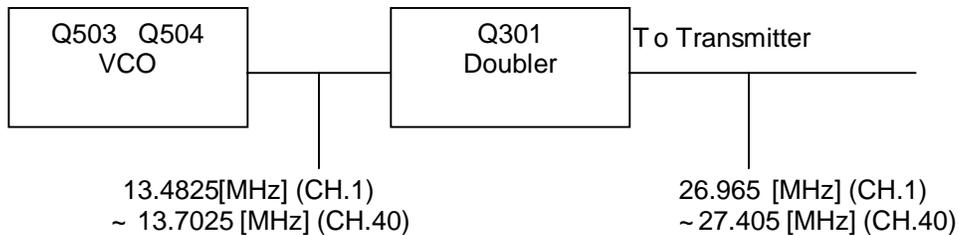


## Description Of Frequency Determining And Stabilizing Circuit Introduction

The frequencies for transmitter and receiver local frequencies are all derived a signal 4.5 [MHz] crystal by means of a phase locked loop. The first local oscillator frequencies are 16.27 [MHz] (CH.1) to 16.71 [MHz] (CH.40). The second local frequency is fixed at 10.240 [MHz] to generate second IF 455 [KHz]. During transmit, the VCO of the PLL operates 13.4825[MHz] (CH.1) to 13.7025 [MHz] (CH.40). The VCO frequency goes to the doublers circuit Q301, L301, L302 which doubles the frequency to generate 26.965 [MHz] (CH.1) to 27.405 [MHz] (CH.40).



The VCO operating frequency for the receiver is 16.27 [MHz] (CH.1) to 16.71 [MHz] (CH.40) as the first local oscillator, injected through the buffer amp Q506 into the first FET balanced mixer Q107, Q108

### Descriptions Of Each Block

#### 1. Introduction

The synthesizer is implemented with the following

Components : PLL IC (IC6)

X-TAL (X401)

VCO, Varicap Diode (D503,504)

IC101 is a MCU that includes LCD driver and all of control circuit.

The PLL IC (IC6) of PLL block,

The Q503, L404, C511, C512, C513, C507, Varicap diode D503 and D504 are clap oscillator circuit to operate as a VCO.

The Q505 is a switching transistor to turn on or turn off the tuning capacitor in the VCO oscillator tank circuit for transmitter or receiver. The Q506 works as a buffer amp for RX local frequencies (16 [MHz]) and TX carrier generating frequencies (13 [MHz]).

#### 2. Reference Frequency

The crystal, X401(4.5 [MHz]) and other components at pin1 and 16 of IC6 can make a reference frequency oscillator with internal amplifier.

##### 2-1. VCO

The Q503 and surrounding parts are consisting a clap oscillator work as a VCO of IC6 with appropriate control voltage on D503 and D504, the can be oscillate over the required range of 13.4825[MHz] to 16.71 [MHz].

##### 2-2. Programmable Divider And PLL Data Control

The MCU(IC101) and PLL IC (IC6) communicate by serial data for PLL IC data setting.

The programmable inputs for each channels set by MCU (IC101). Each input signal to control the PLL IC is done with the provided key input pins 20 and 21 of IC101.

### 2-3. Phase Detector And VCO Control

The phase detector is a digital phase comparator which compares the phase of the reference signal with programmable divider output square waves and develops a series of pulses whose DC level depends on the phase error of each signal.

The phase detector pulse output is fed to an active low pass filter and RC low pass filter output signal of IC6 is filtered and fed to varicap D503 and 504 control the VCO frequency.

### TRANSMITTER / RECEIVER BUFFER AMP

Output signal of Q503 is fed into the buffer AMP Q506, L401 to increase the strength of TX carrier frequency and 1<sup>st</sup> local frequencies.

#### Transmitter Doublers

The output signal of Q506, L401 goes to an amplifier with tuning circuit Q301, L301, L302 which doubles incoming 13 MHz signals.

#### Switching Of Tuning Capacitor In VCO

The VCO circuit must tune with a wide range of frequencies 13.4825 ~ 13.7025 [MHz] for transmitter and 16.27 ~ 16.710 [MHz] for receiver. To comply above range of VCO, the tuning Capacitance should be switched for transmission or reception.

The tuning circuit consists with L401, C507, C512, C513, C522, when the VCO is working as a receiver Q505 becomes turn off. So, L401 AND D503,504 makes tuning function. When transmitting Q505 becomes on. So, L401 and the parallel capacitance of C522 and D503,504 make tuning function.

#### Receiver Local Oscillator outputs

1<sup>ST</sup> mixer : The secondary output signals of L401 is injected to the source of 1<sup>ST</sup> mixer Q107, Q108 in the 1<sup>ST</sup> IF mixer section.

2<sup>ND</sup> mixer : The output of 10.24 [MHz] oscillator circuit with X1 is injected into the IF module (IC102). Incoming IF signal and 10.24 [MHz] signal are mixed inside the IF IC to extract 2<sup>ND</sup> IF signal 455 [MHz]. FM and AM signals are recovered with envelope detector.

#### Frequency Stability

Let :  $F_o$  = Crystal Oscillator Frequency

$F_r$  = Phase Detector Reference Frequency

$F_{vco}$  = VCO Frequency

$F_t$  = Transmit Frequency

Then :  $F_r = F_o / 1800$

And under locked conditions :  $F_r = F_{vco} / N$

Where , "N" is the programmable divider ratio.

Then :  $F_{vco} = N \times F_r$

From which it can be seen, the percentage error in  $F_t$  is the same as percentage error in  $F_o$ .

The stability of the crystal oscillator is determined primarily by the itself and having passive components of the oscillator.

The choice of crystal and components is such that the required frequency stability is maintained over the required voltage and temperature range.

## Description Of Transmitter And Receiver

### 1. The Transmitter

#### RF Amplification

The output of doublers AMP Q301 is fed through tuning IFT L301 and L302 to the base of pre-driver AMP Q305.

The output is then supplied through tuning circuit L303 to RF driver AMP Q306.

The output of Q306 is supplied with tuning circuit L304, C321, RFC306 and goes to the base of final RF AMP Q307. The output of Q307 is supplied to the antenna through L-C tuning circuit.

#### CIRCUIT FOR SUPPRESSION OF SPURIOUS RADIATION

The tuning circuit between the output of final AMP Q303 and antenna, 7-stage "LPF" network L310, C331, C332, L311, C333, C335, L312, C337, serves as a spurious radiation suppressor. This network also serves to match the impedance between TX power AMP Q307 and the antenna.

#### Circuits For Limiting Power

After finished all alignment, to constant voltage supply circuit limits the available power 4 [W] or slightly less. RV-203 and corresponding three transistors control supply voltage of RF amplifier and other circuits.

Tune all the trimming parts for maximum indication of RF power meter and adjust RV-203 to make 4 [W] indication of RF power meter. The tuning is adjusted so that the actual power is from 3.8 to 4.0 [W]. There are on other additional controls for adjusting the TX output power.

#### Max Deviation Control

The deviation signals are filtered with RC network and goes to the OP AMP IC IC3 make nominal signal level to achieve wanted modulation. To control incoming audio signal, diode D451,452 and corresponding limiter circuit controls with proportional to sampled audio output level adjust RV501 shall not exceed  $\pm 2$ [KHz] max deviation under 1.25 [KHz] AF 20 dB up from 1kHz modulation level input.

#### Max Modulation Control

The modulation signal are filtered with RC network and goes to the audio AMP IC IC104 make amplitude signal to achieved AM modulation.

To control incoming audio signal, diode D202, Q208, and Q207 corresponding limiter circuit controls with proportional to sampled audio output level adjust by RV201 shall not exceed 100% max modulation under 60% AF 20dB up from 1KHz modulation input.

### 2. The RECEIVER

RF AMP Q104 amplify RF signal from antenna, the amplified RF SIGNAL is fed through tuning coils L102, L103 to the gate of double balance mixer FET, Q107, Q108 also VCO sources frequency lower 10.695 MHz than the frequency of each channel is supplied to mixer.

The source of 10.695MHz frequency filtered by CF1 is fed to through to IC102.

The 455KHz frequency signal produced from IC102 by mixing the output source of CF1 10.695MHz filter and the source of 10.240MHz frequency from crystal oscillator X1.

Internal AM and FM detector of IC102 detect AM and FM audio signal.

A.G.C(Automatic Gain Control) signal of IC102 fed to IC103, D122, Q121 control receiving sensitivity.

The AM detected audio signals fed through R157, C167, D151, VR101 to low frequency audio AMP for driving speaker.

The FM audio detected and amplified audio signal is fed through high cut filter R161, C153, D152, VR101 to speaker.

