TI DSP, MCU, Xilinx Zynq FPGA 프로그래밍 전문가 과정

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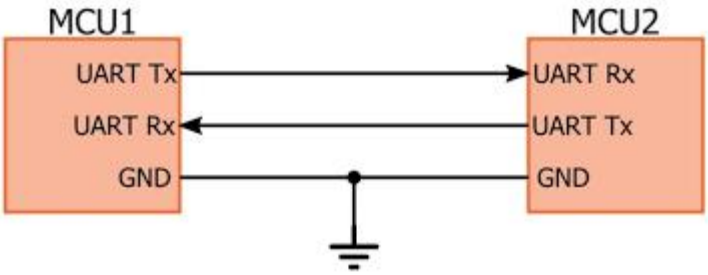
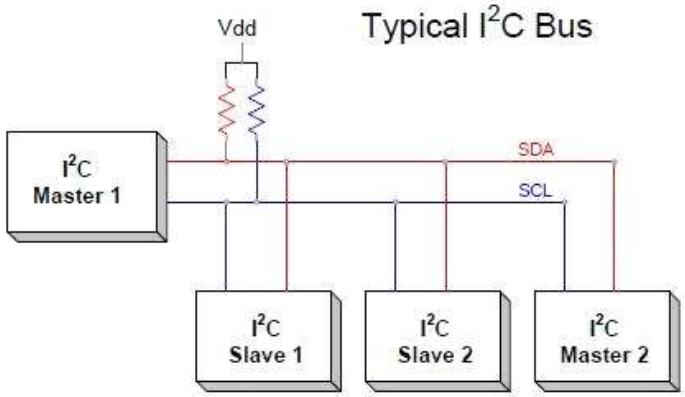
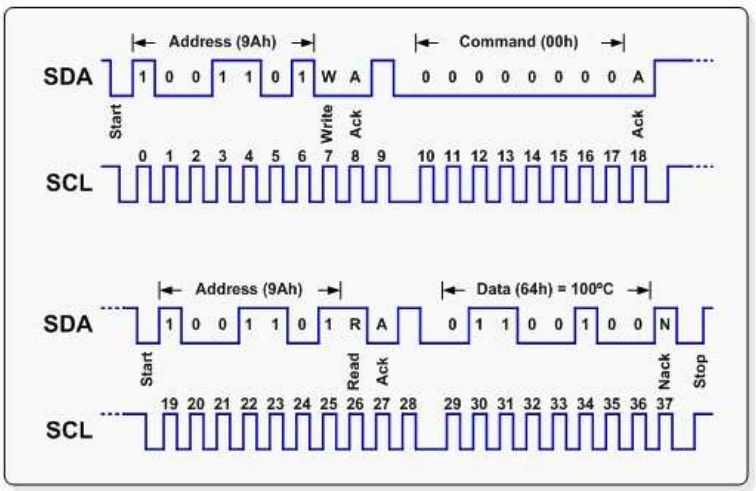
Uart & I2C 통신



Uart란 Harf duplex 방식의 통신으로, Rx, Tx 2개의 선을 이용하여 TTL 레벨에서 통신한다.



I2C는 단 2개의 선 sda와 scl로, 여러 개의 디바이스를 제어할 수 있는 장점이 있다.
여러 개의 디바이스를 제어하기 때문에, 각 디바이스마다 address가 존재한다.



위와 같이, start bit, address, R/W bit, Ack, data, ack로 이루어져 있다.
이 프로토콜에 따라 데이터를 전송하면, I2C 통신이 활성화된다.
MPU6050의 경우, clk == 400kHz, write address == 0x6B

```c
#include "HL_sys_common.h"
#include "HL_system.h"
#include "HL_etpwm.h"
#include "HL_sci.h"
#include "HL_gio.h"
#include "HL_i2c.h"
#include "HL_rti.h"
#include <string.h>
#include <stdio.h>
#define UART           sciREG1
#define MPU6050_ADDR    0x68
void sciDisplayText(sciBASE_t *sci, uint8 *text, uint32 len);
void pwmSet(void);
void wait(uint32 delay);
void MPU6050_enable(void);
void MPU6050_acc_config(void);
void disp_set(char *);
uint32 rx_data = 0;
uint32 tmp = 0;
uint32 value = 0;
volatile char g_acc_xyz[6];
volatile int g_acc_flag;
#define IDX     6
uint32 duty_arr[IDX] = {1000, 1200, 1400, 1600, 1800, 2000};
int main(void)
{
    char txt_buf[64] = {0};
    unsigned int buf_len;
    volatile int i;
    signed short acc_x, acc_y, acc_z;
    double real_acc_x, real_acc_y, real_acc_z;
    sciInit();
    disp_set("SCI Configuration Success!!\n\r\0");
    gioInit();
    disp_set("GIO Init Success!!\n\r\0");
    i2cInit();
    disp_set("1\n\r\0");
    wait(10000000);
    MPU6050_enable();
    disp_set("MPU6050 Enable Success!!\n\r\0");
    MPU6050_acc_config();
    disp_set("MPU6050 Accelerometer Configure Success!!\n\r\0");
    rtiInit();
    rtiEnableNotification(rtiREG1, rtiNOTIFICATION_COMPARE0);
    _enable_IRQ_interrupt_();
    rtiStartCounter(rtiREG1, rtiCOUNTER_BLOCK0);
    disp_set("RTI Init Success!!\n\r\0");
    etpwmInit();
    disp_set("ETPWM Configuration Success!!\n\r\0");
    etpwmStartTBCLK();
    wait(1000000);
    for(;;)
    {
        if(g_acc_flag)
```

```
        {
            acc_x = acc_y = acc_z = 0;
            real_acc_x = real_acc_y = real_acc_z = 0.0;
            acc_x = g_acc_xyz[0];
            acc_x = acc_x << 8;
            acc_x |= g_acc_xyz[1];
            real_acc_x = ((double)acc_x) / 2048.0;
            acc_y = g_acc_xyz[2];
            acc_y = acc_y << 8;
            acc_y |= g_acc_xyz[3];
            real_acc_y = ((double)acc_y) / 2048.0;
            acc_z = g_acc_xyz[4];
            acc_z = acc_z << 8;
            acc_z |= g_acc_xyz[5];
            real_acc_z = ((double)acc_z) / 2048.0;
            sprintf(txt_buf, "acc_x = %2.5lf\tacc_y = %2.5lf\tacc_z = %2.5lf\n\r\0",
                    real_acc_x, real_acc_y, real_acc_z);
            buf_len = strlen(txt_buf);
            sciDisplayText(sciREG1, (uint8 *)txt_buf, buf_len);
            g_acc_flag = 0;
        }
    }
#if 0
    for(;;)
    {
        tmp = sciReceiveByte(UART);
        rx_data = tmp - 48;
        sprintf(txt_buf, "rx = %d\n\r\0", rx_data);
        buf_len = strlen(txt_buf);
        sciDisplayText(sciREG1, (uint8 *)txt_buf, buf_len);
        pwmSet();
        sprintf(txt_buf, "PWM Duty = %d\n\r\0", value);
        buf_len = strlen(txt_buf);
        sciDisplayText(sciREG1, (uint8 *)txt_buf, buf_len);
    }
#endif
    return 0;
}
void pwmSet(void)
{
    value = duty_arr[rx_data];
    etpwmSetCmpA(etpwmREG1, value);
    wait(10000);
}
void wait(uint32 delay)
{
    int i;
    for(i = 0; i < delay; i++)
        ;
}
void sciDisplayText(sciBASE_t *sci, uint8 *text, uint32 len)
{
    while(len--)
    {
```

```
        while((UART->FLR & 0x4) == 4)
            ;
        sciSendByte(UART, *text++);
    }
}
void MPU6050_enable(void)
{
    volatile unsigned int cnt = 2;
    unsigned char data[2] = {0x00U, 0x00U};
    unsigned char slave_word_address = 0x6bU;
    i2cSetSlaveAdd(i2cREG2, MPU6050_ADDR);
    disp_set("2\n\r\0");
    i2cSetDirection(i2cREG2, I2C_TRANSMITTER);
    disp_set("3\n\r\0");
    i2cSetCount(i2cREG2, cnt + 1);
    disp_set("4\n\r\0");
    i2cSetMode(i2cREG2, I2C_MASTER);
    disp_set("5\n\r\0");
    i2cSetStop(i2cREG2);
    disp_set("6\n\r\0");
    i2cSetStart(i2cREG2);
    disp_set("7\n\r\0");
    i2cSendByte(i2cREG2, slave_word_address);
    disp_set("8\n\r\0");
    i2cSend(i2cREG2, cnt, data);
    while(i2cIsBusBusy(i2cREG2) == true)
        ;
    while(i2cIsStopDetected(i2cREG2) == 0)
        ;
    disp_set("10\n\r\0");
    i2cClearSCD(i2cREG2);
    wait(1000000);
}
void MPU6050_acc_config(void)
{
    volatile unsigned int cnt = 1;
    unsigned char data[1] = {0x18U};
    unsigned char slave_word_address = 0x1cU;
    i2cSetSlaveAdd(i2cREG2, MPU6050_ADDR);
    i2cSetDirection(i2cREG2, I2C_TRANSMITTER);
    i2cSetCount(i2cREG2, cnt + 1);
    i2cSetMode(i2cREG2, I2C_MASTER);
    i2cSetStop(i2cREG2);
    i2cSetStart(i2cREG2);
    i2cSendByte(i2cREG2, slave_word_address);
    i2cSend(i2cREG2, cnt, data);
    while(i2cIsBusBusy(i2cREG2) == true)
        ;
    while(i2cIsStopDetected(i2cREG2) == 0)
        ;
    i2cClearSCD(i2cREG2);
    wait(1000000);
}
void rtiNotification(rtiBASE_t *rtiREG, uint32 notification)
```

```
{
    unsigned char slave_word_address = 0x3B;
    i2cSetSlaveAdd(i2cREG2, MPU6050_ADDR);
    i2cSetDirection(i2cREG2, I2C_TRANSMITTER);
    i2cSetCount(i2cREG2, 1);
    i2cSetMode(i2cREG2, I2C_MASTER);
    i2cSetStop(i2cREG2);
    i2cSetStart(i2cREG2);
    i2cSendByte(i2cREG2, slave_word_address);
    while(i2cIsBusBusy(i2cREG2) == true)
        ;
    while(i2cIsStopDetected(i2cREG2) == 0)
        ;
    i2cClearSCD(i2cREG2);
    i2cSetDirection(i2cREG2, I2C_RECEIVER);
    i2cSetCount(i2cREG2, 6);
    i2cSetMode(i2cREG2, I2C_MASTER);
    i2cSetStart(i2cREG2);
    i2cReceive(i2cREG2, 6, (unsigned char *)g_acc_xyz);
    i2cSetStop(i2cREG2);
    while(i2cIsBusBusy(i2cREG2) == true)
        ;
    while(i2cIsStopDetected(i2cREG2) == 0)
        ;
    i2cClearSCD(i2cREG2);
    g_acc_flag = 1;
}
void disp_set(char *str)
{
    char txt_buf[64] = {0};
    unsigned int buf_len;
    sprintf(txt_buf, str);
    buf_len = strlen(txt_buf);
    sciDisplayText(sciREG1, (uint8 *)txt_buf, buf_len);
    wait(100000);
}
```