

Product Design Document: PCB Radio

Finn Hittson

October 24th, 2023

Introduction

This document describes the main design features of PCB Radio. Figure 1 shows the block diagram of PCB Radio which outline the main features, how they are connected, and what is being passed between them. The following sections describe the individual blocks in more detail, listing the input, outputs, and block functionality.

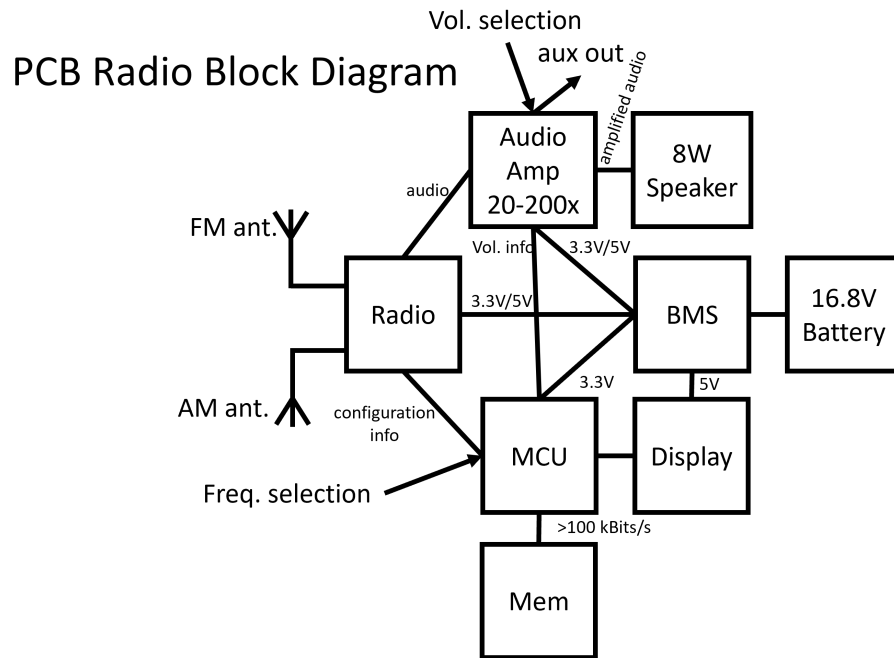


Figure 1: Block diagram of PCB Radio.

Si473 Block

Block Inputs:

1. Configuration information signal from MCU block including broad band type selection, frequency tuning, and programming line.
2. 5V supply from BMS block.
3. Electrical signal from antenna.

Block Outputs:

1. Audio signal sent to Audio Amp block between $\mp 5V$.
2. Frequency and translated information, from received signal, to MCU block.

Block functionality: Si473 block tunes, translates, and prepares received signal into a useable audio signal and extracts other related information to MCU for display such as frequency and radio station information.

Display Block

Block Inputs:

1. Signal array from the MCU of what pixels to turn on.

Block Outputs:

1. Visualizes selected frequency, volume, and state of the Battery block through signal array.

Block functionality: Display block allows the user to see what frequency they are listening to, what the volume level is, and what the charge level of the battery is.

WiFi Block

Block Inputs:

1. Data sequences from Mem block.
2. Configuration information with MCU block.

Block Outputs:

1. Song data files stored in Mem block.
2. Configuration information with MCU block.

Block Functionality: WiFi block gives PCB Radio WiFi connectivity to allow for wireless MCU configuration, memory reading, and the ability to load songs into the Mem block wirelessly.

Mem Block

Block Inputs:

1. Time sequences of data from the MCU block above 100 kbits/sec.

Block Outputs:

1. Time sequences of data to the MCU block above 100 kbits/sec.

Block functionality: Mem block stores sequences of data collected by the sensors of the system (i.e. antenna, battery temperature, battery current, battery charge). This data can be written to and read from the Mem block. Mem block also stores song files to be played by users selection.

Battery Block

Block Inputs:

1. 0.5A to charge the cells of the Battery block from the BMS block.

Block Outputs:

1. 16.8 V sent to the BMS block that is distributed to PCB Radio's circuitry.

Block functionality: Battery block is the power source of PCB Radio and drives all activity within RAT's circuitry.

BMS Block

Block Inputs:

1. Voltage from battery cells between 0 and 4.2 volts.
2. 0.5A current to charge battery from external source.

Block Outputs:

1. 14.6 V to amplify the audio signal in the Audio Amp block.
2. 5V to power the Si473 IC
3. 3.3V to power the MCU Block
4. Monitored current to charge battery cells.

Block functionality: Monitor charge state of battery cells and charge with cell balancing while monitoring for overcharge, over-discharge, and over-current protection. Supplies voltage to Audio Amp block, Si473 block, and MCU block.

MCU Block

Block Inputs:

1. Memory readings from the Mem block.
2. Received signal data info from Si473 block.
3. Voltage from Audio Amp block.
4. Voltage supply from BMS block.
5. Wifi SPI line.

Block Outputs:

1. Configuration signal to Si473 block.
2. Frequency, volume, and battery information signal to Display block.
3. Data to be written to Mem block.

Block functionality: MCU block is the main data and control management system of PCB Radio's circuitry. It controls which signals to process for audio signal transcription, ships volume, frequency, and battery information to the display, and it reads and writes battery and signal data to and from memory. MCU block is programmable via a micro-USB or using the WiFi block.

Speaker Block

Block Inputs:

1. Amplified audio signal with max voltage of 4V.

Block Outputs:

1. Audio signal translated into sound waves.

Block functionality: Speaker Block translates the electrical audio signal into sound waves for the user to hear. Speaker is 8W with 2Ω resistance.

Audio Amp Block

Block Inputs:

1. Audio signal from Si473 block.
2. Volume level set by user with potentiometer.
3. Input voltage of 14.6V to amplify the signal supplied by the BMS block.

Block Outputs:

1. Amplified signal to be played through speaker or AUX port.

Block functionality: Amp Block allows the user to control the volume of the audio signal (signal gain between 20 and 200).