OPL1000

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

DEVKIT Getting Start Guide

OPULINKS

REVISION HISTORY

Date	Version	Contents Updated
2018-05-10	0.1	• Initial Release
2018-05-17	0.2	• Update section 3.1.2, 3,2,2 because download tool use method has been updated. • Add Figure10 to introduce how to verify AT UART is working • Update Figure 12 content • Add section 3.4 to introduce how to enable APS UART log info output • Split section 3.3 to 3.3.1 and 3.3.2. • Add section 3.3.2 to introduce J-link emulator selection
2018-05-31	0.3	• Mini-USB port will be acted as APS UART port when downloaded user APP after using v1.0.1.19 SDK
2018-06-05	0.4	• Add a new section 3.1 • Update section 3.2.2.
2018-07-13	0.5	• Update section 3.2
2018-08-03	0.6	• Update section 2 and section 3.5 for A1 chip
2018-08-15	0.7	• Update section2, figure2; • Update section3.2 and section 3.3
2018-11-09	0.8	• Update section3.4.1 and section3.4.2 to enable ICE interface
2018-11-20	0.9	• Update section3.4.1 to disable watchdog

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1. INTRODUCTION

1.1 Scope of Document Applications

As OPL10000 DEVKIT is used for evaluating the performance of OPL1000 chip, developing application procedure, this document outlines the composition of DEVKIT, and how to utilize the protocol provided by DEVKIT to execute firmware download and application procedure testing/debug.

1.2 Abbreviations

Abbr.	Explanation
APP	APPlication Procedure
APS	Application Sub-system which also refers to M3 MCU in this chapter
AT	Attention Terminal Command Index
DevKit	Development Kit for OPL1000 Development Evaluation Board OPL1000
EVB	Evaluation Board
FW	FirmWare, embedded Software operating on CPU
ICE	In-Circuit Emulator Debug Tool
RX	Receive
SWD	Serial Wire Debug
TX	Transmit

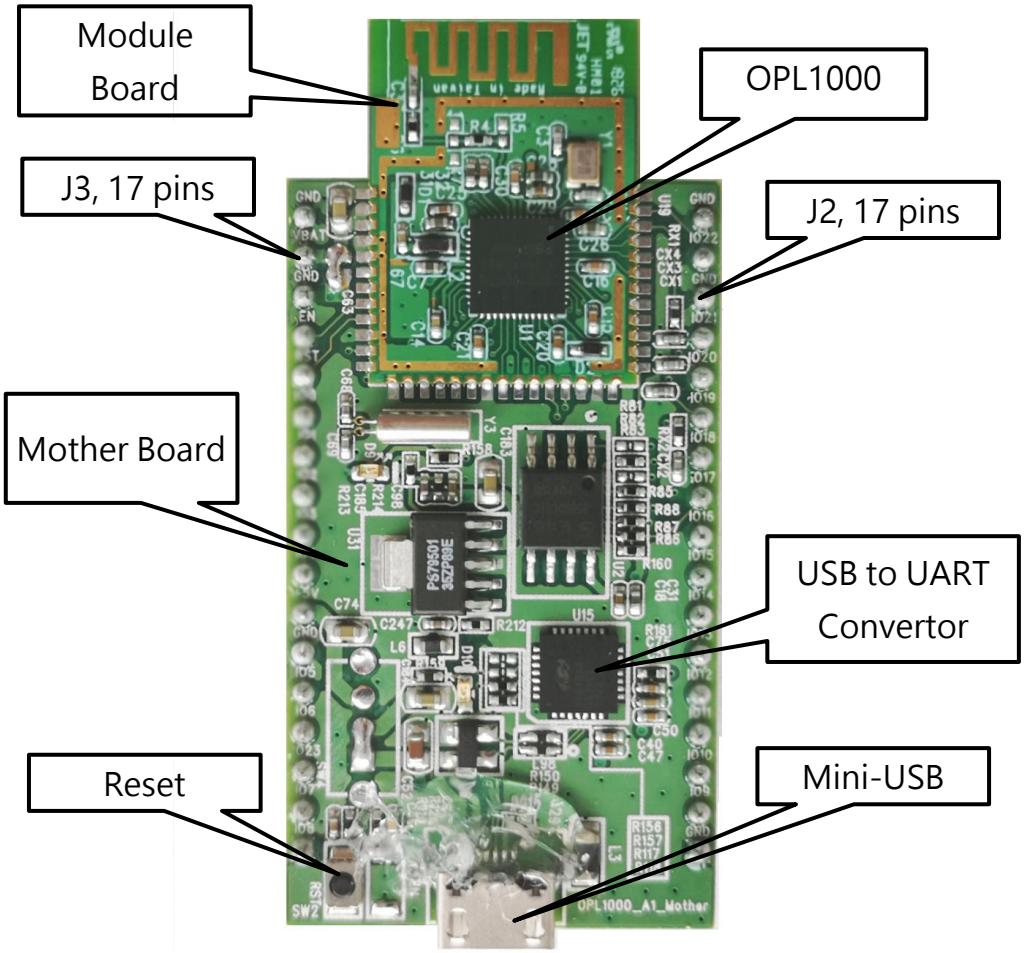
1.3 References

[1] OPL1000-patch-download-tool-user-guide.pdf

2 DEVKIT SUMMARY INTRODUCTION

DEVKIT Board comprises of a development motherboard and OPL1000 module daughterboard. The motherboard comprises of USB to UART conversion chip, Flash chip and power-switch module. OPL1000 module daughterboard comprises of OPL1000 SOC chip and external oscillator, as shown in Figure 1:

Figure 1: Introduction of DEVKIT Board Composition



Opulinks DEVKIT offers mini-USB switch port function, which also offers power-supply function. Users can easily control OPL1000, carry out functional evaluation quickly, through USB usage, before completing product development. DEVKIT motherboard provides certain expansion GPIO pin, ICE mode pin for in-circuit development, as well as UART Tx ad Rx pin. The default setup for OPL1000 is Normal function mode, which can be quickly switched to ICE mode, and in addition, it also provides flash burn-software. Expanded GPIO pin can be embodied with GPIO, ADC, SPI and I2C functions, etc. Expanded pin headers J2 and J3 layout (bottom view), as shown in Figure 2.

Figure 2: Expansion of IO Map

J2						ANT		J3				
ICE Mode	PWM	I2C	ADC	Pin Name	Pin No		Pin No	Pin Name	ADC	SPI	UART	Flash Prg
				GND	pin 17		pin 17	GND				
	Yes			GPIO22	pin 16		pin 16	+3V				
				GND	pin 15		pin 15	GND				
M3_CLK				GPIO21	pin 14		pin 14	CHIP_EN				
M3_DAT				GPIO20	pin 13		pin 13	RST_N				
M0_DAT				GPIO19	pin 12		pin 12	GPIO0(REV)				UART_Prg_Tx
M0_CLK				GPIO18	pin 11	Bottom	pin 11	GPIO1(REV)				UART_Prg_Rx
		SDA	Yes	GPIO17	pin 10	View	pin 10	GPIO2	Yes	MOSI	TxD	
		SCLK	Yes	GPIO16	pin 9		pin 9	GPIO3	Yes	MISO	RxD	
				GPIO15	pin 8		pin 8	GPIO4	Yes	CLK		
				GPIO14	pin 7		pin 7	Ex_5V				
				GPIO13	pin 6		pin 6	GND				
	Yes			GPIO12	pin 5		pin 5	GPIO5	Yes	CS		
				GPIO11	pin 4		pin 4	GPIO6	Yes			
				GPIO10	pin 3		pin 3	GPIO23				
	Yes			GPIO9	pin 2		pin 2	GPIO7	Yes	CS		
				GND	pin 1	USB	pin 1	GPIO8	Yes			

Note 1: UAART_Prg Serial-Port Baud Rate of 115200 bps

Note 2: chip Enable (CHIP_EN) and Reset (RST_N) can all be regarded as Reset functions

3 DEVKIT USAGE

OPL1000 DEVKIT Board offers 3 communications ports for user procedure development, which are:

1. AT Serial-Port, the one connecting with mini-USB, is used for firmware upgrade and delivering AT commands to OPL1000. Currently, the USB XXXXX chip adopted by DEVKIT board is Silicon Labs CP210x chip, and users can find out the designated number of the serial-port connected to mini-USB by looking through device manager of "COM and LPT port". For instance, as seen from the equipment port check-list table shown below, the designated number for OPL1000 DEVKIT AT serial-port is COM13.

2. APS serial-port. This serial-port is used for internal debug information, and offline debug application procedure.

3. Cortex M3 SWD Debug interface.

3.1 Installation of USB Drivers

OPL1000 DEVKIT adopts Silicon Labs CP210x USB to UART switching chip. In order for Mini-USB to function properly, driver software correlating to the operating system used by users shall be installed. The folder containing the driver software is "Tool\CP210x_Windows_Drivers".

3.1.1 Installation of Win10/Win 7 System Drivers

Procedure path of system driver for Win10/Win7 of CP210x bridging chip

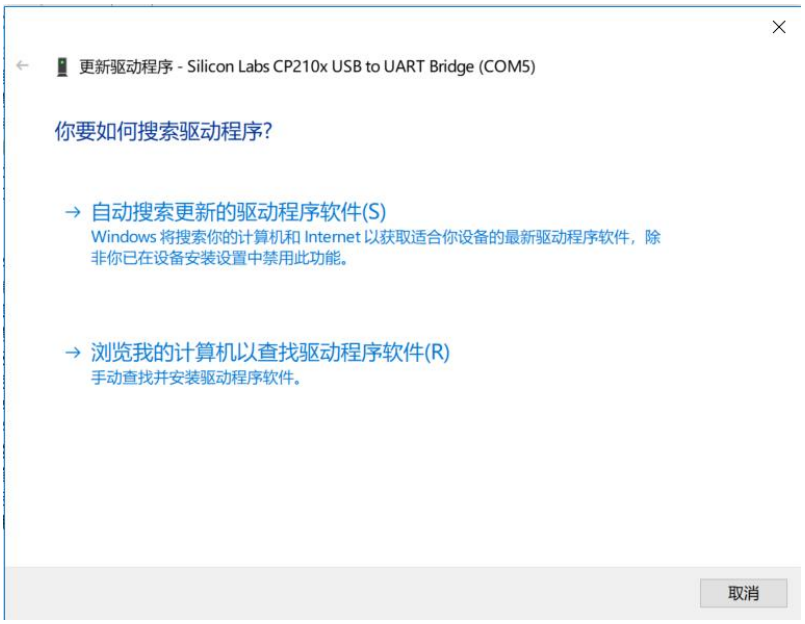
Tool\CP210x_Windows_Drivers\Win7_Win10_x64

Win10 Operating System would automatically install the driver for CP210x bridging chip, however, as this driver is in conflict with the serial-port module base used by download tool,

version downgrade needs to be carried out, i.e. by using the driver procedure in the folder of "Win7_Win10_x64", and the procedure is as follows:

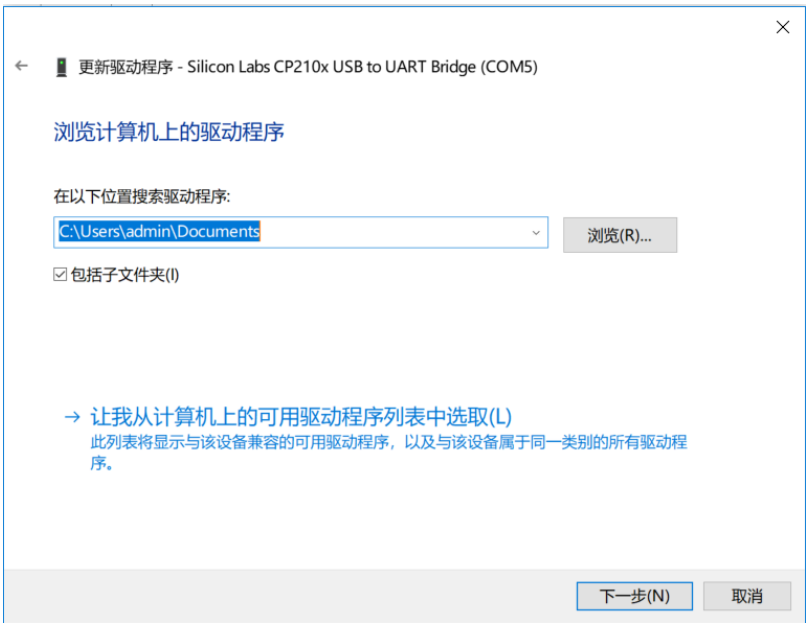
Step 1: First by powering on device manager, select serial-port of the equipment "Silicon Labs CP210x USB to UART Bridge", and "

Figure 3: Win10/Win7 Installation Driver – Search for Driver Procedure



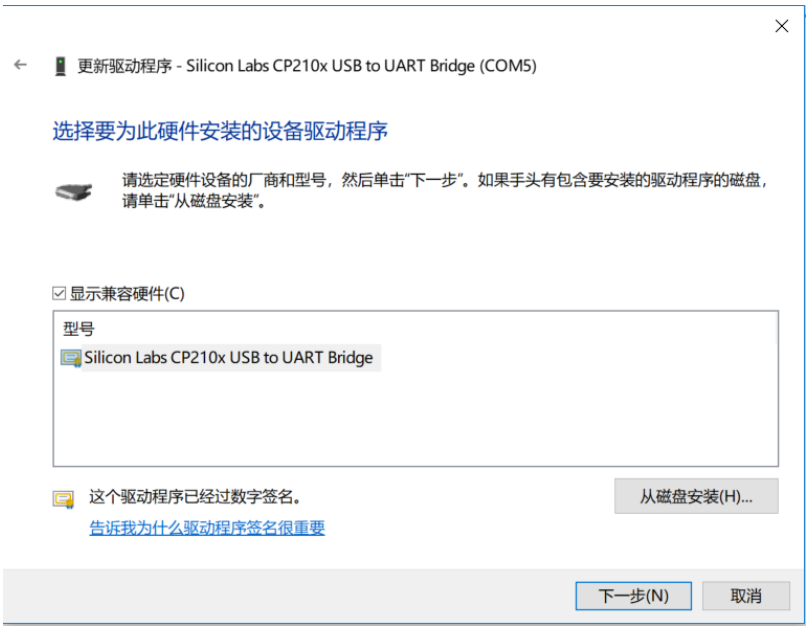
Step 2: Click "Let me choose from the list of available driver procedures of PC", as shown in the diagram below

Figure 4: Win10/Win7 Installation Driver – Selection from List of Driver Procedure



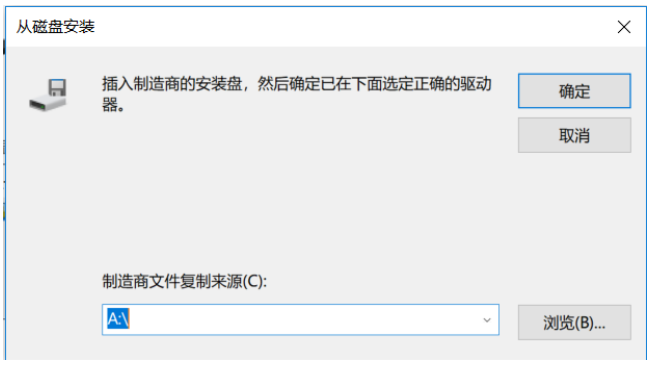
Step 3: As CP210x bridging chip has registered in the system, therefore there is "Silicon Labs CP210x USB to UART Bridge" outlined in the "Display Compatible Hardware" table. Click "Install from hard-disk".

Figure 5: Win10/Win7 Installation Driver – Update Installation Procedure for CP210x



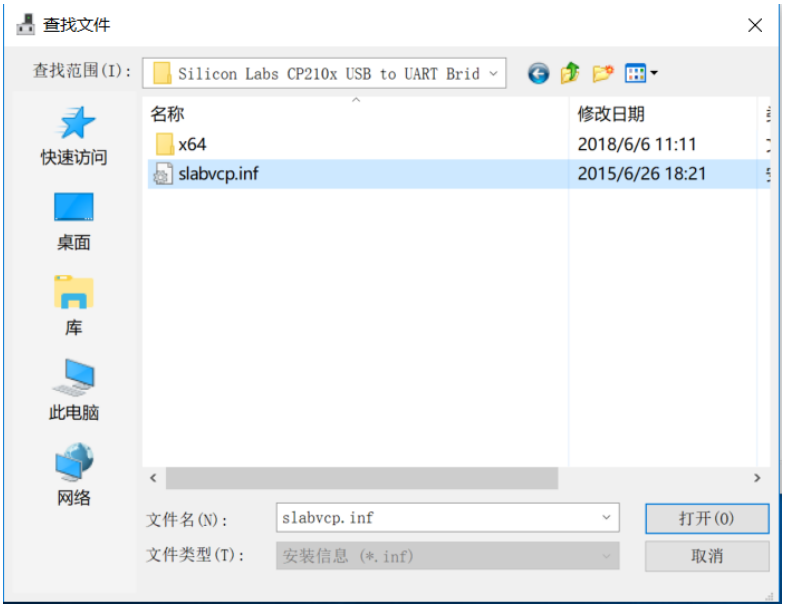
Step 4: Click “Browse” in the prompt window to select “Tool\CP210x_Windows_Drivers\Win7_Win10_x64”folder

Figure 6: Win10/Win7 Installation Driver – Designation of Installation Destination Folder



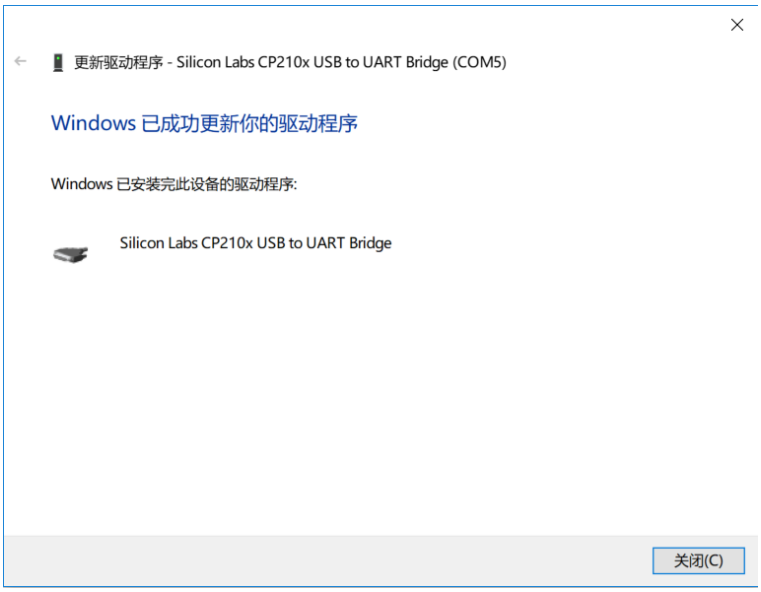
Step 5: Select the slabvcp.inf in the “Tool\CP210x_Windows_Drivers\Win7_Win10_x64” folder, and click “Open”. The “slabvcp.inf” document includes the device information and driver configuration information of CP210x chip.

Figure 7: Win10/Win7 Installation Driver – Select USB inf document



Step 6: Click "Yes" button, "Next" button. Click "Close" button, before completion of installation. When the diagram shown in Figure 8 is displayed, it means that driver update is completed.

Figure 8: Win10/Win7 Installation Driver – Completion of Driver Update



Step 7: Check driver version information to see whether it is 6.7.10. Right-click the serial-port device "Silicon Labs CP210x USB to UART Bridge", before selecting "Driver Procedure" tag page in attribution. If the version indicates 6.7.1.0, it means the driver has been correctly installed.

Figure 9: Win10/Win7 Installation Driver – Check Driver Version information

3.1.2 Installation of WinXP/Vista System Drivers

The procedure path of the system driver of WinXP/Vista system on CP210x bridging chip is, "Tool\CP210x_Windows_Drivers\WinXP_Vista". The overall installation includes three steps:

Step 1: Execute the "CP210xVCPInstaller_x86.exe" command under the WinXP_Vista folder

Step 2: Click "Next" in the prompt window as shown on Figure 10. To get the displayed picture shown on Figure 11. Then select "I accept this protocol", and then "Next".

Figure 10: WinXP/Vista Installation Driver – Execute Driver Installation Procedure

Figure 11: WinXP/Vista Installation Driver – Acceptance of Protocol

Step 3: When installation is completed, click “Done”.

Lastly, check driver version information. Right-click the serial-port device “Silicon Labs CP210x USB to UART Bridge”, before selecting “Driver Procedure” tag page in attribution. If the version indicates 6.7.0.0, it means the version installed is correct.

Figure 12: WinXP/Vista Installation Driver –Information to Check Driver Version

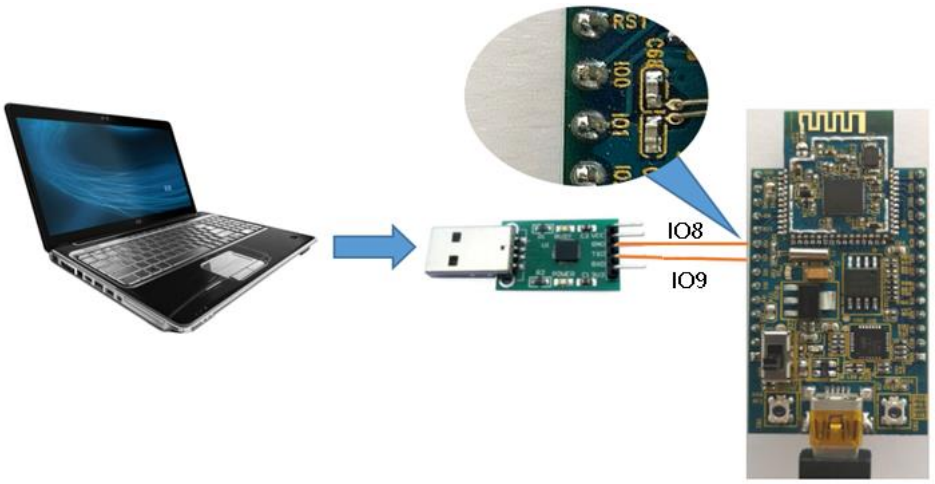
3.2 APS Serial-Port Connection and APS Usage

Both sides of DEVKIT provides two rows of expanded interfaces, which include APS (Debug_prg) serial-port, and realize communications function with M3MCU serial-port. APS serial-port can output printing function of firmware log.

3.2.1 APS Serial-Port Connection

APS serial-port connection utilizes two pins, IO8 and IO9. IO8 is the TX signal output line connected to the RX signal input line of UART switch board. IO9 is the RX signal line of APS serial-port connected to TX signal line of UART switch board. The wiring is shown in the diagram below.

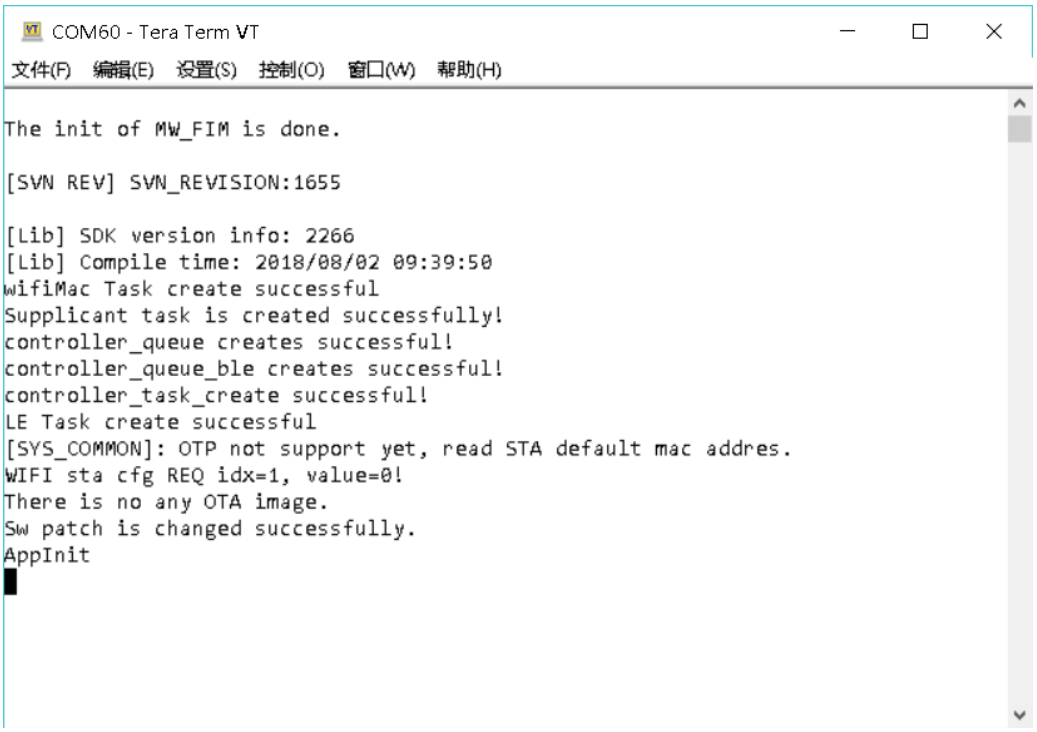
Figure 13: Examples of Wiring for Serial-Port



3.2.2 Print-Out Information of Observation of Firmware Testing through APS

Use Tera Term to connect to Debug_Prg serial-port (in this instance, it is COM60), with Baud Rate set at 115200. As DEVKIT board is reset, printed firmware information can be obtained in the information output window, as shown in Figure 14.

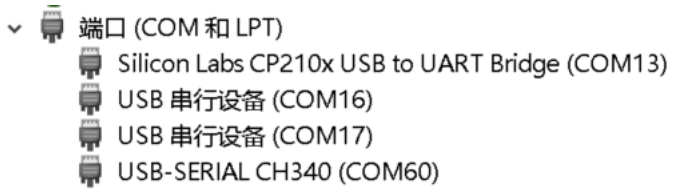
Figure 14: Printed Information of APS Serial-Port Output



3.3 AT Serial-Port Connection and Usage

Mini USB on DEVKIT board offers power-supply function, firmware download and AT command communications functions. As AT serial-port adopts CP201X chip for USB switch serial-port control, once correctly installing the chip driver, then make connection with DEVKIT board. In PC device manager CP210X serial-port device can be detected. In the instance shown in the diagram below, COM 13 is the AT serial-port, and the other CH340 serial-port device, COM 60, is connected to APS serial-port.

Figure 15: DEVKIT AT Serial-Port Equipment



3.3.1 Firmware Update through AT Serial-Port

There are 4 steps from compiling to the download of firmware to DEVKIT, and here is an instance of the task of compiling download of hello_world,

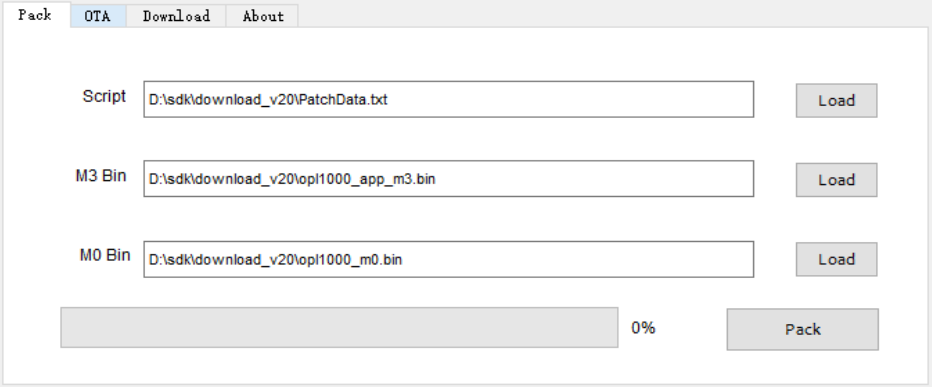
1. By using "keil uVision"(recommended version of no lower than 5.23) software compiling SDK in the demonstration task of hello_world.

   Folder: **SDK\APS_PATCH\examples\get_started\hello_world**

   After compiling is finished, the compiled file, "**opl1000_app_m3.bin",** can be located in the engineering folder of **Output/Objects**

2. The compiled file, "opl1000_app_m3.bin", can be archived under the folder of "FW_Binary". Under the "FW_Binary" folder, there would be the firmware-merged script files of "PathData.txt". In the Pack tabbed page, click the "Load" button on the right-hand-side of the "Script,M3 Bin, M0 Bin text window" to load firmware-merged script files, M3 bin and M0 bin files respectively. After click the "Pack" button, Pack command will merge several independent bin documents into a downloadable "opl1000.bin" file to be archived in the Patch sub-folder under the same folder as "Download Tool".

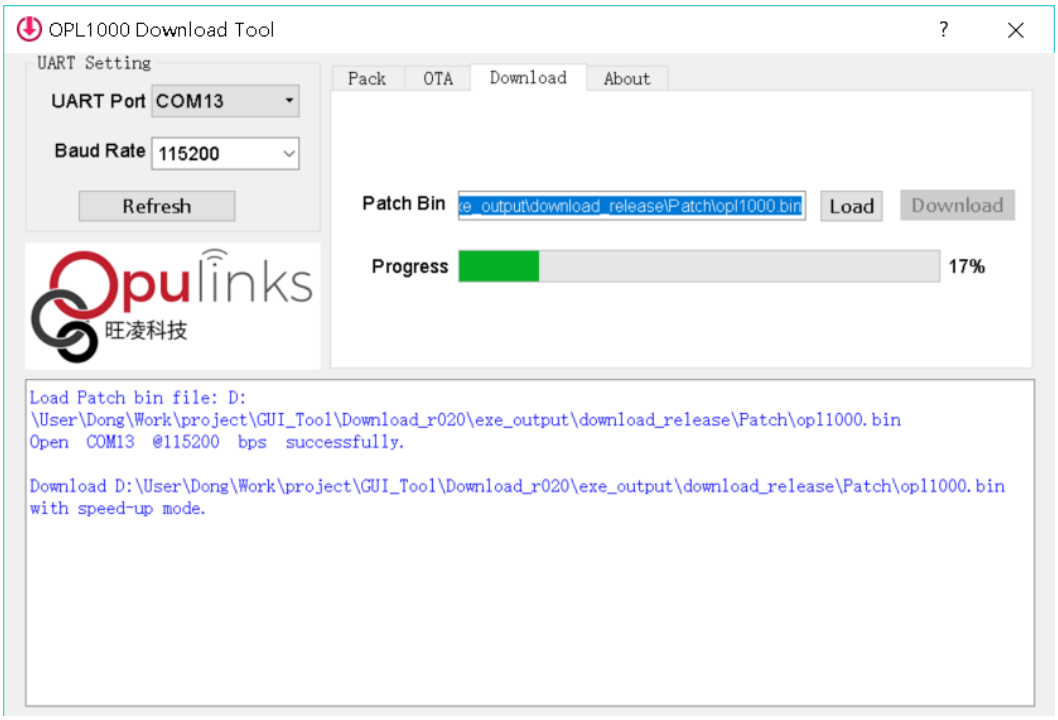
Figure 16: Load M3/M0 Bin Document for Combined Operation



3. Select AT serial-port number designated, with Baud Rate of 115200bps. When switching to "Download" option, the path of Patch Bin would have become a designated opl1000.bin file, before clicking the "Download" button, and reset DEVKIT board within 5 seconds. When download tool automatically detect the reset DEVKIT board, opl1000.bin would start to be downloaded. As the progress bar indicates 100%, it means the download of opl1000.bin has been successful.

OTA firmware download procedure is the same as what is described above, except for during the download of firmware file, onl1000_ota.bin needs to be selected (OTA image document)

Figure 17: Download of Patch Bin Document



4. After the download is completed, DEVKIT board would be automatically reset, as Flash firmware would be loaded to RAM for execution. Select APS serial-port in "UART Port", with Baud Rate of 115200, in order to reset DEVKIT board again, and when the diagram shown below is seen in the serial-port debug tool, it means the firmware downloaded is correct.

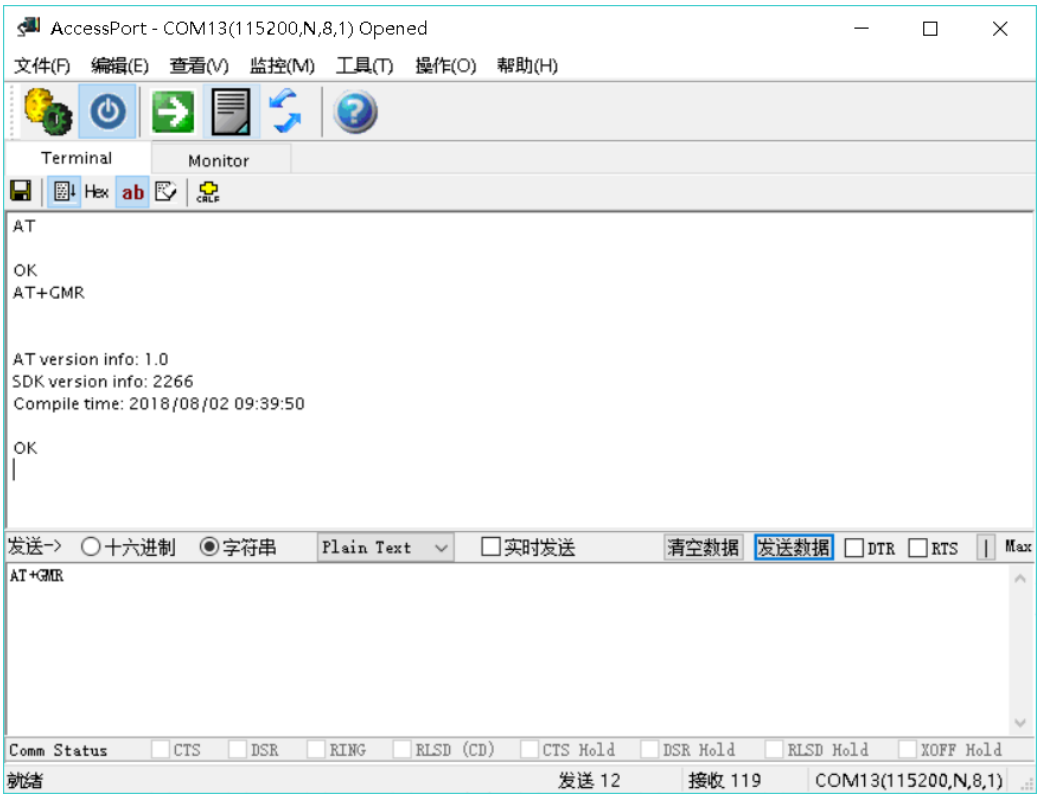
Figure 18: Output of Log Information from APS Serial Port after Activation/Power-On

```
BootMode 10 go to normal path

The init of MW_FIM is done.

[Lib] SDK version info: 1516
[Lib] Compile time: 2018/05/10 17:49:03

[SVN REV] SVN_REVISION:809
wifiMac Task create successful
Supplicant task is created successfully!
controller_queue creates successful!
controller_queue_ble creates successful!
controller_task_create successful!
LE Task create successful
Sw patch is changed successfully.
Hello world 1
Hello world 2
Hello world 3
Hello world 4
Hello world 5
```

3.3.2 Execute AT Command by using AT Serial-Port

Use mini-USB to connect with DEVKIT board and PC, with serial-port tool ON, select AT serial-port number, with Baud Rate of 115200. Under normal circumstances, when hitting ENTER, instruction prompt, "<", appears, before entering "at", and receiving an "OK" return, which means AT functioning normally.

Figure 19: Execute AT Command



3.4 SWD Port

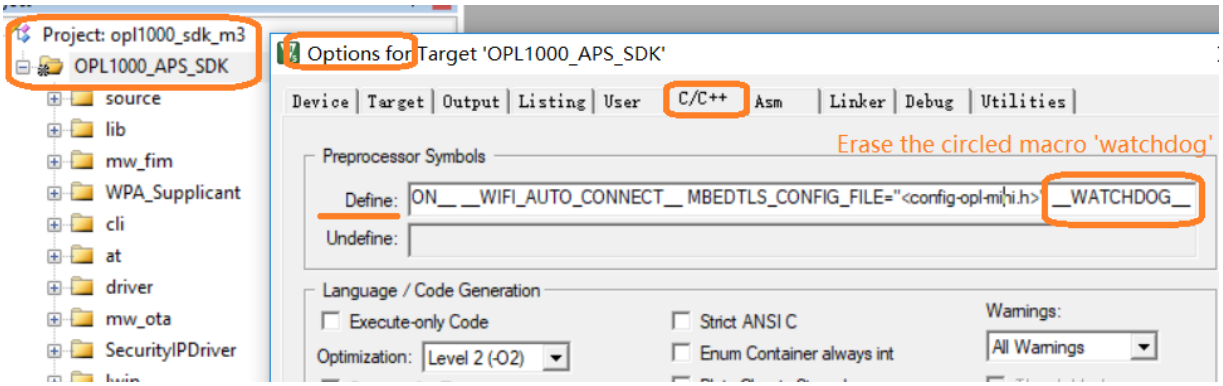
If application procedure needs to be debugged online, ICE emulator is then required, as DEVKIT supports M0 and M3 4-line SWD debug. As user APP is executed on M3, therefore M3 ICE port is needed. Subsequent chapters would go through how to shutdown watchdog and connection method for M3 ICE port.

3.4.1 Disable watchdog （Setting GPIO20 & GPIO21)

As default setting, watchdog function is activated in OPL1000. However, users can disable watchdog function as they see fit, so as to avoid being reset during debugging, while facilitating J-Link Emulator in online debug, with procedure as follows:

1. Use “keil uVision” software (recommended version not lower than 5.23) to open opl1000_sdk_m3 work documents in folder “A1\SDK\APS\project\opl1000\”, then click on “option”of this work, before clicking “C/C++” tag, and delete “__WATCHDOG__”macro-definition, and then rebuild this work.

Figure 20:Disable Watchdog



2.Use “keil” to open “hello_world” work folder (SDK\APS_PATCH\examples\get_started\hello_world) to rebuild it. Then refer to the method outlined in Chapter 3.3.1 to merge “opl1000_app_m3.bin” and “m0 bin” documents, generated by downloaded tool, into “opl1000.bin” document, before burning it onto A1 board.

After the completion of burning data, and re-start of A1 board, “watchdog” would be disabled.

Note: Before rebuild this work, please confirm the following two points:

（1）Configure IO20 and IO21 from “hal_pin_config_project.h” document in the following format:

```
#define HAL_PIN_TYPE_IO_20  PIN_TYPE_ICE_M3_DAT        // PIN_TYPE_NONE
#define HAL_PIN_TYPE_IO_21  PIN_TYPE_ICE_M3_CLK        // PIN_TYPE_NONE
```

（2）The code for reset M0 MCU has been added to the "**opl1000_app_m3.ini"** document in this work folder, "_WDWORD(0x40001108, 0x00000800); // reset m0 MCU"

3.4.2 M3 ICE Port Connection

Connection for M3 ICE port is shown in the diagram below. Wiring configuration is shown in Table 1.

Figure 21: M3 ICE Signal Wiring Diagram on DEVKIT Board

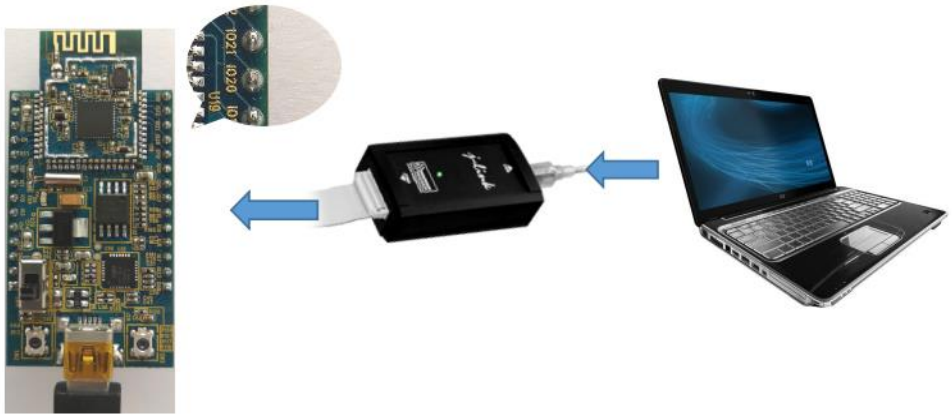


Table 1: Connection of M3 SWD Signals

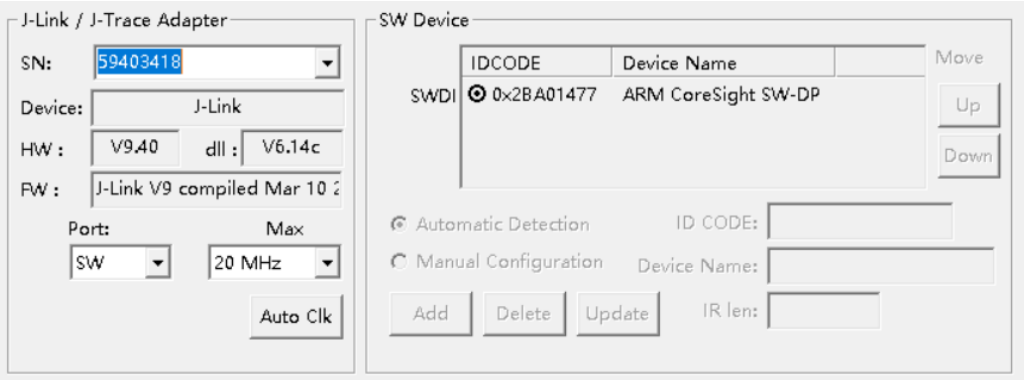
Number	SWD Signal	DEVKIT Board J2 Pin	J-Link Emulator Pin	Note
1	3.3V	--	1	3.3V Power Supply
2	GND	GND	4 - 20	GND
3	SWD_CLK	IO21	9	Clock Signal
4	SWD_DAT	IO20	7	Data signal

Notes: Regarding multi-chip J-Link Emulator, it should be made sure that the designated power-supply 1 being correctly connected

Figure 22: M3 ICE Wiring Diagram on DEVKIT Board

With J-Link emulator and DEVKIT board is connected, if the serial number of SW Device is detected in the debug interface of keil work, it means that the connection has been made correctly, and SWD development and debug work can be carried out properly, as shown in Figure 23.

Figure 23: Correct Identification of J-link ICE Emulator



3.5 Permission and Prohibition of APS Serial-Port Printed Information

Bin documents published after version v1.0.1.17, would not print out the internal debug messages for the firmware, while only the printed messages of user designate codes are preserved, and if the printing access to the internal debug message of the firmware needs to be shared, instruction of "> **tracer level 255 0x07'** should be issued at APS serial-port.

> **tracer level 255 0x07**

If the output access to the internal debug message of the firmware needs to be disabled, instruction of "> **tracer level 255 0x00**" should be issued at APS serial-port.

> **tracer level 255 0x00**

If the output access to the internal debug message of the firmware needs to be disabled, instruction of "> **tracer level 255 0x00**" should be issued at APS serial-port.

As internal debug message of the firmware is instrumental for users to observe the internal operation status of the firmware, if there is need to find and debug internal issues of firmware, then we recommend sharing print-out of internal debug message of the firmware. If the printed internal debug message of the firmware is not to interfere with log printed messages of user's APP, then its print-out function can be disabled.

To understand which internal module out have been activated, with their corresponding internal module names and serial numbers, instruction of "> **tracer**" should be issued at APS serial-port.

> **tracer**

To understand which internal module out have been activated, with their corresponding internal module names and serial numbers, instruction of "> **tracer**" should be issued at APS serial-port.

```
Index                 Name: Level
---------------------------------- Internal Tasks (Start from Index 0)
[ 0]              opl_isr_: 0x00
[ 1]              opl_diag: 0x00
[ 2]          opl_wifi_mac: 0x07
[ 3]        opl_supplicant: 0x00
[ 4]        opl_controller: 0x07
[ 5]                opl_le: 0x00
[ 6]        opl_event_loop: 0x07
[ 7]             opl_tcpip: 0x00
[ 8]              opl_ping: 0x00
[ 9]             opl_iperf: 0x00
[10]             opl_agent: 0x00
[11]       opl_at_wifi_app: 0x00
[12]                opl_at: 0x00
[13]        opl_at_tx_data: 0x00
[14]          opl_at_sock_: 0x00
[15]       opl_at_sockserv: 0x00
---------------------------------- App Tasks (Start from Index 32)
```

"Level = 0x00" indicates that log signal output has been disabled; "Level = 0x07" indicates that log signal output has been activated.

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