

ESM Mode

time	date	mode	voltage	internalTemp	batteryTemp	batteryCharge	
01:30:00	22/04/2023	1	4148.75	24.56	24.75	97.18	100
01:40:00	22/04/2023	1	4132.50	24.44	24.44	96.71	90
01:50:00	22/04/2023	1	4120.00	24.38	24.38	95.92	80
02:00:00	22/04/2023	1	4108.75	24.38	24.56	94.81	70
02:10:00	22/04/2023	1	4101.25	24.25	24.56	93.86	60
02:20:00	22/04/2023	1	4093.75	24.13	24.38	92.75	50
02:30:00	22/04/2023	1	4088.75	24.06	24.38	91.80	40
02:40:00	22/04/2023	1	4083.75	24.00	24.31	90.86	30
02:50:00	22/04/2023	1	4078.75	24.00	24.31	90.07	20
03:00:00	22/04/2023	1	4073.75	23.94	24.25	89.43	10
03:10:00	22/04/2023	1	4071.25	23.88	24.13	88.80	0
03:20:01	22/04/2023	1	4067.50	23.81	24.00	88.21	
03:30:01	22/04/2023	1	4063.75	23.69	24.00	87.64	
03:40:01	22/04/2023	1	4061.25	23.63	23.94	87.21	
03:50:00	22/04/2023	1	4058.75	23.63	23.94	86.78	
04:00:00	22/04/2023	1	4056.25	23.63	23.88	86.49	
04:10:00	22/04/2023	1	4053.75	23.63	23.88	86.06	
04:20:00	22/04/2023	1	4051.25	23.75	23.81	85.77	
04:30:00	22/04/2023	1	4050.00	23.81	23.88	85.48	
04:40:01	22/04/2023	1	4047.50	23.88	23.81	85.20	
04:50:01	22/04/2023	1	4046.25	23.81	23.81	84.91	10.0
05:00:01	22/04/2023	1	4043.75	23.81	23.75	84.62	9.0
05:10:00	22/04/2023	1	4041.25	23.75	23.63	84.48	9.0
05:20:00	22/04/2023	1	4038.75	23.69	23.63	84.17	8.0
05:30:00	22/04/2023	1	4036.25	23.63	23.63	83.85	8.0
05:40:00	22/04/2023	1	4033.75	23.56	23.38	83.52	7.0
05:50:01	22/04/2023	1	4031.25	23.56	23.44	83.20	7.0
06:00:01	22/04/2023	1	3998.75	23.94	23.31	81.73	6.0
06:10:00	22/04/2023	1	3986.25	24.13	23.38	80.26	6.0
06:20:00	22/04/2023	1	4010.00	23.81	23.25	80.09	5.0
06:30:01	22/04/2023	1	4005.00	23.50	23.19	79.93	5.0
06:40:01	22/04/2023	1	4000.00	23.38	23.19	79.44	4.0
06:50:00	22/04/2023	1	3993.75	22.81	22.88	79.12	4.0
07:00:00	22/04/2023	1	3988.75	22.69	22.69	78.46	3.0
07:10:01	22/04/2023	1	3982.50	22.63	22.81	77.81	3.0
07:20:00	22/04/2023	1	3976.25	22.44	22.63	77.16	2.0
07:30:00	22/04/2023	1	3971.25	22.44	22.63	76.51	2.0
07:40:01	22/04/2023	1	3963.75	22.50	22.75	75.86	1.0
07:50:00	22/04/2023	1	3958.75	22.44	22.63	75.04	1.0
08:00:01	22/04/2023	1	3951.25	22.44	22.69	74.22	0.0
08:10:00	22/04/2023	1	3946.25	22.44	22.63	73.40	0.0
08:20:00	22/04/2023	1	3938.75	22.38	22.50	72.58	
08:30:01	22/04/2023	1	3933.75	22.31	22.38	71.76	
08:40:00	22/04/2023	1	3926.25	22.25	22.38	70.94	
08:50:01	22/04/2023	1	3921.25	22.13	22.31	70.28	

time	date	mode	voltage	internalTemp	batteryTemp	batteryCharge
09:00:00	22/04/2023	1	3915.00	22.06	22.31	69.46
09:10:01	22/04/2023	1	3908.75	22.13	22.31	68.64
09:20:00	22/04/2023	1	3903.75	22.00	21.94	67.88
09:30:01	22/04/2023	1	3896.25	21.94	22.00	67.01
09:40:00	22/04/2023	1	3891.25	21.94	22.06	66.43
09:50:01	22/04/2023	1	3885.00	21.94	22.13	65.71
10:00:00	22/04/2023	1		21.88	22.00	64.99
10:10:01	22/04/2023	1		21.81	22.13	64.27
10:20:00	22/04/2023	1		21.88	22.06	63.54
10:30:01	22/04/2023	1		21.88	22.06	62.68
10:40:00	22/04/2023	1		21.81	22.00	61.95
10:50:01	22/04/2023	1		21.75	21.94	61.06
11:00:00	22/04/2023	1		21.69	21.88	60.11
11:10:01	22/04/2023	1		21.75	21.94	59.16
11:20:00	22/04/2023	1		21.69	21.69	57.89
11:30:01	22/04/2023	1		21.63	21.63	56.63
11:40:00	22/04/2023	1		21.56	21.69	55.68
11:50:01	22/04/2023	1		21.63	21.69	54.41
12:00:00	22/04/2023	1		21.81	21.63	51.93
12:10:00	22/04/2023	1		22.06	21.75	49.24
12:20:01	22/04/2023	1		21.81	21.63	48.09
12:30:00	22/04/2023	1		21.63	21.56	46.91
12:40:01	22/04/2023	1		21.63	21.75	46.10
12:50:00	22/04/2023	1		21.50	21.56	44.87
13:00:01	22/04/2023	1		21.50	21.50	43.64
13:10:00	22/04/2023	1		21.50	21.69	42.41
13:20:00	22/04/2023	1		21.50	21.75	41.19
13:30:01	22/04/2023	1		21.50	21.50	40.11
13:40:00	22/04/2023	1		21.50	21.63	38.66
13:50:01	22/04/2023	1		21.56	21.56	37.58
14:00:00	22/04/2023	1		21.56	21.75	36.14
14:10:00	22/04/2023	1		21.56	21.75	35.06
14:20:01	22/04/2023	1		21.63	22.00	33.84
14:30:00	22/04/2023	1		21.69	21.75	32.12
14:40:01	22/04/2023	1		21.75	21.94	30.83
14:50:00	22/04/2023	1		21.75	21.88	29.54
15:00:00	22/04/2023	1		21.88	22.00	27.82
15:10:01	22/04/2023	1		21.94	22.00	26.11
15:20:00	22/04/2023	1		22.00	22.19	24.82
15:30:01	22/04/2023	1		22.13	22.31	23.10
15:40:00	22/04/2023	1		22.13	22.19	21.38
15:50:01	22/04/2023	1		22.19	22.31	19.31
16:00:00	22/04/2023	1		22.25	22.88	17.50
16:10:00	22/04/2023	1		22.50	23.13	15.95
16:20:01	22/04/2023	1		22.44	23.06	14.14
16:30:00	22/04/2023	1		22.56	23.19	12.59

mV

time	date	mode	voltage	internalTemp	batteryTemp	batteryCharge
16:40:00	22/04/2023	1		22.81	23.50	11.03

Safe Mode

time	date	mode	voltage	internalTemp	batteryTemp	batteryCharge
16:49:59	22/04/2023	0	3640.00	23.00	23.75	9.22
16:59:57	22/04/2023	0	3631.25	23.13	23.75	7.60
17:09:55	22/04/2023	0		23.13	23.75	6.37
17:19:52	22/04/2023	0	3616.25	23.25	23.81	5.32
17:29:50	22/04/2023	0	3608.75	23.50	24.00	4.55
17:39:48	22/04/2023	0	3600.00	23.69	24.06	3.87
17:49:46	22/04/2023	0	3591.25	23.81	24.06	3.28
17:59:44	22/04/2023	0	3581.25	24.06	24.19	2.68
18:09:42	22/04/2023	0		24.25	24.19	2.26
18:19:40	22/04/2023	0	3563.75	24.31	24.19	2.11
18:29:38	22/04/2023	0	3555.00	24.50	24.25	2.00
18:39:36	22/04/2023	0	3546.25	24.56	24.38	1.88
18:49:34	22/04/2023	0	3536.25	24.75	24.44	1.77
18:59:32	22/04/2023	0	3527.50	24.75	24.56	1.65
19:09:30	22/04/2023	0		24.88	24.63	1.53
19:19:28	22/04/2023	0	3513.75	24.94	24.56	1.43
19:29:26	22/04/2023	0	3508.75	25.00	24.63	1.37
19:39:24	22/04/2023	0	3503.75	25.00	24.75	1.30
19:49:22	22/04/2023	0	3498.75	24.94	24.69	1.23
19:59:20	22/04/2023	0	3493.75	25.06	24.75	1.15
20:09:18	22/04/2023	0		25.00	24.63	1.08
20:19:16	22/04/2023	0	3478.75	24.88	24.63	0.98
20:29:14	22/04/2023	0	3466.25	24.81	24.56	0.85
20:39:12	22/04/2023	0	3453.75	25.06	24.81	0.68
20:49:10	22/04/2023	0	3442.50	25.13	24.63	0.52
20:59:08	22/04/2023	0		24.88	24.69	0.40
21:09:06	22/04/2023	0		24.75	24.63	0.27
21:19:04	22/04/2023	0		24.63	24.44	0.14
21:29:02	22/04/2023	0		24.44	24.50	0.12
21:39:00	22/04/2023	0		24.50	24.38	0.12
21:48:58	22/04/2023	0	3381.25	24.38	24.31	0.11
21:58:56	22/04/2023	0	3371.25	24.31	24.31	0.10
22:08:54	22/04/2023	0		24.25	24.25	0.09
22:18:52	22/04/2023	0	3351.25	24.25	24.31	0.09
22:28:50	22/04/2023	0	3341.25	24.25	24.38	0.08
22:38:48	22/04/2023	0	3331.25	24.25	24.31	0.07
22:48:46	22/04/2023	0	3321.25	24.25	24.38	0.06
22:58:43	22/04/2023	0	3311.25	24.19	24.38	0.05
23:08:41	22/04/2023	0		24.25	24.38	0.05
23:18:39	22/04/2023	0	3292.50	24.19	24.25	0.04
23:28:37	22/04/2023	0	3283.75	24.19	24.25	0.04
23:38:35	22/04/2023	0	3273.75	24.13	24.25	0.03
23:48:33	22/04/2023	0	3263.75	24.13	24.25	0.02

mV

time	date	mode	voltage	internalTemp	batteryTemp	batteryCharge
23:58:31	22/04/2023	0	3256.25	24.06	24.25	0.01
00:08:29	23/04/2023	0	3246.25	24.06	24.25	0.00
00:18:27	23/04/2023	0	3238.75	24.06	24.25	0.00
00:28:25	23/04/2023	0	3230.00	24.06	24.06	0.00
00:38:23	23/04/2023	0	3221.25	24.00	24.25	0.00
00:48:21	23/04/2023	0	3213.75	24.00	24.06	0.00
00:58:19	23/04/2023	0	3206.25	23.88	24.25	0.00
01:08:17	23/04/2023	0	3200.00	23.63	24.19	0.00
01:18:14	23/04/2023	0	3193.75	23.56	24.25	0.00
01:28:12	23/04/2023	0	3186.25	23.44	24.19	0.00
01:38:10	23/04/2023	0	3178.75	23.44	24.19	0.00
01:48:08	23/04/2023	0	3173.75	23.38	24.13	0.00
01:58:06	23/04/2023	0	3166.25	23.25	24.06	0.00
02:08:04	23/04/2023	0	3158.75	23.19	24.00	0.00
02:18:01	23/04/2023	0	3151.25	23.25	24.06	0.00
02:27:59	23/04/2023	0	3143.75	23.25	24.06	0.00
02:37:57	23/04/2023	0	3136.25	23.13	23.94	0.00
02:47:55	23/04/2023	0	3127.50	23.00	23.88	0.00
02:57:52	23/04/2023	0	3118.75	22.88	23.81	0.00
03:07:50	23/04/2023	0	3110.00	22.75	23.63	0.00
03:17:48	23/04/2023	0	3100.00	22.69	23.56	0.00
03:27:45	23/04/2023	0	3088.75	22.75	23.63	0.00
03:37:43	23/04/2023	0	3077.50	22.94	23.56	0.00
03:47:40	23/04/2023	0	3063.75	23.19	23.63	0.00
03:57:38	23/04/2023	0	3050.00	23.25	23.69	0.00
04:07:36	23/04/2023	0	3035.00	23.25	23.75	0.00
04:17:34	23/04/2023	0	3018.75	23.38	23.75	0.00
04:27:31	23/04/2023	0	3002.50	23.31	23.81	0.00
04:37:29	23/04/2023	0	2983.75	23.25	23.81	0.00
04:47:27	23/04/2023	0	2965.00	23.19	23.75	0.00
04:57:25	23/04/2023	0	2943.75	23.25	23.56	0.00
05:07:23	23/04/2023	0	2921.25	23.31	23.56	0.00
05:17:20	23/04/2023	0	2898.75	23.38	23.63	0.00
05:27:18	23/04/2023	0	2872.50	23.31	23.63	0.00
05:37:16	23/04/2023	0	2845.00	23.31	23.50	0.00
05:47:13	23/04/2023	0	2816.25	23.13	23.44	0.00
05:57:11	23/04/2023	0	2783.75	23.19	23.31	0.00
06:07:09	23/04/2023	0	2747.50	23.13	23.25	0.00
06:17:07	23/04/2023	0	2706.25	23.06	23.13	0.00
06:27:04	23/04/2023	0	2657.50	23.06	23.31	0.00
06:37:02	23/04/2023	0	2598.75	23.00	23.38	0.00
06:46:59	23/04/2023	0	2523.75	22.94	23.50	0.00

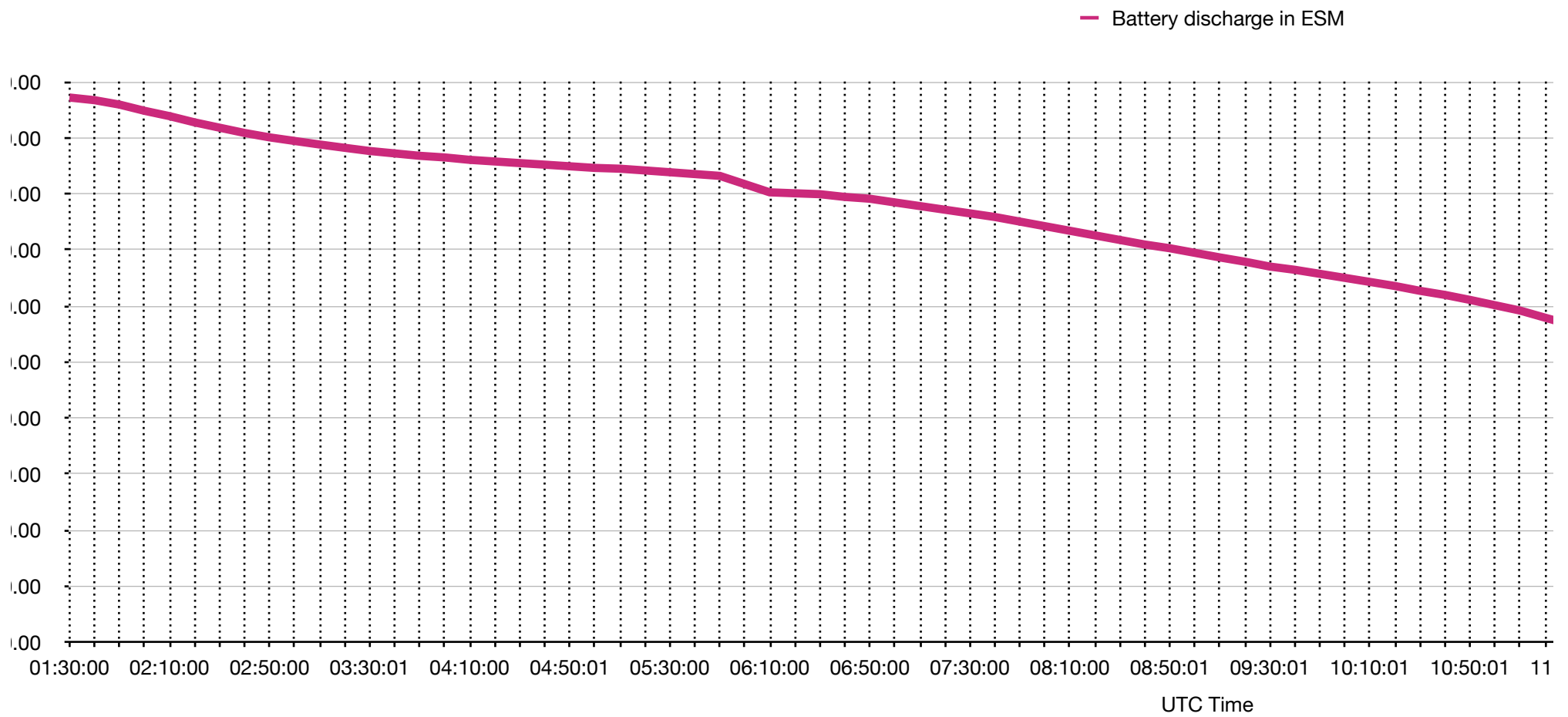


Figure 1.1: Battery discharge graph with CubeSat in ESM mode, from 100% to 10%. Battery
 April 22 01:30 UTC 97.18% - April 22 16:40 UTC 11.03% ==> **Total ESM time: 15**

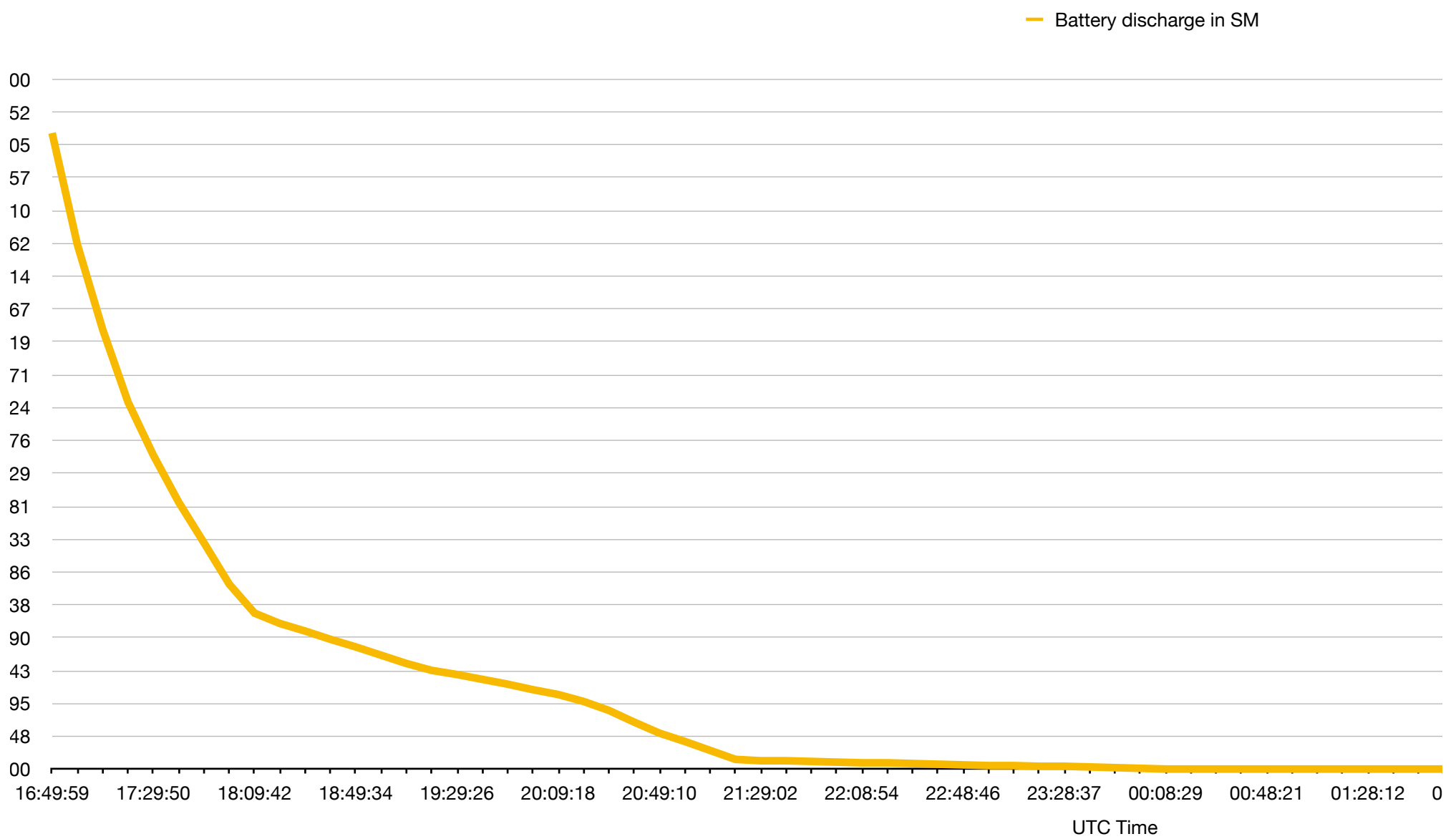


Figure 1.2: Battery discharge after SM was activated in CubeSat. Battery: Efest 180
 April 22 16:49 UTC 9.22% - April 22 23:58 UTC 0.01% - (April 23 00:08 UTC 0.00% - Apr
 Observation, at some point the percentage stuck at 0.0% and Cubesat was still running with this perc
 ==> **Total SM time before completely dying : 13 hours, 57 mins**
 Note: From 9.22 to first 0.0% it took 7 hours, 28 mins.

OBSERVATIONS: Voltage and percentage was reported by the DFRobot battery gauge.

Given the fact that the CubeSat was running in SAFE MODE for almost a whopping 14 hours, this demonstrates that **the Efest 18650, 3000 mAh has the capacity to run the Cubesat for a total of 29 hours, 7 mins before fully discharging**. Moreover, this indicates that there’s a potential failure in the code computing battery percentage, or else the battery gauge is defective.

NOTES:

1) Changing the CubeSat SM code to use voltage instead of percentage should allow it to run in ESM for way longer, at least enough to survive 24h+ and recharge its solar battery.

2) Other than that, I could adjust the SM threshold to be 0.0% instead of 10%, given the fact that from 10% to 0% took 7 hours, 28 mins, and then after that it ran other 6 hours and 38 mins.

Run time from 100% to first 0%: 15 hours, 10 mins + 7 hours, 28 mins = **22 hours, 38 mins**.
Real total: 29 hours, 7 mins.

In theory, with an avg consumption of 70.708 mAh in ESM, it should last 42.4 hours.
24h: 1,697 mAh.

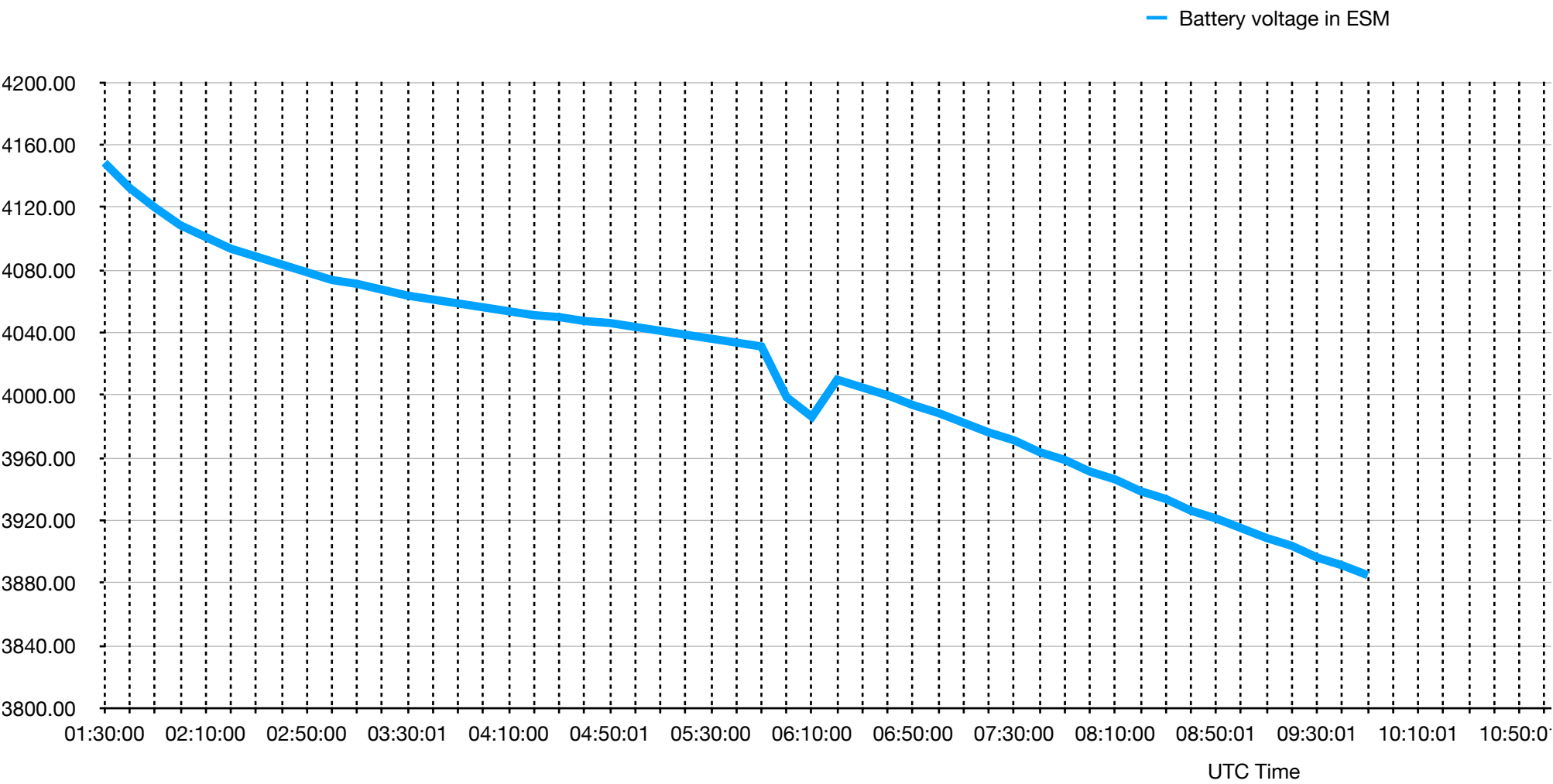
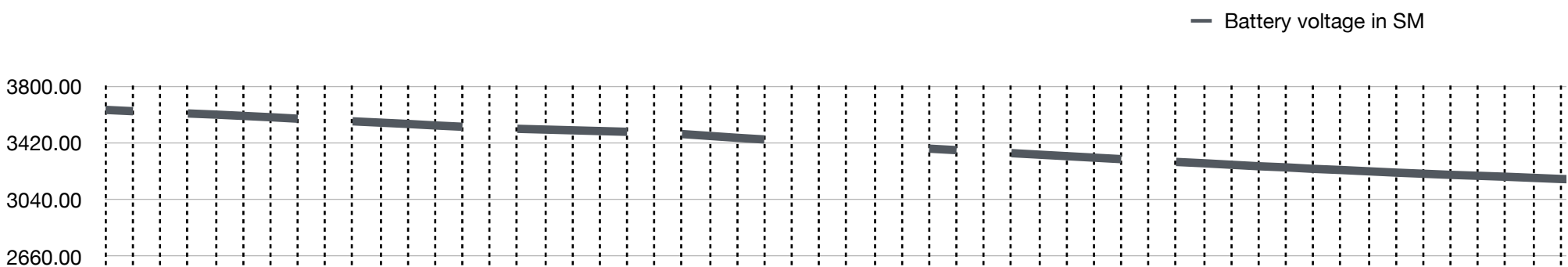


Figure 2.1: Battery voltage while in ESM mode. Notice that voltage data was missing in the I
==> **Total ESM time: 15 hours, 10 mins.**



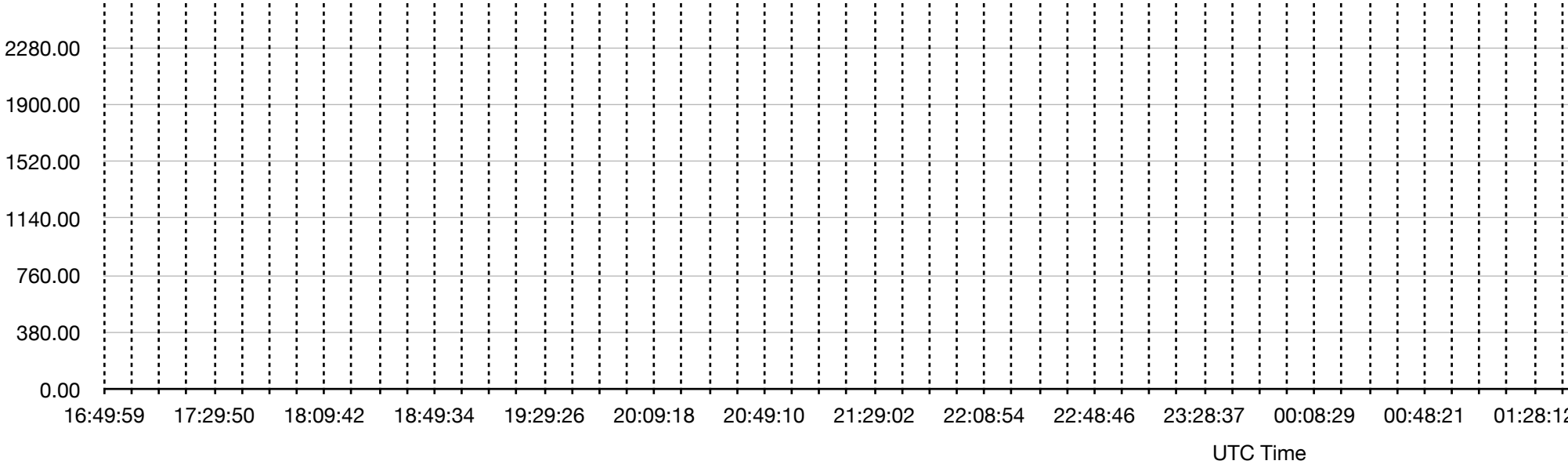
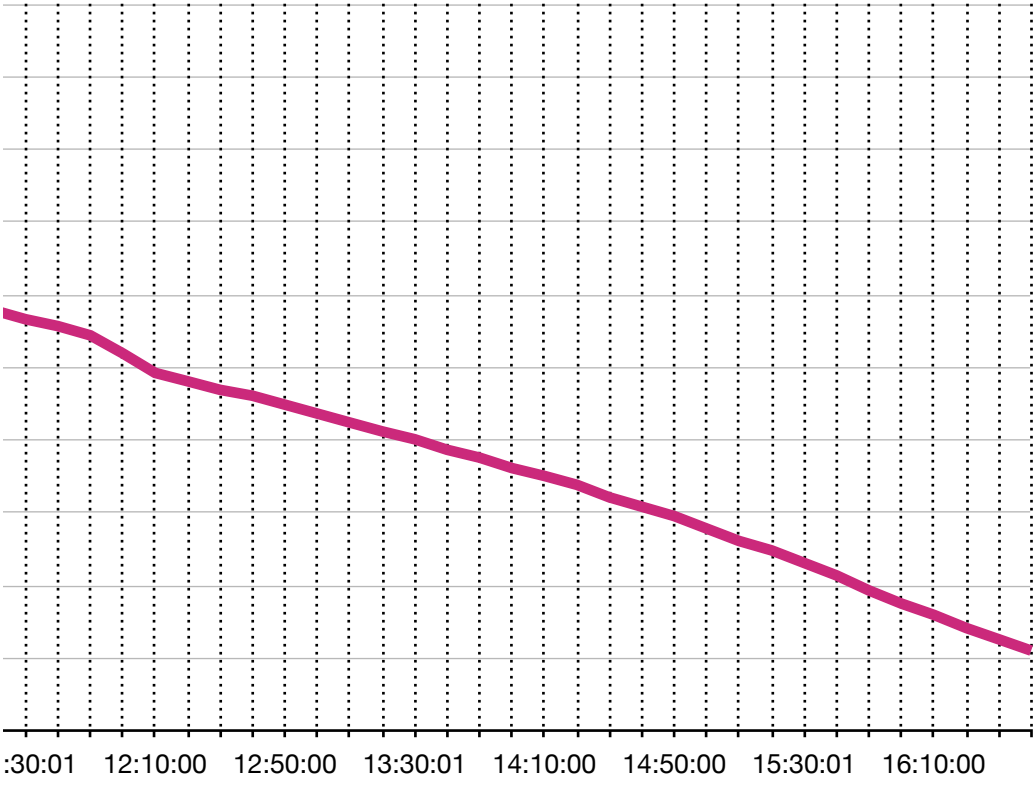
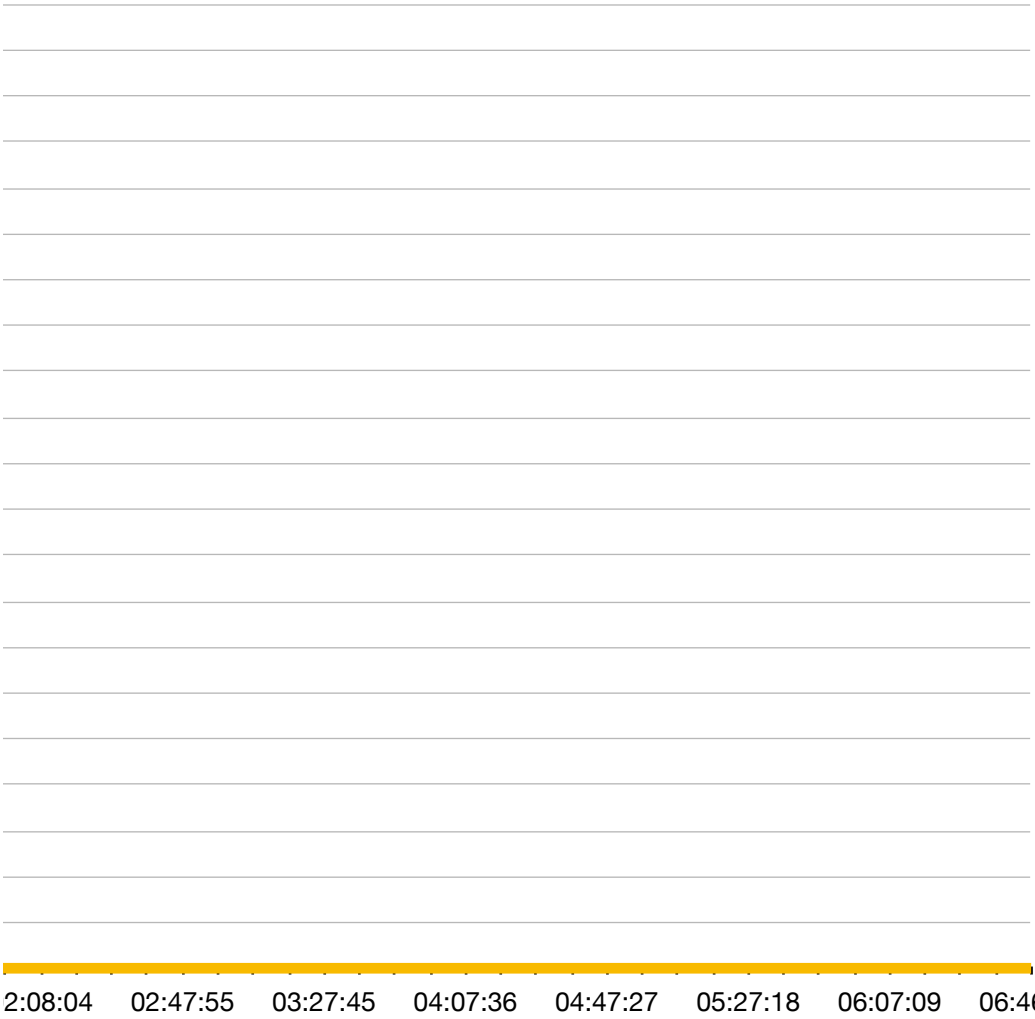


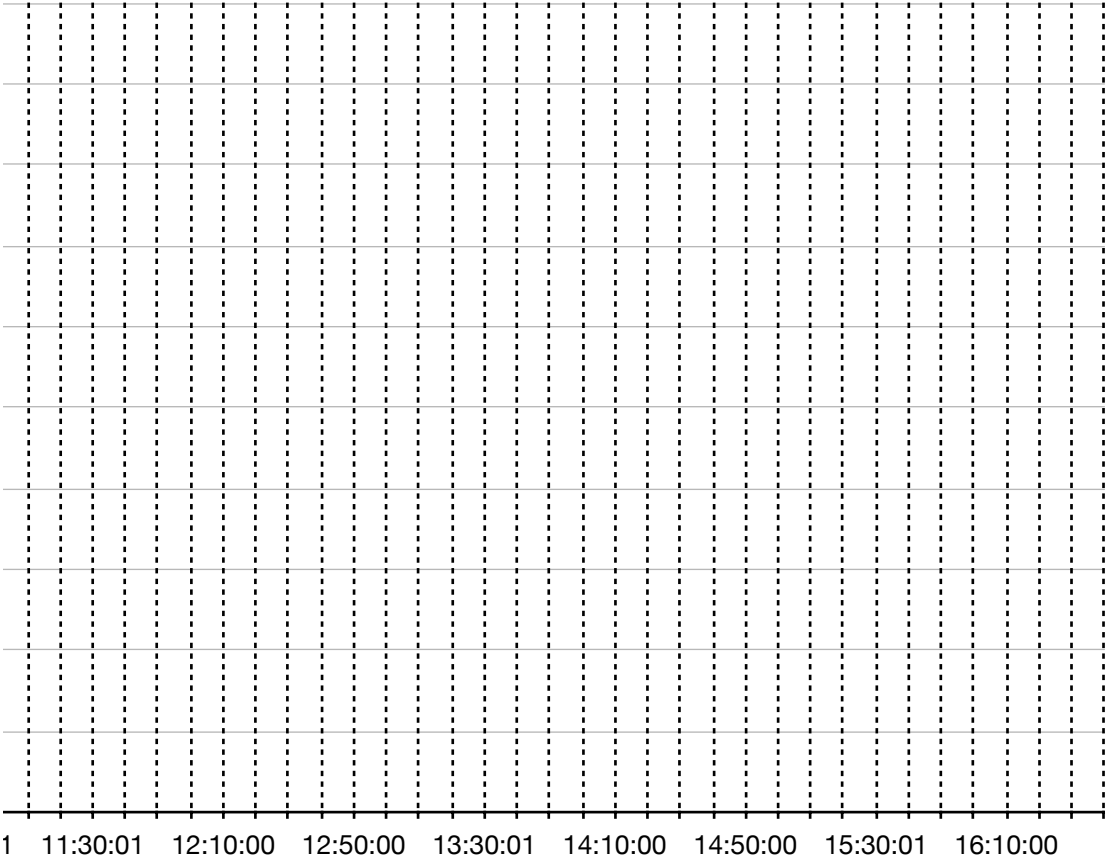
Figure 2.2: Battery voltage while in SM mode. Notice that voltage data was missing
=> Total SM time before completely dying : 13 hours, 57



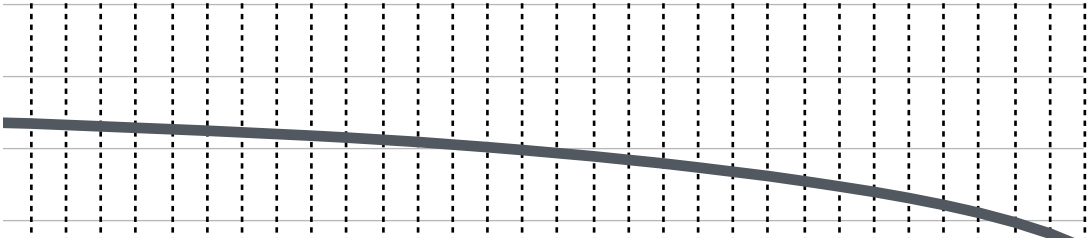
y: Efest 18650, 3000 mAh.
5 hours, 10 mins.

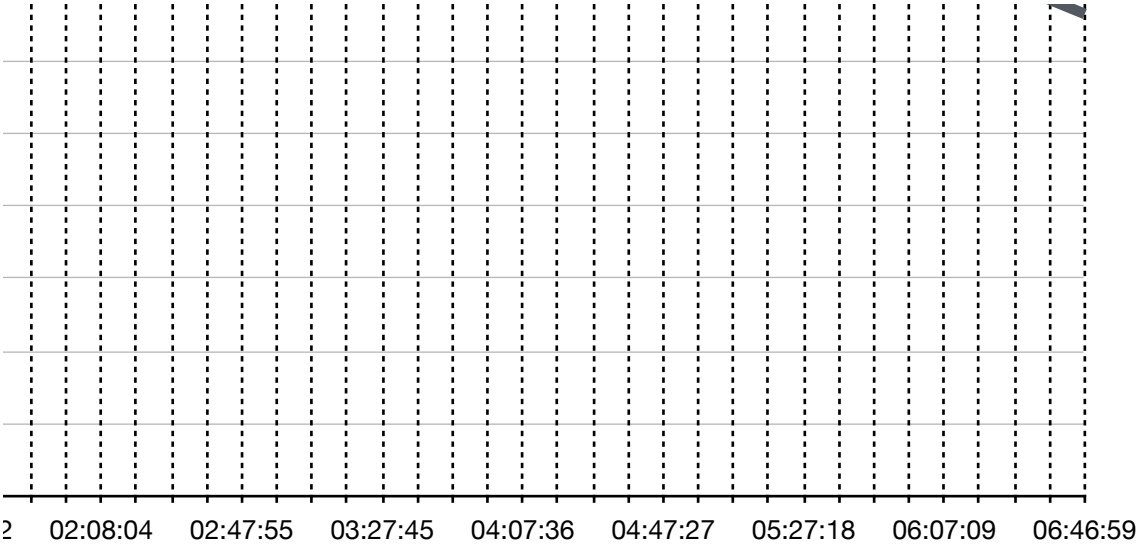


350, 3000 mAh.
il 23 6:46 UTC 0.00%) .
centage other 6 hours and 38 mins.
s.



ast 6 hours before activation of SM.





ssing in some points.
mins.

