BG95-M3 Low Power Design Guide

LPWA Module Series

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About the Document

Revision History

Version	Date	Author	Description
-	2022-09-07	Bayes YANG	Creation of the document
1.0	2022-09-08	Bayes YANG	First official release

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1 Introduction

In most Cat NB2 and Cat M1 applications, devices are battery-powered. Therefore, low-power operation is one of the key requirements for devices that support Cat NB2 and Cat M1. This document mainly introduces solutions and reference designs for reducing the power consumption of BG95-M3 module in low-power applications.

2 Low Power Solutions

The low power solutions provided in this document only apply to wireless terminals featuring following characteristics:

- Use primary batteries (lithium-thionyl chloride battery or lithium manganese battery) as the main power source
- Long service life
- Low frequency of data transmission

2.1. Power Supply Solutions

The power supply of the BG95-M3 ranges from 3.3 to 4.3 V (typ.3.8 V), and the power supply for MCU is 3.3 V normally. The module in low power solution needs a large battery capacity to ensure long service life. The lithium-thionyl chloride (Li-SOCl2) battery is a great choice for two reasons:

- It provides high energy ratio and voltage.
- It has a preferable discharge and rather low self-discharge.

The following table lists two common models of Li-SOCl2 battery and their key parameters. You can choose one as needed:

Table 1: Parameters of Li-SOCl2 Batteries

Parameter	ES-341520	ES-261550
Nominal Capacity	19 Ah @ 2 mA, 3 V	8.5 Ah @ 4 mA, 3 V
Nominal Voltage	3.6 V	3.6 V
Maximum Continuous Discharge Current	-	-
Maximum Pulse Current	1000 mA @ 1 s	3000 mA @ 1 s
Temperature Range	-40 to +85 °C	-40 to +85 °C
Voltage Delay	Not supported	Not supported

2.2. Power Supply Reference Design

The power design is vital in reducing the whole system's power consumption. As the power supply of BG95-M3 ranges from 3.3 to 4.3 V, please ensure that the input voltage never drops below 3.3 V even in burst transmission. The following figure shows a reference design with ES-341520 as the power supply.

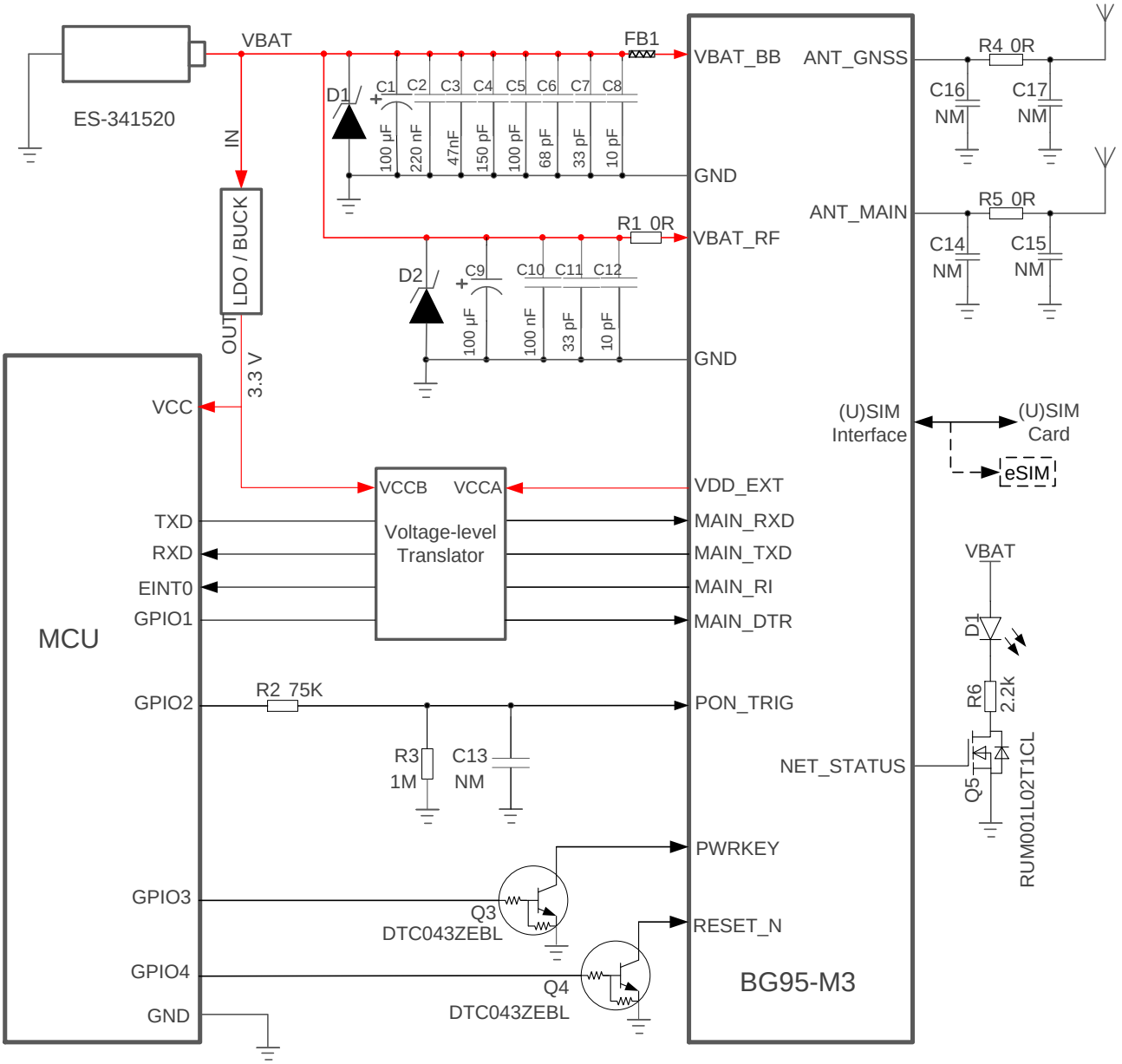

Figure 1: A Reference Design With ES-341520 as the Power Supply

NOTE

1. As NET_STATUS function increases the power consumption, if unnecessary, it is recommended to turn it off.
2. RESET_N connects directly to PWRKEY inside the module.
3. Since PON_TRIG has a 100 kΩ pull-down resistor inside the module, this resistor value of 100 kΩ should be considered in calculating the voltage divider resistance.

2.3. Power Consumption in Low Power Design

To choose a battery with proper capacity in low power solutions, it is necessary to evaluate the module's power consumption in normal operating environment. The power consumption varies with different ECLs and in diverse environments.

Here is one typical working process of the module: Power Off → Start Up → Network Searching → RRC Connection → RRC Release → Idle → Sleep → Power down → Power Off.

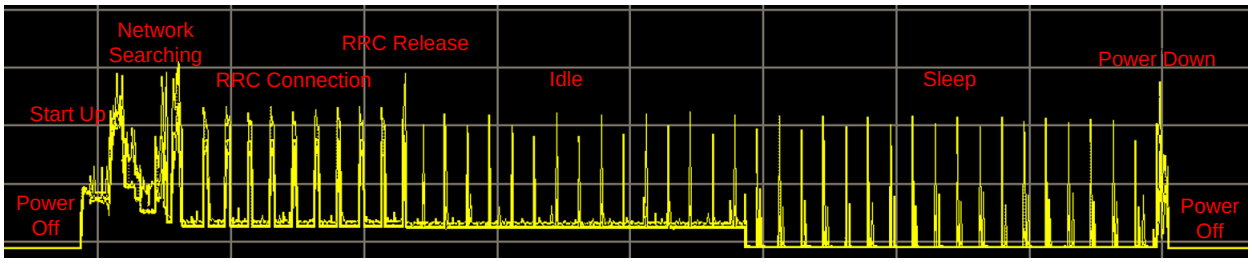

Figure 2: One Typical Working Process of the Module

Here is one typical working process of the module after it is woken up from PSM: PSM → Wake up (by PON_TRIG pin) → Network Searching → Send Data → RRC Connection → RRC Release → Sleep → PSM.

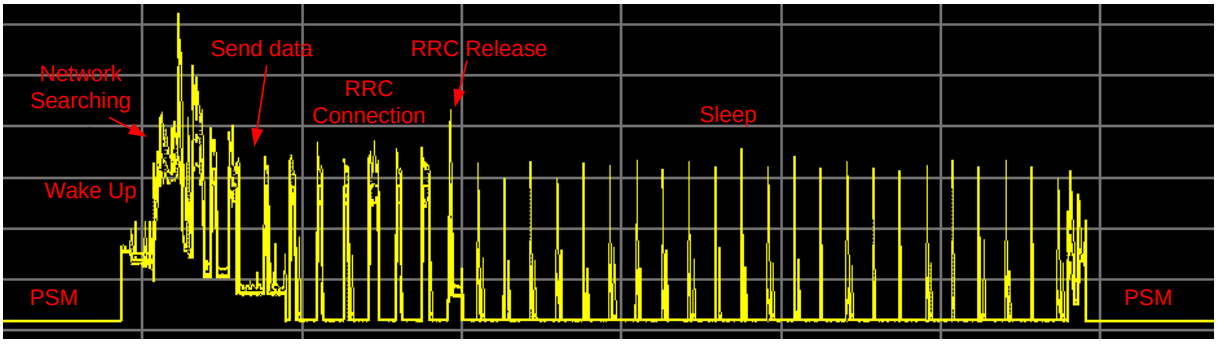

Figure 3: One Typical Working Process of the Module After it is Woken Up from PSM

2.3.1. Power Consumption (Real Networks)

The following tables show the module's power consumptions in different conditions with different ECLs. Related to signal strength, the following data are for your reference only.

Table 2: Power-off Power Consumption

RAT	Power-off	
	RSRP (dBm)	Avg Consumption (μA)
LTE Cat M	-80	14.68
	-112	14.51
	-122	14.56
LTE Cat NB	-85	14.61
	-118	14.47
	-125	14.52
GSM	-64	14.53
	-91	14.52
	-101	14.46

Table 3: Start Up Power Consumption

RAT	Start Up			
	RSRP (dBm)	Avg Duration (s)	Avg Consumption (mA)	Electric Capacity (mAh)
LTE Cat M	-80	8.07	48.83	0.1095
	-112	7.50	48.61	0.1013
	-122	7.38	50.31	0.1031
LTE Cat NB	-85	7.42	50.87	0.1048
	-118	7.41	52.31	0.1077
	-125	7.42	50.53	0.1041
GSM	-64	8.73	49.06	0.1190

	-91	8.58	52.29	0.1246
	-101	8.77	49.59	0.1208

The network searching power consumption is closely related to network coverage and signal strength. The data in the tables below are test results in real networks.

Table 4: Network Searching Power Consumption

RAT	Network Searching			
	RSRP (dBm)	Avg Duration (s)	Avg Consumption (mA)	Electric Capacity (mAh)
LTE Cat M	-80	1.74	81.19	0.0392
	-112	1.73	65.53	0.0315
	-122	2.16	71.71	0.0430
LTE Cat NB	-85	2.37	54.38	0.0358
	-118	3.19	60.29	0.0534
	-125	6.88	71.02	0.1357
GSM	-64	5.43	64.58	0.0974
	-91	5.74	67.96	0.1084
	-101	5.20	76.47	0.1105

Table 5: RRC Power Consumption

RAT	RRC Connection			
	RSRP (dBm)	Avg Duration (s)	Avg Consumption (mA)	Electric Capacity (mAh)
LTE Cat M	-80	9.79	53.43	0.1453
	-112	9.76	53.23	0.1443
	-122	9.55	52.44	0.1391
LTE Cat NB	-85	9.91	43.52	0.1198

	-118	9.76	45.39	0.1231
	-125	9.73	40.11	0.1084

RAT	RRC Release			
	RSRP (dBm)	Avg Duration (s)	Avg Consumption (mA)	Electric Capacity (mAh)
LTE Cat M	-80	0.43	40.41	0.0048
	-112	0.48	48.82	0.0065
	-122	0.72	41.39	0.0083
LTE Cat NB	-85	0.28	45.34	0.0035
	-118	0.26	50.38	0.0036
	-125	0.70	52.52	0.0102

Table 6: Idle Power Consumption

RAT	Idle			
	Mode	RSRP (dBm)	Avg Consumption (mA)	Electric Capacity (mAh)
LTE Cat M	DRX = 1.28 s	-80	19.842	0.0070
		-112	19.656	0.0069
		-122	19.659	0.0069
	DRX = 2.56 s	-80	18.342	0.0130
		-112	18.403	0.0131
		-122	18.395	0.0131
LTE Cat NB	DRX = 1.28 s	-85	15.515	0.0055
		-118	15.521	0.0055
		-125	15.571	0.0053
	DRX = 2.56 s	-85	14.752	0.0104
		-118	14.762	0.0105

		-125	15.337	0.0109
GSM	DRX = 0.4 s	-70	14.004	0.0018
		-90	14.393	0.0018
		-101	14.589	0.0019

Table 7: Sleep Power Consumption

RAT	Sleep			
	Mode	RSRP (dBm)	Avg Consumption (mA)	Electric Capacity (mAh)
LTE Cat M	DRX = 1.28 s	-80	2.633	0.0009
		-112	2.906	0.0010
		-122	3.238	0.0011
	DRX = 2.56 s	-80	1.826	0.0013
		-112	1.664	0.0011
		-122	1.691	0.0012
	e-I-DRX = 81.92 s @ PTW = 2.56 s, DRX = 1.28 s	-80	0.943	0.0214
		-112	0.951	0.0216
		-122	0.967	0.0220
	e-I-DRX = 40.96 s @ PTW = 10.24 s, DRX = 2.56 s	-80	1.145	0.0130
		-112	1.064	0.0121
		-122	1.084	0.0123
LTE Cat NB	DRX = 1.28 s	-85	1.662	0.0005
		-118	1.662	0.0006
		-125	1.706	0.0006
	DRX = 2.56 s	-85	1.079	0.0007
		-118	1.181	0.0008
		-125	1.102	0.0007

	e-I-DRX = 81.92 s @ PTW = 2.56 s, DRX = 1.28 s	-85	0.865	0.0196
		-118	0.924	0.0210
		-125	0.867	0.0197
	e-I-DRX = 40.96 s @ PTW = 10.24 s, DRX = 2.56 s	-85	1.118	0.0127
		-118	1.204	0.0137
		-125	1.407	0.0160
GSM	DRX = 0.4 s	-70	2.559	0.0003
		-90	2.393	0.0003
		-101	2.020	0.0002

Table 8: Power Consumption of Waking Up from Sleep

RAT	Wake Up from Sleep			
	RSRP (dBm)	Avg Duration (s)	Avg Consumption (mA)	Electric Capacity (mAh)
LTE Cat M	-80	0.008	16.122	0.00003
	-112	0.007	17.233	0.00003
	-122	0.008	15.635	0.00003
LTE Cat NB	-85	0.008	16.872	0.00003
	-118	0.007	18.638	0.00003
	-125	0.008	16.811	0.00003
GSM	-70	0.008	15.312	0.00003
	-90	0.010	16.081	0.00003
	-101	0.008	15.652	0.00003

Table 9: Power-down Power Consumption

RAT	Power-down			
	RSRP (dBm)	Avg Duration (s)	Avg Consumption (mA)	Electric Capacity (mAh)
LTE Cat M	-80	0.86	41.48	0.0099
	-112	1.36	51.72	0.0195
	-122	0.89	43.73	0.0108
LTE Cat NB	-85	1.23	39.95	0.0136
	-118	1.36	50.89	0.0192
	-125	2.47	54.12	0.0371
GSM	-64	2.09	53.62	0.0311
	-91	2.66	54.52	0.0403
	-101	2.79	53.69	0.0416

Table 10: PSM Power Consumption

RAT	PSM	
	RSRP (dBm)	Avg Consumption (uA)
LTE Cat M	-80	4.07
	-112	4.07
	-122	4.06
LTE Cat NB	-80	4.08
	-118	4.07
	-125	4.07

Table 11: Power Consumption of Waking Up from PSM

RAT	Wake up from PSM (by PON_TRIG pin)			
	RSRP (dBm)	Avg Duration (s)	Avg Consumption (mA)	Energy Consumption (mAh)
LTE Cat M	-85	0.48	45.96	0.0061
	-112	0.52	45.02	0.0065
	-122	0.52	44.65	0.0064
LTE Cat NB	-84	0.48	46.12	0.0061
	-118	0.49	45.31	0.0062
	-125	0.49	45.89	0.0062

Table 12: Power Consumption of Sending Data

RAT	Send data					
	Data Size (B)	Socket	RSRP (dBm)	Avg Duration (s)	Avg Consumption (mA)	Electric Capacity (mAh)
LTE Cat M	50	UDP	-80	3.80	45.445	0.0479
			-112	3.33	46.871	0.0439
			-122	3.10	53.687	0.0463
		TCP	-80	5.37	56.925	0.0849
			-112	4.19	57.017	0.0664
			-122	4.75	54.666	0.0722
	200	UDP	-85	3.61	44.450	0.0446
			-112	3.87	45.895	0.0494
			-125	4.21	50.109	0.0587
		TCP	-85	3.57	55.126	0.0547
			-112	4.94	68.541	0.0949
			-125	5.62	57.227	0.0894

	500	UDP	-80	3.98	47.725	0.0528
			-112	3.19	49.027	0.0435
			-122	4.44	45.569	0.0562
		TCP	-80	3.72	51.126	0.0529
			-112	4.84	57.455	0.0773
			-122	4.43	50.479	0.0621
	10K	UDP	-85	4.52	55.240	0.0694
			-112	5.41	51.110	0.0769
			-125	4.46	58.896	0.0729
		TCP	-85	5.20	65.188	0.0943
			-112	6.53	65.995	0.1199
			-125	5.43	68.125	0.1027
LTE Cat NB	50	UDP	-80	3.76	53.919	0.0564
			-112	4.25	53.197	0.0640
			-122	3.51	54.300	0.0530
		TCP	-80	4.34	54.086	0.0652
			-112	4.87	54.353	0.0736
			-122	5.54	53.909	0.0830
	200	UDP	-85	4.12	52.092	0.0559
			-112	3.91	54.257	0.0559
			-125	3.31	54.528	0.0501
		TCP	-85	4.49	54.733	0.0684
			-112	4.33	54.868	0.0660
			-125	5.26	54.805	0.0801
	500	UDP	-80	3.90	53.098	0.0575
			-112	4.02	54.884	0.0613

			-122	3.98	54.630	0.0605
		TCP	-80	4.71	53.393	0.0699
			-112	4.79	55.644	0.0740
			-122	4.43	55.883	0.0688
	10K	UDP	-85	15.62	60.513	0.2626
			-112	15.59	60.718	0.2629
			-125	15.58	60.896	0.2637
		TCP	-85	42.00	62.371	0.7277
			-112	42.20	61.951	0.7260
			-125	33.39	61.147	0.5674
GSM	50	UDP	-70	6.71	64.001	0.1193
			-90	6.68	77.907	0.1447
			-101	2.14	81.755	0.0487
		TCP	-70	6.03	71.359	0.1195
			-90	8.18	92.886	0.2110
			-101	7.07	84.160	0.1653
	200	UDP	-70	6.78	70.790	0.1333
			-90	6.83	90.693	0.1722
			-101	8.05	86.248	0.1930
		TCP	-70	6.79	71.095	0.1342
			-90	6.83	100.734	0.1913
			-101	6.99	85.905	0.1669
	500	UDP	-70	4.29	51.913	0.0618
			-90	8.60	50.817	0.1213
			-101	5.79	59.369	0.0956
		TCP	-70	6.97	71.726	0.1389

			-90	7.02	91.218	0.1780
			-101	7.15	84.521	0.1679
	10K	UDP	-70	8.04	91.855	0.2052
			-90	10.39	167.526	0.4838
			-101	7.86	200.306	0.4373
		TCP	-70	10.93	103.021	0.3127
			-90	11.49	111.158	0.3547
			-101	11.75	190.739	0.6227

2.3.2. GNSS Power Consumption (Real Networks)

The following table shows the test conditions for the module in real networks.

Table 13: GNSS Power Consumption (Real Network)

Description	Conditions	Avg Duration (s)	Avg Consumption (mA)	Electric Capacity (mAh)
Searching (**AT+CFUN=0**)	Cold start @ Real network	32.16	69.363	0.619
	Hot start @ Real network	1.15	67.399	0.0215
	Warm start @ Real network	30.51	70.107	0.594
	Lost state @ Real network	-	69.74	-
Tracking (**AT+CFUN=0**)	Open Sky @ Real network, Passive Antenna	-	18.461	-
	Open Sky @ Real network, Active Antenna	-	21.901	-

For more information about the AT command mentioned above, see ***document [1]***.

2.4. Cases Introduction

A terminal's power consumption can be calculated in two modes: full functionality mode and power saving mode. Whichever mode the terminal is in, its power consumption comes from the following four parts:

- MCU control system
- LPWA module system
- Battery self-discharge
- Other integrated circuits

The remaining battery capacity can be estimated by confirming the following things:

1. the ECL and signal strength.
2. the registered network.
3. the module's turn-on process and the (e)DRX cycling and operating time in idle and sleep modes.
4. the times of T3324 and T3412 in PSM mode.
5. the data transmission protocol, and the data size.
6. the method of GNSS start up.

The following shows some examples of how to calculate the power consumption of a terminal with a 10-year service life:

2.4.1. LTE Cat M1 Cases

The following table shows the test conditions for the module in real networks.

Table 14: Test Conditions (LTE Cat M1 Band 3)

Test case 1
Power Off → Start Up → Network Searching → RRC → Sleep (DRX = 1.28 s) → PSM
Test case 2
PSM → Wake Up → Send data (TCP 200B) → Sleep (DRX = 1.28 s) → PSM
Test case 3
Idle (DRX = 1.28 s) → Send data (TCP 200B) → Idle (DRX = 1.28 s)
Test case 4
Idle (DRX = 1.28 s) → Sleep (DRX = 1.28 s) → Wake up → Send data (TCP 200B) → Idle (DRX = 1.28 s) → Sleep (DRX = 1.28 s)
Test case 5
Cat M1 + GNSS → Sleep (DRX = 1.28 s) → PSM → Wake up → GNSS positioning data → Cat M1 + GNSS → Sleep (DRX = 1.28 s) → PSM

Table 15: Example 1 (LTE Cat M1 Band 3)

Status	Example 1 (LTE Cat M1 Band 3)			
	RSRP/dBm	Avg Duration/s	Electric Quantity/mAh	Comment
Start Up	-112	7.50	0.1013	
Network Searching		1.73	0.0315	
RRC		10.24	0.1508	
Sleep		1.28	0.0010	
PSM		≈ 24 h	0.09768	
Wake Up from PSM		0.52	0.0065	

The power consumption on the 1st day differs from that on other days of the year when the module wakes up from PSM rather than start up from turn-off.

1st Day: 0.1013 mAh + 0.0315 mAh + 0.1508 mAh + 0.0010 mAh + 0.00407 mA × 24 h = 0.38228 mAh;

364 Days: (0.0065 mAh + 0.0315 mAh + 0.1508 mAh + 0.0010 mAh + 0.00407 mA × 24 h) × 364 days = 0.28748 mAh × 364 days = 104.64272 mAh;

1st Year: 0.38228 mAh + 104.64272 mAh = 105.025 mAh;

10 Years: 105.025 mAh + 0.28748 mAh × 365 days × 9 years = 1049.3968 mAh.

Table 16: Example 2 (LTE Cat M1 Band 3)

Status	Example 2 (LTE Cat M1 Band 3)			
	RSRP/dBm	Avg Duration/s	Electric Quantity/mAh	Comment
PSM	-112	≈ 24 h	0.09768	
Wake up from PSM		0.52	0.0065	
Send data		4.94	0.0949	TCP 200B
Sleep		1.28	0.0010	
PSM		≈ 24 h	0.09768	

1 Day: 0.0065 mAh + 0.0949 mAh + 0.0010 mAh + 0.00407 mA × 24 h = 0.20008 mAh;

1 Year: 0.20008 mAh × 365 days = 73.0292 mAh;

10 Years: 73.0292 mAh × 10 years = 730.292 mAh.

2.4.2. LTE Cat NB1 Cases

The following table shows the test conditions for the module in real networks.

Table 17: Test Conditions (LTE Cat NB1 Band 8)

Test case 1
Power Off → Start Up → Searching → RRC → Sleep (DRX = 1.28 s) → PSM
Test case 2
PSM → Wake up → Send data (TCP 200B) → Sleep (DRX = 1.28 s) → PSM
Test case 3
Idle (DRX = 1.28 s) → Send data (TCP 200B) → Idle (DRX = 1.28 s)
Test case 4
Idle (DRX = 1.28 s) → Sleep (DRX = 1.28 s) → Wake up → Send data (TCP 200B) → Idle (DRX = 1.28 s) → Sleep (DRX = 1.28 s)
Test case 5
Cat LTE CAT NB1 + GNSS → Sleep (DRX = 1.28 s) → PSM → Wake up → GNSS positioning data → Cat LTE CAT NB1 + GNSS → Sleep (DRX = 1.28 s) → PSM

Table 18: Example 3 (LTE Cat NB1 Band 8)

Status	**Example 3 (LTE Cat NB1 Band 8)**			
	RSRP (dBm)	**Avg Duration (s)**	**Electric Quantity (mAh)**	**Comment**
Start Up	-118	7.41	0.1077	
Network Searching		3.19	0.0534	
RRC		10.02	0.1267	
Sleep		1.28	0.0006	
PSM		≈ 24 h	0.09768	

Wake Up from PSM	0.49	0.0062

The power consumption on the 1st day differs from that on other days of the year when the module wakes up from PSM rather than start up from turn-off.
1st Day: 0.1077 mAh + 0.0534 mAh + 0.1267 mAh + 0.0006 mAh + 0.00407 mA × 24 h = 0.38608 mAh;

364 Days: (0.0062 mAh + 0.0534 mAh + 0.1267 mAh + 0.0006 mAh + 0.00407 mA × 24 h) × 364 days = 0.28458 mAh × 364 days = 103.58712 mAh;

1st Year: 0.38608 mAh + 103.58712 mAh = 103.9732 mAh;

10 Years: 103.9732 mAh + 0.28458 mAh x 365 days x 9 years = 1038.8185 mAh.

Table 19: Example 4 (LTE Cat NB1 Band 8)

Status	Example 4 (LTE Cat NB1 Band 8)			
	RSRP (dBm)	Avg Duration (s)	Electric Quantity (mAh)	Comment
PSM	-118	≈ 24 h	0.09768	
Wake up from PSM		0.49	0.0062	
Send data		4.33	0.0660	TCP 200B
Sleep		1.28	0.0006	
PSM		≈ 24 h	0.09768	

1 Day: 0.0062 mAh + 0.0660 mAh + 0.0006 mAh + 0.00407 mA × 24 h = 0.17048 mAh;

1 Year: 0.17048 mAh × 365 days = 62.2252 mAh;

10 Years: 62.2252 mAh × 10 years = 622.252 mAh.

2.4.3. GSM Cases

The following table shows the test conditions for the module in real networks.

Table 20: Test Conditions (GSM850)

Test case 1
Power Off → Start Up → Searching → RRC → Sleep (DRX = 0.4 s)
Test case 2
Sleep (DRX = 0.4 s) → Wake up → Send data (TCP 200B) → Sleep (DRX = 0.4 s)
Test case 3
Idle (DRX = 0.4 s) → Send data (TCP 200B) → Idle (DRX = 0.4 s)
Test case 4
Idle (DRX = 0.4 s) → Sleep (DRX = 0.4 s) → Wake up → Send data (TCP 200B) → Idle (DRX = 0.4 s) → Sleep (DRX = 0.4 s)
Test case 5
GNSS → Sleep (DRX = 0.4 s) → Wake up → GNSS positioning data → GNSS → Sleep (DRX = 0.4 s)

2.5. The Module's Power Consumption

2.5.1. Power Consumption (Instrument)

The table below lists the module's power consumption in all operating modes.

Table 21: The Module's Power Consumption (3.8 V Power Supply, Room Temperature)

Description	Conditions	Average	Unit
Leakage [1]	Power-off @ USB and UART disconnected	12.99	μA
PSM [2]	Power Saving Mode	3.89	μA
Rock Bottom	**AT+CFUN=0** @ Sleep mode	0.575	mA
Sleep Mode	LTE Cat M1 DRX = 1.28 s	1.89	mA

[1] The module's power consumption in PSM is much lower than that in power-off mode due to the following two designs:

- More internal power supplies are powered off in PSM.
- The internal clock frequency is reduced in PSM.

[2] The module's USB and UART are disconnected. GSM network (if available) does not support PSM.

(USB disconnected)	LTE Cat NB1 DRX = 1.28 s	1.49	mA
	EGSM900 DRX = 5	1.21	mA
	DCS1800 DRX = 5	1.20	mA
	LTE Cat M1 e-I-DRX = 81.92 s @ PTW = 2.56 s, DRX = 1.28 s	0.63	mA
	LTE Cat NB1 e-I-DRX = 81.92 s @ PTW = 2.56 s, DRX = 1.28 s	0.67	mA
Idle Mode (USB disconnected)	LTE Cat M1 DRX = 1.28 s	18.9	mA
	LTE Cat NB1 DRX = 1.28 s	14.8	mA
	LTE Cat M1 e-I-DRX = 81.92 s @ PTW = 2.56 s, DRX = 1.28 s	18.2	mA
	LTE Cat NB1 e-I-DRX = 81.92 s @ PTW = 2.56 s, DRX = 1.28 s	14.3	mA
LTE Cat M1 data transfer (GNSS OFF)	B1 @ 21.29 dBm	193.65	mA
	B2 @ 20.73 dBm	190.76	mA
	B3 @ 20.67 dBm	185.14	mA
	B4 @ 20.85 dBm	185.14	mA
	B5 @ 21.02 dBm	194.99	mA
	B8 @ 21.02 dBm	197.31	mA
	B12 @ 20.96 dBm	189.54	mA
	B13 @ 20.99 dBm	198.75	mA
	B18 @ 20.97 dBm	193.49	mA
	B19 @ 20.95 dBm	197.63	mA
	B20 @ 20.92 dBm	197.33	mA
	B25 @ 21.08 dBm	190.67	mA
	B26 @ 20.98 dBm	195.96	mA

	B27 @ 20.69 dBm	192.07	mA
	B28A @ 20.87 dBm	192.04	mA
	B28B @ 21.03 dBm	197.39	mA
	B66 @ 21.11 dBm	188.1	mA
	B85 @ 20.87 dBm	185.3	mA
LTE Cat NB1 data transfer (GNSS OFF)	B1 @ 20.86 dBm	153.2	mA
	B2 @ 21.28 dBm	155.14	mA
	B3 @ 21.07 dBm	149.14	mA
	B4 @ 20.91 dBm	147.72	mA
	B5 @ 20.55 dBm	154.68	mA
	B8 @ 21.01 dBm	158.82	mA
	B12 @ 20.88 dBm	148.37	mA
	B13 @ 21.09 dBm	167.03	mA
	B18 @ 20.79 dBm	157.12	mA
	B19 @ 20.68 dBm	156.29	mA
	B20 @ 21.01 dBm	161.75	mA
	B25 @ 21.02 dBm	154.16	mA
	B28 @ 20.82 dBm	147.82	mA
	B66 @ 21 dBm	148.58	mA
	B71 @ 20.81 dBm	137.53	mA
	B85 @ 20.64 dBm	146.51	mA
GPRS data transfer (GNSS OFF)	GPRS GSM850 4UL/1DL @ 30.5 dBm	670.73	mA
	GPRS GSM900 4UL/1DL @ 29.65 dBm	623.34	mA
	GPRS DCS1800 4UL/1DL @ 26.24 dBm	408.25	mA
	GPRS PCS1900 4UL/1DL @ 26.43 dBm	423.12	mA

	GPRS EGSM900 1UL/4DL @ 31.96 dBm	255.82	mA
	GPRS DCS1800 1UL/4DL @ 29.35 dBm	179.29	mA
EDGE data transfer (GNSS OFF)	EDGE GSM850 4UL/1DL @ 22.97 dBm	519	mA
	EDGE EGSM900 4UL/1DL @ 22.51 dBm	517.59	mA
	EDGE DCS1800 4UL/1DL @ 22.73 dBm	439.73	mA
	EDGE PCS1900 4UL/1DL @ 22.27 dBm	443.94	mA

Table 22: The Module's GNSS Power Consumption (3.8 V Power Supply, Room Temperature)

Description	Conditions	Typ.	Unit
Searching (**AT+CFUN=0**)	Cold start @ Instrument	70.00	mA
	Hot start @ Instrument	73.66	mA
	Warm start @ Instrument	72.54	mA
	Lost state @ Instrument	69.24	mA
Tracking (**AT+CFUN=0**)	Instrument Environment @ Passive Antenna	22.31	mA
	Open Sky @ Real network, Passive Antenna	21.792	mA
	Open Sky @ Real network, Active Antenna	22.357	mA

For more information about the AT commands mentioned above, see ***document [1]***.

2.5.2. Power Consumption in DFOTA (Real Networks)

The following table shows the module's DFOTA power consumption in real networks (Cat M1 Band 3).

Table 23: The Module's DFOTA Power Consumption in Real Networks (3.8V)

ECL	Feature	Download process	Upgrade process
ECL0	Time/s	146.33	62.67
	Avg Consumption/mA	11.34	21.40

Electric Capacity/mAh	460.49	376.74

3 Appendix References

Table 24: Related Documents

Document Name
[1] Quectel_BG95&BG77&BG600L_Series_AT_Commands_Manual
[2] Quectel_BG95_Series_Hardware_Design

Table 25: Terms and Abbreviations

Abbreviation	Description
DFOTA	Delta Firmware Upgrade Over-The-Air
DRX	Discontinuous Reception
ECL	Enhanced Coverage Level
eDRX	extended Discontinuous Reception
EGSM	Extended Global System for Mobile
GSM	Global System for Mobile Communications
IC	Integrated Circuit
LTE Cat M	Long Term Evolution Category M
LTE Cat NB	Long Term Evolution Category Narrow Band
MCU	Microprogrammed Control Unit
NB-IoT	Narrow Band Internet of Things
PSM	Power Saving Mode
RAT	Radio Access Technology

RRC	Radio Resource Control
RSRP	Reference Signal Receiving Power
TAU	Tracking Area Update
TCP	Transmission Control Protocol
UDP	User Data Protocol
UE	User Equipment