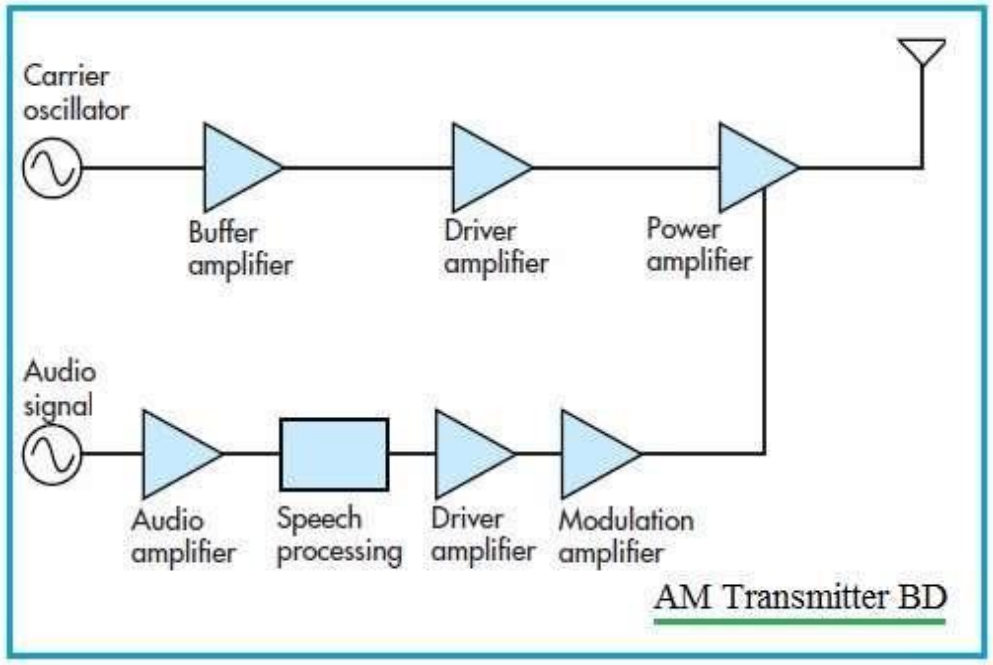
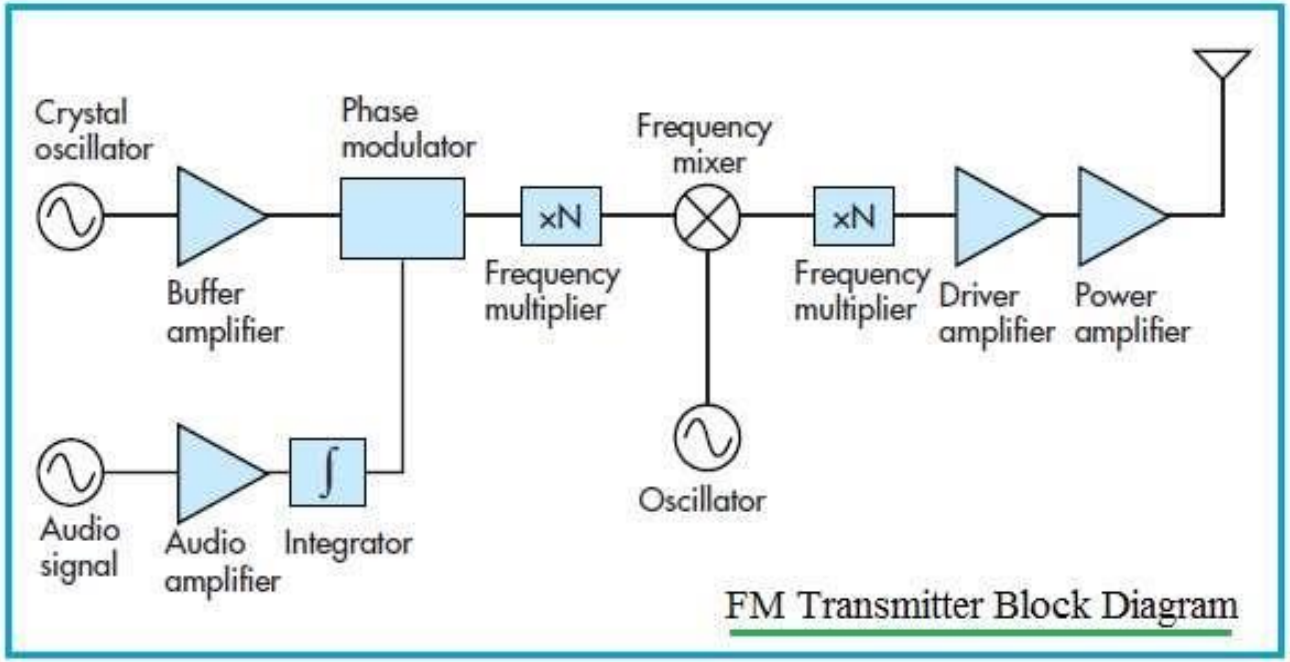
Transmitter options

Multiple ways to make transmitters

AM/FM transmitter

FM uses a continuous, un-pulsed wave but changes its frequency up and down to transmit information
AM changes the carrier frequency's Amplitude to produce a sound. -- This is what SSB relies on.



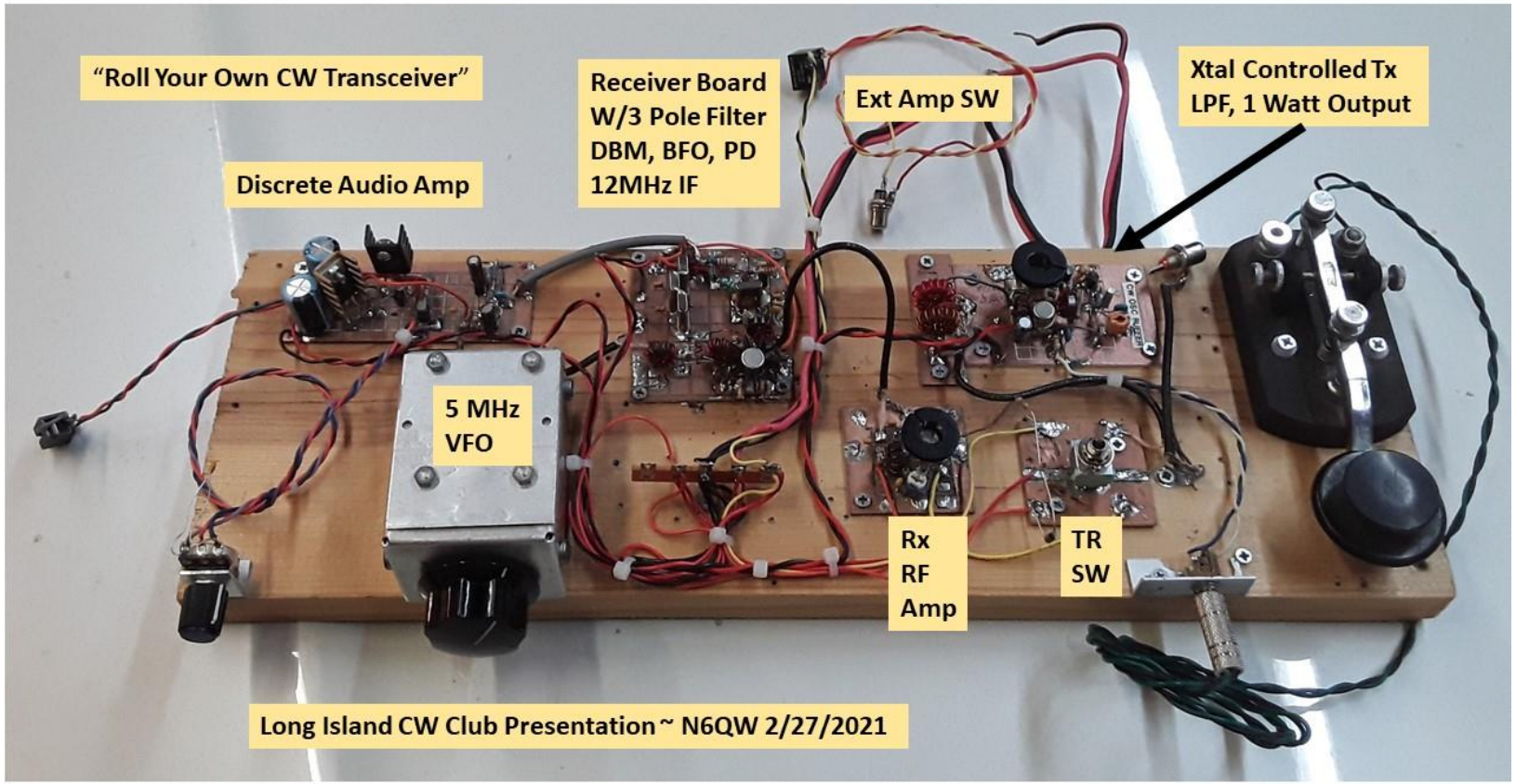


Credit: RF Wireless World

CW Transmitter

- CW does not involve Frequency or Amplitude modulation.
- It is the simplest form of signal: by turning the fixed-frequency carrier on/off.
- Pixie kit uses CW - It operates by turning on/off the carrier frequency
- Simpler electronics and cheaper components, but harder to get working right than a SSB transmitter. Due to the challenge of frequency/phase drift when implementing amplifiers.

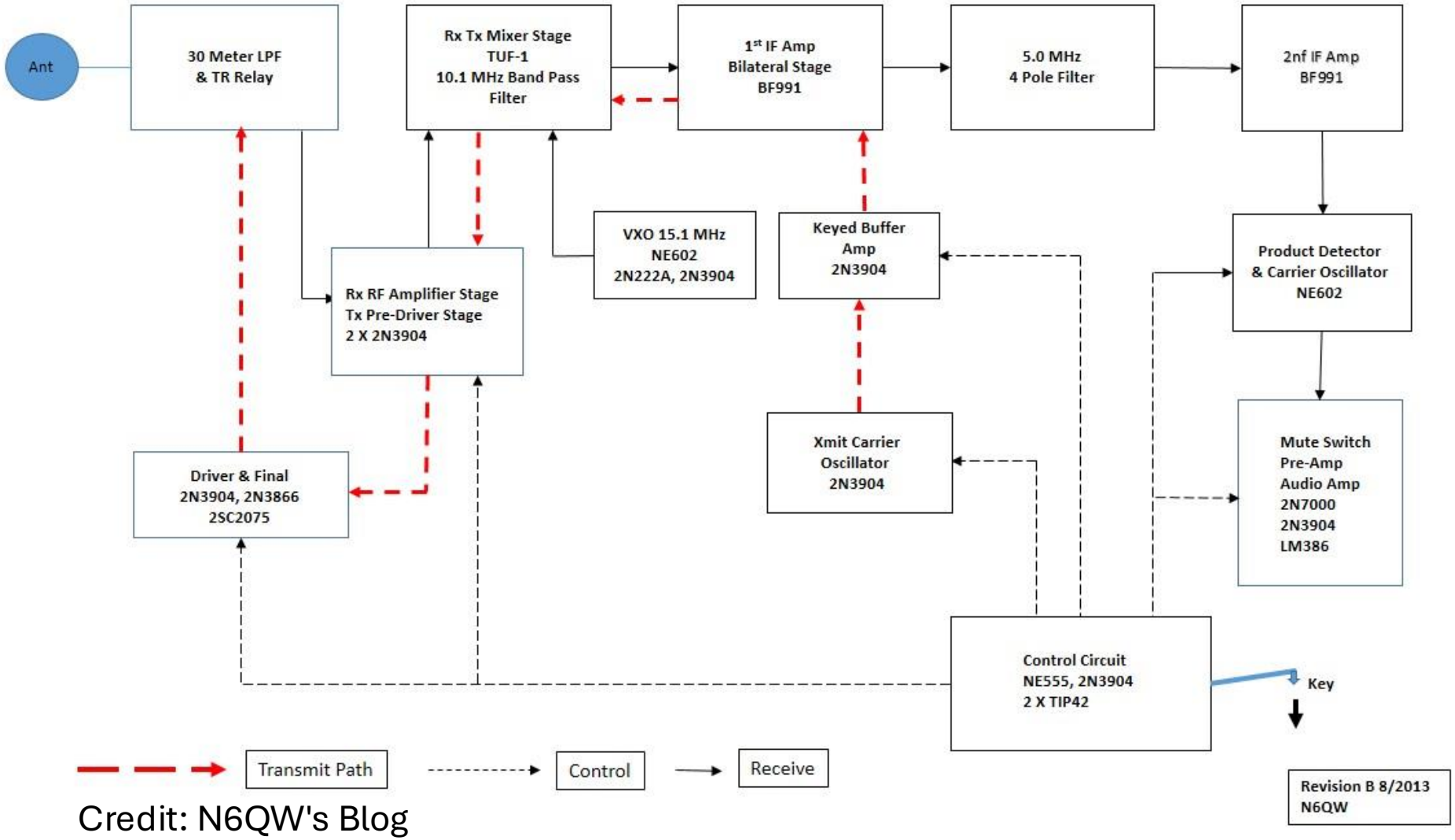
CW Transmitter



Credit: https://n6qw.blogspot.com/2024/01/january-26-2024-simple-cw.html

N6QW made a very useful reference for CW transmission in the 30M /40M HF band using a 5MHZ Variable frequency Oscillator

CW Transmitter



Credit: N6QW's Blog

LPF: Low pass filter

TUF-1: frequency mixer: https://www.minicircuits.com/pdfs/TUF-1+.pdf?srsltid=AfmBOoparhG8-Oh8l3nyAYVkAo_unl8gey16g6hLUGkq1mKqNCi5VZv

Xmit: Transmit

IF Amp: Intermediate Frequency Amplifiers

CW Transmitter

1. **Microcontroller (MCU):** An Arduino or similar device reads input from a CW key and controls the DDS chip via a digital interface like I2C.
2. **DDS Module:** The MCU sends a command to the DDS (e.g., AD9850 or Si5351) to generate a precise carrier frequency.
3. **CW Keying Circuit:** This circuit shapes the output of the DDS into clean, click-free dots and dashes, preventing key clicks that can cause interference.
4. **RF Amplifier:** The keyed RF signal is amplified to the desired power level.(BJT – Class A amplifier)
5. **Low-Pass Filter (LPF):** This filter removes unwanted harmonics generated by the amplifier and the DDS sampling process before the signal is sent to the antenna.
6. **T/R (Transmit/Receive) Switch:** A relay or PIN diode switch directs the antenna between the transmitter and receiver sections, controlled by the MCU.

CW Receiver

1. **Antenna**: Receives the incoming CW signal.
2. **T/R Switch**: Directs the received signal from the antenna to the receiver section.
3. **RF Filter:** A band-pass filter selects the desired amateur radio band and blocks out-of-band signals.
4. **Mixer:** The DDS-generated frequency acts as a local oscillator (LO) and is mixed with the incoming RF signal. The output is a lower-frequency Intermediate Frequency (IF).
5. **IF Filter:** A narrow crystal or ceramic filter selects the desired IF signal and rejects unwanted frequencies. For CW, this filter is very narrow to improve selectivity.
6. **Product Detector:** The IF signal is mixed with a Beat Frequency Oscillator (BFO) to convert the CW tone into an audible frequency, typically around 700 Hz. The BFO can also be a second, digitally controlled output from the DDS.
7. **Audio Amplifier:** The detected audio is amplified and sent to a speaker or headphones.

DDS-based SSB transceiver

1. **Microphone:** An audio input picks up the operator's voice.
2. **Speech Amplifier and Compressor:** The audio is amplified and its dynamic range is compressed to increase the average power of the voice signal.
3. **Balanced Modulator:** The compressed audio is mixed with a fixed, crystal-generated carrier frequency. The balanced modulator outputs a Double-Sideband (DSB) signal with the carrier suppressed.
4. **SSB Filter:** This is typically a very sharp crystal filter that passes only one of the sidebands (either Upper Sideband, USB, or Lower Sideband, LSB) and rejects the other, as well as the suppressed carrier.
5. **Mixer:** The clean SSB signal from the filter is mixed with the variable frequency from the DDS. The DDS now acts as the Variable Frequency Oscillator (VFO), allowing the operator to tune across the band.
6. **RF Amplifier and LPF:** The resulting SSB signal is amplified and filtered to remove harmonics, just as in the CW transmitter.
7. **T/R Switch:** Switches the antenna to transmit mode.

SSB Receiver

Antenna: Receives the incoming SSB signal.

T/R Switch: Directs the received signal to the receiver.

RF Filter and Pre-amplifier: A band-pass filter followed by an optional low-noise amplifier improves sensitivity and selectivity.

Mixer: The incoming RF signal is mixed with the DDS output (acting as the VFO) to produce a fixed IF.

IF Amplifier and Filter: The IF signal is amplified and filtered by a crystal filter, which is typically wider for SSB than for CW.

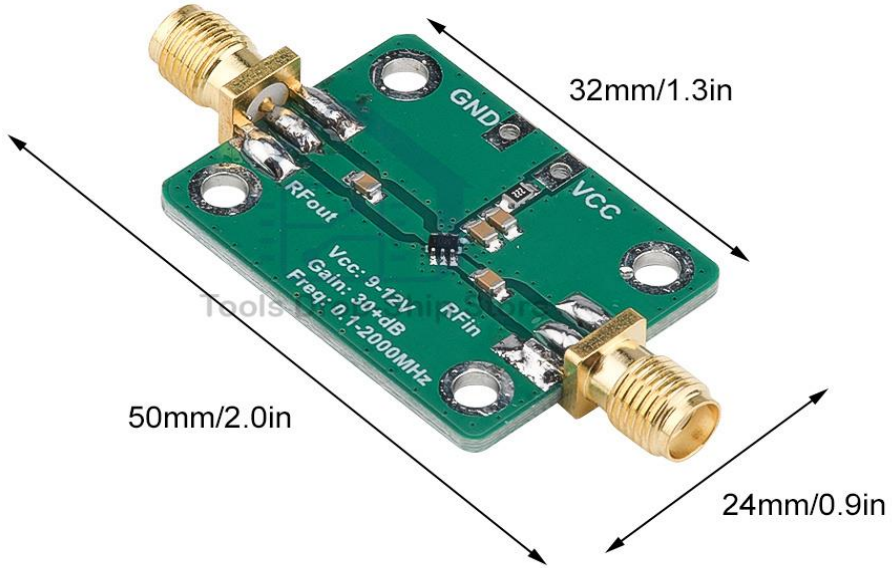
Product Detector: The IF signal is mixed with a Beat Freq Oscillator signal to recover the original audio. The BFO is usually a fixed frequency, generated by a crystal oscillator or the DDS, offset by a specific amount from the IF.

Audio Amplifier: Amplifies the recovered audio for the operator.

Linear amplifier

- Linear Amp for tx: https://www.amazon.com/FORIOT-Frequency-Wideband-Amplifier-0-1-2000MHz/dp/B0CFLB7QLF/ref=sr_1_10?dib=eyJ2IjoiMSJ9.6HKvAaLYc-mIB5Q6Q6vDx2j7ChbHqExiYwXHtG6Mx6C_g2YTjQW_qN2zyjN_RNZ62CkwDPNzp9kg0phuKVs-u7aIRtoq3QzoJBlMOhgvo-5K7avrlc_zCanCvaOKCl1rL3K1MaQe27n2Y9f8GIsCKtaqdW1EA6uAzSt7FVRJeJgEkN-a_FW-RStJqUDY6v1ycEOfZoQu1TQRFbSZzd38BoAiZDDw0G5mjt5VYKKln6Y.A9LRjAENPp39WJyCK-roYmDdG81TIAsNZMZmKQbT5ic&dib_tag=se&keywords=hf+power+amplifier&qid=1760475649&sr=8-10

Linear amplifier architecture and chip choice



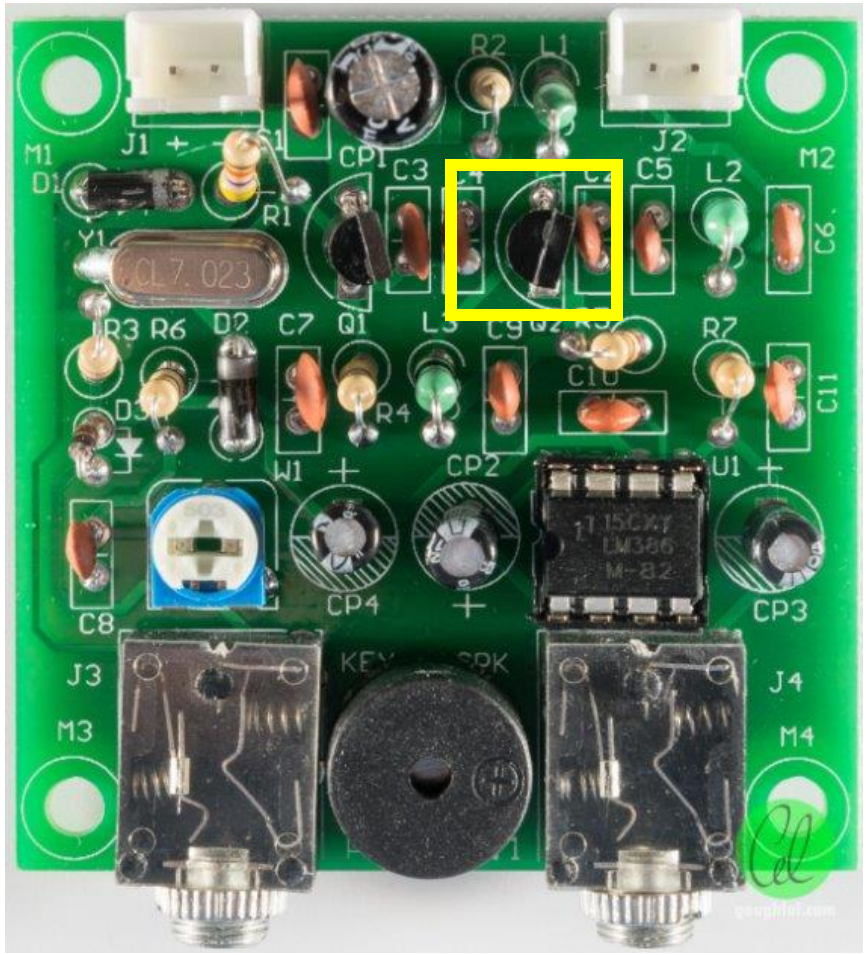
Weight:5.9g

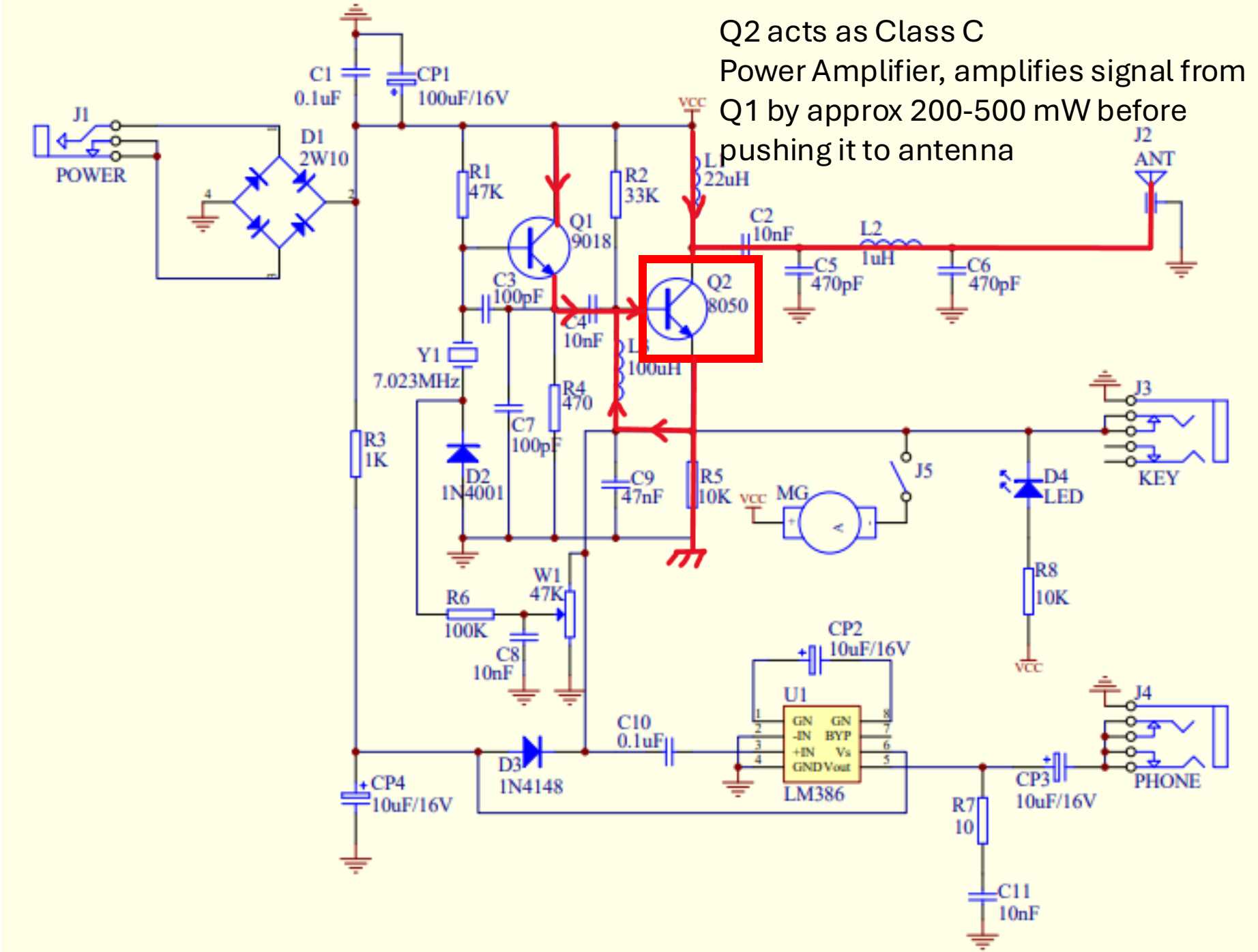
Pixie Kit Transmitter Poweramp Architecture

On-market product research

Pixie kit Transmitter Poweramp design

- Overall output power sits at approx. ½ Watt
- Poweramp uses a transistor, Q2, takes output from crystal oscillator from Q1
- Issue: Limited linearity – low power, low maximum wattage.
- Capacitors situated all around the circuit connected to ground are simply for the purpose of lowering the noise floor by "cleaning"/smoothing the signal.
- Common transistors used as Class 3 power amplifiers include the 2n2222 and the 8050 series




Q2 acts as Class C
Power Amplifier, amplifies signal from Q1 by approx 200-500 mW before pushing it to antenna
J1
POWER
D1
2W10
C1
0.1uF
CP1
100uF/16V
VCC
R1
47K
R2
33K
L1
22uH
Q1
9018
Q2
8050
C2
10nF
L2
1uH
C5
470pF
C6
470pF
J2
ANT
C3
100pF
C4
10nF
Y1
7.023MHz
L3
100uH
R4
470
C7
100pF
R3
1K
D2
1N4001
C9
47nF
R5
10K
MG
J5
J3
KEY
D4
LED
R8
10K
W1
47K
R6
100K
C8
10nF
CP2
10uF/16V
U1
GN
-IN
+IN
GND
BYP
Vs
Vout
LM386
C10
0.1uF
D3
1N4148
CP4
10uF/16V
J4
PHONE
CP3
10uF/16V
R7
10
C11
10nF

ATS-20 Transmitter Poweramp Architecture

On-market product research

ATS-20 Transmitter Poweramp design

- ATS-20 is an All-band receiver-only radio.
- It features no transmitter circuit, and hence does not contain or have a need for a transmitter poweramp.