

## 8. CIRCUIT DESCRIPTION

### 8.1 INTRODUCTION

THE FREQUENCIES FOR TRANSMITTER AND RECEIVER LOCAL FREQUENCIES ARE ALL DRIVEN FROM A SINGLE 12.8 [MHz] TCXO BY MEANS OF A PHASE LOCKED LOOP.

THE FIRST LOCAL OSCILLATOR FREQUENCIES ARE 441.1625 [MHz] (CH.1) TO 446.3125 [MHz] (CH.14) FOR RECEIVER. THE SECOND LOCAL FREQUENCY IS FIXED AT 20.945 [MHz] TO GENERATE SECOND IF 455 [KHz] . DURING TRANSMIT, THE VCO OF THE PLL OPERATES 462.5625 [MHz] TO 467.7125 [MHz] .

Q201,Q202 VCO	462.5625 [MHz]	Q203 BUFFER AMP	TO TRANSMITTER 462.5625 [MHz] (Ch. 1)
	467.7125 [MHz]		467.7125 [MHz] (Ch. 14)

THE VCO OPERATING FREQUENCY FOR THE RECEIVER IS 441.1625 [MHz] (CH. 1) TO 446.3125 [MHz] (CH. 14) AS THE FIRST LOCAL OSCILLATOR, INJECTED THROUGH THE BUFFER AMP Q203 INTO THE FIRST TR MIXER Q105.

### 8.2 DESCRIPTIONS OF EACH BLOCK

#### (1) INTRODUCTION

THE SYNTHESIZER IS IMPLEMENTED WITH THE FOLLOWING COMPONENTS : PLL IC(U101), CRYSTAL OSCIL(X101), TCXO(X102) VCO, VARI\_CAP DIODE(D201)

THE U101 IS A BIPOLA\_LSI THAT INCLUDES PRESCALLER, THE Q201, Q202, L201, C202, D202, C206, C207, C215, L202, C201, C208 D201 ARE CLAP OSCILLATOR CIRCUIT TO OPERATE AS A VCO OF THE U101.

THE D202 IS A SWITCHING DIODE TO CONNECT OR DISCONNECT THE TUNING CAPACITOR IN THE VCO OSCILLATOR TANK CIRCUIT FOR TRANSMITTER OR RECEIVER.

THE Q203 WORKS AS A BUFFER AMP FOR RX LOCAL FREQUENCIES AND TX CARRIER GENERATING FREQUENCIES.

(2) REFERENCE FREQUENCY (TCXO)

THE TCXO, X102(12.80 [MHZ] ) AND OTHER COMPONENTS AS PIN.11 OF U101 CAN MAKE A REFERENCE FREQUENCY OSCILLATOR WITH INTERNAL AMPLIFIER. THIS SET IS USED EXTERNAL CLOCK SOURCE BY THE TCXO.

THE REF\_FREQUENCY(12.8MHz) IS ADJUSTED BY RV102 EXACTLY.

(3) VCO

THE Q202 AND SURROUNDING PARTS ARE CONSISTING A CLAPP OSCILLATOR WORKS AS A VCO OF U101 WITH APPROPRIATE CONTROL VOLTAGE ON D202.

THE VCO CAN BE OSCILLATE OVER THE REQUIRES RANGE OF 441.1625 [MHz] TO 467.7125 [MHz] .

(4) PROGRAMMABLE DIVIDER AND ITS CONTROL

THE PROGRAMMABLE INPUTS FOR EACH CHANNELS ARE SETTED IC INSIDE.

EACH INPUT SIGNAL TO CONTROL THE PLL IC(U101) IS DONE WITH THE PROVIDED(CPU U301) KEY MATRIX INPUT PINS-(PIN15 TO PIN18) AND FOR EACH KEY MATRIX INPUT, AN INTERNAL CODE CONVERT EPROM PROVIDES THE APPROPRIATE BINARY CONTROL TO THE PLL\_IC(U101) FOR THAT CHANNEL.

SINCE THE BINARY NUMBER NECESSARY TO CHANCE DURING TRANSMIT AND RECEIVE, AND ADDITIONAL BIT IS REQUIRES AT PIN. 9 OF U301 TO ALLOW THE ROM TO RECOGNIZING THE STATUS IS TX OR RX.

THE PROGRAMMABLE DIVIDER TO PLL\_IC (U101).

THE U101 OUTPUT IS FED TO THE PHASE DETECTOR FOR COMPARING WITH THE 6.25 [KHZ] REFERENCE FREQUENCY INSIDE.

(5) 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 PULSE 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 FED TO VARI\_CAP D201 CONTROL THE VCO FREQUENCY.

(6) TRANSMITTER / RECEIVER BUFFER AMP

OUTPUT SIGNAL OF Q201 IS FED INTO THE BUFFER AMP Q302 TO INCREASE THE STRENGTH OF TX CARRIER FREQUENCY AND 1ST LOCAL FREQUENCIES.

(7) SWITCHING OF TUNING CAPACITOR IN VCO

THE VCO CIRCUIT MUST USE WITH A WIDE RANGE OF FREQUENCIES 462.5625 ~ 467.7125 [MHz] FOR TRANSMITTER AND 441.1625 ~ 446.3125 [MHz] FOR RECEIVER.

TO COMPLY ABOVE RANGE OF VCO, THE TUNING CAPACITANCE SHOULD SWITCHED FOR TRANSMISSION OR RECEPTION.

THE TUNING CIRCUIT CONSISTS WITH R145, C204, C205, R204, D202 WHEN THE VCO IS WORKING AS A RECEIVER, WHEN TRANSMITTING MODE, D202 BECOMES TURN OFF. WHEN RECEIVING MODE, D202 BECOMES ON, L201 AND THE PARALLEL CAPACITANCE OF C202, AND C206, C207 MAKE TUNING FUNCTION.

(8) RECEIVER LOCAL OSCILLATOR OUTPUTS

1ST MIXER : THE OUTPUT SINGLES OF Q203 IS INJECTED TO THE

SOURCES OF 1ST MIXER Q105 IN THE 1ST IF MIXER SECTION.  
2ND MIXER : THE OUTPUT OF 20.945 [MHz] OSCILLATOR CIRCUIT  
WITH X101 IS INJECTED INTO THE IF\_IC(U102). INCOMING IF SIGNAL  
AND 20.945 [MHz] SIGNAL ARE MIXED INSIDE THE IF IC TO  
EXTRACT 2ND IF SIGNAL 455 [KHz].  
FM SIGNAL ARE RECEIVED WITH ENVELOPE DETECTOR.

#### (9) ADJUSTING & TUNING PROCEDURE

##### TX FREQUENCY ADJUSTMENT

- CONNECT ANTENNA TO FREQUENCY COUNTER EQUIPMENT
- PRESS PTT AND ADJUST THE EXACT FREQUENCY OF THE CHANNEL BY RV 102

##### AUTO SQUELCH LEVEL ADJUSTMENT

- CONNECT SSG OUTPUT TO ANTENNA OF RADIO
- ADJUST SSG LEVEL TO -127dBm AND ADJUST AUDIO NOISE TO OFF-LEVEL BY RV 101.

### 8.3 FREQUENCY STABILITY

LET :

$F_o$ =CRYSTAL OSCILLATOR FREQUENCY

$F_r$ =PHASE DETECTOR REFERENCE FREQUENCY

$F_{vco}$ =VCO FREQUENCY

$F_t$ =TRANSMIT FREQUENCY

THEN :  $F_r = F_o / 2048$

AND UNDER LOCKED CONDITIONS :  $F_r = F_{vco} / N$

WHERE, "N" IS THE DIVIDE RATIO OF PROGRAMMABLE DIVIDER.

THEN :  $F_{vco} = N * F_r$

FROM WHICH IT CAN BE SEEN, THE PERCENTAGE ERROR IN THE SAME AS THE PERCENTAGE ERROR IN  $F_o$ .

THE STABILITY OF THE CRYSTAL OSCILLATOR IS DETERMINED IN  $F_t$

IS THE SAME AS THE PERCENTAGE ERROR IN  $f_0$ .  
THE HAVING PASSIVE COMPONENTS OF THE OSCILLATOR.  
THE CHOICE OF CRYSTAL AND COMPONENTS IS SUCH THAT THE  
REQUIRES FREQUENCY STABILITY IS MAINTAINED OVER THE  
REQUIRED VOLTAGE AND TEMPERATURE RANGE.

#### 8.4 DESCRIPTION OF OTHER CIRCUITS

##### TRANSMITTER

###### (1) RF AMPLIFICATION

THE OUTPUT OF BUFFER AMP Q203 IS FED THROUGH TUNING C123  
TO THE BASE OF PRE DRIVER AMP Q103.  
THE OUTPUT OF Q101 IS SUPPLIED TO THE ANTENNA THROUGH  
L-C TUNING CIRCUIT.

###### (2) CIRCUIT FOR SUPPRESSION OF SPURIOUS RADIATION

THE TUNING CIRCUIT BETWEEN THE OUTPUT OF FINAL AMP Q101  
AND ANTENNA, 3 STAGE "LPF TYPE" NETWORK L101, L102, L103,  
C101, C104, C105, C106 SERVES AS A SPURIOUS RADIATION  
SUPPRESSOR.

THIS NETWORK ALSO SPURIOUS RADIATION SUPPRESSOR.  
THIS NETWORK ALSO SERVES TO MATCH THE IMPEDANCE  
BETWEEN TX POWER TR Q101 AND ANTENNA.

###### (3) MAXIMUM MODULATION CONTROL

MODULATION SIGNALS ARE FILTERED WITH RC NETWORK AND  
GOES TO THE OP\_AMP IC(U304) TO MAKE NOMINAL SIGNAL LEVEL  
TO ACHIEVE WANTED MODULATION.

TO CONTROL INCOMING AUDIO SIGNAL, U304A IS USED PREAMP  
AND LEVEL LIMITING CIRCUIT, U304B IS USED LOW PASS FILTER.  
THE VALUE OF U304AB SHALL NOT EXCEED  $\pm 2.5$  [KHZ] DEVIATION  
UNDER, WHEN 1 [KHZ] AF LEVEL IS UP 20dB FROM [1.25KHZ]  
DEVIATION LEVEL INPUT.

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RECEIVER

(1) RF AMP Q104 AMPLIFY RF SIGNAL FROM ANTENNA, AND THEN THE AMPLIFIED RF SIGNAL IS FED THROUGH SAW FILTER SAW101 TO THE BASE OF MIXER Q105, ALSO VCO SOURCE'S FREQUENCY LOWER 21.40 [MHz] THAN THE FREQUENCY OF EACH CHANNEL IS SUPPLIED TO MIXER.

(2) THE SOURCE OF 21.4 [MHz] FREQUENCY IS FED THROUGH CF101 TO IF AMP Q106.

(3) THE 455 [KHZ] FREQUENCY SIGNAL IS PRODUCED FROM IC102 BY MIXING THE OUTPUT SOURCE OF CF101 21.4 [MHz] FILTER AND THE SOURCE OF 20.945 [MHz] FREQUENCY FROM CRYSTAL OSCILLATOR X101.

(4) THE IC(U102) IS A FM DETECTOR WHICH PRODUCES AUDIO SIGNAL

THE AUDIO SIGNAL IS FED THROUGH R355 TO AUDIO POWER AMP(U305) FOR DRIVING SPEAKER.