Smart Advent Calendar Application Note

How to build

About this document

Scope and purpose

This Application Note is intended to enable users to build an Smart Advent Calendar combining the Infineon XMC1100 Boot Kit, the 24V Protected Switch Shield with BTT6030-2EKA and BTT6020-1EKA and a self-made shield containing five BTS3035TF low side switches. Intended audience

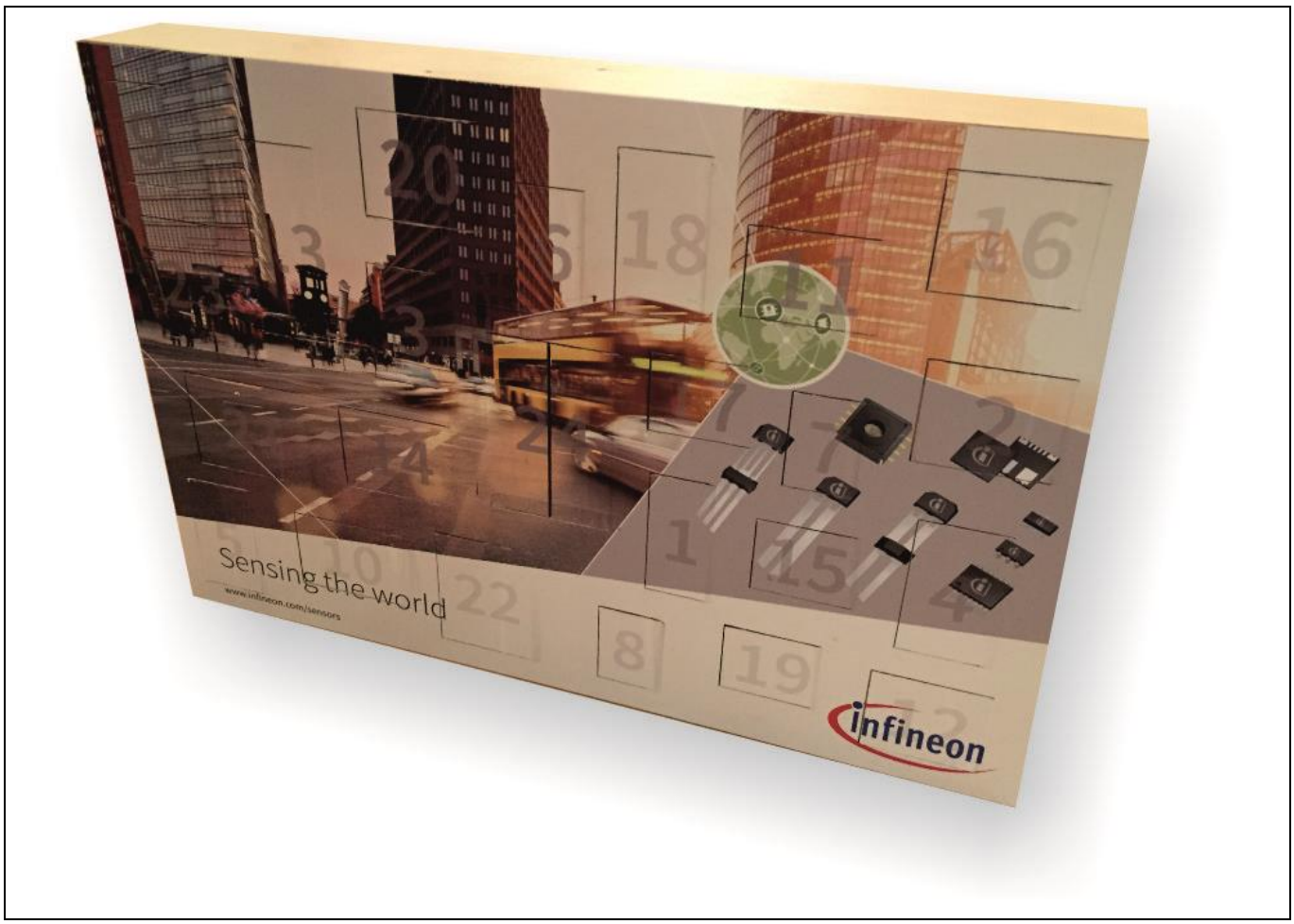

Figure 1 Smart Advent Calendar

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1 Laser Cutting

The wooden parts of the calendar are laser cut. The cutter used works with raw material of 600x450mm.
The parts are cut out of 3mm and 1,5mm wood.
You will need 3mm pieces of:

- 1x 600x400 (front)
- 4x 600x450 (boxes)
- 2x 600x80 (casing)
- 2x 394x80 (casing)
- 1x 598x398 (back plate)

and a 1,5mm piece of:

- 1x 220x120 (coil holdings)

The lines shown in red are cut lines, the blue ones are marking lines and the black ones will be engraved.

1.1 Boxes – 3mm

Start with the four different laser layouts of the boxes. The cut slices will be assembled to the 24 Boxes of the calendar.

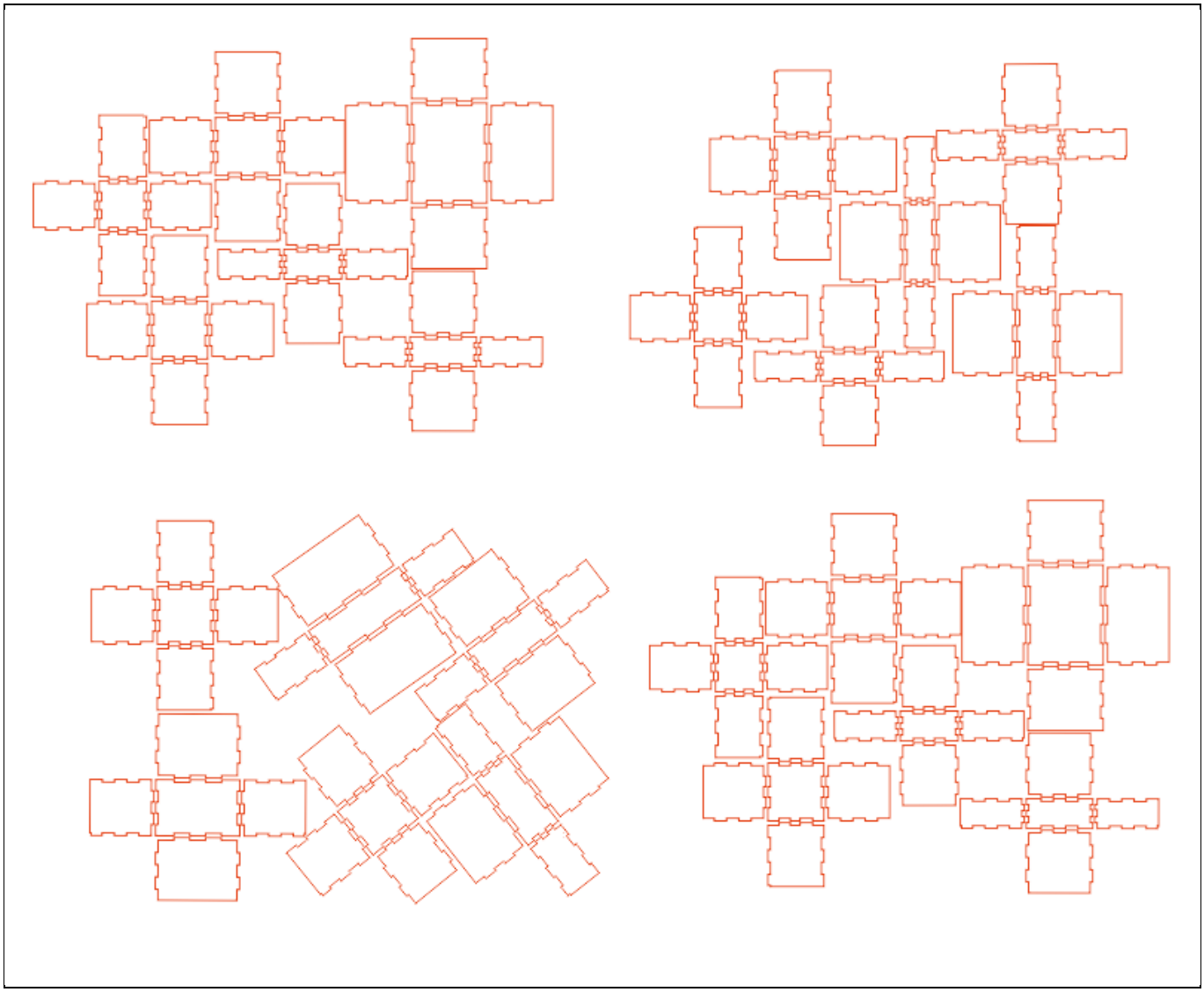

Figure 2 Laser cut layout for all boxes

1.2 Front -3mm

This part will be the front of the calendar. The doors are hold in place even after cutting to align the doors for later processes. The bridges which holds the doors can be removed later with a cutter.
The blue edges are there to align the coil holdings later, the engraved circles will hold magnets on each door. Make sure the laser is configured accordingly to engrave deep enough to place the magnet of your choice (we have chosen 4x1mm magnets).

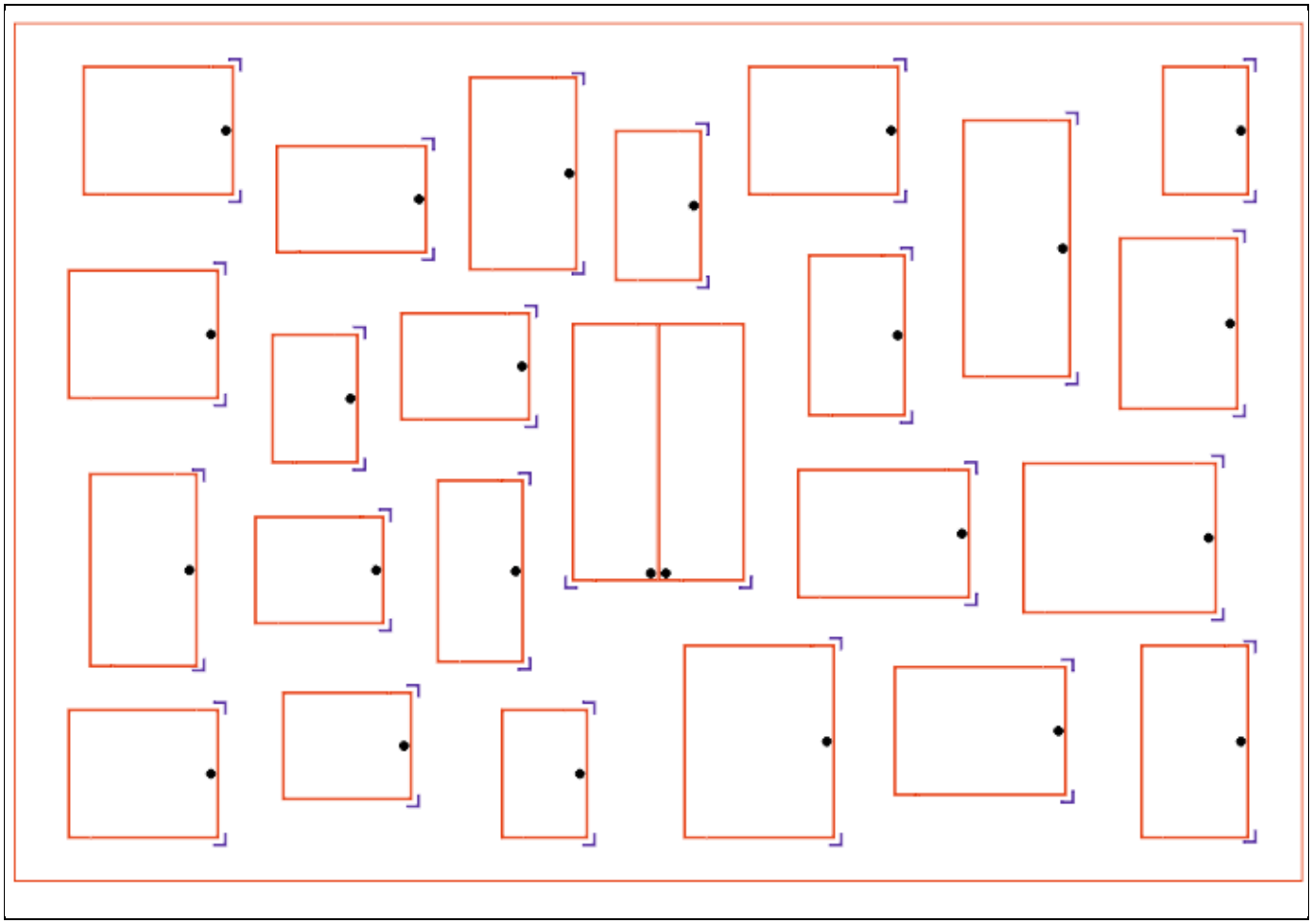

Figure 3 Laser cut layout front (Backside)

1.3 Coil holdings – 1,5mm

This parts will be used later to produce the coil actuators.

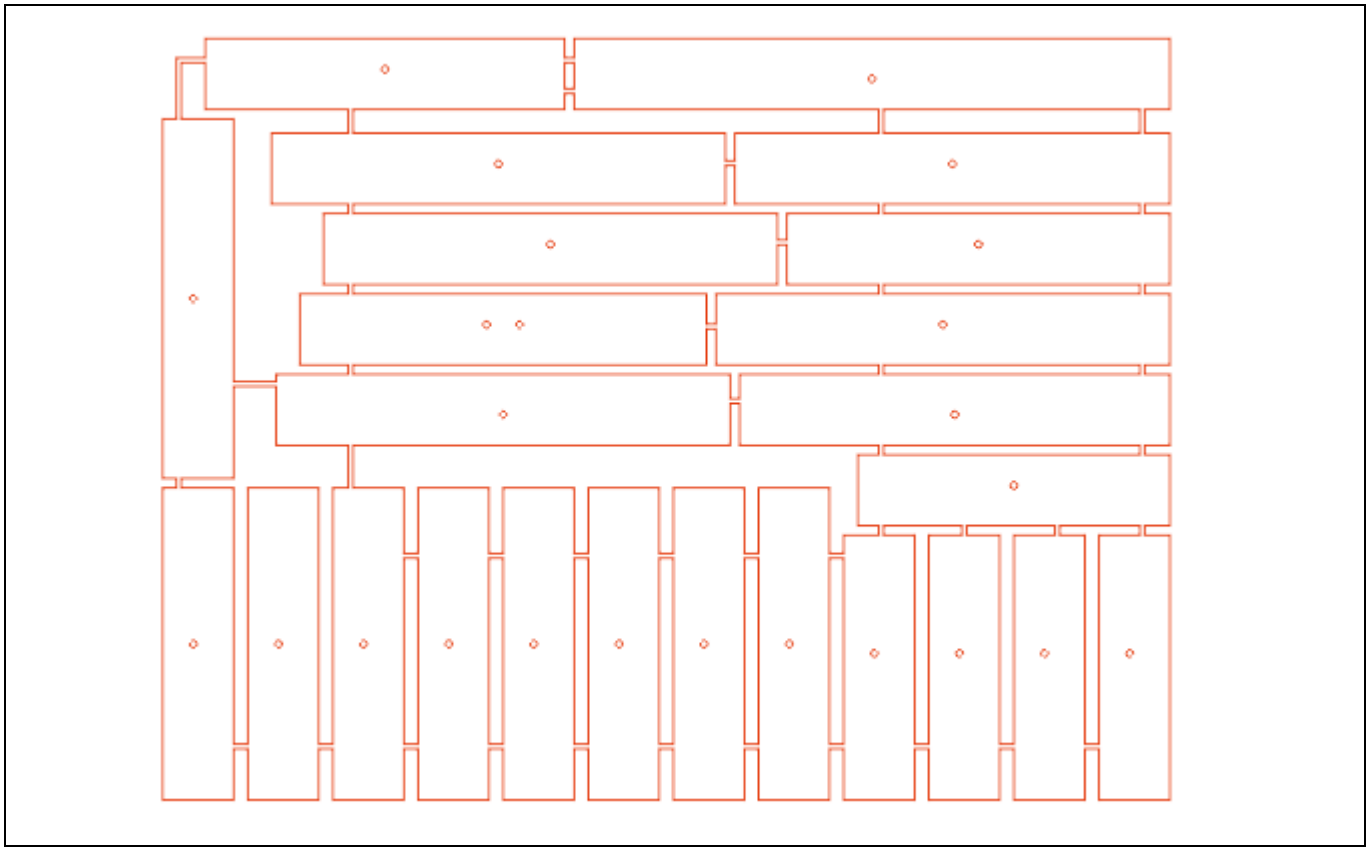

Figure 4 Laser cut layout coil holdings

2 Build the frame

The Basic frame exists of the front and side panels/casing panels. Glue these pieces together.
To enhance the structure there are four rectangle wooden pillars in the corners on which the back cover can be screwed.

Also the magnets can already been glued into the front plate.

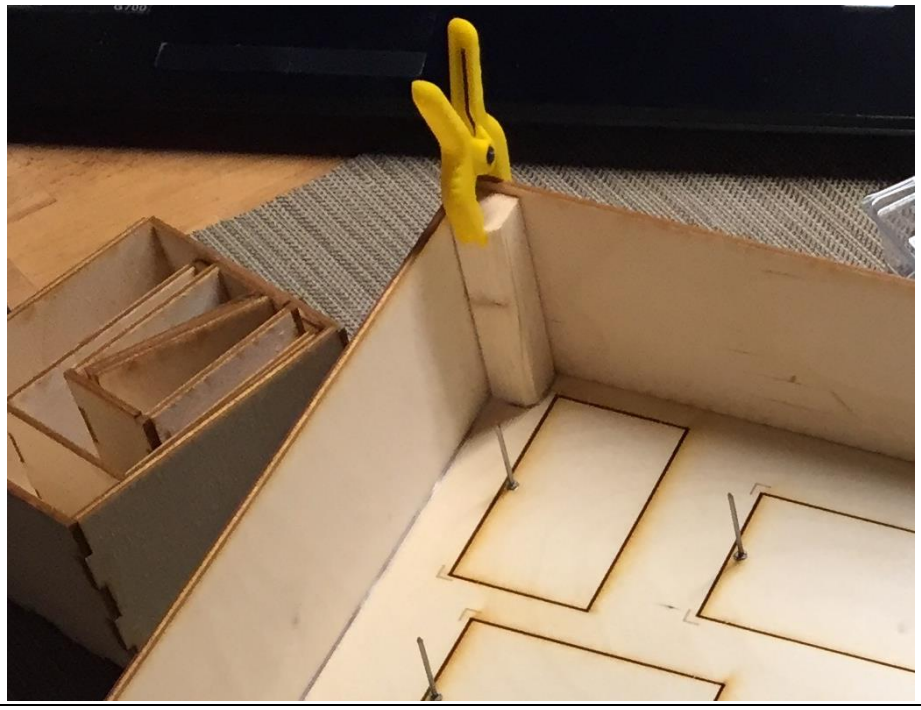

Figure 5 Rectangle reinforcements in a corner

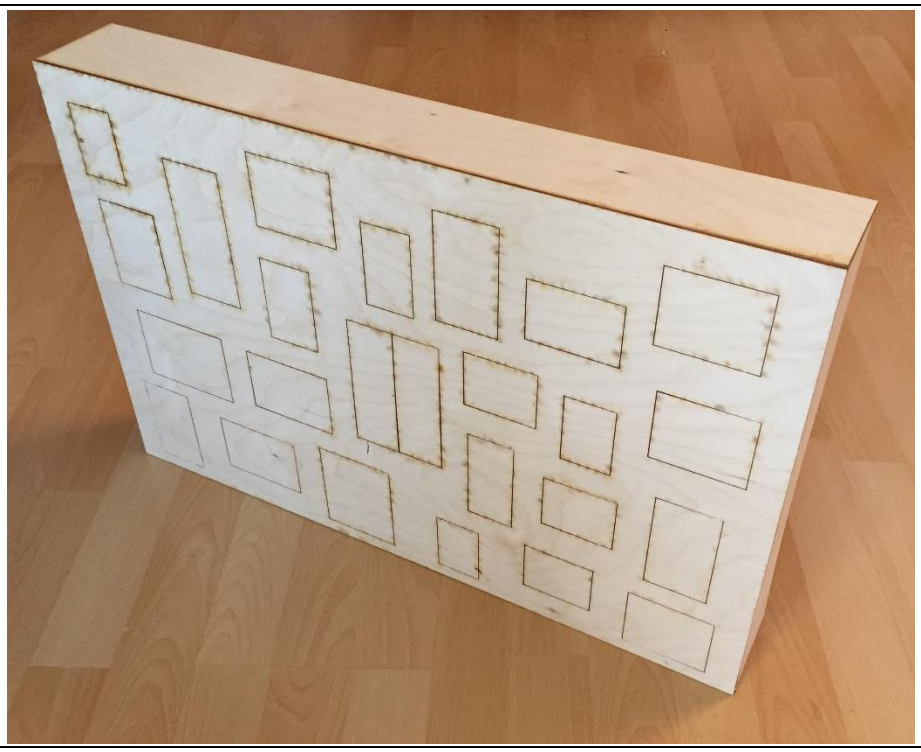

Figure 6 Wooden frame

3 Build the Boxes

The boxes can be glued together, positioned due to the grooves in the parts.

One side of the side panels is lowered. This gap is used to fit the coil holding.

Figure 7 Assembled wooden boxes

4 Build the Actuators

The actuators exist of

- Laser cut wooden coil holdings
- 25x 30mm flat head nails bright iron blank
- 25x 7.5m of 0.28mm enamelled copper wire

The nails have to be hammered into the wooden pieces so that the head of the nail is on the same level with the surface of the holding.
After this the 7.5m long wires will be twisted around the nails. The easiest way to do this is to insert the end of the nail into an electric screwdriver and fix one end of the wire on the coil holding.

To get a nice look on the front side, when a door is opened we added a 0,5mm thick brushed aluminum layer on top. You can skip this if you prefer to see the wood and nail heads.

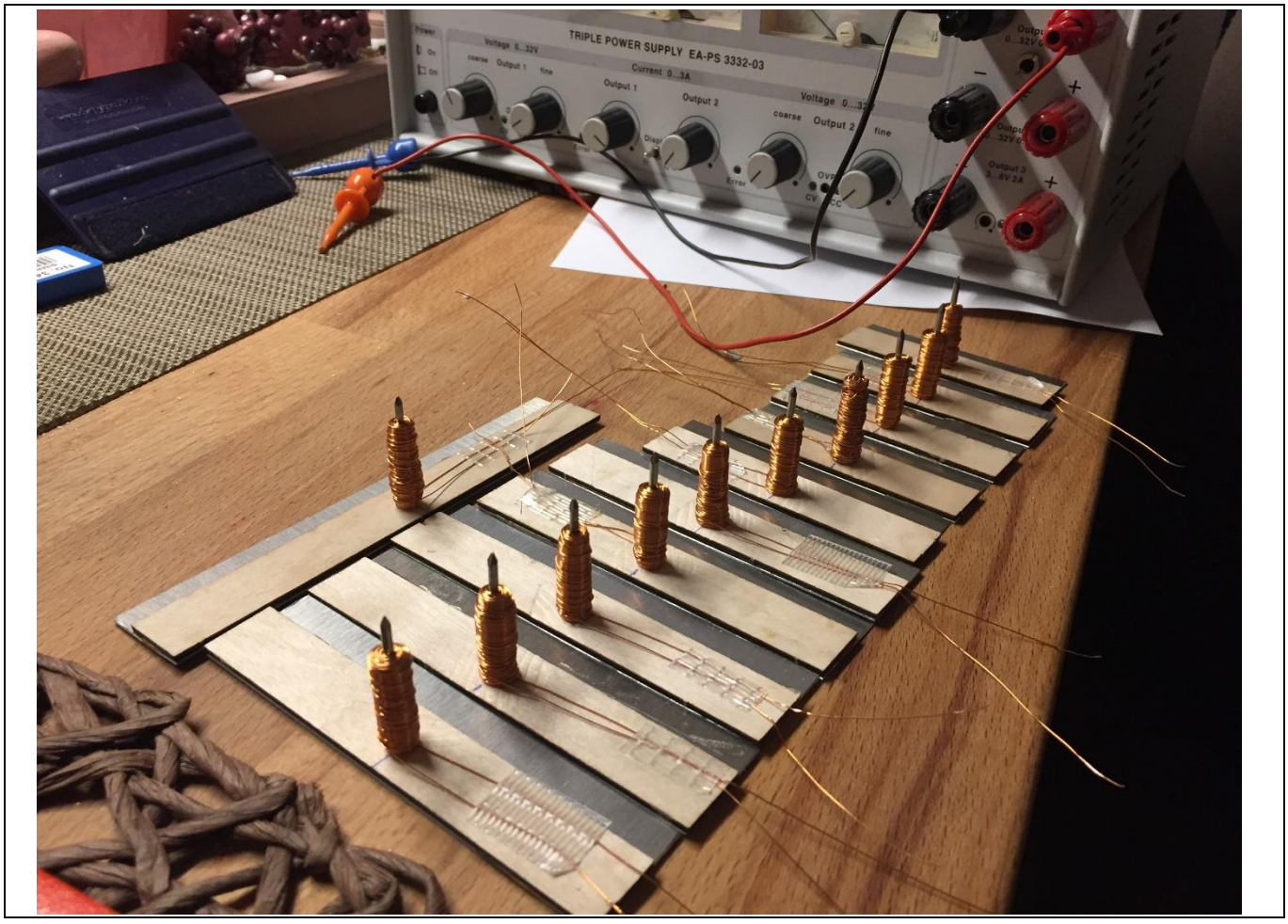

Figure 8 Assembled actuators

It is also easy to solder the diodes already in this state. Please check every door each. Due to the position of the magnets, the polarity of each one can differ, so the diodes direction might be not the same for all actuators.

5 Electronics

The electronics exist of:

- XMC1100 Boot Kit
- 24V Protected Switch Shield with BTT6030-2EKA and BTT6020-1EKA
- Self-made smart low side switch shield containing five BTS3035TF
- A RTC module with own battery

The High side switch shield and the controller board can be used without further modifications.ses as is. The low side switch shield is build up on an Arduino UNO breakout board with a 0.1” grid. The two shields will be stacked on top of the controller board. The RTC module is placed below the XMC PCB and connected via I2C.

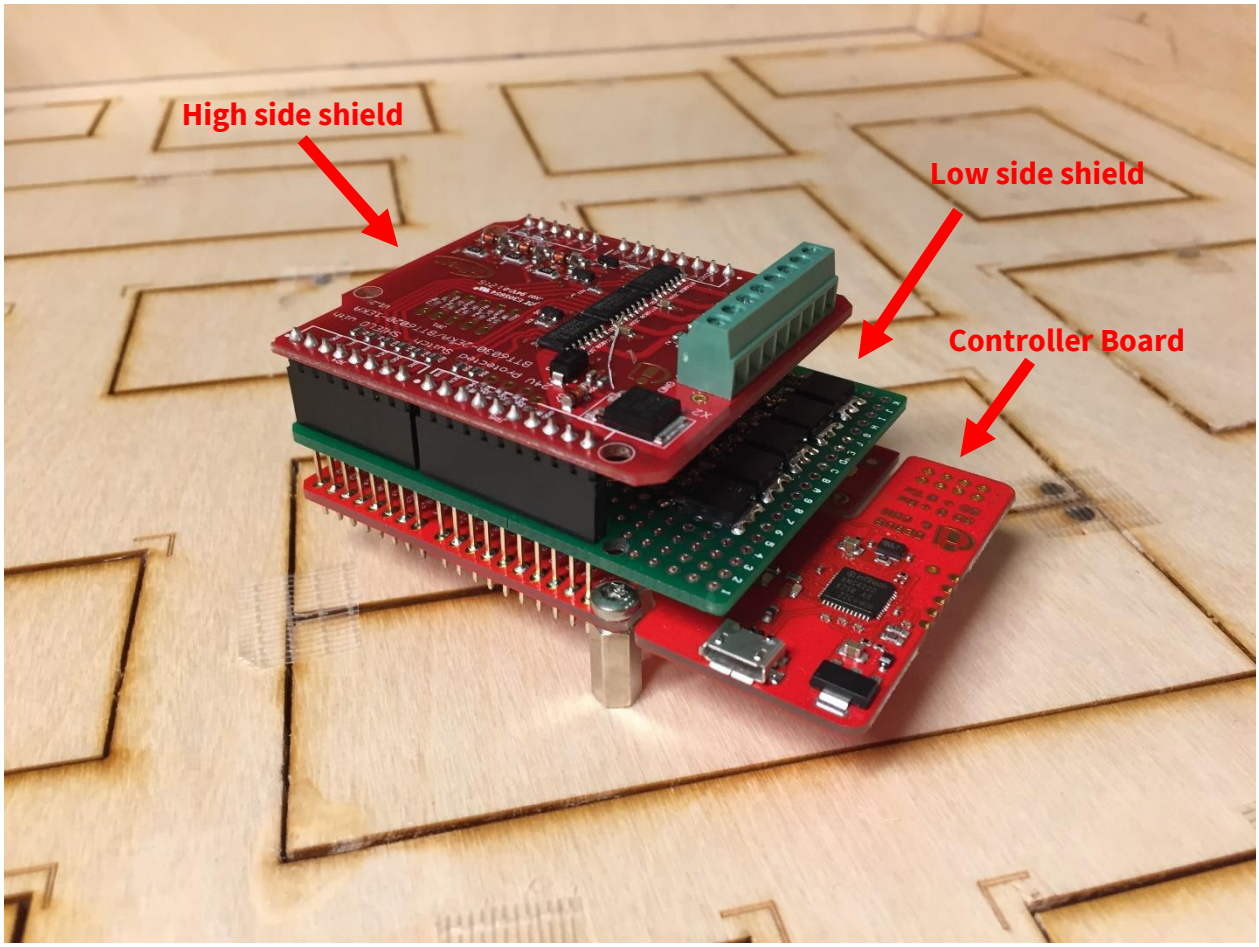

Figure 9 Electronics stack

The five BTS can be connected directly to the output of the microcontroller. The pins can be found in the schematics.

6 System assembly

Glue the electronic stack in the wooden frame (we used a two component epoxy resin to glue the spacer on the bottom of the electric stack to the frontplate) and connect the actuators according to the schematics.

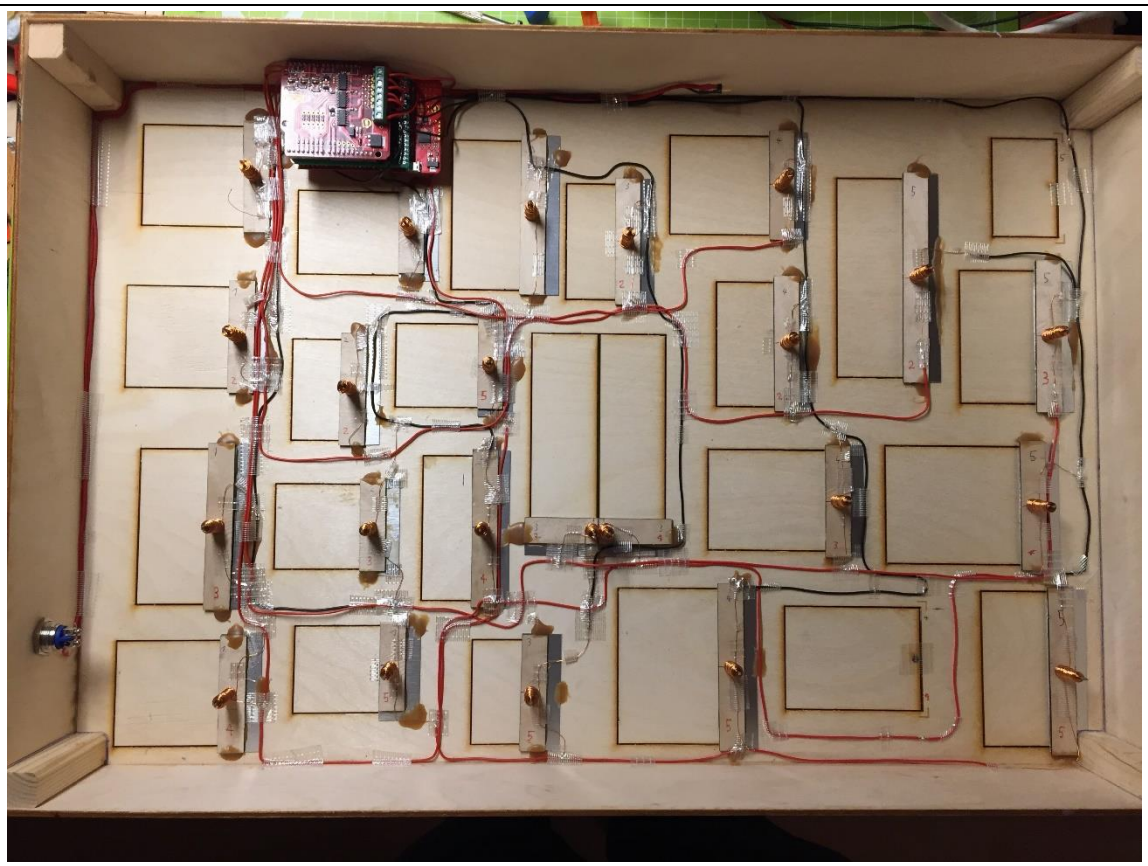

Figure 10 Assembly without boxes

As a last step glue the wooden boxes on the back side of the front and screw the back plate onto the four pillars.

7 Schematics

Here you can find the schematics of the setup.
The system is powered via a 3s LiPo battery. You can also use another type of battery but keep in mind that there will be around 3-4 A during operation. As long as the button is pressed, the microcontroller will be switched on (reads the actual date out of the RTC and set the pair of high and low side switches accordingly). Each high side switch activates a row of the matrix, each low side switch a column. The actor at the crossing point of active row and column will be active.

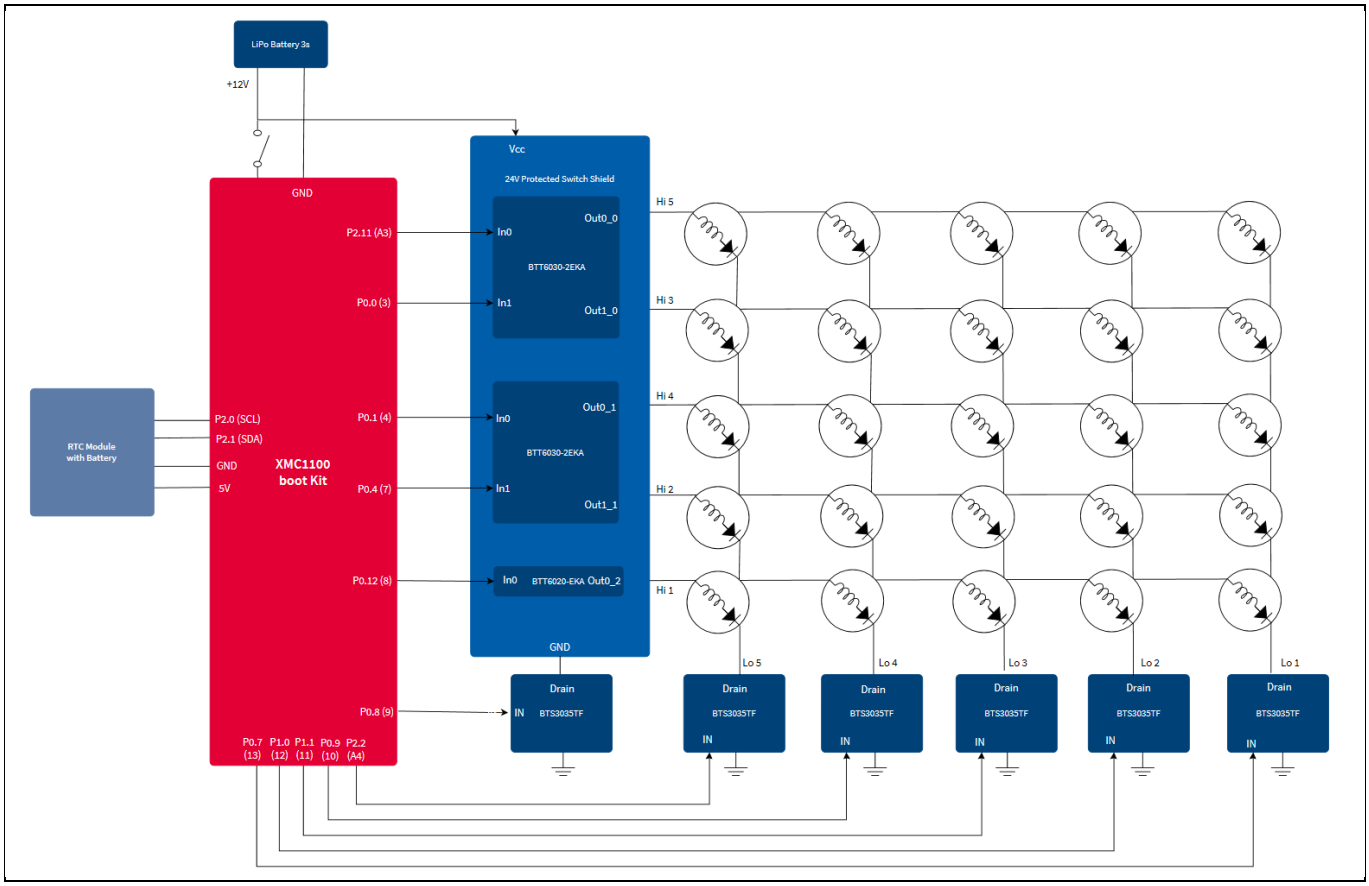

Figure 11 Calendar Schematics

Revision history

Document version	Date of release	Description of changes
V1.0	05.11.2018	Initial release
V2.0	09.11.2018	Small changes for better understanding

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