

## **C75WX-ST THEORY OF OPERATION**

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***C75WX-ST THEORY OF OPERATION***

## 1. INTRODUCTION

### 1.1. Main Components list:

PLL IC AND LCD DISPLAY DRIVER (IC5-LC72322)

CRYSTAL (X2-4.5MHz)

VARICAP DIODE (KVD251S, D7 FOR CB MODE, D1 FOR WX MODE)

IF IC (IC1-DBL5018)

RX AUDIO AMP IC (IC6-LM386)

TX AUDIO AMP IC (IC2-TDA2003)

COMPANDER IC (IC3-TA31101AF)

SWITCH IC (IC4-MC4066) FOR COMPANDER CONTROL

RF POWER TRANSISTOR (Q25-2SC2078D)

LCD DISPLAY (LCD1)

## 2. PLL FREQUENCY SYNTHESIZER

### 2.1. REFERENCE FREQUENCY

The crystal, X2 (4.5 MHz) and other components at pins 1 and 80 of IC5 form an oscillator with an amplifier internal to IC5.

The oscillator output is internally fed to a divide by 1800 to produce a 2.5KHz square wave, which is the reference input to the phase detector.

### 2.2. 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 condition:

$$F_r = F_{vco} / N \text{ (Where N is the programmable divider ratio)}$$

From which it can be seen that the percentage error in  $F_t$  is the same as the percentage error in  $F_o$ . The stability of the crystal oscillator is determined primarily by the crystal and to a lesser extent by the active and passive components of the oscillator. The choice of crystal and components is such that the required frequency stability is maintained under the required voltage and temperature range.

### 2.3. PHASE DETECTOR AND VCO CONTROL

The phase detector is a digital phase comparator which compares the leading edges of the reference with programmable divider output square waves and develops a series of pulses whose DC level depends on whether

the phase error is leading or lagging. The phase detector (pin 78 of IC5) output is fed to a charge pump and then to pin 78 of IC5. The low pass filter output at pin 78 of IC5 is filtered and fed to varicap D7 control the VCO frequency.

The result is second order PLL with loop dynamic a essentially controlled by the active low pass filter.

#### 2.4. SWITCHING OF TUNING CAPACITOR IN VCO OSCILLATOR TANK CIRUIT

The VCO circuit must tune with a wide range of frequency 13.4825 MHz – 13.7025MHz for transmitter and 16.27 MHz – 16.710 MHz for receiver.

The use of one tuning capacitor in common has such adverse effects as a decrease in the tuning circuit and the occurrence of may spurious .To eliminate these effect, the tuning capacitance is switching for transmission of reception.

The tuning circuit consists of the primary of L10, C63, C64, C65, C67, becomes off so, the primary of L10 and mark tuning function. When transmitting, Q3 becomes on. So, the primary of L10 and the parallel capacitance of C66 make tuning function.

#### 2.5. TRANSMIT DOUBLER

The Q22 output is obtained as base output and fed to base of double transistor Q28.

At this stage, the frequency is doubles .The Q28 output tank circuit is double tuning circuits (27 MHz) L11 and L12 to stop the 13.5 MHz frequency.

#### 2.6. SWITCHING OF TUNING CAPACITOR IN VCO OSCILLATOR TANK CIRUIT

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#### 2.7. RECEIVER LOCAL OSCILLATOR OUTPUTS

First mixer:

The secondary output of VCO tank circuit L10 is injected through buffer AMP Q18 and the buffer output through the bade of 1st mixer (Q12).

Second Mixer:

The output of 10.240MHz oscillator circuit with X1 is injected into the IF IC internally.

Incoming IF signal and 10.240MHz signal mixed inside the IF IC to extract 2nd IF signal 455KHz.

Audio signals are recovered with the way quadrature detector.

#### 2.8. FAULT PROTECTION

IC5 included an auxiliary exclusive or phase detector which functions as a lock detector. If locks is lost pin 11

base low and the base pin of Q33 is cut off, to prohibit transmission. Transmission cannot be made if a code other than those for 40 channel is input to IC5.

### 3. RX , CB Receiver Section, 40 channels

#### RECEIVER

CB receiver is dual conversion super-heterodyne type with the first IF 10.695 MHz and the second IF 455KHz. Receiver is separated into two blocks, 1st IF section and 2nd IF section. The PLL synthesizer supplies the first local frequency 16.270 – 16.71 MHz. With the provided first local frequencies Q12 mixes the incoming signals to generate first IF signal. Mixed signals were filtered with the CF1 (10.695 MHz) crystal filter and tuned circuits. With the 10.240 MHz signals, IF IC (IC1) mixes the incoming signals to generate second IF signal. Output signal of mixer were filtered with CF2 (455KHz filter) the 455KHz signals from the 2nd IF filter were amplified with IF IC101. After application the signals fed to the envelope detector circuit of IC1. Then could see the recovered signals. With the amplitude of recovered signals, it can be used as a AGC. With the swing of AGC IC2, Q11, D6 voltage all previous stages can be controlled that connection.

A SoundTracker switch controls the speech signal path of the microphone amplifier TR13. When the ST switch is set to ON, it cuts the TR13 output and directs it to a Componder chip IC3(TA31101AF) for speech signal dynamic range compressing. The output of IC3 is then fed to IC2(TDA2003) for the remaining processing. When the ST switch is set to OFF, the compander function is turned off.

### 4. TX, Transmitter Section

#### 4.1 RF AMPLIFICATION

The output of double AMP Q28 is fed through double tuning (27 MHz) L11, L12 to the base of RF AMP Q33. The output is then supplied through tuning circuit L13 to RF driver AMP Q29. The Q29 output is capacitance divided by tuning circuit L14 and C95 and passed through the base of final RF stage the Q30 output is supplies to the antenna through L - C tuning circuit.

#### 4.2 CIRCUIT FOR SUPPRESSION OF SPURIOUS RADIATION

The tuning circuit between frequency synthesizer and final AMP Q33 and 3-stage "PI" Network, C99, C100, C102, C105, C103, C106, C104 in the Q30 output circuit serve to suppress spurious radiation. This network serves to impedance match a Q30 to the antenna and to reduce content to acceptable levels. In the frequency synthesizer.

#### 4.3 MODULATION

The MIC input is fed then to audio power AMP IC3 which feeds modulation transformer T1. The audio output at the secondary of T1 is fed in series with the B+ voltage to the oscillator of driver Q29 and final Q30 to oscillator modulation both these stages.

#### 4.4 CIRCUIT FOR LIMITING MODULATION

A portion of the modulating voltage is rectified by D11 which turns on Q24, Q25 which attenuates the MIC input to MIC AMP IC2.

The resulting feedback loop-keeps the modulation from exceeding 100 percent input approximately 40 dB greater than that required to produce-50 percent modulation.

#### **4.5 Comander circuit**

IC3 (TA31101AF) is the Comander which acts for compressing the dynamic range of the audio signal in the transmitting path, and expanding the dynamic range of the audio signal in the receiver path. This will result in an improved signal to noise

A SoundTracker key controls the speech signal path of the microphone. When the ST is set to ON, the speech signal directly to a comander IC3 (TA31101AF) for dynamic range compressing. Then output of IC3 is to IC2(TDA2003) for amplify processing. When the ST key is set to OFF, the comander function is off. the speech signal directly to audio amplifier IC2(TDA2003) not via to IC3 (TA31101AF) .

#### **5. WX, Weather Band Receiver Section, 10 channels**

Weather receiver is dual conversion super-heterodyne type with the first IF 10.695MHz and the second IF 455KHz. PLL supplies the local frequencies below 10.695MHz to convert 10.695MHz signals. Q7 amplifies the incoming weather signals. Q8 mixes the incoming weather signal and local to generate IF frequency possessing audio information. There stage 455KHz amplifier circuit IC1 amplify the 455KHz signal to make enough level for discriminate the audio signal. IFT L9 and R41 are working as a FM detector.