# Introduction of power consumption mode

XIAO ESP32C3 can be switched between different power consumption modes:

- Active: General operating mode, where both CPU and chip RF are in operating state. In this mode, the chip will receive, transmit and listen to signals normally.
- Modem-sleep: The CPU is active with variable clock frequency (80MHz/160MHz, which will be switched automatically depending on CPU load and peripherals used) The baseband and RF of Wi-Fi and BLE are turned off, but both will stay connected. While the Wi-Fi is enabled, the chip will cut back to Active mode from time to time, and the power consumption will be changed between the both modes.
- Light-sleep: CPU suspended. Any wake-up event (MAC, host, RTC timer or external interrupt) will wake up the chip. Wi-Fi or BLE will stay connected.
- Deep-sleep: CPU and most peripherals are suspended, only the timer and memory of the RTC are working, Wi-Fi connection data is stored in the RTC.

Compared to competing products, there is a 32.768 kHz crystal clock circuit on XIAO ESP32C3, which providing a low-frequency RTC clock for the CPU. This allows the XIAO ESP32C3 to run in Deep-sleep low-power mode for extremely low standby power consumption (44 $\mu$ A) and long standby time with external batteries, providing a more diverse range of low-power application scenarios. The operating states of the ESP32-C3 modules in different power consumption modes are shown below.



Modules having power in specific power modes:



Active, Modem-sleep, and Light-sleep; optional in Light-sleep

## Test results

The low power mode summary test results of XIAO ESP32C3 are shown in the following table:

	Active	Modem-sleep	Light-sleep
Current with Wi-Fi	74.7mA	24.4mA	3.6mA
enabled			
Current with BLE	/	26.8mA	9.7mA
enabled			

\*Current in Deep-sleep mode: 44.0µA

# **Detailed Test Procedure**

Note: ESP32-C3 needs AT firmware pre-burned, and AT command sent through serial port to set the power consumption mode.

#### Power consumption test with Wi-Fi enabled

Reference of AT command:

•••

AT+CWMODE =1 -> Configure to S tation mode. AT+CWJ AP ="SSID","Password" -> Connect to the AP. AT+SLEEP =0 -> Configure to Active mode. AT+SLEEP =1 -> Configure to Modem-sleep mode. AT+SLEEP =2 -> Configure to Light-sleep mode.

Test results in Active mode:

A.	Keysight BenchVue Advanced Power Control a	and A	nalysis													(	0⊡ ×
4	Instrument Connection Instrument Control		Scope		CCDF	WI AR	:B										
	Interactive Front Panel Image - Instrument A		• • • • • • • • • • • • • • • • • • •														
	1 T V Set 42000 V cv +Lim 300000 A.1 Off Set 0000 A	10 <b>2</b>															
	▲ SSCOM V5.13.1 単口/网络数 ー □ × 通讯 誤口 単口设置 显示 发送 多字符串 小工具 報助 緊系作者 大野谷坂																
	[10:02:11:942]☆→○,47=51227=0 [10:02:11:974]%+◆,47=51227=0 0K [10:02:19:922]☆→○,47=509008=1 [10:02:19:923]%+◆,47=509008=1																
	OK [10:02:21.682]法→◇AT+CVJAF-"0m#Flux", "1234567890" [10:02:21.683]W(+→AT+CVJAF-"0m#Flux", "1234567890" VJFI BIZOMBET			di reducerkenendu	an kasal na akun du	penduaritus	induared and	wadaanka ak	eardweith richard	handaanad servatsi		hadaaduu	nataganatan	ahawkaat	nulumba	ulmanth con	Manaketashewada
	[10.02:21.816]8t+◆¥IFI CONSECTED [10:02:22.423]8t+◆¥IFI GOT IP OK		A-I1	35.107 15:33	7.107 15:3	9.107	15:41.10	7 15:4	3.107 15:	45.107	15:47.10	07 1	5:49.107	15:5	1.107	15:53.	107 15:55.107
			00:1	5:54 / 01:00:00	Horizontal: 2 s							P (	7 💱	RANGE	⊕	Q 🗙	202
		Markers and Measurements / Trace Settings															
	19日時(10076 UB Serial Fert ■ 1022度示 作符数 19日時(10076 UB Serial Fert ■ 1022度示 作符数 19日時(10076 UB Serial Fert ■ 1056月間) 19日時(10576 UB Serial Fert ■ 1056月間) 19日時(10576 UB Serial Fert ■ 10576 UB Serial Fert ■ 105766 UB Serial Fert ■		Marker	s & Measurements A-11	5 Trace Settings Min 71.07820	1 24 mA	74.6	Avg 94679 mA	Measurement Ma 103.987	ts of Window ax 001 mA	Pea 32.9	ak to Peak 908797 mA		Charge / 1 414.974	Energy µA h	Cha 1.4	rge / Energy 93905047 C
	www.daxia.com  S:58  R:122  COM76 문 //		Trace Co	nfiguration	Active												
		Ou	tput 1				Output 2				Form	iula					
		V1	2 mV /	∿ ~	4.99768 V	<b>•</b>	V2 1V/	1	/~ 0V	▼ ▲	F1 7	1 V /	1	/ ~ ov		<b>•</b>	
		11	50 mA /	/ <u></u>	167.29631 mA	▼ ▲	I2 1 A /	1	/ ~ 0A	<b>T</b>	F2 •	1 V /	1	/~ ov		•	
		P1	1W/	1/2 ~	• 0 W	▼ ▲					F3 V	1 V /	1	, ~ ov		▼ ▲	
	Stop Data Log 🕟 Start Arb																● Export

Test results in Modem-sleep mode:

Keysight BenchVue Advanced Power Control a	and Analysis	)⊻ -∂×
Instrument Connection Instrument Control	Scope	
Interactive Front Panel Image - Instrument A	• • • • • • • • • • • • • • • • • • •	
1 * V A Set 42000 V CV ++Lim 30000 A.4 off Set 1000 A		
0K [10:17:20.399]左→◇AT+BLEGATISSENCES [10:17:20.375]IJk→◆AT+BLEGATISSENCES 0F		
UK [10:17:29.009])∰→◆AT+BLEADISTART [10:17:29.010])∰→ <b>\$</b> AT+BLEADISTART DK [10:17:23.05])∰→◆AT+BLEADISTART		
10:17:33.716]\\\$+ ◆AT+BLEADDR? +BLEADDR: 10:91: 08:00:64:22" 0K	A-11 = f	
[10:17:46.097]\\\$< +4L2COMT:0, "55:22:64:74:45:54" [10:17:46.687]\\\$< +4L2COMTARM:0,0,0,6,0,500 [10:17:46.684]\\\$< +4L2COMTARM:0,0,0,36,0,500	31:54.284 31:56.284 31:58.284 32:00.284 32:00.284 32:02.284 32:06.284 32:06.284 32:06.284 32:02.284 32:12.7 2810 00:02:21:57 01:00:00 Horizontal: 2.s / ◆	84 32:14.284
▲ 「「「「」」「「」」「「」」「」」「」」「「」」「」」「」」「」」「」」「」」	Markers and Measurements / Trace Settings	
<ul> <li>端口号 COM76 188 Serial Port ▼ 「 HEX展示 保存数</li> <li>※ 新出口 C 更多串口设置 ▼ 加川道職和分包</li> </ul>	Markers & Measurements Trace Settings Measurements of Window	
□ 市15 F OTA 波特室:[115200 ] 方可能/#支援の3003/# 安 近 高な主席点2014点尾谷 【升援劉96.13.1] 大大援第UUT技能の9回話 ★11~fbread中国 24.223 [COL17.2] (COL17.2]	Min         Avg         Max         Peak to Peak         Charge / Energy         Charge           A-11         21.34751 mA         26.819918 mA         86.741224 mA         65.393714 mA         148.926 µA h         536.	ge / Energy 133328 mC
www.daxia.com 5/4 K223 COW/6 E	Trace Configuration Active +	
	Output 1         Output 2         formula           01         2 mV /         0/         ~ 4.99768 V         ▲         ~ 0V         ▼         ▲         2 mV /         0/         ~ 0V         ▼         ▲         ■         0V         ▼         ▲         ■	
📕 Stop Data Log 🕟 Start Arb	0 H M	🕼 🕞 Export

Test results in Light-sleep mode:

Ab.	Keysight BenchVue Advanced Power Control a	and A	nalysis	;												0⊻ -∂×
	Instrument Connection Instrument Control	$\checkmark$	Scope	-	CCDF	∕₩ ARI	в									
	Interactive Front Panel Image - Instrument A						*	• •~~				~~ <b>!                                   </b>	*			
	1 **	9 <b>8</b>														
	和助 則系作者 大学H2法 [10:11:01:982找→◇AT+CMMOR8=1 [10:11:01:971]收←参録T+CMMOR8=1 ot															
	[10:11:02.930]法→○Af*(NJAF="OnePlus", "1234567890" [10:11:02.945]版★◆Af*(NJAF="OnePlus", "1234567890" WTT DISSONDET (10:11:03.058]版★◆AfFI CONDETED															
	[10:11:03.983]敞←●VIFI 607 IP 0K [10:11:08.018]发→◇AT*SLEEF=2		A-11													
	UTU: 11:08:025 JAR + AT+SLEEP=2 08			۱												
			00:2	8:09 / 01:00:00	Horizontal: 2 s	/ -	27:54	.019 27:5	6.019 27:5 Bj	8.019 2 18	28:00.0	Pig 28:	02.019	RANGE	≅.019 2 ©e.€.Q	
			👻 Ma	rkers and Measure	ments / Trace Sett	ings										
			Marker	s & Measurements	Trace Settings				Measurements	of Window						
	1 First P Dif & (7年, 17.400 ) 为了要将北发家Songhy 发 送 请您注册器立创作结尾雷户 发 送 【 计级程序5 13 1】 大发摄系UT开发版9.9回廊 ★ST-Thread中国》				Min 309.97(	jμA	3	Avg .598382 mA	Max 130.3665	64 mA	130	ak to Peak .056588 mA		19.986	μA h	71.950136 mC
			Trace Co	nfiguration	Active	<u> </u>										
		01	itput 1				Output	2	in the second	Concerning and the	Forr	nula				
		VI	2 mV /	<u>^</u> ~	4.99768 V		V2 1	// \\	~ 0V		F1	V 1V/	_	∿ ~ ov		
		n	50 mA	/ // ~	167.29631 mA		12 17	×/ //	~ 0A		F2	1 1 /		0 ~ 00		
-		Ľ	1.11/		0.0	لكامد					-3	1.4/		0 - 0 0		
L	Stop Data Log 🕑 Start Arb															Export 🕞 🕞

#### Power consumption test with BLE enabled

Reference of AT command:

•••

AT+CWMODE =0 -> Turn off Wi-Fi RF. AT+BLEINIT=2 -> Configure to Server mode. AT+BLEADVSTART -> Turn on BLE broadcast. AT+SLEEP=1 -> Configure to Modem-sleep mode. AT+SLEEP=2 -> Configure to Light-sleep mode.

Test results in Modem-sleep mode:

Keysight BenchVue Advanced Power Control and Analysis													
Instrument Connection Instrument Control	Scope Scope CCDF /WM ARB												
Interactive Front Panel Image - Instrument A	, ( ( )~~~~~ ) »												
1 ** V Set 1 2000 /A         2 0.002 V -00 mA           V ** 100 2000 /A         5et 1000 V           V ** 100 2000 /A         5et 1000 V           M SSCOM V3.131 #口/#820         - C           水田田 年口燈 長元 没送 参井市中 小工具 特別 民族市学 大都知道         大都和田 小工具													
[10:17:17.148]₩↔ ◆AT+BLEINIT=2 ^													
ок (0.17.20.300) В → Ол числатизатиза 19.17.20.300) В → Ол числатизатиза (0.17.20.300) В → Ол числатизати (0.17.20.00) В → Ол числатизатизати (0.17.20.00) В → Филасован Ол. 00.00, 0.00 (0.17.20.00) В → Филасован Ол. 00.00, 0.00 (0.17.20.00) В → Филасован Ол. 00.00, 0.00 (0.17.20.00) В → Филасован Ол 0.00, 0.00 (0.17.20.00) В → Ол 0.00 (0.17.20.00) В → Филасован Ол 0.00, 0.00 (0.17.20.00) В → Филасован Ол 0.00 (0.17.20.00	A : 11 31:54:284 31:56:284 31:58:284 32:00:284 32:00:284 32:00:284 32:00:284 32:00:284 32:00:284 32:184 32:10:284 32:1000000000000000000000000000000000000	32:14.284 E											
端口号 COM76 VSB Serial Port ▼ 「HIX显示 保存数	Markers & Measurements Trace Settings												
	Min         Avg         Max         Peak to Peak         Charge / Energy         Charge         Charge         Finergy         Charge         Charge         Finergy         Charge         Charge         Finergy	2 / Energy 33328 mC											
	Trace Configuration     Active     +												
	Output 1 Output 2 Formula												
📕 Stop Data Log 🕟 Start Arb	Q. 11 = Q	Export											

Test results in Light-sleep mode:

20	Keysight BenchVue Advanced Power Control	and A	nalysis											0 🗹 –	Ξ×
•	Instrument Connection Instrument Control	$\checkmark$	Scope		CCDF	WIL AR	в								
	Interactive Front Panel Image - Instrument A						<b>** •  </b> -		~~{ <b>I &gt; &gt;</b>						
	1         V         2         0.002 V           8:et i 4:00         0         0 m A           9:et i 4:00         No         Set i 4:00           V         V         Set i 4:00           No         Module         No           Meter         Properties         Menu           Settings         Select Output         Back           1         2         3         4           00         00         00         00	80 10 10 10 10 10 10 10 10 10 10 10 10 10	∧-11 ÷												
	All On All Off		34:	23.650 34:25	.650 34:27	.650	34:29.650	34:31.650	34:33.65	50 34:	35.650 34:3	7.650 34:3	9.650 34:4	1.650 34:43.	650
			00:3	4:44 / 01:00:00	Horizontal: 2 s				- 31-5			Service Range	® € Q €		
			👻 Ma	rkers and Measure	ments / Trace Setti	ngs									
			Marker	s & Measurements	Trace Settings										
					Min 330.632	11A	Avg	measure nA 87	Max	WINDOW	Peak to Peak	Charge / E	nergy Ch	arge / Energy	
			Trace Co	nfiguration	Active										
			tput 1	_			Output 2				Formula				
		VI	2 mV /	∿ ~	4.99768 V	▼ ▲	V2 1V/	∿ ~ ov			1 V 1V/	∿ ~ ov			
		11	50 mA ,	/ 1/~	167.29631 mA	▼ ▲	12 1A/	<b>√</b> ~ 0 A			2 7 1 1 /	∿ ~ ov		1	
		P1	1W/	∿ ~	o w	▼ ▲				F	3 7 1V/	∿ ~ ov			
(	Stop Data Log 🜔 Start Arb													• <b>0</b> ° ⊡ =	xport

## Power consumption test in Deep-sleep mode

Reference of AT command:

•••

```
AT+GSLP =sleeptime -> Configure to Deep-sleep mode and hold for 'sleeptime'
```

Test results in Deep-sleep mode:



## Reference

• Datasheet | ESP32C3 Series