HackerBox 0048: SIMSAT

by HackerBoxes

Greetings to HackerBox Hackers around the world! For HackerBox 0048, we are experimenting with programming ESP8266 WiFi microcontroller modules, GSM mobile/cellular communications for IoT, integrated GPS satellite positioning, multi-band antennas, coaxial RF adapters, and power supply considerations for embedded wireless communication systems.

This Instructable contains information for getting started with HackerBox 0048, which can be rel="nofollow">purchased here while supplies last. If you would like to receive a HackerBox like this right in your mailbox each month, please subscribe at HackerBoxes.com and join the revolution!

HackerBoxes is the monthly subscription box service for enthusiasts of electronics and computer technology - Hardware Hackers - The Dreamers of Dreams.

Step 1: Content List for HackerBox 0048

- WeMos D1 Mini Pro ESP8266 WiFi Module
- SIM808 GSM and GPS Breakout Module
- Soracom Cellular IoT SIM with $10 Credit
- GSM Quadband SMA Antenna
- GPS Antenna with 1m SMA Cable
- Two SMA to uFL/IPX Coaxial Cables
- MicroUSB Breakout Module
- Three Black Mini Solderless Breadboards
- Bundle of 65 Male Jumper Wires
- Pentester Labs "Hack the Planet" Decal
- Exclusive HackerBoxes Maker Decal

Some other things that will be helpful:

- Soldering iron, solder, and basic soldering tools
- Computer for running software tools

Most importantly, you will need a sense of adventure, hacker spirit, patience, and curiosity. Building and experimenting with electronics, while very rewarding, can be tricky, challenging, and even frustrating at times. The goal is progress, not perfection. When you persist and enjoy the adventure, a great deal of satisfaction can be derived from this hobby. Take each step slowly, mind the details, and don't be afraid to ask for help.

There is a wealth of information for current and prospective members in the HackerBoxes FAQ. Almost all of the non-technical support emails that we receive are already answered there, so we really appreciate your taking a few minutes to read the FAQ.

Step 2: WeMos D1 Mini Pro

The WeMos D1 Mini Pro is a mini WiFi module featuring 16MB flash, external antenna connector, and built-in ceramic antenna. The module is based on the ESP-8266EX system-on-chip (SOC).

Make the initial tests of the WeMos D1 Mini Pro before soldering the header pins onto the module.

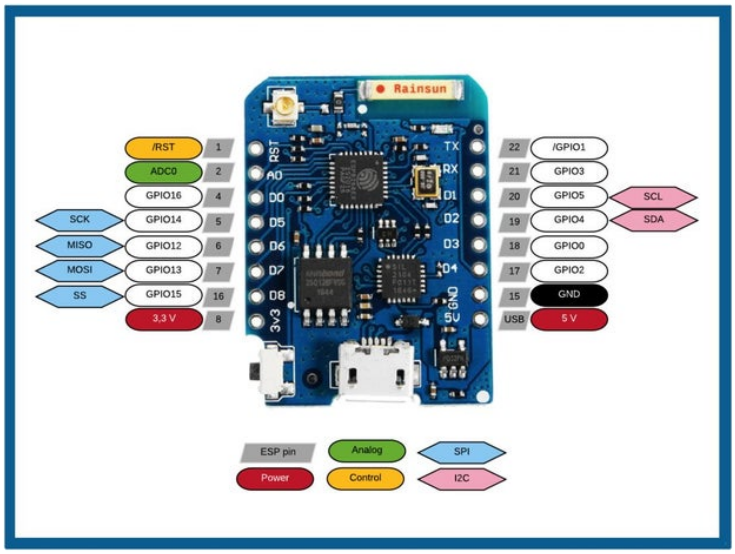
Instal the Arduino IDE and the ESP8266 support package

Under tools>board, be sure to select the "WeMos D1 R1"

Load the example code at Files>Examples>Basics>Blink and program it to the WeMos D1 Mini Pro

The example program should cause the blue LED on the module to blink. Experiment with modifying the delay parameters to make the LED blink with different patterns. This is always a good exercise to build confidence in programming a new microcontroller module.

Once you are comfortable with the module's operation and how to program it, carefully solder the two rows of header pins into place.



Step 3: Satellite Positioning

Satnav systems use satellites to provide autonomous geo-spatial positioning. They allow small electronic receivers to determine their location (longitude, latitude, and altitude/elevation) to high precision (within a few centimeters to metres) using time signals transmitted along a line of sight by radio from satellites. As of October 2018, the United States' Global Positioning System (GPS) and Russia's Global Navigation Satellite System (GLONASS) are fully operational global navigation satellite systems (GNSS). China's BeiDou Navigation Satellite System (BDS) and the European Union's Galileo are scheduled to be fully operational by 2020. Japan's Quasi-Zenith Satellite System (QZSS) is a GPS satellite-based augmentation system to enhance GPS's accuracy, with satellite navigation independent of GPS scheduled for 2023. Global coverage for each system is generally achieved by a satellite constellation of 18–30 medium Earth orbit (MEO) satellites spread between several orbital planes. (Wikipedia)

https://www.youtube.com/watch?v=wCcARVbL_Dk

Step 4: SIM808 Breakout Module

The SIM808 module is a combined GPS receiver and GSM cellular/mobile transceiver. (Datasheet)

In this step, we will enable and explore the GPS receiver functionality.

WIRING: As shown, the SIM808 is wired to the serial port of the WeMos D1 Mini (or most any microcontroller) using three lines: RX, TX, and GND. The pins in the diagram correspond to the same code below. The 5V Power and Ground can be supplied from any high quality USB power bank or adapter using the included MicroUSB breakout. A bench power supply or similar supply can also be used. Do not try to power the SIM808 from the WeMos D1 Mini.

ANTENNA: Connect the GPS Antenna via its 1m SMA ccable to one of the SMA to uFL/IPX coaxial adapter cables. Connect the uFL/IPX end of the adapter cable to the coaxial connector on the SIM808 module marked GPS.

SATELLITES: Power up the SIM808 with the GPS Antenna connected. The RED LED (power) will come on. After a couple of minutes four (or more) GPS satellites should be acquired and the BLUE LED on the SIM808 will start blinking slowly.

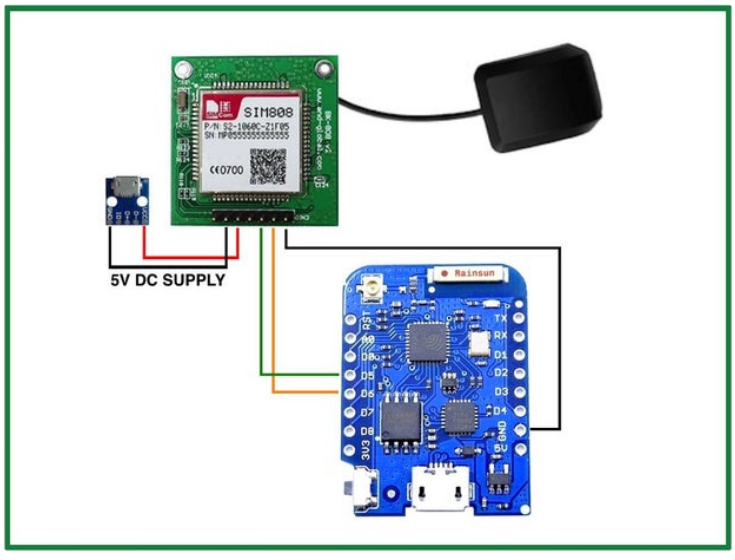
SAMPLE CODE: Use the Arduino IDE to program the GPSdemo.ino example code into the WeMos D1 Mini. The Arduino Serial Monitor can be used to

observe the time and position information determined by the GPS receiver. For example:

"1,1,20191001155512.000,36.118994,-115.167543,119.400,1.06,94.9,1,,1.1,1.4,0.8,,7,7,,,39,,"

UTC). The next two fields are latitude and longitude. These can be pasted into a google search box for mapping to verify your location. Test the lat/long in the example string above for a map to DEF CON 28 in August 2020.

Note that the field starting with the year (for example, 2019) can be broken down as a date/time stamp (in



Step 5: SORACOM Cellular IoT SIM

The Soracom IoT SIM is designed for IoT devices, development and deployment at scale. Featuring commitment-free, pay-as-you-go pricing and multi-carrier connectivity in over 130 countries. Available in a full range of SIM and eSIM form factors, with service across 2G, 3G, 4G LTE and Cat M1 bands (where available).

TEN DOLLAR CREDIT: The included Soracom IoT SIM includes a $10 data credit for initial experimentation.

SIM SIZE FORMAT: As shown in the image, the Soracom SIM Card includes an all-in-one or three-way SIM, the SIM808 modules requires he Micro SIM format so be careful not to pop out the Nano SIM outline.

SORACOM LINKS:

Soracom Registration Video

Soracom Developer Documentation

ANTENNA: The "Rubber Duckie" GSM Quadband SMA Antenna can be connected to the SIM808 coax port marked GSM using the second SMA to uFL/IPX Coaxial Adapter Cable.

EXAMPLE GSM CODE: TinyGSM, SIM808 Tracker, SnortTracker

Step 6: Satellite Internet - Coming Soon

Satellites can do a lot more than tell us where we are. The next era of satellite internet will be the result of a race to deliver affordable high-speed, low-latency internet. Several well-funded organizations have already begun launching satellites and more have launches scheduled soon. Satelliteinternet.com takes a look at those networks and the companies building them.

https://www.youtube.com/watch?v=-9CM3d5UO6A

Step 7: Hack the Planet

We hope you are enjoying this month's HackerBox adventure into electronics and computer technology. Reach out and share your success in the comments below or on the HackerBoxes Facebook Group. Also, remember that you can email support@hackerboxes.com anytime if you have a question or need some help.

What's Next? Join the revolution. ***Live the HackLife.*** Get a cool box of hackable gear delivered right to your mailbox each month. Surf over to HackerBoxes.com and sign up for your monthly HackerBox subscription.

Looks like the kit includes the D1 mini Lite (1MB), not the Pro (16MB). You'll want to update the text here, and in the store description.

The D1 Mini Lite has the ESP8285 chip instead of the ESP8266. Because the ESP8285 chip has 1M flash on chip, there is no external serial flash chip as there is on this one. For the IDE board settings, "WeMos D1 R1" seems to work best since this is the original style D1 Mini Pro, which is more like the full-size (uno sized) D1 R1.
https://wiki.wemos.cc/products:retired:d1_mini_pro_v1.0.0