

THEORY OF OPERATION

1. SEMICONDUCTORS AND FUNCTION

1.1 IC COMPLEMENT

REF.NO	TYPE	MANUFACTURER	FUNCTION
IC201	DBL-5018	DAE WOO	IF DEMODULATOR
IC501	TB31202FN	THOSHIBA	PLL IC
IC801	TK11235	TPKO JAPAN	REGULATOR
IC401	KIA324F	KEC	MIC AMP
IC402	KIA324F	KEC	R/TX AUDIO FILTER
IC403	KIA324F	KEC	LOW PASS FILTER
IC301	NJM386M	JRC	AUDIO AMP
IC902	24C02S	PRO-CHIPS	EEPROM
IC901	TMP87CH21DF	TOSHIBA	CPU

1.2 TRANSISTOR COMPLEMENT

REF.NO	TYPE	MANUFACTURER	FUNCTION
Q101	AT31625	H.P	FINNAL RF AMP
Q102	BFQ67W	VISHAY	DRIVER AMP
Q103	BFQ67W	VISHAY	PREDRIVER AMP
Q5,Q6	BFQ67W	VISHAY	LNA
Q7	BFQ67W	VISHAY	1'ST MIXER
Q8	MMBC1321	MOTOROLA	IF AMP
Q702	2SC4226	NEC	VCO BUFFER AMP
Q701	2SC4226	NEC	VCO OSC
Q704	KTC3875	KEC	REGULATOR
Q802	KRA110S	KEC	RX B+ SW
Q801	KRA110S	KEC	TX EN2 SW
Q803	KRA110S	KEC	TX EN1 SW
Q403	KRA110S	KEC	CTCSS B+ SW
Q402	KTC3875	KEC	TONE AMP
Q401	KRA110S	KEC	AUDIO MUTE SW
Q301	KTA1505	KEC	AUDIO MUTE SW
Q302	KRC111S	KEC	PTT SW
Q303	KRA110S	KEC	LAMP SW
Q901	KRC245S	KEC	MIC AMP MUTE SW

; REMARKS.

KEC : KOREA ELECTRONICS CO., LTD.

DAE WOO : DAE WOO ELECTRONICS CO., LTD

TOSHIBA : TOSHIBA JAPAN CO., LTD

MOTOROLA : MOTOROLA CO., LTD

JRC : NEW JAPAN RADIO CO., LTD

PRO-CHIPS : JAPAN MICROCHIP CO., LTD

NEC : NEC JAPAN CO., LTD

H.P : HELWETT PACKARD CO., LTD

VISHAY : VISHAY SEMI CONDUCTOR

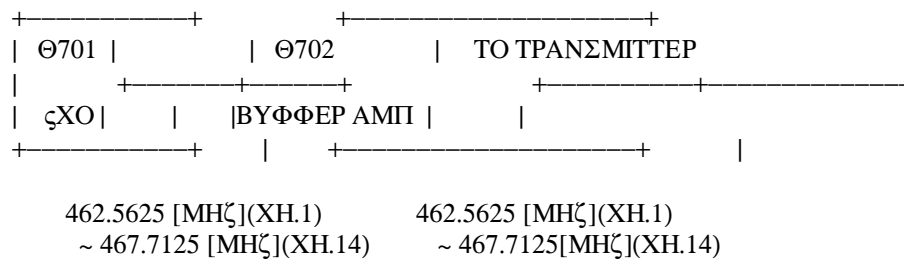
2. DESCRIPTION OF FREQUENCY DETERMINING AND STABILING CIRCUIT

2.1 INTRODUCTION

THE FREQUENCIES FOR TRANSMITTER AND RECEIVER LOCAL FREQUENCIES ARE ALL DRIVED FROM A SINGLE 21.25 [MHz] CRYSTAL BY MEANS OF A PHASE LOCKED LOOP. THE FIRST LOCAL OSCILLATOR FREQUENCIES ARE 440.8625 [MHz] (CH.1) TO 446.0125 [MHz] (CH.14).

THE SECOND LOCAL FREQUENCY IS FIXED AT 21.25 [MHz] TO GENERATE SECOND IF 455 [KHz].

DURING TRANSMIT, THE VCO OF THE PLL OPERATES 462.5625 [MHz] (CH.1) TO 467.7125[MHz](CH.14).



THE VCO OPERATING FREQUENCY FOR THE RECEIVER IS 440.8625 [MHz] (CH.1) TO 446.0125 [MHz] (CH.14) AS THE FIRST LOCAL OSCILLATOR, INJECTED THROUGH THE BUFFER AMP Q702 INTO THE FIRST TR MIXER Q7

2.2 DESCRIPTIONS OF EACH BLOCK

(1) INTRODUCTION

THE SYNTHESIZER IS IMPLEMENTED WITH THE FOLLOWING

COMPONENTS : PLL IC (IC501), 2nd OSC (X501), VCO, VARICAP DIODE (D701)

THE IC501 IS A CMOS LSI THAT INCLUDES PRESCALLER, THE Q701, D701, C713, C716, C711, L703 ARE CLAPP OSCILLATOR CIRCUIT TO OPERATE AS A VCO OF THE IC501.

THE Q705 IS A SWITCHING TRANSISTOR TO CONNECT OR DISCONNECT THE TUNING CAPACITOR IN THE VCO OSCILLATOR TANK CIRCUIT FOR TRANSMITTER OR RECEIVER.

THE Q702 WORKS AS A BUFFER AMP FOR RX LOCAL FREQUENCIES AND TX CARRIER GENERATING FREQUENCIES.

(2) REFERENCE FREQUENCY

THE CRYSTAL, X501(21.25 [MHz]) AND OTHER COMPONENTS AT PIN.10 AND 11 OF IC501 CAN MAKE A REFERENCE FREQUENCY OSCILLATOR WITH INTERNAL AMPLIFIER.

(3) VCO

THE Q701 AND SURROUNDING PARTS ARE CONSISTING A CLAPP OSCILLATOR WORKS AS A VCO OF IC501 WITH APPROPRIATE CONTROL VOLTAGE ON D701, THE VCO CAN BE OSCILLATE OVER THE REQUIRED RANGE OF 440.8625 [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 IC501 IS DONE WITH THE PROVIDED (CPU IC 901) KEY MATRIX INPUT PINS – PIN17 TO PIN20 AND FOR EACH KEY INPUT, AN INTERNAL CODE CONVERT EPROM PROVIDES THE APPROPRIATE BINARY CONTROL TO THE IC501 FOR THAT CHANNEL.

SINCE THE BINARY NUMBER NECESSARY TO CHANGE DURING TRANSMIT AND RECEIVE, AN ADDITIONAL BIT IS REQUIRED AT PIN.33 OF IC901 TO ALLOW THE ROM TO RECOGNIZING THE STATUS IS TX OR RX.

DURING TRANSMIT, THE PUSH TO TALK SWITCH MAKES PIN.33 OF CPU IC IS HI DIGITALLY UNDER TRANSMIT MODE.

THE PROGRAMMABLE DIVIDER TO PLL IC501.

THE IC501 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 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 FED TO VARICAP D701 CONTROL THE VCO FREQUENCY.

(6) TRANSMITTER / RECEIVER BUFFER AMP

OUTPUT SIGNAL OF Q701 IS FED INTO THE BUFFER AMP Q702 TO INCREASE THE STRENGTH OF TX CARRIER FREQUENCY AND 1st LOCAL FREQUENCIES.

(7) SWITCHING OF TUNING CAPACITOR IN VCO

THE VCO CIRCUIT MUST TUNE WITH A WIDE RANGE OF FREQUENCIES $462.5625 < 467.7125$ [MHz] FOR TRANSMITTER AND $440.8625 < 446.0125$ [MHz] FOR RECEIVER.

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

THE TUNING CIRCUIT CONSISTS WITH D701, C716, L703, C711, Q701, C706, C710

(8) RECEIVER LOCAL OSCILLATOR OUTPUTS

1st MIXER : THE OUTPUT SIGNALS OF Q702 IS INJECTED TO THE SOURCES OF 1st MIXER Q7 IN THE 1st IF MIXER SECTION.

2nd MIXER : THE OUTPUT OF 21.25 [MHz] OSCILLATOR CIRCUIT WITH X101 IS INJECTED INTO THE IC501. INCOMING IF SIGNAL AND 21.7 [MHz] SIGNAL ARE MIXED INSIDE THE IF IC TO EXTRACT 2nd IF SIGNAL 450 [KHz].

FM SIGNALS ARE RECOVERED WITH ENVELOPE DETECTOR.

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

FROM WHICH IT CAN BE SEEN, 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 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.