Instructions for Installing and Testing the Water Leak Detector Firmware

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Table of Contents

1. Purpose

This document will guide the maker of a Water Leak Detector (WLD) to install the WLD firmware into the WLD Photon/Electron module. You should first assemble and inspect the hardware: (a) the WLD printed circuit board (PCB) and (b) the plastic box enclosure, including the faceplate with the toggle switch, backlit push button switch and servo with the wiring that attaches these components to the WLD PCB. You may optionally assemble and connect the water leak sensors to the RJ11 connector boards and wire the connector boards to the WLD PCB. However this latter step may be deferred as the firmware can be uploaded to the Photon/Electron and tested without first connecting the water leak sensors. Released documentation for these steps may be found at:

- PCB assembly instructions: **xxxxx**
- Enclosure assembly instructions: **xxxx**
- Sensor wiring instructions: xxxxx

You will also need to register with Blynk.cc, install the Blynk app on your smartphone, and copy the WLD Blynk project into your Blynk app. In so doing, you will obtain a Blynk "auth code" that you will need to add to the WLD firmware in order for it to compile and flash to your Photon. Instructions for the Blynk app may be found at: **xxxxxxxxx**

NOTE: We *strongly recommend* that you obtain your particle.io account, register your Photon/Electron, flash the Blink application to your Photon/Electron, and test that this all works with the Photon/Electron standing alone (section 3, below). After successfully performing this step, you may then insert you Photon/Electron into the WLD PCB, power it up using the PCB flash the WLD firmware to it and verify that it is working (sections 4 & 5, below).

2. Overview

The WLD is fully documented on Git Hub at **xxxx**

The WLD uses a processor from *particle.io* as the local compute resource. The WLD has been tested with the Photon (WiFi), but it designed to be compatible with the Electron (2G/3G). This document will refer to the Photon but should be the same process for the other Particle-compatible devices.

Many steps in this document involve services from *particle.io, Blynk.cc* and *GitHub.com*. These instructions were accurate at the time they were created, but we have no control over these other providers; the reader may need to adjust to new realities.

The process consists of several steps.

- Power up the Photon (standalone) and connect it to the internet
- Verify the Photon (standalone)
- Install the WLD Firmware (in circuit)
- Verify the WLD (in circuit)
- (Optional[1]) Calibrate the servo and re-install the firmware with calibrated values for servo meter constants.

3. Power up the Photon and connect to the internet

If you don't have a *particle.io* user account, you will have to create one. Use a web browser on your computer to go to: https://docs.particle.io/guide/getting-started/start/photon/

Note that if you purchased only the Photon and not the starter kit, you will not have all of the components shown on this web page. You only need the Photon and a micro-USB to Standard-USB cable to perform this step. Follow all of the steps on this web page until you have the "Blink an LED" firmware installed on your Photon and verified by observing the Photon's "D7" LED blinking.

If the multi-color LED on the Photon is "breathing cyan" and the D7 LED is blinking, you have successfully set up your particle.io account, captured your Photon into your account, and compiled and flashed firmware to it over the Internet. If you are not in this state, follow the on-line instructions at particle.io to get to this point before proceeding further.

4. Install the WLD Firmware

Preliminary Steps

Disconnect your Photon from power and plug the Photon into the connector on your (assembled and inspected) WLD PCB. Make sure that (a) the micro USB connector on the Photon is facing

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[1] The servo usually comes calibrated well enough to use without a separate calibration step. Instructions are provided to calibrate the servo more accurately if you feel a need to do so.

the same side of the PCB as the Large USB connector and (b) that pin 1 of the Photon is as far forward in the PCB connector as possible. See the picture below:
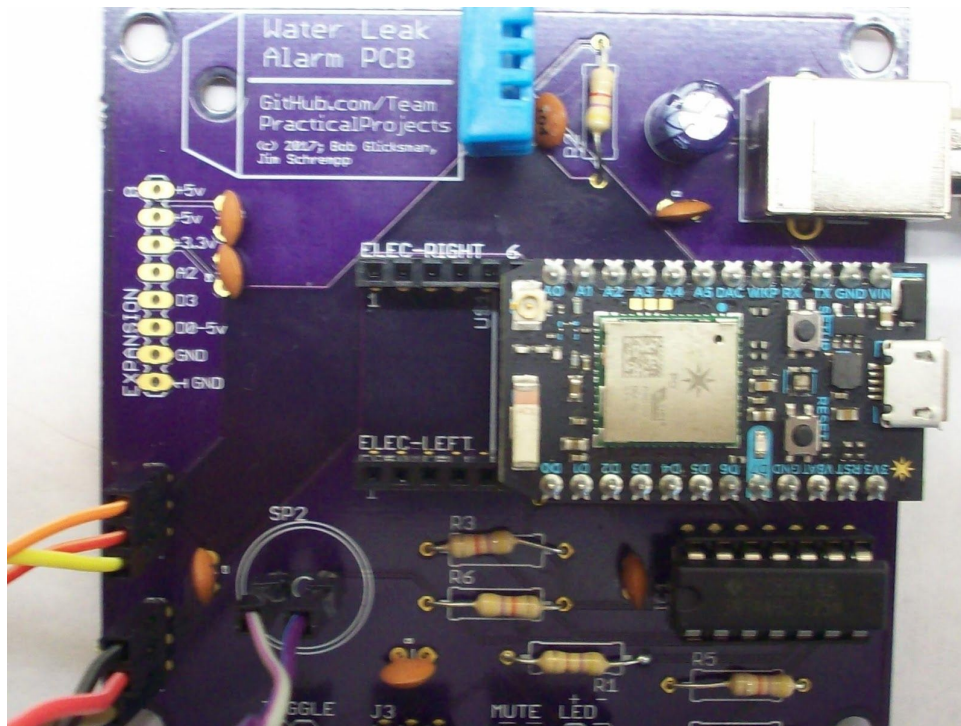
Note in the photo above that there are spare socket pins on the left side of the Photon connector (ELEC-RIGHT and ELEC-LEFT). These pins are not used with the Photon – they are for use with the Particle Electron.

Double check that the Photon is properly positioned and properly seated in the connector on the PCB. Double check that all other components are properly seated, soldered and positioned on the PCB.

If you haven't already done so, connect up the toggle switch, servo and backlit pushbutton from the WLD faceplate to the connectors on the WLD PCB. See the following document for details:

Xxxxxxx

You may optionally connect the water leak sensors to the PCB at this time; see the following document for details:

Xxxxxxx

Carefully inspect all connections to be sure that they are correct and are properly seated. Now, power up the WLD PCB by inserting the "B" side of a standard USB A/B cable into the USB connector on the WLD PCB and the "A" end of the cable into your USB power supply. Plug in the USB power supply. After a few seconds, you should see the Photon connecting to your WiFi (blinking green), followed by it connecting to the Internet (breathing Cyan) and running the "blink an LED" app that you had previously programmed into it. If you have a multimeter handy, you may also want to verify the 5 volt and 3.3 volt power to the WLD PCB by testing the +5v and +3.3v pins on the EXPANSION connector (left side of the PCB) referenced to GND. *Make sure that all of this is working before proceeding to the next step.*

Two ways to load Firmware

With your Particle processor there are two ways to load the firmware Over The Air: From their web based tool or from the IDE on your laptop. (A third way is via a cable connected to your laptop but that is less convenient and we leave it as an exercise for the reader.) Here we will cover the use of the Web IDE. See Appendix 1 for a discussion of the laptop tools.

Create a Web Based Project

In the *particle.io* build site (https://login.particle.io/login?app=web-ide&redirect=https://build.particle.io/build) first log in and then type a name for your app (suggestion: "WLD") under "Current App". You will see a skeleton app in the editor pane on the right side of your screen:

```
void setup() {

}

void loop() {

}
```

Delete all of these lines of code completely.

Download the WLD Firmware from GitHub and Copy it into the Particle Web IDE Editor.

The latest WLD Firmware is stored on the public site GitHub . There are many ways to use GitHub. We will use the most simple way possible.

In any web browser on any computer, go to

https://github.com/TeamPracticalProjects/WaterLeakSensor

Make sure that the current branch is "master" on the left side of the screen.

On the right hand side of the screen should be a button labeled "clone or download". Click it and select "download zip" to download a zip archive of the entire repository to your computer. Download this zip archive to your desktop or any other location on your computer where you will be able to locate it later.

Once the download is complete, unzip the file and navigate to the "Firmware" folder. Open the "Firmware" folder, then the "WaterLeakDetector" folder and finally the "src" folder. You should see a single file called "WaterLeakDetector.ino". Open this file using any text editor or word processor on your computer.

Add the Firmware to Your Web Project

Copy all the text from the WaterLeakDetector.ino file into your clipboard. Make sure that you copy *everything.*

Now paste the text into the code editor on the *particle.io* build site where you previously erased all the code. Make sure that the entire file is in the editor window of the web IDE. Give the project a name, such as "WLD".

Add the DHT11 and Blynk Libraries to your Firmware

In the Particle Web IDE, click on the Libraries icon. Search for the Blynk library in the Community Libraries. Select the Blynk library and click on "INCLUDE IN PROJECT". Then select the WLD project and CONFIRM the include of the Blynk library into the WLD project.

In the web IDE, again click on the Libraries icon. Search for the Piettetech_DHT library in the Community Libraries. Select the Piettetech_DHT library and click on "INCLUDE IN PROJECT". Then select the WLD project and CONFIRM the include of the Piettetech_DHT library into the WLD project. You should see the following lines of code at the very top of your project source code:

```
// This #include statement was automatically added by the Particle IDE.
#include <PietteTech_DHT.h>

// This #include statement was automatically added by the Particle IDE.
```

```
#include <blynk.h>
```

Copy Your Blynk Authentication Token into the Firmware

You will need to copy your authentication token ("auth token") from the Blynk app on your smartphone into the firmware. You should have e-mailed your auth token to yourself when you installed the Blynk app and the WLD project, as described in document **xxxxx**. If you wish to generate a new auth token and/or e-mail the token to yourself again, open the Blynk app on your smartphone and select the WLD project. Click on the little icon at the top that looks like a hex nut to get to the project settings screen. Then scroll down to the "devices" section and select your Photon device. Tap the device, then again, and you will see a "Refresh" button and an "E-mail" button. Tap "Refresh" to generate a new token. Tap "E-mail" to e-mail yourself the current token.

Next, open your e-mail on the computer that you are running the Particle Web IDE and open the e-mail message with the token. Copy the token to your computer's clipboard.

In the IDE you are using, scroll down to the line of code that says (around line #107):

char auth[] = YOUR BLYNK AUTH TOKEN GOES HERE // DO NOT CHECK IN YOUR BLYNK AUTH!!

Delete all of the text to the right of the equals (=) sign and then paste the clipboard contents (the auth token) after the = sign. Now surround the auth token with double quotes ("); i.e. a double quote at the beginning of the auth token and another at the end of the auth token, leaving no spaces. Finally, add a semicolon (;) at the end of this line of code, right after the ending double quote. In summary, the original line of code should now look something like:

char auth[] = "1234dcbae01234ab98cd76543abcab03";

Now, save your work by clicking the save (folder) icon in the IDE editor window.

In the web IDE, go to the Devices tab and make sure that your Photon device is selected. The system firmware target that we have tested with is 0.6.2. We suggest that you select this version if it is not the latest.

Verify the WLD Firmware

Now, click on the "Compile and Verify" icon. Your code should compile correctly.

Flash the Firmware

After compiling the firmware, click on the flash icon (lightning bolt) to flash the WLD Firmware to your Photon.

Watch the OTA

Now watch your Photon; Over The Air (OTA) updates can take a minute. It should blink magenta a few times (perhaps so fast you've missed it?) and then restart including flashing green as it connects to your WiFi network again. Then start breathing cyan. This is a typical Photon reset cycle and you will come to recognize this sequence as very normal.

Note that if the Particle.io cloud decides to update the low level firmware in your device, then it may cycle through blinking magenta, flashing green, and breathing cyan several times. Once your new device has been through this cycle it should not happen again until Particle.io issues another release.

Once the Photon begins to breath cyan it will run the setup() function in the WLD firmware. This will take a second or two. Then, the green backlight of the pushbutton switch should come on. The light will come on solid if the water leak sensors are installed and dry; otherwise, the light will flash on and off and the buzzer will make an annoying noise. You can mute the buzzer by pressing the backlit pushbutton switch (the green backlight will still flash until the water leak alarm clears). The servo "meter" should also move to some position, indicating either temperature or humidity based upon the toggle switch position.

5. Verify the WLD

At this point, you can verify that the WLD is working, with the except of the water leak sensors if you have not yet installed them. Complete operation of the WLD is described in the WLD_User_Manual document which can be found in the zip archive, or at:

xxxxxxx

We suggest that you test all of the features of the WLD at this time, including:

- Photon: The multicolor LED on the Photon should be breathing cyan and the D7 LED should flash on and off at 4 second intervals.
- Local operation: The faceplate pushbutton should light solid green if the water leak sensors are installed and dry; otherwise it should be flashing green. When a sensor is wet or disconnected, the buzzer should make an annoying noise which can be muted by pressing the flashing pushbutton. The servo meter should read out the temperature or the humidity depending upon the position of the toggle switch. Flipping the toggle switch selects the other reading on the servo meter.
- Blynk App operation: Open the Blynk app on your smartphone and select the WLD project. You should see the temperature and humidity indicated on little meters at the top of the app screen. If the pushbutton is flashing green, there should be a red dot in the "ALA.." box below the Temperature meter. There should be a WLD reset message and perhaps some Alarm messages in the large text box labeled TERMINAL.

You can also open up the "console" at the particle.io website and, after logging in, click on the "events" tab (>_) on the left side of the screen. Within about 1 minute, you should see a set of temperature and humidity readings in the events window. New temperature and humidity readings will be published to the particle cloud every 1 minute by your WLD.

6. Calibrate the Servo Meter

Generally speaking, hobby servos are pretty well calibrated right out of the box and your faceplate servo meter should give good readings with the servo horn properly positioned (manually[2]). However, if you feel a need to better calibrate the servo meter, a detailed procedure is given in the document "Servo Meter Calibration.pdf" that is included in the zip archive and on GitHub at:

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In order to calibrate the servo, you will need to flash the firmware called "ServoCal.ino" that is in in the ServoCal/src folder that is within the Firmware folder in your zip archive, or at GitHub at:

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[2] With the firmware installed, open up the particle.io console and log in. The click on events on the left hand side (>-) and wait about a minute for temperature and humidity readings to show up. Place the toggle switch on the WLD enclosure faceplate in the temperature position and press the servo horn onto the servo spindle so that it points to the correct temperature on the faceplate (as as close as you can get).

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Open the ServoCal.ino file with a text editor or word processing program and copy the contents to your computer's clipboard *entirely*. Then log in to particle.io/ide, open a new app, and delete all of the skeleton text that is present:

```
void setup() {

}

void loop() {

}
```

Delete all of these lines of code completely.

Next, paste in the contents of the clipboard into the blank Web IDE editor window, making sure that all of the code is there. Give this program a name (suggested: ServoCal) and save it. Then compile and verify this firmware and flash it to your Photon. Follow the directions in the document "Servo Meter Calibration.pdf" to determine the calibration endpoint values and write these values down somewhere. Now, go back in the Web IDE to your WLD firmware and change the constants MAX_POS and MIN_POS (around lines #76 and #77) in the source code to the calibration values that you determined and wrote down. Save this file, compile and verify it and re-flash it to your Photon to have an improved calibration of the servo meter.

Appendix 1: Using the Particle Dev IDE

Particle.io provides a web based programming environment that is trivial to use. This is what's detailed in the instructions above. However, once you begin serious development with your Photon, you'll want to take the time to set up the local IDE. Particle.io provides a modified version of the popular Atom IDE they call Particle Dev.

Particle Dev runs on your local machine with your source files on your local file system; there is no need to duplicate source code files by copying and pasting into the web IDE. This allows you to download updates from GitHub and use them immediately. It also makes it easy for you to submit enhancements to the WLD project.

Particle Dev still performs firmware updates Over The Air (OTA) so you don't need to connect your Particle device to your laptop.

Git - We use GitHub for our collaborative development. If you're just going to work on the WLD for your own goals, then you don't have to use Git (although, we strongly recommend using some kind of source control). If you want to be part of the WLD development community, then you will need to install Git on your local machine and sign up for a free account at GitHub. This is not a tutorial on Git and GitHub. They take some getting used to, but they are powerful, not that hard to use once you get the hang of it, and they are free!

Set up the Particle Dev IDE

Download the Particle Dev from xxxx and install it on your laptop.

Get WLD Firmware

Download the WLD project from GitHub into a directory on your computer.

Open the Project in the IDE

In the IDE go to File/Add Project Folder. Navigate to the WLD folder: WaterLeakSensor/Folder/WaterLeakDetector and click Open. (Do not go a level deeper to the "src" folder.)

Click the reveal icon (">") on the src folder to show the firmware files. Click on the name WaterLeakDetector.ino to open the source file.

Add your Blynk Auth Token

At this point you need to add your own Blynk authorization token to the firmware. Go to the section in this document titles "Copy Your Blynk Authentication Token into the Firmware" and follow the instructions. Then come back here.

Select Your Device

If using the ATOM IDE, go to the menu at the bottom of the window and click "no devices selected". Select your Photon device from the drop down menu.

Verify the WLD Firmware

Now, click on the "Compile and Verify" icon (check mark in a cloud). Your code should compile correctly. You'll know this because the status menu at the bottom of the window will say "Success!" and you'll see a firmware binary file appear in the navigation tree.

If there's a problem you might see the status in Particle Dev go red and say something like "timeout". While many times you can click on the red status and a pop-up will detail the problem with your source, sometimes that doesn't work. In those cases the command-line compile is a big help. Open a command window on your laptop. Navigate to the folder

WaterLeakSensor/Folder/WaterLeakDetector

and at the prompt type "particle compile photon". This should give you more extensive error messages. Remember to scroll up to look at the first error generated and fix that one. Then compile again and see if it now works.

Flash the Firmware

After compiling the firmware, click on the flash icon (lightning bolt) to flash the WLD Firmware to your Photon.

Now go to the section of this document titled, "Watch the OTA".

You have now used Particle Dev to flash new firmware to your Photon!

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