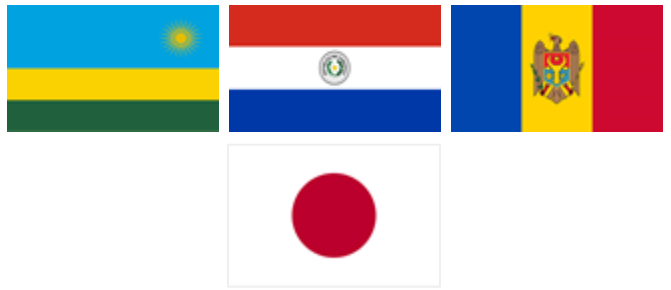
EPS - Power Budget

DATE: 03- 04- 2025

Kumo



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Power Generation Simulation w/o ADCS

Estimation from BIRDS 4 Real orbit Data and BIRDS X Test

Tumbling mode

Parameters	Units	Values
Solar cell efficiency	(cEff)	0.29
Solar constant	(sPower, [W/m²])	1366
Number of solar cells on each side	nPX	6
	nMX	3
	nPY	6
	nMY	6
	nPZ	0
	nMZ	0
Total number of solar cells	X,Y,Z	21
Area per one solar cell	(cArea, [m²])	0.003018
Beta angle	(deg)	0.3165
Energy generated	**(mWh)**	**5022**

Parameters	Units	Values
Power Loss in blocking diode (BIRDS-X)	(mW)	242
DC/DC converter efficiency (LEOPARD)	(η1)	0.93
Battery Losses (LEOPARD)	(mWh)	110
Energy available after losses	**(mWh)**	**4335**

(nPX, nPY, nMY) -X failed	(nMX, nPY, nMY) +X failed	(nPX, nMX, nMY) +Y failed
18	**15**	**15**
4295	**3585**	**3586**
3660	**3000**	**3000**

Power flow w/o ADCS

Size	Working panels	Available Energy [mWh]	State	Op. Mode	Initial	Nominal	COM UHF	New UHF	CABUREI	TUM	eOBC
Battery capacity [mWh]		74,520		Consumed Energy [mWh]	2,291.40	2,597.31	2,314.31	2,350.99	5,152.67	6,271.01	3,069.93
DOD limit		20.00%									
3U	4 panels (21 cells)	4,335.00	Sun [mWh]		1,494.39	1,693.90	1,509.33	1,533.25	3,360.44	4,089.79	2,002.13
			Eclipse [mWh]		797.01	903.41	804.98	817.73	1,792.23	2,181.22	1,067.80
			Bat DC [mWh]		797.01	903.41	804.98	817.73	1,792.23	2,181.22	1,067.80
			DOD		1.07%	1.21%	1.08%	1.10%	2.41%	2.93%	1.43%
			PBat C [mWh]		2,840.61	2,641.10	2,825.67	2,801.75	974.56	245.21	2,332.87
			PDOC		3.81%	3.54%	3.79%	3.76%	1.31%	0.33%	3.13%
	3 panels (18 cells)	3,660.00	Sun [mWh]		1,494.39	1,693.90	1,509.33	1,533.25	3,360.44	4,089.79	2,002.13
			Eclipse [mWh]		797.01	903.41	804.98	817.73	1,792.23	2,181.22	1,067.80
			Bat DC [mWh]		797.01	903.41	804.98	817.73	1,792.23	2,611.01	1,067.80
			DOD		1.07%	1.21%	1.08%	1.10%	2.41%	3.50%	1.43%
			PBat C [mWh]		2,165.61	1,966.10	2,150.67	2,126.75	299.56	0.00	1,657.87
			PDOC		2.91%	2.64%	2.89%	2.85%	0.40%	0.00%	2.22%
	3 panels (15 cells)	3,000.00	Sun [mWh]		1,494.39	1,693.90	1,509.33	1,533.25	3,360.44	4,089.79	2,002.13
			Eclipse [mWh]		797.01	903.41	804.98	817.73	1,792.23	2,181.22	1,067.80
			Bat DC [mWh]		797.01	903.41	804.98	817.73	2,152.67	3,271.01	1,067.80
			DOD		1.07%	1.21%	1.08%	1.10%	2.89%	4.39%	1.43%
			PBat C [mWh]		1,505.61	1,306.10	1,490.67	1,466.75	0.00	0.00	997.87
			PDOC		2.02%	1.75%	2.00%	1.97%	0.00%	0.00%	1.34%

Power Generation Simulation Nadir Pointing (-X)

Parameters	Units	Values
Solar cell efficiency	(cEff)	0.29
Solar constant	(sPower, [W/m²])	1366
Number of solar cells on each side	nPX	6
	nMX	3
	nPY	6
	nMY	6
	nPZ	0
	nMZ	0
Total number of solar cells	X,Y,Z	21
Area per one solar cell	(cArea, [m²])	0.003018
Beta angle	(deg)	0.3625
day_TLE	days	22
month_TLE	month	2
hour_TLE	hours	22
Energy generated	**(mWh)**	**7838**

Estimation from BIRDS 4 Real orbit Data and BIRDS X Test

Parameters	Units	Values
Power Loss in blocking diode (BIRDS-X)	(mW)	242
DC/DC converter efficiency (LEOPARD)	(η1)	0.93
Battery Losses (LEOPARD)	(mWh)	110
Energy available after losses	**(mWh)**	**6954**

(nPX, nPY, nMY) -X failed	nMX, nPY, nMY) +X failed	(nPX, nMX, nMY) +Y failed
18	**15**	**15**
7273	**4636**	**4024**
6428	**3976**	**3407**

Power flow Nadir Pointing (-X)

Size	Working panels	Available Energy [mWh]	State	Op. Mode	OSIL Target	ADCS Pointing
Battery capacity [mWh]		74,520		Consumed Energy [mWh]	5,647.52	5,259.42
DOD limit		20.00%				
3U	4 panels (21 cells)	6,954.00	Sun [mWh]		3,683.17	3,430.06
			Eclipse [mWh]		1,964.36	1,829.37
			Bat DC [mWh]		1,964.36	1,829.37
			DOD		2.64%	2.45%
			PBat C [mWh]		3,270.83	3,523.94
			PDOC		4.39%	4.73%
	3 panels (18 cells)	6,428.00	Sun [mWh]		3,683.17	3,430.06
			Eclipse [mWh]		1,964.36	1,829.37
			Bat DC [mWh]		1,964.36	1,829.37
			DOD		2.64%	2.45%
			PBat C [mWh]		2,744.83	2,997.94
			PDOC		3.68%	4.02%
	3 panels (15 cells)	3,407.00	Sun [mWh]		3,683.17	3,430.06
			Eclipse [mWh]		1,964.36	1,829.37
			Bat DC [mWh]		2,240.52	1,852.42
			DOD		3.01%	2.49%
			PBat C [mWh]		0.00	0.00
			PDOC		0.00%	0.00%

Power Generation Simulation Detumbling

Parameters	Units	Values
Solar cell efficiency	(cEff)	0.29
Solar constant	(sPower, [W/m²])	1366
Number of solar cells on each side	nPX	6
	nMX	3
	nPY	6
	nMY	6
	nPZ	0
	nMZ	0
Total number of solar cells	X,Y,Z	21
Area per one solar cell	(cArea, [m²])	0.003018
Beta angle	(deg)	0.3625
day_TLE	days	22
month_TLE	month	2
hour_TLE	hours	22
Energy generated	**(mWh)**	**7686**

Estimation from BIRDS 4 Real orbit Data and BIRDS X Test

Parameters	Units	Values
Power Loss in blocking diode (BIRDS-X)	(mW)	242
DC/DC converter efficiency (LEOPARD)	(η1)	0.93
Battery Losses (LEOPARD)	(mWh)	110
Energy available after losses	**(mWh)**	**6812**

(nPX, nPY, nMY) -X failed	(nPX, nMX nPY, nMY) +Y 3 cells failed	(nPX, nMX, nMY) +Y failed
18	**18**	**15**
5722	**4825**	**1964**
4986	**4152**	**1491**

Power flow Detumbling

Size	Working panels	Available Energy [mWh]	State	Op. Mode	Nominal	COM UHF	New UHF	CABUREI	TUM	eOBC
Battery capacity [mWh]		74,520		Consumed Energy [mWh]	2,597.31	2,314.31	2,350.99	5,152.67	6,271.01	3,069.93
DOD limit		20.00%								
3U	4 panels (21 cells)	6,812.00	Sun [mWh]		1,693.90	1,509.33	1,533.25	3,360.44	4,089.79	2,002.13
			Eclipse [mWh]		903.41	804.98	817.73	1,792.23	2,181.22	1,067.80
			Bat DC [mWh]		903.41	804.98	817.73	1,792.23	2,181.22	1,067.80
			DOD		1.21%	1.08%	1.10%	2.41%	2.93%	1.43%
			PBat C [mWh]		5,118.10	5,302.67	5,278.75	3,451.56	2,722.21	4,809.87
			PDOC		6.87%	7.12%	7.08%	4.63%	3.65%	6.45%
	3 panels (18 cells)	4,159.00	Sun [mWh]		1,693.90	1,509.33	1,533.25	3,360.44	4,089.79	2,002.13
			Eclipse [mWh]		903.41	804.98	817.73	1,792.23	2,181.22	1,067.80
			Bat DC [mWh]		903.41	804.98	817.73	1,792.23	2,181.22	1,067.80
			DOD		1.21%	1.08%	1.10%	2.41%	2.93%	1.43%
			PBat C [mWh]		2,465.10	2,649.67	2,625.75	798.56	69.21	2,156.87
			PDOC		3.31%	3.56%	3.52%	1.07%	0.09%	2.89%
	3 panels (15 cells)	1,491.00	Sun [mWh]		1,693.90	1,509.33	1,533.25	3,360.44	4,089.79	2,002.13
			Eclipse [mWh]		903.41	804.98	817.73	1,792.23	2,181.22	1,067.80
			Bat DC [mWh]		1,106.31	823.31	859.99	3,661.67	4,780.01	1,578.93
			DOD		1.48%	1.10%	1.15%	4.91%	6.41%	2.12%
			PBat C [mWh]		0.00	0.00	0.00	0.00	0.00	0.00
			PDOC		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Power Generation Simulation Sun Pointing

Parameters	Units	Values
Solar cell efficiency	(cEff)	0.29
Solar constant	(sPower, [W/m²])	1366
Number of solar cells on each side	nPX	6
	nMX	3
	nPY	6
	nMY	6
	nPZ	0
	nMZ	0
Total number of solar cells	X,Y,Z	21
Area per one solar cell	(cArea, [m²])	0.003018
Beta angle	(deg)	0.3625
day_TLE	days	22
month_TLE	month	2
hour_TLE	hours	22
Energy generated	**(mWh)**	**8335**

Estimation from BIRDS 4 Real orbit Data and BIRDS X Test

Parameters	Units	Values
Power Loss in blocking diode (BIRDS-X)	(mW)	242
DC/DC converter efficiency (LEOPARD)	(η1)	0.93
Battery Losses (LEOPARD)	(mWh)	110
Energy available after losses	**(mWh)**	**7416**

(nMX, nPX, nPY, nMY) +X 3 cells failed	(nMX nPY, nMY) +X failed	(nPX, nMX, nMY, nPY) -Y 3 cells failed	(nPX, nMX, nPY) -Y failed
18	**15**	**18**	**15**
5996	**3656**	**6507**	**4679**
5241	**3065**	**5716**	**4016**

Power flow Sun Pointing

Size	Working panels	Available Energy [mWh]	State	Op. Mode	Nominal	COM UHF	New UHF	CABUREI	TUM	eOBC	ADCS Pointing
Battery capacity [mWh]		74,520		Consumed Energy [mWh]	2,597.31	2,314.31	2,350.99	5,152.67	6,271.01	3,069.93	4,919.73
DOD limit		20.00%									
3U	4 panels (21 cells)	7,416.00	Sun [mWh]		1,693.90	1,509.33	1,533.25	3,360.44	4,089.79	2,002.13	3,208.52
			Eclipse [mWh]		903.41	804.98	817.73	1,792.23	2,181.22	1,067.80	1,711.21
			Bat DC [mWh]		903.41	804.98	817.73	1,792.23	2,181.22	1,067.80	1,711.21
			DOD		1.21%	1.08%	1.10%	2.41%	2.93%	1.43%	2.30%
			PBat C [mWh]		5,722.10	5,906.67	5,882.75	4,055.56	3,326.21	5,413.87	4,207.48
			PDOC		7.68%	7.93%	7.89%	5.44%	4.46%	7.26%	5.65%
	3 panels (18 cells)	5,241.00	Sun [mWh]		1,693.90	1,509.33	1,533.25	3,360.44	4,089.79	2,002.13	3,208.52
			Eclipse [mWh]		903.41	804.98	817.73	1,792.23	2,181.22	1,067.80	1,711.21
			Bat DC [mWh]		903.41	804.98	817.73	1,792.23	2,181.22	1,067.80	1,711.21
			DOD		1.21%	1.08%	1.10%	2.41%	2.93%	1.43%	2.30%
			PBat C [mWh]		3,547.10	3,731.67	3,707.75	1,880.56	1,151.21	3,238.87	2,032.48
			PDOC		4.76%	5.01%	4.98%	2.52%	1.54%	4.35%	2.73%
	3 panels (15 cells)	4,016.00	Sun [mWh]		1,693.90	1,509.33	1,533.25	3,360.44	4,089.79	2,002.13	3,208.52
			Eclipse [mWh]		903.41	804.98	817.73	1,792.23	2,181.22	1,067.80	1,711.21
			Bat DC [mWh]		903.41	804.98	817.73	1,792.23	2,255.01	1,067.80	1,711.21
			DOD		1.21%	1.08%	1.10%	2.41%	3.03%	1.43%	2.30%
			PBat C [mWh]		2,322.10	2,506.67	2,482.75	655.56	0.00	2,013.87	807.48
			PDOC		3.12%	3.36%	3.33%	0.88%	0.00%	2.70%	1.08%

Operational modes consumption

Subsystem	Component	Initial	Normal	COM	New UHF	CABUREI	OSIL Max	TUM	eOBC	ADCS Max
FAB + OBC		ON	ON	ON	ON	ON	ON	ON	ON	ON
BPB	CPLD	ON	ON	ON	ON	ON	ON	ON	ON	ON
LED + Antenna		ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF
UHF	Rx, Tx, CW	Rx, CW	Rx, Tx, CW	Rx, Tx, CW	Rx	Rx, Tx, CW	Rx, Tx, CW	Rx, Tx, CW	Rx, Tx, CW	Rx, Tx, CW
New UHF	Rx, Tx, CW	Rx	Rx	OFF	ON	OFF	OFF	OFF	OFF	OFF
CABUREI		OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
OSIL		OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
TUM	nominal	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
	sleep	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
eOBC		OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF
ADCS		ON	ON	ON	ON	ON	ON	ON	ON	ON
Power consumption [mWh]*		2,291	2,597	2,314	2,351	5,153	5,307	6,271	3,069	4,920

*including a 10% margin

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