UAV Linear Accelerometer Module

by Natalia Cherkasova

An **unmanned aerial vehicle (UAV)**, commonly known as a **drone**, is an aircraft without a human pilot aboard. The flight of UAVs may be controlled either autonomously by onboard computers or by the remote control of a pilot on the ground or in another vehicle.

Technical Inquiry

It is required to design an UAV Linear Accelerometer Module. Hardware and software must meet the next requirements:

* using of microcontroller PIC16F877A working in the Master-mode;
* approximate overall module dimensions - 150x50x50 mm;
* the module has to provide data polling of the digital accelerometer LSM303 on each of three axis. Exchange interface is I^2C. Frequency of a clock signal in the I^2C-bus is 100 kHz;
* the accepted data have to be send through the USART-interface to an onboard computer on-request. Data rate is 57600 bps;
* the module must be functional in the input voltage range from 5,5V to 12,6V at a constant current.

Analysis of Technical Inquiry

Functionally the device is represented by an accelerometer sensor unit, a computing block and a power source (except the onboard computer).

Tasks for the computing block:

*1. I^2C-interface control.

*2. Last received data storing.

*3. Securing of data communication with the onboard computer on-request and ready-signal waiting of receiving the next byte.

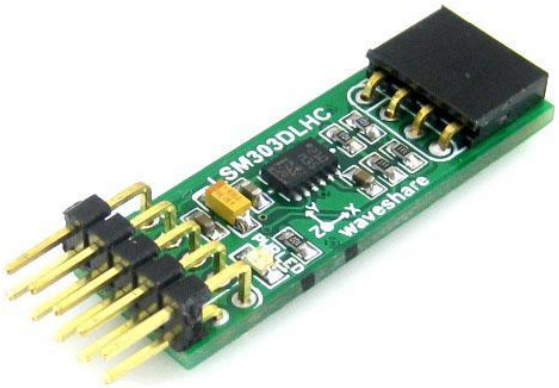
To solve these special tasks it is practicable to use a microcontroller PIC16F877A with a hardware implementation of I^2C-interface and a possibility of receiving external interrupt signals.

I^2C (Inter-Integrated Circuit) is a serial protocol for two-wire interface to connect low-speed devices like microcontrollers, I/O interfaces and other similar peripherals in embedded systems.

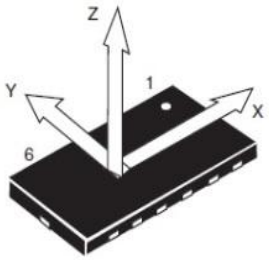
I^2C bus is popular because it is simple to use, there can be more than one master, only upper bus speed is defined and only two wires with pull-up resistors are needed to connect almost unlimited number of I^2C devices. Each slave device has a unique address. Transfer from and to master device is serial and it is split into 8-bit packets.

A **Universal Synchronous/Asynchronous Receiver/Transmitter (USART)** is a type of a serial interface device that can be programmed to communicate asynchronously or synchronously.

USART provides the computer with the interface necessary for communication with modems and other serial devices. In program-to-program communication, the synchronous mode requires that each end of an exchange respond in turn without initiating a new communication. Asynchronous operation means that a process operates independently of other processes.

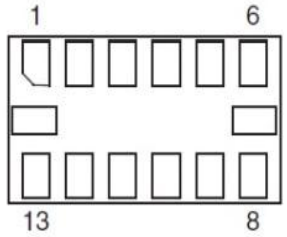


LSM303

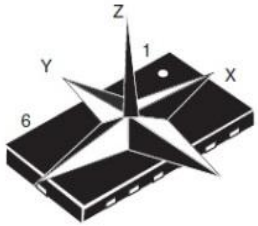


TOP VIEW

DIRECTION OF DETECTABLE ACCELERATIONS

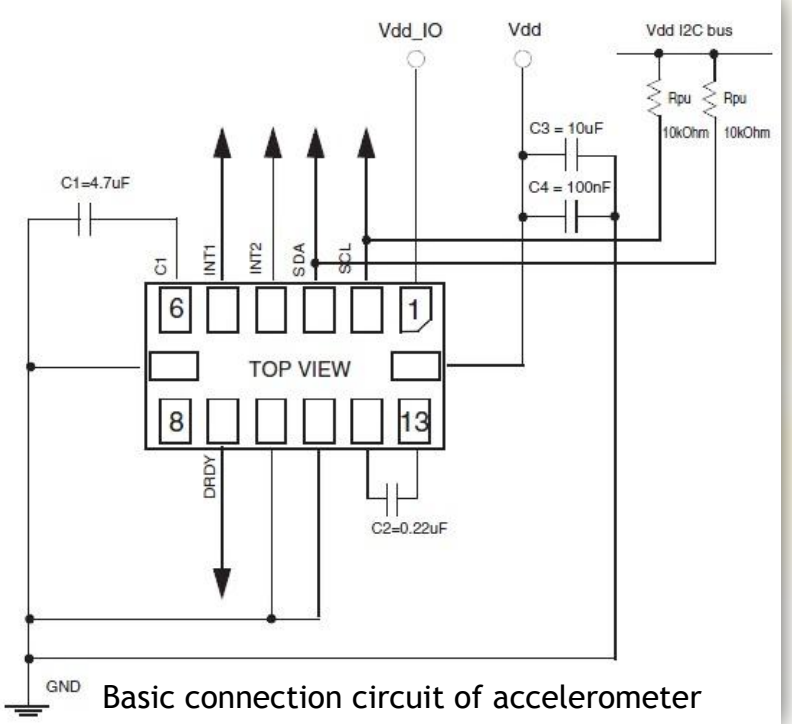


BOTTOM VIEW



TOP VIEW

DIRECTION OF DETECTABLE MAGNETIC FIELDS



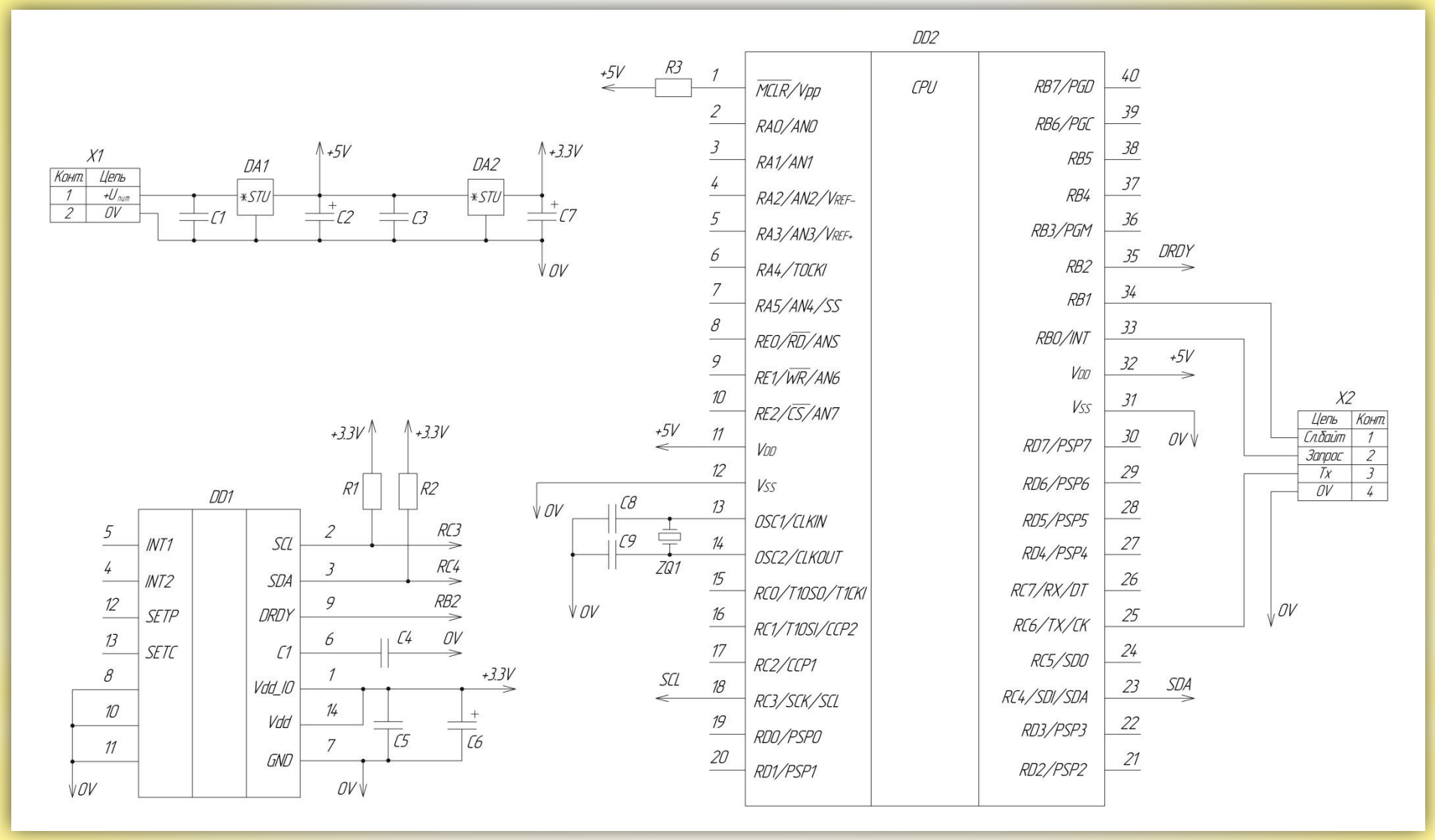
Basic connection circuit of accelerometer

An **accelerometer** is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic - caused by moving or vibrating the accelerometer. By measuring the amount of static acceleration due to gravity, you can find out the angle the device is tilted at with respect to the earth. By sensing the amount of dynamic acceleration, you can analyze the way the device is moving.

In my project I will use the LSM303 accelerometer.

Conclusion

* Program listing for microcontroller is written in C and takes 7 standard A4 sheets.
* Electric circuit in paper became the real model based on PIC16F877A microcontroller and LSM303 accelerometer.
* UAV was constructed as model aircraft (see below).



Electric circuit

Expressing my appreciation to:

Alexander Akishev – for the help in designing the module and programming the microcontroller.

Nikolay Vasilevskiy – for implementation of the project as the real UAV with the Raspberry PI onboard computer.

Thank you for your attention!