Regency® COMMUNICATIONS, INC.

SERVICE MANUAL

UHF REPEATER

MODEL MCCU01RA MCCU01RB

1227 S. PATRICK DRIVE.
SATELLITE BEACH, FLA

0300-4136-700

PRINTED IN U.S.A.
3-80

CONTENTS

SECTION 1 GENERAL INFORMATION

1-1 DESCRIPTION

The Regency MICRO-COM U01RA, U01RB is an FM repeater for use in the 450-512 MHz Land Mobile Communications Band. It is equipped with facilities which permit local control of the repeater, for use by a dispatcher and/or for use by maintenance personnel in making tests on the repeater.

As supplied, the repeater is designed to mount into a standard 19" relay rack structure.

The repeater control system provides for the following functions:

1. Operation of the transmitter by:
   a. Noise Squelch (Carrier)
   b. Tone Squelch (CTCSS)
   c. Tone + Noise Squelch (CTCSS + Carrier)
2. Provisions for plugging in up to three tone squelch frequencies, for use on community repeater systems. Eight additional tone squelch frequencies may be added internally, if desired.
3. Three minute cutoff timer, with warning tone.
4. Carrier drop out delay.
5. Provisions enabling operation of the repeater by a local operator. These provisions also enable maintenance technicians to receive and transmit test transmissions using each of the installed tone squelch frequencies.

The receiver section is Certified under Part 15, Subpart C of the FCC Rules. The transmitter is Type Accepted under the following FCC Rules parts:

21 Domestic Public Radio Services
90 Private Land Mobile Radio Services (89,91,93)
95 General Radio Service

No	GENERAL	NOMINAL	GUAR
1	CHANNELS	1	———
2	FREQ RANGE	450–512 MHz 2 BAND	———
3	OPERATING TEMP	–30°C TO +60°C	———
4	OPERATING DUTY CYCLE	CONTINUOUS DUTY	———
5	SIZE (W-D-H)	19"x9.5"x3" RACK MOUNTED	———
6	WEIGHT	6 LBS. 7 OZ.	———
7	POWER	@ 13.6 VDC	———
	CURRENT DRAIN	13.6 VDC	———
8	RCVR SQUELCH	400 MA *	———
9	RCVR MAX. AUDIO	850 MA *	———
10	TRANSMIT	1050 MA	———
11	ANTENNA	50 Ω	———
12	CHANNEL SPACING	25 KHz	———

No	RECEIVER	NOMINAL	GUAR
	SENSITIVITY	———	———
13	20 DB Q	.4 µV	.5 µV (MAX)
14	12 DB SINAD	.3 µV	.35 µV (MAX)
	AUDIO SQ SENSITIVITY	———	———
15	THRESHOLD	.2 µV	.25 µV (MAX)
16	TIGHT	.55 µV	.7 µV (MAX)
17	CTCSS	———	.2 µV (MAX)
18	ADJ. CH SEL 20DB	–120 dB	–100 dB (MIN)
19	ADJ. CH. DESEN 12DB	– 83 dB	– 80 dB (MIN)
20	OPERATING BANDWIDTH	±750 KHz FM. CTR	SEE 304–116
21	SPURIOUS & IMAGE	–85 dB	–80 dB (MIN)
22	IM 20 DB Q	———	–75 dB (MIN)
23	IM 12 DB SINAD	———	–75 dB (MIN)
24	MAB	± 6.5 MHz	± 7.5 MHz (MAX)
25	FREQ STAB TEMP.	———	± .00025% (MAX)
26	FREQ STAB VOLTAGE	———	± .0001% (MAX)
27	AUDIO RESPONSE	———	EIA +2/–8: 6 dB OUT DE-EMPHASIS
28	AUDIO OUT PWR (MAX)		4 W @ 5% DISTORTION

NO	RECEIVER	NOMINAL	GUAR
29	AUDIO OUT PWR (MAX)	———	5 W @ 10% DISTORTION
30	SQ BLOCKING	———	3KHz DEV. 300–3KHz NONE EIA
31	RCVR ATTACK TIME	———	100 MS (MAX)
32	RCVR SQ CLOSING	———	150 MS (MAX)
33	HUM & NOISE RATIO	50dB/60dB (UNSQ/SQ)	45dB/55dB (UNSQ/SQ)
34	UNDESIRED CONDUCTED (AC)	———	———
35	UNDESIRED CONDUCTED (RF)	———	———
36	UNDESIRED RADIATED	———	FCC
37	HIGH HUMIDITY	———	———
38	VIBRATION STAB	———	———
39	SHOCK STAB	———	———

	TRANSMITTER	NOMINAL	GUAR
40	PWR OUTPUT	700 MW	500 MW
41	DC PWR IN TO FINAL	———	3.5 W
42	OUT FREQ STAB (TEMP)	———	± .00025% MAX

NO	TRANSMITTER	NOMINAL	GUAR
43	OUT FREQ STAB (VOLT)	———	± .0001% (MAX)
44	SPUR & HARM CONDUCTED	– 55 dB	– 50 dB
45	SPUR & HARM RADIATED	– 55 dB	– 50 dB
46	OPERATING BANDWIDTH	± 750 KHz FM. CTR.	———
47	EMISSION	———	16 F 3
48	MODULATION	———	± 5 KHz (MAX)
49	AUDIO FREQ DISTORTION	———	3% (MAX)
50	FM HUM & NOISE	———	– 60 dB (MIN)
51	AM HUM & NOISE	———	– 34 dB (MIN)
52	AUDIO FREQ RESPONSE	———	EIA + 1/–3: 6 dB OUT PRE-EMPHASIS
53	TRANS CARRIER ATTACK	———	EIA: 100 MS (MAX)
54	SIDEBAND SPECTRUM	———	EIA: – 55 dB (MIN)
55	HIGH HUMIDITY	———	———
56	VIBRATION STABILITY	———	———
57	SHOCK STABILITY	———	———

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	RELEASE 201 SJR 2-13-80	2/13/80	DLF

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE FRACT ± ~ DEC .XX ± ~ .XXX ± ANGLE ± ~

MATERIAL ———

FINISH ———

MCCUOIR

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DWG.

APPROVALS	DATE
DRAWN SJR	2-13-80
CHECKED	
QA/TG. SUPV	
ENGR.	

Regency

COMMUNICATIONS INC.
SATELLITE BEACH, FLORIDA 32937

SPECIFICATIONS
MCCUOIR

SIZE B | PART NUMBER 304–183 | REV. A

SCALE ——— | SHEET 1 OF 2

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
		SEE SHT 1	9/25/79	DLP

TRANSFER AUDIO: WITHIN 3 dB FROM 400 Hz TO 2 KHz

OPERATION OF THE TRANSMITTER BY LOCAL MICROPHONE
& SELECTION OF: 1. NOISE SQUELCH (CARRIER)
2. TONE SQUELCH (CTCSS)
3. TONE & NOISE SQUELCH (CTCSS & CARRIER)

TIMERS: 1. CARRIER DROP OUT DELAY: 2 SEC
2. TIME OUT TIMER: 3 MIN WITH WARNING TONE

NUMBER OF TONE CHANNEL PROVISIONS
STANDARD: 3
OPTIONAL: 11

	NOISE SQUELCH	TONE & NOISE SQUELCH
REPEATER KEY-UP TIME:	NORMAL - 100 MS	150 MS
	GUAR. - 150 MS	250 MS

* CURRENT DRAIN (REPEAT MODE: CARRIER WITHOUT CTCSS)
AT 25°C 1. NO LOCAL VOLUME: 1025 MA
2. AVERAGE LOCAL VOL.: 1100 MA
3. FULL VOLUME: 1500 MA
ADD 185 MA FOR HEATERS FULL ON (-30°C)
ADD 65 MA FOR EACH SET OF MA-116/MA-121

* AFTER 3 MIN WARM UP TIME

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE FRACT ± DEC .XX± .XXX± ANGLE ±	APPROVALS DRAWN CMcC	DATE 9/79
			CHECKED	
			OPTG. SUPV	
		MATERIAL	ENGR	9.79
	MCCUOIR	FINISH		
NEXT ASSY	USED ON			
APPLICATION		DO NOT SCALE DWG.		

Regency® COMMUNICATIONS INC.
SATELLITE BEACH, FLORIDA 32937

SPECIFICATIONS
MCCUOIR

SIZE B PART NUMBER 304-183 REV A
SCALE ~ SHEET 2 OF 2

1-3 INSTALLATION

Mechanical Mounting

The MCCU01RA,U01RB is supplied for mounting in standard relay racks. Slide brackets may be attached to the repeater chassis to permit easy access to the technician adjustments without removing completely from the rack cabinet.

The microphone hang-up clip must be mounted so it is electrically grounded to the metal case of the repeater. Mount it in a convenient location, accessible to the technicians, or the local operator (if any).

1-4 OPERATION INSTRUCTION FOR LOCAL CONTROL POSITION

The operator at the local control position should realize that the unit is a repeater, and that it performs repeater functions for various mobiles, independently of the local control operator's actions, unless interrupted by the local operator when making a transmission over the repeater transmitter.

Volume Control

This control varies the audio volume level to the local loudspeaker, and should be set to a comfortable listening level. It has no control over the volume of the repeating function, and it has no control over the volume of transmissions made over the local microphone.

Power Indicator Lamp

A red indicator lamp is located on the front panel. It is used to show that the power to the repeater unit is "on".

Transmit Indicator Lamp

A red indicator lamp is located on the front panel. When this lamp glows, it indicates that the repeater transmitter is turned on. This lamp will glow whether the repeater transmitter is activated by the local microphone or by a distant mobile.

Tone Squelch Monitoring Function (For units equipped with Tone Squelch)

When the microphone is placed in its hang-up hook, the Tone Squelch System is effective and only signals from stations having the appropriate tones will be heard in the local loudspeaker.

On shared radio channels, it is considered good manners to listen in on the channel before transmitting. When the microphone is removed from the hook, the Tone Squelch circuits are placed in the MONITOR condition, and any signal on the channel will be heard regardless of whether it has the appropriate tone coding.

If the operator attempts to transmit a message by merely pressing the microphone button while the microphone remains in the hang-up hook, the tone squelch tone will not be transmitted, and the message will not get through (unless the listening station just happens to be in the MONITOR position at the time).

Microphone

A hand-held microphone is supplied with the unit. To transmit a message, remove the microphone from its hang-up hook, press the push-to-talk button on the side of the microphone, and speak into the microphone. The Transmit Indicator will glow to signify that the transmitter is operating.

Good results are obtained by holding the microphone about one inch from the lips, inclined at about a 30 degree angle away from the face. Speak clearly in a normal tone of voice across the face of the microphone.

1-5 CRYSTAL SPECIFICATIONS

Miniature plug-in crystals are utilized in both the receiver and transmitter sections.

The following Regency Part Number crystals are used:

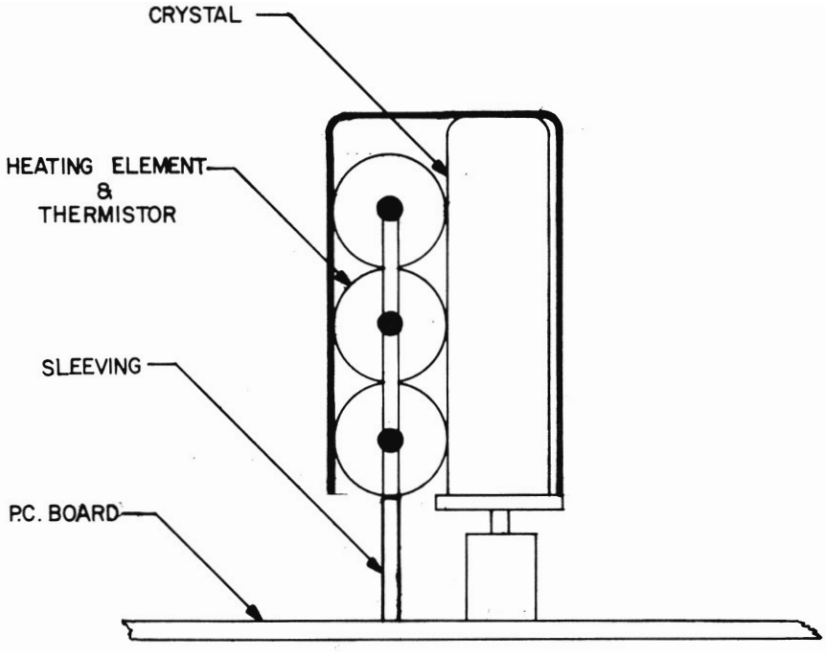
Transmit Crystals:	302-539
Receive Crystals:	302-540

Crystals should be ordered by specifying the above part numbers and the exact channel frequency required.

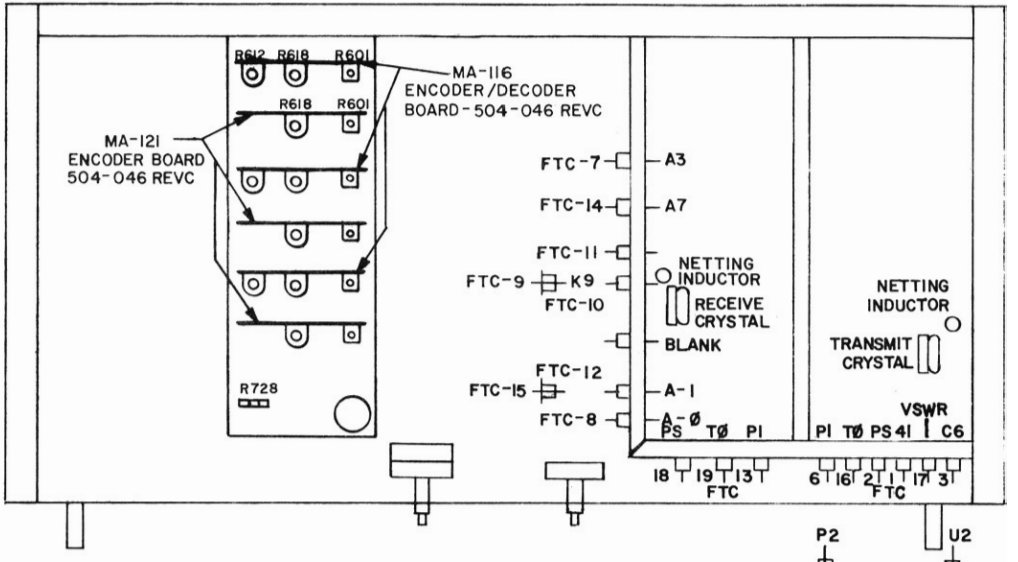
Installation of crystals requires the services of a competent technician with appropriate test equipment. Instructions for the necessary adjustments are included in the receiver alignment and transmitter tuning procedures later in this manual.

1-6 CRYSTAL INSTALLATION

Special care must be taken to install the crystals correctly. The conduction type crystal heater which is used to warm the crystals at low ambient temperatures relies on having proper physical contact between the heater element and the crystal for effective operation. The Crystal Heater Detail, (Figure 1-7) demonstrates the correct method of crystal installation. The crystal must be pressed down into the socket pins far enough for the rim around the bottom of the crystal to clear the heating element and the crystal clip must make good contact between the side of the crystal and the element.



1-7 CRYSTAL HEATING DETAIL



CRYSTAL LOCATION
MA-116 & MA-121 SET UP
ADJUSTMENT LOCATION

1-8
5-12
7-8

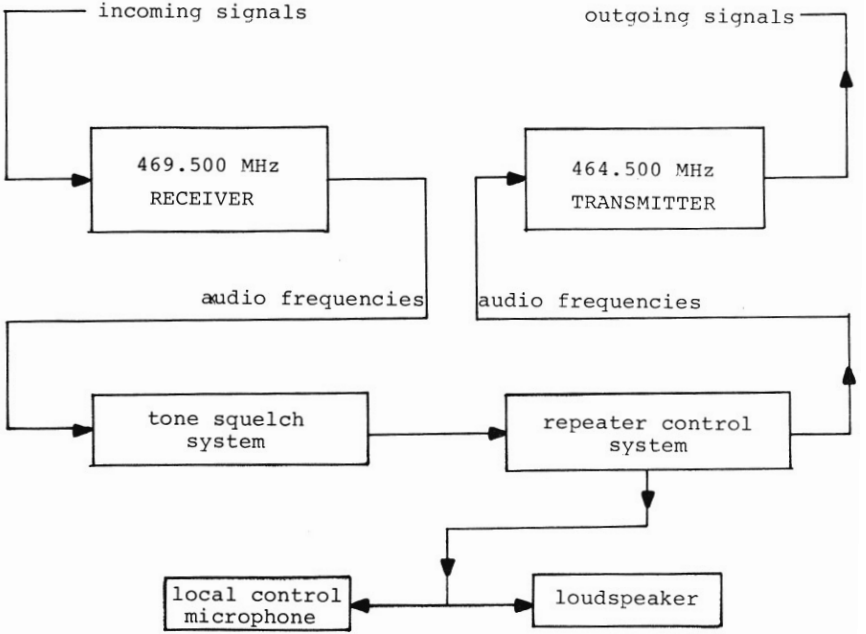
SECTION 2 REPEATER SYSTEM

2-1 DESCRIPTION

A block diagram of the repeater system is shown in Figure 2-2. The block diagram shows the major functions of the various portions of the repeater. To make explanation of the diagram easier to follow, the operating frequencies have been assumed to be 469.50 MHz receiver and 464.50 MHz transmit. This follows the pattern of frequency assignments in the 450-470 MHz band in the United States. Mobiles functioning with this system would transmit on 469.50 MHz (so they will be received by the repeater receiver) and would receiver on 464.50 MHz (so they will "hear" the repeater transmitter).

As the block diagram shows, signals received on 469.50 are demodulated by the receiver, and the audio intelligence is sent to the tone squelch system. If the received signal has the same tone squelch frequency as one of the installed tone squelch boards, the tone squelch system, acting with the repeater control system turns the transmitter on, and retransmits the original intelligence.

Additionally, as the block diagram shows, an operator at the repeater location can transmit through the local microphone and can hear incoming mobiles through the local loudspeaker. Features within the tone squelch system and the repeater control system permit the operator at the repeater location to transmit one of the tone squelch frequencies, and also enable the loudspeaker to be silent except when a signal with that tone squelch frequency is received.



2-2 REPEATER SYSTEM BLOCK DIAGRAM

3-1 RECEIVER CIRCUIT DESCRIPTION

The antenna is connected to a 2 Section RF Helical Filter, L205 and L206, which acts as a preselector for incoming signals.

Q203 is a grounded gate, low noise, J-FET amplifier. Its output is fed through an additional 2 Section Helical Filter, L212 and L213 and delivered to the gate of Q206, a J-FET mixer.

L.O. (Local Oscillator) injection for the J-FET mixer Q206 is a frequency of 10.7 MHz lower than the incoming signal frequency. It is obtained from a crystal oscillator-multiplier chain, consisting of Q201, Q202 and Q205. Q201 is a crystal oscillator, using a third overtone crystal in the 48.8 to 55.7 MHz range. The output circuit of Q201 oscillator is tuned to the third harmonic of the crystal frequency, and this harmonic is amplified by a buffer-amplifier consisting of Q202. Q202 drives Q205, which operates as a frequency tripler, providing the wanted local oscillator injection frequency. This wanted injection frequency is separated from various harmonics and subharmonics by the L215 and L216 section of the helical filter and delivered to the source of the mixer, Q206.

The output of Q206 consists of a 10.7 MHz IF signal which is fed to a six-pole monolithic crystal filter, consisting of XF201, XF202 and XF203. This filter provides most of the adjacent channel selectivity of the receiver. The signal is then amplified by Q207. The amplified 10.7 MHz IF signal is then coupled to IC201 (terminal 18) which contains the second mixer circuitry and the second L.O. circuitry operating at 10.245 MHz.

The 455 KHz output of IC201 (terminal 3) is coupled through a tuned circuit to the input of the ceramic filter, CF201. CF201 is a narrow-band filter centered at 455 KHz, and it provides additional adjacent channel rejection. The output of CF201 goes back to IC201 (terminal 5) where it is amplified approximately 60dB. Also included in IC103 is the limiting circuitry and a quadrature detector circuit. L123, connected between terminals 4 and 8 of IC201, is the adjustable quadrature coil.

The audio output from IC201 Pin 10 leaves the shielded receive compartment at Pin AØ to the repeater control board where it is deemphasized. Then the audio returns to the shielded receiver at Pin A3 where it is coupled to the audio amplifier circuit. Also, from Pin AØ, the squelch noise is applied to the squelch control. From the squelch control the noise returns to the input of the noise operated squelch circuit at Pin A1.

From Pin A1, the noise is filtered and then amplified by the internal squelch amplifier in IC201. The amplified noise is rectified by CR204 and CR207 and the DC voltage is applied to Pin 14 of IC201. From Pin 14 the voltage is applied to an internal squelch switch which pulls Pin 16 high with a receive signal. This high is applied to the base of Q204 and will cause it to conduct.

From Pin A3 the audio signal is coupled to the base of Q204. Q204 is an audio switch and emitter follower. The audio output from the emitter at Pin A4 leaves the shielded receiver to the volume control and control board. From the arm of the volume control it returns to the shielded receiver at Pin A6. From Pin A6 the audio is amplified by IC202 to loudspeaker level.

3-2 RECEIVER VOLTAGES

Voltage on active component MCCU01R

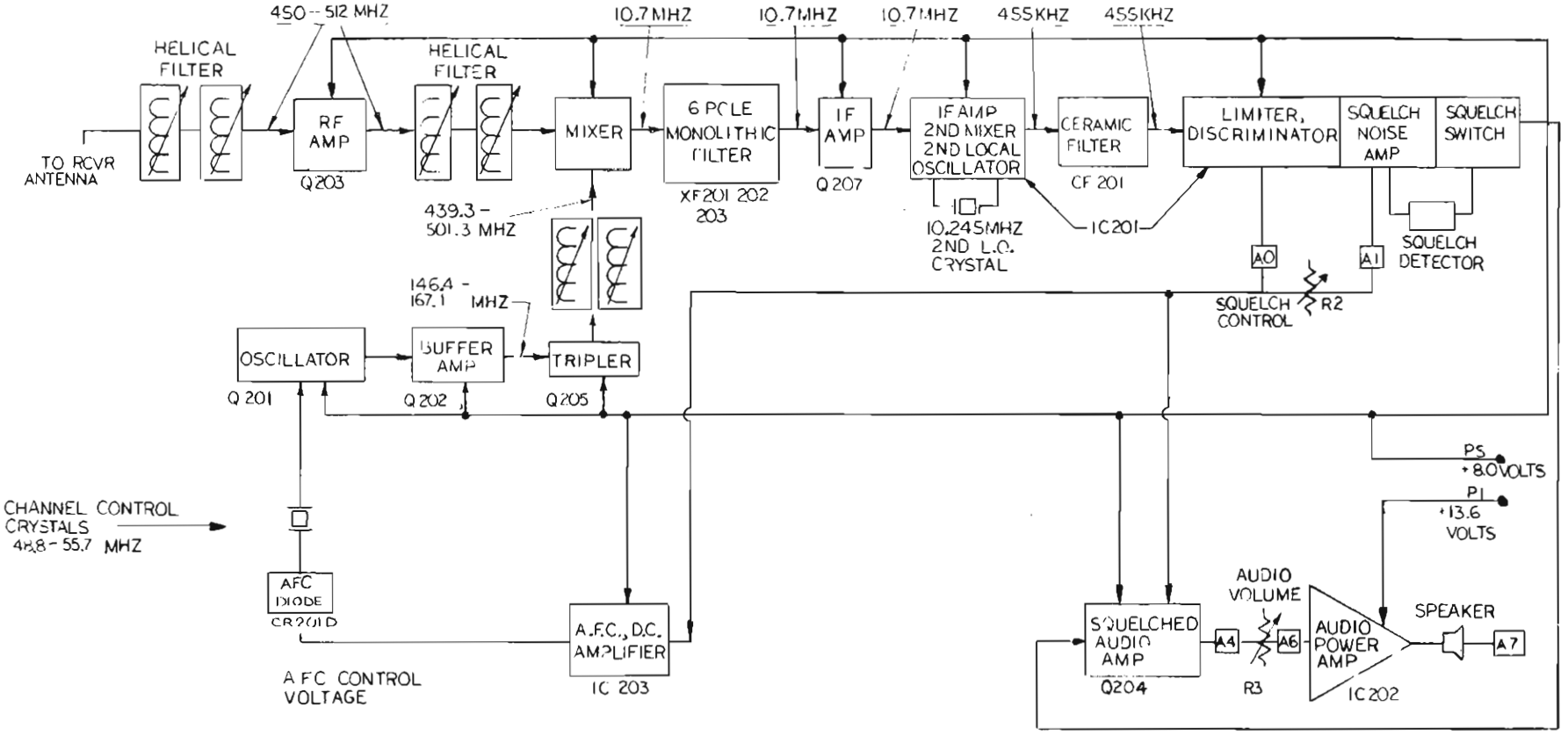
	Lo ON			Lo OFF		
	E	B	C	E	B	C
Q201	2.2v	2.7v	8.2	2.2	2.9	8.2
Q202	3.2	3.7	8.2	3.3	4.2	8.2
Q205	.7	.54	8.2	0	.6	8.2
Q207	.2	.85	5.2	.2	.85	5.2
	S	G	D	S	G	D
Q203	1.2	0	7.8	1.2	0	7.8
Q206	.71	0	6.8	.64	0	6.8
					sq. on	
	E	B	C	E	B	C
Q204	2.4	3	8.2	.9	0	8.2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
IC201	8.0	7.6	7.7	8.2	1	1	1	8	4	3.4	4.1	2.2	2.2	0	7.6	7.5	0	2
sq. on	8	7.6	7.7	8.0	1	1	1	8	4	3.4	4	2.2	2.2	.6	0	0	0	2

	1	2	3	4	5
IC202	.7	.6	0	6.7	13.6
Sq.	.7	.6	0	6.7	13.6

	1	2	3	4	5	6	7	8
IC203	7	5.5	5	0	4.0	4.0	2.8	8.2

K11 3.2



3-3 RECEIVER BLOCK DIAGRAM

SECTION 4 TRANSMITTER

4-1 TRANSMITTER CIRCUIT DESCRIPTION

AUDIO SECTION

Integrated Circuit IC301 (sections A and B) constitutes the audio circuitry of the transmitter. IC301A provides a high impedance input for the ceramic microphone and supplies pre-emphasis and amplification prior to the modulation limiting circuit which consists of Q307 and Q308. IC301B provides additional amplification, and acts as an active filter to provide the post-limited filter action. The output of IC301B is fed to a control potentiometer which controls the audio voltage sent to the modulator section and, therefore, is used to set the peak modulation deviation of the transmitter.

IC301B also provides an amplified input to feed tones for continuous tone squelch systems, or other tone systems, into the transmitter modulation circuits.

CRYSTAL OSCILLATOR

Y301A serves as the crystal oscillator, using a crystal at 1/36 of the channel frequency. The crystal is a fundamental cut, in the frequency range 12.5 to 14.3 MHz.

Direct frequency modulation of the crystal is obtained by applying the modulation signals from the audio section to varactor modulator diode, CR301A.

FREQUENCY MULTIPLIER SYSTEM

The output of the crystal oscillator, Q301, is tuned to three times the crystal frequency, and this signal is amplified by buffer-amplifier Q302, then delivered to the tripler circuit, Q303, then delivered to the doubler circuit Q304. Q304 drives another doubler, Q305, to obtain a combined frequency multiplication of 36 to reach the channel frequencies from 450-512 MHz. The doubler Q305 develops about 800 milliwatts of power to drive the helical preselector.

VSWR SYSTEM

The VSWR system is a part of the external power amplifier and controls the voltage to the collector of Q305. For test purposes when not used with the external amplifier, the VSWR line must be connected to keyed +13.6 volt line (Pin 2 to Pin 3 of the control socket on rear of repeater chassis).

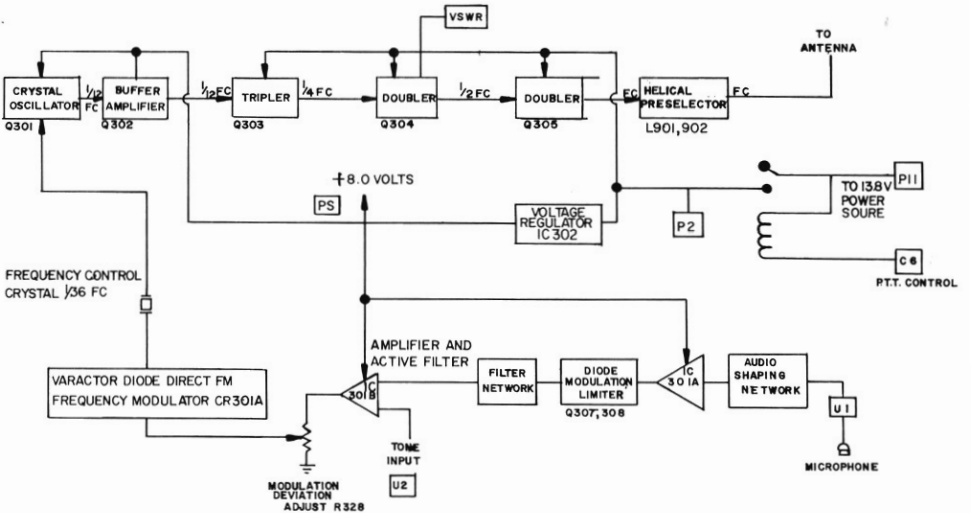
Voltage on active components MCCU01R

	E	B	C	No Lo	E	B	C
Q301	1.8	2.2	8		1.7	2.3	8.2
Q302	1.4	1.8	3.1		1.4	2.2	3.6
Q303	0	-1.5	10.5		0	0	13.6
Q304	0	- .75	9.5		0	0	13.6
Q305	0	0	11.5		0	0	13.6
Q306	.2	.9	13.6				
Q307	4	3.9	3.9				
Q308	3.9	4	4				

	1	2	3	4	5	6	7	8
IC301	3.8	3.8	3.8	0	3.8	3.8	3.8	8

	1	2	3
IC302	8.2	0	3.6

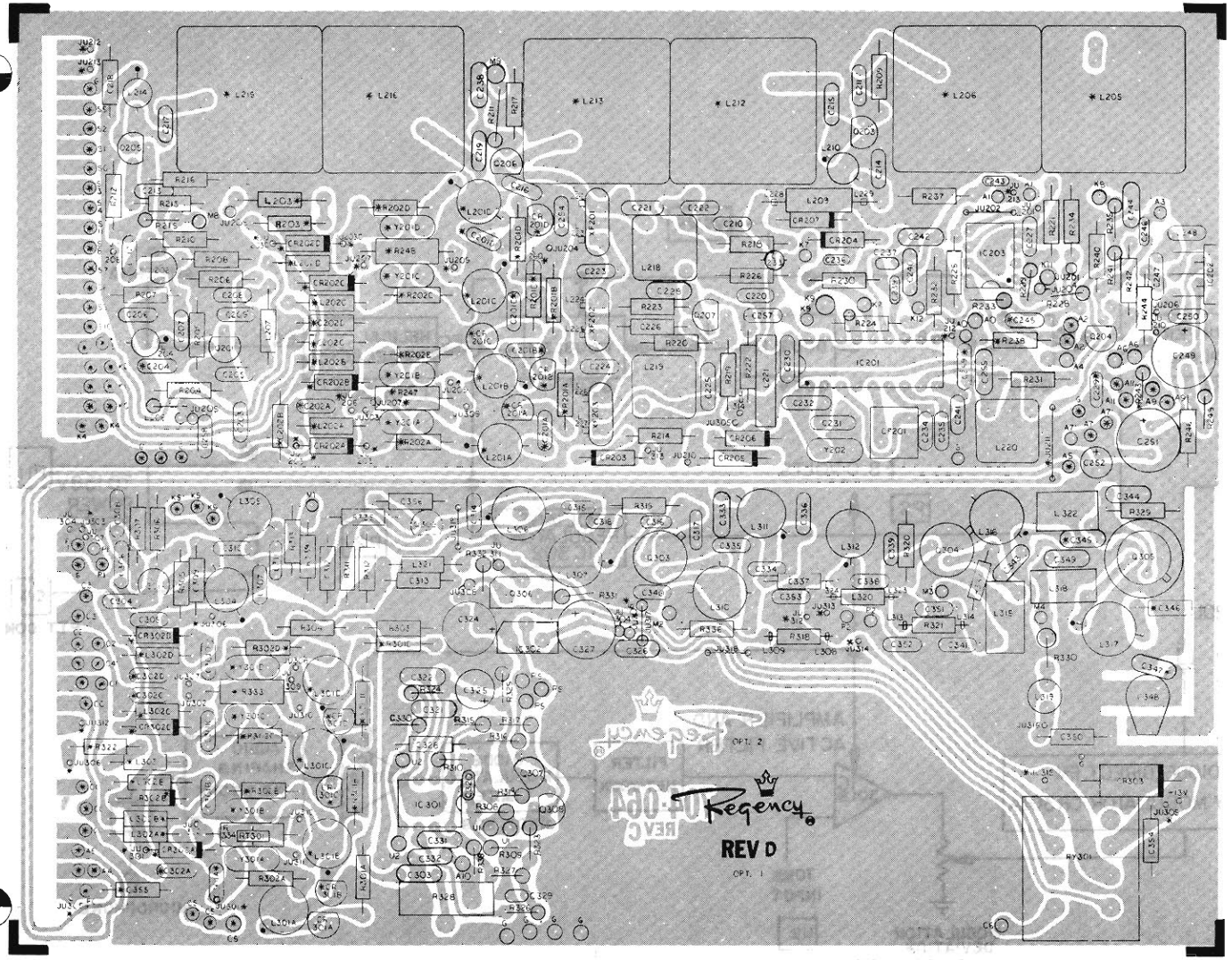
	M1	M2	M3	M4
Tuned	1.5	10.2	9	12
No Lo	2.1	13.6	13.6	13.6



4-3 TRANSMITTER BLOCK DIAGRAM

NO.	REVISION	DATE	APPROVED
A	ECN AA-748	6/14/78	BKJ
B	ECN AA-868	6/14/79	BKJ
C	ECN AA-882	10/1/79	BKJ
D	ECN AA-936	11/19/80	BKJ

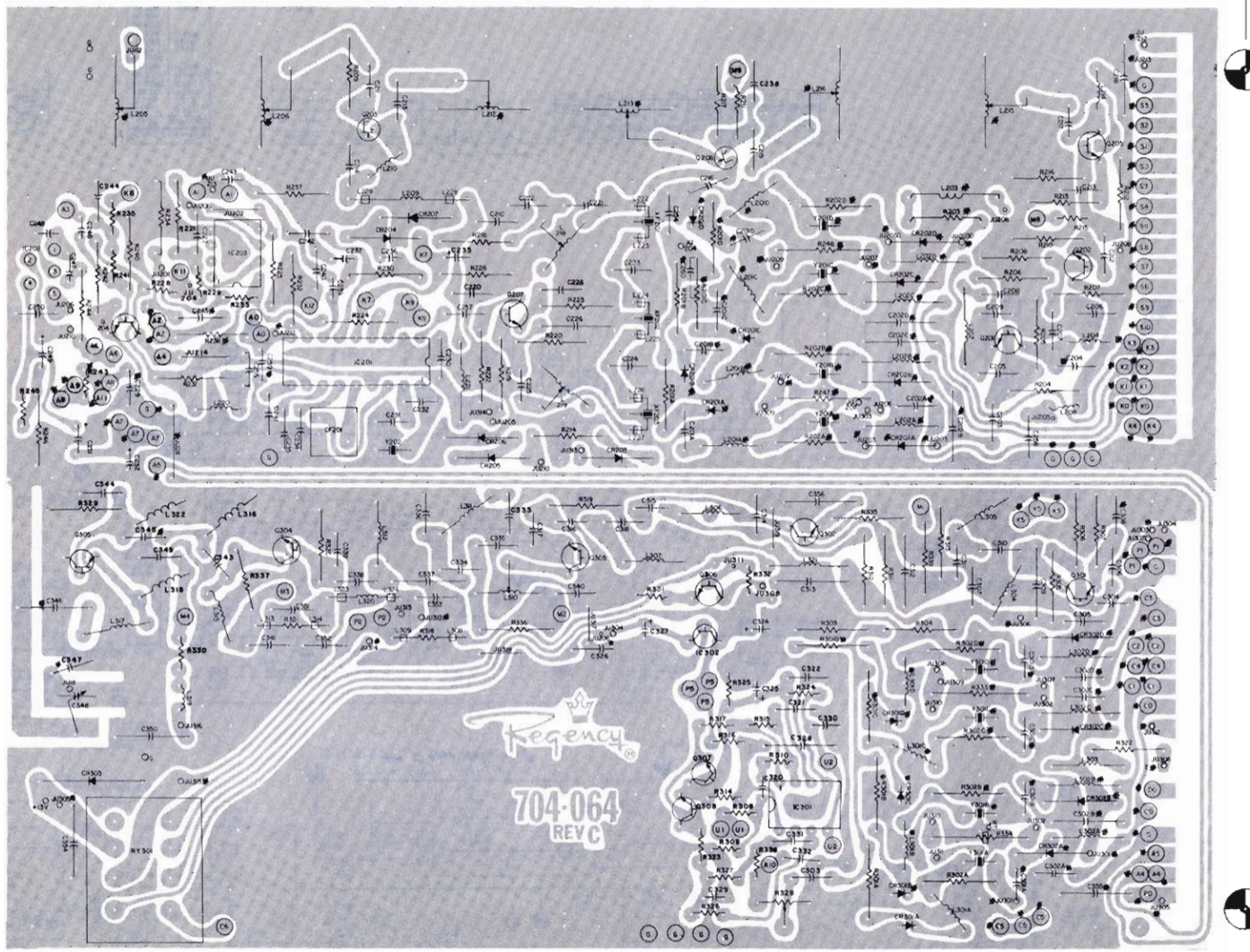
REDUCE TO 8.000 X.003



REDUCE TO 5.150 X.125

SCHEMATIC / PARTS PLACEMENT
PRINTED CIRCUIT BD.

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	A	RELEASE R-879		
	B	EN AA-748		
	C	EN 88-902		



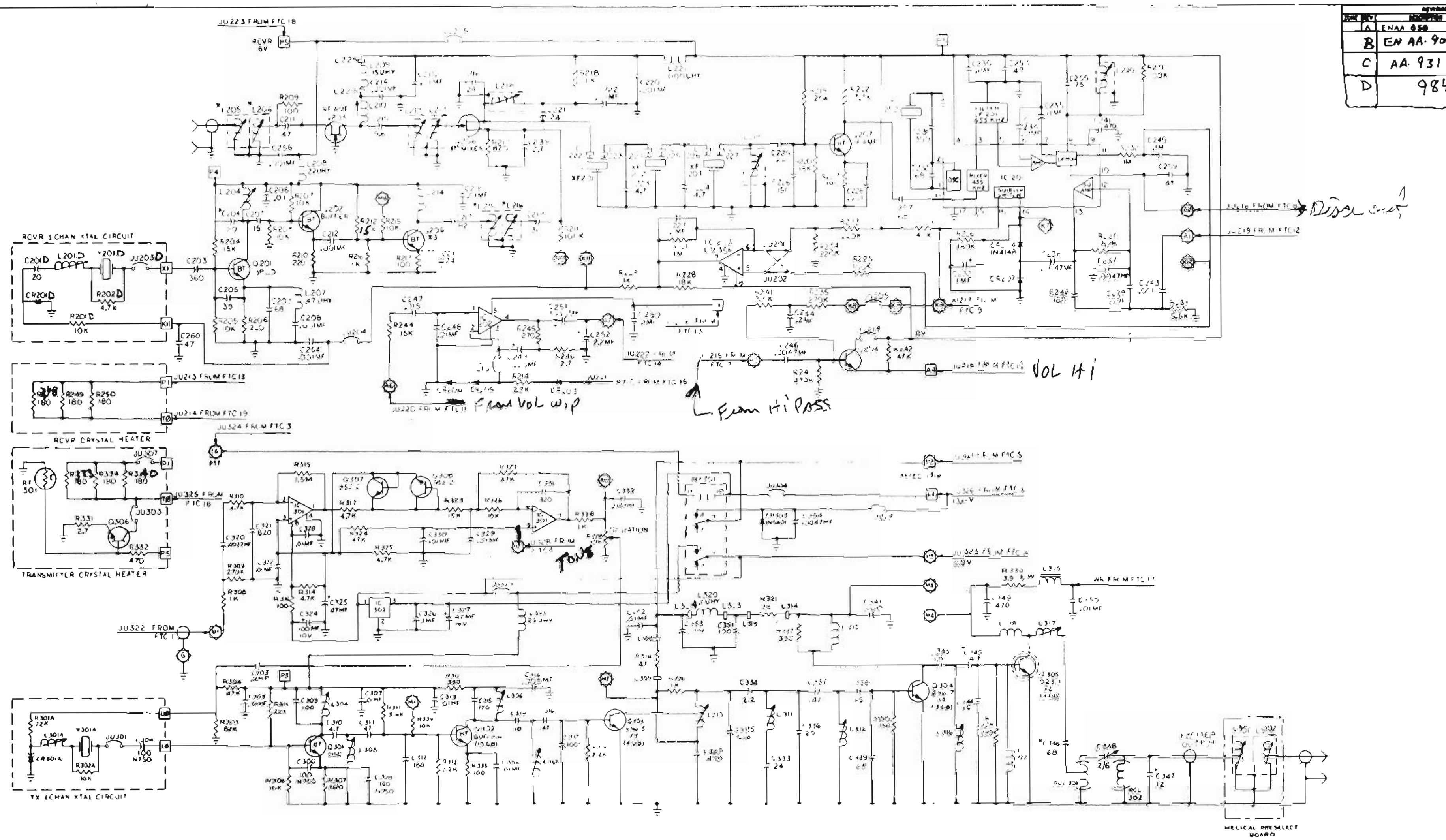
			APPROVALS	DATE
MCU 30II				
NEXT ASSY	USED ON	DO NOT SCALE DRW		
APPLICATION				

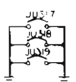
COMMUNICATIONS, INC.
SATELLITE BEACH, FLORIDA 32937

PARTS OVERLAY
MCU 30 II MAIN BOARD

SIZE C | 704-064 | REV C
SCALE 4/1 | SHEET 1 OF 1

REV	DESCRIPTION		
A	ENAA 858	DJB	
B	EN AA-901	DLF	10/4/79
C	AA-931	DAJ	10-26-79
D	984	DF	1-80





REF. DES. CHART	
LAST	NOT USED
C260	C323
C356	C313
R250	R227
R340	R239
Q207	R216, 231
Q306	R338
IC203	
L227	L211
L323	C256
IC302	R338
JU205	
JU214	
JU303	
JU329	JU307

R203 C202 L202
R236 C229 L203
R238 C245 L217
R243 C301 L302
R297 C302 L303
R322 C355

* PARTS VARIABLE

MODEL	FREQ RANGE	C304	C345	C346	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	C352
[illegible]	[illegible] MHZ	22	47	56	[illegible]	PINK [illegible]	ORANGE 102	GREEN 103	ORANGE [illegible]	YELLOW 104	ORANGE [illegible]	PINK [illegible]	PINK [illegible]
[illegible]	[illegible] MHZ	26	22	47	62	BROWN [illegible]	BLUE 106	VIOLET [illegible]	BLUE [illegible]	WHITE 108	GRAY 159	BROWN [illegible]	BROWN [illegible]

NOTES:

1. ALL CAPACITOR VALUES NOT SPECIFIED OTHERWISE ARE PICO-FARAD.
ALL RESISTOR VALUES NOT SPECIFIED OTHERWISE ARE OHMS, 1/4 WATT.
2. ⬡ DENOTES PIN LOCATED ON PC BOARD.
□ DENOTES CIRCUIT TIE POINT.
DENOTES SOLDERED IN JUMPERS
DENOTES HARDWIRED JUMPERS - USER SELECTED.
DENOTES PLUGGED IN JUMPERS (OPTIONS).
— - — DENOTES BOARD BOUNDARIES.
— — — DENOTES CIRCUIT VARIATIONS.
3. PARTS MARKED WITH * ARE VARIABLE WITH MODEL, SEE PARTS VARIABLE CHART.
4. REF SCHEMATIC MCCR 604-157

SCHEMATIC
MCCUOIR

MCU-30 II

NEXT ASSY | USED ON
APPLICATION

APPLICATION	
NEXT ASSY	USED ON

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	R-216	11/79	DLF

REV. A SH 1 DWG. NO. TP-14-266

TEST PROCEDURE

MCCU01R 19" RACK MOUNT UHF REPEATER

I. Test Set-Up (Refer to Figure 1)

1. MCCU-01R Repeater
2. DC Power Supply 13.VDC @ 2A
3. Audio and subaudible Signal Generator
4. R.F. Signal Generator
5. 450 MHz Thruline Wattmeter, 1W element
6. 30dB Power Pad
7. Frequency Counter*
8. Deviation Meter*
9. Spectrum Analyzer
10. UHF Notch Filter
11. HP410 DC VTVM
12. Sinadder or Distortion Meter with 1 KHz notch filter
13. AC VTVM
14. Audio Oscilloscope
15. PTT Switch
16. DC Voltmeter
17. 10.7 MHz Oscillator
18. AC VTVM
19. Microphone Matching Network
20. Audio Generator
21. MCCU01R Short Protector
22. Temperature Indicator

*May be replaced with Cushman or similar equipment.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE	APPROVALS	DATE
FRACT. ± DEC .XX± .XXX± ANG. ±	DRAWN	
	CHECKED	
	QFTG. SUPV.	
MATERIAL	ENGR. DLF	11/13/79
FINISH		
DO NOT SCALE DRWG.		

Regency® COMMUNICATIONS INC.
SATELLITE BEACH, FLORIDA 32937

TEST PROCEDURE
MCCU01R 19" RACK MOUNT UHF REPEATER

SIZE	PART NUMBER	REV.
A	TP 14-266	A

SCALE | SHEET 1 OF 6

II. Set-Up Instructions

A. Set Up Control Board
1. Add J0 jumper between A1 and A3 on P706.
2. Connect tone select lead JU703 (black) to ground Pin G.
3. Connect JU718 (yellow) to squelch Pin P708.
4. Disconnect JU702 (white) from P709.

B. DC Input Short to Ground Test
1. Set S1 to Position A. Connect external DC power to P1.
2. If D2 (red) is on, B+ is shorted to ground in receiver.
3. If B+ is not shorted to ground switch S1 to Position B. Power on indication should be on. Reset S1 to Position A.
4. Install P2, key transmitter; if D2 is on, B+ shorted in transmitter.

C. Preliminary Preparations for Transmitter Testing
1. Insert tune-up crystal; set S1 to Position B.
2. Connect transmitter output to load.
3. Insert PTT keying switch.
4. Preset L901 and L902 tuning screws down into the can until the screws are even with the top of the nut.
5. Preset C348 for maximum capacitance.

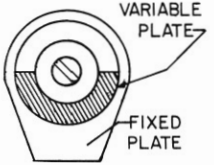


Figure 4 - Preset C348 for maximum capacitance

D. Preliminary Preparations for Receiver Testing
1. Insert tune-up crystal. Both transmit and receive tune-up crystals are selected as follows:

Freq Band	450-476 MHz	470-512 MHz
Frequency	462 MHz	492 MHz

2. Set UHF-FM signal generator (2) to tune-up crystal frequency as measured on frequency counter (9).
a. Set squelch control clockwise
3. Preset L210 as follows: above 465 MHz, screw the slug all the way into the coil; below 465 MHz screw the slug out to the top of the coil.

III. Transmitter Tune Up

A. VTVM metering - Metering point M1 must be referenced to ground, but metering points M2 through M4 may be referenced to ground or to 13.6V. Key transmitter with external PTT and key only when measuring or tuning.

1. Monitor M1. Tune L304 and L305 for minimum positive voltage. A reading of 2.1V indicates oscillator, Q301, is not oscillating.

The following metering points will be described referenced to 13.6 VDC. The VTVM is set in the -DCV position and all test points are peaked. To reference to ground, set the VTVM in the +DCV position and dip all test points. Either way the voltage difference between tuned and not tuned will be identical.

2. Monitor M2. Alternately tune L306 and L307 for maximum negative voltage. Tune L310 for a minimum. Voltage should be -2.5V to -3.0V. A reading of 0V indicates Q303 stage has no output.

3. Monitor M3. First tune L312 for maximum negative voltage, then tune L311. Tune L316 for a minimum. Voltage should read -3.5V to -5.0V when tuned. A reading of 0V indicates Q304 stage has no output.

4. Monitor M4. Tune L316 for maximum negative voltage, then tune L317 for maximum negative voltage. Voltage should read -2.5 VDC. A reading of 0V indicates Q305 stage has no output. Tune C348 for minimum negative voltage at M4. Voltage dip should be to -1.5 VDC.

5. Tune L901 and L902 for maximum power out by alternating 2 turns on each of the screws. Tune L316, L317 and C348 and set the tuning screws on L901 and L902 as far as possible into the can for maximum power output. Power output should exceed 0.5W.

B. Connect counter (7) to the output of the 20dB attenuator (6) and set the F1 warp control, L301A to the nominal crystal frequency ±100 Hz.

C. Conducted spurious emissions measurement. Tune band reject filter (10) so that the carrier is not notched and set the spectrum analyzer (9) carrier indication to the 0dB reference line. Tune the band reject filter to attenuate the carrier at least 30dB. In the MCCU01R all harmonics should be 60dB or more lower than the reference.

D. Deviation adjustment

1. Connect audio generator (20) to microphone input. Set the generator for 1 KHz at 1 VAC. Connect the deviation meter(8) to the attenuator (6) output.
2. Key the transmitter and adjust R328 for ±5 KHz deviation as measured on the meter.

E. Check the modulation sensitivity by reducing the audio generator output until the deviation is ±3 KHz. The measured generator output on the AC VTVM (18) should be less than 20mv rms.

F. The crystal heater circuit can be checked in two ways. The check must be made at 25°C (76°F) after the DC voltage to the MCCU01R has been turned on for at least 3 minutes. In the preferred test, the sensor of the temperature indicator (22) is positioned between the crystal clip and the crystal in both the transmitter and receiver. The reading must be within 49°C to 59°C on both. Alternately the voltage at the collector of Q306 must be within 6.0 to 8.0 VDC.

IV. Table of Performance Limits for Transmitter

PARAMETER	MIN	TYP	MAX	UNITS
M1	+2	+1.8	+1.6	VDC
M2	0	-2.5	-3.5	VDC
M3	0	-3.5	-5	VDC
M4	0	-1.5	-2	VDC
Deviation	-	-	±5.0	KHz
Mic Mod Sens	-	10	20	mVac
Xtal Temp at 25°C	49	54	59	°C
Collector Q306 at 25°C	6.0	7.0	8.0	VDC
MICRO-COM U01R				
Tx Power Putput	.5	.8	1.2	W
DC current	1	1.1	1.2	A

V. Receiver Alignment Procedure

A. Connect AC VTVM (13) across the speaker load and adjust the ON-OFF Volume Control for a readable VTVM reading on the 1 VAC scale.
B. Monitor K11 with DC VTVM (11). Inject strong 10.700 MHz signal into the vicinity of L319 and Q207. Set K11 to 3.5 VDC by adjusting L220.
C. Monitor M8 with the DC VTVM (11). Adjust L204 for minimum voltage at M8. A voltage dip of 0.05V from the oscillator off to the oscillator on should be observed. A reading of 0.6 VDC indicates no drive to Q205.
D. Modulate signal generator (3) with a 1 KHz tone at ± 3 KHz deviation. Increase generator output for 6dB SINAD on sinadder (12).
E. Adjust L205, L206, L212 and L213 for best 12dB SINAD by constantly reducing the signal generator output for 12dB SINAD.
F. Adjust L215 and L216 for best 12dB SINAD.
G. Monitor K11 with DC VTVM. Adjust L201D to 3.5V.
H. Increase deviation to ±6 KHz. Adjust L218 and L219 for best 12dB SINAD.
I. Set the signal generator (3) for a 1 KHz tone at ±3 KHz deviation. Adjust the generator output for 12dB SINAD. The generator should read no more than .35 uv.
J. Increase the signal generator output to 100 uv and turn the volume control R3 to full volume. The AC VTVM (13) should exceed 4.0 VAC.
K. Set the signal generator to -130dBm and remove the modulation. Set AC VTVM (13) to the 1V scale and use the volume control to set voltage to 1.0 VAC. Increase the signal generator output until the AC VTVM reads 0.1 VAC. This is 20dB quieting and the generator should read less than 0.5 uv.
L. Set the signal generator (3) output to -130dBm. Set the squelch control R2 to threshold, just quieting the receiver noise. Increase the signal generator output until noise appears. This is threshold squelch and the generator should read less than .25 uv.
M. Turn the squelch control fully counterclockwise. Increase the signal generator output until the squelch opens. This is tight squelch and the generator should read less than 0.7 uv.

DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED DLF	DATE 11/19/79	A	TP 14-266	A
DO NOT SCALE DWG.		SCALE		SHEET 4

N. Monitor K11 with DC VTVM (11) set on 10V scale. Set signal generator (3) for 100 uv and offset the frequency +3.0 KHz from the crystal frequency. Voltage at K11 should increase from 3.5 VDC on frequency to at least 4.5 VDC with +3.0 KHz offset.

O. The receiver desensitization test must be made with all shields, covers, (except top cover) and screws firmly in place. The signal generator (4) is modulated with 1000 Hz at 3 KHz deviation with the RF output corresponding to 12dB SINAD. The transmitter is keyed, by shorting feed-thru capacitor FTC-3 to ground, into a 50 ohm load (6). The signal generator output is increased for 12dB SINAD. The maximum acceptable signal generator increase is 1.0dB.

VI. Table of Performance Limits

PARAMETER	MIN	TYP	MAX	UNITS
M8	-	.5	.55	VDC
12dB SINAD	-	.3	.35	uv
20DBQ	-	.4	.5	uv
Threshold Squelch	-	.2	.25	uv
Tight Squelch	-	.55	.7	uv
Audio Output 1 KHz Tone 3 KHZ Dev	4.0	4.2	-	VAC
Noise Output	4.0	4.2	-	VAC
K11 +3 KHZ offset	4.5	6.0	-	VAC
Desens	-	-	1.0	dB

VII. Tone/Control Board Checkout Procedure

A. Timer Test

1. Connect JU702 (white) to P709 (transmit).
2. Turn up volume control so you can hear the receiver in the local loudspeaker.
3. Open squelch control. Transmitter should now be activated.
4. Closing squelch control should turn off transmitter after two second delay.
5. Open squelch control again. Transmitter should be activated. Monitor transmit audio on modulation meter. After a period of three minutes the time-out warning oscillator should be audible. Then the time-out timer should automatically turn off the transmitter.

B. Transfer Audio Level Setting

1. Modulate the generator with a 1000 Hz tone at ±3 KHz peak modulation deviation.
2. Then monitor the transmitter modulation deviation and adjust R728 (on tone/control board) to obtain a reading of ±3 KHz peak modulation deviation.

C. Tone Squelch Test

1. Connect JU718 (yellow) to NC.
2. Clip R762 (33K) "pull-up" resistor. LD701 should light and transmitter should be activated.
3. Install Test Encoder (MA-121) into P701.
   Install Test Decoder (MA-116) into P702.
   Modulate FM signal generator with test subaudible frequency at 500 Hz deviation. LD701 should light and transmitter should be now modulated by the test encoder.
4. This test should be repeated to the remaining tone positions. P703, P704, P705 and P706, each time clipping the associated "pull-up" resistor (33K) and replacing this resistor in the unused position(s).

D. Local Tone Squelch Test

1. Test Decoder should be in P706. Install tone select lead JU703 (black) to S13. Unsquelch radio and then apply ground to Pin 5 of the microphone jack (microphone in grounded hang-up clip). Audio from speaker should be muted until test decoder is activated.

E. Tone Plus Carrier Test

1. Install JU718 (yellow) to P707.
2. Remove signal generator from receiver antenna port.
3. Remove test decoder from P706. LD703 should light, but the transmitter should not be keyed.
4. Squelch control should now operate transmitter.
5. Replace the clipped resistor R764.

DRAWN	DATE	SIZE	PART NUMBER	REV.
APPROVED DLF	DATE 11/13/79	A	TP 14-266	A
DO NOT SCALE DWG.		SCALE		SHEET 6

DO NOT SCALE DWG.

DRAWN

APPROVED L. F.

DATE 11/20/73

SIZE A

SCALE

PART NUMBER TP 14-266

REV. A

SHEET

TEST INTERCONNECTION DIAGRAM FOR MCCUOIR

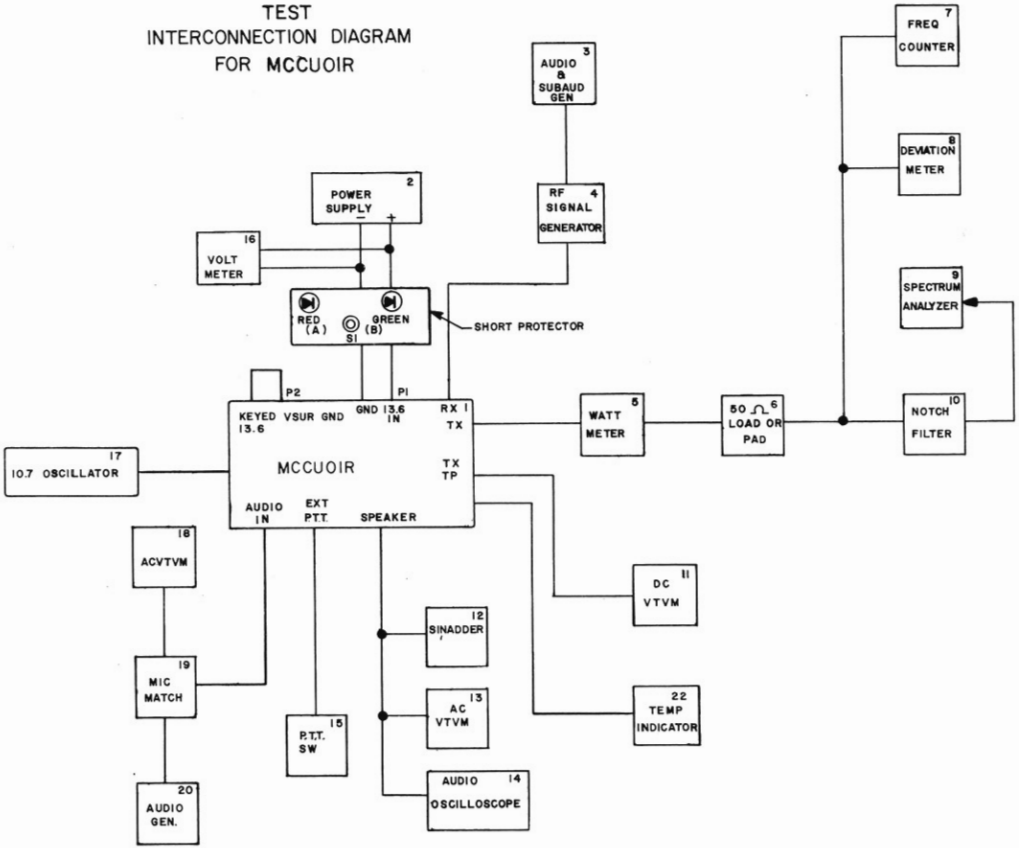


FIGURE - 1

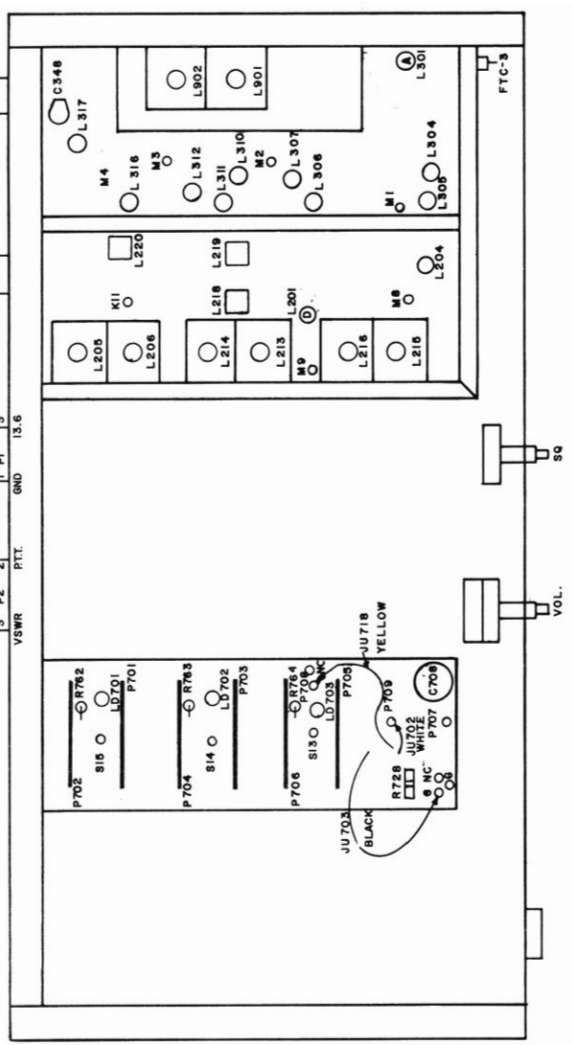

TX OUT
RX IN
3 P2 2
VSWR P.T.T.
1 P1 3
GND 13.6
C348
L317
L902
L901
L301
FTC-S
M4
L316
M3
L312
L311
L310
M2
L307
L306
M1
L304
L305
K11
L220
L219
L218
L201
L204
M9
M8
L205
L206
L214
L213
L216
L215
SQ
VOL.
P702
R762
S15
LD701
P701
P704
R763
S14
LD702
P703
P706
R764
S13
LD703
P708
JU718
YELLOW
P709
C708
JU702
WHITE
P707
R728
JU703
BLACK

FIGURE - 2

SECTION 5 MA-116 TONE ENCODER-DECODER, AND MA-121 TONE ENCODER

5-1 GENERAL INFORMATION

The model MA-116 Tone Squelch Encoder-Decoder is used as a tone decoder for CTCSS (tone squelch) operation of the Regency repeater. Since the MA-116 can serve as either an encoder or a decoder, it can be used in either the encoder or decoder sockets of the repeater.

The model MA-121 Tone Squelch Encoder is a simplified version of the MA-116 encoder-decoder, in which only those components needed for the encoding function are installed.

Normally, for each tone frequency accommodated by the repeater, one MA-116 is installed in a decoder position and one MA-121 is installed in an encoder position.

5-2 MA-116 ENCODER-DECODER CIRCUIT DESCRIPTION (Tone Receiving Condition)

Audio from the receiver discriminator is fed into the tone squelch board at terminal A1, and passes through the High Pass Filter IC601A, and back to the receiver's audio amplifier circuits at terminal A3. The high pass filter removes the CTCSS tones, which are below the normally utilized speech frequencies, so they will not be heard on the receiver loudspeaker.

Audio from the receiver discriminator (At A2) is also fed into an active filter, consisting of IC601B, IC602A and IC602B. This filter is a high Q, bandpass filter, that can be tuned for operation on any of the CTCSS tone frequencies. The components of the filter which determine the operating tone are precision resistors and condensers; R601, R602, R603, R604, R605, R606, R607, C601 and C602.

If the received tone is the proper one, as determined by the bandpass filter, it will be present in the output of IC602 and will be amplified by IC603, and then rectified to a D.C. signal by the tone rectifier CR602. This D.C. signal is then amplified further by the D.C. amplifier, IC603A. The output of IC603 is normally high, and goes to a low voltage upon receipt of proper tone. This output appears at terminal K-7 which connects to the corresponding terminal K-7 on the tone/control board and is used to disable the receiver audio section when no tone is being detected.

5-3 MA-121 ENCODER CIRCUIT DESCRIPTION

A block diagram of the encode only circuit board is shown on Figure 5-9, and a circuit diagram is shown in Figure 5-10.

The operating frequency of the tone system is controlled by an active filter, consisting of IC601B, IC602A and IC602B. This filter is a high Q, bandpass filter, that can be tuned for operation on any of the CTCSS tone frequencies. The components of the filter which determine the operating tone are precision resistors and condensers; R601, R602, R603, R604, R605, R606, R607, C601 and C602.

IC603A is an integrated circuit operational amplifier, used as a limiting amplifier. It is connected between one of the inputs and one of the outputs of the active filter described above. This limiting amplifier thus serves as a feedback path which causes the total circuit to oscillate at a frequency determined by the active filter. The limiting action of IC603 serves to keep the level of oscillation from overloading the active filter, thus keeping the output from the active filter sinusoidal.

5-4 TONE SETTING INSTRUCTIONS (MA-116 and MA-121)

The tone frequency is determined by (a) the insertion of jumpers to determine which of three bands of operation is desired and (b) the adjustment of a precision potentiometer to determine the specific tone frequency.

For purposes of installing the jumpers, the total CTCSS frequency is divided into three bands, the low band being 67.0 Hz to 110.9 Hz; the middle band 114.8 Hz to 192.4 Hz, and the high band 203.5 Hz to 253.0 Hz.

INSTALL JUMPERS FOR THE PROPER BAND

Figure 5-11 shows the jumper locations. Determine which band includes the desired frequency, and insert (or remove) jumpers according to the following chart:

67.0 Hz to 110.9 Hz	Low Band	JU601,JU602,JU603,JU604 are all removed.
114.8 Hz to 192.4 Hz	Middle Band	JU601,JU603 in place. JU602, JU604 removed.
203.5 Hz to 253.0 Hz	High Band	JU602, JU604 in place. JU601, JU603 removed.

After soldering or unsoldering jumpers, at least five minutes should elapse before making any final frequency adjustment. This is necessary to permit the precision resistors and capacitors in the vicinity of the soldering points to stabilize in temperature.

TONE SETTING PRECAUTIONS

Accurate frequency setting is necessary on CTCSS (tone squelch) systems. When making the above frequency adjustments, be sure that you set the tone as precisely as possible. If the tone board is to

operate in a system using reed type tone boards, be sure that your frequency setting is within .1 or .2 Hz if possible. Especially on reed tone systems, it is advisable to measure the tone frequency of several of the existing units; it is not safe to assume that the system is really operating on exactly the frequency stamped on the nameplate.

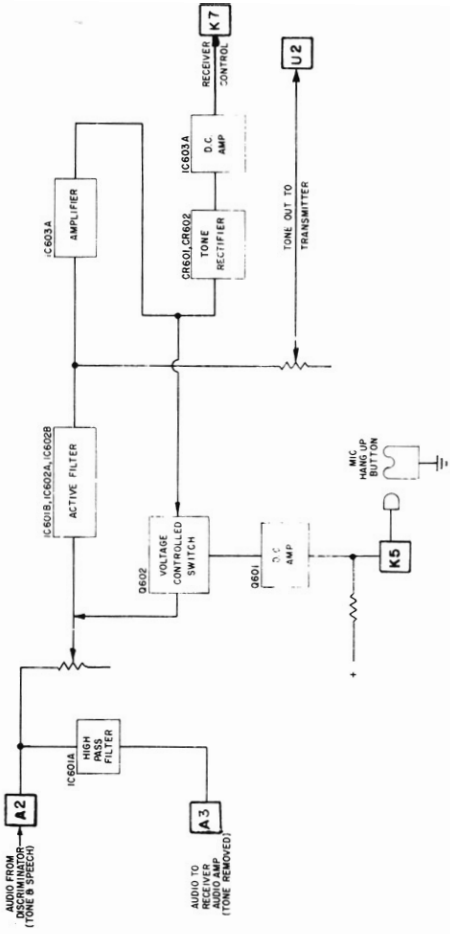
5-5 ADJUSTMENT PROCEDURE (Setting Tone Receive Threshold on MA-116)

With the receiver in the receive condition, and the microphone hang up button grounded to the transceiver chassis, inject a signal of the appropriate channel frequency into the transceiver antenna jack, and modulate this signal with the wanted CTCSS tone frequency, with a deviation of plus and minus 250 Hz. Then, adjust R612 (on the tone board) until the signal just opens the tone squelch system, and allows the receiver audio to function, (See Fig. 5-11).

After performing this adjustment of R612, check to be sure that the tone squelch will actually open when the tone deviation of the receive signal becomes as much as plus and minus 250 Hz. Further, check to be sure that noise bursts do not come through when the receiver is not receiving any incoming signal.

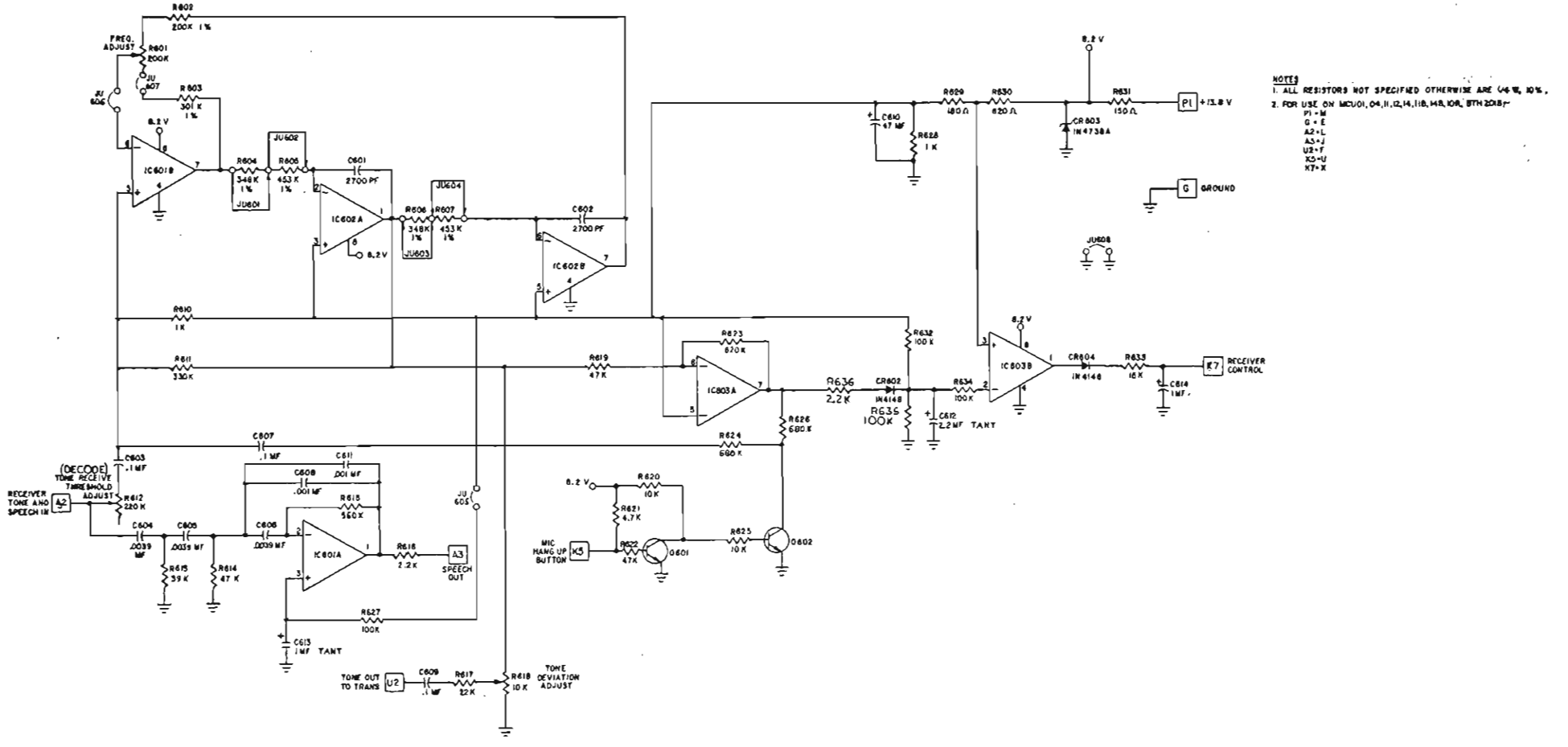
5-6 ADJUSTMENT PROCEDURE (Setting Tone Modulation Deviation on MA-121)

Adjust R618, on the tone squelch board to obtain a tone modulation deviation of plus and minus 500 Hz. Then, insert a 100 millivolt, 1,000 Hz tone into pin four of the microphone jack, and adjust R240, (the transmitter deviation control on the transceiver) to obtain plus and minus 5 KHz peak modulation deviation. If R240 was changed much, remove the 1,000 Hz tone, and readjust R618 to obtain a tone squelch modulation deviation of plus and minus 500 Hz.



MA-116 BLOCK DIAGRAM

FIG. 5-7



NOTES
1. ALL RESISTORS NOT SPECIFIED OTHERWISE ARE (1/4 W, 10%,
2. FOR USE ON MCU01, 04, 11, 12, 14, 11B, 14B, 10R, 8TH 2CRB+
   P1 = M
   G = E
   A2 = L
   A3 = J
   U2 = F
   K5 = U
   K7 = X

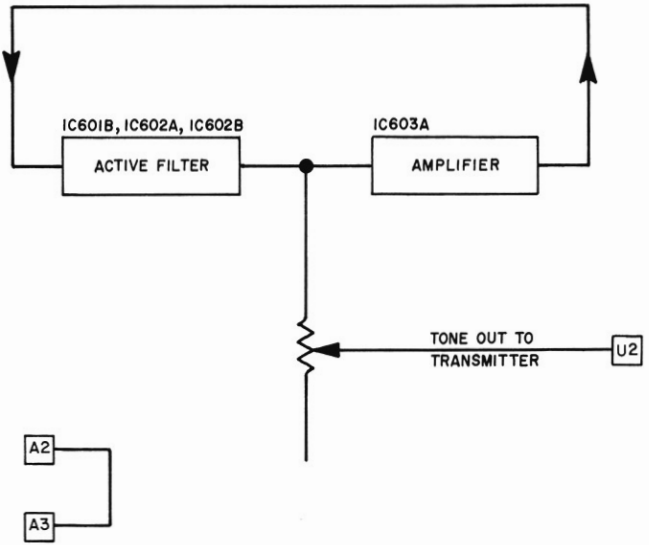
FIG. 5-8

8TH 2018 MCU 81R TMCU MCC R

Regency ELECTRONICS INC.

2W-C

SCHEMATIC MA-116



MA-121
FIG. 5-9 BLOCK DIAGRAM

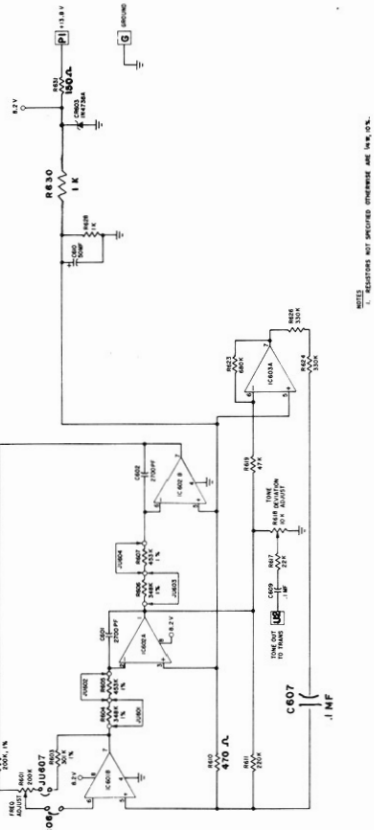
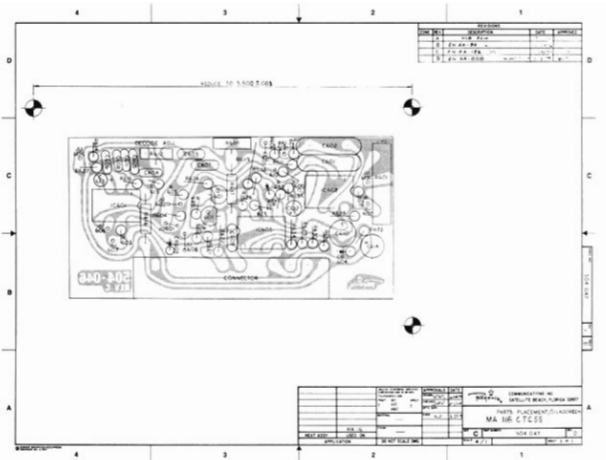
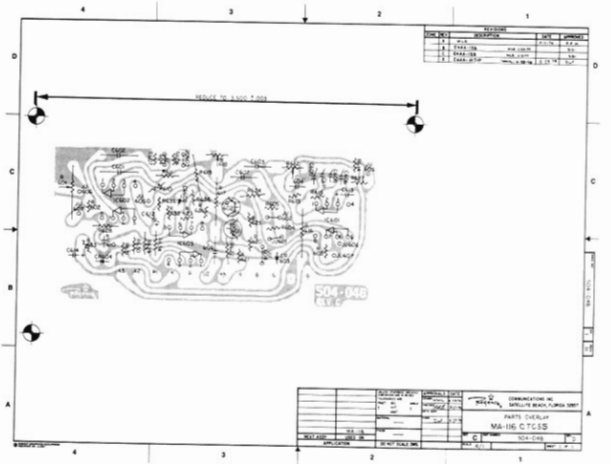


FIG. 5-10 SCHEMATIC
MA-121



5-11 CTCSS TONE BOARD TOP VIEW



5-11 CTCSS TONE BOARD BOTTOM VIEW

SECTION 6 REPEATER CONTROL SYSTEM

6-1 REPEATER CONTROL BOARD

An interconnection schematic of the repeater is shown in Figure 6-10. The repeater control functions are performed by the repeater control board, which is shown in detail on the interconnection schematic. The control board components carry 700 series numbers. Follow Figure 6-10 while reading the following.

The control board is arranged to permit operation of the repeater by noise squelch, CTCSS (Continuous Tone Controlled Squelch, often abbreviated as "tone squelch") tones or by CTCSS plus noise squelch.

The MCCU01R repeater is equipped to hold three different tone decoders and four additional on each accessory tone squelch board. Any number up to eleven may be installed, but the first one should be installed in P706, located on the repeater control board. Similarly, the repeater is equipped to hold three different tone encoders, and four additional on each accessory tone squelch board. Any number up to eleven may be installed, but the tone generator corresponding to the first tone encoder should be installed in P705.

6-2 AUDIO PATHS

Audio from the receiver is fed to Pin A2 of the tone receiver in the P706 receptacle. This audio contains both the speech and the CTCSS tone portions of the received signal. An active high pass filter removes those frequencies below about 400 Hz, which includes the CTCSS tones and feeds the remaining signal (now speech only) back to the receiver at Pin A3. (In units not equipped with tone squelch, a jumper is placed between Pins A1 and A3 to provide an audio path. This speech-only signal is then passed through the emitter follower audio switch in the receiver and fed to the front panel volume control R3. Audio from the arm of R3 is fed back to the receiver audio power amplifier and raised to loudspeaker levels to operate the local loudspeaker. Thus, R3 controls the volume heard by the local operator and has no effect on re-transmitted audio.

Receive audio, for retransmission, is taken from the high side of R3, passed through the repeater modulation input control, R728, and sent to the transmitter modulation circuits. Since this audio has passed through the high pass filter in the tone squelch board, it contains only speech components, and does not contain any CTCSS tone. If CTCSS tone is used, the CTCSS tone for the re-transmitted signal comes from the appropriate encoder board, as will be explained later.

6-3 TRANSMITTER ACTIVATION BY NOISE SQUELCH (Carrier)

When JU718 is connected to the "Squelch" contact pin, P708, the transmitter will be activated by any signal that is accepted by the receiver's noise squelch system. When a signal is received and the receiver's noise squelch system causes the receiver to become unsquelched, audio amplifier Q204 in the receiver draws current through R3, the front panel volume control. This current creates a high across R727 that causes Q708 to conduct. Q708 causes Q707 to conduct, which places an effective ground on the cathode of CR712, which causes Q709 to conduct, which then causes Q716 to conduct. Q716 places an effective ground on the PTT terminals of the transmitter, and therefore activates the transmitter.

6-4 TRANSMITTER ACTIVATION BY TONE PLUS NOISE SQUELCH (CTCSS + Carrier)

When JU718 is connected to the "tone" contact pin, P707, the receiver noise squelch is no longer in control of the activation of the transmitter, but used to control Q720 as a clamp across Q714, preventing repeater from being keyed up without carrier present. In this condition, tone decoders, tuned to specific subaudible tones plus noise squelch activate the transmitter when the appropriate tone is detected on a received signal.

To follow the operation under tone squelch (CTCSS) control, assume that a tone decoder board for 127.3 Hz had been installed in the P706 connector of the repeater control board, and that a tone encoder for the same frequency has been installed in the corresponding P705 connector, also on the repeater control board.

Unsquelched audio from the receiver is connected to Pin A2 of all of the CTCSS tone receivers. When no tone is being received, Pin K7 of all tone receivers will have a positive voltage causing Q702, Q704, Q706, Q802, Q804, Q806 to be conducting and Q701, Q703, Q705, Q801, Q803 to be non-conducting. When a signal with 127.3 Hz tone is received, the 127.3 Hz tone receiver in P706 will sense the presense of the tone, and the positive voltage will disappear from its K7 terminal, causing Q706 to be non-conducting, thereby causing Q705 to be conducting. Current pulled by the collector of Q706 pulls current through LD703 and CR712, causing LD703 to light, and causing Q709 to conduct. The conduction of Q709 eventually causes the transmitter to be activated in the same manner as it would be in the noise squelch operation mode described earlier.

When no CTCSS tones are received, the cathodes of CR709 and CR710 are held at a positive voltage by R719. CR709 and CR710 constitute a diode switch. In this condition, the switch is open, preventing the output of the tone encoder (Pin U2, P705) from reaching the transmitter tone input terminal U2. Similar diode switches prevent the output of other tone encoders from reaching the transmitter tone input. When a 127.3 Hz tone is received, the action of Q706 and Q705 cause the voltage on the cathodes of switch diodes CR709 and CR710 to disappear. The diodes are then forward biased by current through R715 and R716, and therefore will conduct the tone from the P705 tone generator to reach the tone input to the transmitter.

6-5 OPERATION BY LOCAL MICROPHONE, PIT FUNCTION

The local microphone may be used for dispatching from the repeater location, or for testing the repeater station during maintenance procedures. This is a ceramic type microphone with a switch section that disconnects the microphone element when the PTT switch is released.

One pole of the microphone PTT switch is connected to Pin 3 of the microphone connector S1. Inside the transmitter, Pin 3 goes to the coil of the PTT relay. Since the other side of this relay is connected to plus 13 volts, approximately 13 volts appears at Pin 3 of the microphone jack. This voltage is blocked by diode CR721, but when the PTT switch is closed the voltage at Pin 3 drops to zero, causing K9 to go low, which causes Q204 (receiver audio switch) not to conduct, and thereby preventing the retransmission of any received audio during the time the local microphone is depressed.

If the repeater is equipped with tone, the tone select test lead JU703 is normally connected to contact S13. When the microphone button is depressed, S13 is pulled almost to ground, causing CR709 and CR710 to conduct, thereby permitting the tone generated by the tone encoder in P705 to be delivered to the transmitter tone input. Thus, the 127.3 Hz tone assumed above will be transmitted when the local microphone switch is operated.

If it is desired to actuate other tones for test purposes, the Tone Select lead JU703 may be connected to the appropriate tone selection contact for the desired tone, i.e., S13, S14 and S15. When the microphone PTT switch is activated, the CTCSS tone associated with the selected contact will be transmitted. After the test, be sure to return JU703 to S13 for normal operation.

6-6 TONE MONITORING PROVISIONS

Assuming that the tone select test lead is connected to S13 and that a 127.3 Hz tone decoder is plugged into P706, the positive voltage of Pin K7 of P760 (under the no-tone received condition), acting through R750 at Pin P710 to block the receiver audio power amplifier, (IC212), thereby muting the local loudspeaker.

When a tone of 127.3 Hz is received, S13 is no longer positive, and the blocking voltage is removed from Pin P712, thereby permitting the receiver audio amplifier to operate normally.

The above has described the operation when the microphone is in its grounded hanger. When the microphone is in its hanger, only signals bearing the specific tone installed in P706 will be heard in the loudspeaker. The microphone hang-up button is connected through the microphone cable to Pin 5 of the microphone connector J1, placing a ground on the base of Q717, which causes Q717 to be non-conductive. Under this condition, only the signals bearing the 127.3 Hz tone assumed above will be heard in the local loudspeaker, as described above.

When the microphone is lifted from its hanger, the base of Q717 is pulled positive by R749, causing Q717 to conduct, forcing Pin P710 low, removing blocking voltage from CI202, regardless of the voltage coming from S13. Under this condition, referred to as the "MONITOR" condition, all audio signals that pass through the receiver noise squelch system will be passed on to the receiver audio amplifier and the local loudspeaker. This "MONITOR" condition permits the operator to listen on the channel before transmitting, and thus avoid breaking up an ongoing communication on the channel.

Summarizing the action of the microphone hang-up button, and its monitoring actions:

When the microphone is in its hanger, all received signals with appropriate tone squelch frequencies (those for which a tone decoder has been installed) will be retransmitted by the repeater, but only those signals bearing one specific tone (selected by the placement of the tone-select test lead, JU703) will be heard in the local loudspeaker. This enables the local operator to avoid being bothered by transmissions over the repeater which do not concern him.

When the microphone is removed from its hanger, all received signals, regardless of whether they have the correct tone, or any tone, will be heard in the local loudspeaker. This permits the operator to monitor activity on the channel before transmitting.

6-7 THREE MINUTE TIMER, DROP-OUT DELAY, TIME-OUT WARNING OSCILLATOR

When the transmitter is not activated, Q709 is non-conducting, causing Q710 to be non-conducting, causing Q711 to be conducting.

Since the collector of Q711 is shunted across timing condenser C708, C708 cannot be charged through R735. When the transmitter is activated by the receipt of a signal, Q710 is turned on which makes Q711 non-conducting, thus removing the short across C708. C708 then is slowly charged through R735. When C708 becomes charged to about 1.2 volts, it causes Q713 to conduct. Once Q713 begins conduction, it turns on Q712 which puts more base current into Q713, causing it to conduct heavily and turn on Q714. Q714 acts as a short across the line leading to the base of Q716, turning Q716 off. Since Q716 collector is connected to the PTT lead of the transmitter, the short it creates between this lead and ground is removed, and the transmitter turns off as soon as the drop-out delay capacitor C714 is discharged.

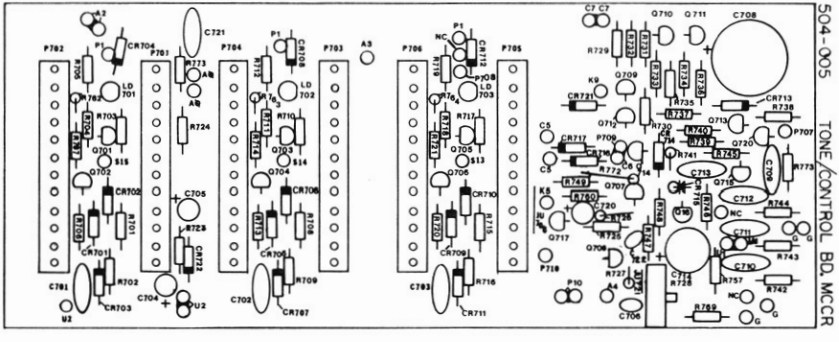
When Q713 becomes conductive, it also supplies collector current to the time-out warning oscillator, Q715. Q715 is connected as a phase shift oscillator and its output is connected into the transmitter modulation input. The beep from the time-out warning oscillator is transmitted during the few seconds of the drop-out delay caused by C714. C714, in the base circuit of Q716 serves as a "drop-out delay". While the transmitter is turned on, C714 becomes charged. When the received signal disappears, the charge on C714 holds Q716 in conduction for about two seconds. Thus, the transmitter remains activated for about two seconds after the received signal disappears.

REVISIONS			
ZONE	REV	DESCRIPTION	DATE
	A	RELEASE R-170	6-1-79 6/22/79

REV B, EN AA-738 5-22-79

REV C, EN AA-984 1/2/80

REDUCE TO 6.000 ±.003



REPEATER CONTROL BOARD TOP VIEW

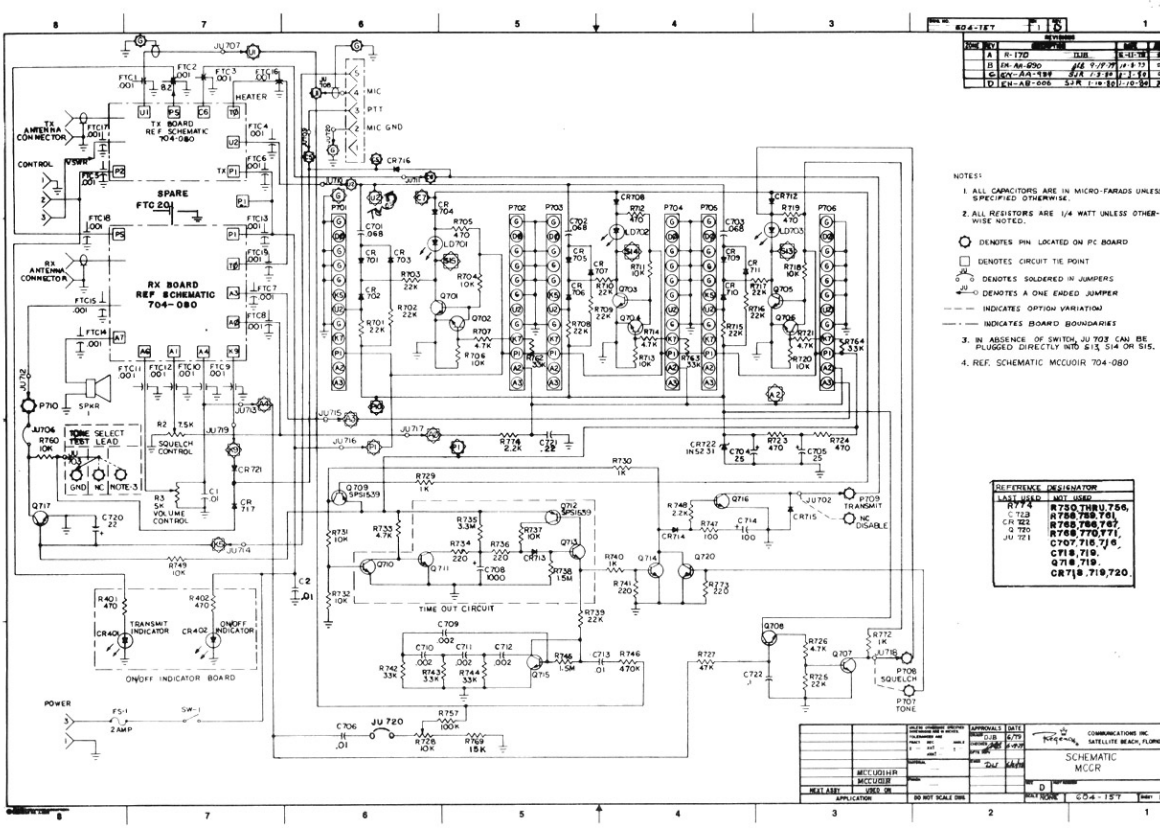
6-8

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACT. DEC. ANGLE	APPROVALS	DATE
	DRAWN	
	CHECKED	

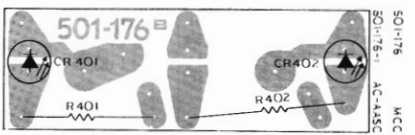
COMMUNICATIONS INC.
SATELLITE BEACH, FLOR

504-294 TONE/CONTROL BD. MCCR

REPEATER CONTROL BOARD BOTTOM VIEW


604-157
REVISIONS
ZONE REV STATUS DATE APP'D
A R-17D 6-11-78 RLB
B EN-AA-290 11/6 9-7-79 JR 8-79 DLF
C ECN-AA-499 SVR 1-3-84 JR 1-84 DLF
D ECN-AB-006 SVR 11-8-84 JR 10-84 DLF
TX ANTENNA CONNECTOR
CONTROL
SWR
SPARE
FTC20
TX BOARD REF SCHEMATIC 704-080
HEATER
RX ANTENNA CONNECTOR
RX BOARD REF SCHEMATIC 704-080
SPKR
TONE TEST SELECT LEAD
GND NC NOTE 3
SQUELCH CONTROL
VOLUME CONTROL
MIC
PTT
MIC GND
TIME OUT CIRCUIT
TRANSMIT INDICATOR
ON/OFF INDICATOR
ON/OFF INDICATOR BOARD
POWER
2 AMP
TRANSMIT DISABLE
TONE SQUELCH
NOTES:
1. ALL CAPACITORS ARE IN MICRO-FARADS UNLESS SPECIFIED OTHERWISE.
2. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE NOTED.
DENOTES PIN LOCATED ON PC BOARD
DENOTES CIRCUIT TIE POINT
DENOTES SOLDERED IN JUMPERS
DENOTES A ONE ENDED JUMPER
INDICATES OPTION VARIATION
INDICATES BOARD BOUNDARIES
3. IN ABSENCE OF SWITCH, JU 703 CAN BE PLUGGED DIRECTLY INTO S13, S14 OR S15.
4. REF. SCHEMATIC MCCUOIR 704-080
REFERENCE DESIGNATOR
LAST USED NOT USED
R774 R730 THRU 756, R758, 759, 761, R765, 766, 767, R769, 770, 771, C707, 718, 718, C715, 719, Q716, 719, CR718, 719, 720.
MCCUOIHR MCCUOIR USED ON
NEXT ASSY APPLICATION
DO NOT SCALE DWG
APPROVALS DATE
D.J.B. 4/79
COMMUNICATIONS INC. SATELLITE BEACH, FLORIDA 32937
SCHEMATIC MCCR
SIZE D
MAT'L NO. 604-157
SHEET 1 of 1

6-11 LED BOARD TOP VIEW



6-11 LED BOARD BOTTOM VIEW

REPEATER SETUP FOR TONE SQUELCH OPERATION

		No Signal Received, Trans Off	Signal Received, Trans On	Same, After Time-Out	Transmitter Turned On By Local Mike
Q701(Q703,Q705)	e	0	0	0	0
	b	.02	.9	.8	.02
	c	12.4	.16	.16	.9
Q702(Q704,Q706)	e	0	0	0	0
	b	.7	0	0	.7
	c	0	.9	.8	0
Q707	e	0	0	0	0
	b	.23	.75	.75	.23
	c	.84	.12	.12	.84
Q708	e	.28	1.7	1.7	.28
	b	.82	2.3	2.3	.82
	c	5.1	5.1	5.1	5.1
Q709	e	12.6	13.6	13.6	13.6
	b	13.2	12.7	12.6	13.2
	c	8	13.5	13.5	0
Q710	e	0	0	0	0
	b	0	.7	.7	.7
	c	.8	.02	0	.02
Q711	e	0	0	0	0
	b	.8	.02	0	.02
	c	0	.2	13	0
Q712	e	14	13.5	13.5	14
	b	13.5	13	12.8	13.5
	c	14	13.5	13.5	14
Q713	e	0	0	11.8	0
	b	0	0	12.2	0
	c	13.5	13.5	13	13.5
Q714	e	0	0	0	0
	b	0	0	.82	0
	c	10	10	.08	0
Q715	e	0	0	0	0
	b	0	0	.5	0
	c	0	0	6.2	0

REPEATER SETUP FOR TONE-SQUELCH OPERATION(cont.)

		No Signal Received, Trans Off	Signal Received, Trans On	Same, After Time-Out	Transmitter Turned On By Local Mike
Q716	e	0	0	0	0
	b	.001	.72	.45	1.1
	c	13	0	13.6	.3
Q717	(e	0	0	0	0
mike	(b	0	0	0	0
on hook	(c	3.5	.16	0	.012
Q720	e	0	0	0	0
	b	.84	.12	.12	.84
	c	10	10	.08	0
*513,514,515		11.5	.9	.9	.9

*Reading on socket or T.P. of tone receiver for tone being received.

SECTION 7 - REPEATER SETUP INSTRUCTIONS

Assuming that the receiver and transmitter are tuned properly to their respective channels, and that the antenna system, with its duplexers and/or filters has been properly installed and tuned, the following instructions should be followed to set the repeater into operation.

7-1 PREPARATION FOR NOISE SQUELCH OPERATION

In this type of operation, no tone boards are installed in that tone receptacles, and the transmitter is activated by any signal that operates the receiver noise squelch system.

1. Check to see that a jumper is installed between A1 and A3 on P706.

2. Connect the "Tone Test Select Lead" JU703 (blk) to the "ground" Pin G.

3. Connect JU713 (yel) to the "Squelch" Pin P708.

4. Adjacent to each of the tone decoder plugs, P702, P704, P706, P802, P804 and P808, there must be a 33,000 ohm "pullup" resistor, connected to Pin P1 and K7 of the connector. Be sure that these are in place.

5. Connect JU702 (white) to P709 (transmit).

Turn up the front panel volume control so you can hear the receiver in the local loudspeaker. The transmitter should now be activated whenever a signal opens the noise squelch, or if the noise squelch is put into the noisy condition by a setting of the squelch control. Note that the transmitter will be automatically turned off if the noise squelch system has held it on continuously for about three minutes. Also, note that the transmitter does not turn off instantly after the noise squelch silences the receiver. About two seconds of delay is provided by C714.

7-2 AUDIO LEVEL SETTING, NOISE SQUELCH OPERATION

The proper setting of audio levels is very important in the repeater operation. Excessive audio level settings can cause the performance of the repeater to be seriously degraded and can make the repeater transmissions sound noisy and distorted. It is recommended that the following procedures be followed, without any attempts at shortcuts.

1. The transmitter modulation deviation control, R328, located on the transmitter chassis should be set as follows:

   Inject a 100 millivolt (.1 volt) tone at 1,000 Hz into the microphone jack, (Pin #4 high, Pin #1 ground), and adjust R240 so modulation just reaches ± 5 KHz peak. The transmitter may be activated by grounding C5 or C6.

2. Set the repeat function modulation input audio level control, R728, located on the tone/control board as follows:

   Connect a FM signal generator capable of being set to within .00025% of channel frequency to the receiver antenna port.

   Set the signal generator to the receive channel frequency, modulate the generator with a 1,000 Hz tone, with ±3 KHz peak modulation deviation. Adjust generator attenuator to provide a strong, noise free signal and assure yourself that the signal is properly centered in the receiver, and that the receiver is delivering a clean, 1,000 Hz tone output.

   Then monitor the transmitter modulation deviation and adjust R728 to obtain a reading of ±3 KHz peak modulation deviation.

7-3 PREPARATION FOR TONE SQUELCH OPERATION

Tone Encoder and Decoder Installations

The repeater has sockets to accomodate up to three different CTCSS tones. For each tone accommodated, one tone decoder and one tone encoder is used. (Some repeaters operate without any outgoing tone. For such use, the tone encoder need not be installed.) Normally, the tone encoders and decoders are installed at the factory, and the initial order specifies the tone frequencies to be used. However, if it is desired to add CTCSS tone in the field, or if additional CTCSS tones are to be added in the field, the following instructions apply.

One MA-121 tone encoder should be ordered for each tone frequency required.

One MA-116 tone decoder should be ordered for each tone frequency required.

NOTE: The MA-116s are the same items as the tone boards used in the MCU series mobiles. They are used as an encoder-decoder in the mobiles, but are normally used as a decoder only in the repeater.

Tone Squelch Operation

In tone squelch operation, the repeater transmitter is activated only by signals bearing the appropriate tone squelch frequency(s).

To prepare the repeater for tone squelch operation, plug JU718 (yel) to P707. Plug JU702 (wht) to P706. Then proceed with the following instructions for tone encoder and decoder installations.

For the first tone to be installed, install the encoder in P706.

Install subsequent tones as follows:

	Encoder	Decoder
Second Tone	P703	P704
Third Tone	P701	P702

When a tone decoder board is installed in each of the connectors P702, P703, etc., the 33,000 ohm "pull-up" resistor just adjacent to that connector should be clipped out of the circuit. This pull up resistor must remain in the circuit of each unused connector, and must be removed from the circuit on each connector which has a tone decoder installed.

If an operator is stationed at the repeater location, it is normally desired that he will hear transmissions from mobiles on only one of the installed tones. To accomplish this, connect the Tone Select Test Lead ,JU703 (black), to one of the "TONE" test point pins which is physically located between the encode and decode module for that particular tone, i.e., S13 or S14, etc. (Monitoring provisions incorporating the grounded microphone hang-up clip permit the operator to monitor all incoming signals when the microphone is removed from its hanger.)

7-4 AUDIO LEVEL SETTING, TONE SQUELCH ENCODER OPERATION

The first steps in the level setting procedure are to set the transmitter modulation deviation, and the repeat function audio level control R728. The procedures to follow are the same as those outlined in step 1 and 2 of the noise squelch level setting procedure, given in Section 7-2.

Once these two steps have been completed, you are ready to set the transmit tone levels. Remove the signal generator from the receiver, and connect the tone select test lead (JU703) to S13. Then activate the transmitter by pushing the PTT switch on the microphone. Then set R618, the tone output level control, on the tone encoder in P705 to obtain .5 KHz tone modulation deviation, as indicated by a FM modulation meter. Then proceed to set the tone levels on the remaining tone generators as follows:

Connect JU703 Tone Select Test Lead To:	Set R618 Level Control On Tone Encoder Located In Connector:
S14	P703
S15	P701

The next step is to set the tone receive threshold on all of the tone decoders.

7-5 AUDIO LEVEL SETTING, TONE SQUELCH DECODER OPERATION

When the MA-116 Encoder-Decoder is used it is necessary to set the tone receive threshold adjustment, R612 (on the tone board) in this manner:

With the receiver in the receive condition, and the microphone hang up button grounded to the transceiver chassis, inject a signal of the appropriate channel frequency into the transceiver antenna jack, and modulate this signal with the wanted CTCSS tone frequency, with a deviation of plus and minus 250 Hz. Then, adjust R612 (on the tone board) until the signal just opens the tone squelch system. This is indicated by the corresponding LED (LD701, 702, 703).

After performing this adjustment of R612, check to be sure that the tone squelch will actually open when the tone deviation of the receive signal becomes as much as plus and minus 250 Hz. Further, check to be sure that noise bursts do not come through when the receiver is not receiving any incoming signal.

7-6 SQUELCH CONTROL SETTING

It is important that the squelch control for the noise operated squelch system in the receiver be set properly, regardless of whether noise squelch or tone squelch operation of the repeater is planned.

The typical squelch control setting method, i.e., merely setting the control to the "edge" of the noisy portion may be used. It is more satisfactory, however, to set the squelch control for a known level of signal. This will enable the repeater to operate at proper sensitivity, yet will avoid service calls to reset the squelch because of operator annoyance at squelch openings not caused by wanted signals.

The preferred method is this: Remove the microphone from the hang-up hook, to disable the tone squelch (if used). Inject a signal from a signal generator into the receiver as shown in the Receiver Alignment Chart. Set the signal generator attenuator to provide a .3 microvolt signal to the receiver. Then set the squelch control to the point at which the squelch opens reliably when the signal is connected, and closes when the signal is removed.

7-7 FINAL LISTENING TESTS OF AUDIO LEVEL SETTING

When the repeater has been placed in final operation, it is a good idea to make a listening test to be certain that the Audio Level Setting procedure has been done properly. This is emphasized, because an improperly high level setting can make the repeater sound as if close-in mobiles are at the fringes of coverage, thereby seriously compromising the overall performance of the system.

An ideal way to conduct this listening test is as follows: Have a mobile go to the fringe of reception, and monitor how it sounds on the local loudspeaker in the repeater itself. Have the mobile find a location where you can hear it coming in with a somewhat noisy, but readable signal, and arrange for the mobile to stay fixed at that location. Then monitor the repeater mobile speech by listening to it in close-in mobile, or at the control station. The apparent noise level should not be different than that observed in the repeater's local loudspeaker.

This procedure is suggested as a TEST of the setting of the Audio Level Setting --NOT as an appropriate way of making the setting. Once the listening test assures you that the level is set--mark its setting and be sure that it is not changed unless the proper test equipment and procedures (as outlined earlier) are carried through.

8-1 RECEIVER BOARD

LOCATION	DESCRIPTION	PART NUMBER
RESISTORS	(all resistors are ¼W 5% unless otherwise noted)	
R201D	10K ohm	4704-0103-032
R202D	4.7K	4704-0472-042
R203	not used	
R204	15K	4704-0153-032
R205	10K carb comp ¼W 10%	4700-0103-042
R206	220 ohm comp ¼W 10%	4700-0221-042
R207	10K comp ¼W 10%	4700-0103-042
R208	10K comp ¼W 10%	4700-0103-042
R209	100 ohm carb comp	4700-0101-042
R210	220 ohm comp ¼W 10%	4700-0221-042
R211	100K	4704-0104-032
R212	15K	4704-0153-032
R213	100 ohm carb comp	4700-0101-042
R214	2.2K	4700-0222-032
R215	10K ohm	4704-0103-032
R216	1K comp ¼W 10%	4700-0102-043
R217	820 ohm comp ¼W 10%	4700-0821-042
R218	1K	4704-0102-032
R219	120K	4704-0124-032
R220	15K	4704-0153-032
R221	1 meg	4704-0105-032
R222	3.3K	4704-0332-032
R223	180 ohm comp ¼W 10%	4700-0181-042
R224	47K	4704-0473-032
R225	100K	4704-0104-032
R226	180K	4704-0184-032
R227	not used	
R228	18K	4704-0183-032
R229	1K	4704-0102-032
R230	82K	4704-0823-032
R231	100K	4704-0104-032
R232	1 meg	4704-0105-032
R233	220K	4704-0224-032
R234	220K	4704-0224-032
R235	270K	4704-0274-032
R236	not used	
R237	5.6K	4704-0562-032
R238	not used	
R239	not used	
R240	470K	4704-0474-032
R241	220K	4704-0224-032
R242	47K ohm	4704-0473-032
R243	not used	
R244	15K	4704-0153-032
R245	270 ohm	4704-0271-032
R246	2.7 ohm	4704-0279-032

LOCATION	DESCRIPTION	PART NUMBER
R248	180 ohm comp ½W 10%	4701-0181-044
R249	180 ohm comp ½W 10%	4701-0181-044
R250	180 ohm comp ½W 10%	4701-0181-044
CAPACITORS		
C201D	20pf CD 10 NPO 50V	1500-0200-650
C202	not used	
C203	360pf SM 50V LCQ-17	1506-0361-550
C204	22pf 10 NPO 50V	1500-0220-650
C205	39pf CD NPO 500V	1500-0390-505
C206	.01mf CD +8-2 50V	1503-0103-007
C207	15pf CD 10 NPO 500V	1501-0150-001
C208	.001mf CD +9-2 50V	1503-0102-003
C209	68pf 5 NPO 50V RD205	1524-0680-002
C210	.01mf CD +8-2 50V	1503-0103-007
C211	47pf 5 NPO 50V RD205	1524-0470-002
C212	.001mf CD +8-2 50V	1503-0102-003
C213	24pf CD 10 NPO 50V	1500-0240-650
C214	.001mf CD +8-2 50V	1503-0102-003
C215	5.6pf CD 10 NPO 500V	1500-0569-905
C216	24pf CD 10 NPO 50V	1500-0240-650
C217	82pf RD 5 NPO 50V RD205	1524-0820-002
C218	.02 Tub Cer 30 25V	1538-0103-804
C219	36pf CD 5 50V	1500-0360-550
C220	.001mf CD +8-2 50V	1503-0102-003
C221	24pf CD 10 NPO 50V	1500-0240-650
C222	.01mf CD +8-2 50V	1503-0103-007
C223	4.7pf CD NPO 500V	1500-0479-905
C224	4.7pf CD NPO 500V	1500-0479-905
C225	68pf RD 5 NPO 50V RD205	1524-0680-002
C226	150pf TM 10 50V NPO	1539-0151-601
C227	.2mf MC 12V BC-12	1502-0104-005
C228	.001mf +8-2 50V	1503-0102-003
C229	not used	
C230	.1mf MC 12V BC-12	1502-0104-005
C231	300pf SM 50V LCQ-17	1506-0301-550
C232	68pf RD 5 NPO 50V RD205	1524-0680-002
C233	1mf tant 20 15V	1515-0010-003
C234	.01mf CD +8-2 50V	1503-0103-007
C235	.1mf MC 12V BC-12	1502-0104-005
C236	0047mf MY 10 100V	1508-0472-610
C237	0047mf MY 10 100V	1503-0472-610
C238	not used	
C239	.001mf MY 10 100V	1508-0102-610
C240	.1mf MC 12V BC-12	1502-0104-005
C241	470pf CD 20 50V Z5F	1523-0471-002
C242	100pf SM 5 50V LCQ-17	1506-0101-550
C243	.001mf MY 10 100V	1508-0102-610
C244	.2mf 12V +8-2 BC-12	1502-0204-006
C245	not used	
C246	0047mf MY 10 100V	1508-0472-610

LOCATION	DESCRIPTION	PART NUMBER
C247	.015mf MY 10 100V	1508-0153-610
C248	.01mf MY 10 100V	1508-0103-610
C249	220mf E 16V 85D	1513-0221-002
C250	.1mf MC 12V BC-12	1502-0104-005
C251	1000mf E 16V Type U	1513-0102-002
C252	2.2mf tant 20 25V T360	1515-0229-005
C253	47pf RD 5 NPO 50V RD205	1524-0470-002
C254	.001mf +8-2 50V	1503-0102-003
C255	75pf RD 5 NPO 50V RD205	1524-0750-002
C256	not used	
C257	6.8pf CD 10 NPO 500V	1500-0689-905
C258	.001mf +8-2 50V	1503-0102-003
C259	47pf RD 5 NPO 50V RD205	1524-0470-002
C260	47pf RD 5 NPO 50V RD205	1524-0470-002
COILS		
L201D	coil rf var	1800-3191-406
L202	not used	
L203	not used	
L204	coil rf var	1800-5100-521
L205	coil rf var	1800-5129-101
L206	coil rf var	1800-5129-101
L207	choke rf .47uhy Airco	1802-0478-008
L208	choke rf 22uhy	1802-0220-008
L209	choke rf 15uhy Wilco	1802-0150-004
L210	choke rf	1800-5100-522
L211	not used	
L212	coil rf var	1800-5129-103
L213	coil rf var	1800-5129-102
L214	choke	1800-5100-523
L215	coil rf var	1800-5129-104
L216	coil rf var	1800-5129-102
L217	not used	
L218	coil 10.7IF shielded	1800-3248-001
L219	coil 10.7IF shielded	1800-3248-001
L220	coil quad det	1800-3218-800
L221	choke 1000uhy	1800-3409-201
L222	Ferrite bead 56-590-65/4A	2502-0000-001
L223	Ferrite bead 56-590-65/4A	2502-0000-001
L224	Ferrite bead 56-590-65/4A	2502-0000-001
L225	Ferrite bead 56-590-65/4A	2502-0000-001
L226	Ferrite bead 56-590-65/4A	2502-0000-001
L227	Ferrite bead 56-590-65/4A	2502-0000-001
L228	Ferrite bead 56-590-65/4A	2502-0000-001
L229	Ferrite bead 56-590-65/4A	2502-0000-001
TRANSISTORS		
Q201	Blue top SPS1476	4801-0000-003
Q202	Blue top SPS1476	4801-0000-003
Q203	FET U310	4811-3406-200

LOCATION	DESCRIPTION	PART NUMBER
Q204	SPS-952-2	4801-0000-016
Q205	Blue Top SPS1476	4801-0000-003
Q206	Junct Fet 2N5668	4811-0000-030
Q207	Blue Top SPS1476	4801-0000-003
DIODES		
CR201D	Diode varicap	4809-5420-600
CR202		
CR203	IN4148	4805-1241-200
CR204	IN4148	4805-1241-200
CR205	IN4148	4805-1241-200
CR206	IN4148	4805-1241-200
CR207	IN4148	4805-1241-200
INTEGRATED CIRCUITS		
IC201	IF Sub System	3130-6056-500
IC202	TDA2002 AV	3130-5407-602
IC203	LM358N	3130-3167-909
FILTERS		
XF201	xtal filter 2P 10.7MHz	2705-3232-200
XF202	crystal filter	2705-1306-600
XF203	xtal filter 2P 10.7MHz	2705-3232-200
CF201	cer filter CFU-455D2	2700-3209-500
Y202	crystal 10.245 MHz	2301-3151-601

8—2 TRANSMITTER BOARD

LOCATION	DESCRIPTION	PART NUMBER
RESISTORS	(all resistors are ¼W 5% unless otherwise noted)	
R301A	22K	4704-0223-032
R302A	10K ohm	4704-0103-032
R303	82K	4704-0823-032
R304	47K	4704-0473-032
R305	22K	4704-0223-032
R306	10K comp ¼W 10%	4700-0103-042
R307	820 ohm comp ¼W 10%	4700-0821-042
R308	1K	4704-0102-032
R309	270K	4704-0274-032
R310	4.7K ohm	4704-0472-032
R311	5.6K	4704-0562-032
R312	330 ohm comp ¼W 10%	4700-0331-042
R313	2.2K comp ¼W 10%	4700-0222-042
R314	4.7K ohm	4704-0472-032
R315	1.5 meg	4704-0155-032
R316	100 ohm	4704-0101-032
R317	4.7K ohm	4704-0472-032
R318	47 ohm	4704-0470-032
R319	2.2K comp ¼W 10%	4700-0222-042
R320	150 ohm comp ¼W 10%	4700-0151-042
R321	33 ohm comp ¼W 10%	4700-0330-042
R322	not used	
R323	15K	4704-0153-032
R324	47K ohm	4704-0473-032
R325	4.7K ohm	4704-0472-032
R326	10K ohm	4704-0103-032
R327	470K ohm	4704-0473-032
R328	res var	4751-3407-101
R329	330 ohm comp ¼W 10%	4700-0331-042
R330	3.9 ohm comp ¼W 10%	4701-0399-044
R331	2.7 ohm comp ¼W 10%	4700-0279-042
R332	470 ohm	4704-0471-032
R333	180 ohm comp	4701-0181-044
R334	180 ohm comp	4701-0181-044
R335	100 ohm carb comp	4700-0101-042
R336	1K ¼W 10%	4700-0102-042
R337	330 ohm comp ¼W 10%	4700-0331-042
R338	1K	4704-0102-032
R339	10K ohm	4704-0103-032
R340	180 ohm comp	4701-0181-044
CAPACITORS		
C301		
C302		
C303	.2mf MC 12V +8-2 EC-12	1502-0204-006
C304	100pf TC 10 50V	1525-0101-004
C305	.01mf CD +8-2 50V	1503-0103-007

LOCATION	DESCRIPTION	PART NUMBER
C306	100pf TC 10 50V	1525-0101-004
C307	.01mf CD +8-2 50V	1503-0103-007
C308	100pf TC 10 50V	1525-0101-004
C309	100pf TM 10 50V NPO	1539-0101-601
C310	4.7pf CD 10 NPO 500V	1500-0479-905
C311	47pf RD 5 NPO 50V	1524-0470-002
C312	180pf TM 10 50V NPO	1539-0181-601
C313	.01 tub cer 30 25V	1538-0103-804
C314	.005 mf CD +8-2 50V	1503-0502-005
C315	120pf SM 50V LCQ-17	1506-0121-550
C316	47pf RD 5 NPO 50V	1524-0470-002
C317	100pf SM 50V LCQ-17	1506-0101-550
C318	10pf CD 10 NPO 500V	1500-0100-905
C319	not used	
C320	.0022mf MY 10 100V	1508-0222-610
C321	820pf SM 50V LCQ-17	1506-0821-550
C322	.01mf CD +8-2 50V	1503-0103-007
C323	not used	
C324	100mf E 10V 85D Type U	1513-0101-001
C325	47mf E 16V 85D Type U	1513-0470-002
C326	.1mf CD +8-2 50V	1503-0104-010
C327	47mf E 16V 85D Type U	1513-0470-002
C328	.01 tub cer 40 25V	1538-0103-804
C329	.01mf MY 10 100V	1508-0103-610
C330	.01 tub cer 30 25V	1538-0103-804
C331	820pf SM 50V LCQ-17	1506-0821-550
C332	.047mf MY 10 100V	1508-0473-610
C333	22pf CD 10 50V NPO	1500-0220-650
C334	2.2pf CD 10 NPO 500V	1500-0229-905
C335	5.6pf CD 10 NPO 500V	1500-0569-905
C336	18pf CD 5 50V NPO	1500-0180-550
C337	.47pf MUD 10 Type MC	1510-0478-900
C338	10pf CD 10 NPO 500V	1500-0100-905
C339	68pf RD 5 NPO 50V	1524-0680-002
C340	470pf CD 20 50V Z5F	1523-0471-002
C341	360pf SM 5 50V LCQ-17	1506-0361-550
C342	not used	
C343	1.5pf CD 25 NPO 50V	1500-0159-250
C344	39pf CD 5 500V NPO	1500-0390-505
C345	4.7pf CD 10 NPO 500V	1500-0479-905
C346	.68pf MUD 10 Ty MC 209	1510-0688-900
C347	8.2pf 10 500V NPO	1500-0829-905
C348	Trimmer 1-6pf	1517-0000-035
C349	.001mf CD 20 50V Z5F	1523-0102-002
C350	.01 tub cer 30 25V	1538-0103-804
C351	100pf SM 50V LCQ-17	1506-0101-550
C352	.01mf CD +8-2 50V	1503-0103-007
C353	.001mf CD 20 50V Z5F	1523-0102-002
C354	4700pf tub cer 30 25V	1538-0472-804
C355	not used	
C356	.01 tub cer 30 25V	1538-0103-804

LOCATION	DESCRIPTION	PART NUMBER
COILS		
L301A	coil rf var tap	1800-3247-201
L302	not used	
L303	not used	
L304	coil rf var (wht)	1800-3191-404
L305	coil rf var (grn)	1800-3191-405
L306	coil rf var (wht)	1800-3191-404
L307	coil rf var (grn)	1800-3191-405
L308	Ferrite bead	2502-0000-001
L309	Ferrite bead	2502-0000-001
L310	coil	1800-3152-029
L311	coil	1800-3152-019
L312	coil	1800-3152-019
L313	ferrite bead	2502-0000-001
L314	ferrite bead	2502-0000-001
L315	choke LM-2	1803-5125-902
L316	coil	1800-3152-009
L317	coil	1800-3152-030
L318	choke molded 1½ turns	2502-5125-907
L319	choke bead	2502-3254-101
L320	choke rf .1uhy 17NR10	1802-0108-008
L321	choke rf 22uhy 17N220	1802-0220-008
L322	choke LM-2	1803-5125-902
L323	ferrite bead	2502-0000-001
L324	ferrite bead	2502-0000-001
INTEGRATED CIRCUITS		
IC301	IC LM358N	3130-3167-909
IC302	IC reg 8.0V LM341	3130-0000-023
TRANSISTORS		
Q301	Blue top SPS1476	4801-0000-003
Q302	Blue Top SPS1476	4801-0000-003
Q303	RF pwr	4704-3169-605
Q304	Pwr SRF 1044K	4804-3169-607
Q305	Pwr rf	4804-3402-301
Q306	Darlington D4001	4814-0000-002
Q307	SPS-052-2	4801-0000-016
Q308	SPS-952-2	4801-0000-016
DIODES		
CR301A	Diode varicap	4809-5420-600
CR302	not used	
CR303	Diode SIL IN5401	4806-0000-013
RELAY		
RY301	Relay 12V	4500-3251-900

VARIABLE PARTS FOR MCCU01RB (470-512 MHz)

LOCATION	DESCRIPTION	PART NUMBER
C204	20pf CD 10 NPO 500V	1500-0200-650
C345	3.3pf CD 10 NPO 500V	1500-0339-905
C346	.47pf MUD 10 Type MC	1510-0478-900
C347	8.2pf CD 10 NPO 500V	1500-0829-905
L205	coil rf var	1800-5129-105
L206	coil rf var	1800-5129-106
L212	coil rf var	1800-5129-107
L213	coil rf var	1800-5129-106
L215	coil rf var	1800-5129-108
L216	coil rf var	1800-5129-109

8-3 ON/OFF INDICATOR BOARD 501-176

LOCATION	DESCRIPTION	PART NUMBER
RESISTORS		
R401	470 ohm	4704-0471-032
R402	470 ohm	4704-0471-032
DIODES		
CR401	LED Red	4810-1282-900
CR402	LED Red	4810-1282-900

LOCATION	DESCRIPTION	PART NUMBER
RESISTORS		
R701	22K	4704-0223-032
R702	22K	4704-0223-032
R703	22K	4704-0223-032
R704	10K ohm	4704-0103-032
R705	470 ohm	4704-0472-032
R706	10K ohm	4704-0103-032
R707	4.7K ohm	4704-0472-032
R708	22K	4704-0223-032
R709	22K	4704-0223-032
R710	22K	4704-0223-032
R711	10K ohm	4704-0103-032
R712	470 ohm	4704-0471-032
R713	10K ohm	4704-0103-032
R714	4.7K ohm	4704-0472-032
R715	22K	4704-0223-032
R716	22K	4704-0223-032
R717	22K	4704-0223-032
R718	10K ohm	4704-0103-032
R719	470 ohm	4704-0471-032
R720	10K ohm	4704-0101-032
R721	4.7K ohm	4704-0472-032
R722	not used	
R723	470 ohm	4704-0471-032
R724	470 ohm	4704-0471-032
R725	22K	4704-0223-032
R726	4.7K ohm	4704-0472-032
R727	47K	4704-0473-042
R728	res var	4751-3407-101
R729	1K	4704-0102-032
R730	1K	4704-0102-032
R731	10K ohm	4704-0103-032
R732	10K ohm	4704-0103-032
R733	4.7K ohm	4704-0472-032
R734	220 ohm	4704-0221-032
R735	3.3 meg	4704-0335-032
R736	220 ohm	4704-0221-032
R737	10K ohm	4704-0103-032
R738	1.5 meg	4704-0155-032
R739	22K	4704-0223-032
R740	1K	4704-0102-032
R741	220 ohm	4704-0221-032
R742	33K	4704-0333-032
R743	33K	4704-0333-032
R744	33K	4704-0333-032

LOCATION	DESCRIPTION	PART NUMBER
R745	1.5 meg	4704-0155-032
R746	470K	4704-0474-032
R747	100 ohm	4704-0101-032
R748	2.2K	4704-0222-032
R749	10K ohm	4704-0103-032
R750	not used	
R751	not used	
R752	not used	
R753	not used	
R754	not used	
R755	not used	
R756	not used	
R757	100K	4704-0104-032
R758	not used	
R759	not used	
R760	10K ohm	4704-0103-032
R761	not used	
R762	33K	4704-0333-032
R763	33K	4704-0333-032
R764	33K	4704-0333-032
R765	not used	
R766	not used	
R767	not used	
R768	not used	
R769	15K	4704-0153-032
R770	not used	
R771	not used	
R772	1K	4704-0102-032
R773	220 ohm	4704-0221-032
R774	8.2K	4704-0822-032
R775	not used	

CAPACITORS

C701	.068mf MY 10 100V	1508-0683-610
C702	.068mf MY 10 100V	1508-0683-610
C703	.068mf MY 10 100V	1508-0683-610
C704	22mf E 10V 85D Type U	1513-0220-001
C705	22mf E 10V 85D Type U	1513-0220-001
C706	.01mf MY 10 100V	1508-0103-610
C707	not used	
C708	1000mf E 16V Type U	1513-0102-002
C709	.002mf CD 20 50V Z5F	1523-0202-002
C710	.002mf CD 20 50V Z5F	1523-0202-002
C711	.002mf CD 20 50V Z5F	1523-0202-002
C712	.002mf CD 20 50V Z5F	1523-0202-002
C713	.01mf MC 8-2 BC-12	1502-0103-006
C714	100mf E 16V 85D Type U	1513-0101-002
C715	not used	
C716	not used	

LOCATION	DESCRIPTION	PART NUMBER
C717	not used	
C718	not used	
C719	not used	
C720	22mf E 10V 85D Type U	1513-0220-001
C721	.22mf 5 100V	1508-0224-510
C722	.1uf CD +8-20 12V BC-12	1502-0104-006
TRANSISTORS		
Q701-708	SPS952	4801-0000-010
Q709	Wt top SPS1539	4801-0000-060
Q710	SPS952	4801-0000-010
Q711	SPS952	4801-0000-010
Q712	Wt top SPS1539	4801-0000-060
Q713-717	SPS952	4801-0000-010
Q718	not used	
Q719	not used	
Q720	SPS952	4801-0000-010
DIODES		
CR701-717	Diode SIL IN4148	4805-1241-200
CR718	not used	
CR719	not used	
CR720	not used	
CR721	Diode Sil IN4148	4805-1241-200
CR722	Diode Zener IN5231B	4808-0000-031
LD701	Diode LED Red	4810-1282-900
LD702	Diode LED Red	4810-1282-900
LD703	Diode LED Red	4810-1282-900

LOCATION	DESCRIPTION	PART NUMBER
RESISTORS	(all resistors are ¼W 5% unless otherwise noted)	
R601	200K var	4571-0204-007
R602	200K res mf	4709-3402-401
R603	301K res mf	4709-3402-402
R604	348K res mf	4709-3402-403
R605	453K res mf	4709-3402-404
R606	348K res mf	4709-3402-403
R607	453K res mf	4709-3402-404
R608	not used	
R609	not used	
R610	1K	4704-0102-032
R611	330K	4704-0334-032
R612	220K var	4751-0224-002
R613	39K	4704-0393-032
R614	47K	4704-0473-032
R615	560K	4704-0564-032
R616	2.2K	4704-0222-032
R617	22K	4704-0223-032
R618	10K var	4751-0103-002
R619	47K	4704-0473-032
R620	10K	4704-0103-032
R621	4.7K	4704-0472-032
R622	47K	4704-0473-032
R623	820K	4704-0824-032
R624	680K	4704-0684-032
R625	10K	4704-0103-032
R626	680K	4704-0684-032
R627	100K	4704-0104-032
R628	1K	4704-0102-032
R629	180	4704-0181-032
R630	820	4704-0821-032
R631	150 res comp ½W 10%	4700-0151-042
R632	100K	4704-0104-032
R633	15K	4704-0153-032
R634	100K	4704-0104-032
R635	100K	4704-0104-032
R636	2.2K	4704-0222-032
CAPACITORS		
C601	2700pf 5%	1504-0272-505
C602	2700pf 5%	1504-0272-505
C603	.1mf 12V	1502-0104-006
C604	.0039mf 5%	1508-0392-510
C605	.0039mf 5%	1508-0392-510
C606	.0039mf 5%	1508-0392-510
C607	.1mf 12V	1502-0104-006
C608	.001mf 5%	1508-0102-510
C609	.1mf 12V	1502-0104-006

LOCATION	DESCRIPTION	PART NUMBER
C610	47mf 10V	1513-0470-001
C611	.001mf 5%	1508-0102-510
C612	2.2mf tant	1515-0229-005
C613	1mf tant	1515-0010-003
C614	1mf	1513-0010-004
INTEGRATED CIRCUITS		
IC601	TL-082/LF353N	3130-3167-912
IC602	TL-082/LF353N	3130-3167-912
IC603	LM358N	3130-3167-909
DIODES		
CR601	not used	
CR602	IN4148	4805-1241-200
CR603	IN4738A	4808-0000-009
CR604	IN4148	4805-1241-200
TRANSISTORS		
Q601	SPS-952	4801-0000-010
Q602	SPS-952	4801-0000-010

8-6 MA-121 TONE ENCODER BOARD

LOCATION	DESCRIPTION	PART NUMBER
RESISTORS (all resistors are ¼W 5% unless otherwise noted)		
R601	200K var	4751-0204-007
R602	200K res mf	4709-3402-401
R603	301K res mf	4709-3402-402
R604	348K res mf	4709-3402-403
R605	453K res mf	4709-3402-404
R606	348K res mf	4709-3402-403
R607	453K res mf	4709-3402-404
R608	not used	
R609	not used	
R610	470 ohm	4704-0474-032
R611	330K	4704-0334-032
R612 - R616	not used	
R617	22K	4704-0223-032
R618	10K var	4751-0103-002
R619	47K	4704-0473-032
R620	not used	
R621	not used	
R622	not used	
R623	680K	4704-0684-032
R624	330K	4704-0334-032
R625	not used	
R626	330K	4704-0334-032
R627	not used	
R628	1K	4704-0102-032
R629	180	4704-0101-032
R630	820	4704-0821-032
R631	150 res comp ½W 10%	4700-0151-042
CAPACITORS		
C601	2700pf 5%	1504-0272-505
C602	2700pf 5%	1504-0272-505
C603 - C606	not used	
C607	.1mf 12V	1502-0104-006
C608	not used	
C609	.1mf 12V	1502-0104-006
C610	47mf 10V	1513-0470-001
INTEGRATED CIRCUITS		
IC601	TL-082/LF353N	3130-3167-912
IC602	TL-082/LF353N	3130-3167-912
IC603	LM358N	3130-3167-909
DIODES		
CR603	IN4738A	4808-0000-009

8-7 CHASSIS ASSEMBLY

LOCATION	DESCRIPTION	PART NUMBER
	ELECTRICAL COMPONENTS	
R2	7.5K, squelch control	4750-1230-306
R3	5K, volume control	4750-1230-305
C1	.01mfd,mylar	1508-0103-610
C2	.01mf,ceramic	1501-0103-009
FTC-1 thru FTC-20	.001mfd, feed-thru	1521-5129-800
SPKR1	speaker	1301-3414-200
SW1	switch (part of R3)	
FS1	fuseholder	2100-0000-003
	fuse 3 amp 3AG 250V	5106-0000-003
	conn. ant.	2105-0000-020
	MECHANICAL COMPONENTS	
	bracket, heat sink	1400-1421-700
	bracket, pcb	1400-3413-100
	panel, front	1405-6413-001
	handle, panel	1407-3413-601
	cover, btm	1413-5425-300
	lug solder	2102-0000-008
	bonding strap	2110-3414-500
	label, rvdc	2507-1419-800
	label, transmit	2507-1419-900
	label, control	2507-1420-000
	label, receive	2507-1420-100
	shield, btm	2508-5425-400
	shield, pcb top	2508-5425-500
	shield, pcb btm	2508-5425-600
	mask, grille	2514-3414-300
	spacer - I.C.	2800-3413-300
	screw 2-56 x 1/4 BH	2801-0250-001
	screw 4-40 x 3/16 BIND	2803-0187-001
	screw 4-40 x 5/8 BIND	2803-0625-001
	screw 6-32 x 5/16 PHIL	2804-0312-010
	screw 4 x 3/16 AB Hex	2808-0187-006
	screw 4 x 1/4 AB H	2811-3185-600
	screw 10-32 x 5/8 BIND	2822-0625-001
	screw 6-32 x 5/16 TAP	2824-0312-028
	clip, xtal	2830-1420-701
	washer int	2841-0000-002
	washer no. 10 splitlock	2843-0000-008
	washer solder	2844-0000-001
	kepnut 4-40 x 1/4 CAD	2852-0440-001
	heatsink	5400-3407-201
	wire tie,knitlok	6005-0000-002
	chassis, MCC, MCCR	1403-7407-100
	shield, MCCR	2508-6412-700
	cover, btm MCCR	1414-5425-300
	panel, top	1405-6412-400
	panel, sub	1405-5426-400
	knob	2402-3414-100

8-8 HELICAL PRESELECT BOARD

LOCATION	DESCRIPTION	PART NUMBER
COILS		
L901	coil rf var	2800-5129-101
L902	coil rf var	1800-5129-101
VARIABLE PARTS FOR MCCU01RB (470-512 MHz)		
L901	coil rf var	1800-5129-105
L902	coil rf var	1800-5129-105