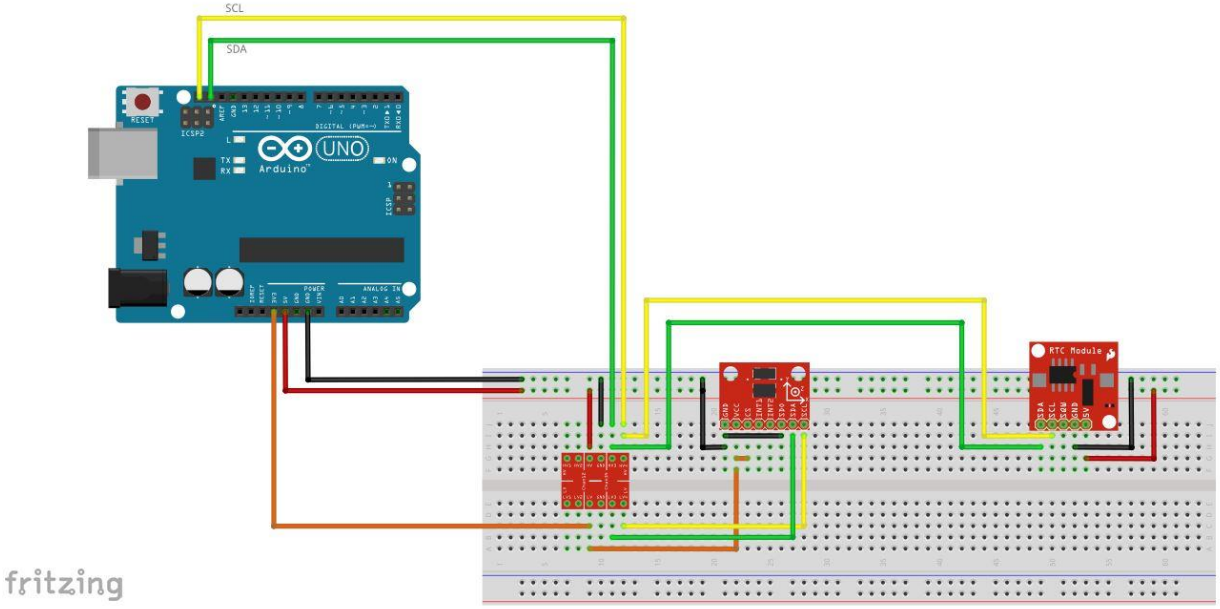
Lab #4b
RTC and ADXL345

Ver 0.7

Background:

This week we will combine what we did in Lab #4a with the ADXL345 Accelerometer in I2C mode. To hook up both devices to the I2C bus, we will need a Level Converter (since the RTC is 5v and the ADXL345 is 3.3). Hook them up as shown:

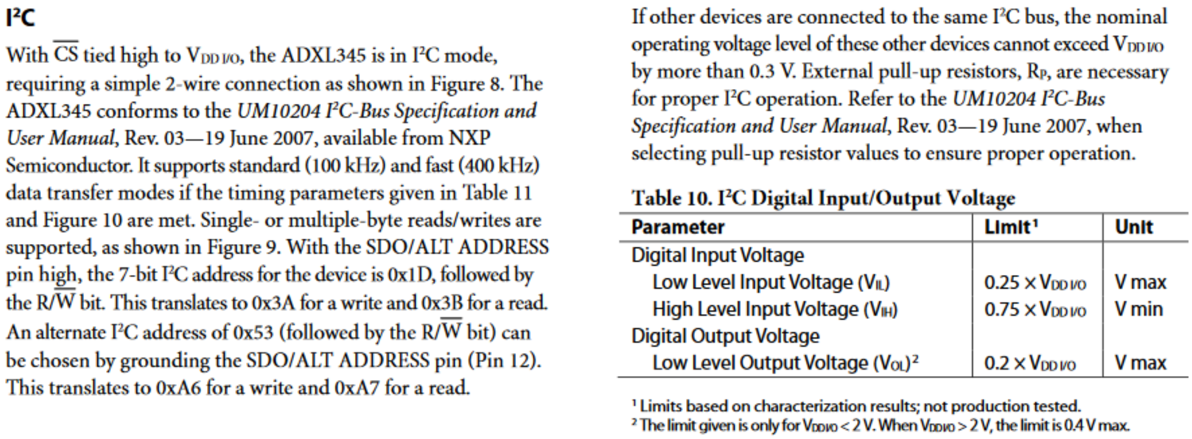


Now copy the project for Lab 7a and create a new copy for Lab 7b and open the project.

We will make one alteration to the existing functions. Remove the i2c_int() function call in the rtc_init() function and move it to main (Before the call to rtc_int()). This is better coding since we will be using i2c for two devices, it will be clear that the i2c is initialized before trying to initialize the RTC and ADXL345.

Now we will add functions to talk to the ADXL345. The code already has functions for stop, write, read, start and init, we will be creating the functions necessary to initialize the ADXL345 and the read the X,Y,Z values.

From the datasheet:



I^{2}C

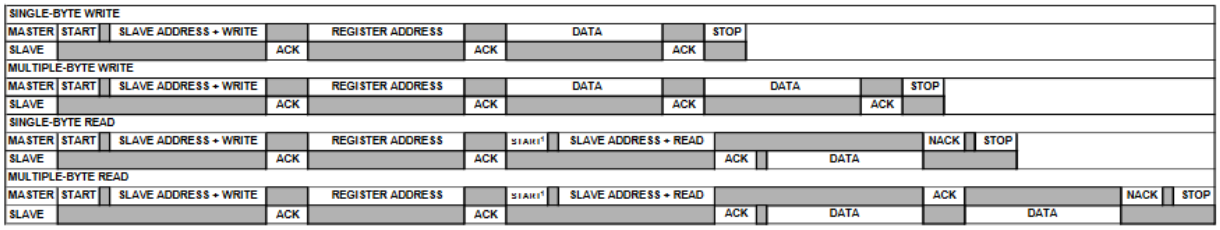
With $\overline{CS}$ tied high to $V_{DD I/O}$, the ADXL345 is in I^{2}C mode, requiring a simple 2-wire connection as shown in Figure 8. The ADXL345 conforms to the *UM10204 I^{2}C-Bus Specification and User Manual*, Rev. 03—19 June 2007, available from NXP Semiconductor. It supports standard (100 kHz) and fast (400 kHz) data transfer modes if the timing parameters given in Table 11 and Figure 10 are met. Single- or multiple-byte reads/writes are supported, as shown in Figure 9. With the SDO/ALT ADDRESS pin high, the 7-bit I^{2}C address for the device is 0x1D, followed by the R/$\overline{W}$ bit. This translates to 0x3A for a write and 0x3B for a read. An alternate I^{2}C address of 0x53 (followed by the R/$\overline{W}$ bit) can be chosen by grounding the SDO/ALT ADDRESS pin (Pin 12). This translates to 0xA6 for a write and 0xA7 for a read.

If other devices are connected to the same I^{2}C bus, the nominal operating voltage level of these other devices cannot exceed $V_{DD I/O}$ by more than 0.3 V. External pull-up resistors, R_P, are necessary for proper I^{2}C operation. Refer to the *UM10204 I^{2}C-Bus Specification and User Manual*, Rev. 03—19 June 2007, when selecting pull-up resistor values to ensure proper operation.

Table 10. I^{2}C Digital Input/Output Voltage

Parameter	Limit[1]	Unit
Digital Input Voltage		
Low Level Input Voltage (V_{IL})	0.25 × $V_{DD I/O}$	V max
High Level Input Voltage (V_{IH})	0.75 × $V_{DD I/O}$	V min
Digital Output Voltage		
Low Level Output Voltage (V_{OL})[2]	0.2 × $V_{DD I/O}$	V max

[1] Limits based on characterization results; not production tested.
[2] The limit given is only for $V_{DDIO} < 2$ V. When $V_{DDIO} > 2$ V, the limit is 0.4 V max.


SINGLE-BYTE WRITE
MASTER | START | SLAVE ADDRESS + WRITE | REGISTER ADDRESS | DATA | STOP
SLAVE | ACK | ACK | ACK
MULTIPLE-BYTE WRITE
MASTER | START | SLAVE ADDRESS + WRITE | REGISTER ADDRESS | DATA | DATA | STOP
SLAVE | ACK | ACK | ACK | ACK
SINGLE-BYTE READ
MASTER | START | SLAVE ADDRESS + WRITE | REGISTER ADDRESS | START1 | SLAVE ADDRESS + READ | NACK | STOP
SLAVE | ACK | ACK | ACK | DATA
MULTIPLE-BYTE READ
MASTER | START | SLAVE ADDRESS + WRITE | REGISTER ADDRESS | START1 | SLAVE ADDRESS + READ | ACK | NACK | STOP
SLAVE | ACK | ACK | ACK | DATA | DATA
07925-009

[1]THIS START IS EITHER A RESTART OR A STOP FOLLOWED BY A START.

NOTES
1. THE SHADED AREAS REPRESENT WHEN THE DEVICE IS LISTENING.

Figure 9. I^{2}C Device Addressing

We will be using the same registers and setup values for the ADXL345 as we did for the SPI Experiment. But if you notice in the figure above, we must send the slave address + write before sending the register and data in I2C mode.

To read the x,y,z values back, we will use the Multiple-Byte Read as shown above.

Also note, since we are connecting SDO to GND, we are using the alternate 7-bit address 0x53.

It is suggested that you pass the full 16 bit values of X,Y,Z using the same method used for the RTC hour, minute and seconds.