OPL1000

ULTRA-LOW POWER 2.4GHZ WI-FI + BLUETOOTH SMART SOC

Electric Current Power Consumption Measurement

OPULINKS

REVISION HISTORY

Date	Version	Contents Updated
2018-08-23	0.1	• Initial Release

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1. INTRODUCTION

1.1. Scope of Document Application

As electric current power consumption measurement methods can measure electric current usage under various scenarios, this document is mainly used in quantitative measurement of the amount of electric current consumed under different scenarios of Power Save. Through the understanding of measurement of electric current power consumption, it can determine whether electric current used can fit with the current designed scope of application. If not, root-cause can be determined through value analysis for improvement.

1.2. Abbreviations

Abbr.	Explanation
USB	Universal Serial Bus
GND	Ground
GPIO	General-purpose input/output

1.3. Reference

[1] OPL1000 Power-Saving-Introduction.pdf

2. ELECTRIC CURRENT POWER CONSUMPTION MEASUREMENT METHODS

Per Figure 1, there are green-circle and pink-circle on DevKit. If green-circle and pink-circle are soldered together, as USB is connected to DevKit, electric current will go through green-circle, before supplying power for the Chip. When measuring Sleep Mode, green-circle and pink circle must be soldered apart, per Figure 2, and when green-circle and pink circle are separated, and USB connected with DevKit, only power for Flash is provided, without powering the Chip end. The power for Chip end will be provided from Power Meter in 3V voltage for the Chip. When the positive power for Power Meter is connected to VBAT of DevKit, the negative power of Power Meter is then connected to GND of DevKit, per Figure 3. Through Power Meter, the amount of current consumed by the Chip can be determined.

Figure 1: DevKit Wiring Diagram

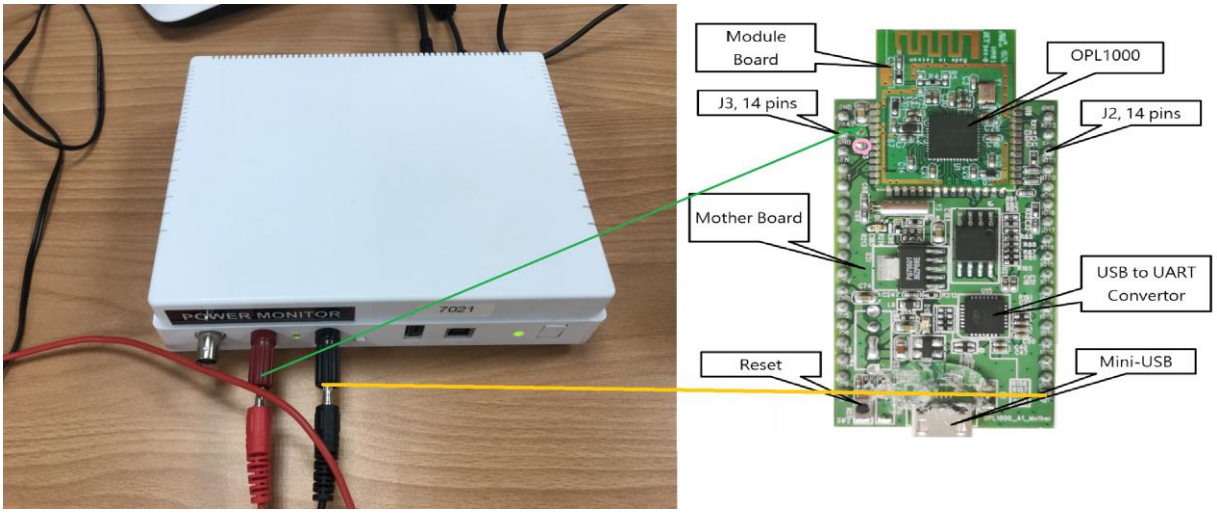


Figure 2: DevKit Soldered Point Diagram

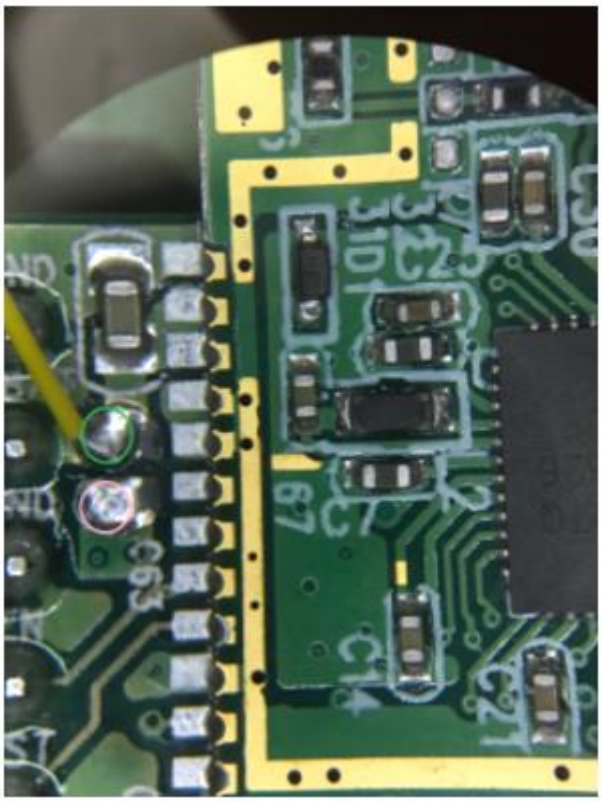
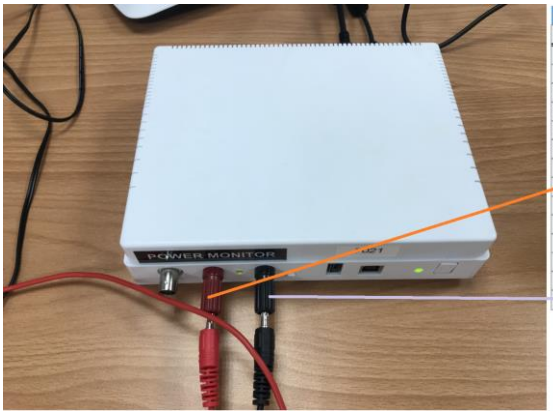


Figure 3: DavKit Pin Point Diagram



J2						ANT	J3				
ICE Mode	PWM	I2C	ADC	Pin Name	Pin No		Pin No	Pin Name	ADC	SPI	UART	Flash Prg
				GND	pin 14		pin 14	GND				
	Yes			GPIO22	pin 13		pin 13	+3V3				
M3_CLK				GPIO21	pin 12		pin 12	GND				
M3_DAT				GPIO20	pin 11		pin 11	CHIP_EN				
M0_DAT				GPIO19	pin 10		pin 10	RST_N				
M0_CLK				GPIO18	pin 9		pin 9	GPIO0(REV)				UART_Prg_Tx
				GND	pin 8		pin 8	GPIO1(REV)				UART_Prg_Rx
		SDA	Yes	GPIO11	pin 7		pin 7	GPIO2	Yes	MOSI	TxD	
		SCLK	Yes	GPIO10	pin 6		pin 6	GPIO3	Yes	MISO	RxD	
				GPIO9(REV)	pin 5		pin 5	GPIO4	Yes	CLK		
				GPIO8(REV)	pin 4		pin 4	Ex_5V				
				GPIO7(REV)	pin 3		pin 3	GND				
	Yes			GPIO23	pin 2		pin 2	GPIO5	Yes	CS		
				GND	pin 1	USB	pin 1	GPIO6	Yes			

If users need to measure electric current consumption often, an easy quick switch can be created, per Figure 4. The connection method for the power supply can be referred to Figure 5. The power supply of the Chip comes from the external Power Meter, as the power supply for Flash on DevKit can be supplied by USB. When users wish to restore the original usage mode, it can be referred to Figure 6. A Jumper is connected to the switch, the original usage can be restored.

Figure 4: DevKit Simple Switch (I)

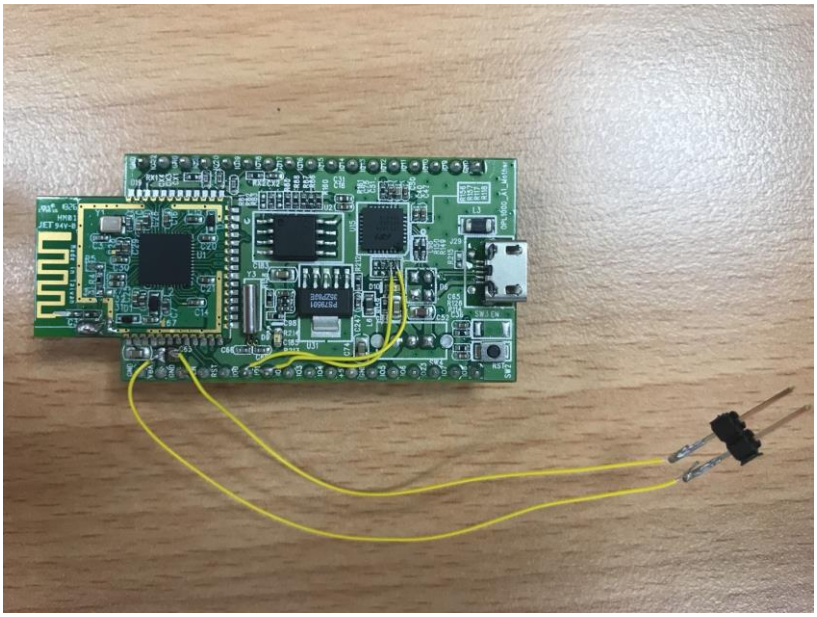


Figure 5: DevKit Simple Switch – Electrical Connection Method

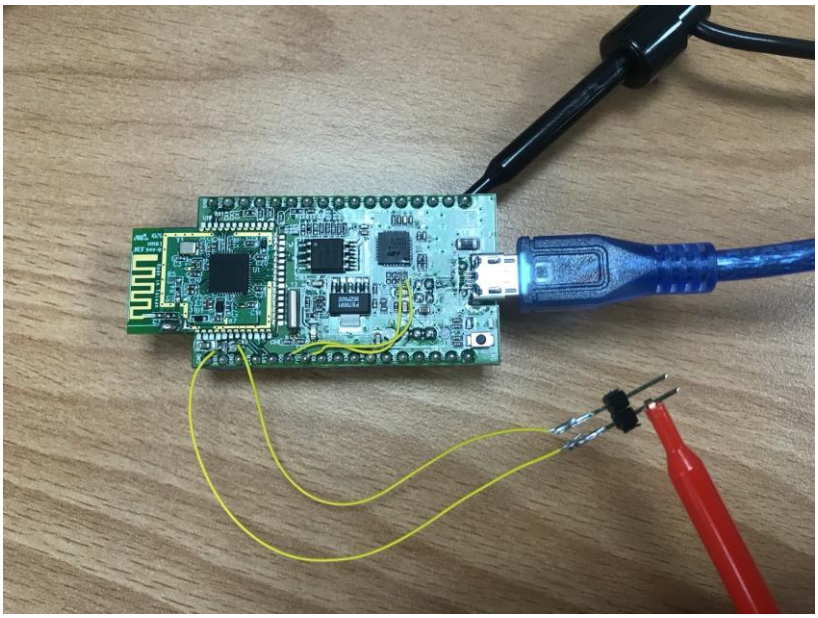
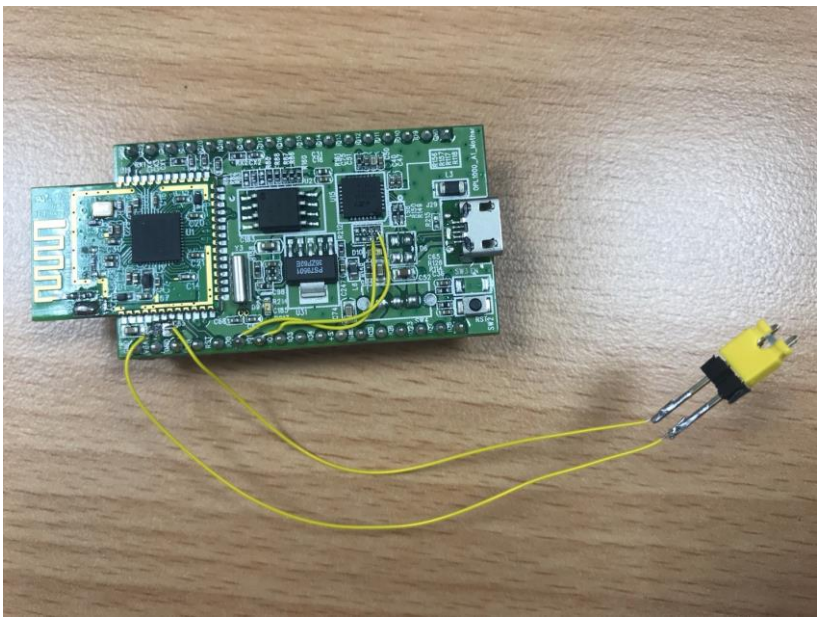


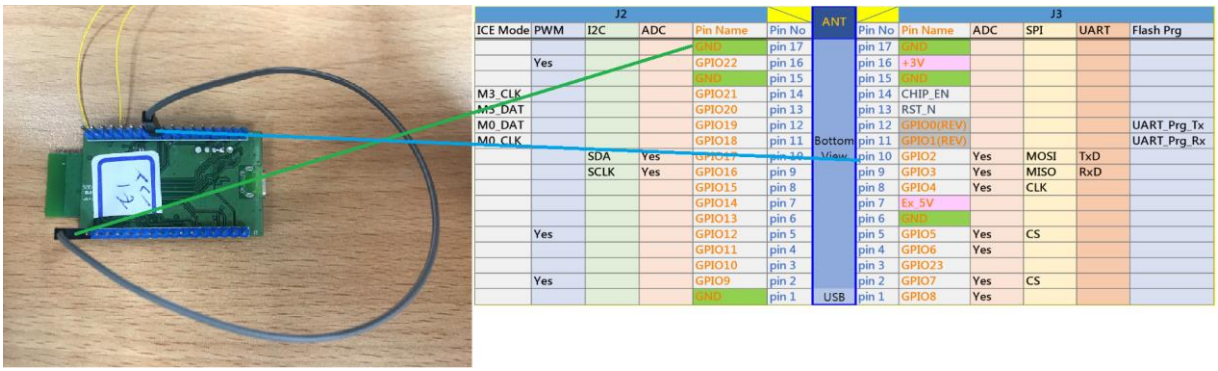
Figure 6: DevKit Simple Switch (II)



3. DEEP SLEEP MODE MEASUREMENT

During deep sleep, Deep sleep mode can be activated by the external GPIO to wake up the DevKit in sleep mode. Users can connect signal lines at the beginning, as shown in Figure 7, by connecting GPIO 2 and GND with one signal line. When users adopt Deep sleep, while wanting to wake up DevKit, as long as the black signal line shown in Figure 7 is removed, DevKit can be woken up and restored to the original operating status.

Figure 7: Deep Sleep Connection Method of Pin Activation



3.1. Using AT command to Activate Deep Sleep

If it merely needs to activate Deep Sleep, input "at+sleep=3" in AT command, as "3" is "Deep Sleep Mode", so it will enter Deep Sleep, as shown in Figure 8. When the "OK" prompt is seen, the measurement of electric current power consumption will be started. The table of electric current power consumption is as shown in Figure 9.

Figure 8: Deep Sleep Command

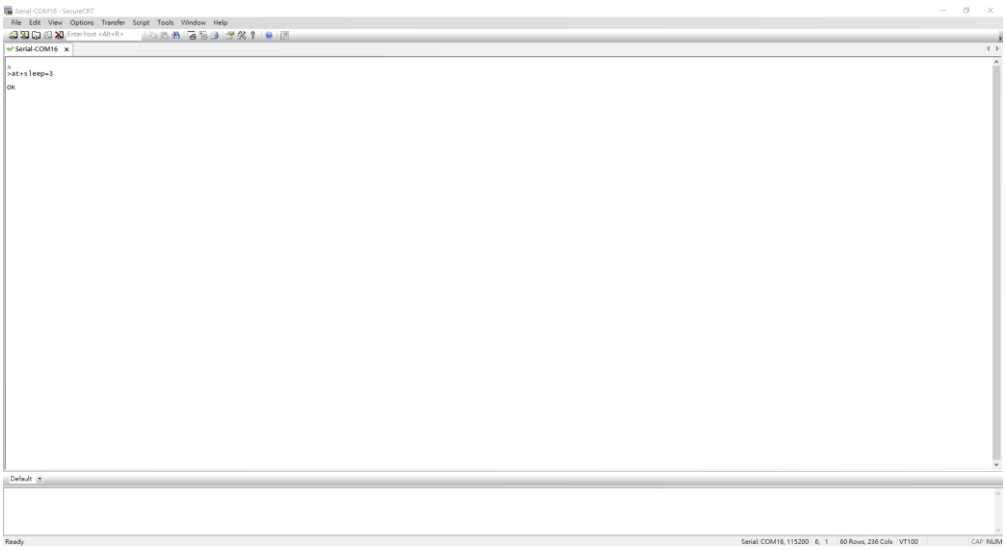
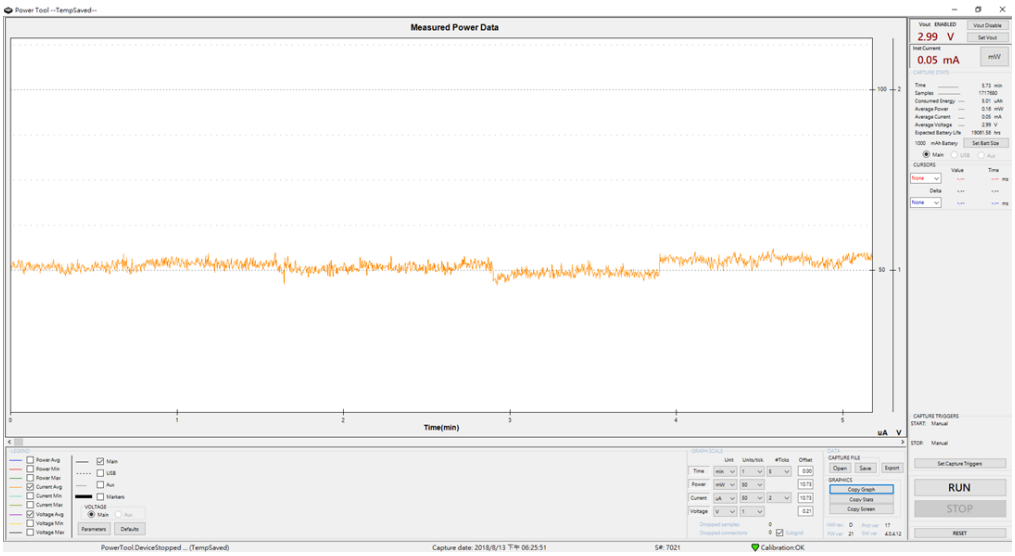


Figure 9: Deep Sleep Power Consumption Measurement (Illustration)



3.2. Using AT command to Activate Deep Sleep + Wake-Up

If user would like to activate Deep Sleep, with external GPIO activated to wake up DevKit, "at+sleep=3,2" can be input on AT Command, as the "3" entered being Deep Sleep Mode, and "2" represents GPIO2 to activate and wake up DevKit, as shown in Figure 10. Then after having entered into Deep Sleep, as shown in the Green Circle shown in Figure 10, as user removes the signal line orange circle will appear, as shown in Figure 10.

Regarding power consumption of electric current, it can be referred to Figure 11. The electric current consumed by DevKit will be at the level of the most energy-efficient average electric current, and when signal line is removed, DevKit will be woken up, and the electric current will be restored to the original working electric current of DevKit.

Figure 10: Deep sleep Activation Command

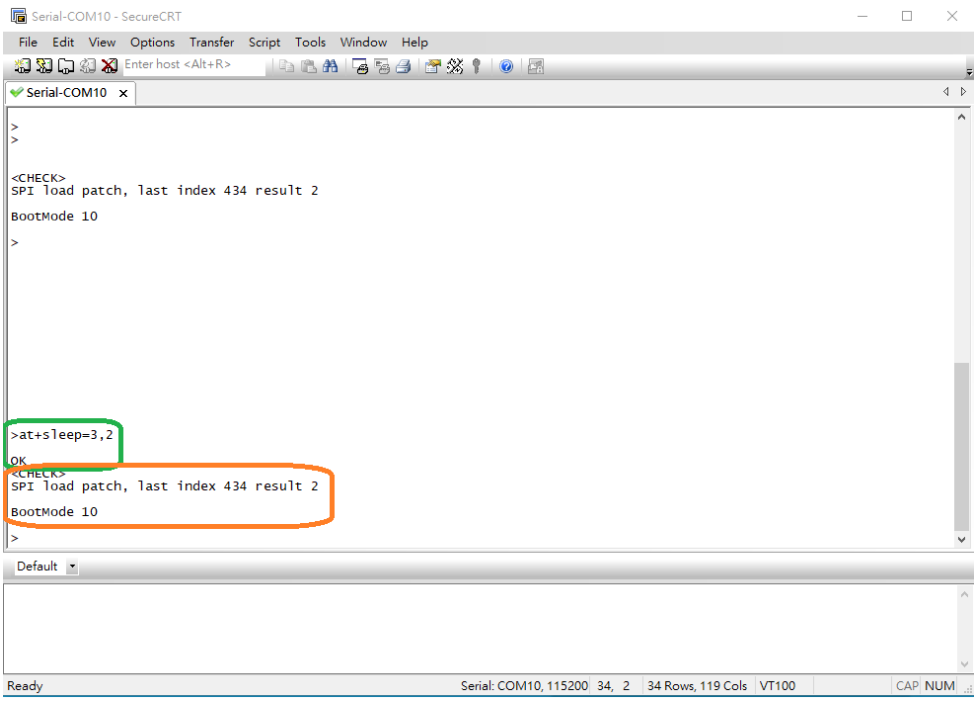
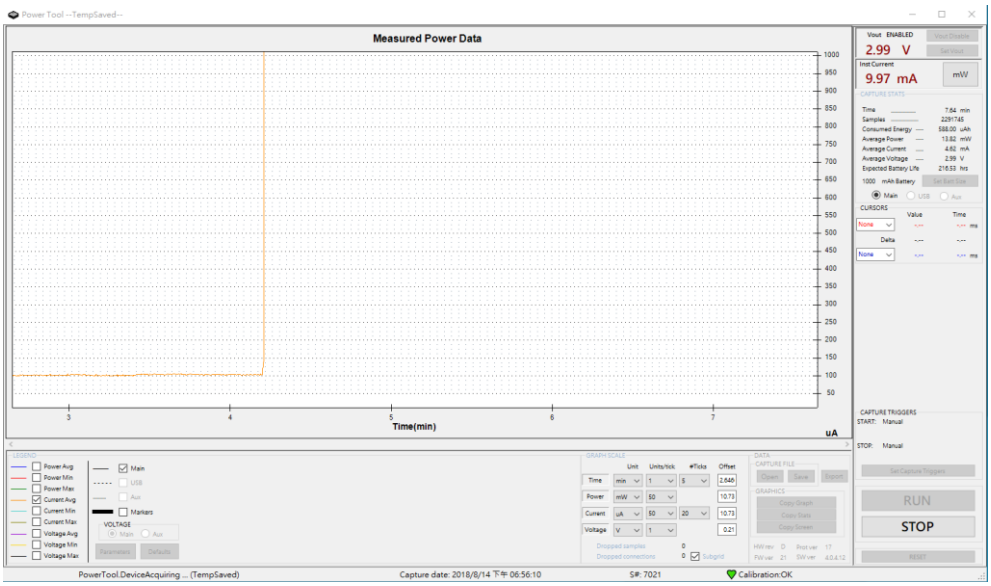


Figure 11: Deep Sleep Activation of Command of Power Measurement (Illustration)



4. SMART SLEEP MODE MEASUREMENT

4.1. WIFI DTIM Sleep Mode

When users wish to activate Smart Sleep, "at+sleep=1" can be input on AT command, as the "1" entered being Smart Sleep Mode, as shown in Figure 12. Under Smart-Sleep Mode, OPL1000 WIFI system will automatically be adjusted twice the reception length of duration of DTIM Beacon interval, so as to switch off or on Wi-Fi module circuit, while achieving energy-saving result.

In terms of electric current power consumption, DevKit will enter into power-saving mode during WiFi connection or scanning. The wave form illustrated in Figure 13 proves that the system is capable of switching off and on WiFi module circuit, and the minimum current value consumed.

Figure 12: Smart Sleep Activation Command

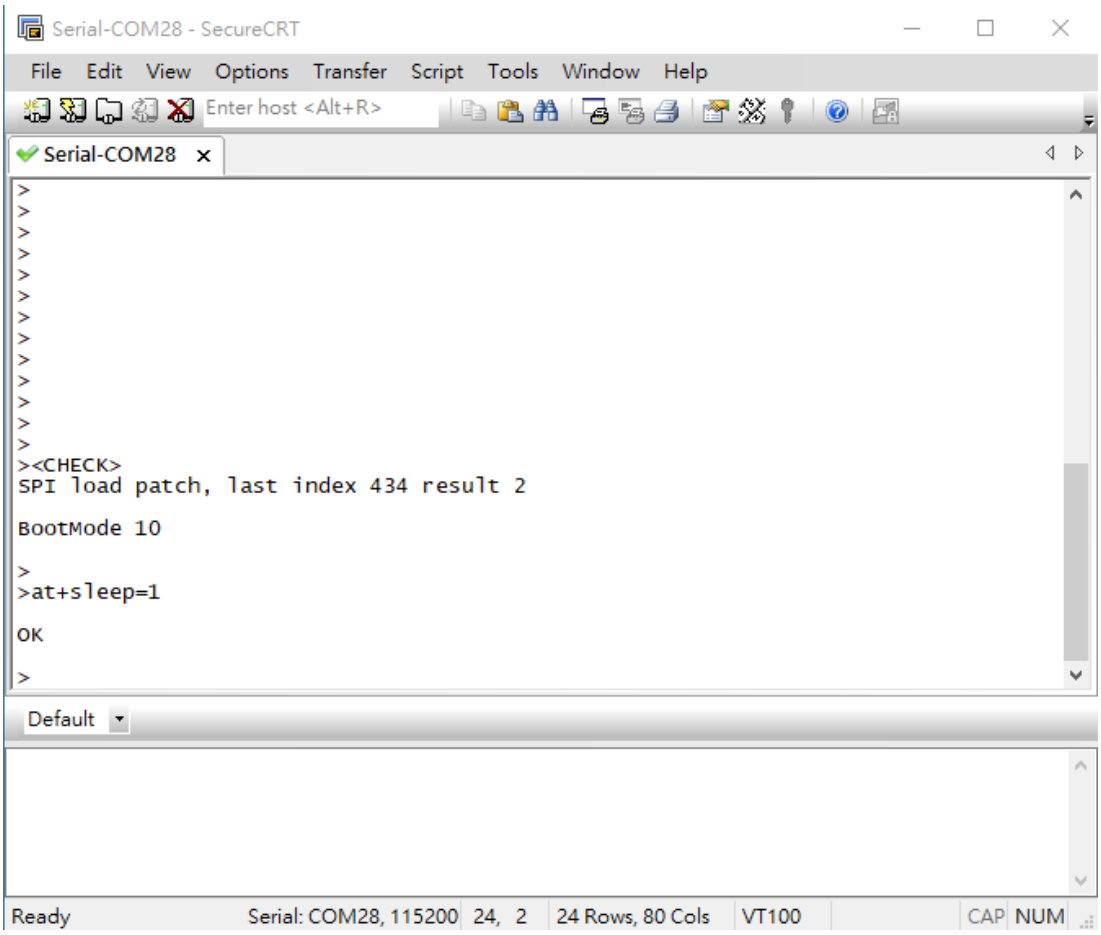
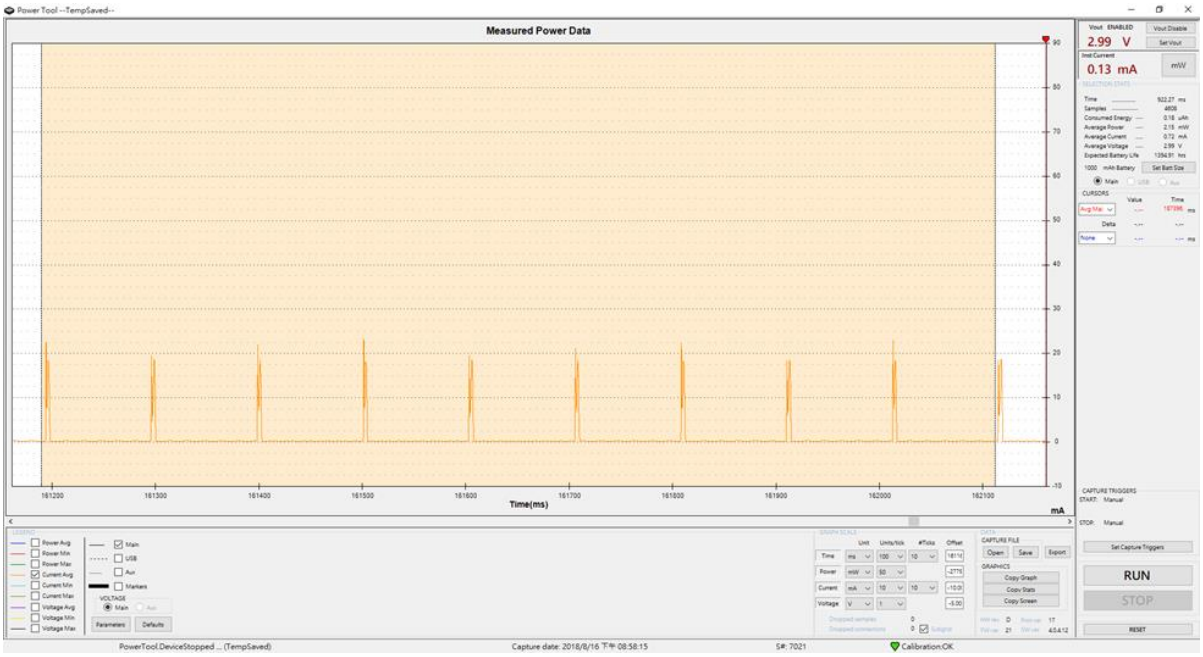


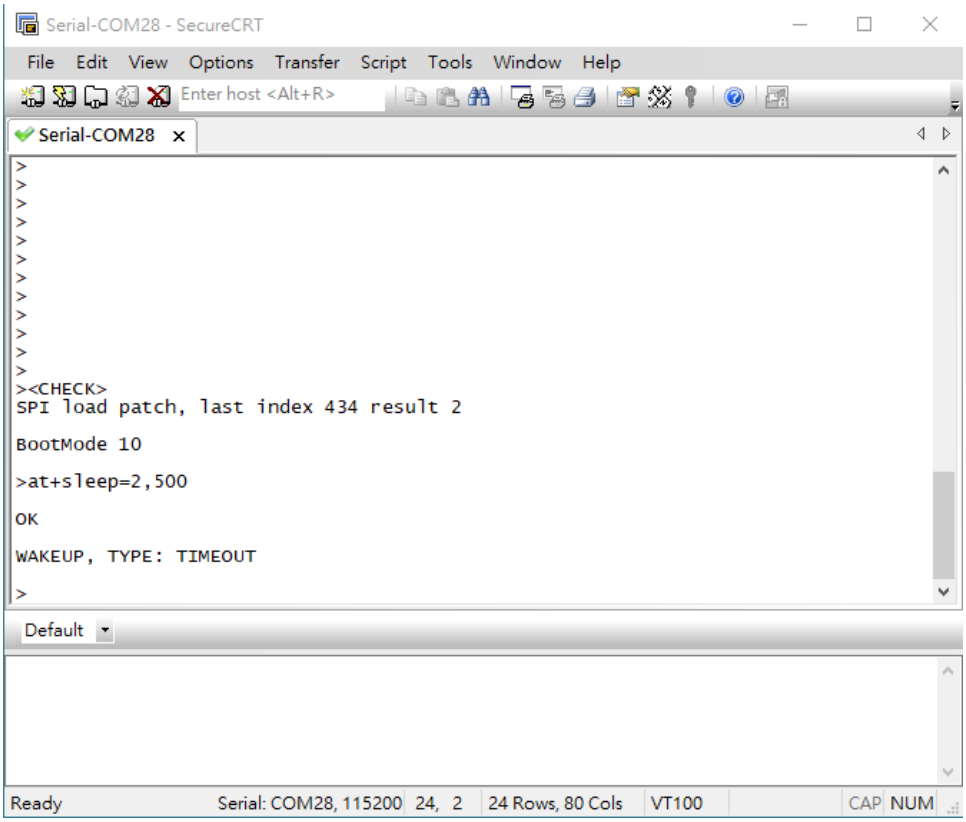
Figure 13: Smart Sleep Activation of Command of Power Measurement (Illustration)



5. TIMER SLEEP MODE MEASUREMENT

When users wish to activate Timer Sleep, which can be referred to Figure 14, "at+sleep=2,500" represents Timer Sleep Mode, as the "500" represents "Enter Sleep Mode first, and then be woken up after 500ms, before entering DevKit working mode. Under such mode, the Chip will disconnect all Wi-Fi connections and data-links, before entering into Sleep Mode, and only the system clock module remains operational so as to facilitate the timed wake-up of the Chip.

Figure 14: Timer Sleep Activation Command (Illustration)



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