RFID Lock Build Instructions

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NOTICE: Use of this document is subject to the terms of use described in the document "Terms_of_Use_License_and_Disclaimer" that is included in this release package. This document can be found at:

https://github.com/TeamPracticalProjects/Wireless_IO_Board/blob/master/Terms_of_Use_License_and_Disclaimer.pdf

Contents

1. Introduction.

This document provides step-by-step instructions to build an RFID Lock based upon the Tokatuker cabinet locking device, see:

https://www.amazon.com/Tokatuker-Electronic-Cabinet-Hidden-Drawer/dp/B075QF1VPR

The RFID Lock is compatible with the MN_ACS RFID Access Control System, see the following for details:

https://github.com/TeamPracticalProjects/MN_ACL

There are three main activities involved in this process:

- Build a Wireless_IO_Board with the necessary components installed to operate the Tokatuker device.
- Modify the Tokatuker device for use with the Wireless_IO_Board.
- Connect the modified Tokatuker device to the Wireless_IO_Board and test it out.

There are two additional (optional) activities that may be performed after these three essential steps are complete:

- Install the RFID_Lock firmware in the Wireless_IO_Board Photon and configure the RFID_Lock to listen for RFID Station check-in events.
- Mount the Tokatuker lock device and locking hasp into a cabinet.

Each of these activities is covered in its own section of this document. Before proceeding with any of these activities, we strongly suggest that you read through the Overview document in this repository:

https://github.com/TeamPracticalProjects/RFID_Lock/blob/master/RFID_Lock_Project_Overview.pdf

2. Building the Wireless_IO_Board.

Complete instructions for building a Wireless_IO_Board can be found at:

https://github.com/TeamPracticalProjects/Wireless_IO_Board/blob/master/Docs/Wireless_IO_Board_Build_Instructions.pdf

The minimum parts needed to operate the Tokatuker locking device are the *Core Components* (section 2.1 of the referenced document) and the *Small Motor Controller Parts* (section 2.2 of the referenced document). You might wish to review all the Wireless_IO_Board repository; in particular the documents:

- https://github.com/TeamPracticalProjects/Wireless_IO_Board/blob/master/Docs/Wireless_IO_Board_User_Manual.pdf

- https://github.com/TeamPracticalProjects/Wireless_IO_Board/blob/master/Hardware/PCB/Wireless_IO_Board_Parts_List.pdf

You may, of course, wish to add additional parts to your Wireless_IO_Board if your project requires additional capabilities; e.g. an external LED, an on-board buzzer, or sensor input(s).

3. Modify the Tokatuker Device.

The following steps are required to modify the Tokatuker locking device for use on this project. In essence, these modifications involve removing the antenna and electronics board from the device and notching the case to bring out the electronic board connector which contains the locking motor wires.

Figure 3-1 shows the rear of the Tokatuker locking device. Five Phillips head screws hold the cover to the device.

Figure 3-1. Tokatuker Lock Rear View.

Remove the five screws holding the back cover to the device, revealing the internals; see figure 3-2. Note the three springs shown in the lower left side of figure 3-2. Leave these springs intact – don't lose them! Note that when reassembling the back cover to the unit, these three springs will seat into the three bumps on the inside of the back cover. Note also the RFID loop antenna in the lower part of figure 3-2 and the electronics board in the upper part of figure 3-2. The electronics board is held in place with two more Phillips head screws.

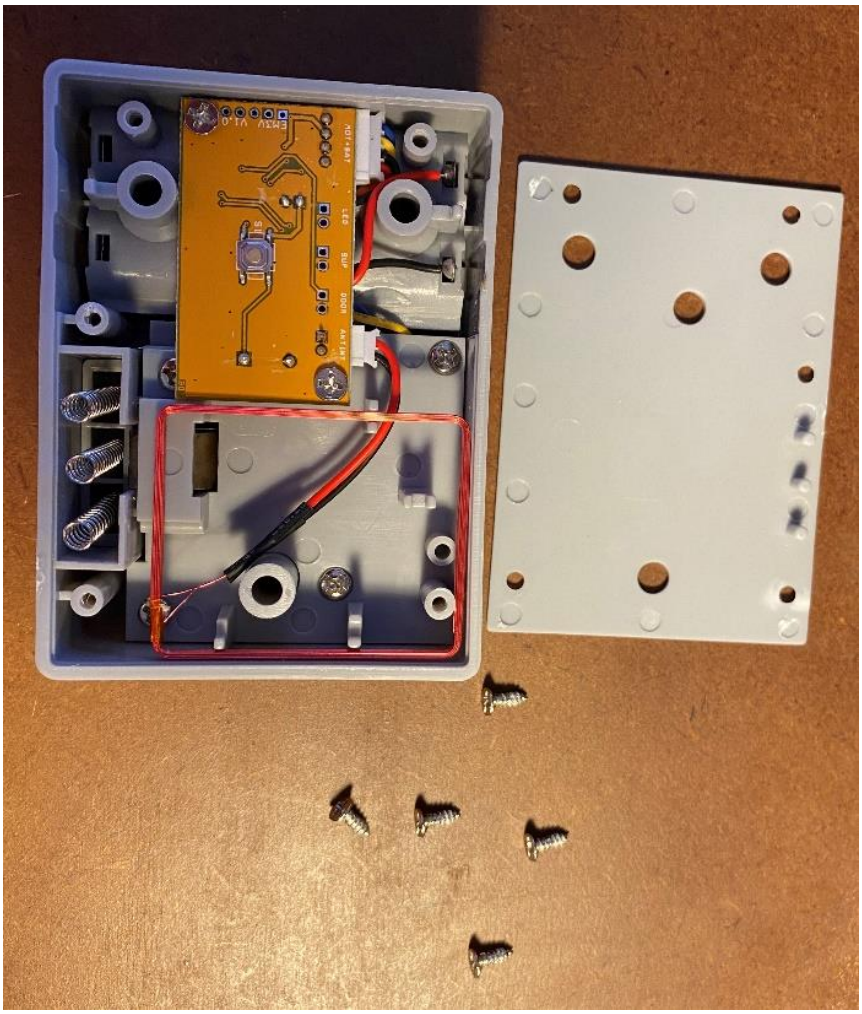

Figure 3-2. Tokatuker Lock Back Cover Removed.

Carefully remove the two Phillips head screws that hold the electronics board in place. Next, carefully lift the RFID loop antenna and electronics board out of the unit – see figure 3-3.

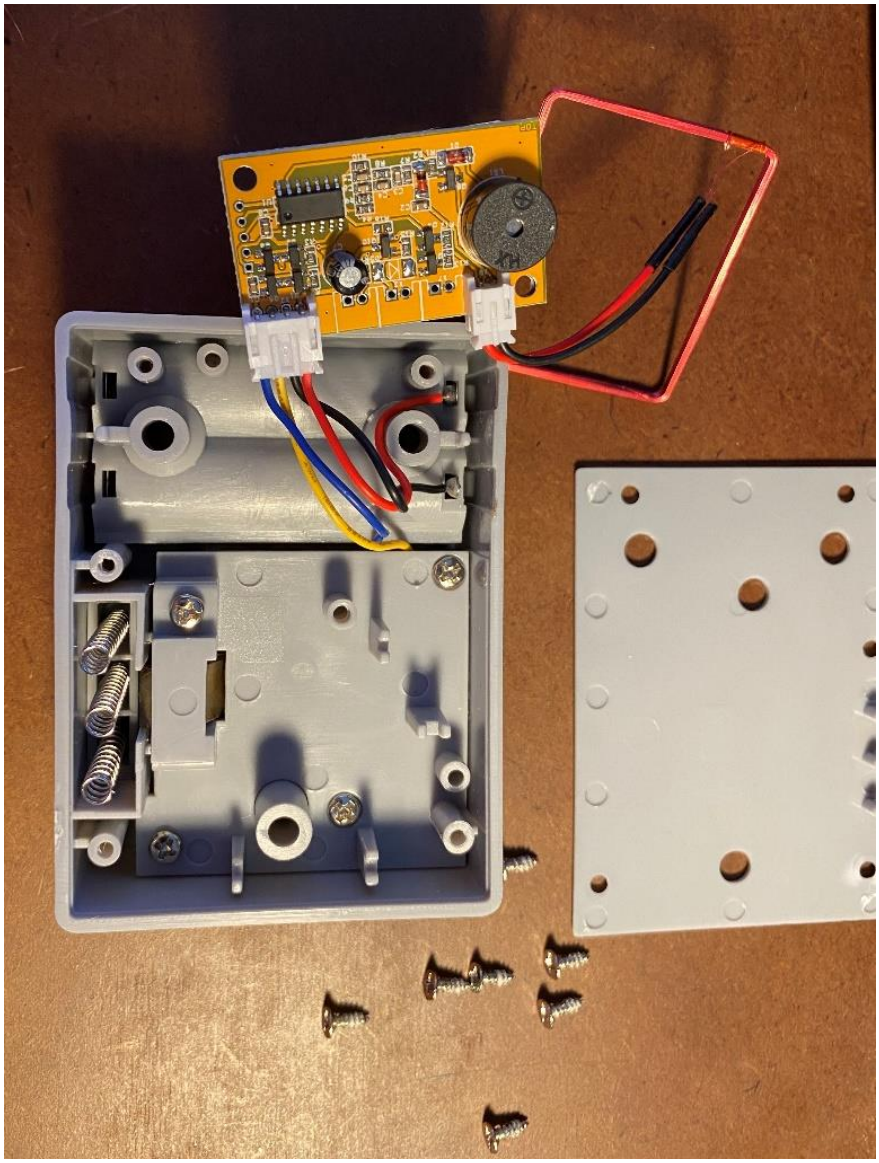

Figure 3-3. Antenna and Circuit Board Removed.

The electronics board has two connectors: a 2-pin connector for connecting the RFID Antenna to the electronics board and a 4-pin connector from the electronics board into the interior of the unit. Unplug the male cable 4-pin connector from the female socket on the electronics board. You can now discard the RFID loop antenna and electronics board; they are not needed for the RFID Lock project. See figure 3-4, below.

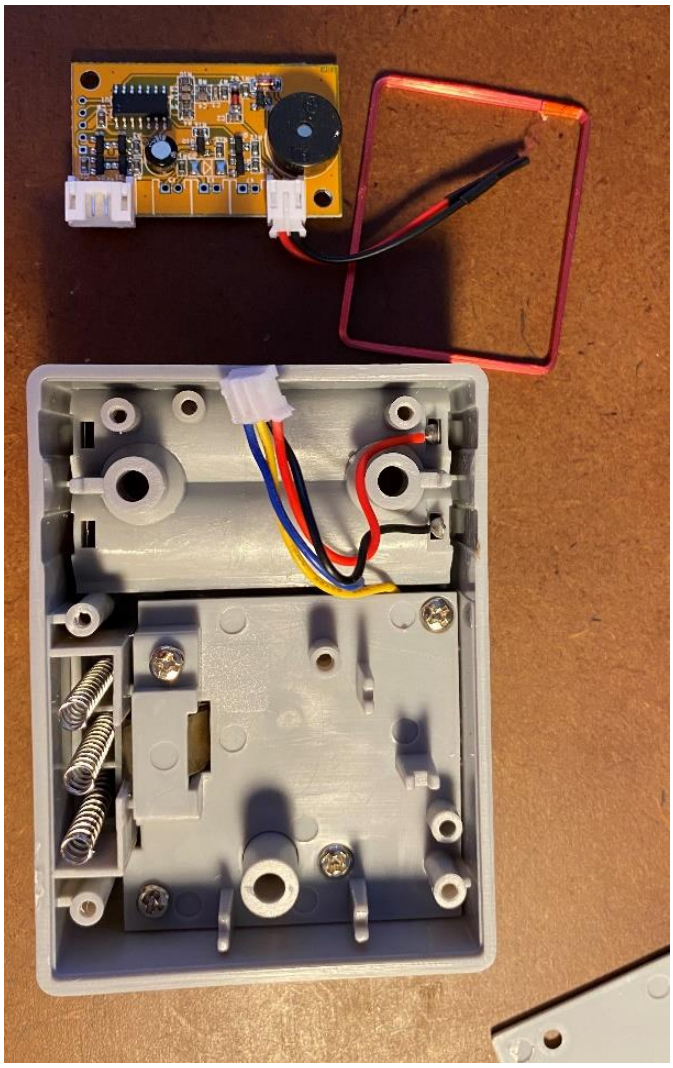

Figure 3-4. Antenna and Circuit Board Unplugged.

The 4-pin male connector needs to become accessible from outside of the re-assembled unit. Take a small file and cut a notch in the top side or the long side of the unit so that the cable can protrude through the side of the unit after the back cover is replaced. See figure 3-5 for an example.

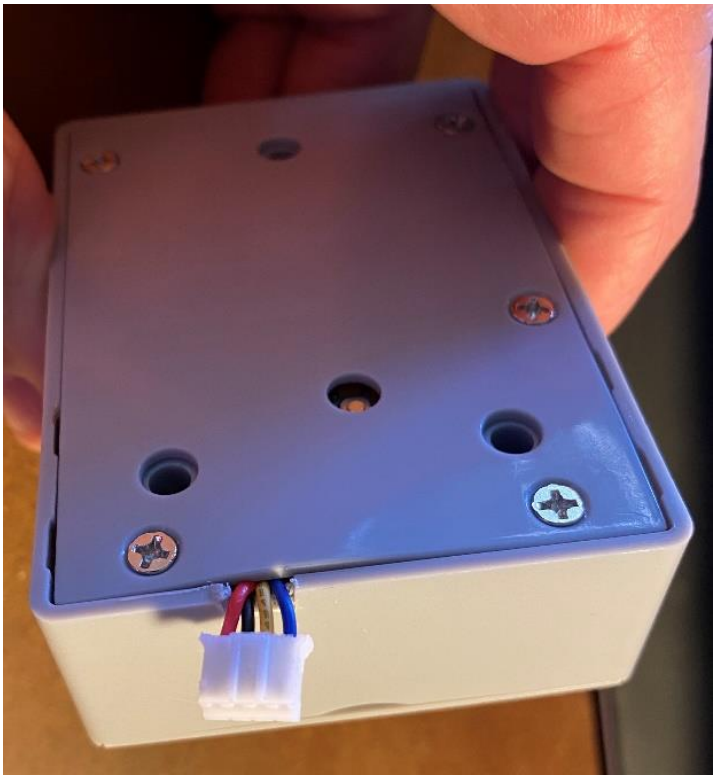

Figure 3-5. Back Cover Replaced with Connector Through Notch.

Place the cable through the notch that you cut and now replace the back cover on the unit, making sure that the three bumps on the inside of the back cover each engage one of the three springs that were noted in figure 3-2. Make sure that each spring is properly engaged in its bump. Now use the five original Phillips head screws to re-fasten the back cover to the unit. The reassembled unit should look similar to figure 3-5.

4. Connect and Test the RFID Lock.

The lock unit connects to the Wireless_IO_Board using two of the four wires on the connector that is exposed through the side of the unit. The wires on this connector are as follows:

- BLUE: lock unit motor +
- YELLOW: lock unit motor –
- BLACK: lock unit battery –
- RED" lock unit battery +

You will not place batteries in the unit. The Wireless_IO_Board supplies its own motor power. Therefore, the red and black leads will not be used. Wire the blue and yellow leads to the Wireless_IO_Board motor terminal block, as follows:

- BLUE wire to the outside connector of the motor terminal block
- YELLOW wire to the inside connector of the motor terminal block

See figure 4-1. For details. We have found that male-male jumpers (such as those used for solderless breadboards) work fine for this purpose, but you can use any wires that work.

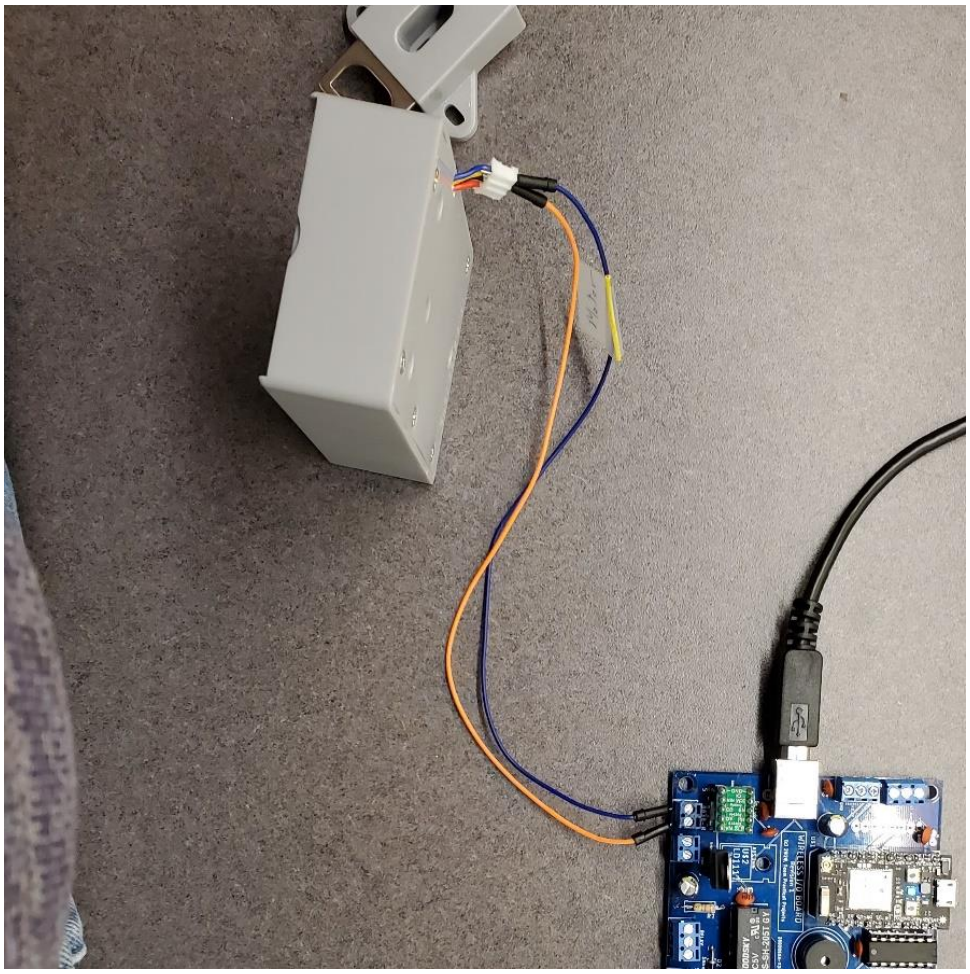

Figure 4-1. Wiring the modified lock unit to the Wireless_IO_Board.

You can use the program “locktest.ino” to test out the modified lock unit connection to the Wireless_IO_Board. Complete instructions can be found in section 3 of the document:

https://github.com/TeamPracticalProjects/Wireless_IO_Board/blob/master/Docs/Wireless_IO_Board_User_Manual.pdf

You can trip the lock by using the Particle console to call the function “tripLock”. No arguments are necessary. The other functions available on the console are not applicable to these instructions and won’t perform any useful actions.

In order test that the lock is properly wired to the Wireless_IO_Board, insert one of the locking hasps into the lock unit, as shown in figure 4-2. Note the proper orientation of the hasp!

***** WARNING ***** Make sure that you keep your face, hands and other parts of your body away from the front of the lock unit when a hasp is inserted. When the lock is tripped, the hasp is ejected with considerable force! *Keep all objects (particularly yourself) at least 6 feet away from the front of the lock unit!*

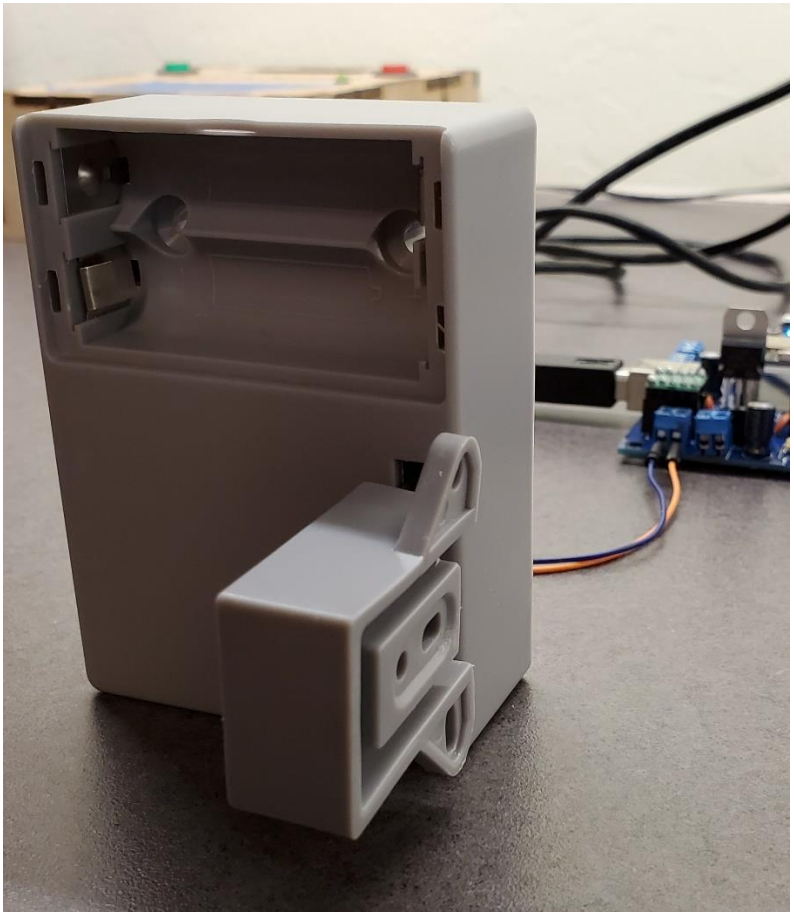

Figure 4-2. Hasp inserted in the Lock.

With the hasp inserted into the lock unit as shown in figure 4-2, and keeping well clear of the front of the lock unit, click "CALL" by the "tripLock" function on the Particle console to call this function. The lock unit should click, ejecting the hasp, and then (after 2 seconds), the lock unit should click again. After this second click, the lock unit is reset and the hasp will lock into the lock unit again.

NOTE: If you hear the unit click but the hasp is not ejected, or if the hasp won't lock into the lock unit to begin with, then you probably have the lock motor leads connected backwards! Carefully check the connections – the polarity matters!

5. Install and Configure the RFID Lock Firmware.

The firmware flashed to the Photon on the Wireless_IO_Board per section 4 of this document is used for testing purposes. In order to have your RFID_Lock become part of the Maker Nexus Access Control System (MN_ACS) and respond to RFID card taps on RFID Stations, you must flash different firmware onto the Wireless_IO_Board Photon. The firmware that you need is located in this repository at:

https://github.com/TeamPracticalProjects/RFID_Lock/tree/master/Software/Particle_SW

Download the folder "LockFirmware" to your computer. Next, open the Particle Workbench[1] on your computer and set the "workspace" to this folder. You can compile and flash the firmware to your Photon device using the Particle Workbench. Using the Particle Workbench is beyond the scope of this document. Refer to Particle's on-line documentation and tutorials for details.

Once the RFID_Lock firmware is flashed to your Wireless_IO_Board Photon, you should see the D7 LED flashing blue about once per second. You must now use the "MN_Station_Configurator" App (running on an Android device) to set the "deviceType" and the "Lock Listen code" into the Wireless_IO_Board Photon. Complete instructions for this can be found at:

https://github.com/TeamPracticalProjects/MN_ACL/blob/master/Documents/RFID_Administrator_User_Manual.pdf

[1] If you don't have the Particle Workbench (Visual Studio Code) on your computer, see Particle's documentation at: https://www.particle.io/workbench. Refer the Particle's documentation for installation and operating instructions.

6. Mount the RFID Lock in a Cabinet.

The RFID Lock can mount in most any cabinet or drawer. We have found a handy little inexpensive cabinet that is suitable for holding keys and other small parts that might need to be secured from casual use by unauthorized personnel. See:

https://www.amazon.com/Darice-Unfinished-Wooden-Hinged-Multicolor/dp/B00KNAPNWW

This section contains some suggestions about mounting the RFID Lock into this cabinet.

NOTE: We have chosen to mount the lock device and hasp with screws that go through the cabinet cover and side wall. This means that someone could gain access to the inside of the cabinet by unscrewing these screws. If this is not OK with you, we suggest that you use blind headed screws, pop rivets, super glue or some other means of mounting the lock device and hasp that cannot be removed from the outside of the cabinet. You will also have to find a way to secure the cover hinges from removal, as they come mounted with two Phillips head screws each. However, if you make these changes to our design, please make note that there may be no way to open the cabinet if the lock device mechanism fails!

Step #1 is to remove the hinged hasp and locking ring from this cabinet. Each part is secured to the cabinet by two small Phillips head screws. Leave the front cover hinges in place.

Next, remove the wires between the Wireless_IO_Board and the lock device. Insert the locking hasp into the lock device in the correct locking position, see figure 6-1.

Figure 6-1. Positioning Lock and Hasp for Mounting.

Determine where in the cabinet you wish to mount the locking device. The locking device mounts to the inside swing cover of the cabinet. The hasp mounts on the inside side of the cabinet. The Wireless_IO_Board mounts on the back wall of the cabinet, with a hole drilled into the side or back of the cabinet to feed the USB power cable to the Wireless_IO_Board.

The lock device and hasp must align properly when they are individually mounted to the cabinet cover and side. The old adage of “measure twice and cut once” applies here! Carefully place the assembly of lock and hasp in the box and carefully align them so that the back of the lock device is flush with the inside surface of the cover when it is closed and the hasp is flush with the inside side wall of the cabinet. Carefully mark these positions on the cabinet, see figures 6-1 and 6-2.

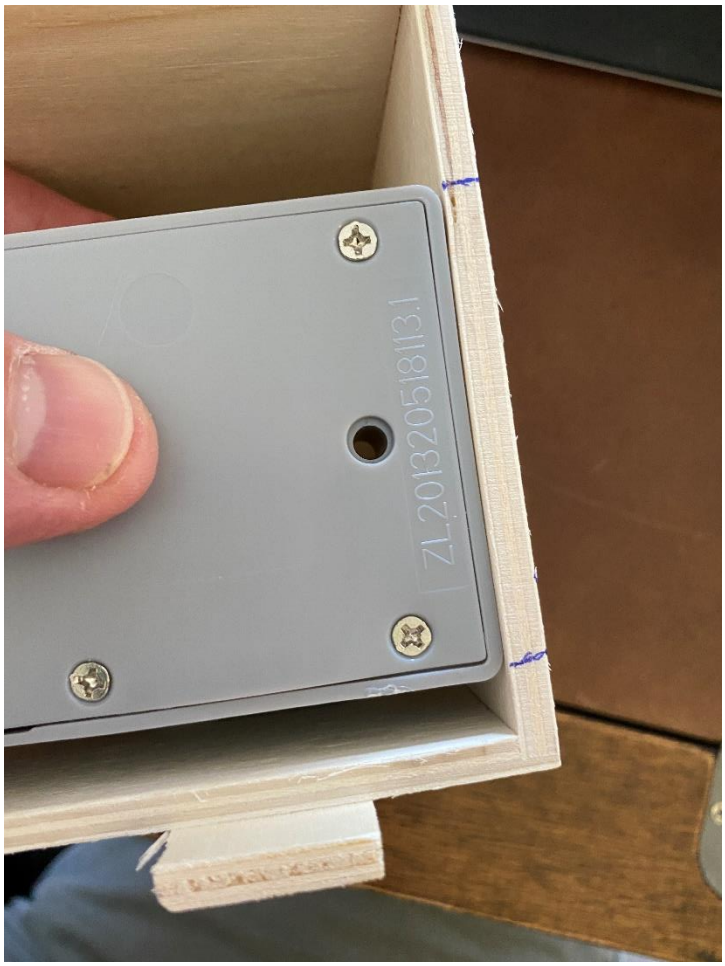

Figure 6-2. Mark Mounting Locations for Lock and Hasp

The locking device will mount to the inside of the cabinet cover with three screws (in the holes provided through the device). The hasp will mount to the inside of the side wall of the cabinet. It is difficult to drill screw holes from the inside; therefore, we recommend that you make paper templates for drilling the holes and drill them from the outside of the cabinet. Figure 6-3 shows how we made a paper drilling template for the hasp, marking the hasp mounting holes with the lock and hasp assembled. Figure 6-4 shows how we made a paper drilling template for lock device itself.

Figure 6-3. Mark Mounting Holes for Hasp Template.

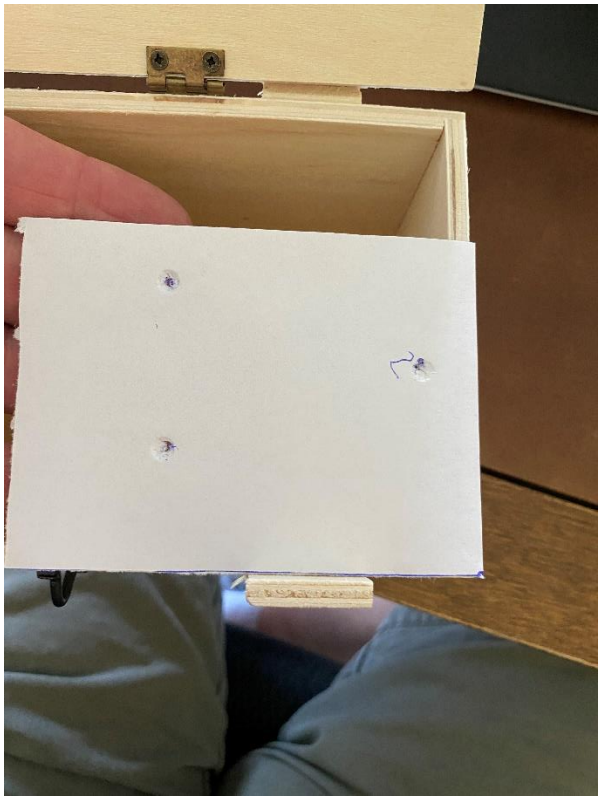

Figure 6-4. Mark Holes for Lock Template.

Carefully cut out each template and very carefully align the hasp template with the marked hasp location on the cabinet and the lock template with the marked lock device location on the cabinet cover. The templates should be taped or glued to the outside of the cabinet with the proper orientation for drilling the mounting holes. Drill mounting holes sized for the type and size of the fasteners that you have selected.

The Wireless_IO_Board has four mounting holes, one in each corner of the board. They are sized to comfortably house #6 hardware. You may use metal or nylon screws to mount the Board to the back of the cabinet; however, we suggest that you use only nylon standoffs, washers and nuts to avoid shorting out the electronic circuitry. We recommend using ½" threaded female-female nylon standoffs between the Board and the back of the cabinet. Therefore, the Board can be mounted using #6 x ¼" screws on both the cabinet side and the Board side. Once again, we suggest using nylon screws on the board side; metal screws can be used on the cabinet side if you wish. See figure 6-5, below.

Figure 6-5. Mounting and Cabling the Wireless I/O Board.

After mounting the lock device and hasp to the cabinet, DO NOT CLOSE THE CABINET DOOR or else you will lock the cabinet closed accidently! Wire the lock device to the Wireless_IO_Board, power up the Board and check that the lock trips correctly. Only after checking this should you close the cover of the cabinet. The cabinet can now be opened by

tripping the RFID Lock, either using the test firmware of section 4 of this document, or the RFID_Lock firmware with an RFID Station of section 5 of this document.

Dress the motor control and USB power wires using cable ties, similar to figure 6-5. Make sure that the cabinet closes and opens smoothly. The final assembly should look similar to figure 6-6.

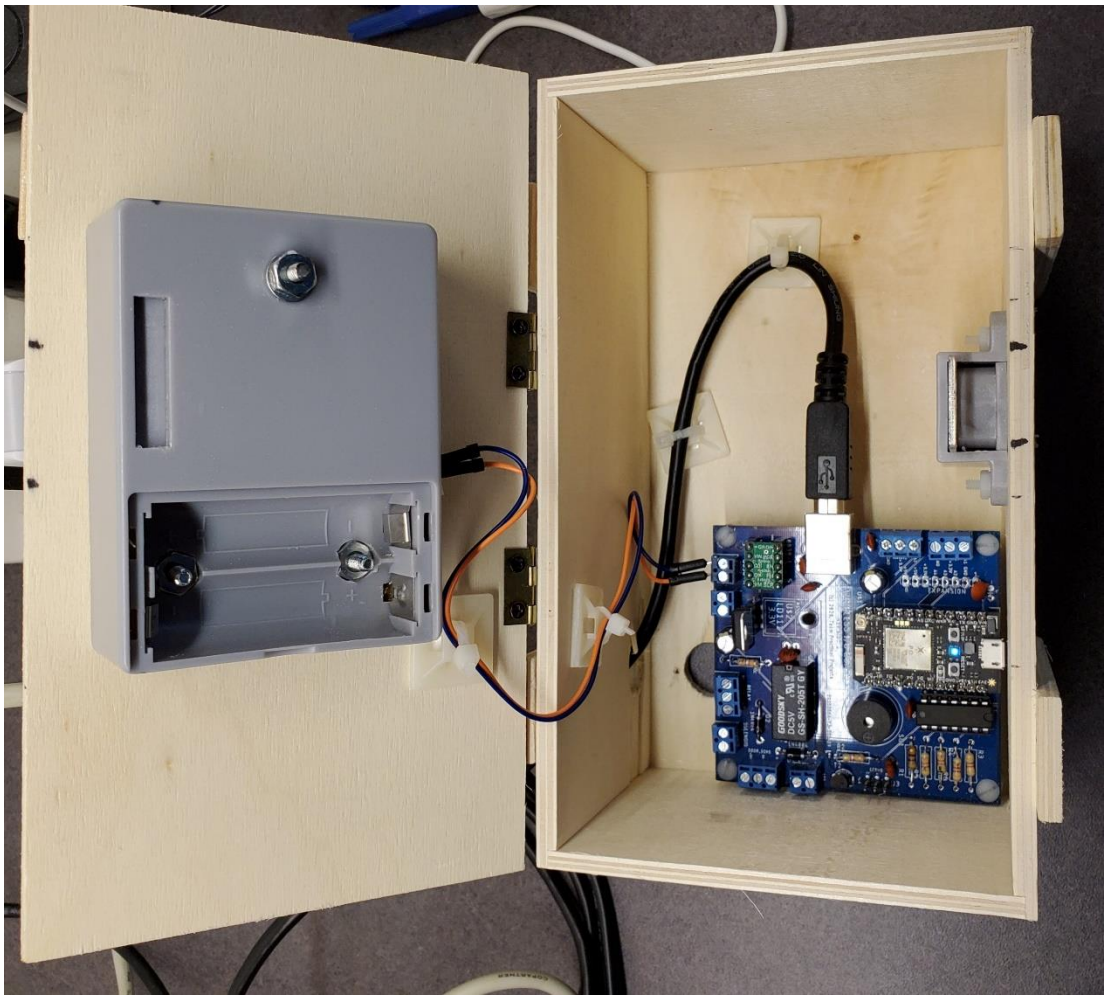

Figure 6-6. Completed Assembly.