPGA) performs 144 FFTs per second. The FFT is performed by an arithmetic logic unit (ALU), which is controlled by a state machine. Both are hard-coded into the FPGA. The operation starts by applying a 1024-point Hanning window onto a waveform. Next, an FFT is implemented. The FFT is broken into a series of "butterfly" operations performed by the ALU. The result has real and imaginary data. Power spectra are calculated by taking the sum of squares of real and imaginary values (the ALU includes a multiplier), which produces a power spectrum with 512 frequency bins. The frequency bins are then combined to give pseudo-logarithmic frequency spacing ($\Delta f/f$). The spectra are reduced to 56 frequency bins with $(\Delta f)/f$ between 6% and 12% when possible. Narrow-band emissions can be fit to an accuracy of $(\Delta f)/f \sim 3\%$, allowing for an accurate determination of plasma density. The spectra can be averaged in time. The fastest reporting rate of any signal is 16 spectra per second. Reporting rates can be as slow as one spectra every 16 s (averaging 256 spectra). The averaging process has 48-bit accuracy to maximize the dynamic range. The amplitudes undergo a pseudo-logarithmic compression to an 8-bit number representing over 120 dB of dynamic range at $\sim 5\%$ precision.

Details

[View XML](#) | [View JSON](#) | [Edit](#)

Version:2.5.0

NumericalData**ResourceID**

spase://NASA/NumericalData/MMS/1/FIELDS/DSP/Fast/Level2/ElectricFieldPowerSpectralDensity/PT2S

ResourceHeader**ResourceName**

MMS 1 Digital Signal Processor (DSP) Double Probe (ADP, SDP), Electric Field Power Spectral Density, Level 2 (L2), Fast Mode, 2 s Data

AlternateName

MMS1_DSP_FAST_L2_EPSD

DOI

<https://doi.org/10.48322/n5ky-bm34>

ReleaseDate

2023-03-04 12:34:56.789

RevisionHistory**RevisionEvent****ReleaseDate**

2021-04-27 15:38:11

Note

Only known prior ReleaseDate of the metadata

RevisionEvent**ReleaseDate**

2022-08-04 12:34:56.789

Note

Added DOI and PublicationInfo minted by LFB, updated the RepositoryID, updated the SPDF MetadataContact Person to Robert M. Candey, metadata updated to SPASE 2.4.1, reviewed by LFB 20220803

RevisionEvent**ReleaseDate**

2023-03-04 12:34:56.789

Note

Standardized the ResourceName Format, Set AlternateName equal to the ProductKey, Revised the Acknowledgement, PublicationInfo Authors, and Contact Person list per request of the MMS DSP/EDP team, metadata updated to SPASE 2.5.0, reviewed by LFB 20230304

Description

The MMS electric field power spectral density (EPSD) is computed onboard by the Digital Signal Processor (DSP). The fast Fourier transform (FFT) calculation is performed on a digitized version of analog signals from the Axial Double Probe (ADP) and Spin-Plane Double Probe (SDP). This data product is computed in space from individual components that are not synchronized to the 1 second pulse. Therefore, the timing between channels can be inaccurate by a fraction of a second. The samples times are interval start times taken from the x component. The spectra are calculated via a 1024-point FFT algorithm on piecewise continuous sets of waveform data. Nine signals can be processed simultaneously. Six of the twelve DC-coupled E, DC-coupled V, or SCM signals (16384 samples/s) are selected for spectral processing at 100% duty cycle. In addition, the three AC-coupled signals (262,144 kS/s) each can be processed at 6.25% duty cycle. Each of the nine signals has 16, 1024-point FFT operations every second; the field-programmable gate array (FPGA) performs 144 FFTs per second. The FFT is performed by an arithmetic logic unit (ALU), which is controlled by a state machine. Both are hard-coded into the FPGA. The operation starts by applying a 1024-point Hanning window onto a waveform. Next, an FFT is implemented. The FFT is broken into a series of "butterfly" operations performed by the ALU. The result has real and imaginary data. Power spectra are calculated by taking the sum of squares of real and imaginary values (the ALU includes a multiplier), which produces a power spectrum with 512 frequency bins. The frequency bins are then combined to give pseudo-logarithmic frequency spacing $(\Delta f)/f$. The spectra are reduced to 56 frequency bins with $(\Delta f)/f$ between 6% and 12% when possible. Narrow-band emissions can be fit to an accuracy of $(\Delta f)/f \sim 3\%$, allowing for an accurate determination of plasma density. The spectra can be averaged in time. The fastest reporting rate of any signal is 16 spectra per second. Reporting rates can be as slow as one spectra every 16 s (averaging 256 spectra). The averaging process has 48-bit accuracy to maximize the dynamic range. The amplitudes undergo a pseudo-logarithmic compression to an 8-bit number representing over 120 dB of dynamic range at $\sim 5\%$ precision.

Acknowledgement

Please acknowledge R.E. Ergun, P.-A. Lindqvist, R.B. Torbert, N. Ahmadi, D.B. Graham, and J.L. Burch for use of these data

PublicationInfo**Authors**

Ergun, Robert, E.; Lindqvist, Per-Arne; Torbert, Roy, B.; Ahmadi, Narges; Graham, Daniel, Bruce; Burch, James, L.

PublicationDate

2022-01-01 00:00:00

PublishedBy

NASA Space Physics Data Facility

Contacts

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3.	InstrumentLead CoInvestigator	spase://SMWG/Person/Roy.B.Torbert			
4.	CoInvestigator	spase://SMWG/Person/Narges.Ahmadi			
5.	CoInvestigator	spase://SMWG/Person/Daniel.Bruce.Graham			
6.	PrincipalInvestigator	spase://SMWG/Person/James.L.Burch			
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8.	MetadataContact	spase://SMWG/Person/Robert.M.Candey			
9.	MetadataContact	spase://SMWG/Person/Lee.Frost.Bargatze			

InformationURL**Name**

The Magnetospheric Multiscale (MMS) Mission home page at Goddard Space Flight Center (GSFC)

URL
<https://mms.gsfc.nasa.gov/>

Description
 The Magnetospheric Multiscale (MMS) Mission Home Page hosted by the Goddard Space Flight Center (GSFC).

PriorIDs
 spase://VSPO/NumericalData/MMS/1/FIELDS/DSP/Fast/Level2/ElectricFieldPowerSpectralDensity/PT2S

AccessInformation

RepositoryID
spase://SMWG/Repository/UCOLO/LASP/MMS_SDC

Availability
 Online

AccessRights
 Open

AccessURL

Name
 FTPS from the MMS SDC (not with most browsers)

URL
<https://lasp.colorado.edu/mms/sdc/public/data/mms1/dsp/fast/l2/epsd/>

Description
 In CDF via ftp from the MMS Science Data Center

AccessURL

Name
 HTTPS from the MMS SDC

URL
<https://lasp.colorado.edu/mms/sdc/public/data/mms1/dsp/fast/l2/epsd/>

Description
 In CDF via http from the MMS Science Data Center

Format
 CDF

Encoding
 None

Acknowledgement
 Please acknowledge R.E. Ergun, P.-A. Lindqvist, R.B. Torbert, N. Ahmadi, D.B. Graham, and J.L. Burch. Also please acknowledge the data providers and CDAWeb when using these data.

AccessInformation

RepositoryID
<spase://SMWG/Repository/NASA/GSFC/SPDF/CDAWeb>

Availability
 Online

AccessRights
 Open

AccessURL

Name
 FTPS from SPDF (not with most browsers)

URL
<https://spdf.gsfc.nasa.gov/pub/data/mms/mms1/dsp/fast/l2/epsd/>

Description
 In CDF via ftp from SPDF

AccessURL

Name
 HTTPS from SPDF

URL
<https://spdf.gsfc.nasa.gov/pub/data/mms/mms1/dsp/fast/l2/epsd/>

Description
 In CDF via http from SPDF

AccessURL

Name
 CDAWeb

URL
https://cdaweb.gsfc.nasa.gov/cgi-bin/eval2.cgi?dataset=MMS1_DSP_FAST_L2_EPSD&index=sp_phys

ProductKey

MMS1_DSP_FAST_L2_EPSD

Description

Access to ASCII, CDF, and plots via NASA/GSFC CDAWeb

Format

CDF

Encoding

None

Acknowledgement

Please acknowledge R.E. Ergun, P.-A. Lindqvist, R.B. Torbert, N. Ahmadi, D.B. Graham, and J.L. Burch. Also please acknowledge the data providers and CDAWeb when using these data.

AccessInformation**RepositoryID**<spase://SMWG/Repository/NASA/GSFC/SPDF/CDAWeb>**Availability**

Online

AccessRights

Open

AccessURL**Name**

CDAWeb HAPI Server

URL<https://cdaweb.gsfc.nasa.gov/hapi>**Style**

HAPI

ProductKey

MMS1_DSP_FAST_L2_EPSD

Description

Web Service to this product using the HAPI interface

Format

CSV

Acknowledgement

Please acknowledge R.E. Ergun, P.-A. Lindqvist, R.B. Torbert, N. Ahmadi, D.B. Graham, and J.L. Burch. Also please acknowledge the data providers and CDAWeb when using these data.

ProcessingLevel

Calibrated

InstrumentIDs<spase://SMWG/Instrument/MMS/1/FIELDS/ADP><spase://SMWG/Instrument/MMS/1/FIELDS/DSP><spase://SMWG/Instrument/MMS/1/FIELDS/SDP>**MeasurementType**

ElectricField

MeasurementType

Waves.Passive

TemporalDescription**TimeSpan****StartDate**

2015-03-17 00:00:00.000

RelativeStopDate

-P2M

Cadence

PT2S

ObservedRegion

Earth.Magnetosheath

ObservedRegion

Earth.Magnetosphere

ObservedRegion

Earth.Magnetosphere.Magnetotail

ObservedRegion

Earth.Magnetosphere.Main

ObservedRegion

Earth.Magnetosphere.RadiationBelt

ObservedRegion

Earth.NearSurface.EquatorialRegion

ObservedRegion

Earth.NearSurface.Plasmasphere

ObservedRegion

Heliosphere.NearEarth

Parameter #1

Name

Epoch

ParameterKey

Epoch

Description

Epoch

Caveats

This parameter exhibits an increasing monotonic progression.

Cadence

PT2S

Units

ns

UnitsConversion

1.0e-9>s

RenderingHints**AxisLabel**

Epoch

ScaleType

LinearScale

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ValidMax

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FillValue

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Support**SupportQuantity**

Temporal

Parameter #2

Name

Epoch_timetag

ParameterKey

Epoch_timetag

Description

Epoch Time Tag

Caveats

This parameter exhibits an increasing monotonic progression.

Cadence

PT2S

Units

ns

UnitsConversion

1.0e-9>s

RenderingHints**AxisLabel**

Epoch_timetag

ValueFormat

e14.8

ScaleType

LinearScale

ValidMin

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ValidMax

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FillValue

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Support**SupportQuantity**

Temporal

Parameter #3

Name

mms1_dsp_epsd_x

Set

Time series defined by using: EPOCH

ParameterKey

mms1_dsp_epsd_x

Description

EPSD, X-Component

Caveats

Average Type: standard

Cadence

PT2S

Units $(V/m)^2/Hz$ **CoordinateSystem****CoordinateRepresentation**

Cartesian

CoordinateSystemName

SC

RenderingHints**DisplayType**

Spectrogram

ValueFormat

e13.6

ScaleType

LogScale

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Wave**WaveType**

PlasmaWaves

Qualifier

Component.I

WaveQuantity

Intensity

Parameter #4

Name

mms1_dsp_epsd_y

Set

Time series defined by using: EPOCH

ParameterKey

mms1_dsp_epsd_y

Description

EPSP, Y-Component

Caveats

Average Type: standard

Cadence

PT2S

Units $(V/m)^2/Hz$ **CoordinateSystem****CoordinateRepresentation**

Cartesian

CoordinateSystemName

SC

RenderingHints**DisplayType**

Spectrogram

ValueFormat

e13.6

ScaleType

LogScale

Structure

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AxisLabel
5888.0

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6400.0**Element****Name**

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6912.0**Element****Name**

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7424.0**Element****Name**

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8704.0**Element****Name**

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RenderingHints**AxisLabel**
9728.0**Element****Name**

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10752.0**Element****Name**

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12800.0
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13824.0
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AxisLabel
14848.0
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AxisLabel
15872.0
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AxisLabel
17408.0
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19456.0
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21504.0
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47104.0
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51200.0
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63488.0
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AxisLabel
69632.0
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77824.0
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AxisLabel
86016.0
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94208.0
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AxisLabel
102400.0
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AxisLabel
110592.0
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RenderingHints
AxisLabel
118784.0
Element
Name
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Index
88
RenderingHints
AxisLabel
126976.0
ValidMin
0.0
ValidMax
2.0e-05
FillValue
-1.0e+31
Wave
WaveType
PlasmaWaves
Qualifier
Component.J
WaveQuantity
Intensity

Parameter #5

Name

mms1_dsp_epsd_z

Set

Time series defined by using: EPOCH

ParameterKey

mms1_dsp_epsd_z

Description

EPSP, Z-Component

Caveats

Average Type: standard

Cadence

PT2S

Units $(V/m)^2/Hz$ **CoordinateSystem****CoordinateRepresentation**

Cartesian

CoordinateSystemName

SC

RenderingHints**DisplayType**

Spectrogram

ValueFormat

e13.6

ScaleType

LogScale

Structure**Size**

88

Element**Name**

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Index

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RenderingHints**AxisLabel**

8.0

Element**Name**

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RenderingHints**AxisLabel**

24.0

Element**Name**

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RenderingHints**AxisLabel**

40.0

Element**Name**

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RenderingHints

AxisLabel
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RenderingHints
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RenderingHints
AxisLabel
152.0
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168.0
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184.0
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928.0
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11776.0**Element****Name**

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12800.0**Element****Name**

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14848.0**Element****Name**

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RenderingHints**AxisLabel**
34816.0**Element****Name**

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38912.0**Element****Name**

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77824.0
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86016.0
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110592.0
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ValidMax
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FillValue
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Wave
WaveType
PlasmaWaves
Qualifier
Component.K
WaveQuantity
Intensity

Parameter #6

Name
mms1_dsp_epsd_omni
Set
Time series defined by using: EPOCH
ParameterKey
mms1_dsp_epsd_omni
Description
EPSP, Omni-directional
Caveats
Average Type: standard
Cadence
PT2S
Units
$(V/m)^2/Hz$
RenderingHints
DisplayType
Spectrogram
ValueFormat
e13.6
ScaleType
LogScale
Structure
Size
88
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Element**Name**

2

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RenderingHints**AxisLabel**

24.0

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Element**Name**

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136.0**Element****Name**
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152.0**Element****Name**
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168.0**Element****Name**
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39**Index**

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94208.0**Element****Name**
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ValidMax

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Wave**WaveType**
PlasmaWaves**Qualifier**
Total**WaveQuantity**
Intensity

Parameter #7

Name

mms1_dsp_seqcnt_lfe

Set

Time series defined by using: EPOCH_TIMETAG

ParameterKey

mms1_dsp_seqcnt_lfe

Description

Sequence Count

Cadence

PT2S

RenderingHints**DisplayType**
TimeSeries**ValueFormat**
i6**ScaleType**
LinearScale**ValidMin**
0**ValidMax**
65535**FillValue**
65535**Support****SupportQuantity**
Other

Parameter #8

Name

mms1_e_freq

ParameterKey

mms1_e_freq

Description

EPSD, Frequency Midpoints

Cadence

PT2S

RenderingHints**ValueFormat**
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ValidMin
8.0

ValidMax
126976.0

FillValue
-1.0e+31

Support
SupportQuantity
Other