Personal Solar-Powered Water Storage Regulation

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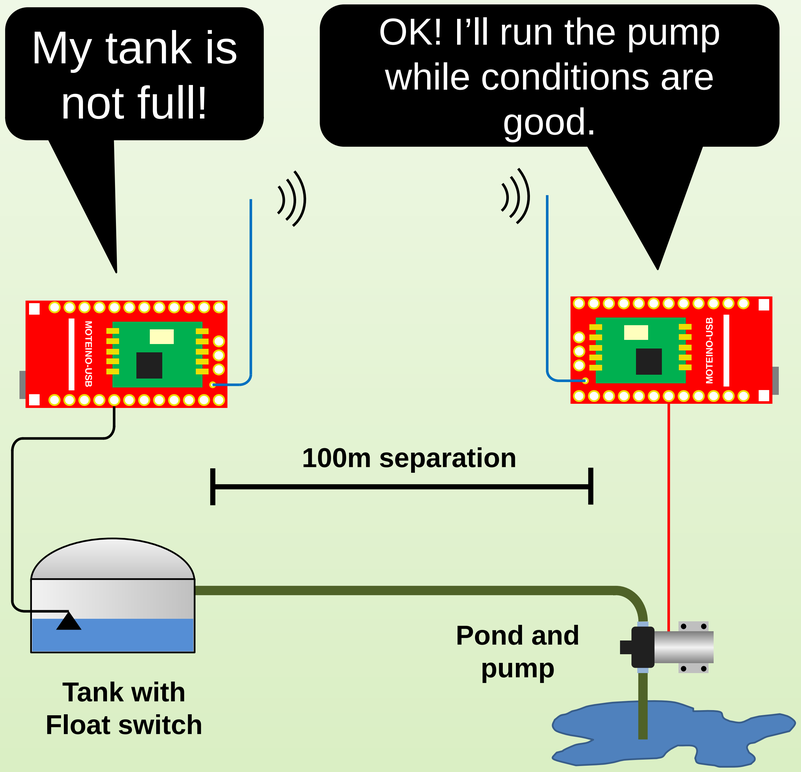
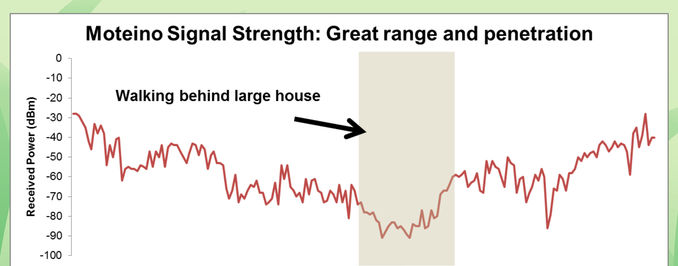
Wireless, off-grid, and sustainable

A 2000-gallon water tank is used for personal gardening and irrigation for organic farming. However, filling the tank with municipal water is costly and unnecessarily depletes the supply of clean drinking water.

A large pond 100m behind the tank can be used to replenish the tank instead. A radio-controlled pump system will be used to provide enough pond water to keep the water tank full.

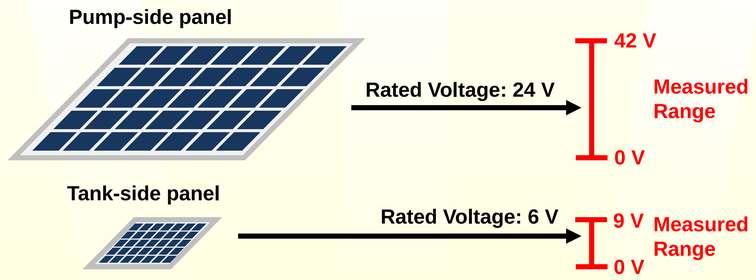
For communication, the Moteino-USB, an Arduino derivative from LowPowerLab, will be used for control communication at 433 MHz.



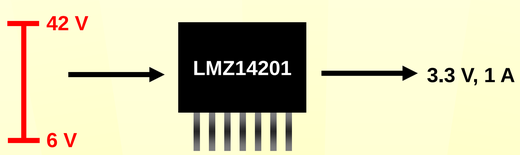


100% Solar – no batteries needed.

- Solar panel voltages drift far beyond their ratings under certain conditions.
- Direct sunlight, low temperatures, and light loading can increase voltage.

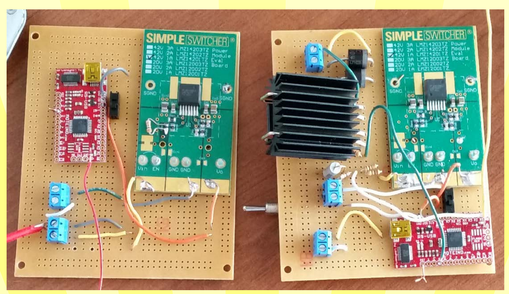


- The solution: LMZ14202 Switching Regulator
- Switching regulators are more efficient, allowing us to use a smaller & cheaper solar panel
- The LMZ14202 can be configured to provide 3.3 V output at 1A, powering the Moteino microcontrollers on both sides of the system.



- In case the solar panel voltage rises above even the 42 V operating condition of the LMZ14201, there is a Schottky diode on the solar panel input that will limit its voltage.
- While there is a 5V to 3.3V LDO linear regulator on the Moteino-USB board, the LDO will accept a 3.3-V input and waste almost no power.

Tank-side control Pump-side control

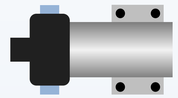


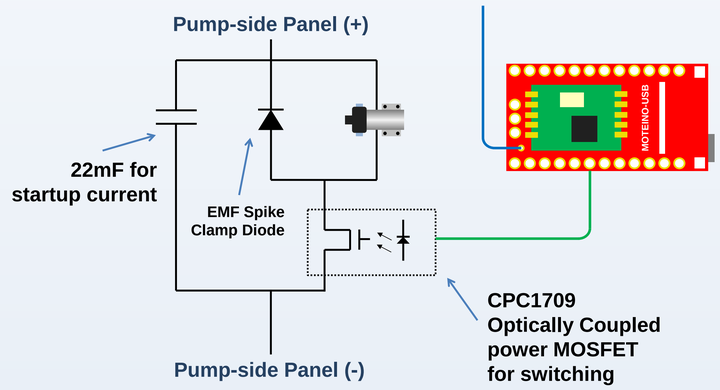
Acknowledgements

- LowPowerLab: starter Moteino example code
- Texas Instruments: LMZ14201 evaluation design
- Bruce Land: Part selection, advice, and use of his backyard

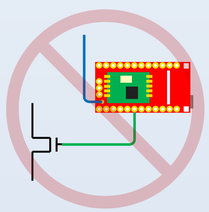
From pond to tank: Get pumped by the sun

- The pump used is a Shurflo 2088-series DC pump that can run directly from the solar panel
- The MCU must control the pump with a low-side driver.
- The pump drops the panel voltage to 24 V and consumes about 2.5 amps at a steady-state.





- When the FET is switched on, the pump demands a lot of current in a short amount of time.
- Solution: Add a large capacitor on the solar panel input to provide this quick burst of current. Otherwise, the motor will drop the panel voltage too low and deactivate the Moteinos.
- As an added bonus, the capacitor also filters out the motor's circuit noise.



- A previous attempt (above) attempted to drive a FET switch directly using the Moteino. However, once the motor was activated, the inrush current proved to be too much for the partially-on MOSFET, causing it to overheat and turn into a resistor of about 100 ohms.
- The optoisolator was chosen for its ability to quickly turn on the conducting FET and prevent this issue.