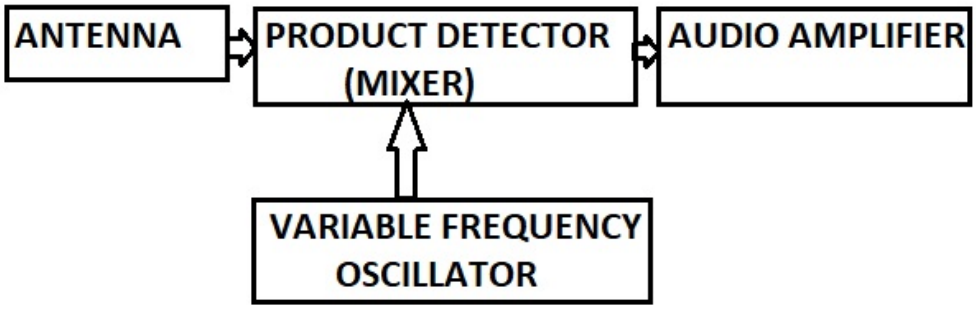
2021 EXTRA CLASS LICENSE COURSE
HANDS-ON PROJECT: DIRECT CONVERSION RECEIVER

SECTIONS TO BE SOLDERED / CONSTRUCTED

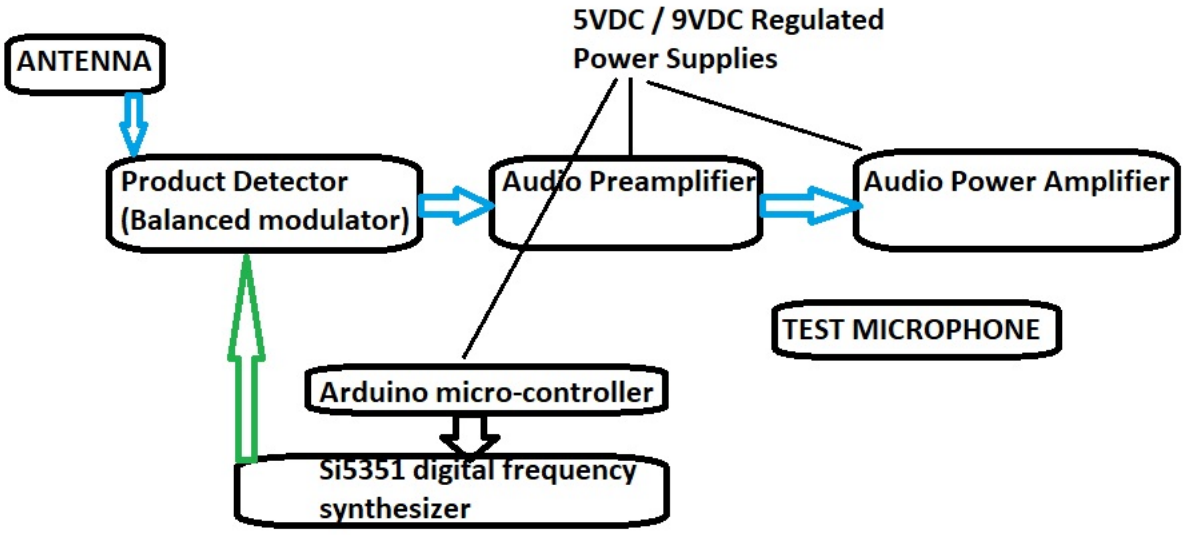
No.	Section
1	**9VDC Power Supply**
2	5VDC Power Supply
3	Audio Power Amplifier
4	Test Microphone
4	Audio Preamplifier
5	Wind trifilar transformers
6	Balanced (de)modulator
7	MAY BE PRE-CONSTRUCTED: Arduino computer controlled variable frequency oscillator / display / controls

A "direct-conversion" receiver is one of the simplest types of SSB/CW/DATA receivers possible. The radio frequency (RF) signal from the antenna may optionally pass through a bandpass filter, and may be limited by diodes for protection of the circuitry, but then proceeds ***directly into a mixer*** (sometimes called a "product detector" and in this implementation, built as a double-balanced diode mixer) where it is mixed with an RF signal from a variable frequency oscillator ("local oscillator" or VFO) to directly create AUDIO signals. The sum frequency (twice the RF frequency) is rejected. The different (audio) frequency is then amplified by a very high gain audio amplifier to allow headphone or speaker operation.



In this receiver, the audio amplifier is broken into two sections, a "preamplifier" and a "power amplifier." Our design is based on the DC40 direct conversion receiver (see https://miscdotgeek.com/building-direct-conversion-receiver-part-1/ and https://web.archive.org/web/20171109081542/http://www.phonestack.com/farhan/dc40.html)/

There is also a small test microphone added to the printed circuit board assembly so that testing of the audio amplifiers can be easily conducted.



This design has been used as a project for the Cornerstone Academy ham radio club, so some of the documention will likely refer to that group as well.

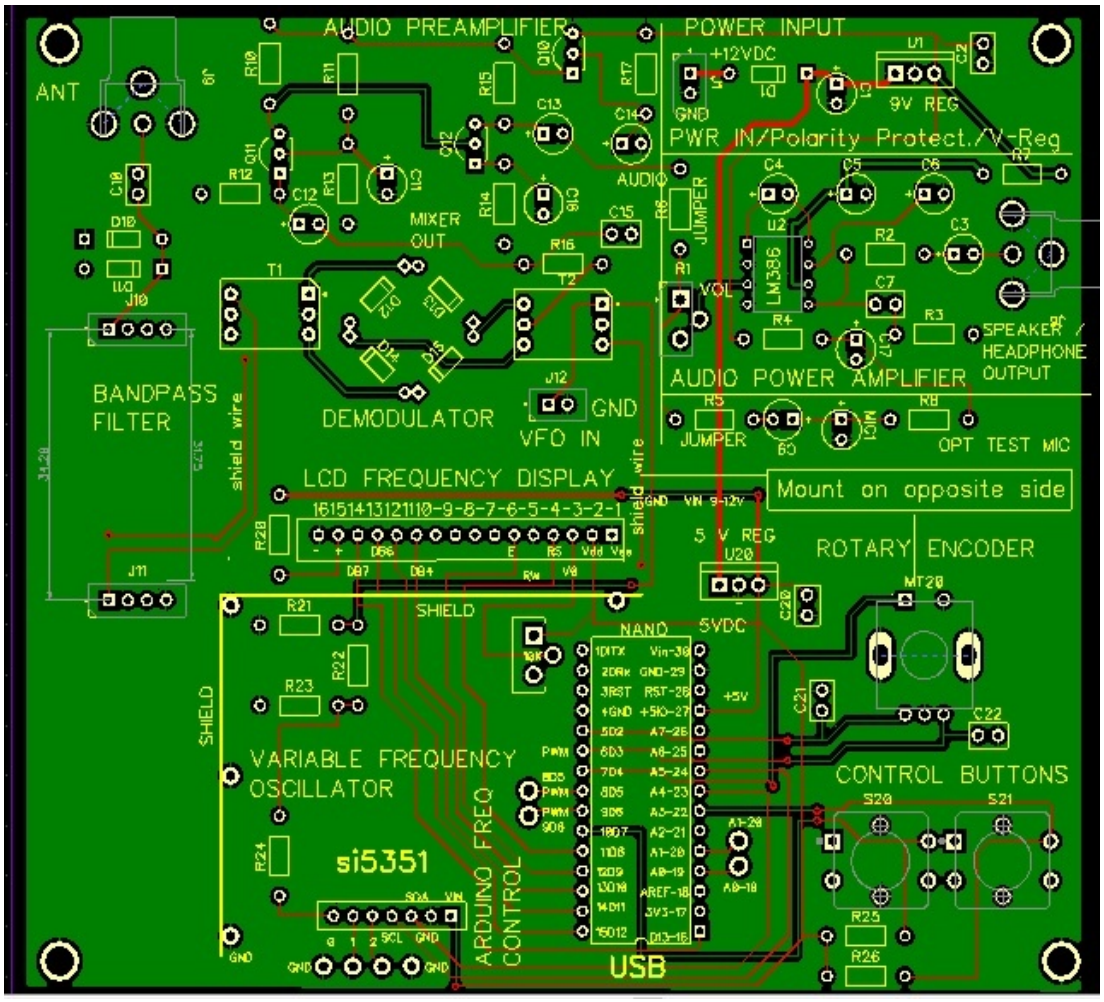
The BENEFIT of a direct conversion receiver is simplicity and reduced parts count. These little receivers can provide a world of fun, with adequate sensitivity when operated with a full sized antenna.

The DISADVANTAGES of a direct conversion receiver are that:

- It cannot distinguish between upper and lower sidebands -- and in fact will receive both if present
- Unless provided with a front end bandpass filter, it can be overwhelmed by strong undesired signals that overwhelm the mixing stage.
- When constructed without adequate planning for shielding and filtering, they can be prone to oscillation and microphonics (tapping on components can be heard in the speaker).

This simple kit was selected for our EXTRA CLASS COURSE to give the participants more insight into

- Linear regulated power supplies (the kit uses two 3-terminal linear regulators, a 9-volt and 5-volt, and an emitter follower in the preamp stage to further reduce chances of feedback through the power supply lines)
- Mixers, particularly the double-balanced diode mixer, which has excellent dynamic range, but provides a loss estimated at 7 dB
- Various types of transistor amplifier stages, including a common base amplifier used to terminate the mixer properly, and a common emitter high gain stage
- Integrated Circuit audio amplifiers, such as the LM386 used in this design
- Si5351 triple-digital oscillator
- Arduino 8-bit microcontroller used to control the Si5351
- Various test equipment, including voltmeter, oscilloscope and spectrum analyzer


AUDIO PREAMPLIFIER
POWER INPUT
+12VDC
9V REG
PWR IN/Polarity Protect./V-Reg
ANT
AUDIO
JUMPER
MIXER
OUT
VOL
LM386
SPEAKER /
HEADPHONE
OUTPUT
AUDIO POWER AMPLIFIER
JUMPER
OPT TEST MIC
BANDPASS
FILTER
shield wire
DEMODULATOR
VFO IN
GND
LCD FREQUENCY DISPLAY
Mount on opposite side
5 V REG
ROTARY ENCODER
SHIELD
NANO
5VDC
VARIABLE FREQUENCY
OSCILLATOR
si5351
ARDUINO FREQ
CONTROL
CONTROL BUTTONS
USB