# Programming the Blue Pill Board & Debugging in Keil Using ST-Link

Step-by-step tutorial



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### Creating a project in Keil

- 1. Open the Keil IDE by clicking on its icon on the desktop.
- 2. Choose *New uVision Project* from the *Project* menu.

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File Edit View	roject Flash Debug Peripherals Tools SVCS	Window Help
📄 💕 🔛 🥥	New µVision Project	: 🚎 //= //👷 🖄 EINTO_I
	New Multi-Project Workspace	
Project	Open Project	
Figer	Close Project	
	Export	•
	Manage	•
	Select Device for Target	
	Remove Item	
	🕅 Options Alt+F	7
Е Р. 🌍 В. {} F. [	Clean target	
Build Output	Build target F	7
	Rebuild all target files	
	Batch Build	
	Translate Ctrl+F	7
▲	Stop build	Þ

3. Create a new folder and Name it *OurFirstProject*. Type the name *ourFirstProject* for the project name and click *Save*.

Organize 🔻 New folder	1= • (
Favorites     Ame     Name     Desktop     Downloads	Date modified Type
<ul> <li>Becent Places</li> <li>MazidiBooks</li> <li>Music</li> <li>Job</li> <li>DATASHEETS</li> </ul>	
H Videos	
File <u>n</u> ame: ourFirstProject Save as <u>t</u> ype: Project Files (*.uvproj)	

4. In the tree expand *STMicroelectronics*. (If STMicroelectronics is not in the tree, read "installing Keil and STM32F103" step-by-step tutorial from our website.) Click on *STM32F103* and choose *STM32F103C8*. Then press *OK*.

Note	
When you choose a chip some general information of the chip is shown in the	
Description box.	

Device			
	Software Packs	<b>•</b>	
Vendor:	STMicroelectronics		
Device:	STM32F103C8		
Toolset:	ARM		
Search:			
	1	Description	
-			
🖻 🖗 S	TMicroelectronics	STMicroelectronics' STM32F1 series of mainstream MCUs covers the	^
8	STM32F1 Series	consumer markets. High performance with first-class peripherals and	
1		I low-power, low-voltage operation is paired with a high level of integration at accessible prices with a simple architecture and easy to.	
	🗄 🐝 STM32F101	use tools.	
-	1 TM32F102	Typical applications include motor drives and application control,	Ξ
2	🗄 📽 STM32F103	inverters, printers, and scanners, alarm systems, video intercom, HVAC	
	STM32F103C4	and home audio equipment.	
1	STM32F103C6	- LCD parallel interface, 8080/6800 modes	
	STMR2EI03CR	- 5 Vtolerant I/Os	
3	STITISTIC LODIER	The second s	
3		Imer with quadrature (incremental) encoder input	*
3		Imer with quadrature (incremental) encoder input	*

5. From the software component tree click on Device and add the Startup file by clicking the checkbox next to Startup. Then, click on the OK button.

oftware Component	Sel.	Variant		Version	Description			
🛛 💠 Board Support		MCBSTM32C	-	2.0.0	Keil Development Board MCBSTM32C			
🚯 🚸 CMSIS					Cortex Microcontroller Software Interface Components			
🛛 💠 CMSIS Driver					Unified Device Drivers compliant to CMSIS-Driver Specifications			
😵 Compiler		ARM Compile	er	1.6.0	Compiler Extensions for ARM Compiler 5 and ARM Compiler 6			
🛛 🗇 Device 🚺		-			Startup, System Setup			
DMA		1,		1.2	DMA driver used by RTE Drivers for STM32F1 Series			
GPIO	-		1.3 GPIO driver used by RTE Drivers for STM32F1 Series					
Startup	2		1.0.0 System Startup for STMicroelectronics STM32F1xx device serie					
🕀 🗇 StdPeriph Drivers								
alidation Output		Desc	ription					
🛛 🦺 Keil::Device:Startup		Addit	tional so	ftware con	nponents required			
e require CMSIS:CORE		Selec	t compo	nent from	list			
ARM::CMSIS:CORE		CMSI	S-CORE	for Cortex-	M, SC000, SC300, ARMv8-M, ARMv8.1-M			

6. Right click on *Source Group 1* and choose Add New Item to Group. This makes a new file and adds it to the project.

D:\computerWorld\Hardware\OurBooks\ArmBooks\Peripherals\STM32F103\KeilTutorials\A: File Edit View Project Flash Debug Peripherals Tools SVCS Window Help	mProgramming\OurFirstProject\
□     □ </th <th>🌌 🕞 🗟 🥐   🍭 •  </th>	🌌 🕞 🗟 🥐   🍭 •
Project 4 🖼	
Target 1 Source Group 1 Devic X Options for Group 'Source Group 1' Alt+F7 Add New Item to Group 'Source Group 1'	
Remove Group 'Source Group 1' and its Files	
Implement     P     Implement     Rebuild all target files       Build Output     Implement     F7	4 (i
A Manage Project Items	
Show Include File Dependencies	
4	
Add a new Item to Group	ULINK2/ME Cortex Debugger

7. Choose the type of file as *C File (.c)* and name it as *main*. Click on the *Add* button and then click on *Close*.

Add New Item	to Group 'Source Group 1'
C File (	c) Create a new C source file and add it to the project. e (.cpp)
Asm Fil h Header Text Fil Image User C	e (s) File (h) e (bd) File (.*) ode Template
Type:	C File (.c)
Location:	D: \computerWorld \Hardware \OurBooks \ArmBooks \Peripherals \STM32F 103 \KelTutorials \AsmProgramming \FirstC
	3 Add Close 4 Help

8. Type the following sample program in the *main.c* file.

```
#include <stm32f10x.h>
void delay ms(uint16 t t);
int main()
{
      RCC->APB2ENR |= 0xFC; //Enable GPIO ports clocks
      GPIOC \rightarrow CRH = 0x44344444; //PC13 as output
      while(1)
      {
             GPIOC->ODR ^= (1<<13); //toggle PC13
             delay ms(1000);
      }
}
//The following delay is tested with Keil and 72MHz
void delay_ms(uint16_t t)
{
      volatile unsigned long 1 = 0;
      for (uint16 t i = 0; i < t; i++)
             for (\overline{1} = 0; 1 < 6000; 1++)
             {
             }
}
```

9. Press *Ctrl+S* to save the file.

# **Connecting the ST-Link**

10. Connect the ST-Link debugger to the Blue pill using 4 female wires as shown in the following figure.



- 11. Connect the USB socket of the ST-Link debugger to your computer.
- 12. Configure the yellow jumpers of the board as shown in the following figure. The jumpers should be set to 0.



#### **Choosing the ST-Link Debugger**

- 13. Open the *Projects* menu and click on *Options for Target Target1* or press *Alt+F7*.
  - 1. Click on the *Debug* tab.
  - 2. Click on the *Use* debugger radio.
  - 3. Choose *ST-Link Debugger* in the Combo box.
  - 4. Click on the *Settings* button.

C Use Simulato	with restrictions	Settings	C Use ST-Lin	k Debugger	- T	Settings
Limit Speed t	o Real-Time			(plus Debugger S-DAP Debugger	^	
Load Applica	ation at Startup 🔽 Run	n to main()	✓ Load J-LIN	( / J-TRACE Cortex s Cortex-M Debugger	<b>_</b>	main()
		Edit	NULin	k Debugger 3 ro Debugger	= [	Edit
Restore Debug	g Session Settings		Restore Stellar	is ICDI s UDA Debugger	100	2
🔽 Breakpoi	nts 🔽 Toolbox		I Bre Altera	Blaster Cortex Debugger		
Vatch W	/indows & Performance Anal	yzer	Watch W	5 Debugger Indows		
Memory I	Display 🔽 System View	wer	Memory [	Display 🔽 System	Viewer	
CPU DLL:	Parameter:		Driver DLL:	Parameter:		
SARMCM3.DLL	-REMAP	1	SARMCM3.DLL			
Dialog DLL:	Parameter:		Dialog DLL:	Parameter:		
DCM.DLL	-рСМ3		TCM.DLL	-рСМ3		
Warn if outd	ated Executable is loaded		Wam if outd	ated Executable is loade	d	
		Component V	awar Description E			
	Manao	le component v	lewer Description Fi	63		

- 14. In the Target Driver Setup window:
  - 1. Click on the Flash Download tab.
  - 2. Enable "Reset and Run".
  - 3. Click on the OK button.

Cortex-M Target Driver Setup Debug Trace Flash Download Download Function C Erase Full Chip C Erase Sectors Do not Erase Programming Agorithm	Pack ) Program Verify Reset and F	RAM for A Start: 0	lgonthm x20000000 Size: [0x1000	
Description	Device Size	Device Type	Address Range	
		Start:	Size:	
	Add	Remove	]	
			3 OK Gancel	Anala

15. Close the Options window by clicking on the **OK** button.

## **Building**

16. To compile click on the *Build* icon or choose *build target* from the *Project* menu.

File E	dit	View	Project	Flash	Debug	Peripherals	Tools	SVCS	Window	Help
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17. If the program is built successfully the following message appears:

Build Output	1	1	×
<pre>Program Size: Code=16 RO-data=0 RW-data=0 ZI-data=0 ".\Objects\ourFirstProject.axf" - 0 Error(s), 0 Warning(s). Build Time Elapsed: 00:00:00</pre>			^
		Þ	Ŧ
	Simulation		

18. Click on the Download icon or press F8 to program the board.

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🖉 🖽 🖽 🤣 •		Target 1	

19. Press the *Reset* button of the blue pill board. If the board program successfully, the green LED of the board should start blinking.

## **Debugging and Tracing**

20. To start debugging click on *Start/Stop Debug Session* icon or choose *Start/Stop Debug Session* from the *Debug* menu. (or simply press *Ctrl+F5*)

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Tools	SVCS	Window	Help				
12 1	四 限	课课	//= //g 🛛 🖄	EINT0_IRQHandler	🖃 🗟 🥐	٢	• • الم 🖉 •

21. Go to the *Peripherals* menu and then *System Viewer*. It has tools for monitoring different peripherals. For now, choose *GPIOC* from *GPIO*. It shows the registers of *GPIOC*; you can see values of registers while tracing the program or change their values by clicking on each bit.



22. To trace the program, use the Step Over button or click on Step Over from the Debug menu. It executes the instructions of the program one after another. To trace the program, you can use the Step button, as well. The difference between the Step Over and Step is in executing functions. While Step goes into the function and executes its instructions one by one, Step Over executes the function completely and goes to the instruction next to the function. To see the difference between them, trace the program once with Step Over and then with

**Step**. When you are in the function and you want the function to be executed completely you can use **Step Out**. In the case, the instructions of the function will be executed, it returns from the function, and goes to the instruction which is next to the function call.



23. To exit from the debugging mode press *Start/Stop Debug Session*.