TI DSP, MCU, Xilinx Zynq FPGA
프로그래밍 전문가 과정

UART based on STM32F407

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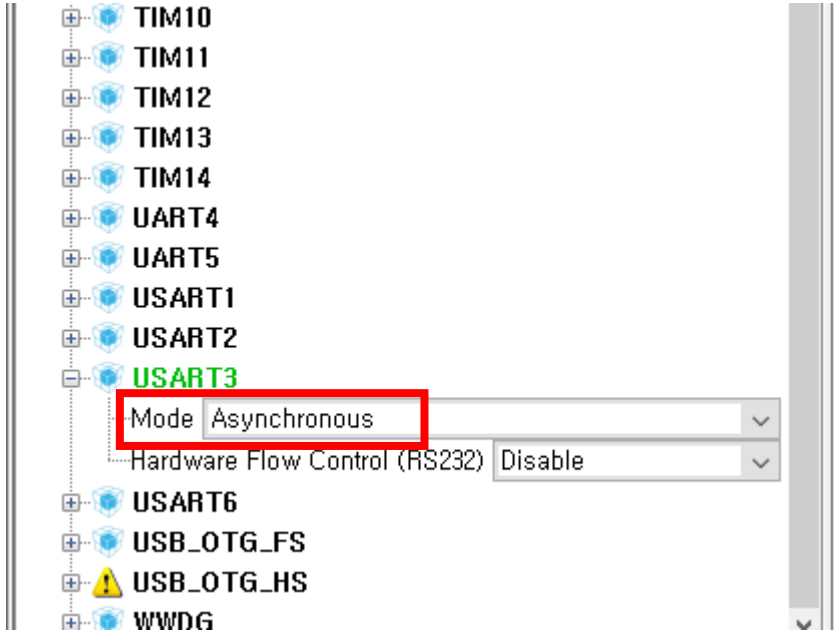
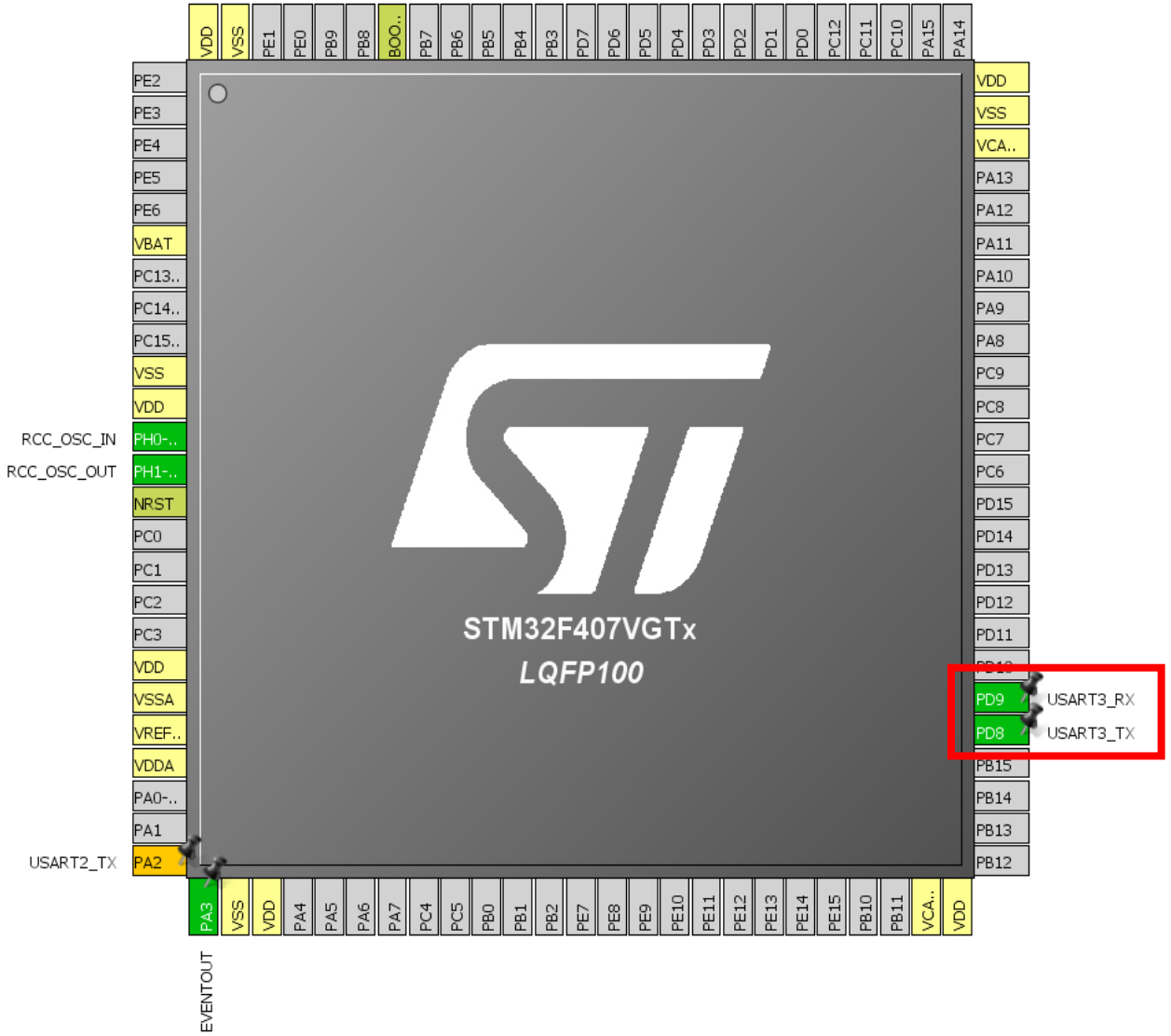
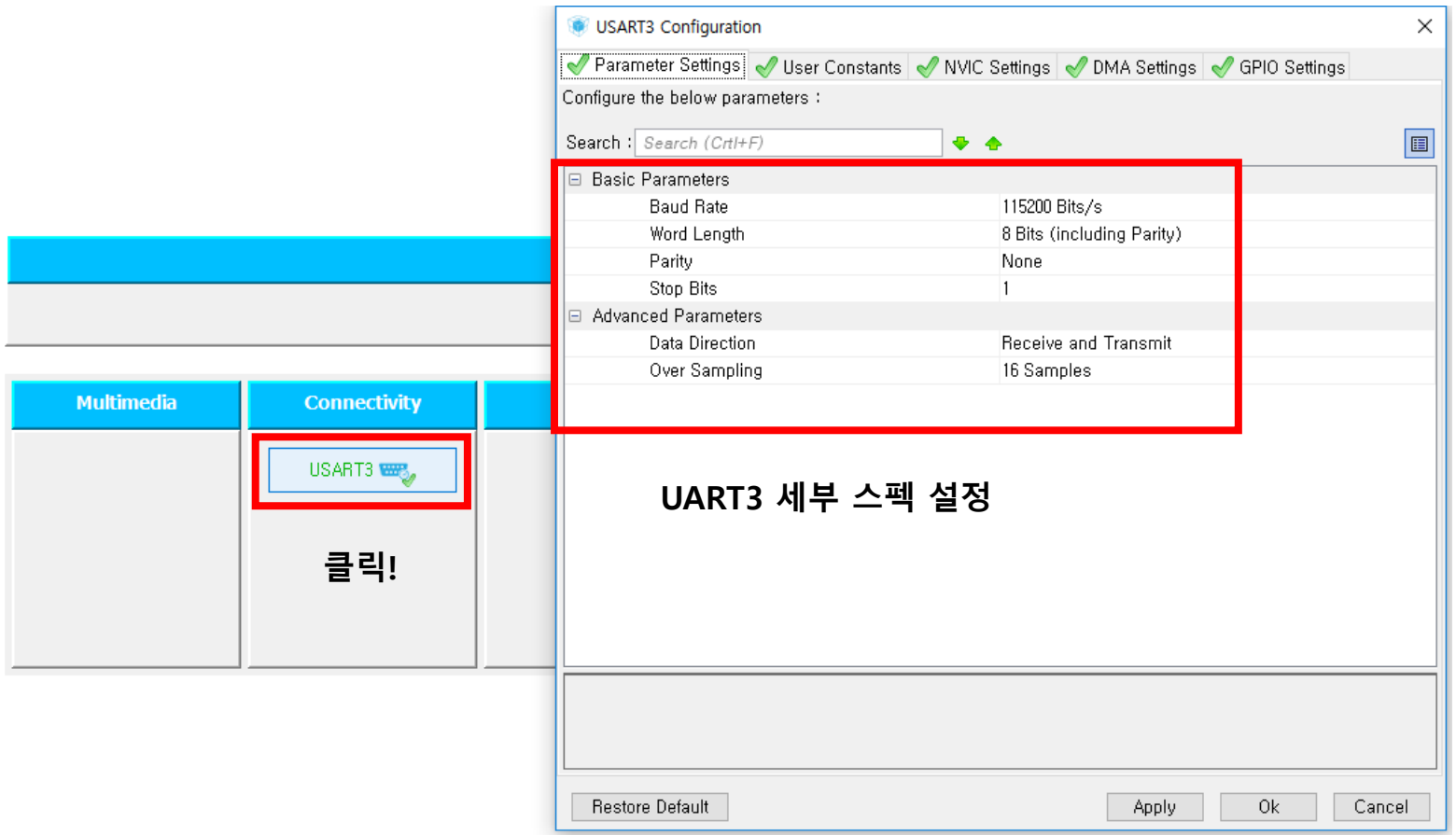
1. UART 폴링방식

- CubeMX 설정 (클럭 트리 설정 생략)



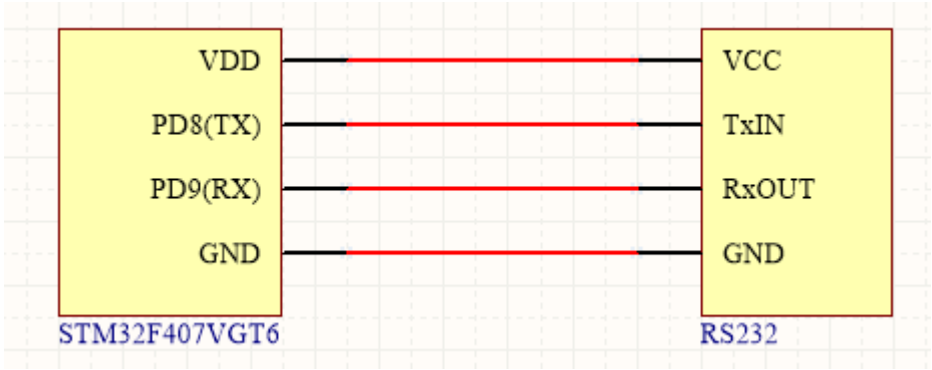




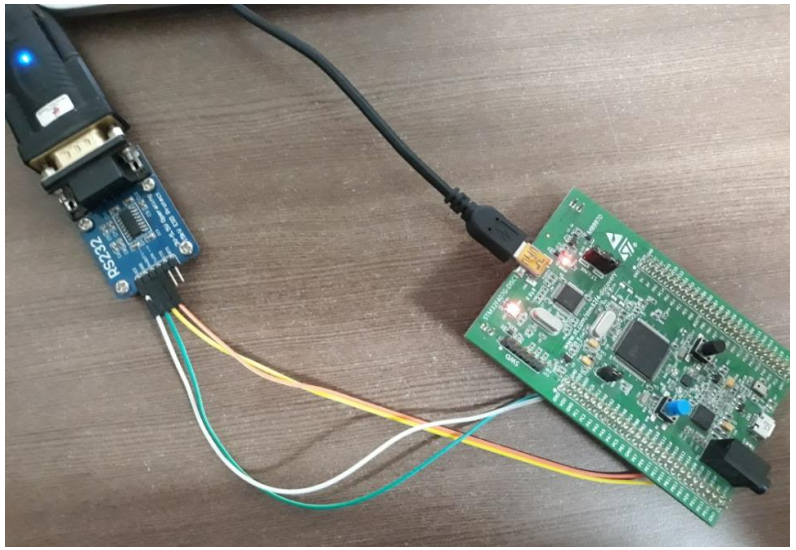
=> 단축키 CTRL+SHIFT+'G' 로 코드 생성

- 하드웨어 연결 상태

USB to RS232 케이블에 바로 연결해도 되지만, 편의상 RS232 모듈을 사용함!



MCU-RS232 회로도 (UART3)

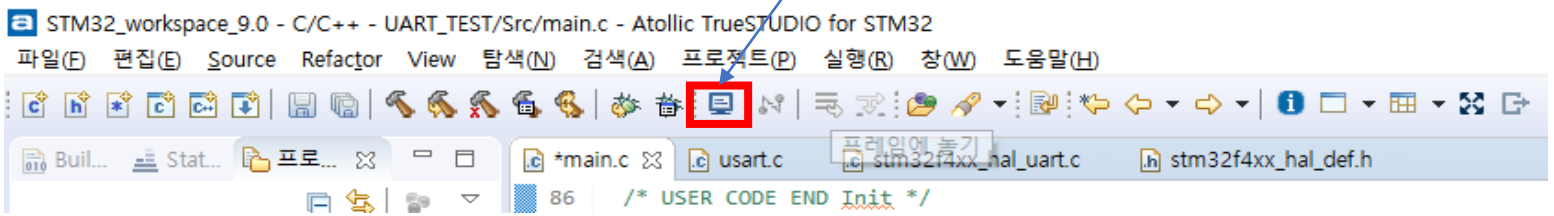


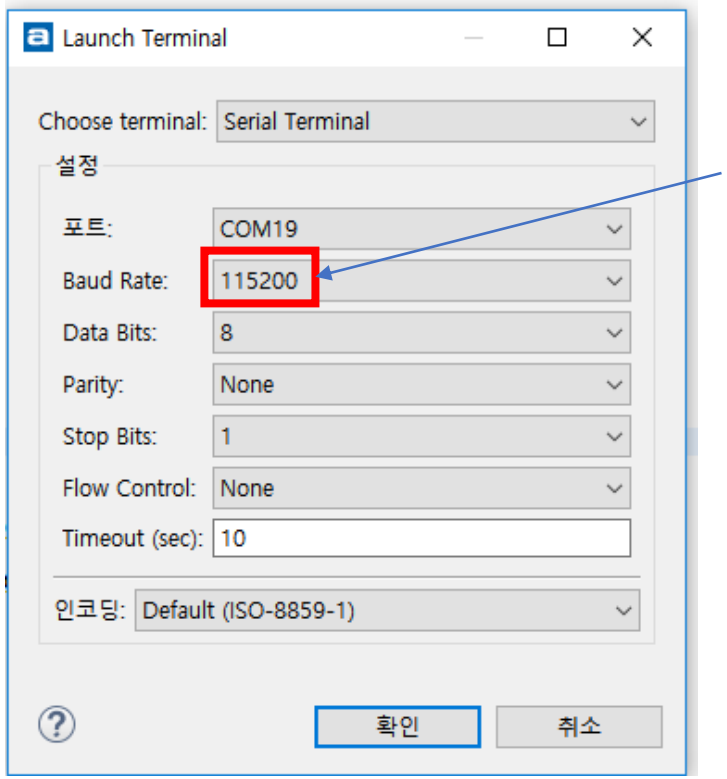
하드웨어 연결 모습

- 코드

```
while (1)
{
/* USER CODE END WHILE */

/* USER CODE BEGIN 3 */
    if(HAL_UART_Receive(&huart3, &recv, 1, 10) == HAL_OK)  <= 폴링방식일 경우 수신을 성공 했는지 체크해야함!
    {
        if(recv == 'a')
            HAL_UART_Transmit(&huart3, "josephahn\r\n", 11, 10);
        else if(recv == 's')
            HAL_UART_Transmit(&huart3, "sangjaeahn\r\n", 12, 10);
    }
}
/* USER CODE END 3 */
```

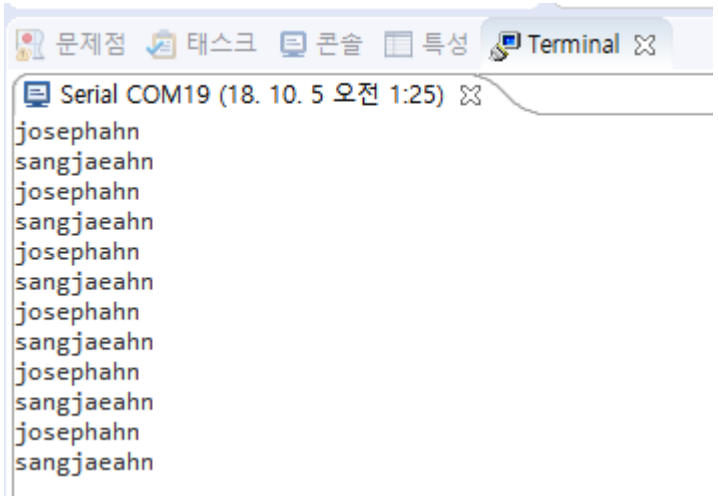
터미널 창





터미널창 통신 설정

장치 관리자 확인



콘솔창 화면

2. UART printf 사용하기

- printf() 함수 내부에 _write() 함수가 존재하고, _write() 함수의 정의부를 바꾸어서 printf() 함수의 출력 대상을 UART로 바꾸어줌!

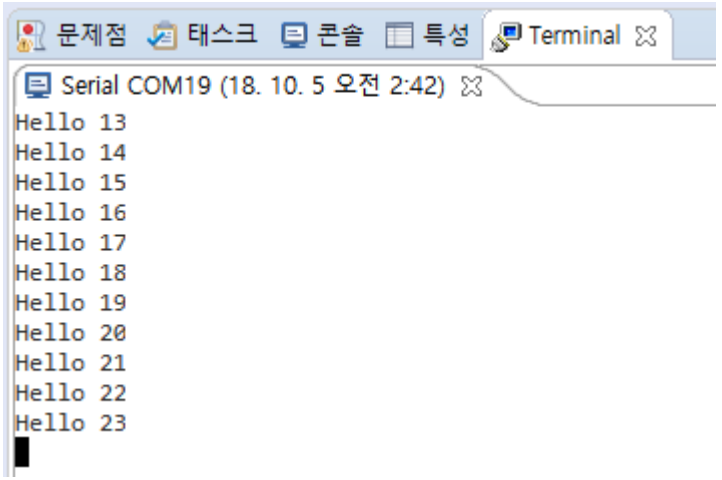
main 문 위에 _write() 함수를 정의 함

```
int _write(int file, char* p, int len)  /* printf 함수 내부의 write 함수 */
{
    HAL_UART_Transmit(&huart3, p, len, 10);
    return len;
}
```

main 문

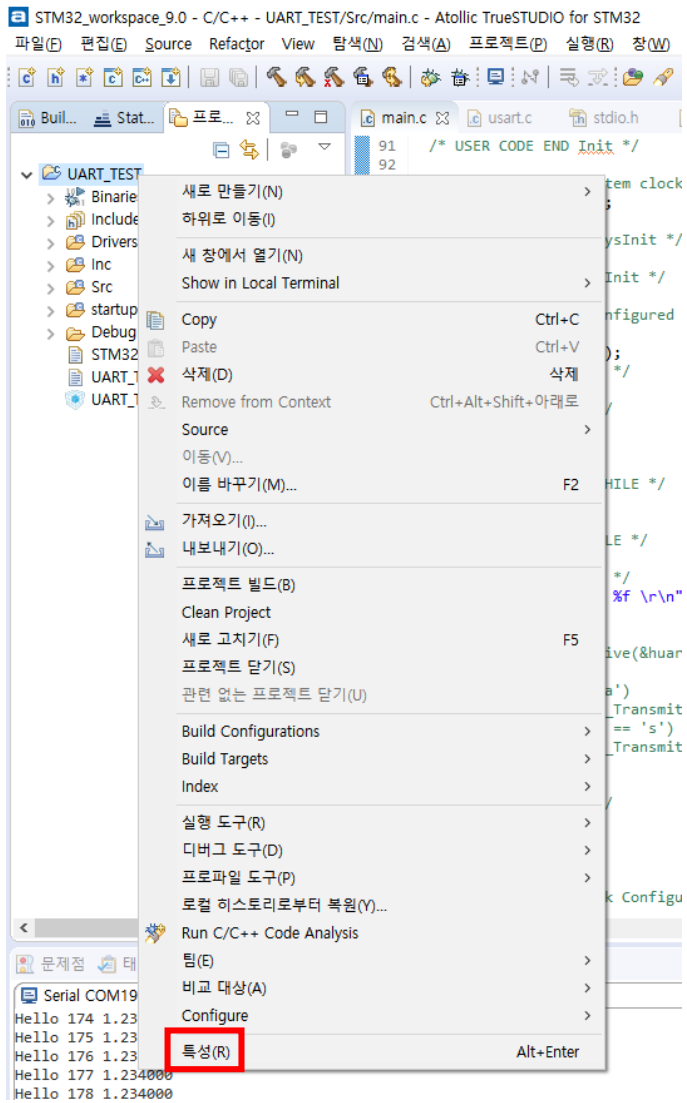
```
while (1)
{
/* USER CODE END WHILE */

/* USER CODE BEGIN 3 */
     printf("Hello %d\r\n", a++);
     HAL_Delay(1000);
}
/* USER CODE END 3 */
```

터미널 창

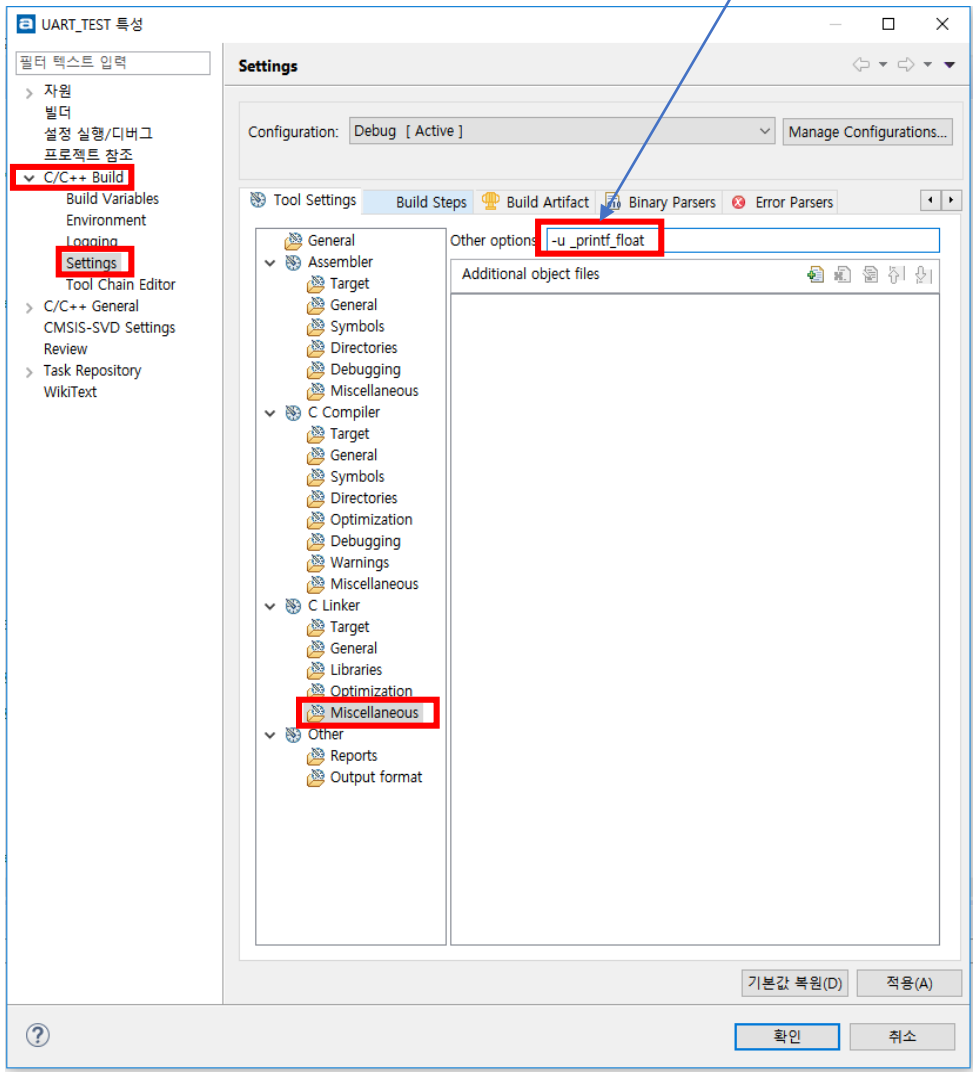


*** 소숫점 출력 방법**

-> 대부분의 마이크로프로세서에서는 printf()함수의 출력이 정수 형태로 출력이 되도록 되어 있음!



옵션 추가

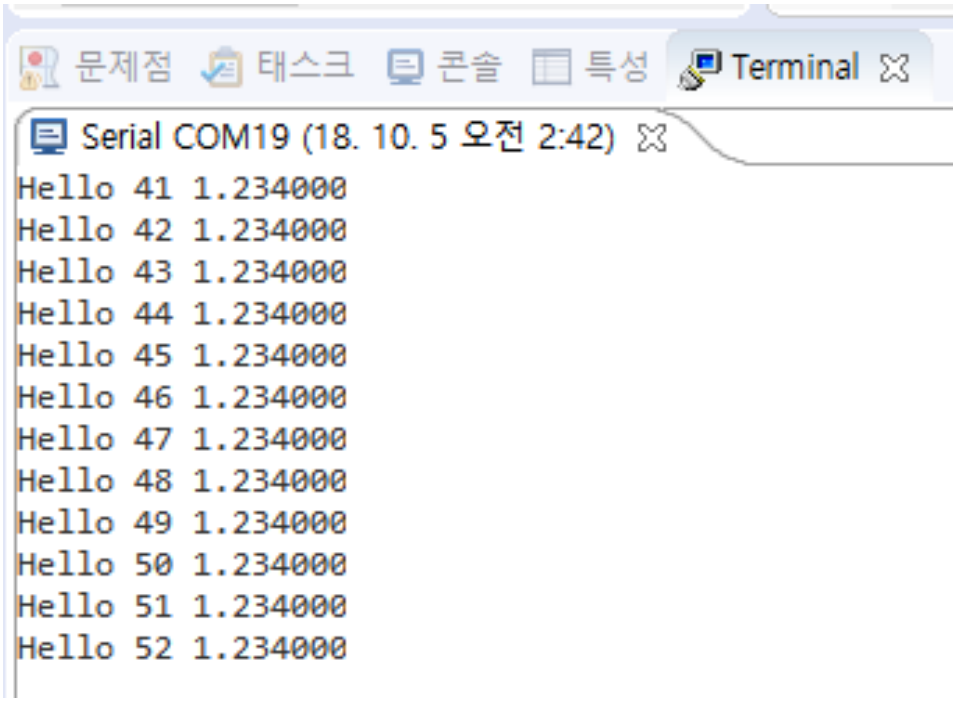


- 소숫점 출력

main 문

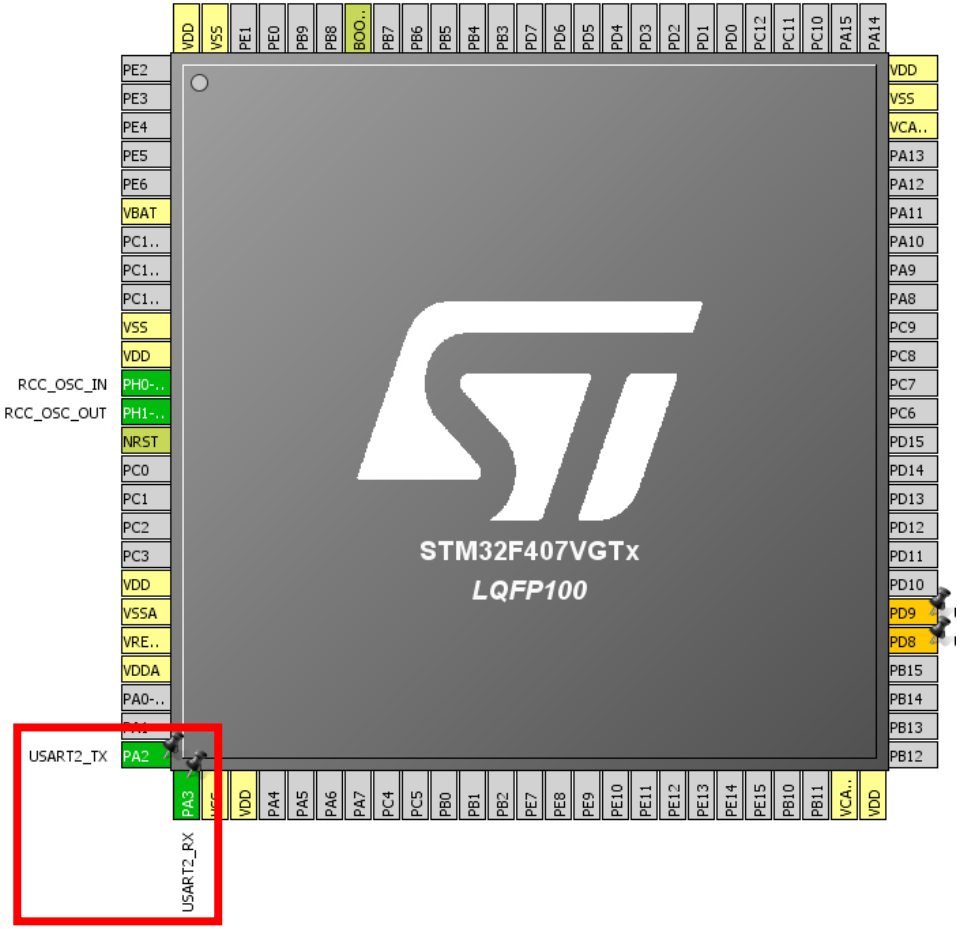
```
uint8_t a=0;
float f = 1.234;
/* Infinite loop */
/* USER CODE BEGIN WHILE */
while (1)
{
/* USER CODE END WHILE */

/* USER CODE BEGIN 3 */
    printf("Hello %d %f\r\n", a++, f);
    HAL_Delay(1000);
}
/* USER CODE END 3 */
```

터미널 창

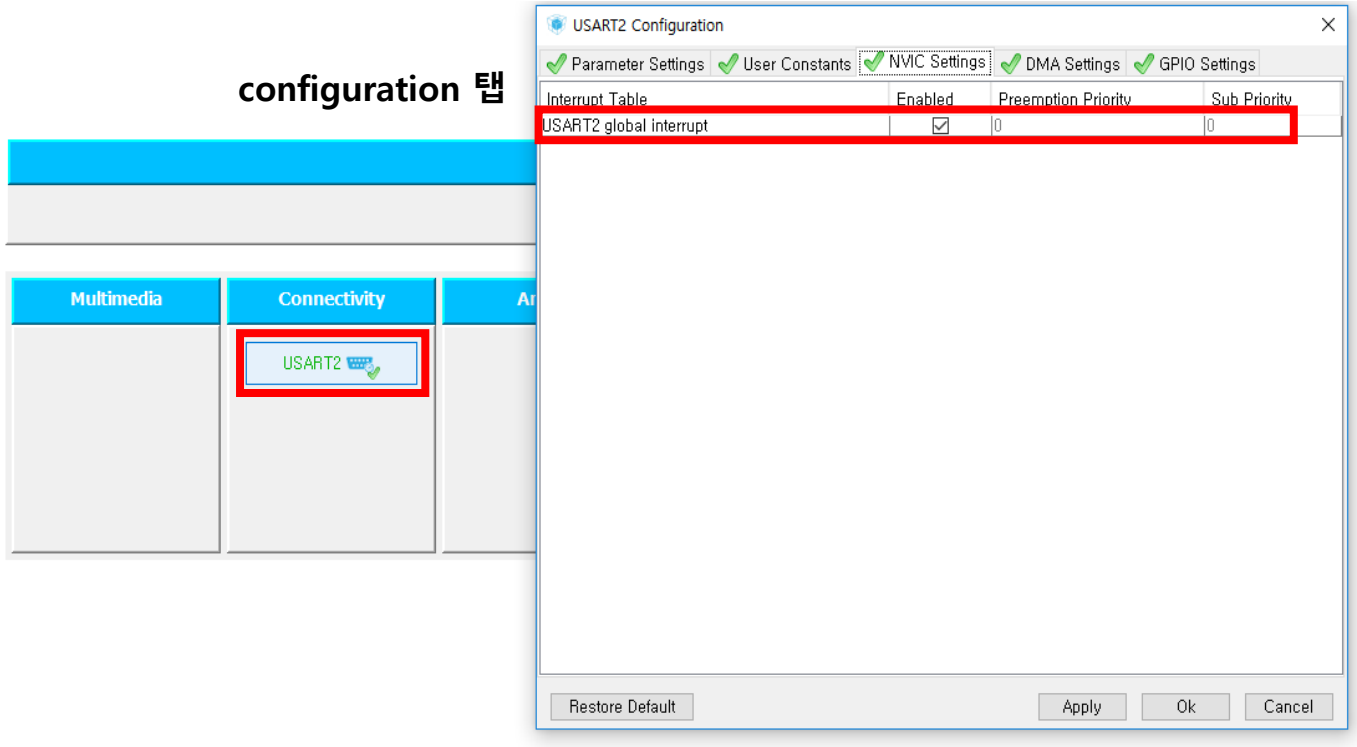


3. UART 인터럽트

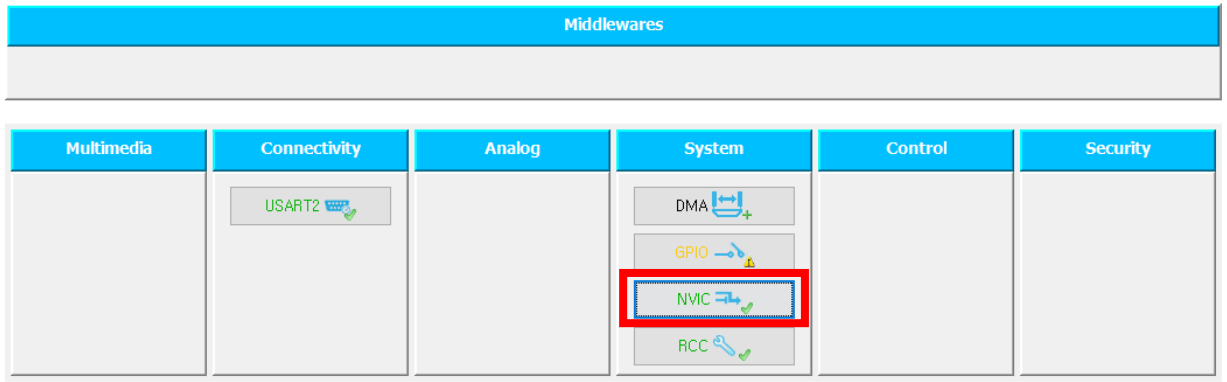
- CubeMX 설정

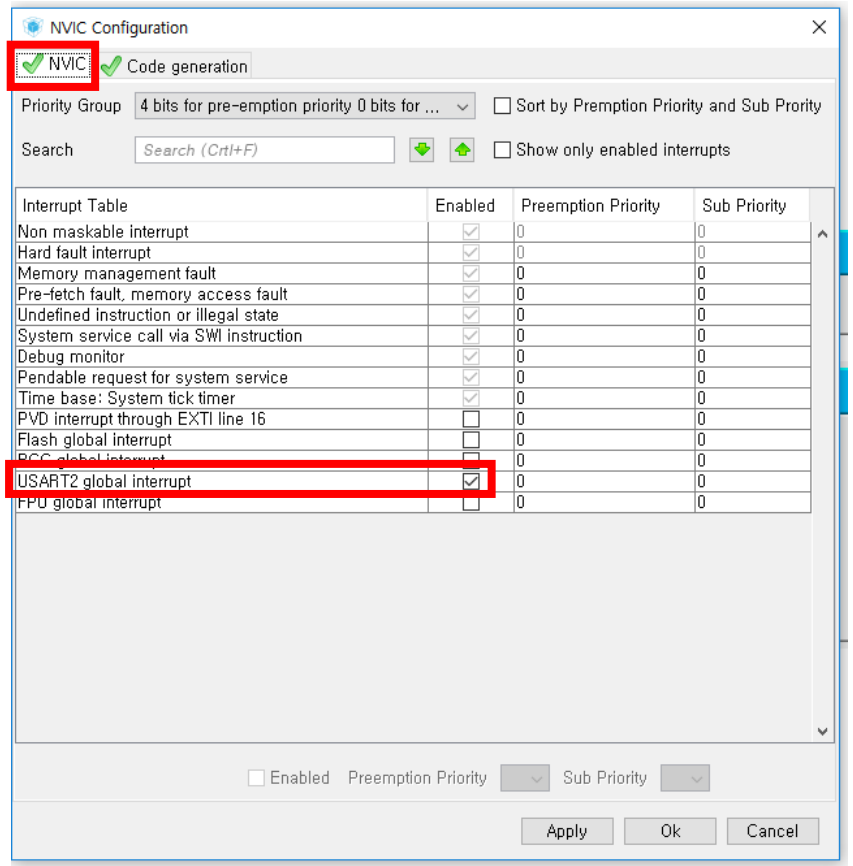


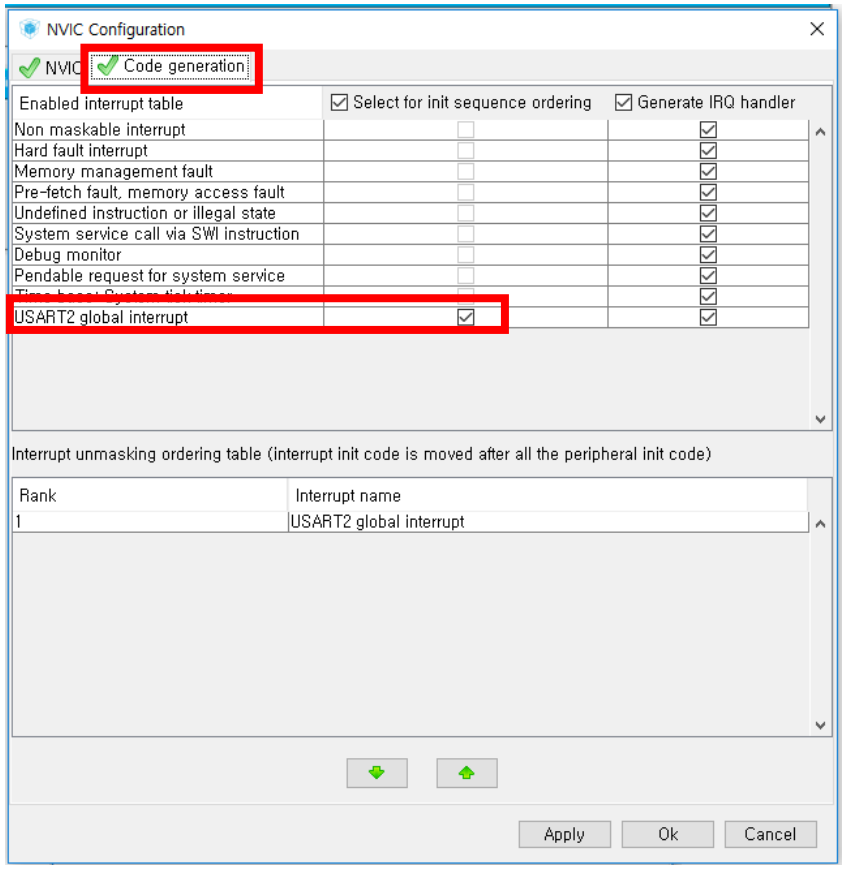
configuration 탭



configuration 탭







- 소스 코드

```
79  int main(void)
80  {
81    /* USER CODE BEGIN 1 */
82      uint8_t recv = 0;
83    /* USER CODE END 1 */
84
85    /* Reset of all peripherals, Initializes the Flash interface and the Systick. */
86    HAL_Init();
87
88    /* Configure the system clock */
89    SystemClock_Config();
90
91    /* Initialize all configured peripherals */
92    MX_GPIO_Init();
93    MX_USART2_UART_Init();
94
95    /* Initialize interrupts */
96    MX_NVIC_Init();
97    /* USER CODE BEGIN 2 */
98
99    // rx3_data에 1바이트 채워지면 인터럽트를 호출하겠다!
100   // 이 코드가 없으면 인터럽트 핸들러 자체가 안걸림!
101   HAL_UART_Receive_IT(&huart2, &rx, 1);
102   /* USER CODE END 2 */
103
104   /* Infinite loop */
105   /* USER CODE BEGIN WHILE */
106   while (1)
107   {
108   /* USER CODE END WHILE */
109
110   /* USER CODE BEGIN 3 */
111       HAL_Delay(1000);
112   }
113   /* USER CODE END 3 */
114
115 }
```

main 문 안에서 반드시 써줘야함!

IRQ 핸들러

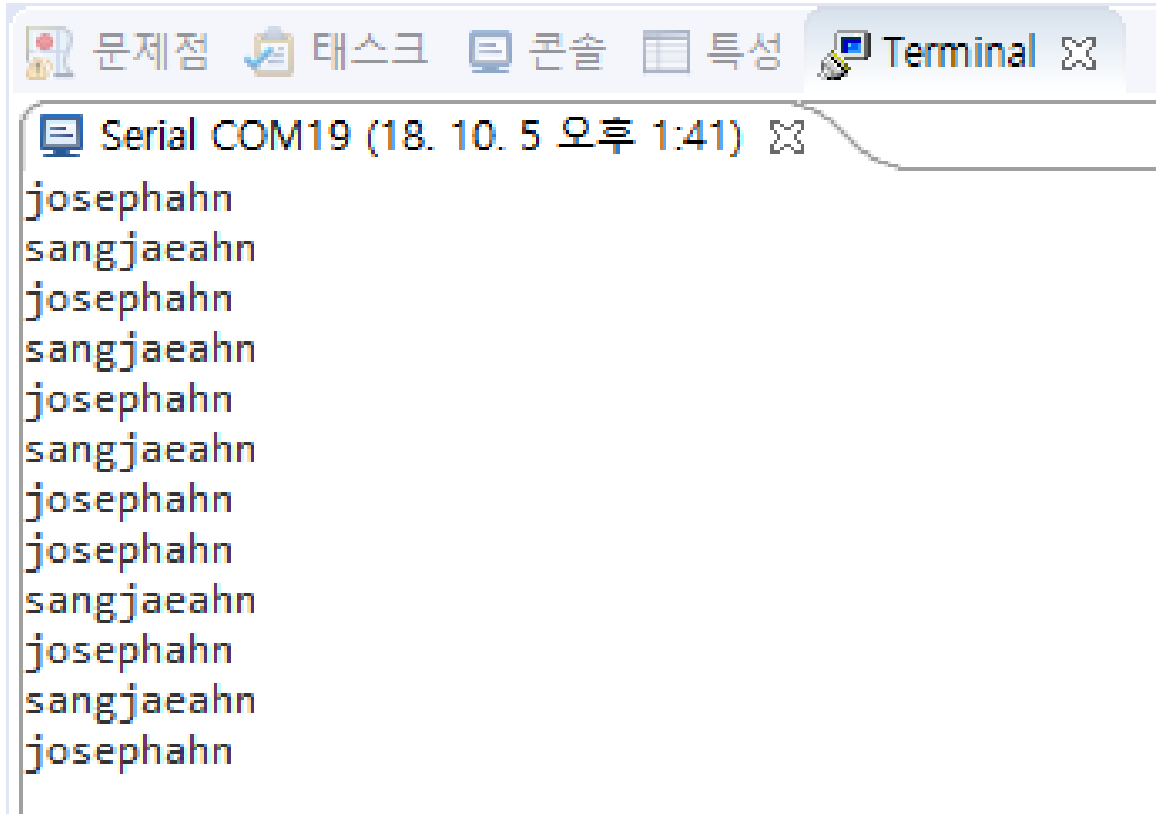
```
void USART2_IRQHandler(void)
{
  /* USER CODE BEGIN USART2_IRQn 0 */

  /* USER CODE END USART2_IRQn 0 */
  HAL_UART_IRQHandler(&huart2);
  /* USER CODE BEGIN USART2_IRQn 1 */

  /* USER CODE END USART2_IRQn 1 */
}
```

IRQ 핸들러에서 이 함수를 호출하게 됨!

=> main 문 밑에서 정의부를 다시 해주어야함!

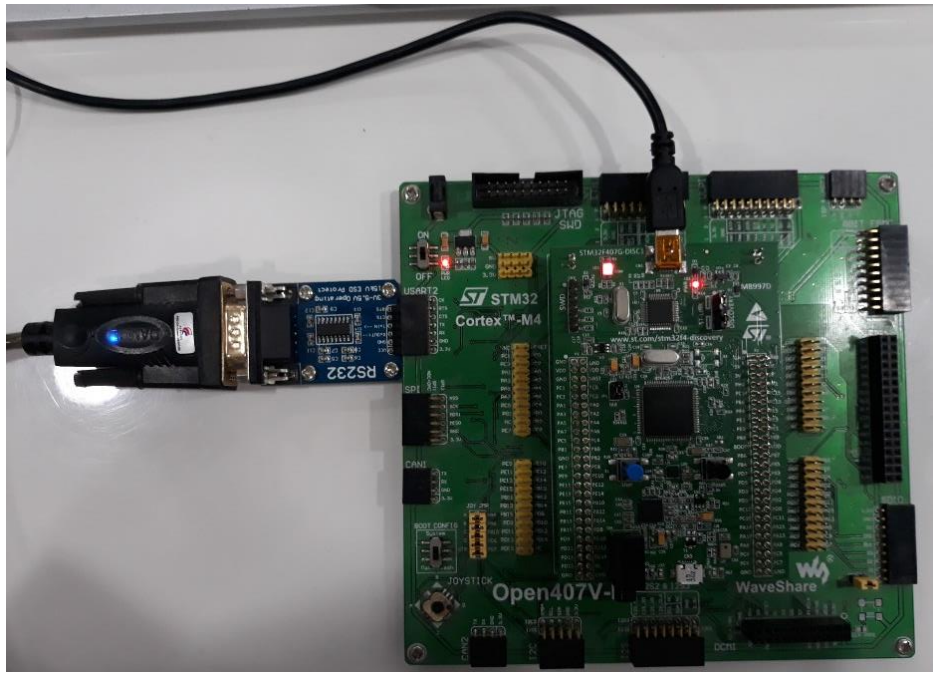
```
187
188 void HAL_UART_RxCpltCallback(UART_HandleTypeDef *huart)
189 {
190     if(huart->Instance == USART2)
191     {
192         HAL_UART_Receive_IT(&huart2, &rx, 1);
193         if(rx == 'a')
194             HAL_UART_Transmit(&huart2, "josephahn\r\n", 11, 10);
195         else if(rx == 's')
196             HAL_UART_Transmit(&huart2, "sangjaeahn\r\n", 12, 10);
197     }
198 }
```

- 결과 화면

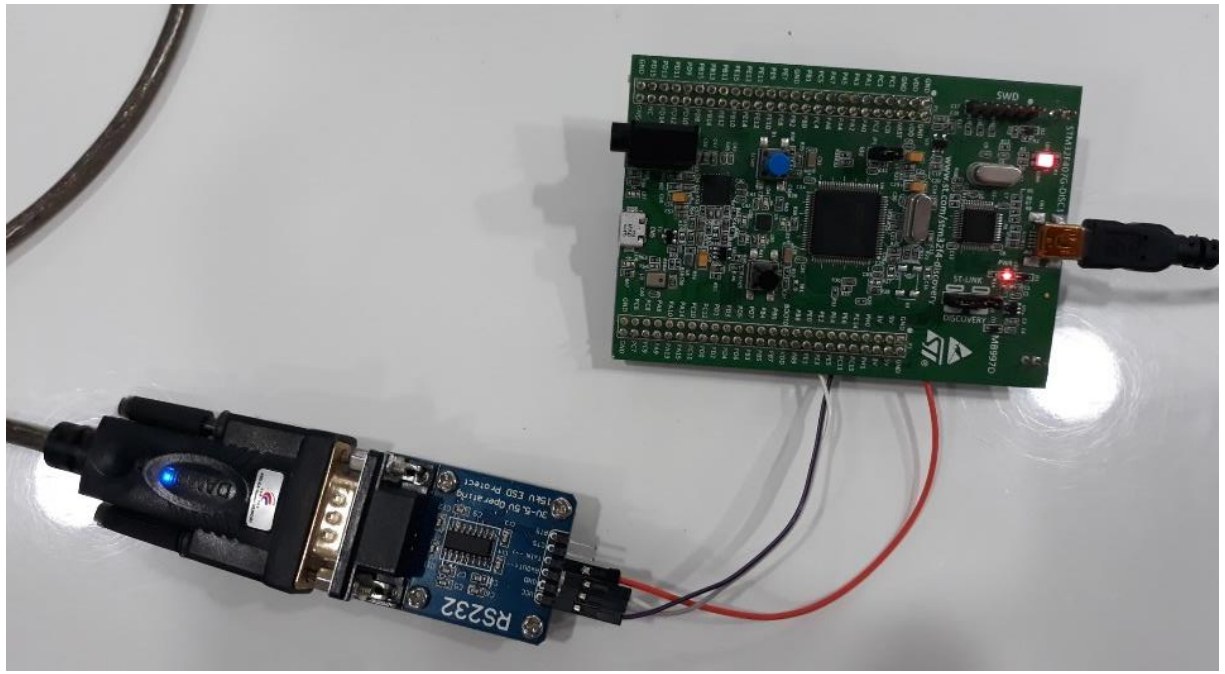

문제점
태스크
콘솔
특성
Terminal
Serial COM19 (18. 10. 5 오후 1:41)
josephahn
sangjaeahn
josephahn
sangjaeahn
josephahn
sangjaeahn
josephahn
josephahn
sangjaeahn
josephahn
sangjaeahn
josephahn

- 하드웨어 연결 상태

MCU–RS232 모듈 연결



STM32F4-DISC1의 확장보드를 사용한 경우



확장보드를 사용하지 않고 점퍼선으로 연결