



life.augmented

STP32MP1 coprocessor development handson

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1 Debug M4 in engineering mode

2 M4 production mode demo

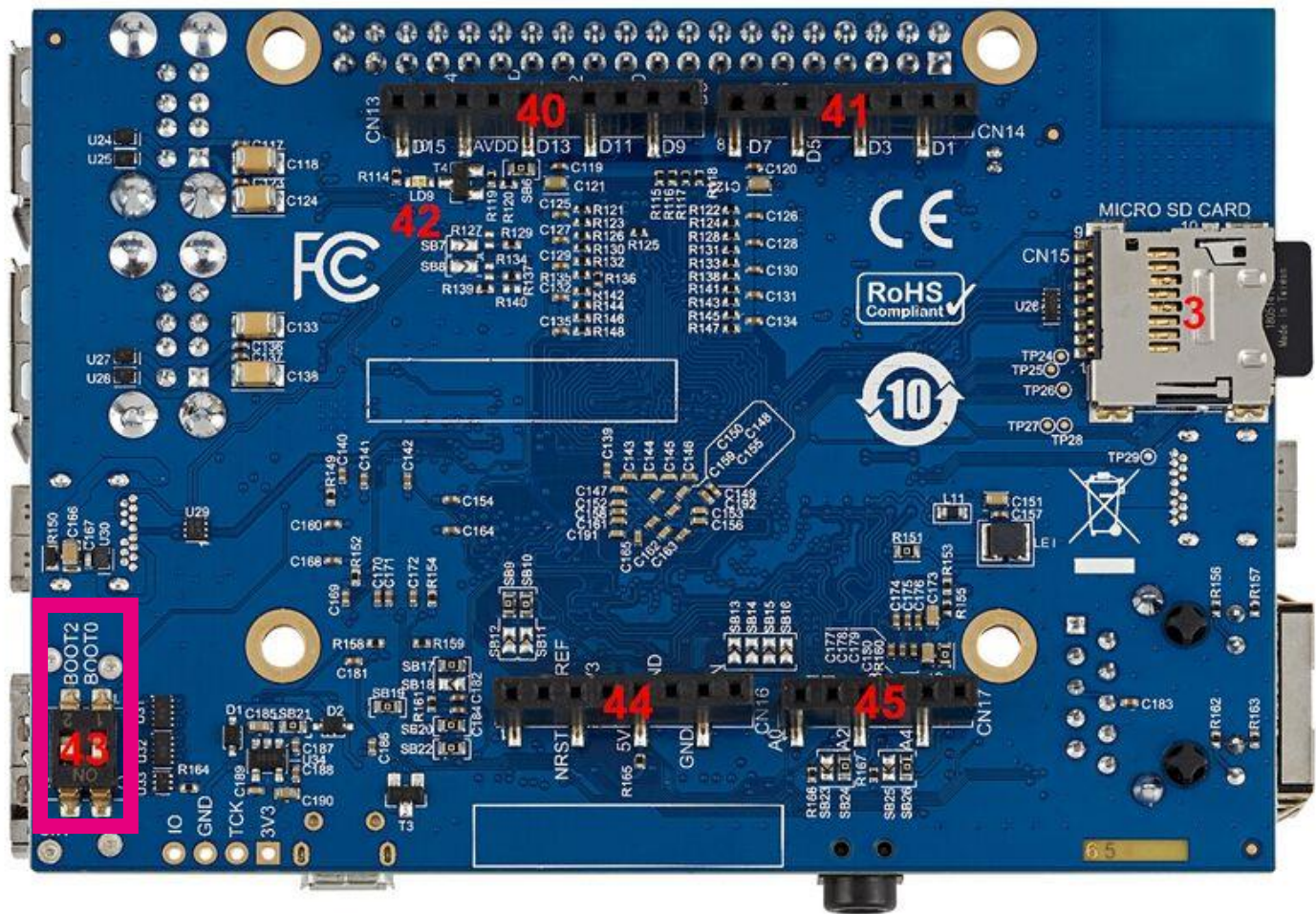
3 Inter-processor communication

Debug M4 in engineering mode



Engineering Mode

Set the board to Engineering mode



Boot mode	Boot 0	Boot 2
Forced USB boot for flashing	0	0
Not supported	ON	0
Engineering boot	0	ON
microSD card	ON	ON

Generating project with STM32CubeMX



Double click the STM32CubeMX icon on the desktop to open it

- Click on « Access to board selector »
- Filter on STM32MP1 (1)
- Then select your board (2) and click on Start project on the top right corner (3)
- Answer « Yes » to the popup « apply peripheral default settings »



1

2

3

Start My project from STBoard

ACCESS TO BOARD SELECTOR

Board Filters

Part Number Search

Vendor

Type

MCU Series

Check/Uncheck All

STM32F0

STM32F1

STM32F2

STM32F3

STM32F4

STM32F7

STM32G0

STM32H7

STM32L0

STM32L1

STM32L4

STM32MP1

STM32WB

Other

Price = 0.0

Oscillator Freq. = 0 (MHz)

Peripheral

Features

Large Picture

Docs & Resources

Datasheet

Buy

Start Project

STM32MP1

STMMicroelectronics STM32MP157C-EV1 Evaluation Board Support and Examples

Unit Price (US\$): 0.0

Mounted device: STM32MP157CAAx

Features

- 2 x DDR3L 16 bits (8GB)
- 4 GByte eMMC
- 4 x USB type-A (host)
- USB micro-AB (OTG)
- 10M/100M/1G Ethernet interface
- Speaker / Headset
- SPDIF RX
- SPDIF TX
- DSI 720p display

Boards List: 3 items

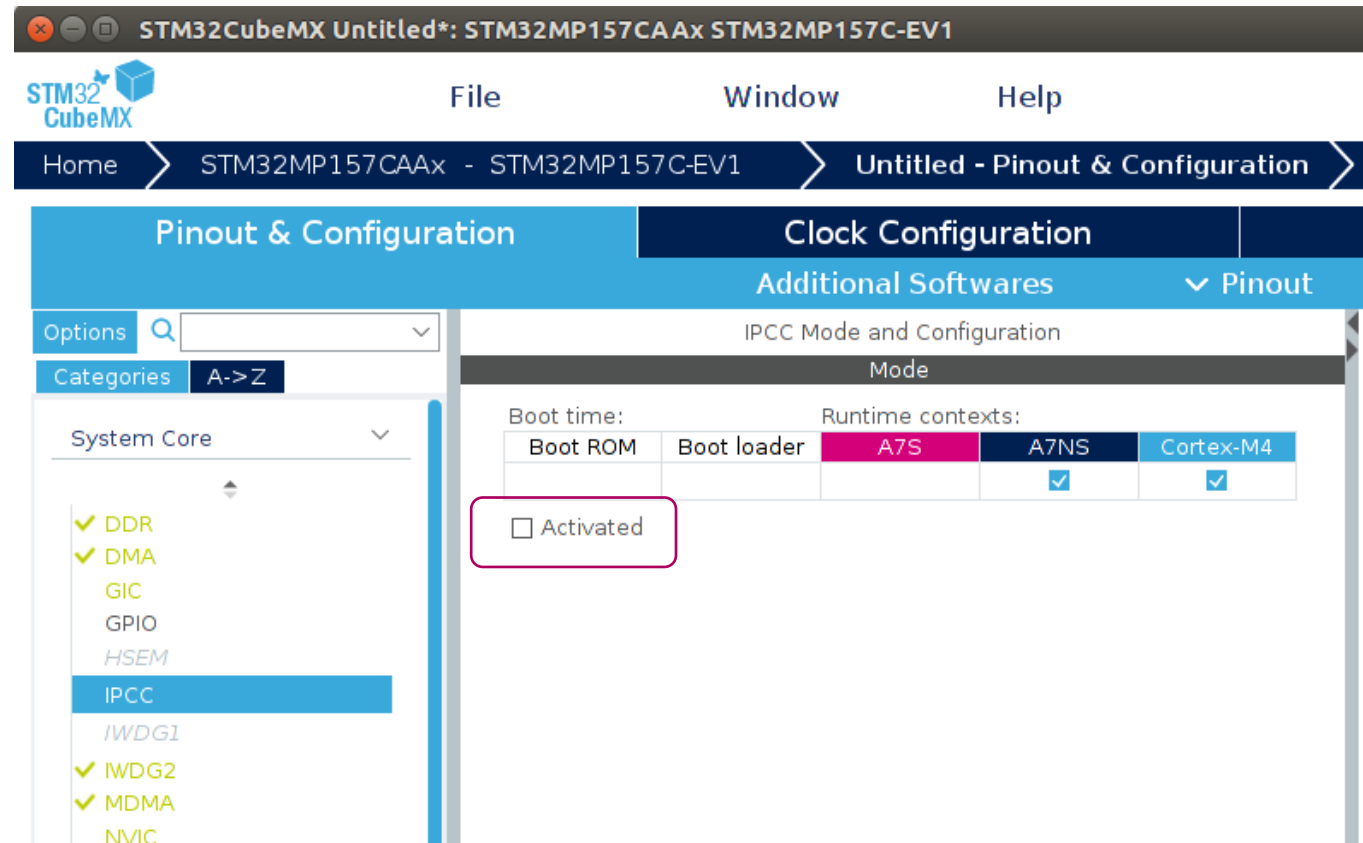
	Thumbnail	Part No.	Type	Marketing Status	Unit Price (US\$)	Mounted Device	Kit Cont.	Included I.
☆		STM32MP157A-EV1	Evaluation Board		0.0	STM32MP157AAAx		
☆		STM32MP157C-DK2	Discovery		0.0	STM32MP157CACX		
☆		STM32MP157C-EV1	Evaluation Board		0.0	STM32MP157CAAx		

Engineering Mode



Disable OpenAMP and IPCC

Until « Activated » box in IPCC automatically disable OpenAMP in the same time.





Engineering Mode

Assign GPIO PH7 to M4.



STM32CubeMX Untitled*: STM32MP157CACx STM32MP157C-DK2

File Window Help

Home > STM32MP157CACx - STM32MP157C-DK2 > Untitled - Pinout & Configuration > GENERATE CODE

Pinout & Configuration Clock Configuration Project Manager Tools

Software Packs Pinout

GPIO Mode and Configuration

Configuration

Group By Peripherals

☒ SDMMC	☒ UART	☒ USART	☒ USB	☒ USBH
☒ I2C	☒ I2S	☒ PWR	☒ RCC	☒ RTC
☒ GPIO	☒ ADC	☒ DDR	☒ DSIHOST	☒ ETH
				☒ SAI
				☒ HDMI

Search Signals

Search (Ctrl+F)

☐ Show only Modified Pins

Pin N...	Signal on...	GPIO mo...	GPIO Pull...	Maximu...	User Label	Modified
PH4	n/a	Output P...	No pull-u...	Low	WL_REG_...	☒
PH5	n/a	Input mo...	No pull-u...	n/a	BT_HOST...	☒
PH7	n/a	Output P...	No pull-u...	Low	LED_Y [L...	☒
PI11	n/a	Input mo...	No pull-u...	n/a	STUSB1...	☒
PZ6	n/a	Output P...	No pull-u...	Low	BT_REG_...	☒
PZ7	n/a	Output P...	No pull-u...	Low	BT DEV ...	☒

PH7 Configuration :

GPIO mode: Output Push Pull

GPIO Pull-up/Pull-down: No pull-up and no pull-down

Maximum output speed: Low

Pinout view System view

Enter User Label
Signal Unpinning
Pin Stacking
Pin Reserved

- ☐ Free
- ☐ Cortex-A7 secure
- ☐ Cortex-A7 non secure
- ☒ Cortex-M4

MCUs Selection Output DDR Interactive logs

Series	Lines	Mcu	Package	Required Peripherals
STM32MP1	STM32MP157	STM32MP157CACx	TFBGA361	None



Project Settings and generation

1. Fill project name
2. Set Project location (if default does not suit you)
3. Choose Toolchain/IDE
4. Generate Code

The screenshot displays the STM32CubeMX software interface. The title bar reads "STM32CubeMX Untitled*: STM32MP157CACx STM32MP157C-DK2". The menu bar includes "File", "Window", and "Help". The breadcrumb navigation shows "Home > STM32MP157CACx - STM32MP157C-DK2 > Untitled - Project Manager". A "GENERATE CODE" button is highlighted with a red box in the top right. The main interface has four tabs: "Pinout & Configuration", "Clock Configuration", "Project Manager" (selected), and "Tools". The "Project Manager" tab is divided into three sections: "Project", "Code Generator", and "Advanced Settings".

- Project Settings:**
 - Project Name:** "Engineer_mode_LED_example" (highlighted with a red box).
 - Project Location:** "/work/STM32CubeIDE/workspace_1.5.1/" (highlighted with a red box), with a "Browse" button.
- Code Generator:**
 - Application Structure:** "Advanced" (dropdown menu).
 - Toolchain Folder Location:** "/work/STM32CubeIDE/workspace_1.5.1/Engineer_mode_LED_example/" (text field).
 - Toolchain / IDE:** "STM32CubeIDE" (dropdown menu, highlighted with a red box).
 - ☒ Generate Under Root
- Advanced Settings:**
 - Linker Settings:**
 - Minimum Heap Size: "0x200" (text field).
 - Minimum Stack Size: "0x400" (text field).
 - Mcu and Firmware Package:**
 - Mcu Reference: "STM32MP157CACx" (text field).
 - Firmware Package Name and Version: (empty text field).

At the bottom, there are tabs for "MCUs Selection", "Output", and "DDR Interactive logs". Below these is a table with the following data:

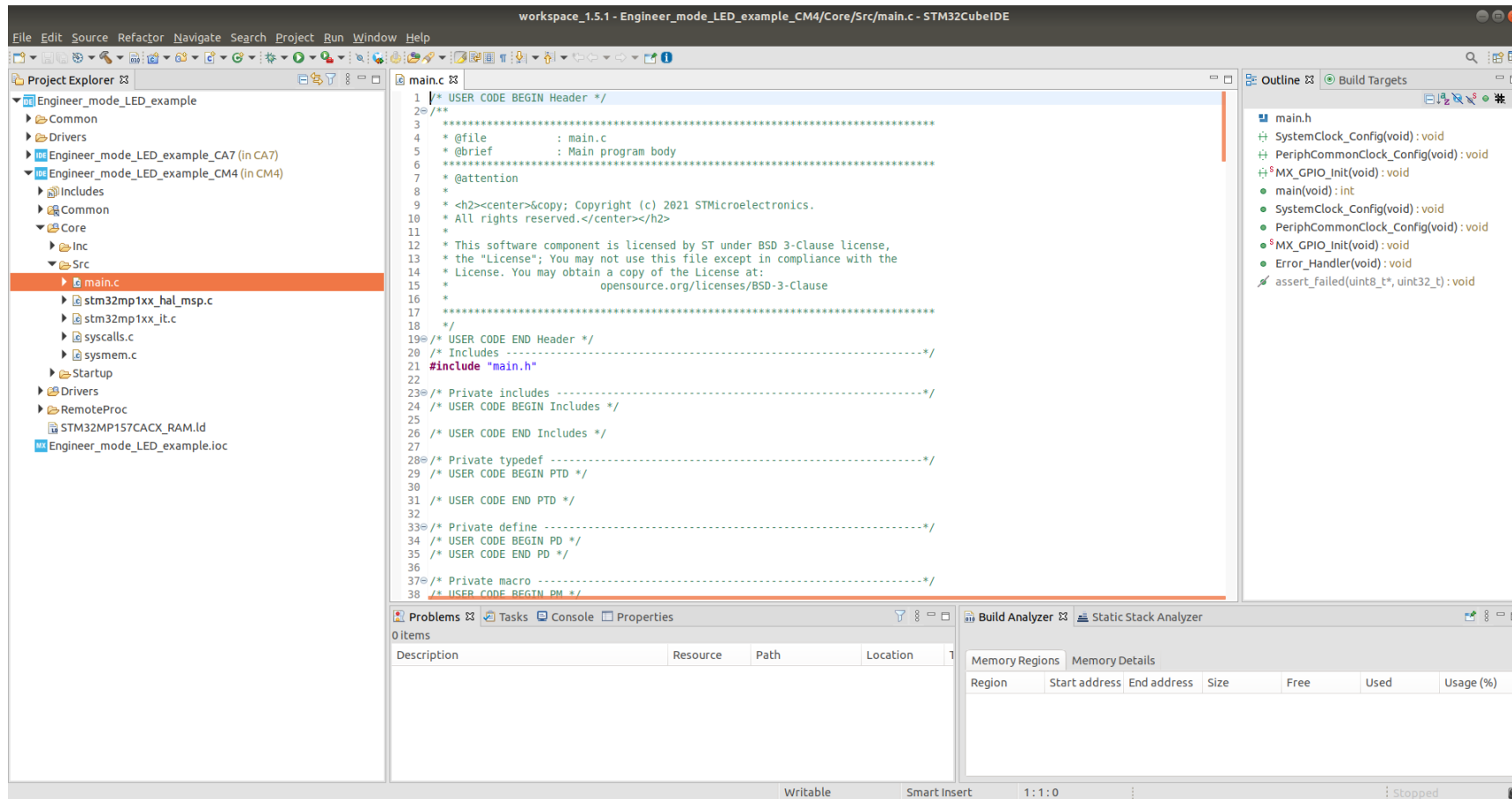
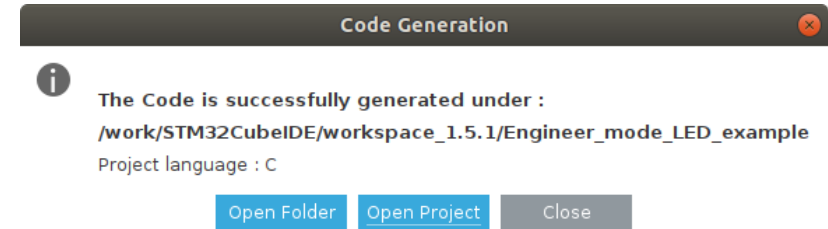
Series	Lines	Mcu	Package	Required Peripherals
STM32MP1	STM32MP157	STM32MP157CACx	TFBGA361	None

Engineering Mode



Open project in CubeIDE

Choose Open Project in the popup window,
Then the project will be opened in CubeIDE



 Add your own code to the user code region

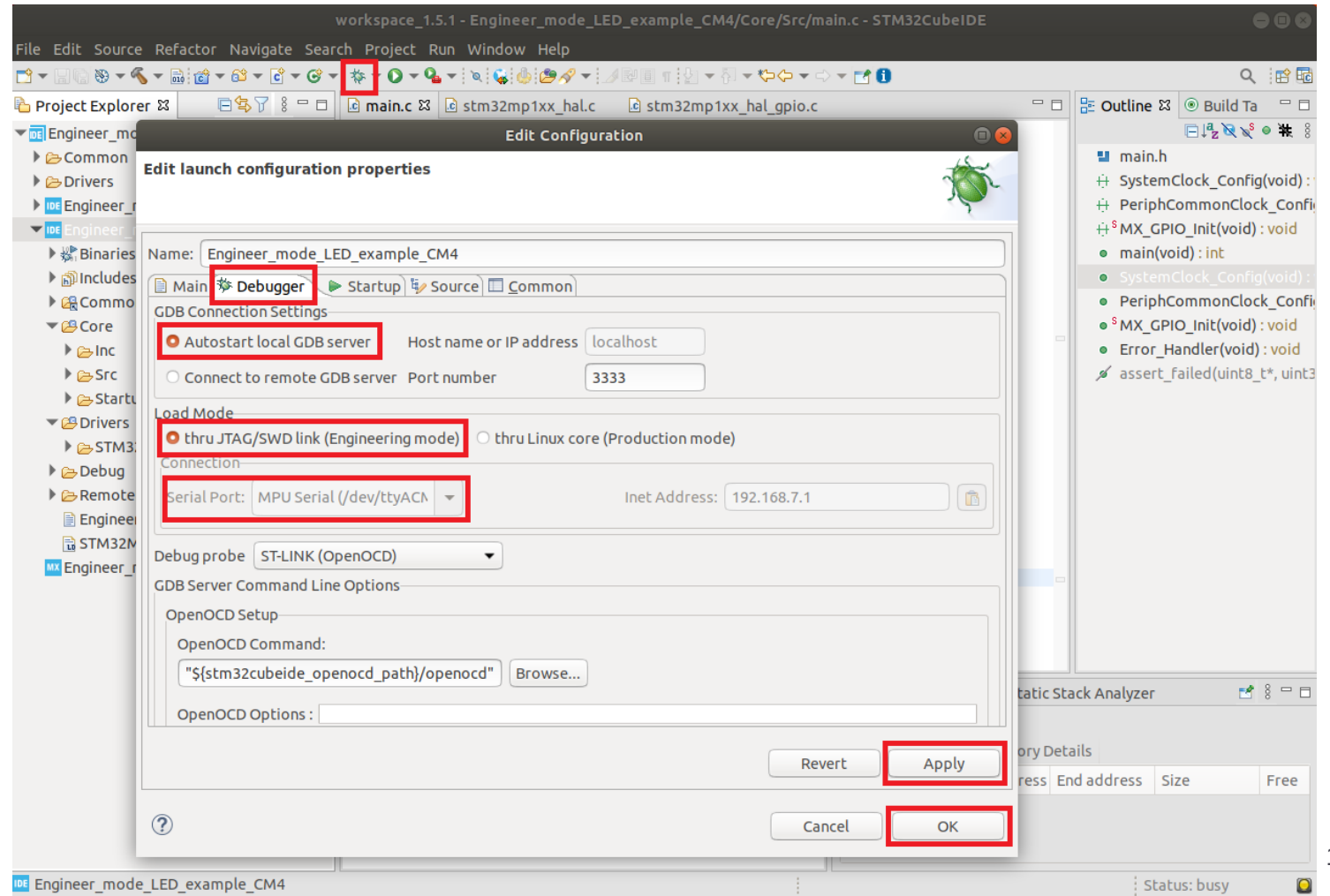
```
main.c  stm32mp1xx_hal.c  stm32mp1xx_hal_gpio.c
95
96  /* Initialize all configured peripherals */
97  MX_GPIO_Init();
98  /* USER CODE BEGIN 2 */
99
100 /* USER CODE END 2 */
101
102 /* Infinite loop */
103 /* USER CODE BEGIN WHILE */
104 while (1)
105 {
106     /* USER CODE END WHILE */
107
108     /* USER CODE BEGIN 3 */
109     HAL_GPIO_TogglePin(LED_Y_GPIO_Port, LED_Y_Pin);
110     HAL_Delay(250);
111 }
112 /* USER CODE END 3 */
113 }
114
115 /**
116  * @brief System Clock Configuration
117  * @retval None
118  */
```

Engineering Mode

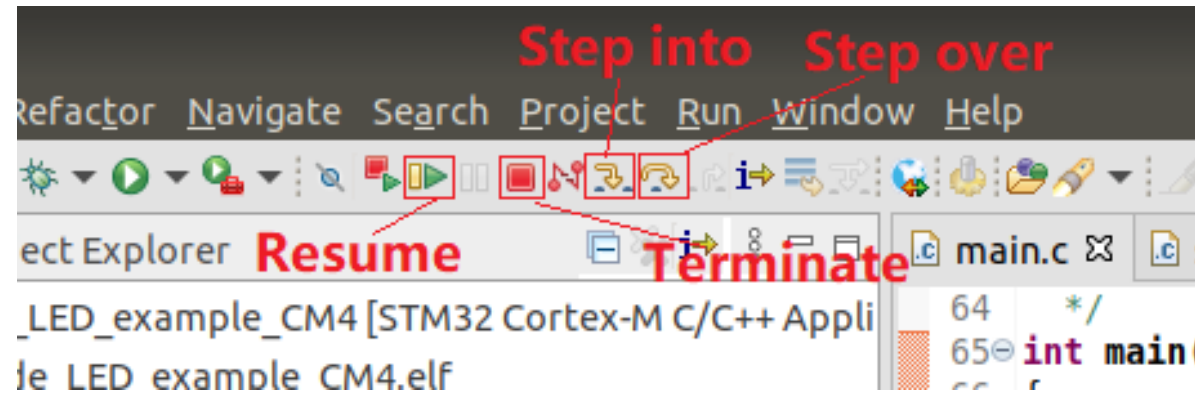


Debug configurations

1. Click the Debug tool on the toolbar to open the Debug configuration window
2. Configure the debug settings as below
3. Click Apply&OK to debug the code



 Exécute and Debug the code



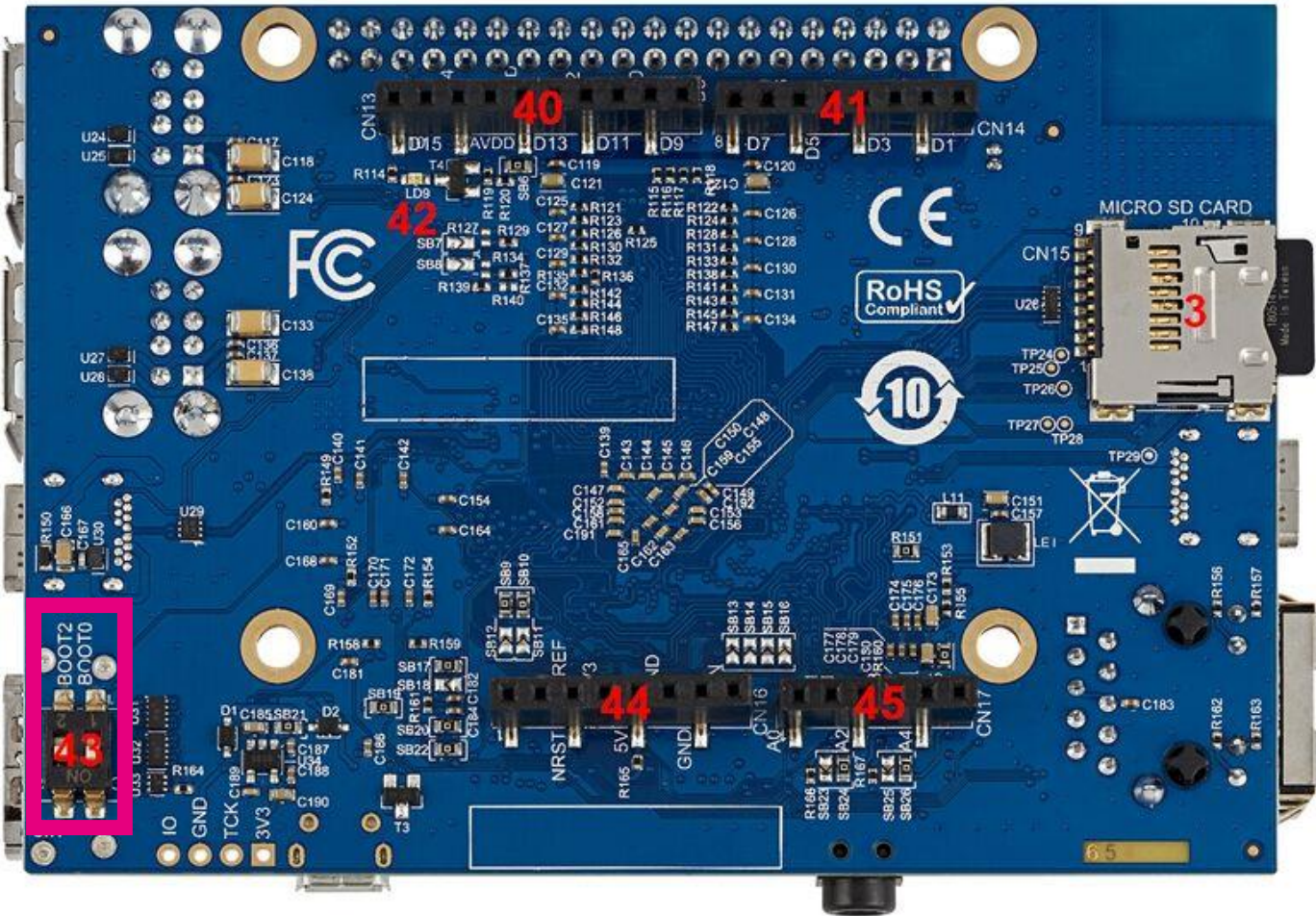
M4 production mode demo

Communicate between A7 and M4 through I2C



Production Mode

Set the board to Production mode



Boot mode	Boot 0	Boot 2
Forced USB boot for flashing	0	0
Not supported	ON	0
Engineering boot	0	ON
microSD card	ON	ON

Connect I2C2 to I2C5

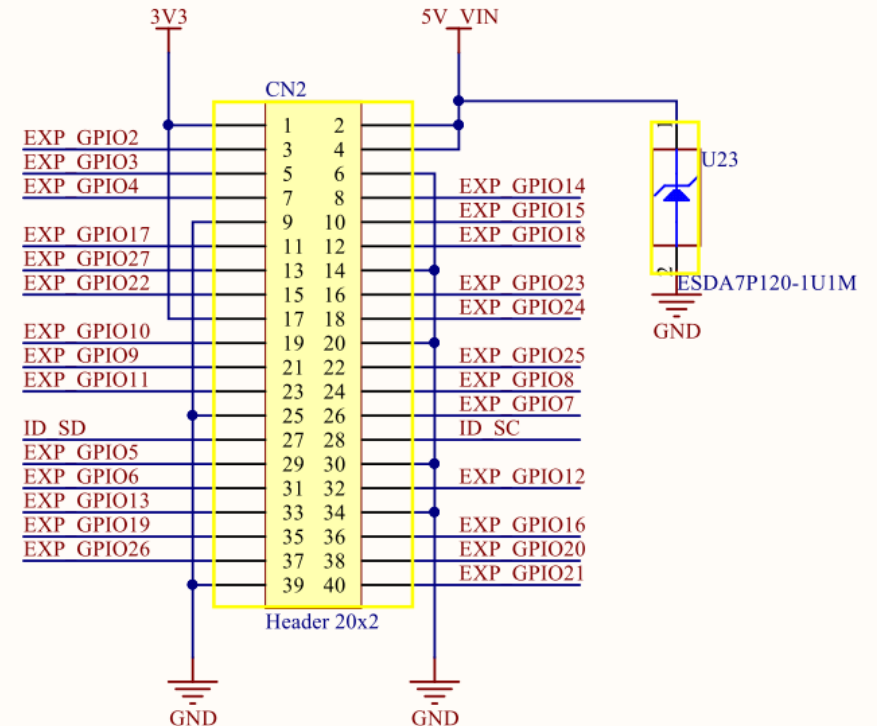
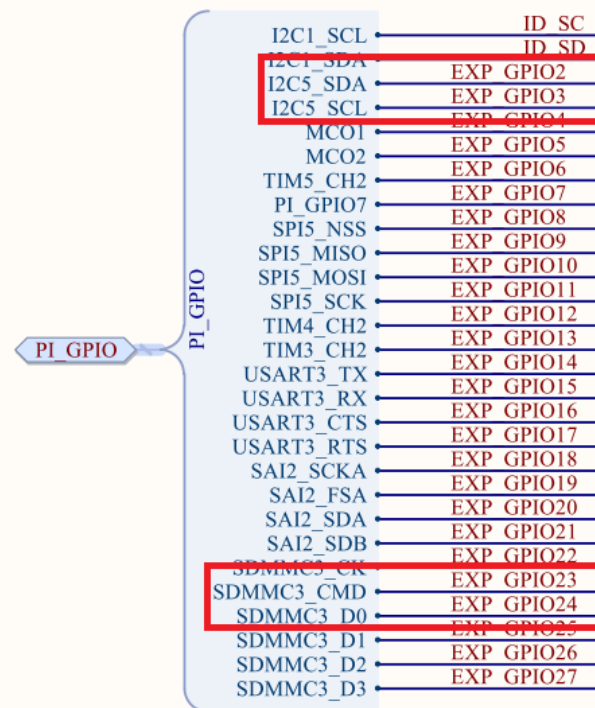
Find a pair of PINs for I2C2

Port F	PF0	-	-	-	-	I2C2_SDA
	PF1	-	-	-	-	I2C2_SCL

Find the PINs' location in CN2

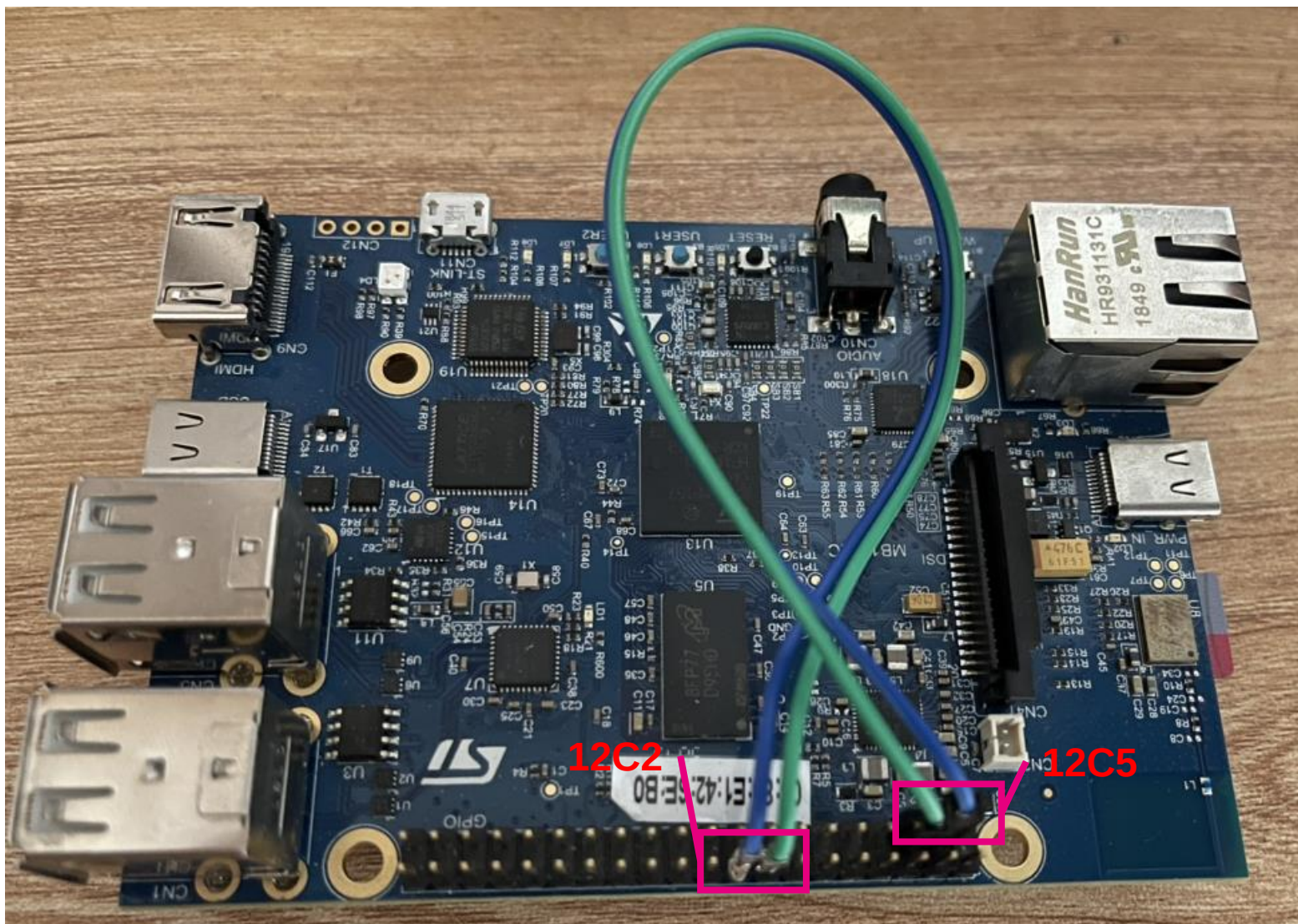
GPIO EXPANSION

SDMMC3_D0	D8	PF0
SDMMC3_CMD	A5	PF1



Connect I2C2 to I2C5

Connect I2C with I2C5



Kernel device tree modification

Assign PINs for I2C2:

```
diff --git a/arch/arm/boot/dts/stm32mp15-pinctrl.dtsi b/arch/arm/boot/dts/stm32mp15-pinctrl.dtsi
index 8035044b8c39..7437b98e0cf2 100644
--- a/arch/arm/boot/dts/stm32mp15-pinctrl.dtsi
+++ b/arch/arm/boot/dts/stm32mp15-pinctrl.dtsi
@@ -356,6 +356,23 @@
     };

+};
+
+    i2c2_pins_c: i2c2-4 {
+        pins {
+            pinmux = <STM32_PINMUX('F', 1, AF4)>, /* I2C2_SCL */
+                <STM32_PINMUX('F', 0, AF4)>; /* I2C2_SDA */
+            bias-disable;
+            drive-open-drain;
+            slew-rate = <0>;
+        };
+    };
+
+    i2c2_pins_sleep_c: i2c2-5 {
+        pins {
+            pinmux = <STM32_PINMUX('F', 1, ANALOG)>, /* I2C2_SCL */
+                <STM32_PINMUX('F', 0, ANALOG)>; /* I2C2_SDA */
+        };
+    };
+
+    i2c5_pins_a: i2c5-0 {
+        pins {
+            pinmux = <STM32_PINMUX('A', 11, AF4)>, /* I2C5_SCL */
```

Kernel device tree modification

Configure I2C2 parameters

```
diff --git a/arch/arm/boot/dts/stm32mp15xx-dkx.dtsi b/arch/arm/boot/dts/stm32mp15xx-dkx.dtsi
index 685a82161cc8..6a1ce5aa22e8 100644
--- a/arch/arm/boot/dts/stm32mp15xx-dkx.dtsi
+++ b/arch/arm/boot/dts/stm32mp15xx-dkx.dtsi
@@ -457,6 +457,19 @@
        status = "disabled";
    };

+&i2c2 {
+    pinctrl-names = "default", "sleep";
+    pinctrl-0 = <&i2c2_pins_c>;
+    pinctrl-1 = <&i2c2_pins_sleep_c>;
+    i2c-scl-rising-time-ns = <185>;
+    i2c-scl-falling-time-ns = <20>;
+    clock-frequency = <400000>;
+    /* spare dmas for other usage */
+    /delete-property/dmas;
+    /delete-property/dma-names;
+    status = "disabled";
+};
+
    &i2s2 {
        clocks = <&rcc SPI2>, <&rcc SPI2_K>, <&rcc PLL3_Q>, <&rcc PLL3_R>;
```

Kernel device tree modification

Enable I2C2 for A7 and I2C5 for M4:

```
diff --git a/arch/arm/boot/dts/stm32mp157c-dk2.dts b/arch/arm/boot/dts/stm32mp157c-dk2.dts
index ba1d15de2f2c..8c3d60d250c3 100644
--- a/arch/arm/boot/dts/stm32mp157c-dk2.dts
+++ b/arch/arm/boot/dts/stm32mp157c-dk2.dts
@@ -169,3 +169,13 @@
         vddio-supply = <&v3v3>;
     };
 };
+
+&i2c2 {
+    status = "okay";
+};
+
+&m4_i2c5 {
+    pinctrl-names = "default";
+    pinctrl-0 = <&m4_i2c5_pins_a>;
+    status = "okay";
+};
```

Rebuild the dtb and download to the board

1. Rebuild the dtb :

```
$ cd /work/developer/linux
```

```
$ makekerneldtb
```

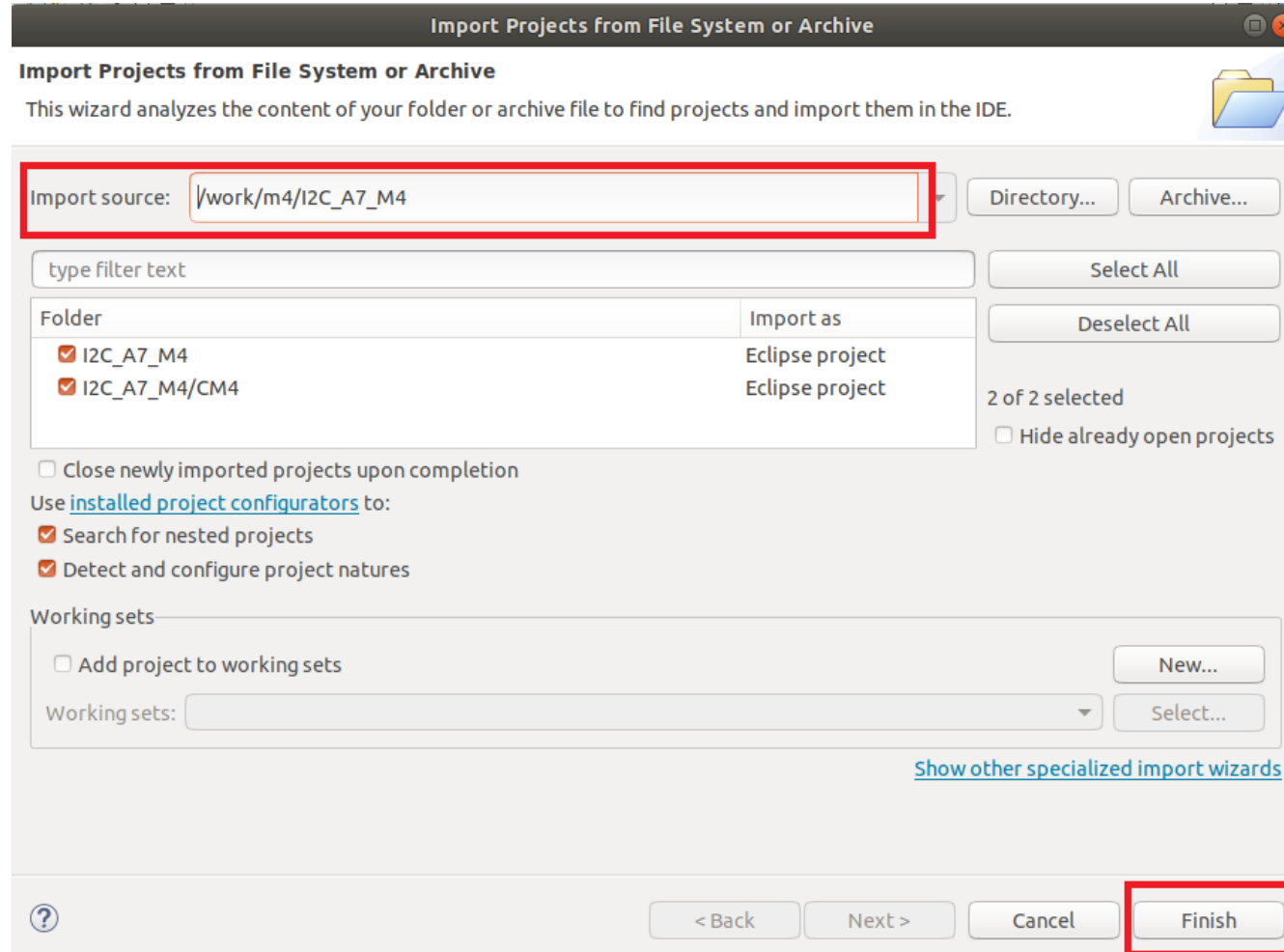
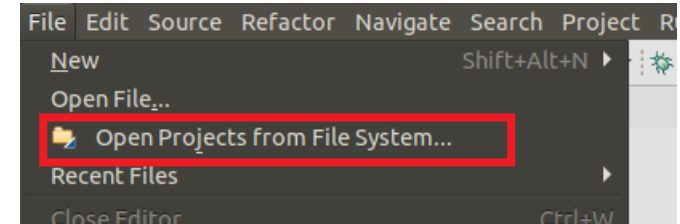
2. Download the dtb to the board :

```
$ scp ./build/arch/arm/boot/dts/stm32mp157c-dk2.dtb root@192.168.7.1
```

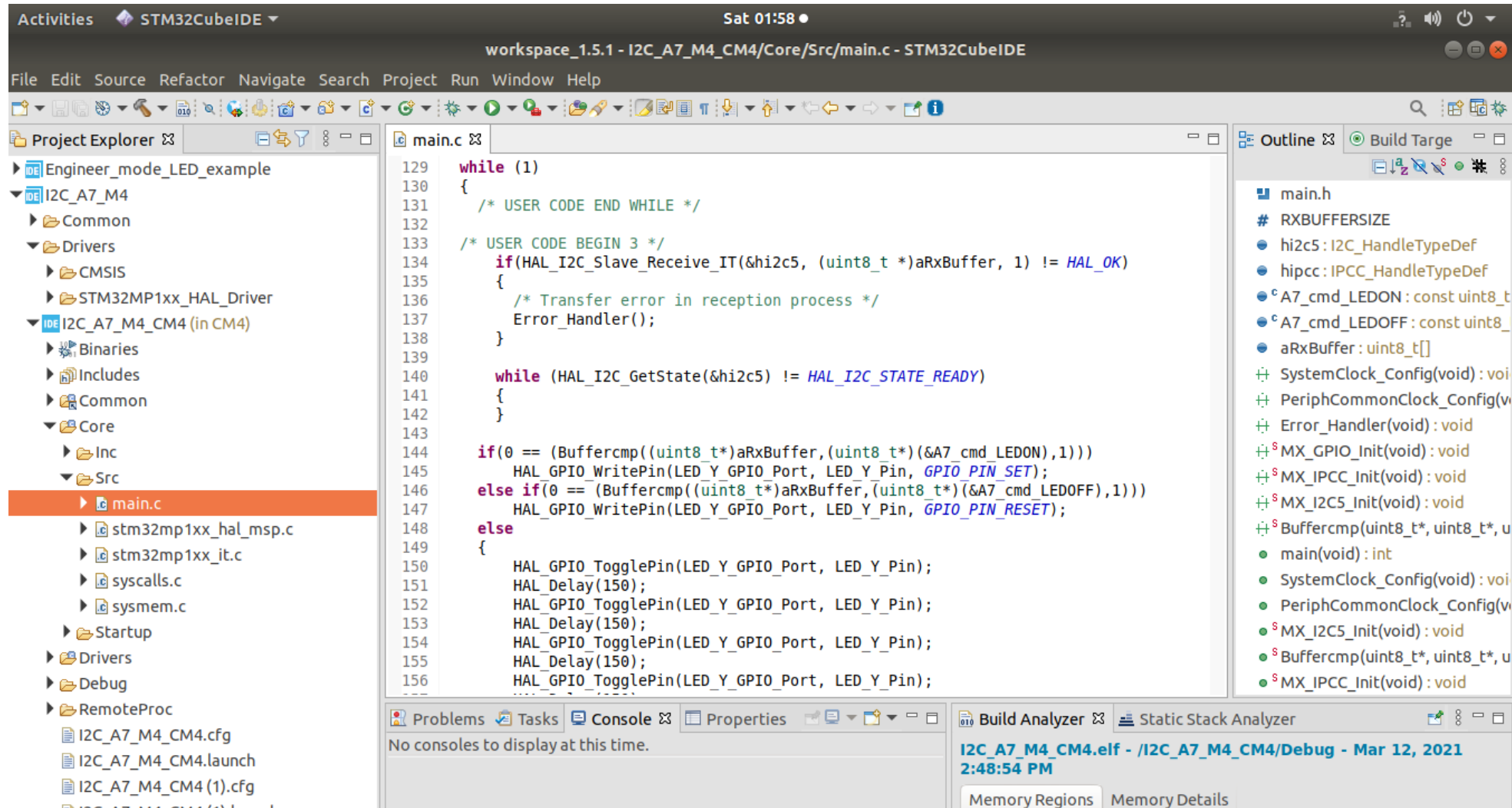
3. Reboot the board

Import the I2C_A7_M4 demo

1. Open CubeIDE, click “File”=>”Open Projects from File System”
2. Fill in the “Import source” textbox with “/work/m4/I2C_A7_M4”
3. Click “Finish”



Code modification



The screenshot displays the STM32CubeIDE interface with the following components:

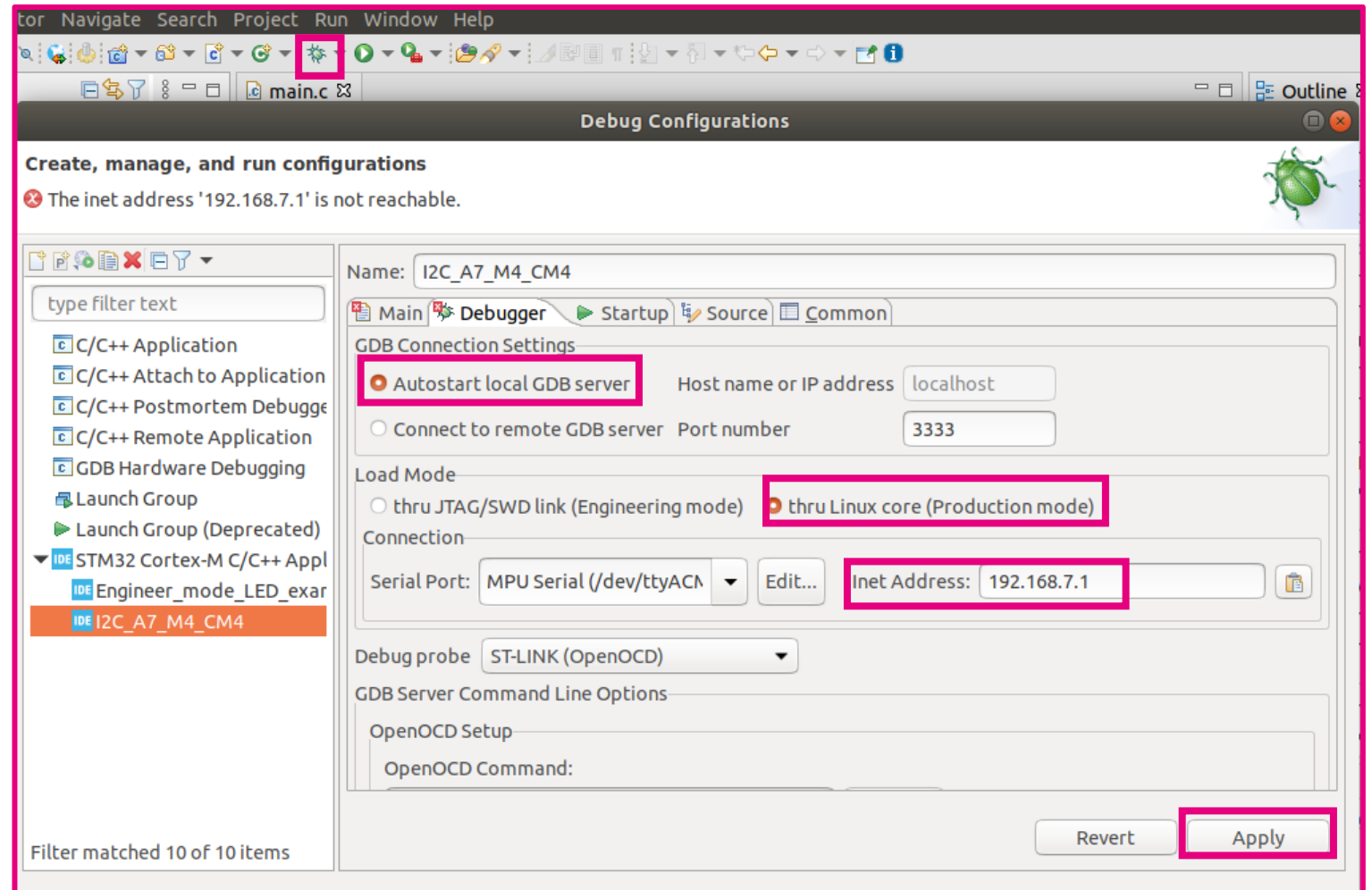
- Project Explorer:** Shows the project structure for 'I2C_A7_M4'. The 'Src' folder is expanded, and 'main.c' is selected.
- Editor:** Displays the code in 'main.c' with line numbers 129 to 156. The code includes a while loop for I2C reception and GPIO pin toggling.
- Outline:** Lists the symbols in the current file, including 'main.h' and various function declarations.
- Build Target:** Shows the build target 'I2C_A7_M4_CM4.elf'.
- Problems/Console:** Displays the message 'No consoles to display at this time.'
- Build Analyzer:** Shows the build output for 'I2C_A7_M4_CM4.elf' dated Mar 12, 2021.

```
129 while (1)
130 {
131     /* USER CODE END WHILE */
132
133     /* USER CODE BEGIN 3 */
134     if(HAL_I2C_Slave_Receive_IT(&hi2c5, (uint8_t *)aRxBuffer, 1) != HAL_OK)
135     {
136         /* Transfer error in reception process */
137         Error_Handler();
138     }
139
140     while (HAL_I2C_GetState(&hi2c5) != HAL_I2C_STATE_READY)
141     {
142     }
143
144     if(0 == (Buffercmp((uint8_t *)aRxBuffer, (uint8_t *)(&A7_cmd_LEDON), 1)))
145         HAL_GPIO_WritePin(LED_Y_GPIO_Port, LED_Y_Pin, GPIO_PIN_SET);
146     else if(0 == (Buffercmp((uint8_t *)aRxBuffer, (uint8_t *)(&A7_cmd_LEDON), 1)))
147         HAL_GPIO_WritePin(LED_Y_GPIO_Port, LED_Y_Pin, GPIO_PIN_RESET);
148     else
149     {
150         HAL_GPIO_TogglePin(LED_Y_GPIO_Port, LED_Y_Pin);
151         HAL_Delay(150);
152         HAL_GPIO_TogglePin(LED_Y_GPIO_Port, LED_Y_Pin);
153         HAL_Delay(150);
154         HAL_GPIO_TogglePin(LED_Y_GPIO_Port, LED_Y_Pin);
155         HAL_Delay(150);
156         HAL_GPIO_TogglePin(LED_Y_GPIO_Port, LED_Y_Pin);
```

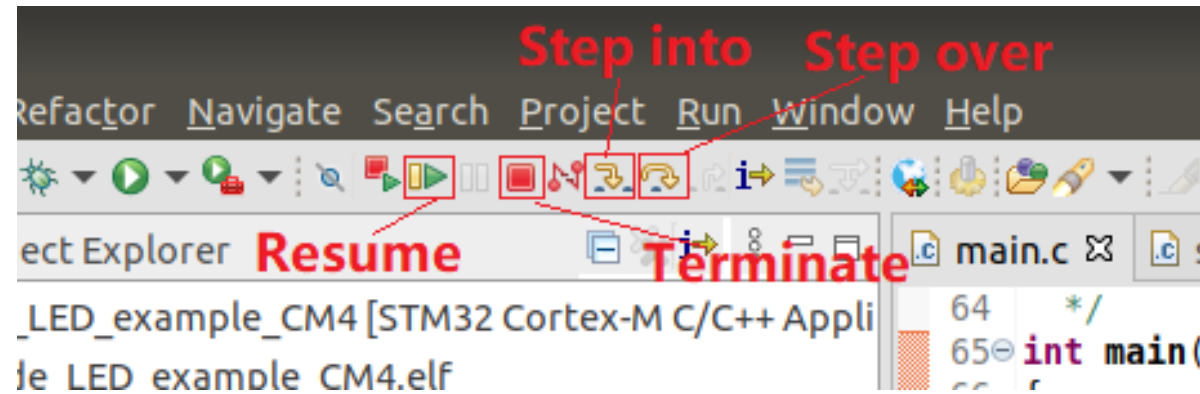


Debug configurations

1. Click the Debug tool on the toolbar to open the Debug configuration window
2. Configure the debug settings as below
3. Click Apply
4. Click the Debug tool to run debug



 Exécute and Debug the code





Test the demo

Send I2C message in linux console to M4:

```
root@stm32mp1:~# i2cset -f -y -a 1 0x7b 0x66 0x00
```

```
root@stm32mp1:~# i2cset -f -y -a 1 0x7b 0x66 0x05
```

```
root@stm32mp1:~# i2cset -f -y -a 1 0x7b 0x66 0x01
```

Check the board to see if the LED on/off/blink correctly.

Try to modify the code to change the phenomenon.

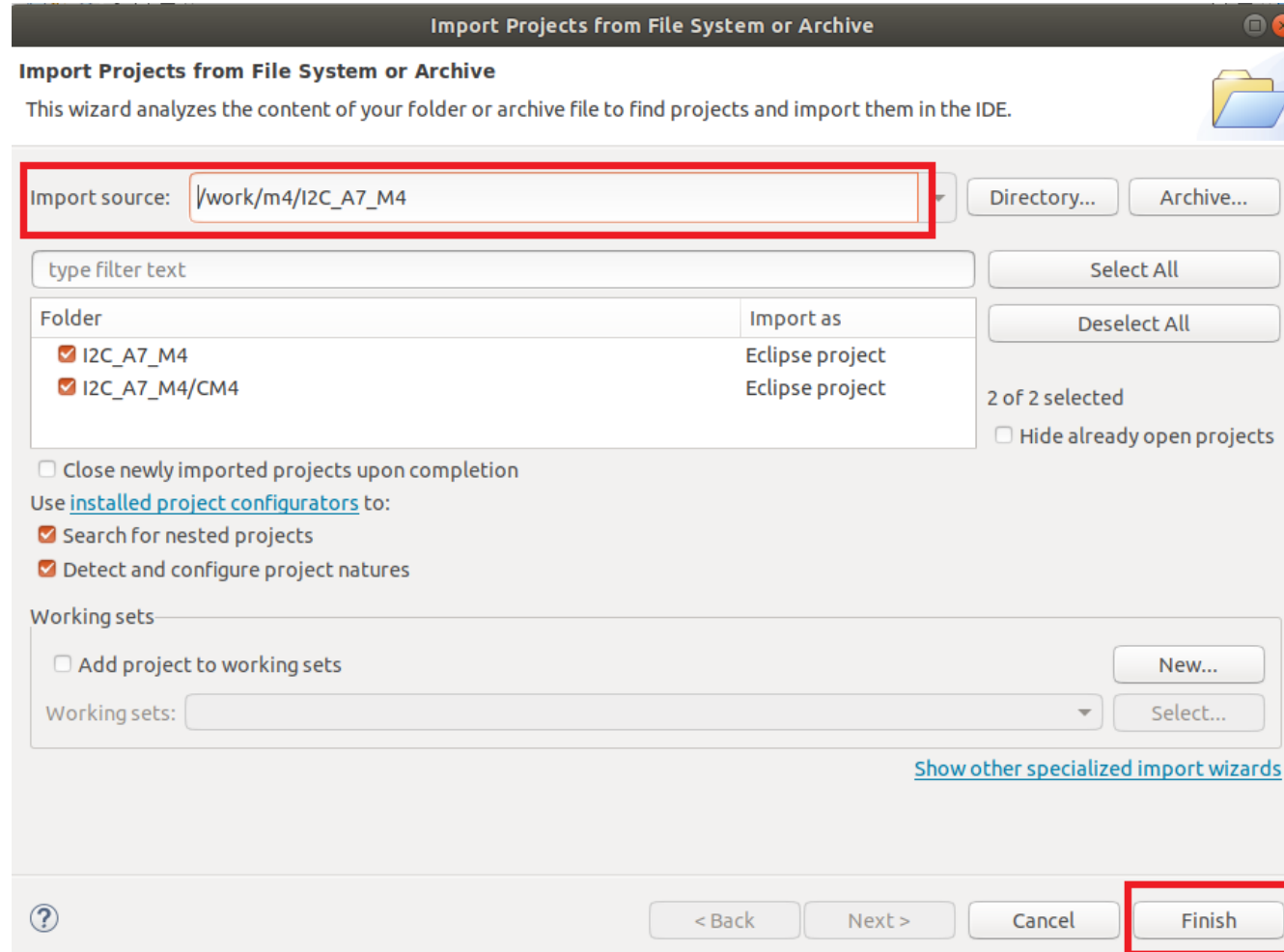
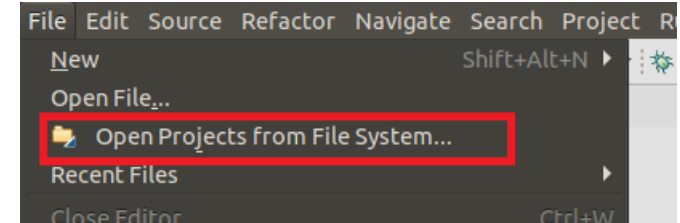
Inter-processor communication



Inter-processor communication

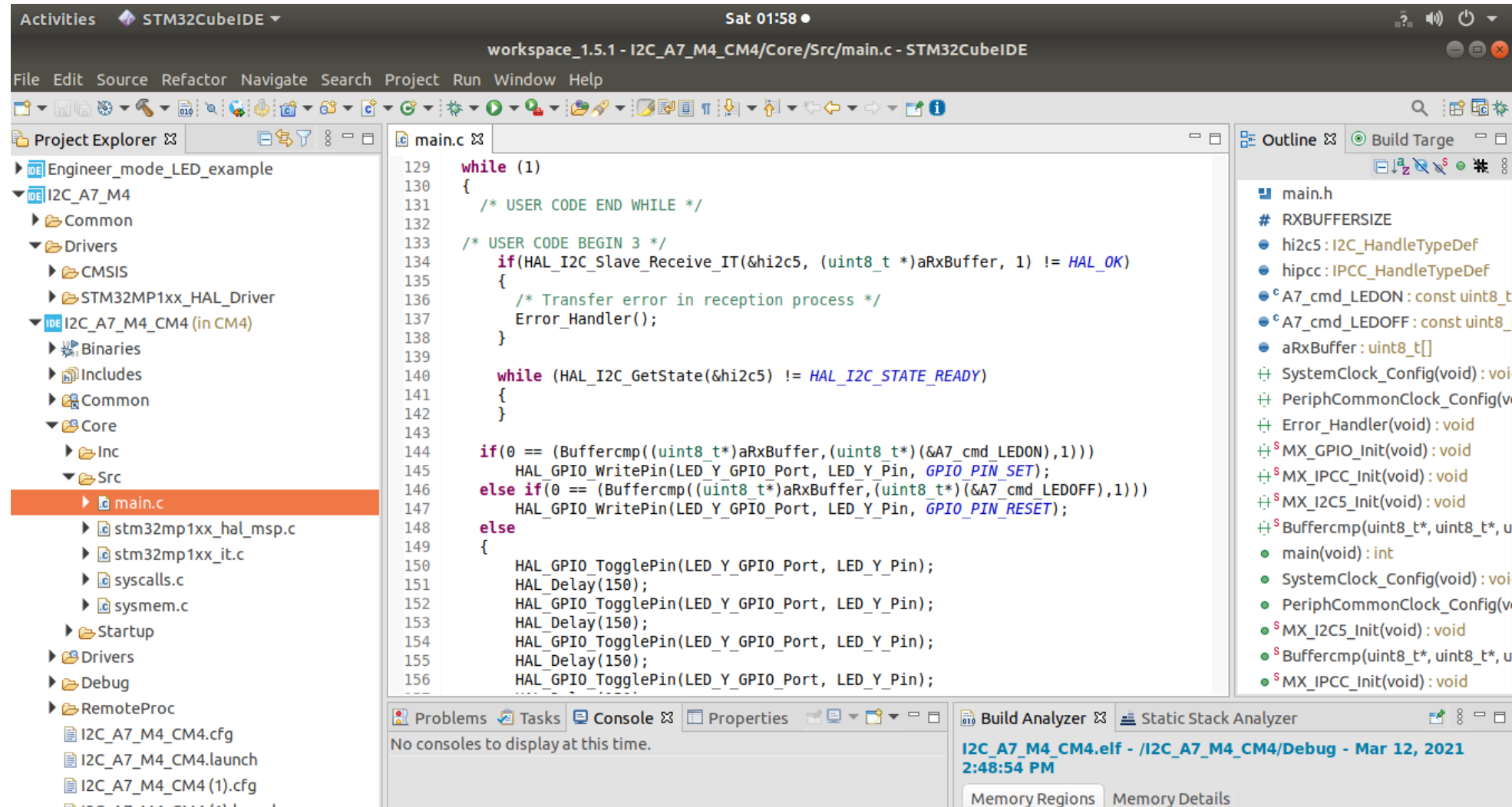
Import the I2C_A7_M4 demo

1. Open CubeIDE, click “File”=>”Open Projects from File System”
2. Fill in the “Import source” textbox with “/work/m4/I2C_A7_M4”
3. Click “Finish”



Inter-processor communication

Code modification



The screenshot displays the STM32CubeIDE interface. The Project Explorer on the left shows the project structure, with the 'main.c' file selected under the 'Core' > 'Src' directory. The main editor window shows the code in 'main.c', which includes a while loop for I2C reception and GPIO pin toggling. The Outline view on the right lists the functions and variables defined in the project. The bottom status bar indicates the build target is 'I2C_A7_M4_CM4.elf' and the build date is 'Mar 12, 2021 2:48:54 PM'.

```
129 while (1)
130 {
131     /* USER CODE END WHILE */
132
133     /* USER CODE BEGIN 3 */
134     if(HAL_I2C_SlaveReceive_IT(&hi2c5, (uint8_t *)aRxBuffer, 1) != HAL_OK)
135     {
136         /* Transfer error in reception process */
137         Error_Handler();
138     }
139
140     while (HAL_I2C_GetState(&hi2c5) != HAL_I2C_STATE_READY)
141     {
142     }
143
144     if(0 == (Buffercmp((uint8_t *)aRxBuffer, (uint8_t *)(&A7_cmd_LEDON), 1)))
145         HAL_GPIO_WritePin(LED_Y_GPIO_Port, LED_Y_Pin, GPIO_PIN_SET);
146     else if(0 == (Buffercmp((uint8_t *)aRxBuffer, (uint8_t *)(&A7_cmd_LEDON), 1)))
147         HAL_GPIO_WritePin(LED_Y_GPIO_Port, LED_Y_Pin, GPIO_PIN_RESET);
148     else
149     {
150         HAL_GPIO_TogglePin(LED_Y_GPIO_Port, LED_Y_Pin);
151         HAL_Delay(150);
152         HAL_GPIO_TogglePin(LED_Y_GPIO_Port, LED_Y_Pin);
153         HAL_Delay(150);
154         HAL_GPIO_TogglePin(LED_Y_GPIO_Port, LED_Y_Pin);
155         HAL_Delay(150);
156         HAL_GPIO_TogglePin(LED_Y_GPIO_Port, LED_Y_Pin);
```

main.h

- # RXBUFFERSIZE
- hi2c5: I2C_HandleTypeDef
- hipcc: IPCC_HandleTypeDef
- A7_cmd_LEDON: const uint8_t
- A7_cmd_LEDON: const uint8_t
- aRxBuffer: uint8_t[]
- SystemClock_Config(void): void
- PeriphCommonClock_Config(v
- Error_Handler(void): void
- MX_GPIO_Init(void): void
- MX_IPCC_Init(void): void
- MX_I2C5_Init(void): void
- Buffercmp(uint8_t*, uint8_t*, u
- main(void): int
- SystemClock_Config(void): void
- PeriphCommonClock_Config(v
- MX_I2C5_Init(void): void
- Buffercmp(uint8_t*, uint8_t*, u
- MX_IPCC_Init(void): void

Build Analyzer

I2C_A7_M4_CM4.elf - /I2C_A7_M4_CM4/Debug - Mar 12, 2021 2:48:54 PM

Memory Regions Memory Details

Inter-processor communication



Load the firmware and start M4

Transfer the elf file to the board:

```
PC$ scp OpenAMP_TTY_echo_CM4.elf root@192.168.7.1:/lib/firmware/
```

Indicate the firmware name for remoteproc:

```
PC $ ssh root @192.168.7.1
```

```
Board# echo OpenAMP_TTY_echo_CM4.elf >/sys/class/remoteproc/remoteproc0/firmware
```

Execute M4 firmware:

```
Board# echo start >/sys/class/remoteproc/remoteproc0/state
```

Check the virtual TTY device:

```
Board# ls -al /dev/ttyRPMSG*
```

Send cmd by A7 and check the feedback from M4:

```
Board# cat /dev/ttyRPMSG0 &
```

```
Board# echo "test" > /dev/ttyRPMSG0
```

Try to modify the code to change the logic.

Exercises



In example 2, why send 0x7b 0x66 ? Change code to send 0x7b 0x33 successfully. (Point:15)

In example 3, change code to send the message received by UART0 to UART1. Point:25)

Combined with example 1 and example 3, toggle LED after receiving virtual TTY data.(Point:5)

Thank you