

# Designing a digital handheld transceiver for kite surfers



## Customer

A startup that enters the consumer electronics market with the first product, a digital handheld transceiver for kite surfers with a built-in MP3 player.

## Task

The customer addressed to us for the expertise in the field of designing a new device.

Requirements for the device:

- Minimum weight and dimensions, easy push-button control.
- Group radio communication on the allowed frequencies to enter the markets of Europe, Asia and America.
- Quality speaker for hands-free communication without headphones offshore, taking into account water and wind noise.
- MP3 player for listening to the music from the device's memory (4 GB).
- High protection against external influences according to IP68: the device should withstand falling into water from a height of 2–3 meters.
- Operation without recharging within 4—5 hours.
- An emergency button.

One of our tasks was to design the circuitry and the PCB, taking into account the requirements for the placement of RF components in a compact enclosure without an external antenna.

We had to provide the coverage range of the device that would be comparable with analog radios in the same form factor.

The second task is software development for the microcontroller and PC applications for easy setting up the walkie-talkie and transferring files to the MP3 player via the external USB interface.

## Solution

### 1. Concept

This handheld transceiver consists of a PCB, a rechargeable battery, a speaker, and a microphone placed inside a plastic enclosure. Also inside the housing, there are antennas for the radio channel and Bluetooth.

The following modules are located on the PCB:

- microcontroller-based control module,
- module for digital reception / transmitting the radio-frequency signal,
- module for control and processing analog audio with noise suppression,
- internal memory module,
- external wireless communication module.

The enclosure is equipped with buttons that control various functions depending on the operation mode:

- PTT — voice recording and information transferring;
- «+» / «-» — volume adjustment;
- «<» / «>» — channel switching in the radio mode;
- «<» / «>» — track selection in MP3 player mode.

## 2. Hardware

The hardware of the transceiver is based on STM32 microcontroller (MCU) with ARM Cortex-M4 core. Communication via the radio channel is implemented using an external CC1120 chip connected to the MCU via SPI. Voice recording and playback is performed with external driver chips based on CMX7262 and CS43L22 chips also connected with MCU via SPI.

The hardware includes a CC2564 Bluetooth module and a 4 GB NAND memory chip. Information is displayed on the external LCD display (LED).

## 3. Software

The software of the device transmits compressed voice data over the radio channel in the digital format. Data transfer is implemented via frames with data integrity checking. The received data is decoded and converted to the analog signal with external chips controlled by STM32high-performance microcontroller.

The business logic of the device performs the algorithm of switching the transceiver into the deep sleep mode (with low power consumption). When the button is pressed, the device switches from the sleep mode and begins listening to the air (checks for frames with useful data). The volume control is enabled, the transmitter / receiver mode is enabled and can be switched to MP3 player mode to play files from the NAND memory of the device.

The MP3 files are played back by transferring PCM data to the external DAC chip connected via I2S in direct memory access mode.

MP3 files are encoded / decoded using the Helix driver library.

The files are recorded in the device via USB from the application installed on the PC. The settings of all the modules included in the device are also available in the application written with the Qt library.

### 4. The enclosure design and mechanical engineering

We developed the industrial and mechanical design, and manufactured prototypes:





### Advantages

- The components are available on the market.
- Small PCB size of due to PCB layout optimization.
- Reduced amount of transmitted information due to encoding voice streams using the external microchip.
- Digital signal transmission instead of analogue (RF).
- The coverage range is comparable to analog transceivers in the same form factor.
- Availability of MP3-player, Bluetooth for headset connection and a large amount of memory
- Using modern CAD to develop hardware.