Application Note

AN000601

Hello World for AS726xN Sensors

How to Implement a Connection between Sensor and µController

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Content Guide

1 Introduction

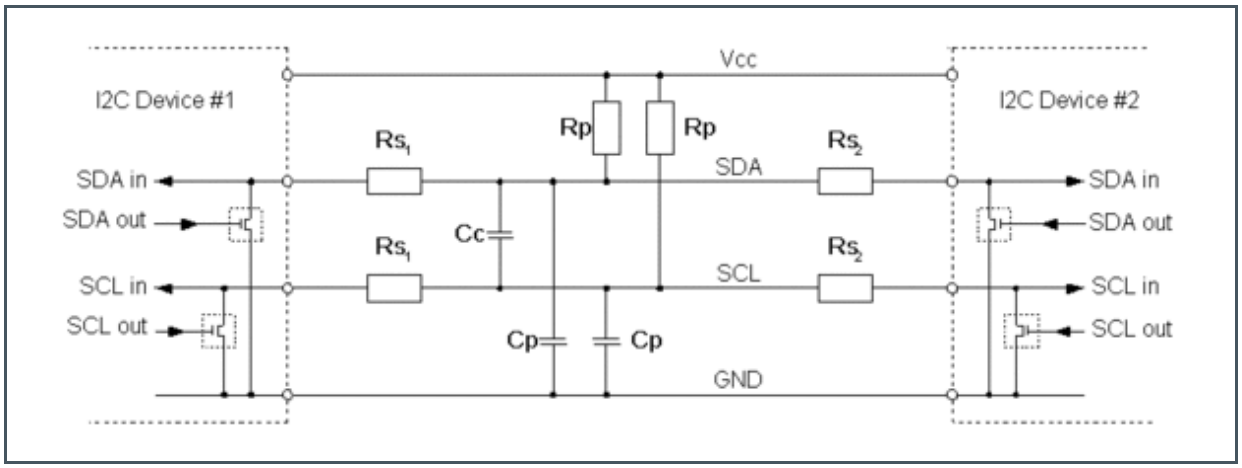
This “Hello World” – Application Note describes how to implement a connection between **ams** AS7264N sensor and a microcontroller via I^2C Communication. This operates with an industrial-standard I^2C connection. The I^2C communication bus is very popular and broadly used by many electronic devices because it can be easily implemented in many electronic designs which require communication between a master and multiple slave devices or even multiple master devices. The easy implementations comes with the fact that only two wires are required for communication between up to almost 128 (112) devices when using 7 bits addressing and up to almost 1024 (1008) devices when using 10 bits addressing.

2 Prepare the Connection

The device has a preset ID or a unique device address so the master can choose with which devices will be communicated.

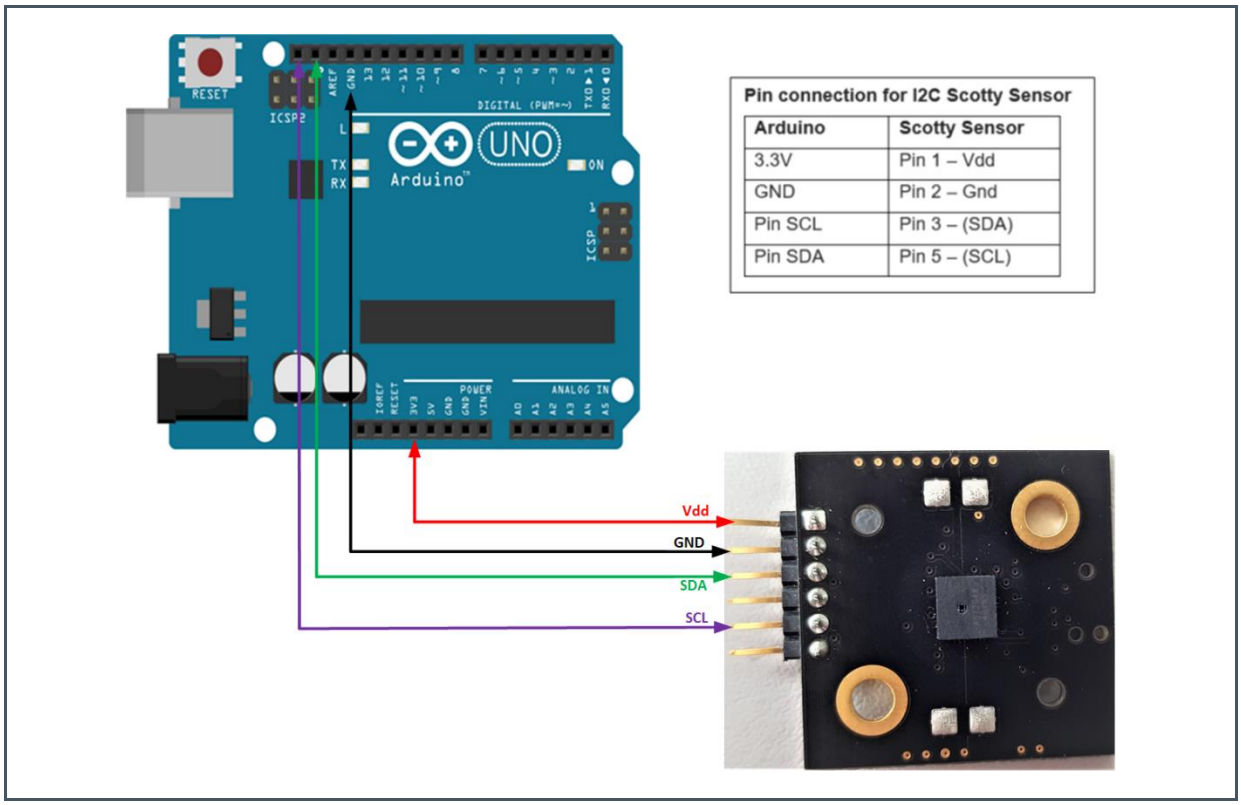
The two wires, or lines are called Serial Clock (or SCL) and Serial Data (or SDA). The SCL line is the clock signal that synchronize the data transfer between the devices on the I²C bus and the master device generates it. The other line is the SDA line, which carries the data. The two lines are “open-drain” which means that pull up resistors needs to be attached to them so that the lines are high because the devices on the I²C bus are active low. Commonly used values for the resistors are from 2K for higher speeds at about 400 kbit/s, to 10K for lower speed at about 100 kbit/s.

Figure 1:
I²C Connection



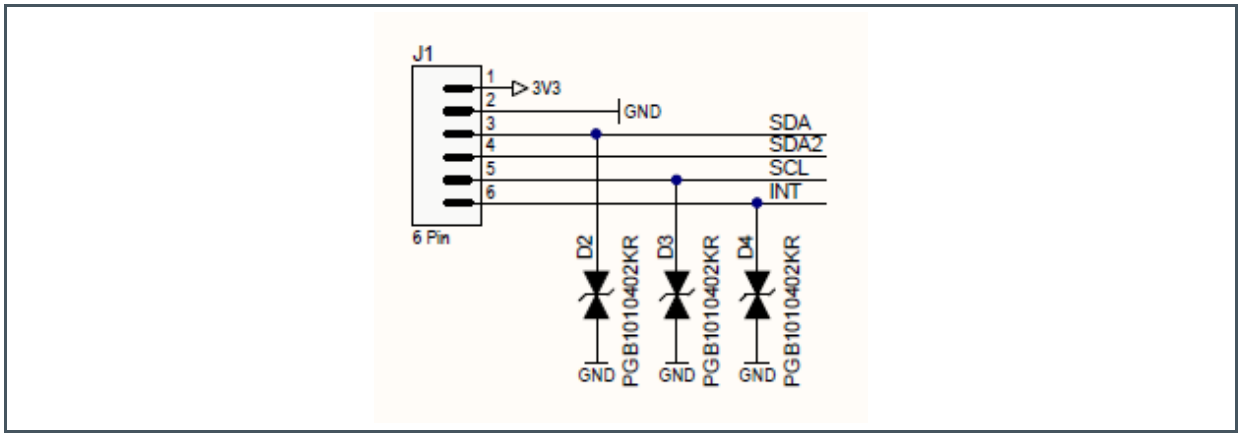
VCC	I²C supply voltage, typically ranging from 1.2 V to 3.6 V
GND	Common ground
SDA	Serial data (I²C data line)
SCL	Serial clock (I²C clock line)
Rp	Pull-up resistance (a.k.a. I²C termination)
Rs	Serial resistance
Cp	Wire capacitance
Cc	Cross channel capacitance

Figure 2:
Hardware Connection of µC and AS7264N Sensor



Insert the device you want to communicate with in the sensor board. Connect ground on the breadboard to ground from the microcontroller. The AS6264N sensor can be equipped with 3.3V power connection. Connect the Serial data pin of sensor (PIN 3) to hardware Serial data pin of the microcontroller and Serial clock pin of sensor (PIN 5) to the hardware Serial clock pin of microcontroller as described in above Figure 2.

Figure 3:
Connector J1 Pinning of AS7264N



3 Installation Requirement

Download the Arduino Software (IDE) from the website https://www.arduino.cc/en/Main/Software. Get the latest version from this download page. You can choose between the Installer (.exe) and the Zip packages. We suggest you use the first one that installs directly everything you need to use the Arduino Software (IDE), including the drivers. With the Zip package, you need to install the drivers manually.

When the download finished, proceed with the installation and please allow the driver installation process when you get a warning from the operating system.

The best way to become familiar with the Arduino Graphical User's Interface (GUI) is to verify your Arduino board is operating properly. Create an Arduino project and run the example Blink.

This simple test program confirms that a number of connection details and that the GUI are working properly.

4 Creating an Arduino Sketch with Wire Library

Once having Arduino development environment set up, you are ready to start working on projects. The section covers the basics that need to know to start writing your sketches and getting them to run on your Arduino. When using the Arduino IDE package, the sketches must follow a specific coding format.

This coding format differs a bit from what seen in a standard C language program. In a standard C language program, there is always a function named main that defines the code that starts the program. When the CPU starts to run the program, it begins with the code in the main function. On the other hand, Arduino sketches do not have a main function in the code. The Arduino bootloader program that is preloaded onto the Arduino functions as the sketch's main function. The Arduino starts the bootloader, and the bootloader program starts to run the code in your sketch. The bootloader program specifically looks for two separate functions in the sketch:

- setup
- loop

The Arduino bootloader calls the setup function as the first thing when the Arduino unit powers up. The code placed in the setup function in sketch only runs one time; then the boot-loader moves on to the loop function code.

The setup function definition uses the standard C language format for defining functions:

```
void setup () {

//code lines

        }
```

Just place the code to run at startup time inside the setup function code block. After the bootloader calls the setup function, it calls the loop function repeatedly, until power down the Arduino unit.

The loop function uses the same format as the setup function:

```
void loop () {

//code lines

      }
```

The main logic of the application code will be in the loop function section. This is where you place code to read sensors and send output signals to the outputs based on events detected by the sensors. The setup function is a great place to initialize input and output pins so that they are ready when the loop runs, then the loop function is where you use them.

Including Libraries

Depending on how advanced your Arduino program is, you may or may not need to use other functions found in external library files. If you do need to use external libraries, you first need to define them at the start of your Arduino program, using the #include directive:

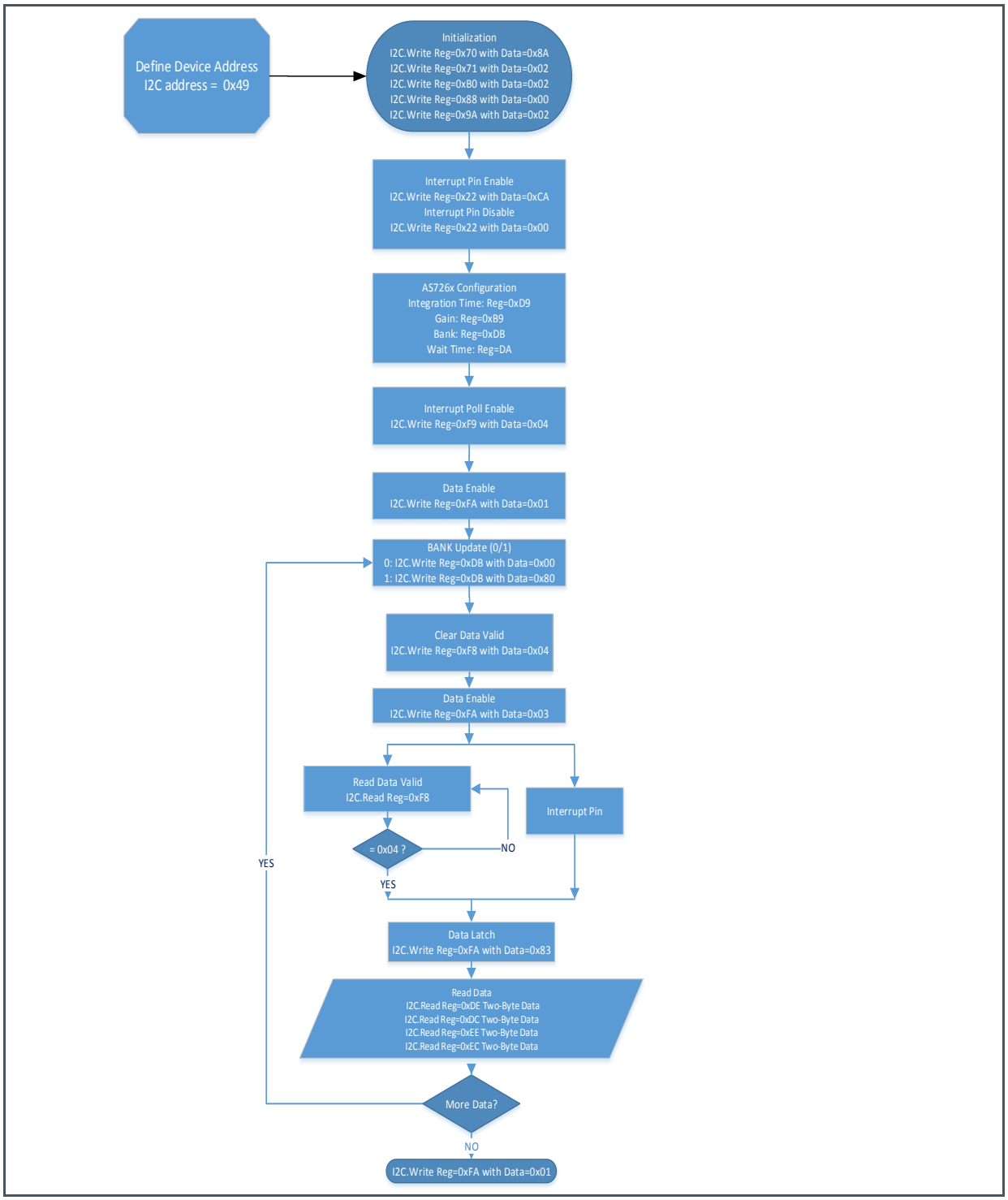
```
#include <library>
```

The #include directives will be the first lines in your sketch, before any other code. If you are using a standard Arduino shield, most likely the shield library code is already included in the Arduino IDE package. Just choose Sketch > Import Library from the menu bar, and then select the shield that you are using. The Arduino IDE automatically adds the #include directives required to write code for the requested shield.

When you open the Arduino IDE, the editor window starts a new sketch. The name of the new sketch appears in the tab at the top of the editor window area, in the following format:

5 Programming Sequence

Figure 4:
Flow Chart



Define the hardware by I²C address and include the “Wire.h” file

```
#include <Wire.h>
#define _i2cAddr (0x49)
```

Function to read the values from the hardware registers

```
byte readRegister(byte addr)
{
    Wire.beginTransmission(_i2cAddr);
    Wire.write(addr);
    Wire.endTransmission();

    Wire.requestFrom(_i2cAddr, 1);

    if (Wire.available())
      {
        //Serial.println(Wire.read());
        return (Wire.read());
      }

    else
      {
        Serial.println("I2C Error");
        return (0xFF); //Error
      }
}
```

Function to write values into the hardware registers

```
void writeRegister(byte addr, byte val)
{
  Wire.beginTransmission(_i2cAddr);
  Wire.write(addr);
  Wire.write(val);
  Wire.endTransmission();
}
```

The readTwoRegister1() function reads the values from the corresponding data register. A 16-bit value is returned (high byte and lower byte combine) by the readingL and readingH variable

```
uint16_t readTwoRegister1(byte addr)
        {
          uint8_t readingL; uint16_t readingH; uint16_t reading = 0;
          Wire.beginTransmission(_i2cAddr);
          Wire.write(addr);
          Wire.endTransmission();

          Wire.requestFrom(_i2cAddr, 2);

          if (2<=Wire.available())
            {
            readingL = Wire.read();
            readingH = Wire.read();
            readingH = readingH << 8;
            reading = (readingH | readingL);
            return(reading);
            }
          else
            {
            Serial.println("I2C Error");
            return (0xFFFF); //Error
            }
        }
```

Like the setup line before it, void loop () is another required Arduino-sketch function. While the setup () function sets your Arduino up, the loop () function executes the main logic in a loop.

This is where the bulk of your Arduino sketch is executed. The program starts directly after the opening curly bracket ({), runs until it sees the closing curly bracket (}), and jumps back up to the first line in loop () and starts all over. The below sketch will get you up and running taking spectral readings. Once this sketch is uploaded, open the serial monitor with a baud rate of 115200 to display the spectral data from the sensor.

```
#include <Wire.h>
#define _i2cAddr (0x49)
void setup()
{
    // Initiate the Wire library and join the I2C bus as a master or slave
    Wire.begin();
    // communication with the host computer serial monitor
    Serial.begin(115200);
}
```

```
  void loop()
  {
writeRegister(byte (0x70),(0x8A));//Device Config 1
writeRegister(byte (0x71), (0x02));//Device Config 2
writeRegister(byte (0xB0),(0x02));//Device Config 3
writeRegister(byte (0x88), (0x00));//Device Config 4
writeRegister(byte (0x9A), (0x02));//Device Config 5

writeRegister(byte (0x22), (0xCA));//Int pin Enable

writeRegister(byte (0xD9), (0x00));//Intergration TIME
writeRegister(byte (0xB9), (0x00));//Gain IDRV
writeRegister(byte (0xDB), (0x80));//Bank Mode
writeRegister(byte (0xDA), (0x80));//WTIME

writeRegister(byte (0xF9), (0x04));//Intterrupt and Polling enble

writeRegister(byte (0xFA), (0x83));//Data Enable

writeRegister(byte (0xBA), (0x80));//Auto Zero
writeRegister(byte (0xD3), (0x80));//Temp Config
writeRegister(byte (0xEA), (0x03));//LEN ON
writeRegister(byte (0x84), (0x01));//LEN IND

writeRegister(byte (0xF8), (0x04));//Intterrupt and Polling clear


 Serial.println(readRegister(byte(0x10)));//Device Identification
 Serial.println(readRegister(byte(0x11)));//Device Version
 Serial.println("Channels");
 Serial.println(readTwoRegister1(byte(0xDC)));//N LOW/HIGH
 Serial.println(readTwoRegister1(byte(0xDE)));//Y LOW/HIGH
 Serial.println(readTwoRegister1(byte(0xEC)));//Z LOW/HIGH
 Serial.println(readTwoRegister1(byte(0xEE)));//X LOW/HIGH
 Serial.println("Next");
 delay(2000);
  }
```

6 Code Debugging and Sensor Reading Using IDE

One should start with the hardware connections and begin hardware debugging. Check wiring – one of the first things to do when wiring the circuit is to check that connected everything correctly.

If test code works, it is time to open the example code and compile. If gets a compilation error when trying to compile or upload code to the board check for errors in syntax, typos and more. Using the correct syntax is vital for making sure code compiles. When compilation fails, the IDE will present with the errors on its bottom part. However, the error messages generated by the Arduino IDE are limited in their description and therefore not always very helpful.

Figure 5:
Arduino IDE with I²C Interface Code for AS7341 Sensors

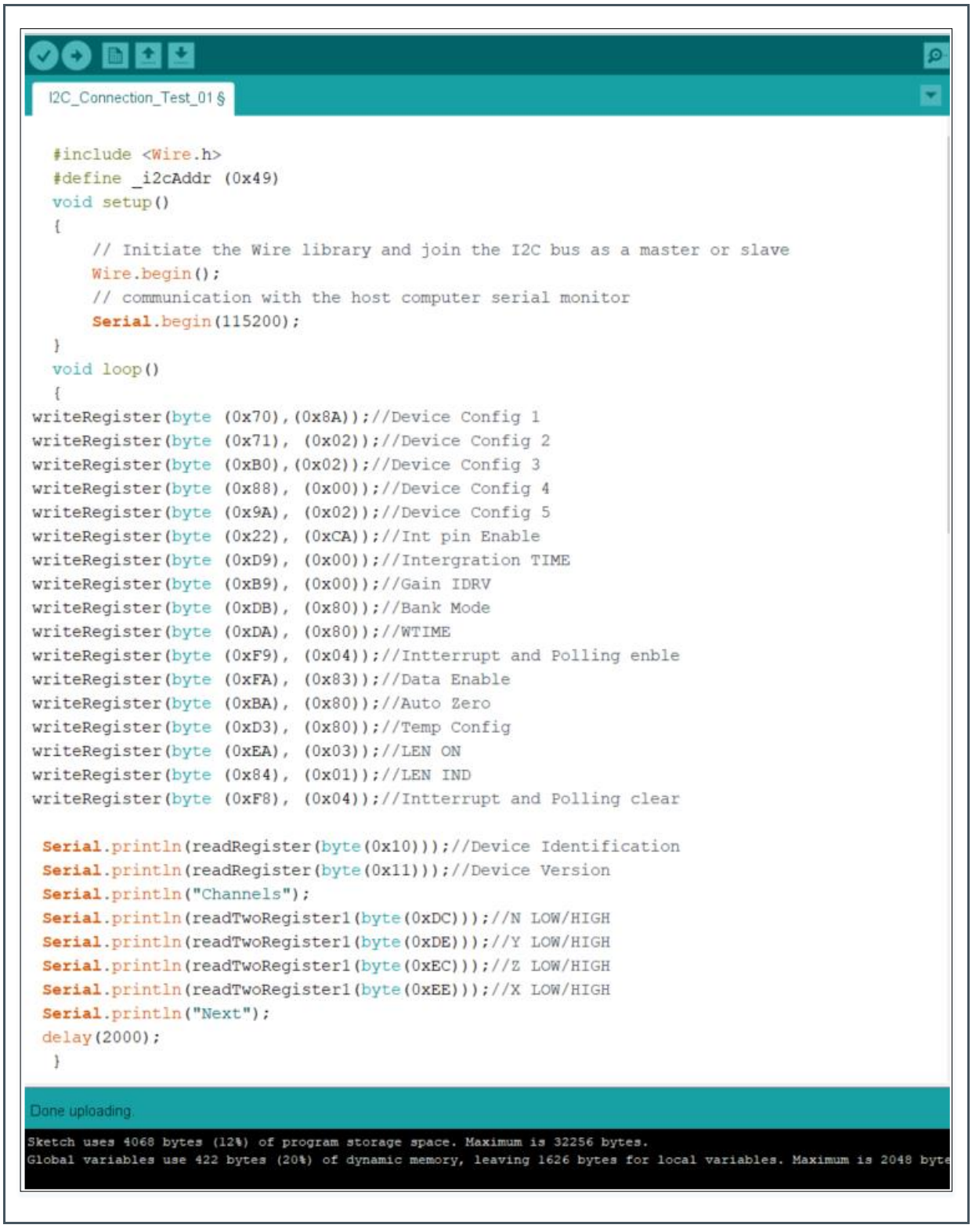
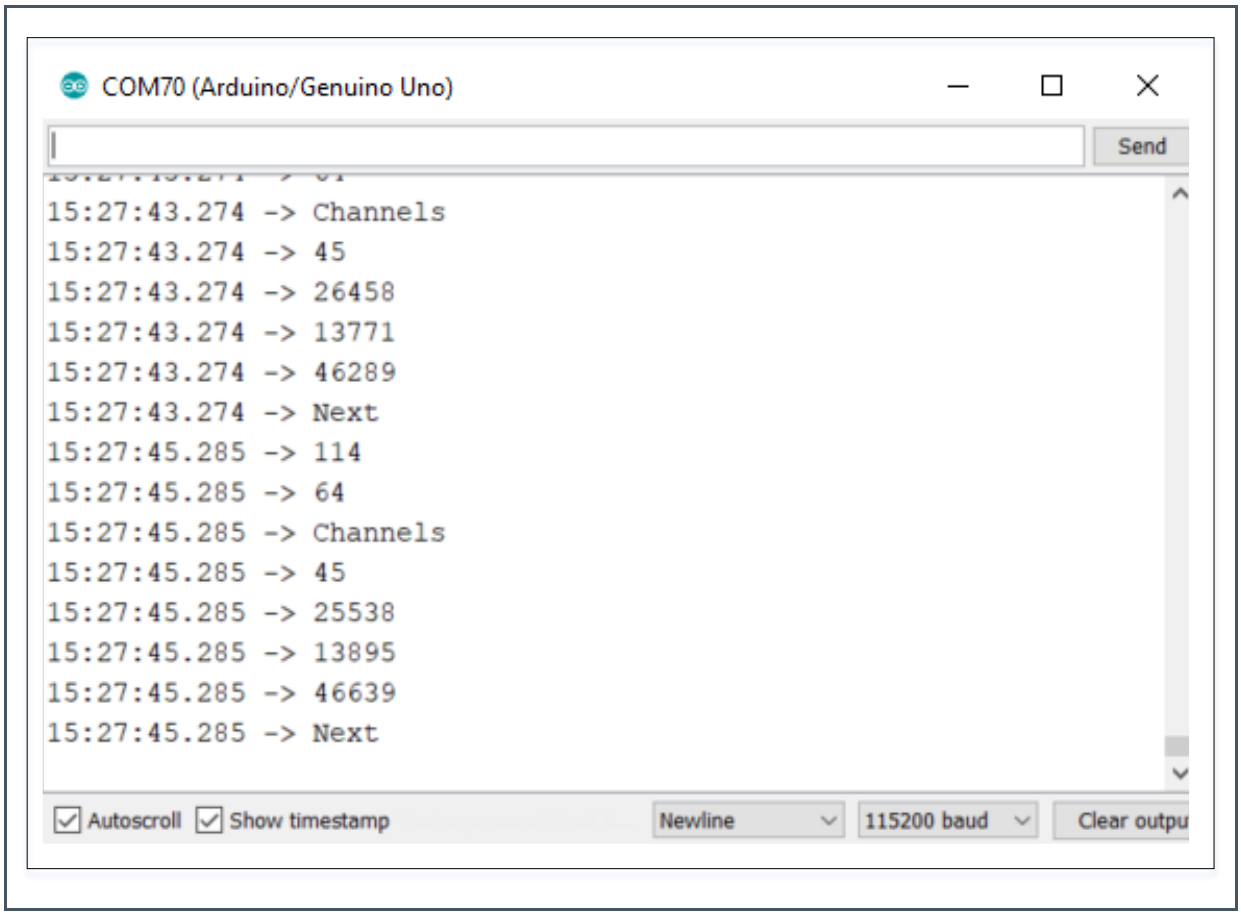


Figure 6:
Arduino IDE with Serial Monitor Response after Executing the One of the Script



As outlined above, if the code fails when trying to run the sketch, need to start debugging the code. First, think and define which parameters to print and use the serial monitor to monitor them on screen.

Once uploaded to your Arduino, open up the serial console at baud speed of serial monitor defined in the code to begin the tester sketch and its results. When executing the sketch, user should see the following output on the serial monitor as shown Figure 6.

7 Revision Information

Changes from previous version to current revision v1-00	Page
Initial version	

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

8 Legal Information

Headquarters
ams AG
Tobelbader Strasse 30
8141 Premstaetten
Austria, Europe
Tel: +43 (0) 3136 500 0

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