# Differential Dynamometer for Stroke Rehabilitation
# Build instruction

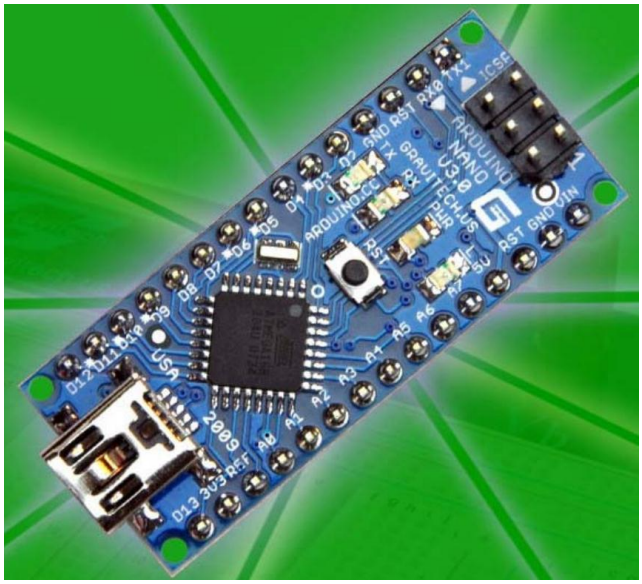
## Bill of Materials

We use in the project the components

| | | | |
|---|---|---|---|
| 1 | Controller | Arduino nano R3 | 1 |
| 2 | 24 bit ADC shield | HX-711 shild | 4 |
| 3 | 8 digits LED shield | max7219 0,36"LED shield | 2 |
| 4 | Tenso brigde | Kitchen Scale Sensor 5 kG | 4 |
| 5 | Push button | Any push button | 2 |
| 6 | Box for device | G1168G Gainta | 1 |
| 7 | Sensor mounting base | Plastic cutting board | 1 |
| 8 | Sensor cable connector | DB25f | 1 |
| 9 | Screws M5x25 mm | | 8 |
| 10 | Nuts M5 | | 8 |
| 11 | Washer 5x10x4 mm | | 8 |

We make some introduction about it.

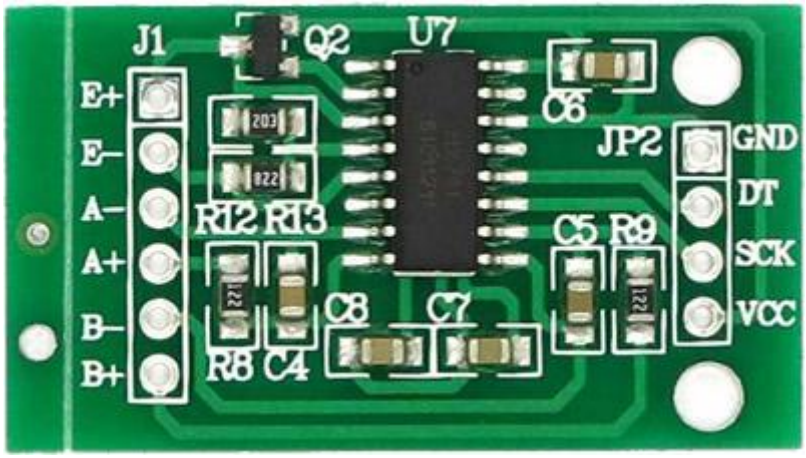
1. Controller Arduino Nano R3.x (992-ARD-NANO30NP) or any Arduino Nano R3.x compatible.



The Arduino IDE code works with any native or compatible PCB.

2. 24 bit ADC shield

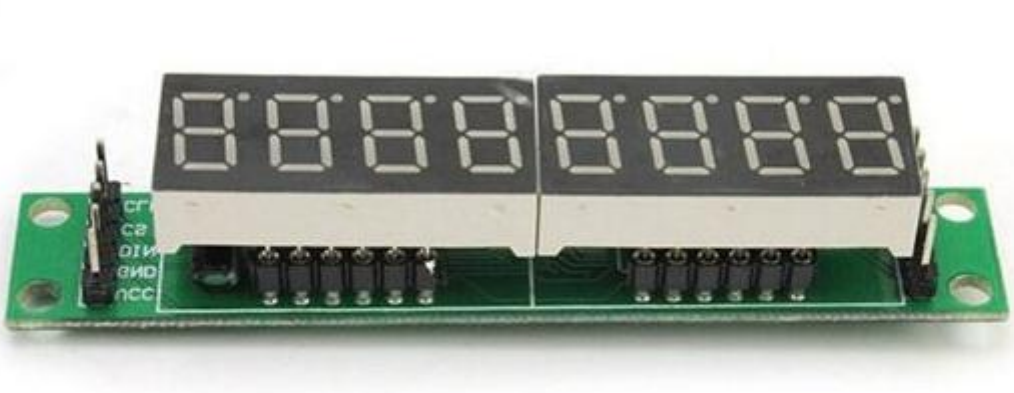
We use Arduino compatible kitchen scale shild (PCB) with HX-711 chip. The signal from tensobridge is very small, so we need at least 24 bit sigma / delta ADC.




It is possible to use 2 or 4 shields, we use 4 because the chip has a long enough (>80 milliseconds) conversion time.

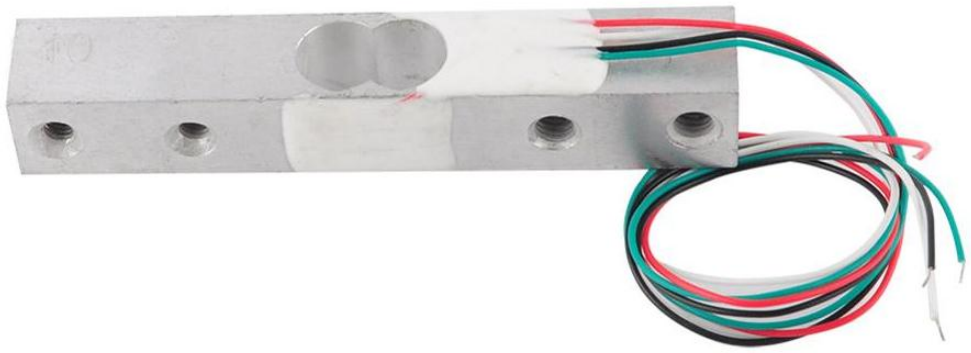
3. Max7219 0,36"LED shield

The Shield made using max7219 chips. The shields (two) show the force of fingers press in digital (4 signs in Gramms) or bar views.



4. Strain Gauges 5 kG

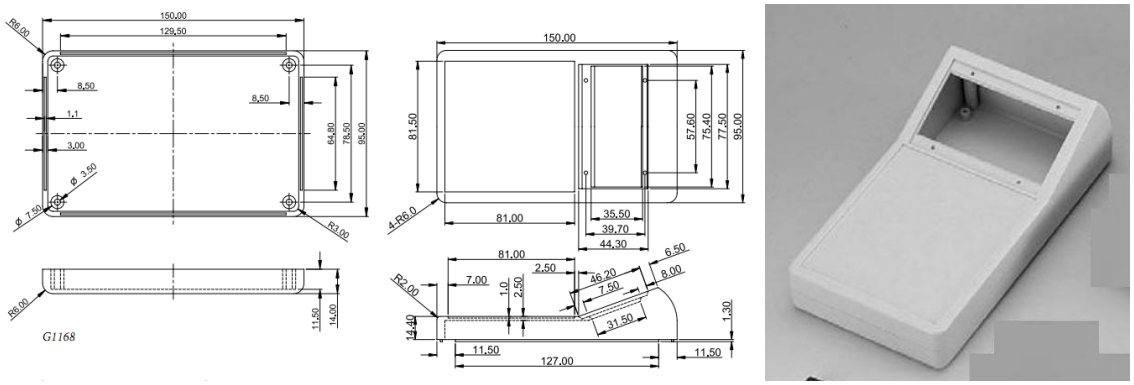
We recommend to use 5 kG Kitchen Scale Sensor sensors, but You can use any kind of sensors in the range 1 kGramms- 10 kGramms.



5. Push button
   You can use one any  momentaty normal open push button, and one toggle push button.


6. Box for device

We use G1168G  Gainta box.  It is very convenienf for display installation.




7. Sensor mounting base

We used plastic cutting board, but any flat surface can be used.

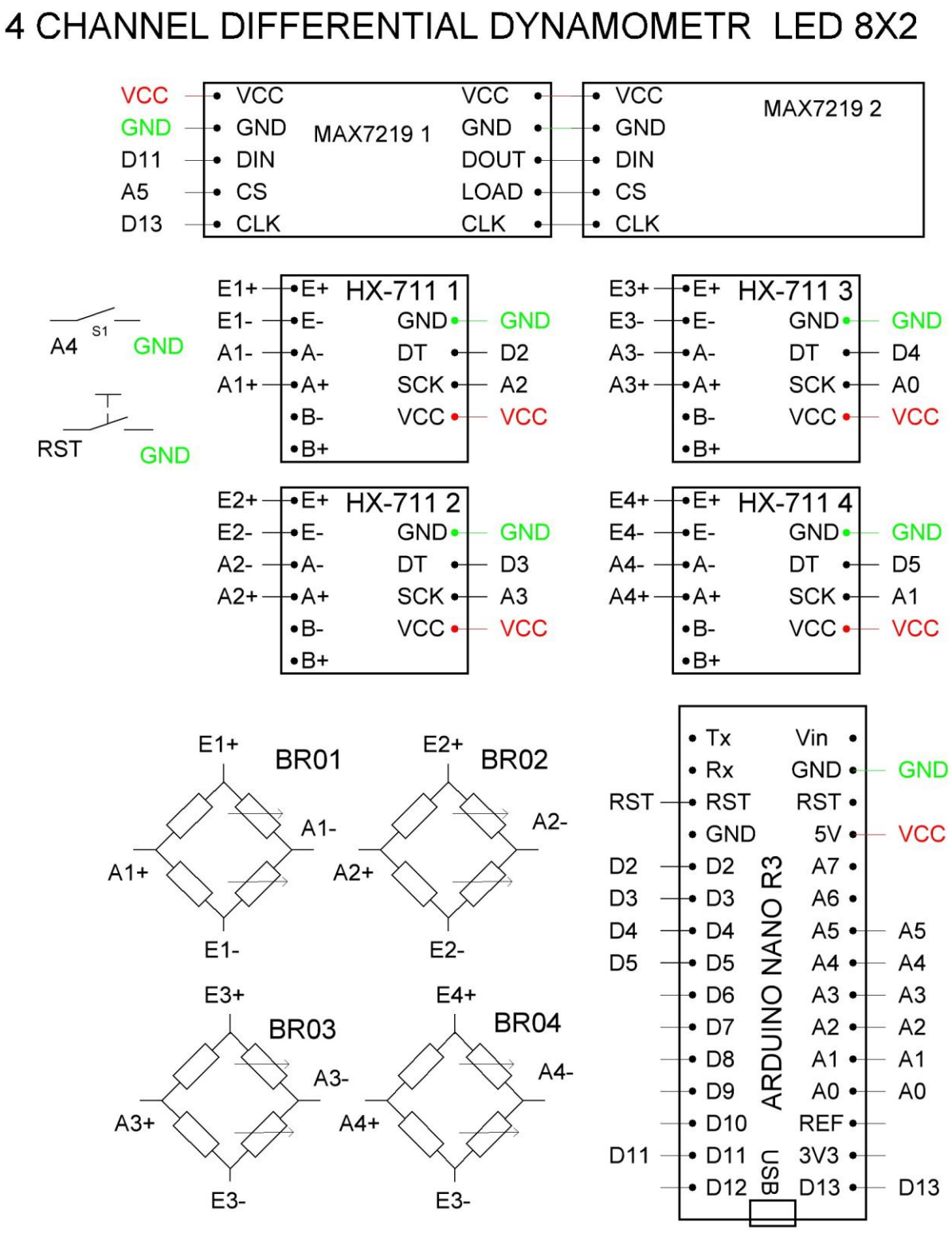
8. Sensor cable connector DB25f and DB25m Cable

You can make the device without connectors, with direct cable connections. We suppose that the device with connectors can be used with other sensor board- for foots etc…You can use Mouser 649-DB25P064TXLF. Cable is shown on the figure too.

9-11. Nuts, screws and washers

The size of screw-thread depends on screw-thread of strain gauges. 5 and 10 kGramms sensors has M5 (metric 5 mm ) screw-thread, 1-2 kGramms sensors have M4 screw-thread.

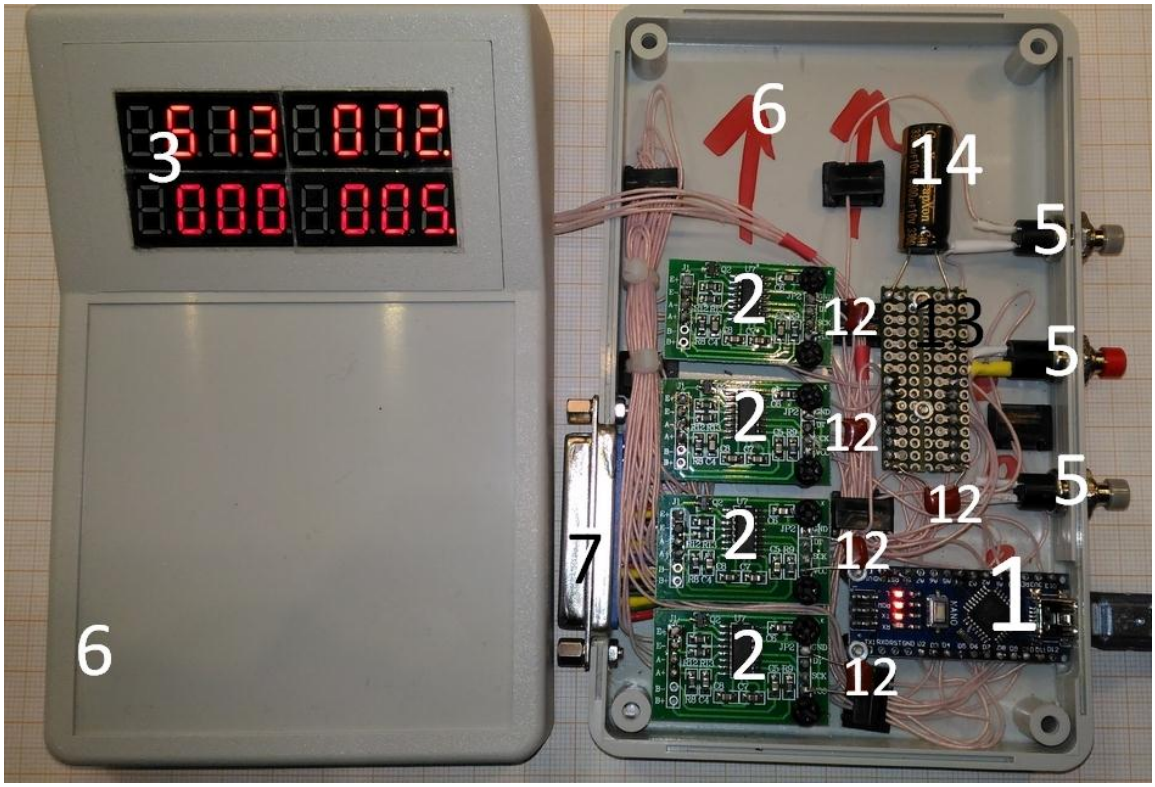
## Schematics




Power supply is over miniUSB connector of Arduino Nano. It is usefull to solder some 0.1 uF 16 V capacitors on GND and VCC junctions of HX-711 shields, and 3300 uF 16 V low ESR capacitor parallel to VCC and GND pins.

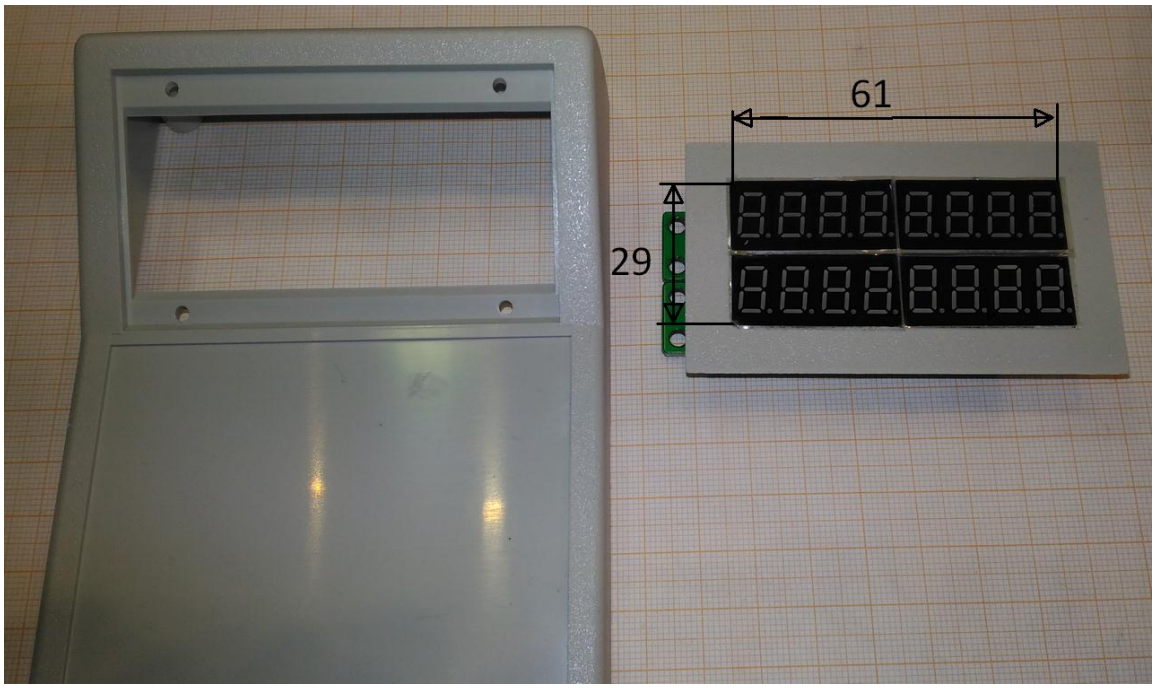
## Mechanical

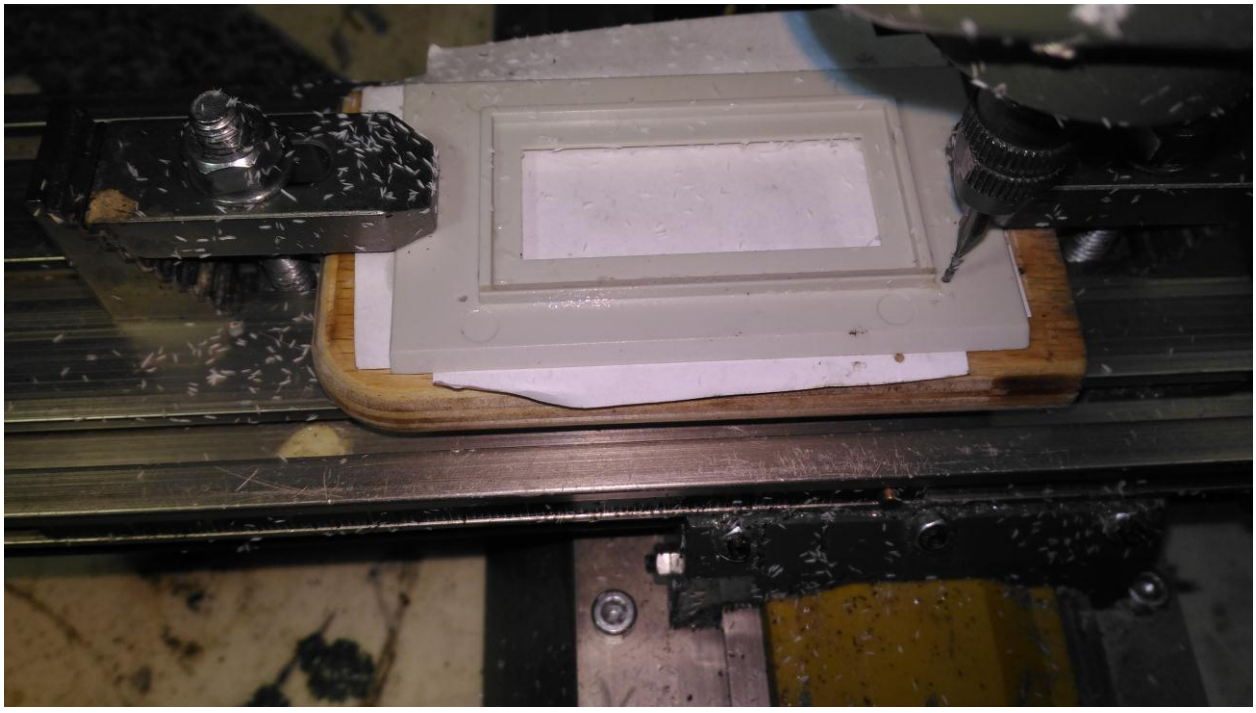
You have to make holes for push button in any convenient place. We placed it on the right side of box, the DB25F connector- on the left side. You can do the device without connector, with wires soldered direct to HX-711 pins.



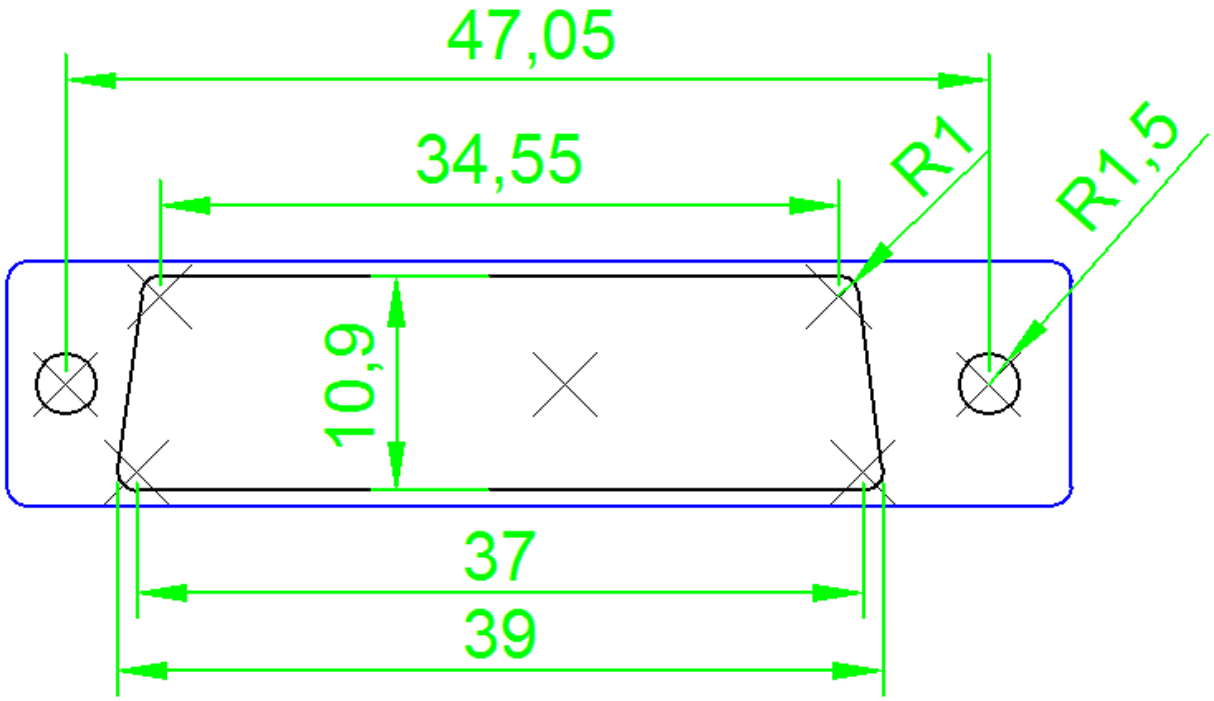

| | |
|---|---|
| 1 | Controller |
| 2 | 24 bit ADC shields |
| 3 | 8 digits LED shields |
| 5 | Push button |
| 6 | Box for device |
| 7 | DB25F connector |
| 8 | Sensor cable connector |
| 12 | 0.1 uF 16 V capacitors |
| 13 | PCB for GND and VCC connections |
| 14 | 3300 uF 16 V low ESR capacitor |

It is only one hole in upper box part- rectangular hole for two LED shields. It is good to make a hole with small mill cutter, but it can be done with knife and saw.



Miller cut the window in box top panel.



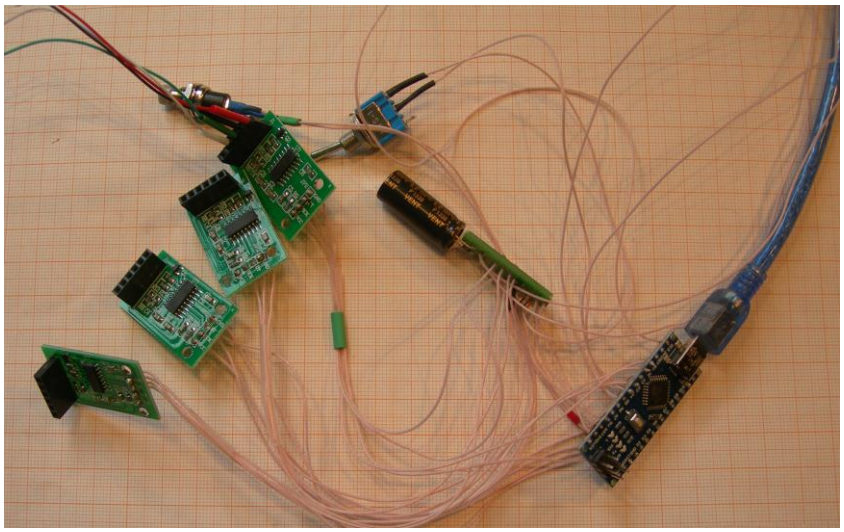

Hole for DB25F connector. Blue- external shield, black- hole , two round holes for screws.

Hole for Arduino USB mini  is situated on the right side and has 8x4 mm size.

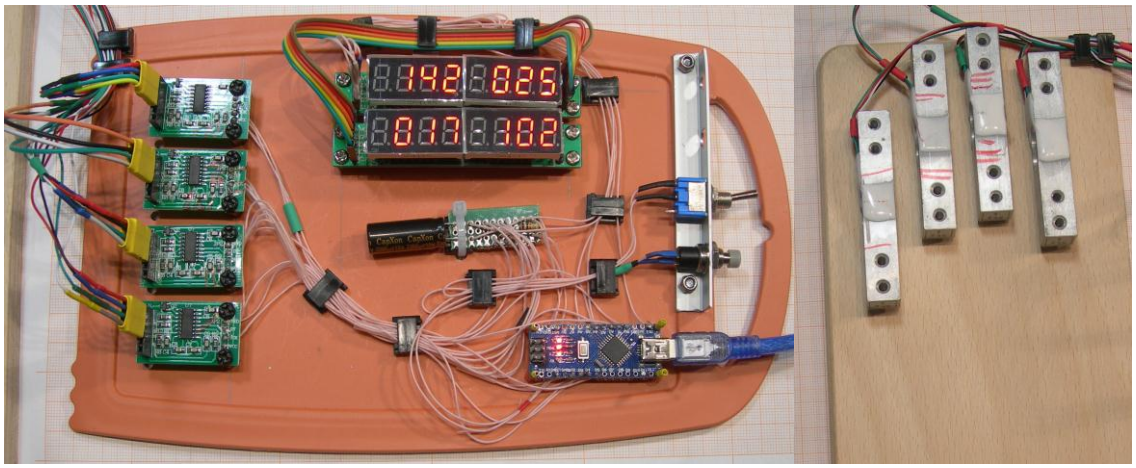
For installation of  HX711, power and Arduino PCBs we use nylon PCB standoff (534-1903C) and nylon screws M3  and  two M2 (for Arduino).

## Electronics

If You are not experienced in electronics, You can test the device withot mount all the PCB and connectors. Here is example of device without box. All the PCBs and sensors are soldered by wires.



The example of  such installation on a tray is shown here, and the sensors on the plywood board for cutting:



After adjustment and verification You can assemble all in box.

## Programming

Install (if You have no)  Arduino IDE, download *.ino file from depository https://github.com/DrOnkel/DifDin.git  and  load it to Your Arduino Nano. If You use another sensors, You have to ajust parameters in lines :

146  CountW[0] /= 4280L;     // Calibrate 0

238  CountW[1] /= 4283L; //Calibrate sensor 1

338  CountW[2] /= 4280L;  // Calibrate sensor 2

424  CountW[3] /= 4283L; // Calibrate sensor 3

You can place all the electronics in a box when You check all the connecrions.

Take an interesting experience. Electronics is usefull and interesting.