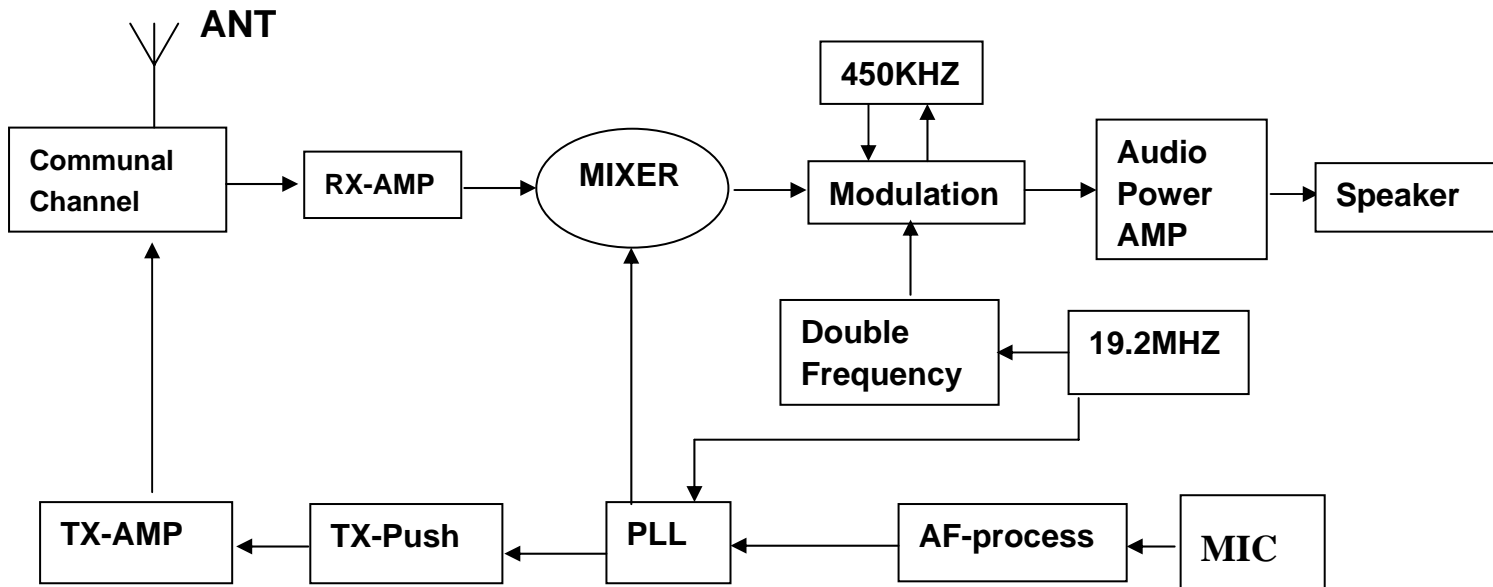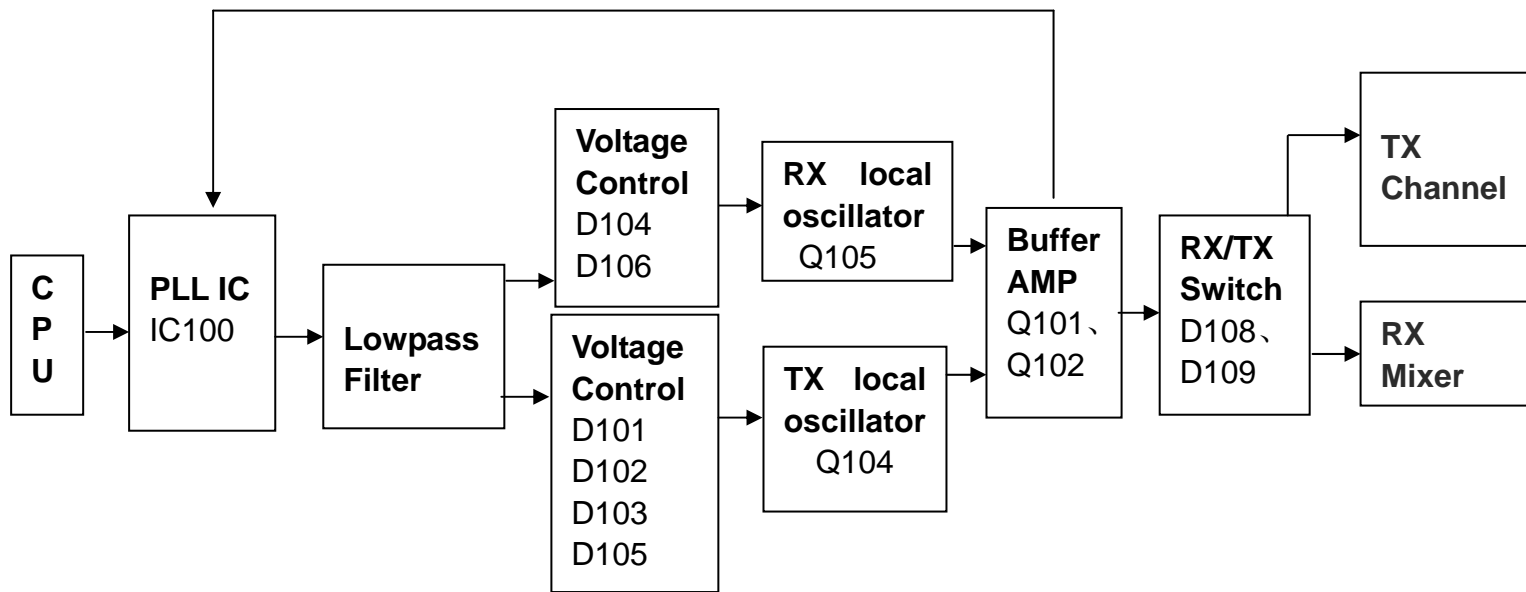# Operation Description

RF Configuration Chart

This circuit, we adopt the project of low local oscillator. The frequency range is 450-512MHz. First intermediate frequency（IF）is 38.85MHz. Second IF is 450KHz. In the circuit, we use PLL (Phase Locked Loop) to make the receiving/transmitting more stable.

```
        ANT                              ┌──────────┐
         \|/                             │ 450KHZ   │
          |                              └────┬─────┘
          ↓                                   ↕
┌──────────┐     ┌────────┐    ╭───────╮  ┌──────────┐   ┌──────────┐   ┌─────────┐
│ Communal │ →   │ RX-AMP │ →  │ MIXER │→ │Modulation│ → │  Audio   │ → │ Speaker │
│ Channel  │     └────────┘    ╰───────╯  └──────────┘   │  Power   │   └─────────┘
└──────────┘                       ↑           ↑         │   AMP    │
     ↑                             │      ┌──────────┐   └──────────┘
     │                             │      │  Double  │ ← ┌──────────┐
     │                             │      │Frequency │   │ 19.2MHZ  │
     │                             │      └──────────┘   └──────────┘
┌──────────┐  ┌─────────┐  ┌──────────┐  ┌──────────┐   ┌─────────┐
│  TX-AMP  │← │ TX-Push │← │   PLL    │← │AF-process│ ← │   MIC   │
└──────────┘  └─────────┘  └──────────┘  └──────────┘   └─────────┘
```
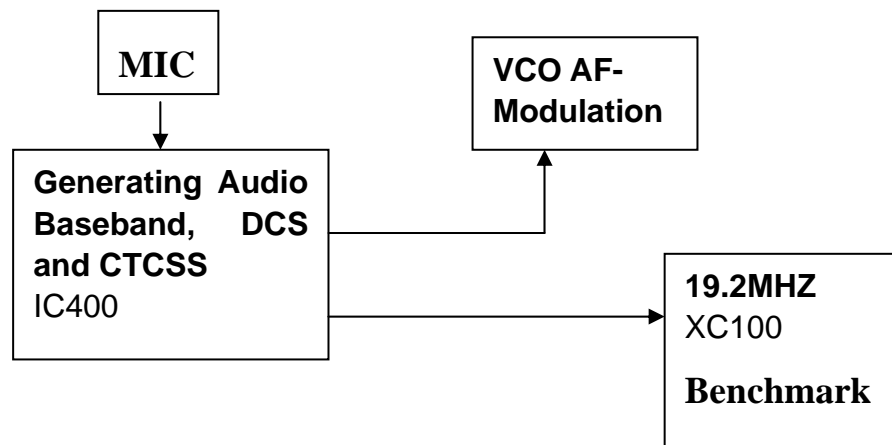
1. VCO Circuit

The receiver use low local oscillator to operate, the circuit is made up as follows:
In the circuit, the RX local oscillator is made up of Q105. The TX local oscillator is made up by Q104, their oscillator frequency are controlled by RX voltage control circuit which is made up of D104 and D106, the TX is controlled by voltage control circuit which consist of D101、D102、D103、D105. During operating, the circuit will be on RX or TX status. After RX/TX oscillated, the signals are sent to the AMP (amplify) circuit which consists of Q101 and Q102, to amplify. The signal is divided into two parts after being amplified. One part returns to PLL IC100 to balance to get the voltage difference，then the voltage difference will pass the lowpass circuit to filtering and control the RX/TX voltage control circuit. The other one will be sent to the RX/TX change-over switch D108、D109, which will divided into two parts of signals, one part will send to TX channel to amplify again, and the other parts will send to RX Mixer to mixing.

```
                                              ┌──────────────┐
                                              │      TX      │
              ┌───────────────────────────────────────────┐  │   Channel    │
              │                                         │  └──────────────┘
              ▼                    ┌──────────┐ ┌──────────┐ │
┌──────┐  ┌──────────┐           │ Voltage  │ │ RX  local│ │ ┌────────┐ ┌──────────┐ ┌──────────┐
│      │  │          │  ┌────────┐│ Control  │ │ oscillator│ │ │ Buffer │ │ RX/TX    │
│ C    │  │ PLL IC   │  │        ││ D104     │ │          │─┼▶│ AMP    │ │ Switch   │ ┌──────────┐
│ P    │─▶│ IC100    │─▶│ Lowpass││ D106     │ │   Q105   │ │ │ Q101、 │▶│ D108、   │▶│   RX     │
│ U    │  │          │  │ Filter ││          │ └──────────┘ │ │ Q102   │ │ D109     │ │  Mixer   │
│      │  │          │  │        │└──────────┘              │ │        │ │          │ └──────────┘
└──────┘  └──────────┘  │        │┌──────────┐ ┌──────────┐ │ │        │ │          │
                        └────────┘│ Voltage  │ │ TX  local│ │ └────────┘ └──────────┘
                                  │ Control  │ │ oscillator│─┘
                                  │ D101     │ │          │
                                  │ D102     │ │   Q104   │
                                  │ D103     │ └──────────┘
                                  │ D105     │
                                  └──────────┘
```
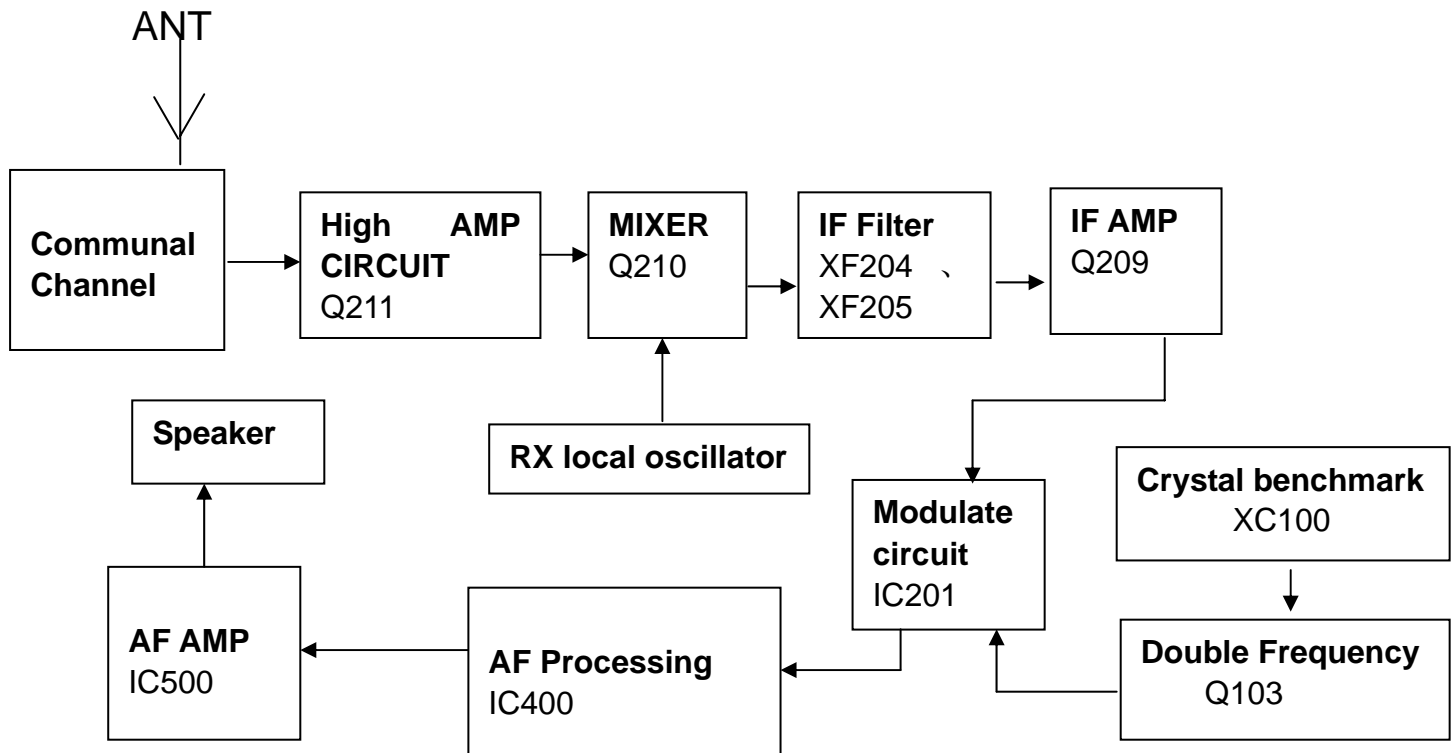
In the circuit of audio, DCS, CTCSS modulation, the audio frequency are sent to audio baseband which inside IC400 for processing by MIC. After the audio frequency is processing, it would be sent to VCO to modulate. In IC400, the DCS and CTCSS signals generate two parts of signals, one is sent to VCO to modulate, the other one is sent to the XC1 to modulate.

```
                 ┌────────┐        ┌──────────────┐
                 │  MIC   │        │  VCO AF-     │
                 └────────┘        │  Modulation  │
                     │             └──────────────┘
                     ▼                    ▲
        ┌──────────────────────┐          │
        │ Generating  Audio    │──────────┘
        │ Baseband,      DCS   │
        │ and CTCSS            │          ┌──────────────┐
        │ IC400               │          │  19.2MHZ     │
        │                     │─────────▶│  XC100       │
        │                     │          │              │
        └──────────────────────┘          │  Benchmark   │
                                          └──────────────┘
```
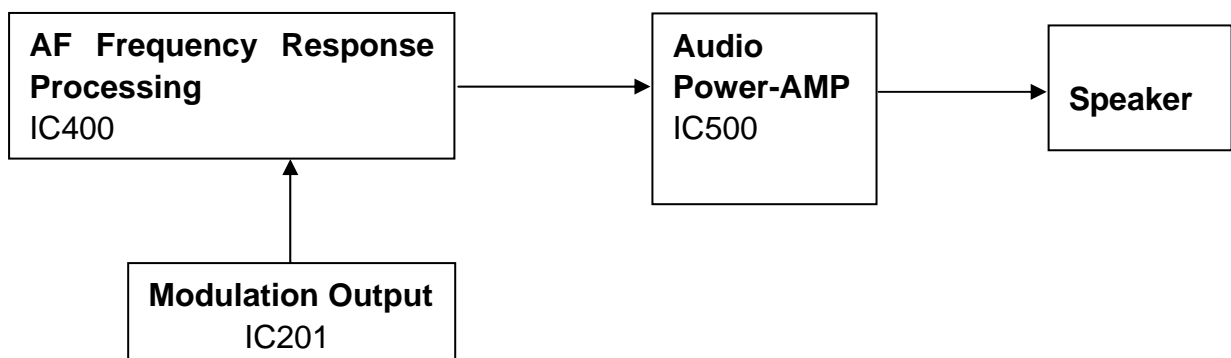
2. The RX Circuit

In the receiver circuit, the HF signals received from ANT, pass the communal channel (lowpass circuit) and enter the RX High-AMP Q211 to amplify. The amplified signals and the local oscillator signals from PLL are sent to the mixer Q210 to mix. After mixing, the signals are filtered by XF204、XF205 and get the first IF signal 38.85MHz. Re-send it to IC201 for the second mixing and get the second IF signal 450KHz, and demodulate it to get the AF signals, then the AF signals are sent to IC400 for DCS, CTCSS processing and AF filtering, finally the signals are sent to IC500 to amplify and spoken out by speaker.

ANT

```
┌──────────────┐        ┌──────────────────┐     ┌──────────────┐     ┌──────────────┐     ┌──────────────┐
│ Communal     │───────▶│ High      AMP    │────▶│ MIXER        │────▶│ IF Filter    │────▶│ IF AMP       │
│ Channel      │        │ CIRCUIT          │     │ Q210         │     │ XF204  、     │     │ Q209         │
│              │        │ Q211             │     │              │     │ XF205        │     │              │
└──────────────┘        └──────────────────┘     └──────────────┘     └──────────────┘     └──────────────┘
```

Speaker

RX local oscillator

Modulate circuit IC201

Crystal benchmark XC100

AF AMP IC500

AF Processing IC400

Double Frequency Q103
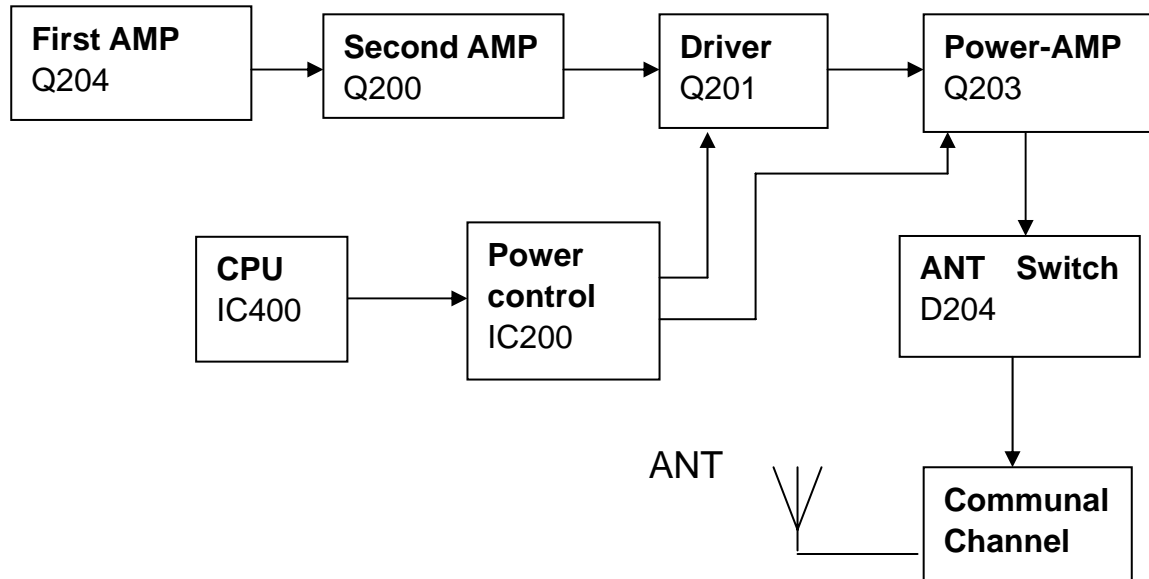
3. AF-Amplify (AMP) Circuit

In the circuit, the signals modulated by IC201 are sent to IC400 to process DCS, CTCSS and frequency response of AF. After processing, the signals are sent to audio power amplifier which made up by IC500 and related periphery circuit to amplify and push the speaker.

```
┌──────────────────────────┐        ┌──────────────┐        ┌──────────────┐
│ AF  Frequency  Response  │───────▶│ Audio        │───────▶│ Speaker      │
│ Processing               │        │ Power-AMP    │        │              │
│ IC400                    │        │ IC500        │        │              │
└──────────────────────────┘        └──────────────┘        └──────────────┘
```

Modulation Output IC201

4. The TX circuit

In the TX circuit, the HF signals generated by VCO, are sent to the Q204、Q200 to amplify.

After amplifying by Q204、Q200, the signals are sent to Q201 to amplify again. Finally, the signals will be sent to Q203 to amplify the power. The amplified power will re-pass the RX/TX switch tube made by D204, and send out by ANT through the communal channel.
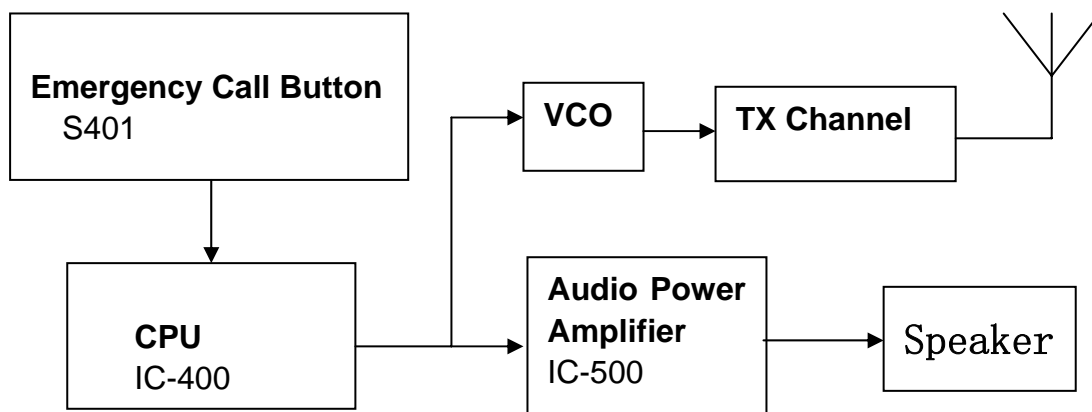
```
┌──────────────┐     ┌──────────────┐     ┌──────────────┐     ┌──────────────┐
│ First AMP    │ ──> │ Second AMP   │ ──> │ Driver       │ ──> │ Power-AMP    │
│ Q204         │     │ Q200         │     │ Q201         │     │ Q203         │
└──────────────┘     └──────────────┘     └──────────────┘     └──────────────┘
                                                  ↑                   ↑
┌──────────────┐     ┌──────────────┐             │          ┌──────────────┐
│ CPU          │ ──> │ Power        │ ────────────┘          │ ANT   Switch │
│ IC400        │     │ control      │                        │ D204         │
└──────────────┘     │ IC200        │                        └──────────────┘
                     └──────────────┘                               │
                                                                    ↓
                              ANT          ⋁            ┌──────────────┐
                                                        │ Communal     │
                                                        │ Channel      │
                                                        └──────────────┘
```

5. Microprocessor (MPU)

The CPU system, which is made up by IC400, works on X801（32.768KHZ）to control the whole functions.

6. Emergency Call Circuit
CPU will send out emergency calling signals when you press Emergency Call button. One is sent to VCO to modulate and send out by TX channel. The other one is sent to the audio power amplifier to amplify and send out emergency calling tone through the speaker.

```
┌────────────────────────┐                           ⋁
│ Emergency Call Button  │              ┌────────┐   ┌──────────────┐
│ S401                   │         ┌──> │ VCO    │──>│ TX Channel   │
└────────────────────────┘         │    └────────┘   └──────────────┘
             │                     │
             ↓                     │
┌────────────────────────┐        │    ┌──────────────┐
│ CPU                    │ ───────┴──> │ Audio Power  │   ┌──────────────┐
│ IC-400                 │            │ Amplifier    │──>│ Speaker      │
└────────────────────────┘            │ IC-500       │   └──────────────┘
                                      └──────────────┘
```

7. Voice Announcement Circuit
When select the channels, CPU will send out a voice data to the speaker to speak out.

```
┌──────────┐                      ┌──────────────┐        ┌──────────┐
│ CPU      │ ───────────────────▶ │ Audio Power  │ ─────▶ │ Speaker  │
│ IC-800   │                      │ Amplifier    │        │          │
│          │                      │ IC-600       │        │          │
└──────────┘                      └──────────────┘        └──────────┘
```