DAEmod-915 Transceiver

Distributed Amateur EFR32FG23 module *for* 915MHz

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Abstract

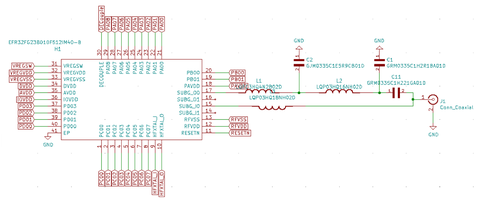
We are creating a 915MHz open-source and open-hardware system for digital radio experimentation in the under-utilized 915MHz ISM band allocation. The main features of the project include a configurable duty cycle and support for multiple FSK/ASK modes. As a result, it is configurable to specific use cases like a remote trail camera or a modernized pager system. We chose low-cost and ubiquitous hardware (ESP32, I2C sensors, EFR32FG23, ...) to build a sustainable platform and showcase the potential use cases of a finalized product. Overall, our design focuses on extensible and easy communication where traditional infrastructure is not suitable.

Goals

- Adhere to open source software and hardware design philosophy
- Build a modular and low cost prototype allowing entire community to contribute.
- Create highly configurable firmware which is easily modifiable by community and end users.

Prototype

The prototype for the DAEmod-915 is basic PCB design for the development and single board device for use in the DAEmod-915 ecosystem. While the board prototype has not yet gone to production, the board will be produced in a small run to test before the first batch of boards is placed.



Background Info

In the US, the 915MHz band is one of the Industrial, Scientific, and Medical bands that covers a frequency range of 902–928 MHz. Besides LoRa, this band isn't as widely used as 433MHz or 2.4GHz. In the table, we compare our goal product against LoRa

	LoRa	Our Product
Frequency	902-928 MHz	902-928 MHz
Data Rate	300 bit/s - 27 kbit/s	512 bit/s - 400 kbit/s
Duty Cycle	Very Low	Up to 100%
Hand-Shake	Required Handshake	Optional Handshake
Broadcasting	Does not Support	Support
License	$6000 Yearly	GPLv3

Software Design

Testing Procedures

Our **function testing** outline to validate the proof-of-concept system.

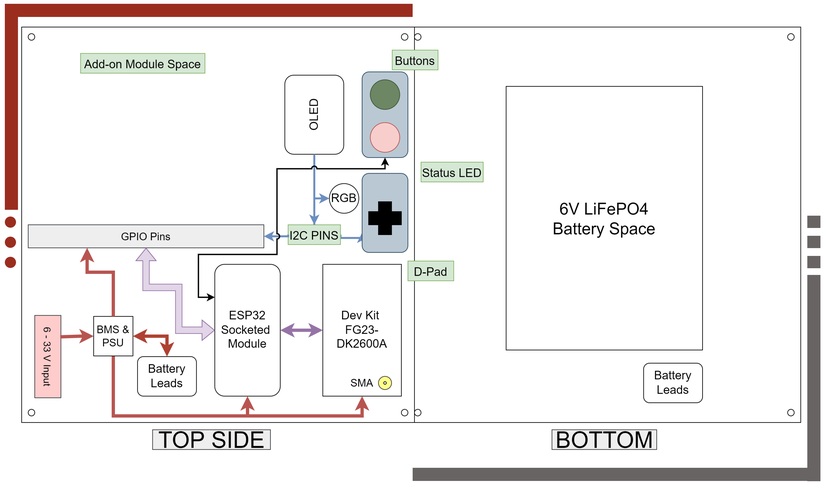
- Component level testing
- Software stability
- Proper hardware connections
- Transceiver Module Operation
- Successful Tx/Rx modulation
- Compliance with regulations
- Module Testing
- Operates as intended
- Communication between systems

Our **quantitative testing** will be done with the Battery, ESP, Display, RGB LED, and Transceiver.

- Max Range Testing for 2dbi and 5dbi Antenna
  - Theoretical 1.80 Miles for 2dbi
  - Theoretical 9.3 Miles for 5dbi
- Power Draw on Maximum RF Tx Power
- Power Draw on Minimum RF Tx Power
- Data Rate at max range for different RF Protocols
- Spurious emissions
- Power envelop of signal
- Signal to Noise Ratio

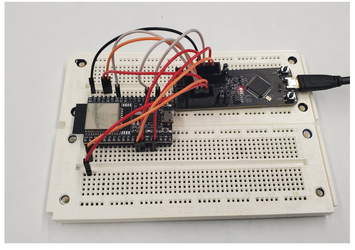
Prototype Block Diagram

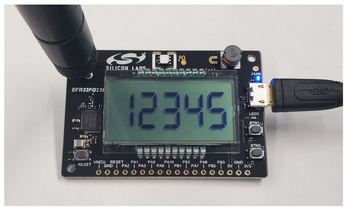
The prototype of this project is designed to allow developers and enthusiasts to attach various modules with additional functionality using various Communication I/O Protocols, We are planning to roll out our initial proof-of-concept with Display, GPS, Battery, and Environment Sensors. The display allows users to see system status and information at a glance and the Battery will allow for portable use. Module support will not stop there, as the ability to continue development with future devices is likely with the massive catalog of common products that use UART, SPI, I^2C. As an example, we can imagine advanced sensors like Doppler Radar or Thermal Imaging sensors being useful to examine the state of real world objects without infrastructure.



ESP32

- Development environment in PlatformIO for VSCode using Espressif 32.
- ESP-PROG for live debugging
- Create set of control signals over UART in the form of AT / Hayes commands.
- Listen on local WiFi server with options to send and print received data.
- GPIO button to start web server, automatically sleep after inactivity.





Dev Kit FG23-DK2600A

- Development environment in Simplicity Studio
- Low Cost, $40
- Selectable modulation schemes including: FSK, ASK, GFSK, AFSK, GMSK, OOK, OQPSK-DSSS
- Silicon Labs IC for final PCB EFR32FG23A010f256GM48

Future Development

PCB: The prototype PCB design is at the beginning stages while we wait for parts from the first round grant from the ARDC. The prototype PCB will include mounting locations for the OLED screen, battery connector, GPIO pins, dev kit EFR32FG23, and ESP32 headers. This PCB is a interconnect and tinker board for the project. With room for intergraded modules and future hardware that will be designed for specific products and use cases.

GitHub: Continued development thought the project GitHub will allow for third-party contributors to continue and expand the software and hardware support. This support will allow for new hardware to be compatible with the current hardware and future hardware. The GitHub will also host documentation for new data modes to be supported by the hardware which can change the use case for the hardware.

AMATEUR RADIO DIGITAL COMMUNICATIONS

Funding: Once the prototype stage of the project is completed, a new grant for a limited production run will be requested from ARDC (Amateur Radio Digital Communications). This grant will allow for development kits for the post-prototype version of the board to be created and seeded for continued development and testing by amateur radio operators and developers.