

MIDLAND
INTERNATIONAL®

VHF-FM 25WATTS

144 TO 148MHz

PLL AMATEUR TRANSCEIVER



MODEL 13-510

OWNER'S GUIDE

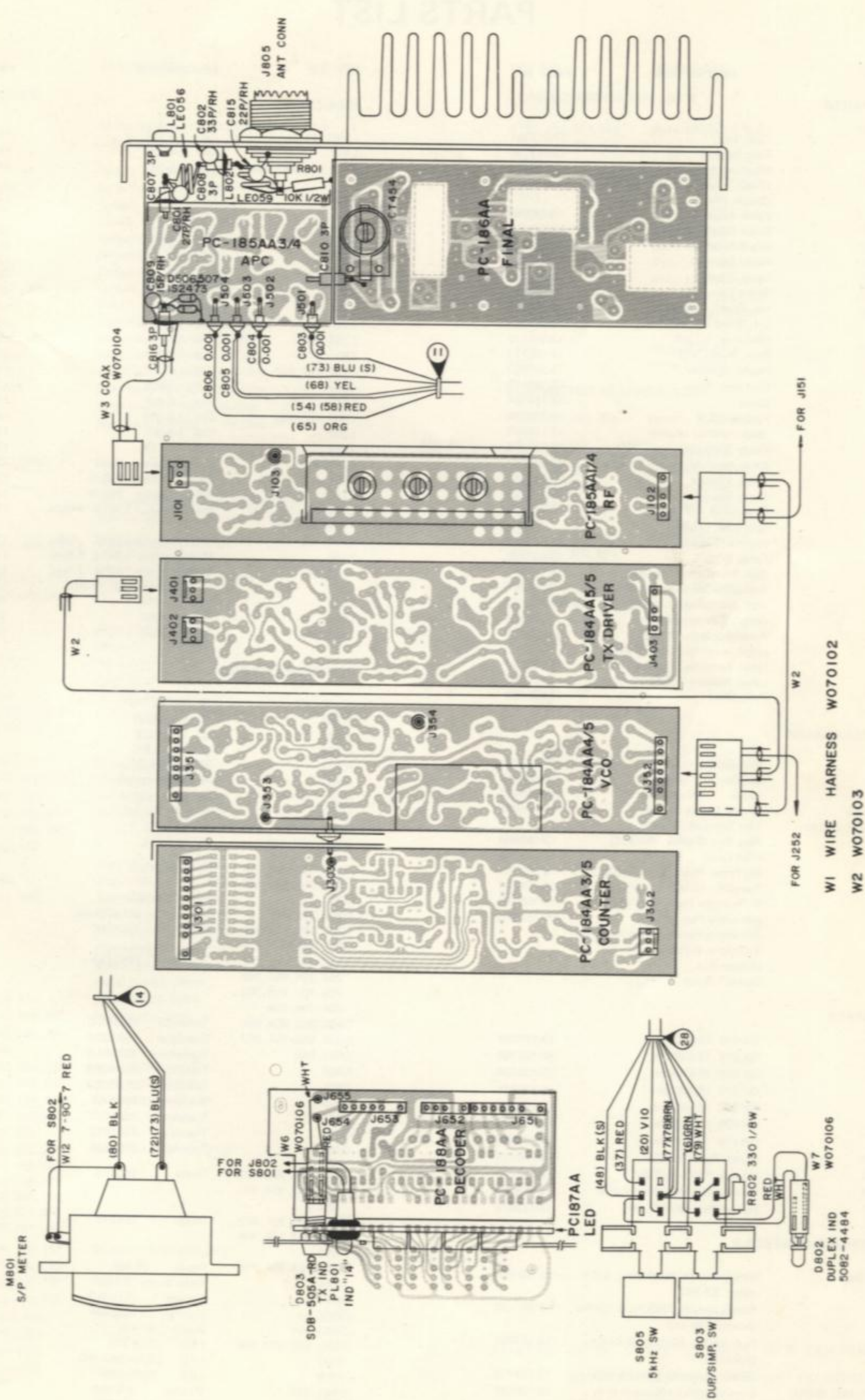
REF. NO.	DESCRIPTION	PART NO.	REF. NO.	DESCRIPTION	PART NO.
RESISTORS			CONNECTOR WAFER ASS'Y		
All Resistors not shown on this parts list are carbon 1/4W, see schematic for specific values.			J 101, 151, 202, 252	Wafer 5045-00A 3pin	13-150250
R-451	Carbon 100 Ohm 1/2W		253, 302, 401, 402		
R-501, 502	Carbon 470 Ohm 1/2W		301		
R-601	Carbon 10K Ohm 1/2W		J 102, 251, 403, 554	Wafer 5048-04A 4pin	13-150251
R-424	Carbon 10 Ohm 1/2W		552		
R-602	Carbon 330 Ohm 1/8W		J-551	Wafer 5048-05A 5pin	13-150252
R-264	Carbon 270 Ohm 1/8W		J-552, 553, 552	Wafer 5048-06A 6pin	13-150253
R-303, 353	Carbon 100 Ohm 1/8W		J-351, 352, 651	Wafer 5048-07A 7pin	13-150254
R-380, 382	Carbon 22K Ohm 1/8W		J-701, 652	Wafer 5048-08A 8pin	13-150255
R-173	Solid 82 Ohm 1W		J-602	Wafer 5048-09A 9pin	13-150256
R-551	Metaloid Resistor 300 Ohm 2W		J-301	Wafer 5048-10A 10pin	13-150257
RT-501	Semi-Fixed RV-182 500 Ohm		J-152, 203, 204, 354	Terminal Pin TP-027	13-150258
RT-551, 552	Semi-Fixed RV-182 5K Ohm		103		
RT-152, 351	Semi-Fixed RV-182 10K Ohm		J-653	Wafer 3094-8A	13-150259
RT-151, 502	Semi-fixed RV-182 50K Ohm		J-601	Wafer 3094-9A	13-150260
RT-401	Semi-fixed RV-189 300 Ohm		CONNECTOR HOUSING ASS'Y		
RT-552	Semi-fixed RV-182 1K Ohm		P-102, 251, 403, 554	Housing SD-5047-4	
CAPACITORS			552		
All capacitors not shown on this parts list are ceramic, 50V, see schematic for specific values.			P-551	Housing SD-5047-5	
C-470, 501, 605, 610	Feed through C2-023 3P		P-152, 553, 553	Housing SD-5047-6	
610			P-351, 352, 551	Housing SD-5047-7	
C-391, 471, 472, 473	Feed through C2-024 5-001P		P-652, 701	Housing SD-5047-8	
503, 504, 505, 506			P-301	Housing SD-5047-10	
B11			P-101, 151, 202, 252	Housing SD-5051-3	
C-401	Mkic 0.56P 500VK		201, 253, 302, 401		
C-102	Mkic 1P 500VK		402		
C-712, 651	Amisium 0.1u 25V		P-555, 555	Housing SD-3021-3	
C-182	Amisium 0.22u 16V		P-152, 203, 204, 354	Housing 18951L	
C-459, 465	Tantalum 2.2u 25V		P-556	Housing SD-3021-2	
CR-301, 302, 362, 364	C.R. Components HA-001	13-130023	P-555, 555	Housing SD-3021-3	
305, 306, 307, 308					
309					
C-215, 599	Electrolytic 0.47u 50V				
C-185, 225, 385, 557	Electrolytic 1.00u 50V				
C-202, 281, 313	Electrolytic 4.70u 25V				
C-201, 211, 212, 214	Electrolytic 10.00u 16V				
219, 311, 355, 362					
383, 563, 565					
C-393	Electrolytic 22.00u 16V				
C-314, 386	Electrolytic 33.00u 16V				
C-216, 221, 224	Electrolytic 47.00u 16V				
C-352	Electrolytic 100.00u 16V				
C-226	Electrolytic 220.00u 16V				
C-552	Electrolytic 470.00u 16V				
C-229	Electrolytic 1000.00u 16V				
C-204	Mylar 0.0022u 50VK				
C-177, 179, 181	Mylar 0.001u 50VK				
C-171, 180, 184, 203	Mylar 0.01u 50VK				
207, 208, 220, 269					
362, 369					
C-217, 357, 358, 351	Mylar 0.023u 50VK				
C-206, 312, 385, 387	Mylar 0.039u 50VK				
C-152, 153, 154, 155	Ceramic 0.01u 25V ZY				
156, 157, 161, 260					
261, 317, 321					
C-166, 251, 252, 257	Ceramic 0.023u 25V ZYg				
263, 264, 268, 269					
273, 274, 279, 318					
319, 326, 354, 366					
373, 375, 507, 555					
505, 580, 581, 582					
C-163, 164, 166, 167	Ceramic 0.039u 25V ZYg				
169, 170, 172, 173					
174, 175, 176, 183					
186, 315, 316, 307					
CT-451, 452, 453	Trimmer CV-024 30P	13-123058			
CT-251, 252, 253	Trimmer CV-028 20P	13-123075			
254, 401, 402					
501, 703, 702					
700, 704, 705					
CT-454	Trimmer CV-037 25P	13-123076			

NOTE: When ordering parts, it is essential to specify the correct model number and serial number of the unit.

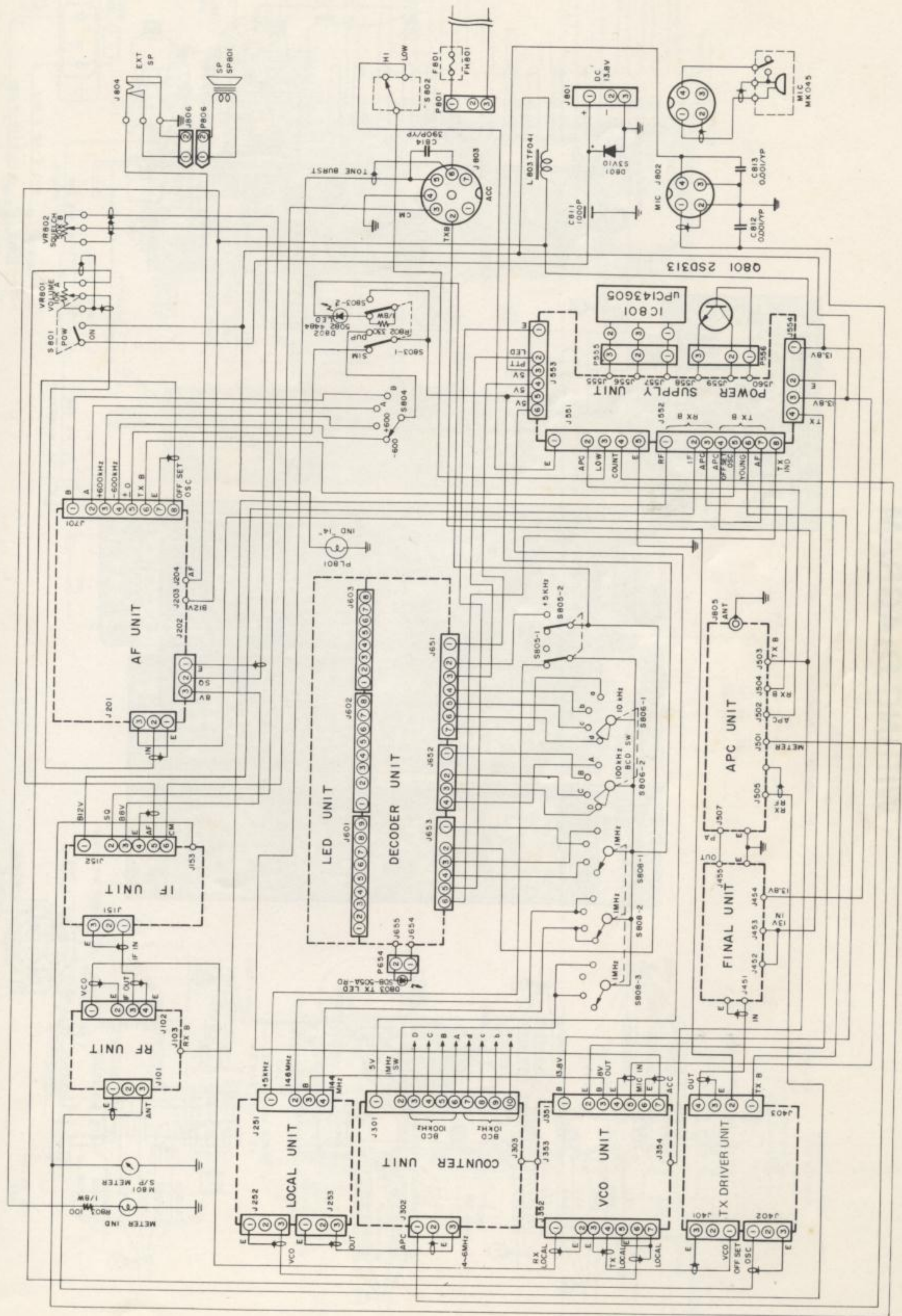
PARTS LIST

REF. NO.	DESCRIPTION	PART NO.	REF. NO.	DESCRIPTION	PART NO.
CASE PARTS			INDUCTANCE		
1	Case, Top	13-010241	L103, 151	Coil LA-151	13-090426
2	Case, Bottom	13-012156	L152	Coil LA-125	13-090426
3	Mounting Bracket	13-188550	L101, 456, 353, 104	Coil LA-169	13-090427
4	Chassis, Main		L407	Coil LA-172	13-090445
5	Chassis, (Rear)				
6	Panel, Front	13-020748	L102	Coil LC-117	13-090428
7	Shield Case (Hexical)	13-089154	L405	Coil LA-170	13-090429
8	Shield Plate	13-089155	L402, 401	Coil LA-171	13-090430
9	Shield Case (A)	13-089156	L403, 364	Coil LA-172	13-090431
10	Cover, Final	13-020747	L404	Coil LA-170	13-090449
11	Shield Case, APC	13-089157	L258	Coil LA-173	13-090432
12	Lid, Shield (A), APC	13-089158	L255	Coil LA-174	13-090433
13	Lid, Shield (B), APC	13-089159	L255, 254	Coil LA-175	13-090434
14	Heat Sink, I.C.202	13-089170	L801	Coil LE-066	13-090435
15	Plan, Shield, VCO	13-089171	L451, 492, 457	Coil LE-067	13-090436
16	Holder, Speaker	13-154157	L503	Coil LE-068	13-090437
17	Heat Sink, Final	13-089173	L802	Coil LE-069	13-090438
18	Stand	13-154184	L406, 452, 454	Coil LE-060	13-090439
19	Holder, P.C.B.	13-154185	L502	Coil LE-061	13-090440
20	Knob, 100Khz selector	13-115155	L362	Coil LC-118	13-090441
21	Knob, 10Khz Selector	13-115156	L257, 365	Micro Inductor 10µH	13-178251
22	Knob, Band Selector & TX offset	13-115157	L301	Micro Inductor 10µH	13-178252
23	Knob, Volume	13-110215	L153	Micro Inductor 30µH	13-178253
24	Knob, Squelch	13-110216	L105, 154, 251, 252	Micro Inductor L2012 470µH	13-178254
25	Plate name, Brand	13-020749	268, 351, 701		
26	Heat-Sink, Chassis		L302, 307	Micro Inductor L2013 1µH	13-178255
27	Window, Frequency	13-020751	L156	Micro Inductor L2011 5.6µH	13-178256
28	Label, FCC	13-023238	L155, 201	Micro Inductor L2014 2.7µH	13-178257
J802	Jack, Microphone JK-068	13-169230	L803	Driver Transformer TF-041	13-178214
J805	Connector, Antenna JK-035	13-193281	L506	Coil LD-018	13-090442
J804	Jack, Ext-Speaker JK-010	13-153158	L601	Coil LD-064	13-090443
J801	Jack, DC Power JK-059	13-153172	L453, 455	Coil LD-070	13-090444
J803	Accessory Jack SK-018	13-153173			
	Label, Serial No., Display Box				
	Label, Serial No., Chassis	13-023239			
	Label, Warning, DC Power Cord	13-023240			
	Plate, Misc	13-020750			
MISCELLANEOUS			SEMICONDUCTORS		
	Microphone MK-045	13-028077	IC152, 362	IC TS-7081AF	
SP801	Speaker SF-045	13-060125	IC151	IC TA-7080P	
ME01	Meter MT-065	13-200083	IC201	IC TA-7083P	
X704, 705	Crystal Socket SK-010	13-150262	IC202	IC TA-7204P	
TP251, 251, 252, 401	Test Terminal TP-019		IC351	IC MC-78L08a	
P801	Plug, Ext. Speaker 1PG-003	13-150283	IC801	IC µPC-143505	
PL-801	Pilot Lamp PL-053	13-201082	IC301	IC µPD-8570W	
P802	DC Power Plug PG-005 ACC.	13-150264	IC302	IC µPC-1008C	
F801	Fuse 6A FS-006	13-204020	IC304	IC N-7473A	
	Microphone Hanger YY-015	13-150951	IC551, 652, 653	IC N-7447B	
	Accessory Plug PG-039	13-150255			
	Styrofoam Holder, Front				
	Styrofoam Holder, Back				
	Display Box				
	Owner's Guide				
CRYSTALS					
X-301	QX-076 10.240MHz	13-128388	Q101, 102, 151, 256,	FET 2SK49-B	
X-252	QX-076 13.678MHz	13-128389	355, 356, 401, 402, 403	FET 2SK-55-D	
X-251	QX-076 13.500MHz	13-128390	Q354	Transistor 2SC4581-LCC	
X-702	QX-076 16.300MHz	13-128391	Q351, 352, 353	Transistor 2SC458C	
X-151	QX-076 16.449MHz	13-128392	Q201, 202, 203, 201,		
X-701	QX-076 16.500MHz	13-128393	357, 555, 666		
X-703	QX-076 17.500MHz	13-128394	Q152, 153, 251, 250,	Transistor 2SC1675-L	
FT-151	Crystal Filter FL-036	13-179273	253, 254, 251, 304,		
FT-152	Ceramic Filter FL-039	13-179274	306, 701, 702, 703,		
FT-153	Ceramic Discriminator FL-015	13-123278	704, 705, 706		
FT-101	Helical Resonator FL-041	13-123279	Q255, 303, 305, 404	Transistor 2SC783-C	
			Q302, 552, 554, 557	Transistor 2SA733-P	
			Q561, 558	Transistor 2SR544-E	
			Q563	Transistor 2SD400-E	
			Q801	Transistor 2SD313-E	
			Q405	Transistor 2SC2063	
			Q431	Transistor 2SC1970	
			Q452	Transistor 2SC1972	
			Q453	Transistor 2SC1946	
			Q303, 251, 252, 303,	Diode 152473	
			304, 653, 654, 651,		
			652		
			Q201, 202, 301, 302,	Diode 152473	
			501, 502, 505, 506		
			507		
			D152, 153, 154, 155	Diode 1R-50P	
			D151	Zener Diode 82-081	
			C051	Varicap 152339G	
			C052	Varicap 152988F	
			D603, 504	Diode M1-402	
			D601, 602, 803, 604	LED TLR-313	
			D803	LED S08-525A-1RD	
			D902	LED 5082-4484	
			D251, 552	Varistor FB-282	
			D801	Diode 52V-10	
S-804, 806	Rotary Switch, Band Mhz. & TX offset SR-041	13-180127			
S802	Rotary Switch, 100KHz & 10KHz Selector, SR-142	13-180128			
S-803	Push Switch, 5KHz up & Duplex/ Simplex	13-183251			
S-802	Switch, Power Hi-Low SW-050	13-188218			
VR-801/802 (S-801)	Control, Volume/Squelch with Switch RV-179	13-160145			

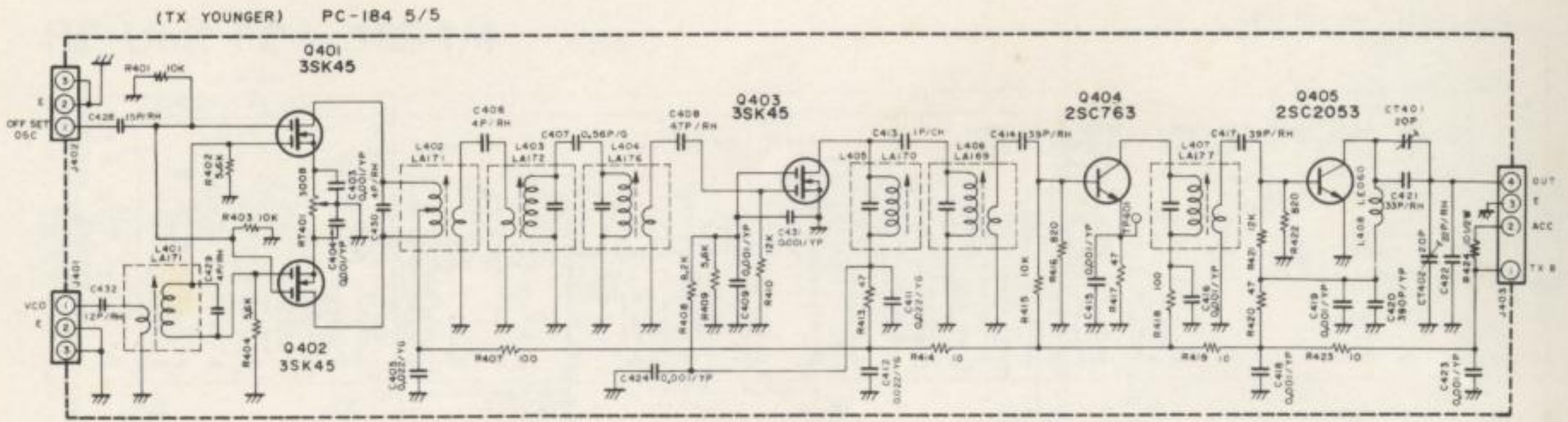
WIRING DIAGRAM



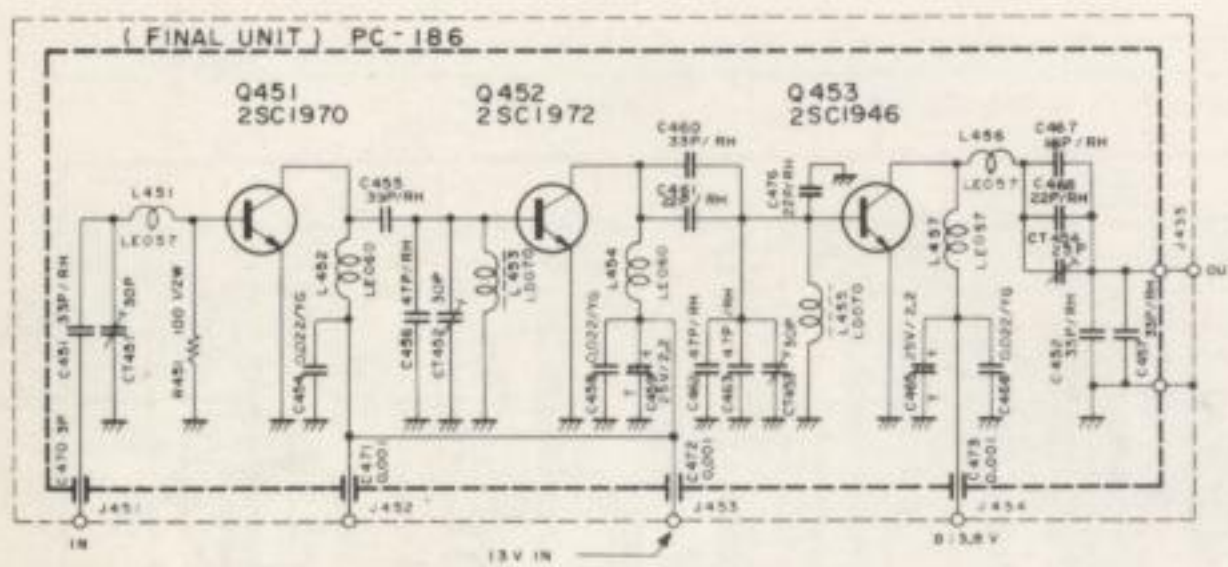
SCHEMATIC DIAGRAM (GENERAL)



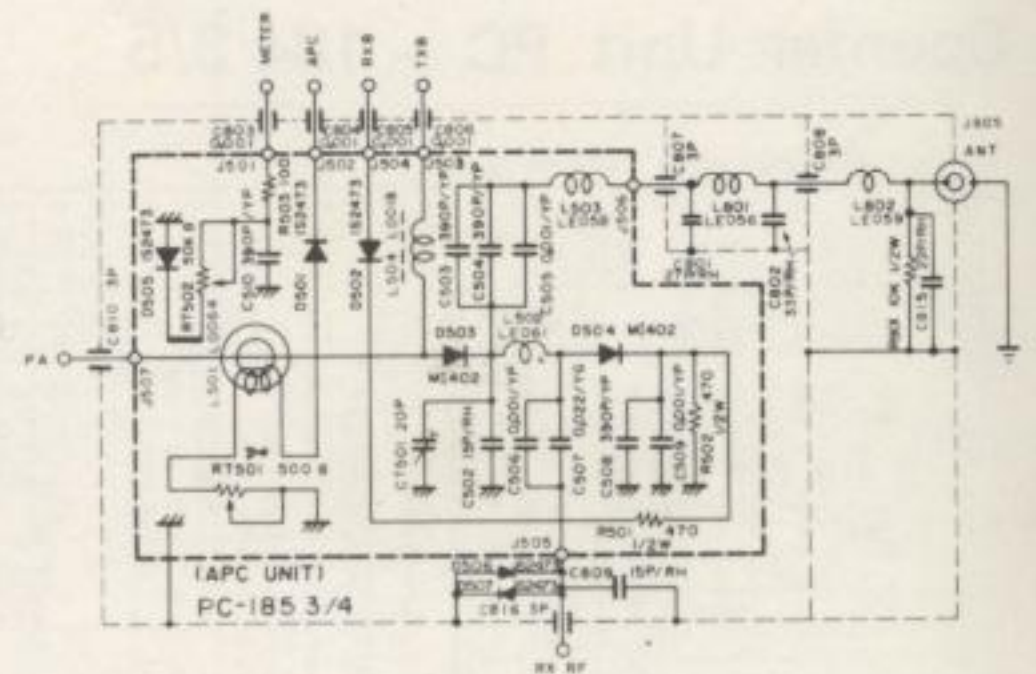
TX Driver Unit PC – 184 5/5



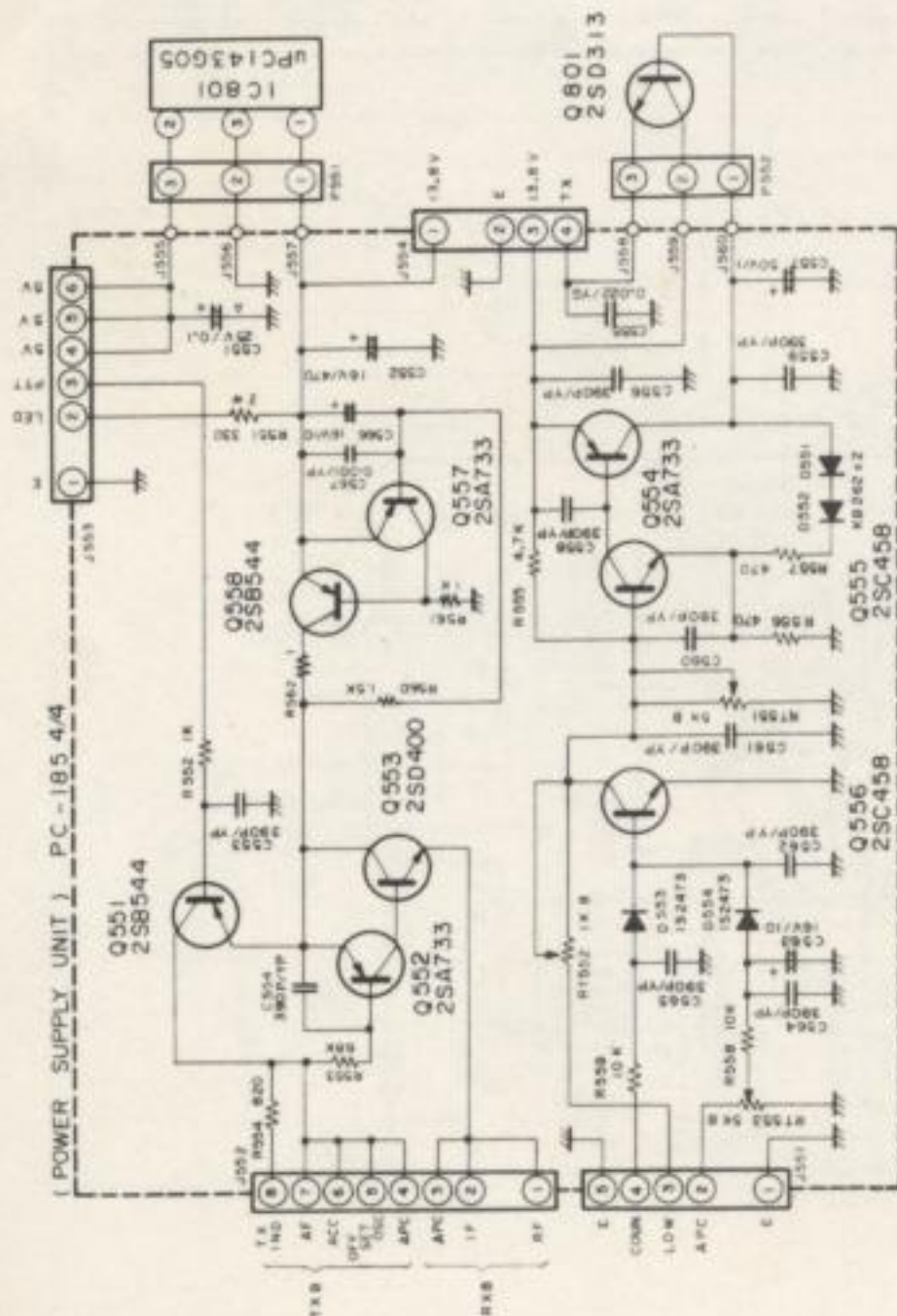
Final Unit PC – 186



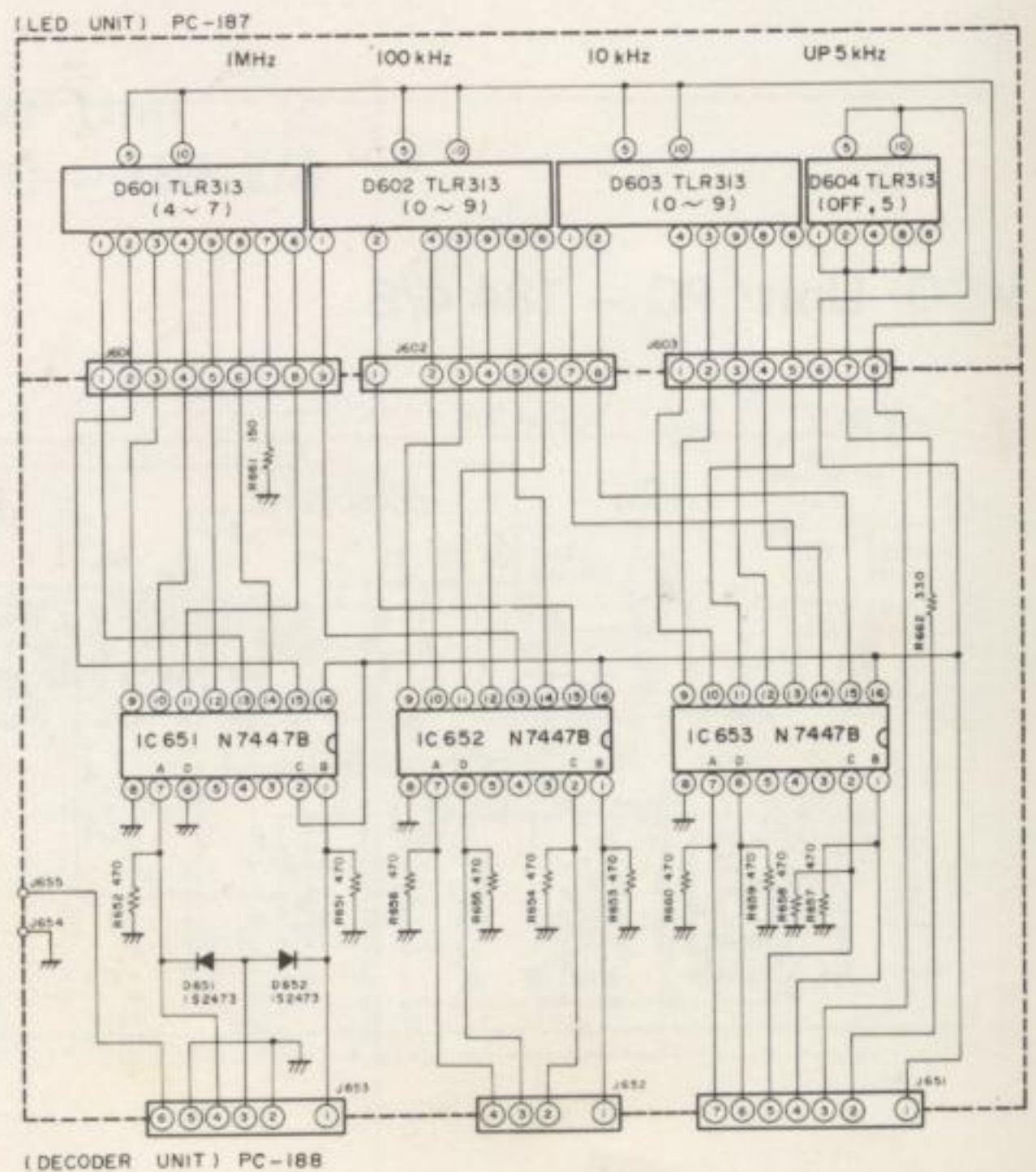
APC Unit PC – 185 3/4



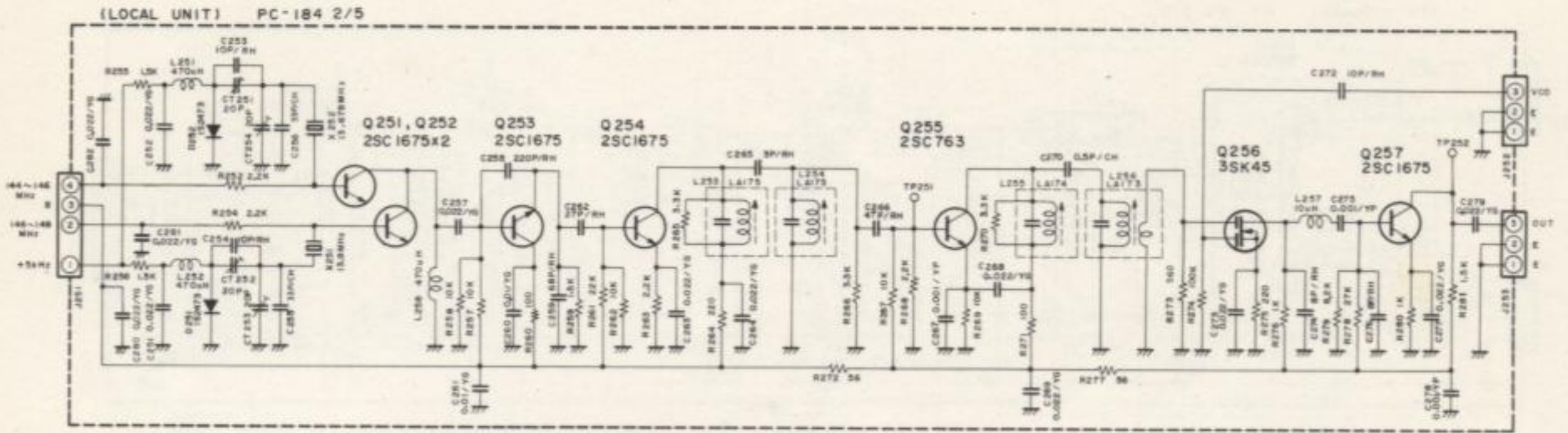
Power Supply Unit PC – 185 4/4



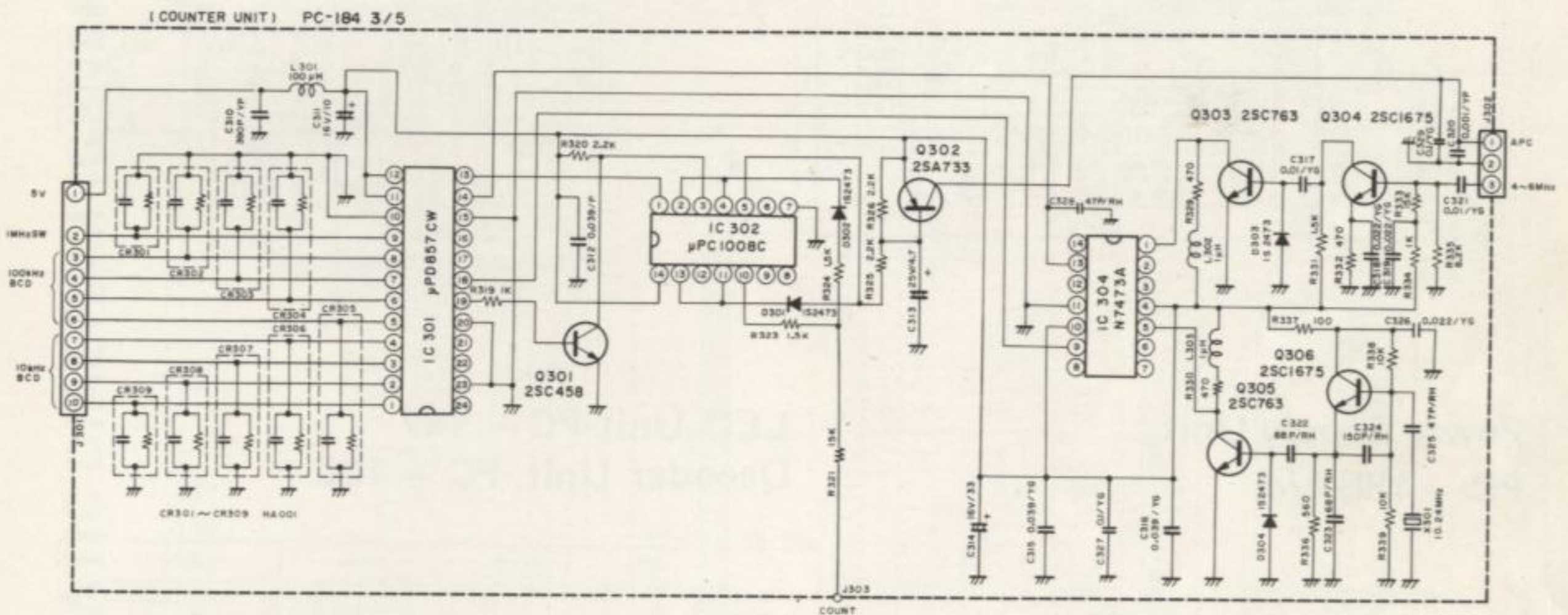
LED Unit PC – 187 Decoder Unit PC – 188



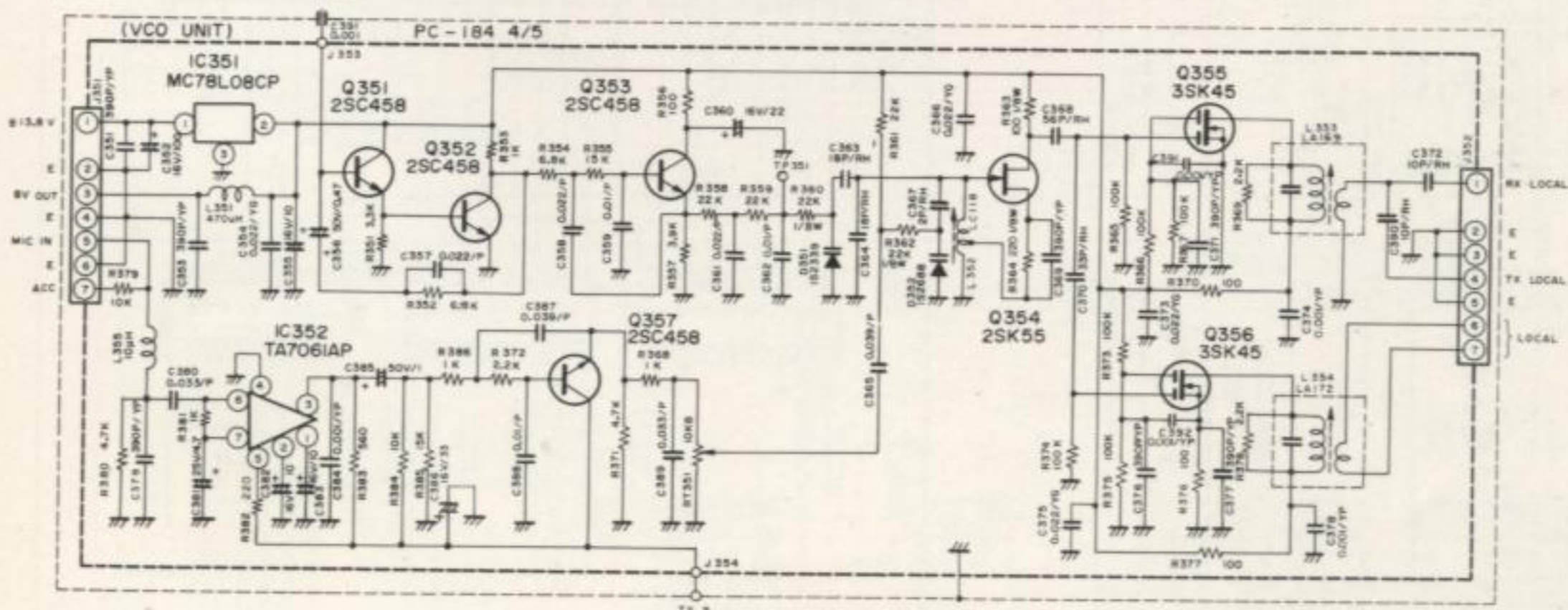
LOCAL Unit PC - 184 2/5



Counter Unit PC - 184 3/5

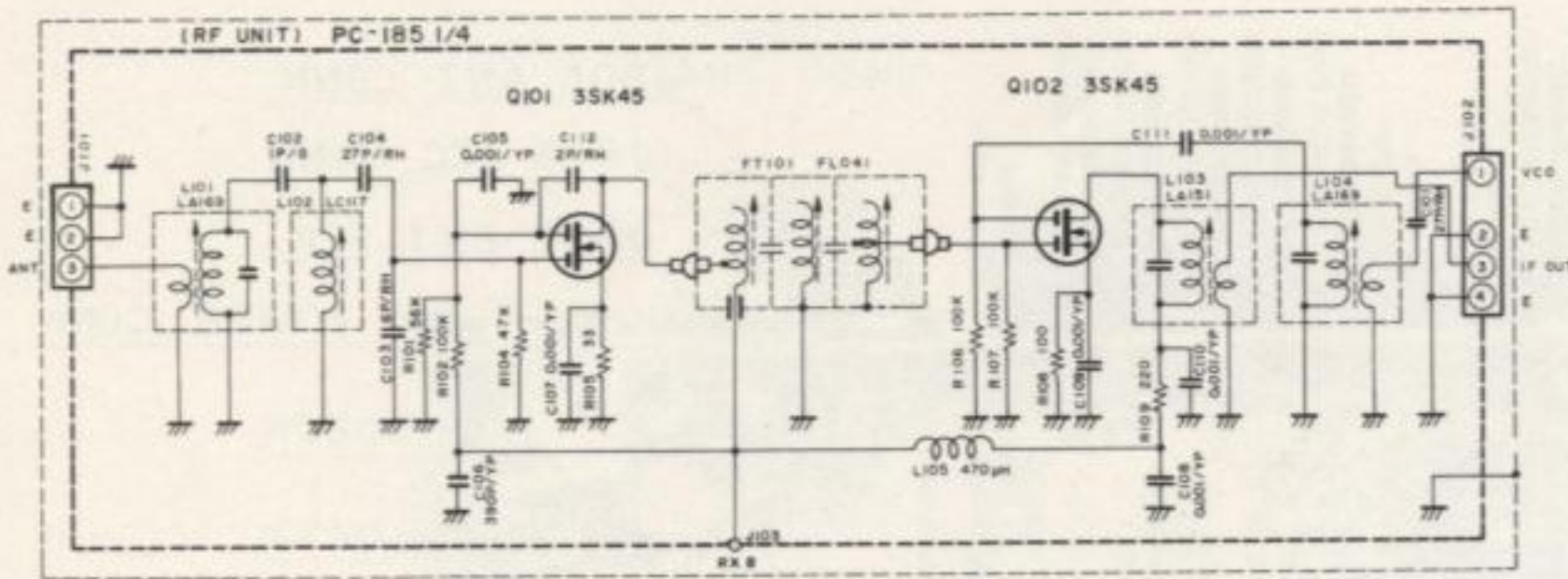


VCO Unit PC - 184 4/5

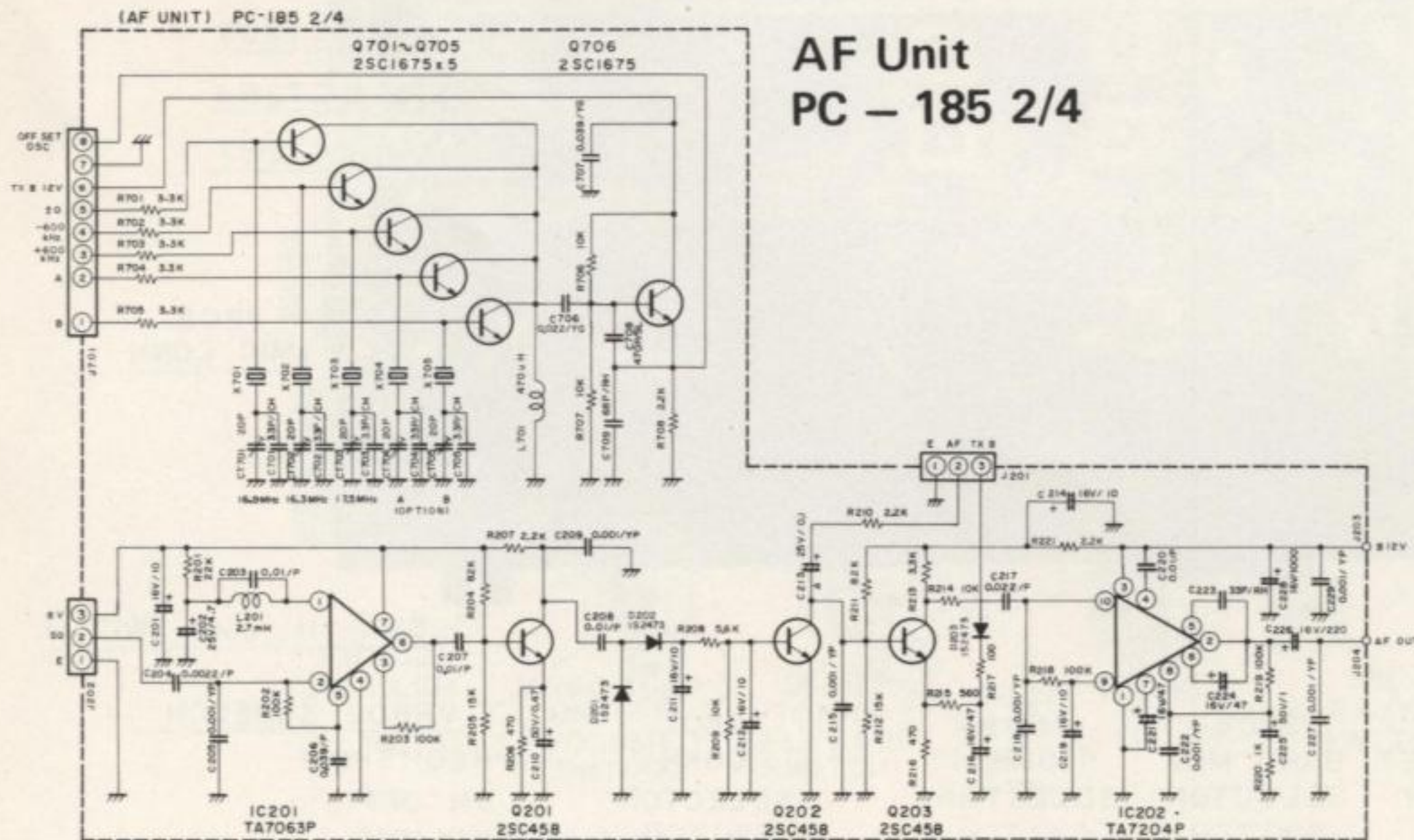
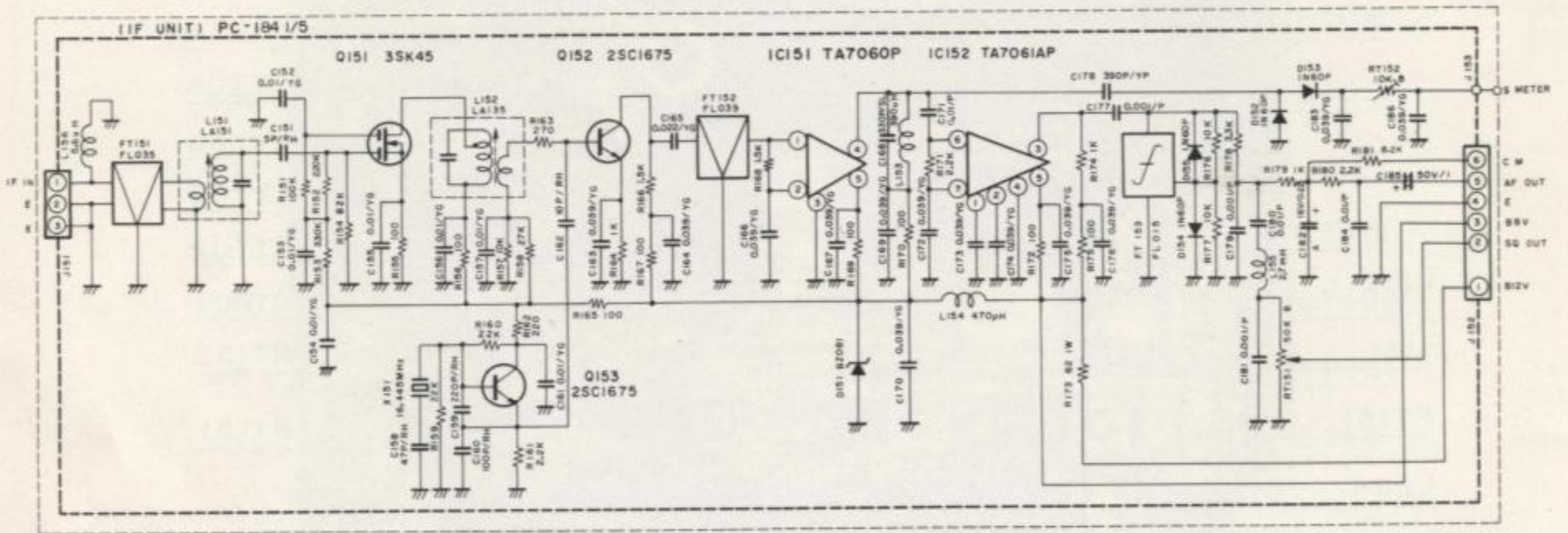


SCHEMATIC DIAGRAM (SEGMENT)

RF Unit PC - 185 1/4

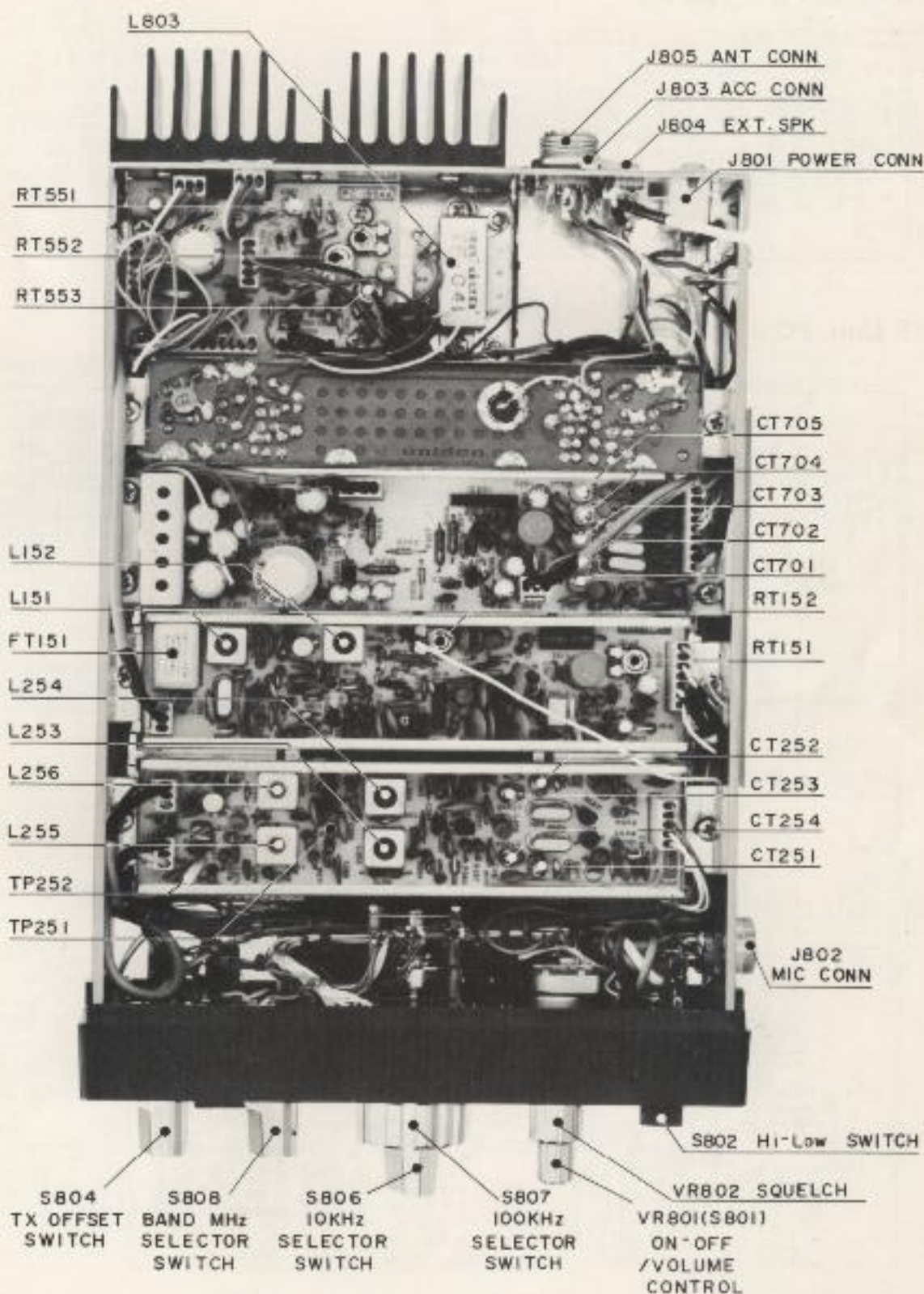


IF Unit PC - 184 1/5

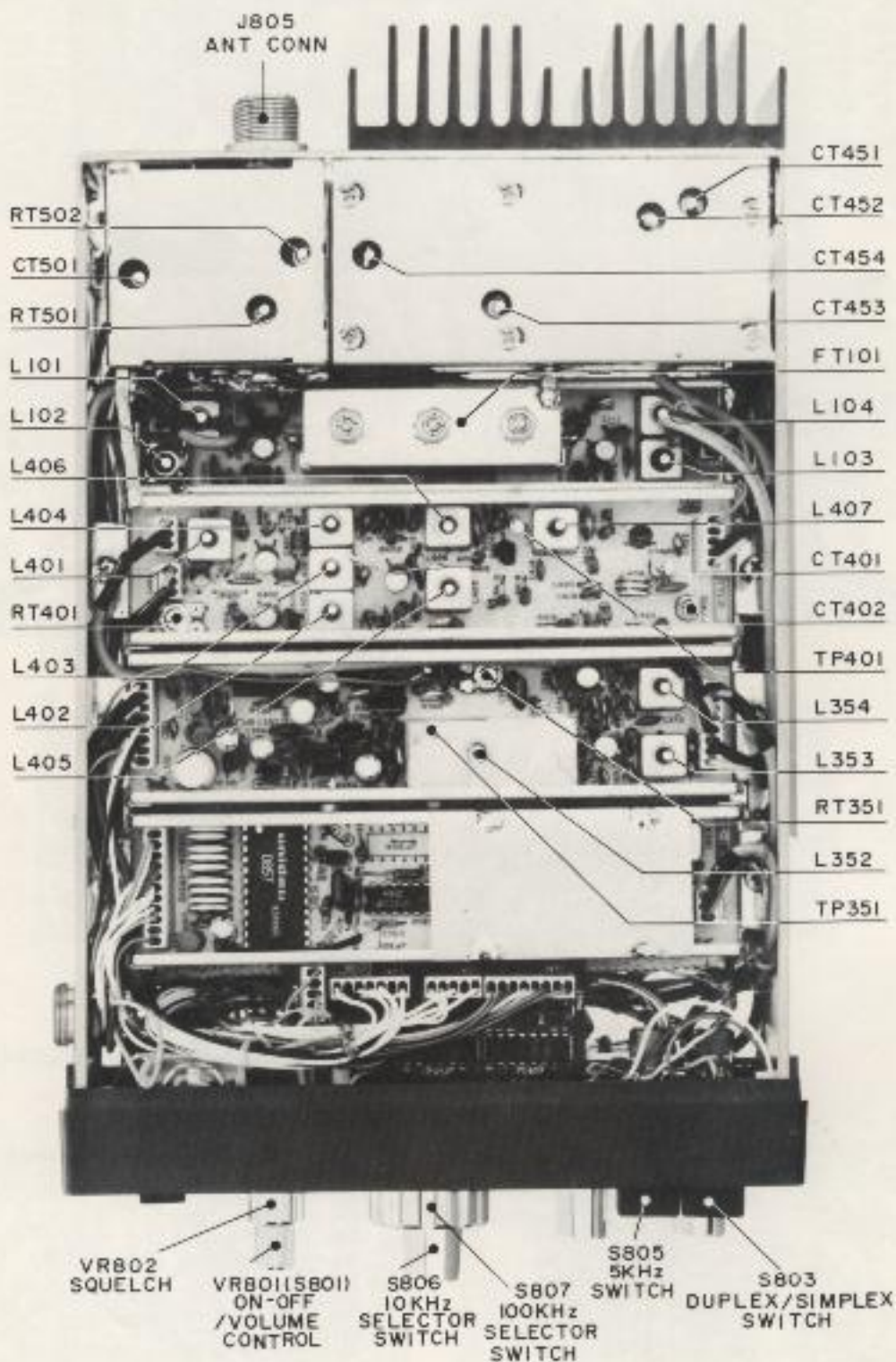


AF Unit PC - 185 2/4

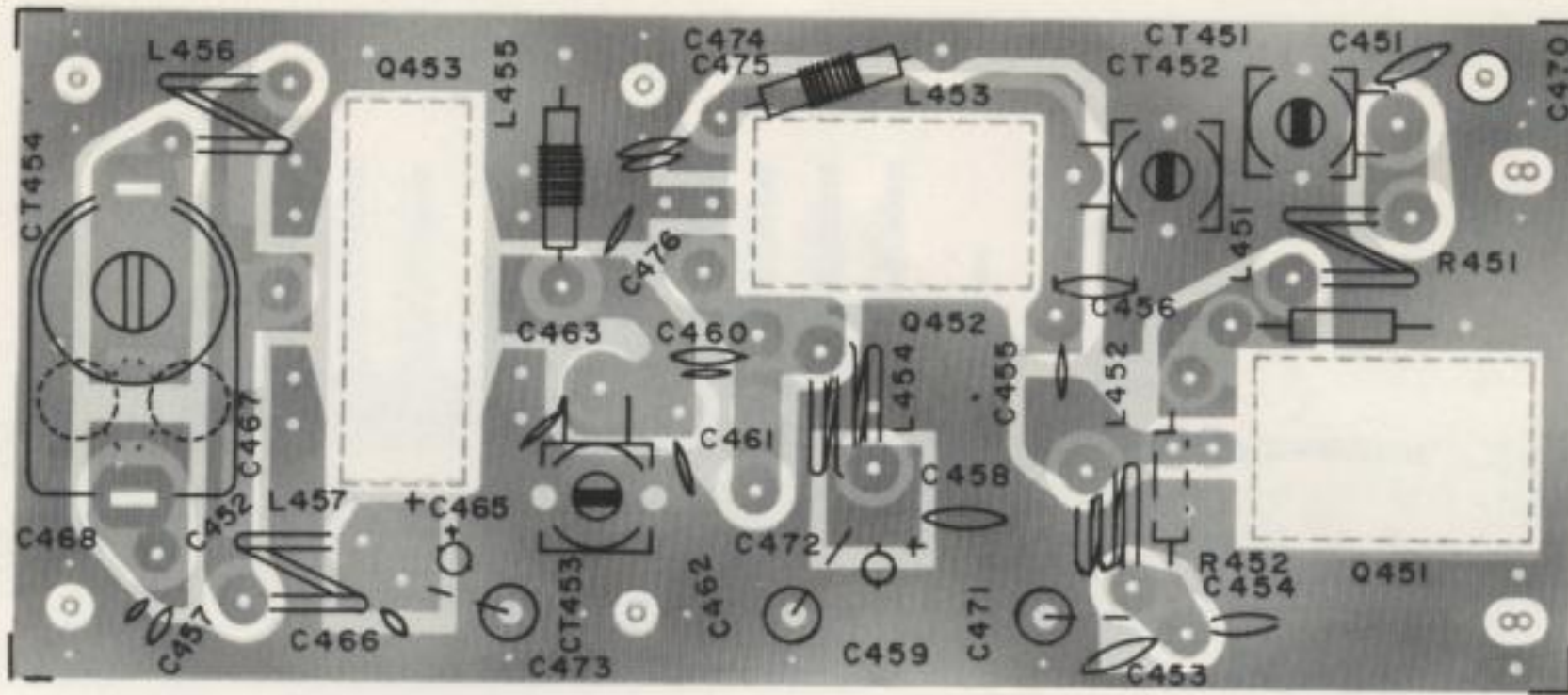
BOTTOM VIEW OF CHASSIS DETAIL



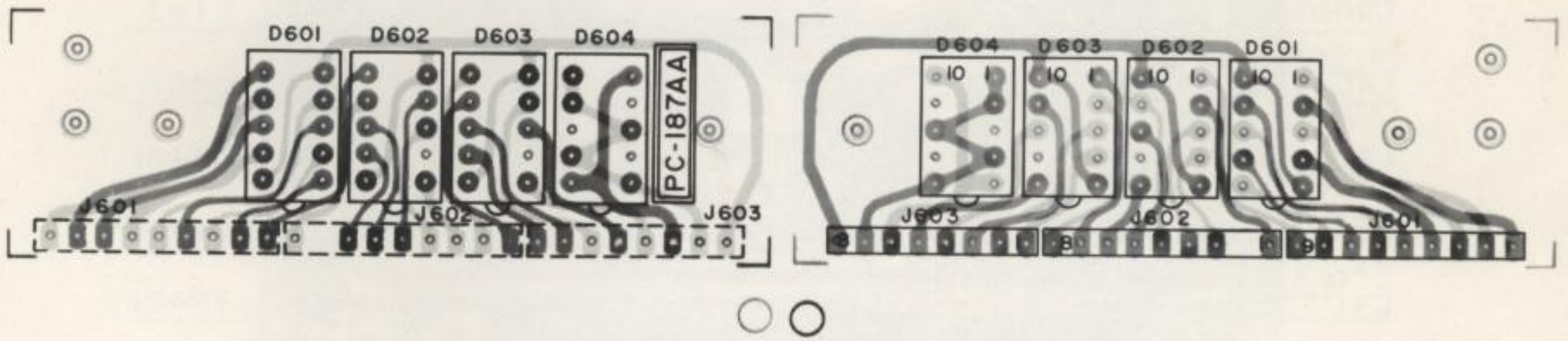
TOP VIEW OF CHASSIS DETAIL



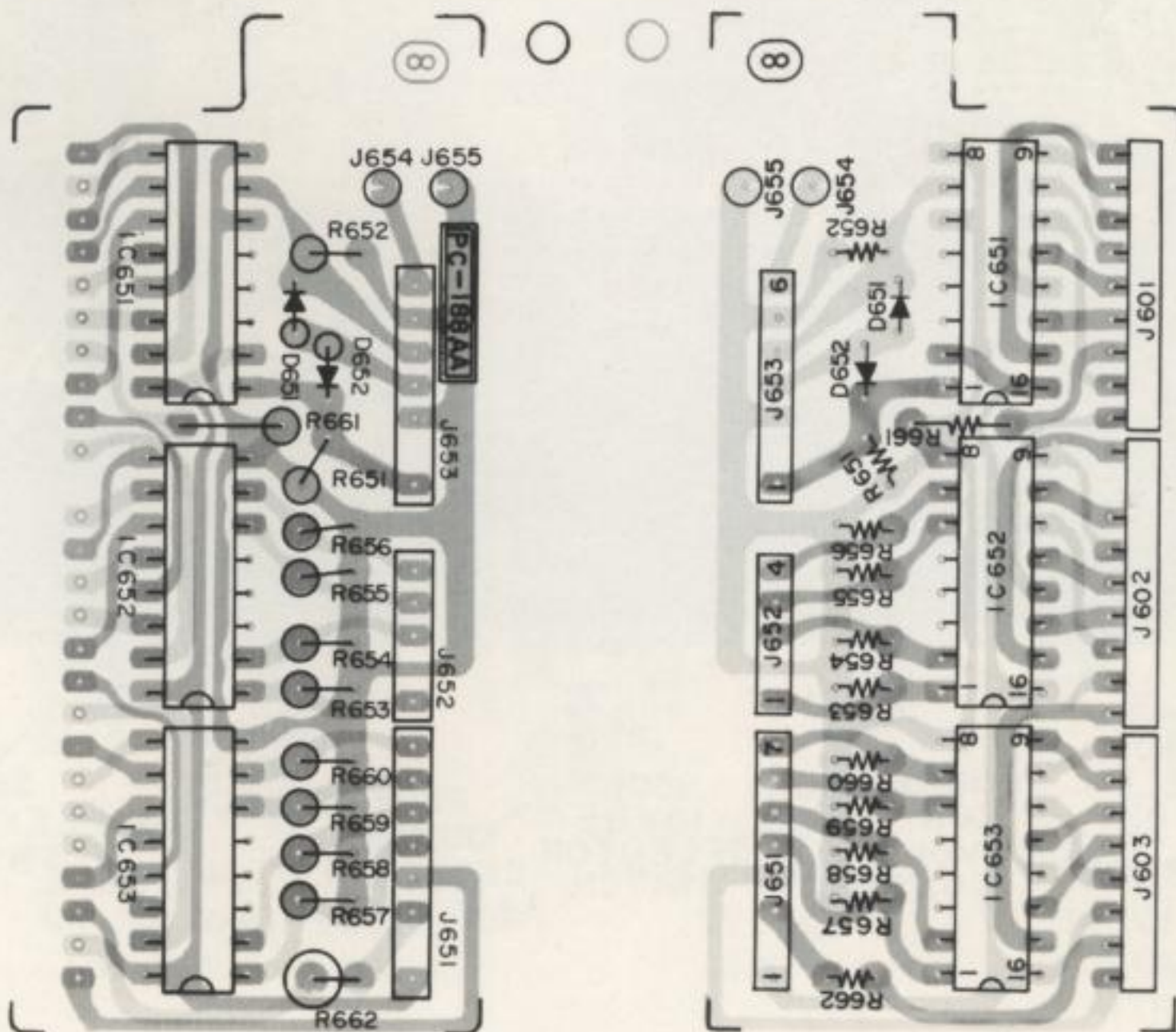
Final Unit PC – 186



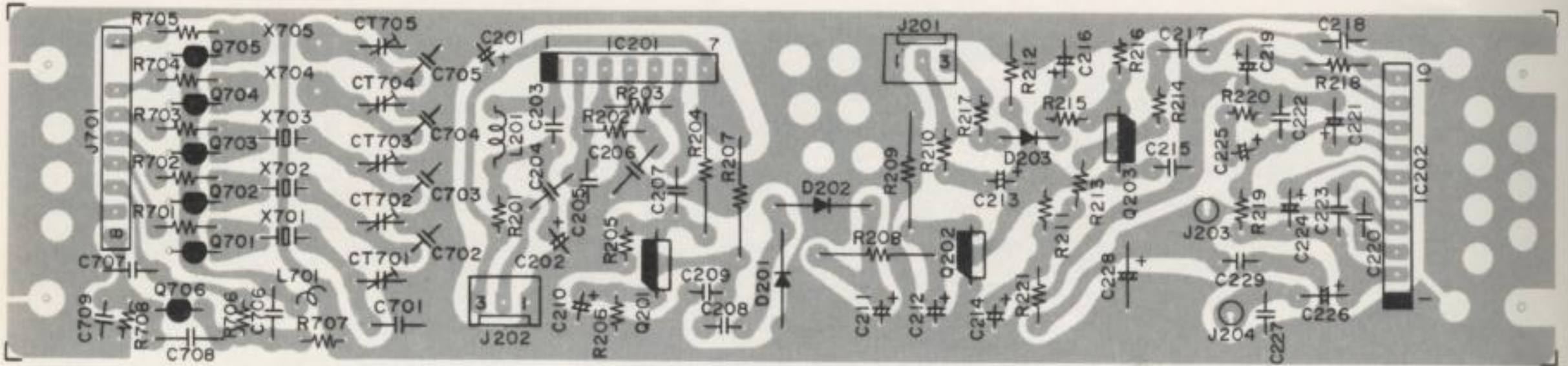
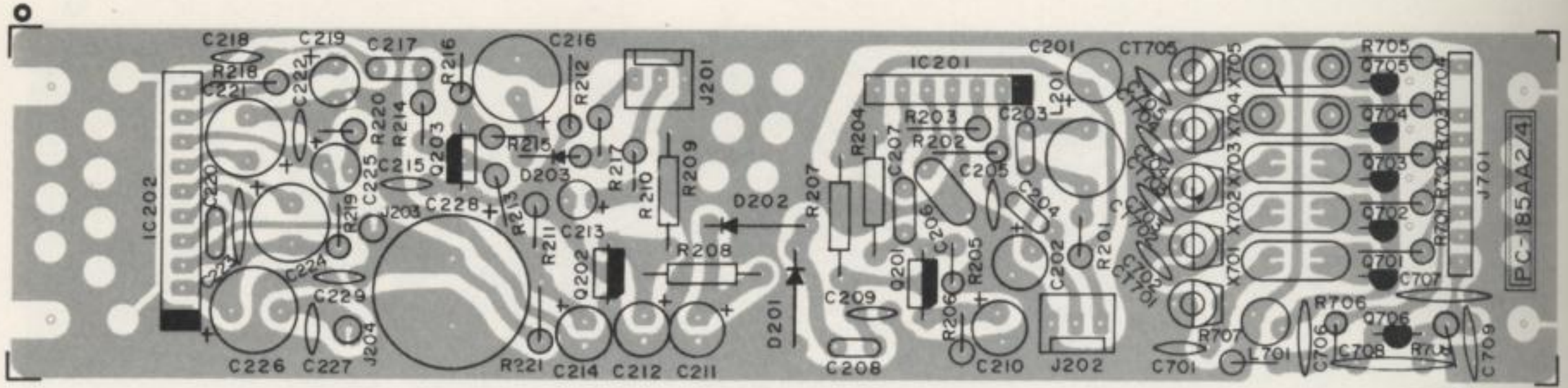
LED Unit PC – 187



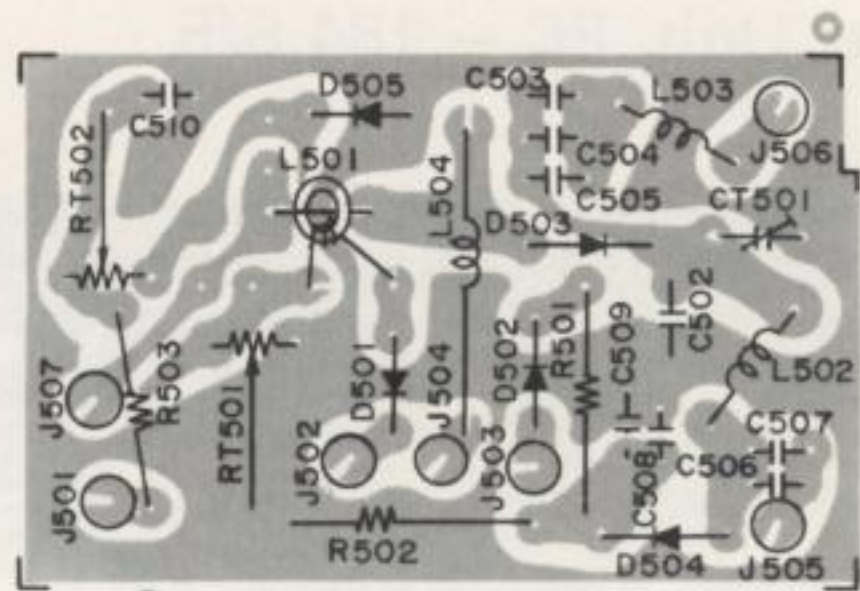
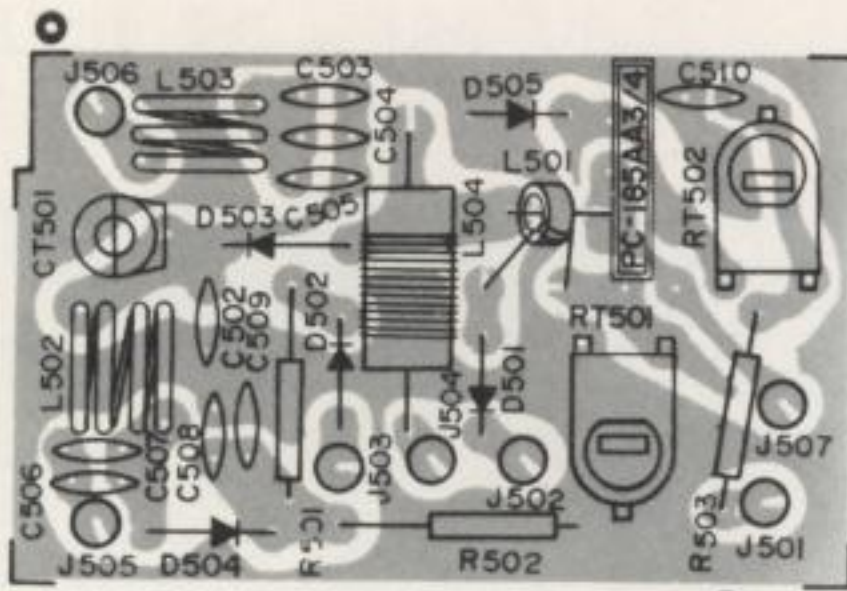
Decoder Unit PC – 188



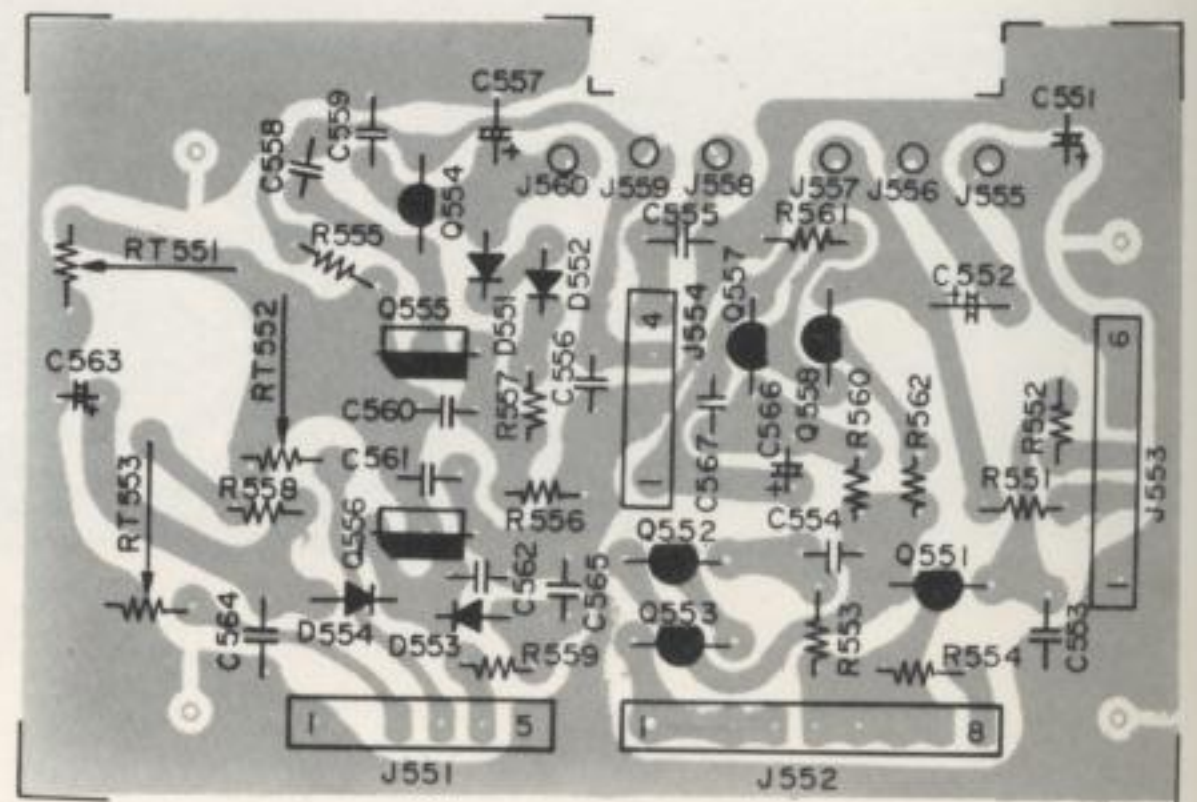
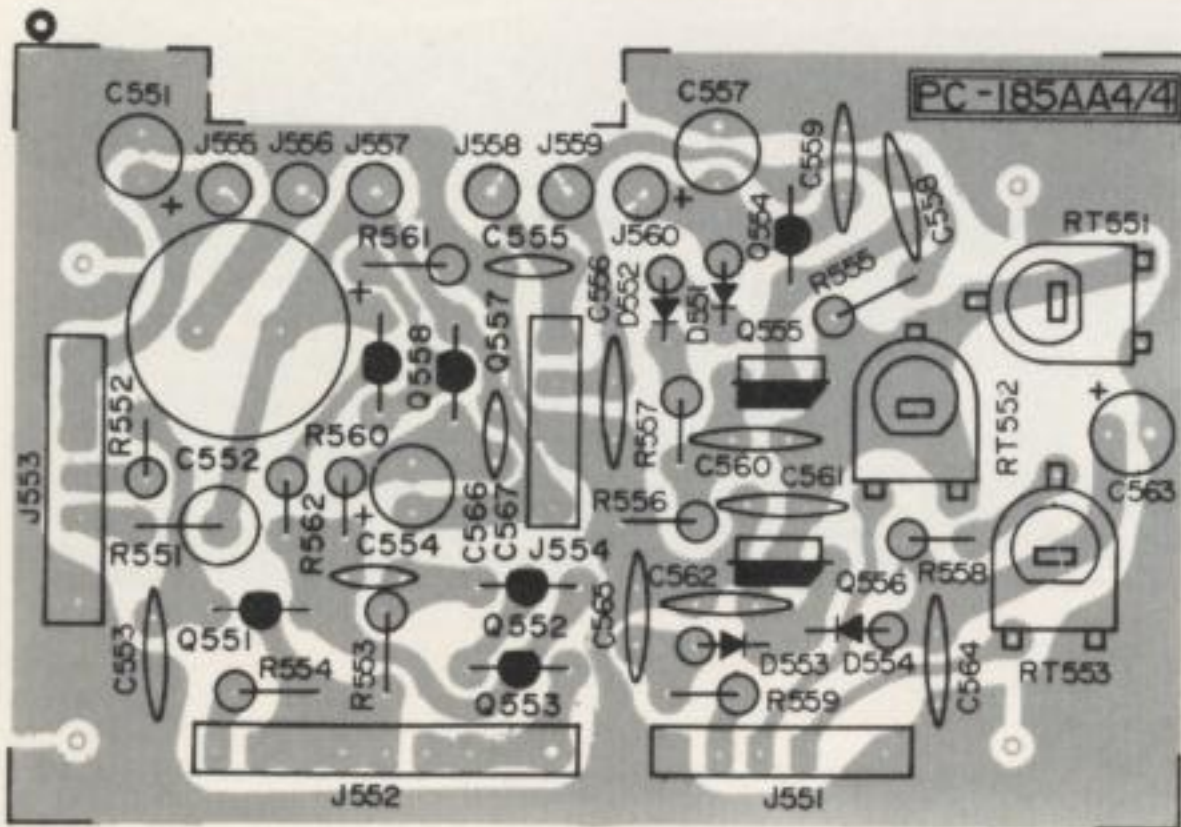
AF Unit PC – 185 2/4



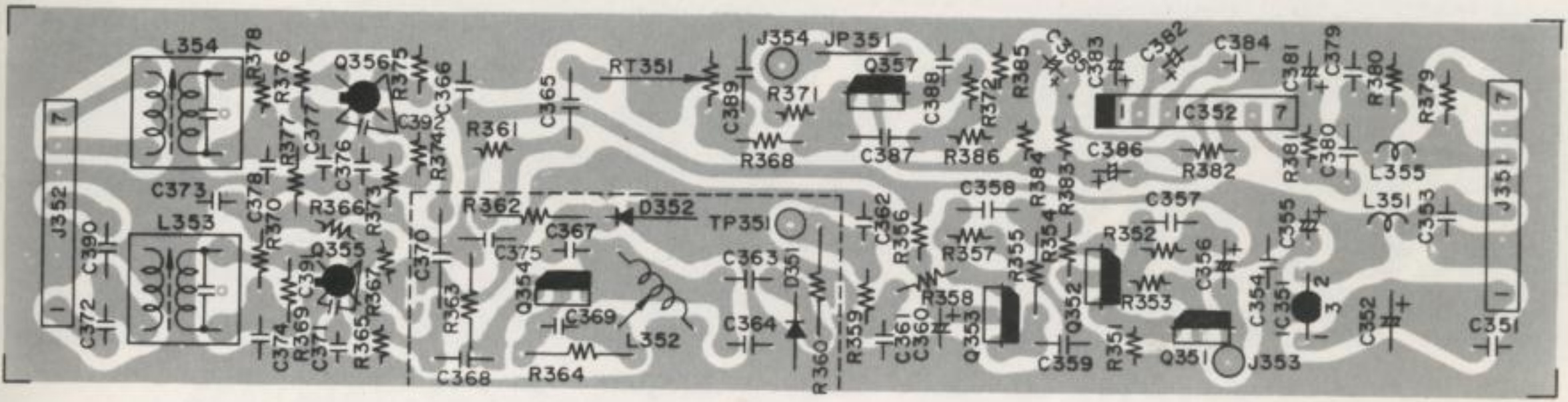
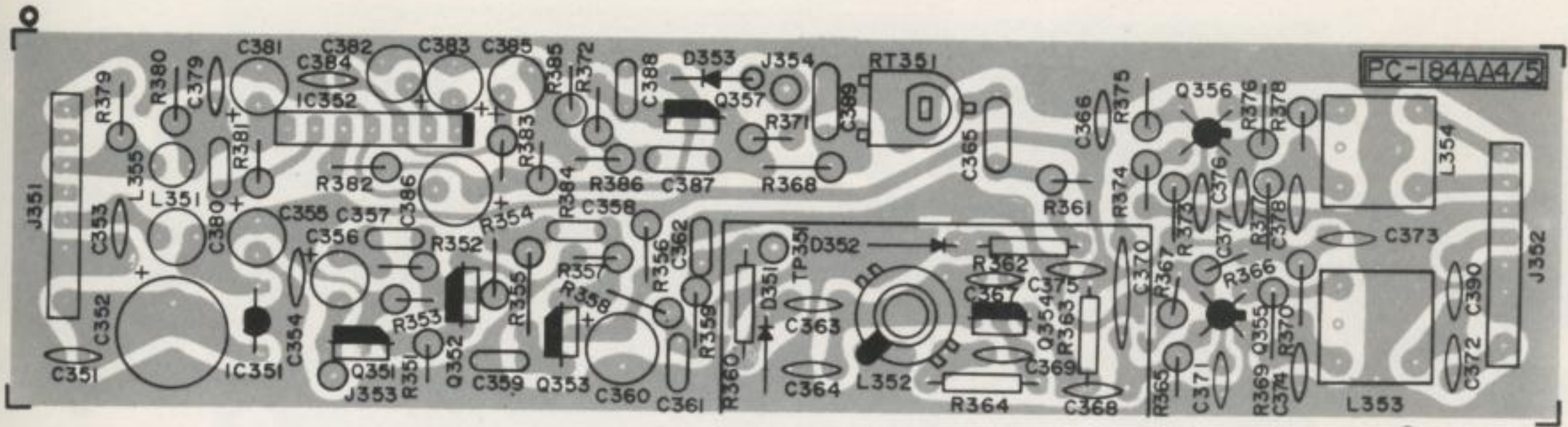
APC Unit PC – 185 3/4



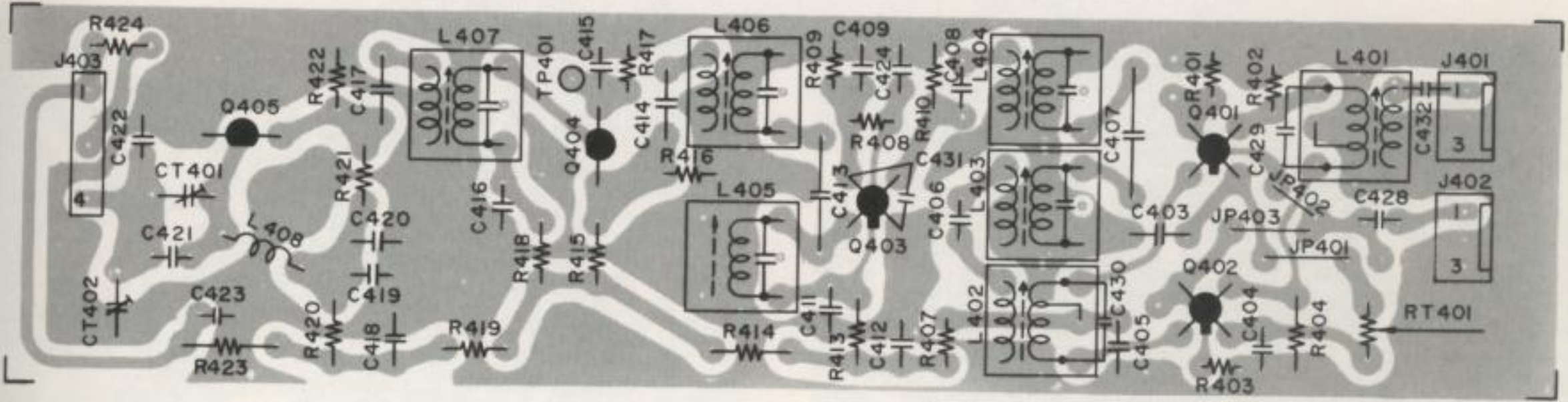
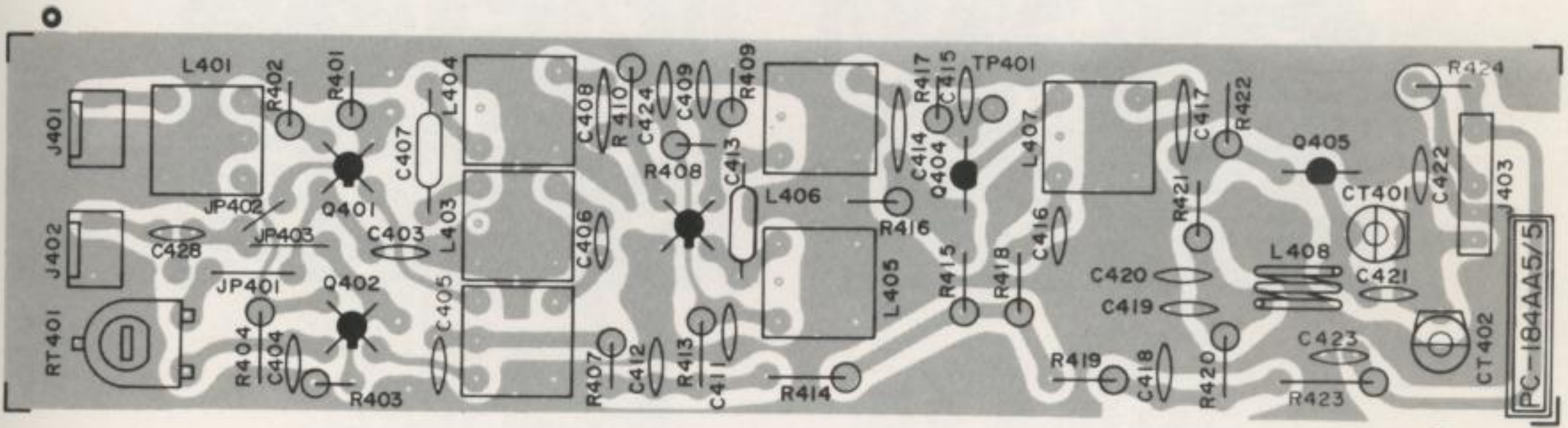
Power Supply Unit PC – 185 4/4



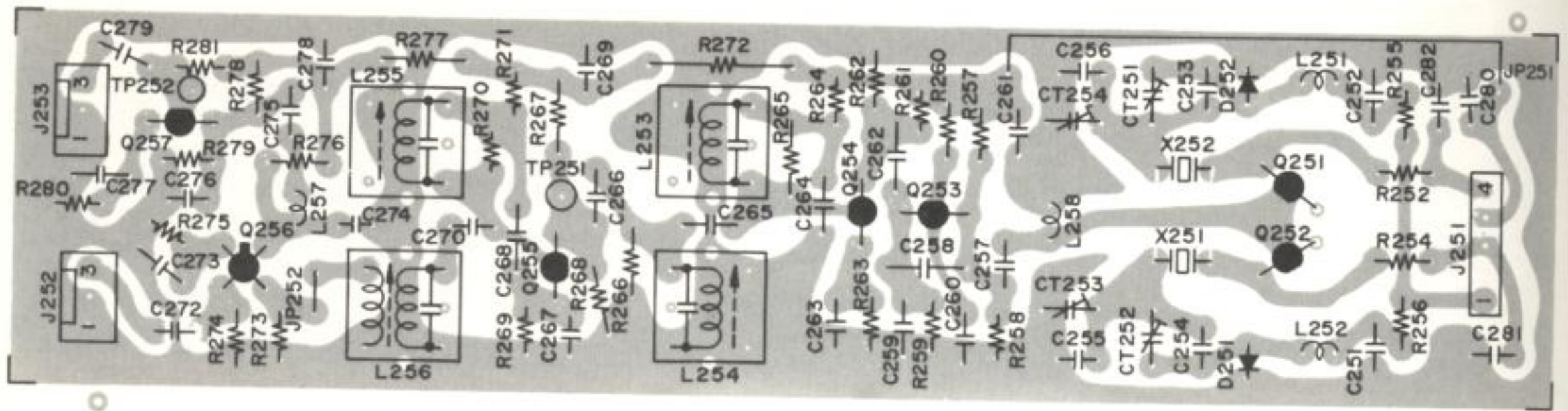
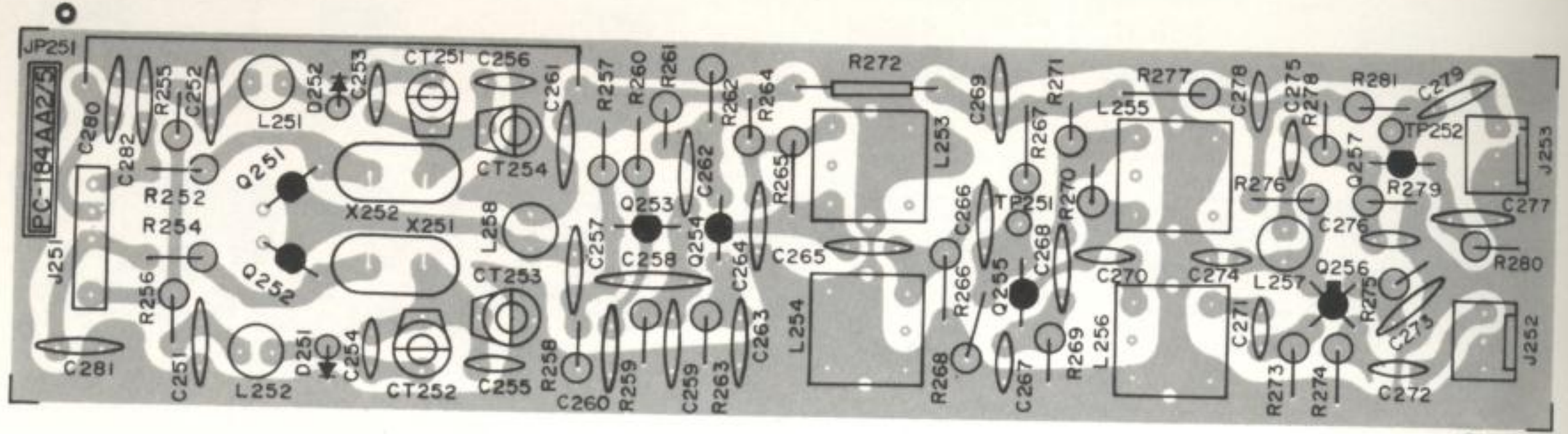
VCO Unit PC - 184 4/5



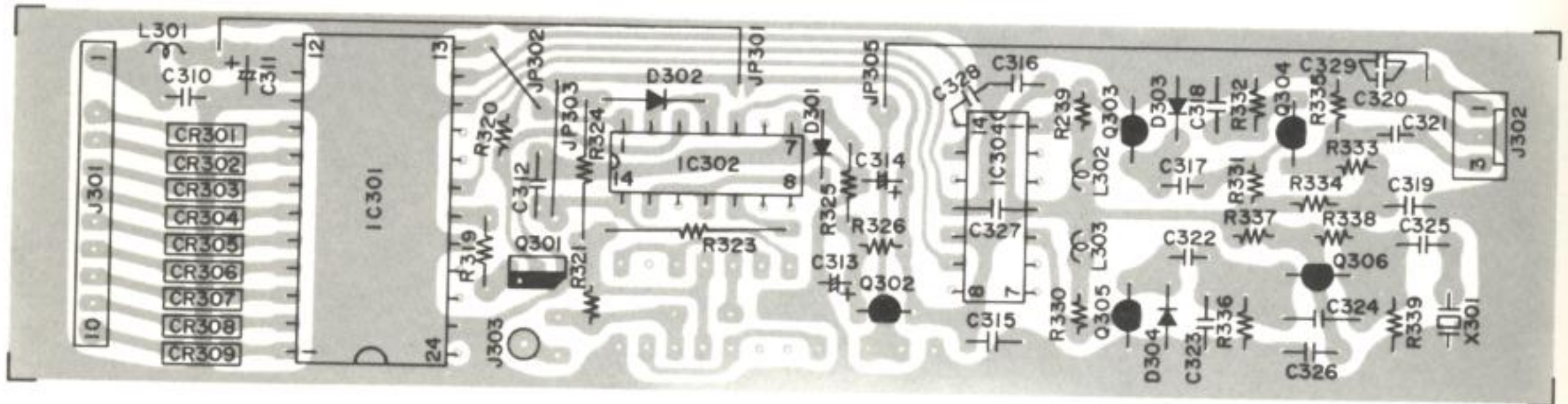
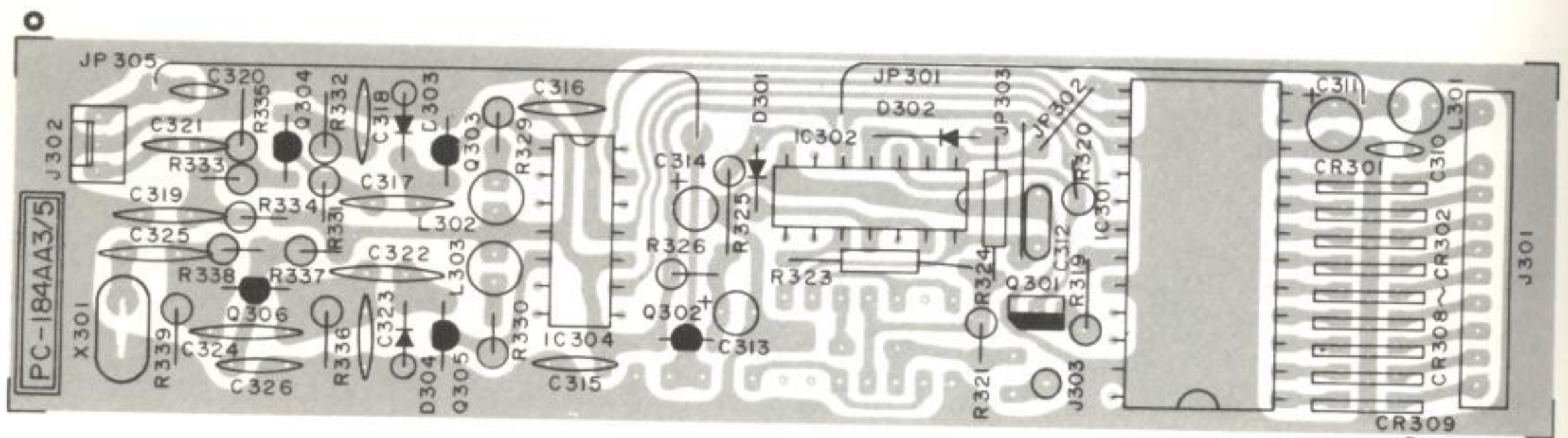
TX Driver Unit PC - 184 5/5



LOCAL Unit PC – 184 2/5

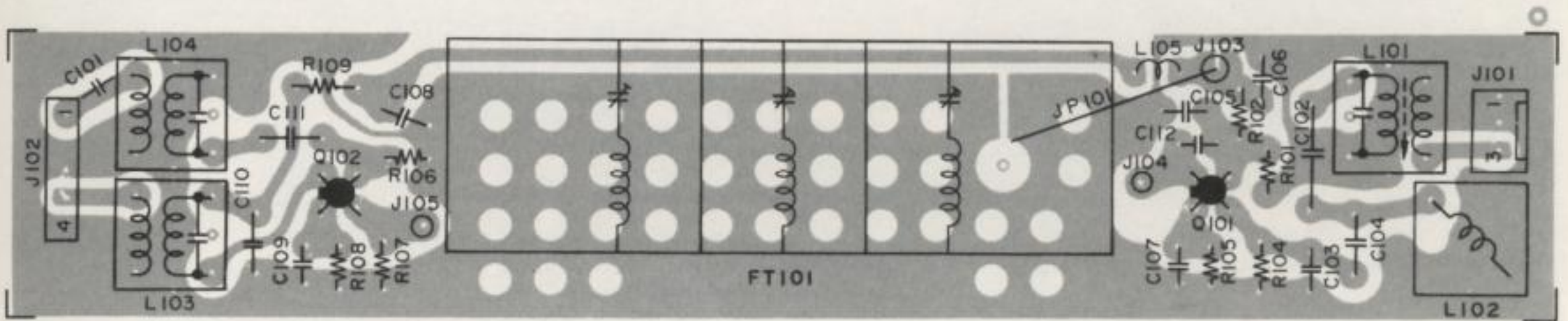
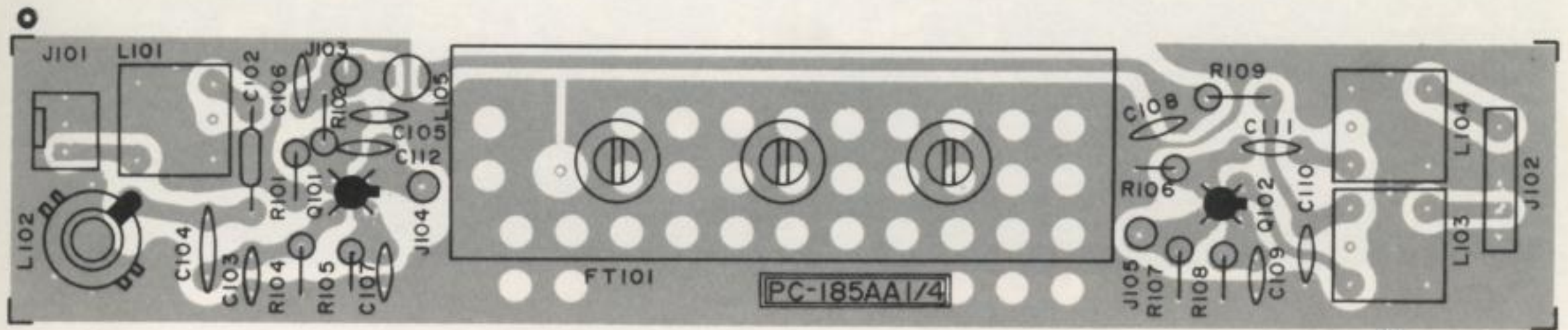


Counter Unit PC – 184 3/5

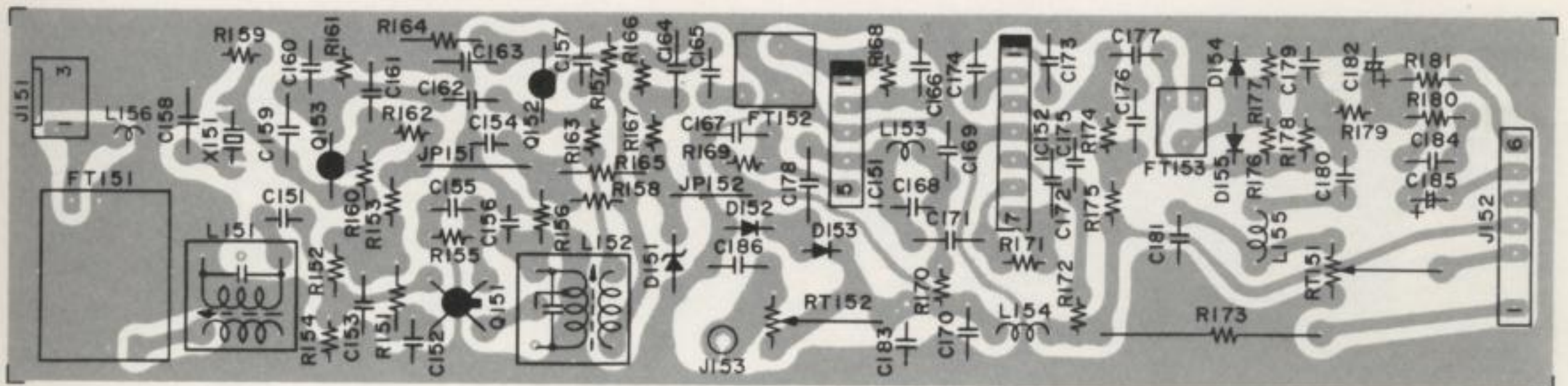
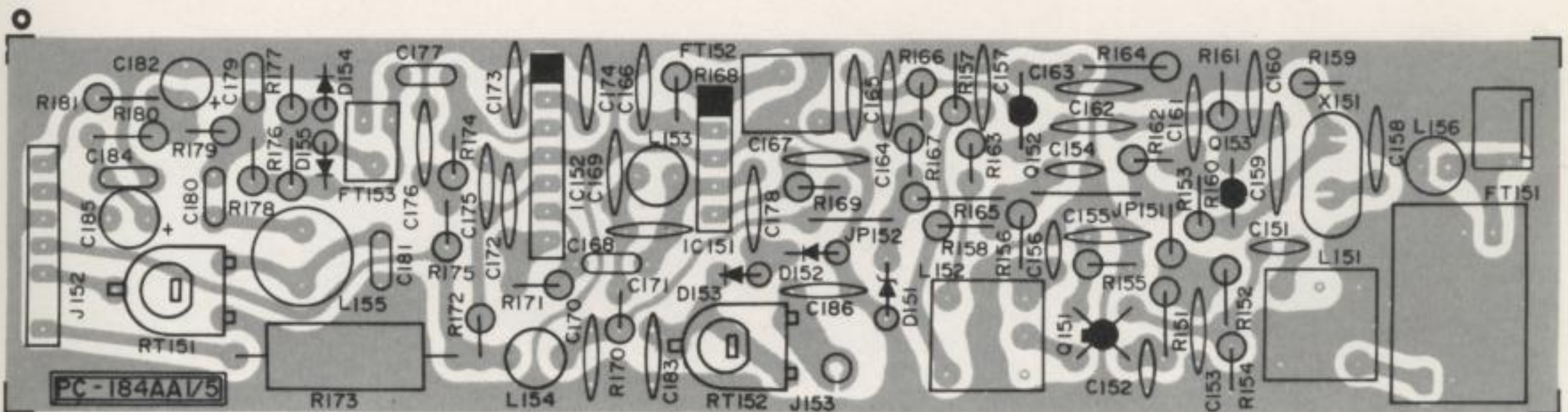


PRINTED CIRCUIT BOARD DETAIL

RF Unit PC - 185 1/4



IF Unit PC - 184 1/5

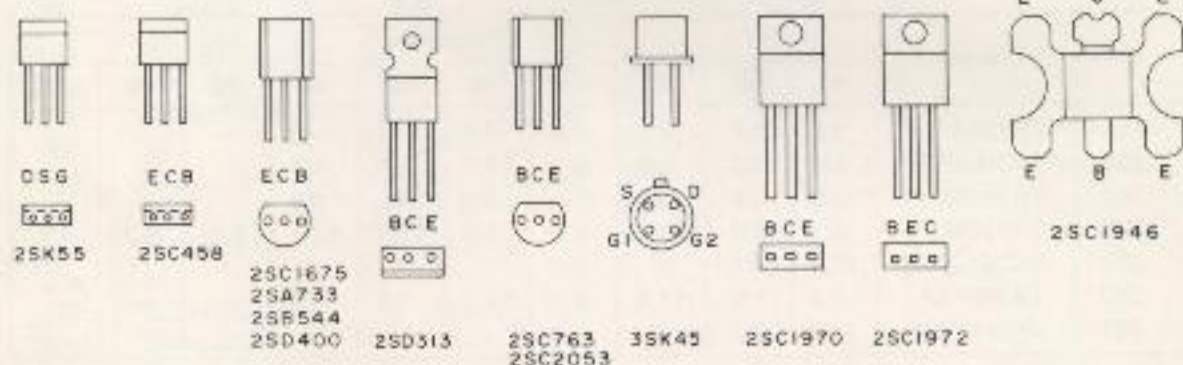


Digital IC

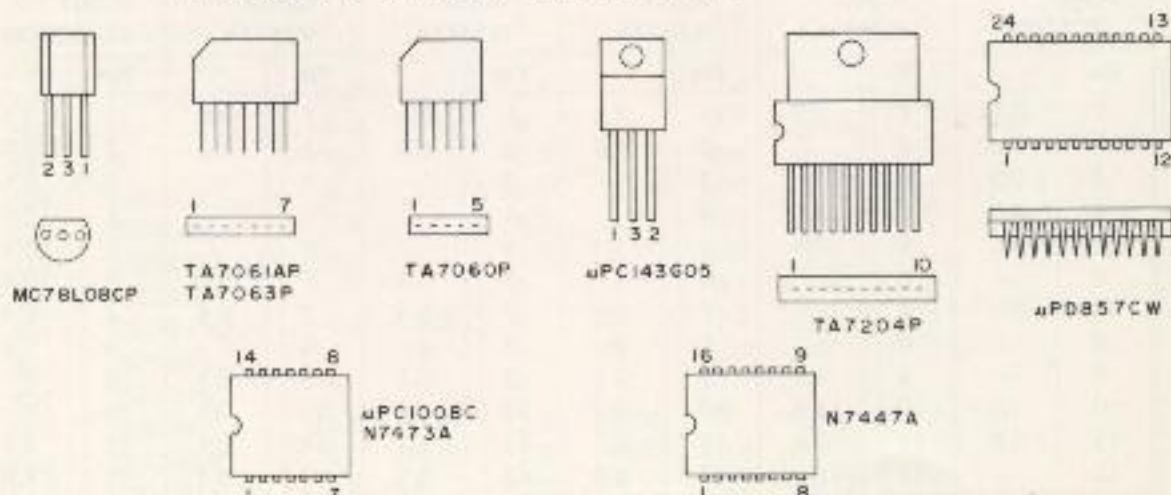
IC302 μPC1008C		IC303 N7473A		IC651 N7447A		IC652 N7447A		IC653 N7447A		IC301 μPD857CW	
Pin		Pin		Pin		Pin		Pin		Pin	
13	4.0	13	1.8	13	0.3	13	0.1	13	0.1	13	0.1
14	4.8	14	—	14	0.1	14	0.3	14	0.3	14	1.8
				15	0.1	15	0.1	15	0.1	15	0
				16	4.9	16	4.9	16	4.9	16	—
										17	—
										18	1.8
										19	2.1
										20	0
										21	—
										22	—
										23	0
										24	—

FET, TRANSISTOR & IC TERMINAL GUIDE

FET & TRANSISTOR CONNECTIONS



INTEGRATED CIRCUIT CONNECTIONS



Bipolar Transistor & J-FET

#	Name	B/G	E/S	C/D	Remarks
557	2SA733-P	13.2	13.8	13.2	
558	2SB544-E	13.2	13.8	13.8	
706	2SC1675-L	6.0	5.6	13.5	

Bipolar Transistor

#	Name	B	E	C	Remarks
Q554	2SA733-P	12.9	13.8	13.8	Normal operating at Hi-power.
		13.8	13.8	3.3	Normal operating at Low-power.
		13.8	13.8	0	Controlled by APC or unlocked signal.
555	2SC458-C	5.8	5.3	13.2	Normal operating at Hi-power.
		1.0	0.6	13.8	Normal operating at Low-power.
		0	0	13.8	Controlled by APC or unlocked signal.
556	2SC458-C	0	0	5.8	Normal operating at Hi-power.
		0	0	1.0	Normal operating at Hi-power.
		0.6	0	0	Controlled by APC or unlocked signal.
801	2SD313-E	13.8	11.2	13.8	Normal operating at Hi-power.
		3.3	2.5	13.8	Normal operating at Low-power.
		0	0	13.8	Controlled by APC or unlocked signal.

Linear IC

#	Name	Pin number									
		#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
IC151	TA7060	1.4	1.4	0	7.6	7.4	-	-	-	-	-
152	TA7061AP	1.8	1.8	5.7	0	7.1	1.6	1.7	-	-	-
201	TA7063P	1.3	0.6	0.1	0	0.7	5.2	8.0	-	-	-
202	TA7204P	0	6.3	13.8	7.7	1.3	11.3	13.1	6.3	6.2	4.6
351	MC78L08CP	13.8	7.4	0	-	-	-	-	-	-	-
352	TA7061AP	1.9	1.9	11.4	0	11.2	1.9	1.9	-	-	-
801	μPC143G05	13.8	4.9	0	-	-	-	-	-	-	-

Digital IC

IC302 μPC1008C		IC303 N7473A		IC651 N7447A		IC652 N7447A		IC653 N7447A		IC301 μPD857CW	
Pin		Pin		Pin		Pin		Pin		Pin	
1	0.1	1	2.3	1	4.9	1	0.4	1	0.4	1	0.4
2	4.0	2	-	2	4.9	2	0.4	2	0.4	2	0.4
3	2.3	3	-	3	-	3	-	3	-	3	0.4
4	4.0	4	4.8	4	-	4	-	4	-	4	0.4
5	4.6	5	2.4	5	-	5	-	5	-	5	0.4
6	-	6	-	6	0	6	0.4	6	0.4	6	0.4
7	0	7	-	7	0.5	7	0.4	7	0.4	7	0.4
8	-	8	-	8	0	8	0	8	0	8	0.4
9	-	9	1.8	9	0.1	9	0.1	9	0.1	9	0
10	1.3	10	4.8	10	0.1	10	0.1	10	0.1	10	0
11	4.0	11	0	11	0.1	11	0.1	11	0.1	11	4.8
12	-	12	-	12	0.3	12	0.1	12	0.1	12	4.8

VOLTAGE CHART

Notes.

1. Measured at 146,00 MHz.
2. Measured by DC voltmeter 50K ohm/V.
3. B; Base, E; Emitter, C; Collector, G; Gate, S; Source, D; Drain.

Dual Gate MOS-FET

#	Name	G1	G2	S	D	Remarks
Q101	3SK45-B	0	3.9	0.3	12.8	
102	do	0	0	0.2	12.3	
151	do	0.7	1.8	0.8	6.0	
256	do	0	0	0.3	5.5	
355	do	0	3.1	0	6.2	
356	do	0	3.1	0.7	6.7	
401	do	0	0	0.3	12.0	
402	do	0	0	0.3	12.0	
403	do	0	4.3	0	11.8	

Bipolar Transistor & J-FET

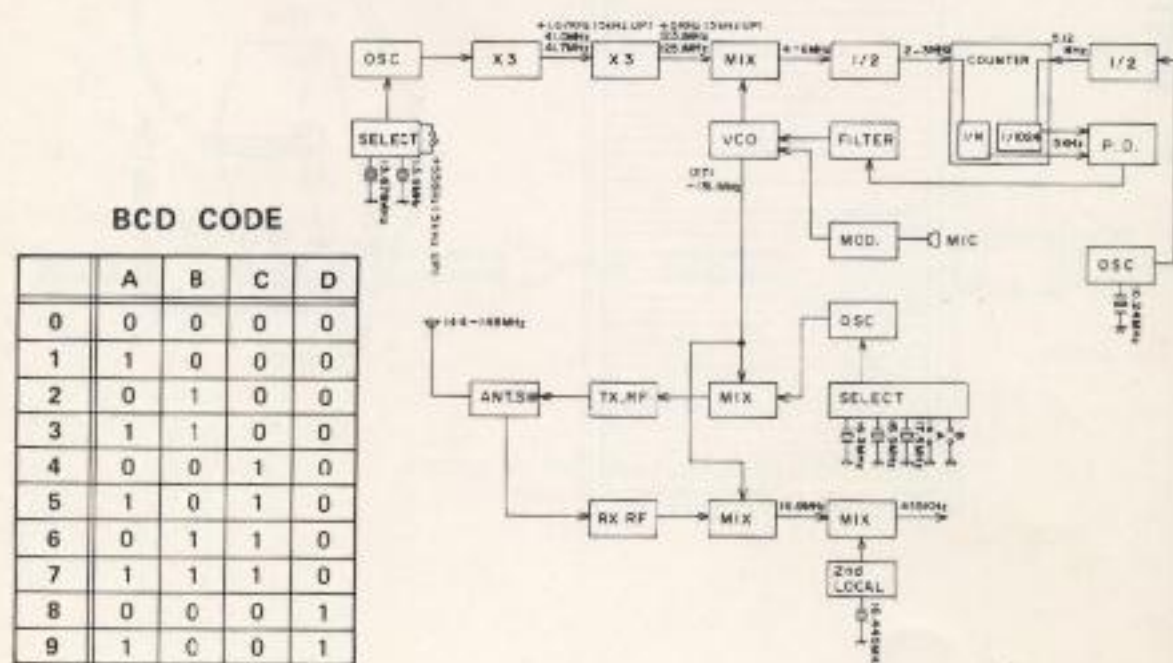
#	Name	B/G	E/S	C/D	Remarks
Q152	2SC1675-L	1.9	1.3	11.5	
153	do	3.0	2.7	6.6	
201	2SC458-C	1.0	0.5	5.5	
202	do	0 (0.6)	0 (0)	1.3 (0)	() : SQ Max.
203	do	1.3 (0) c1.6'	0.7 (0) c5'	4.4 (13.2) c13.2'	() : SQ Max. cc : TX.
253	2SC1675-L	3.5	3.3	7.3	
254	do	2.2	2.6	7.2	
257	2SC763-C	1.5	0.9	5.7	
301	2SC458-C	0.4	0	2.3	
302	2SA733-P	4.7	4.8	0	
303	2SC763-C	0.1	0	2.3	
304	2SC1675-L	1.4	0.9	1.8	
305	2SC763-C	0.1	0	2.4	
306	2SC1675-L	2.0	1.9	4.5	
351	2SC458-LGC	1.2	0.6	7.4	
352	do	0.6	0	4.1	
353	do	4.0	3.4	7.4	
354	2SK55-D	0	0.5	7.0	
357	2SC458-C	7.3	6.9	13.5	
404	2SC763-C	0.7	1.0	9.6	
405	2SC2053	-0.5	0	9.1	
451	2SC1970	-0.3 (-0.2)	0 (0)	11.2 (2.5)	() : Low Power
452	2SC1972	0 (0)	0 (0)	11.2 (2.5)	do
453	2SC1946	0	0	12.7	
551	2SB544-E	13.5 (12.9)	13.5 (13.5)	0 (13.5)	() : TX
552	2SA733-P	12.9 (13.5)	13.5 (13.5)	13.5 (0)	do
553	2SD400-E	13.5 (0)	13.5 (0)	13.5 (13.5)	do

FREQUENCY CHART

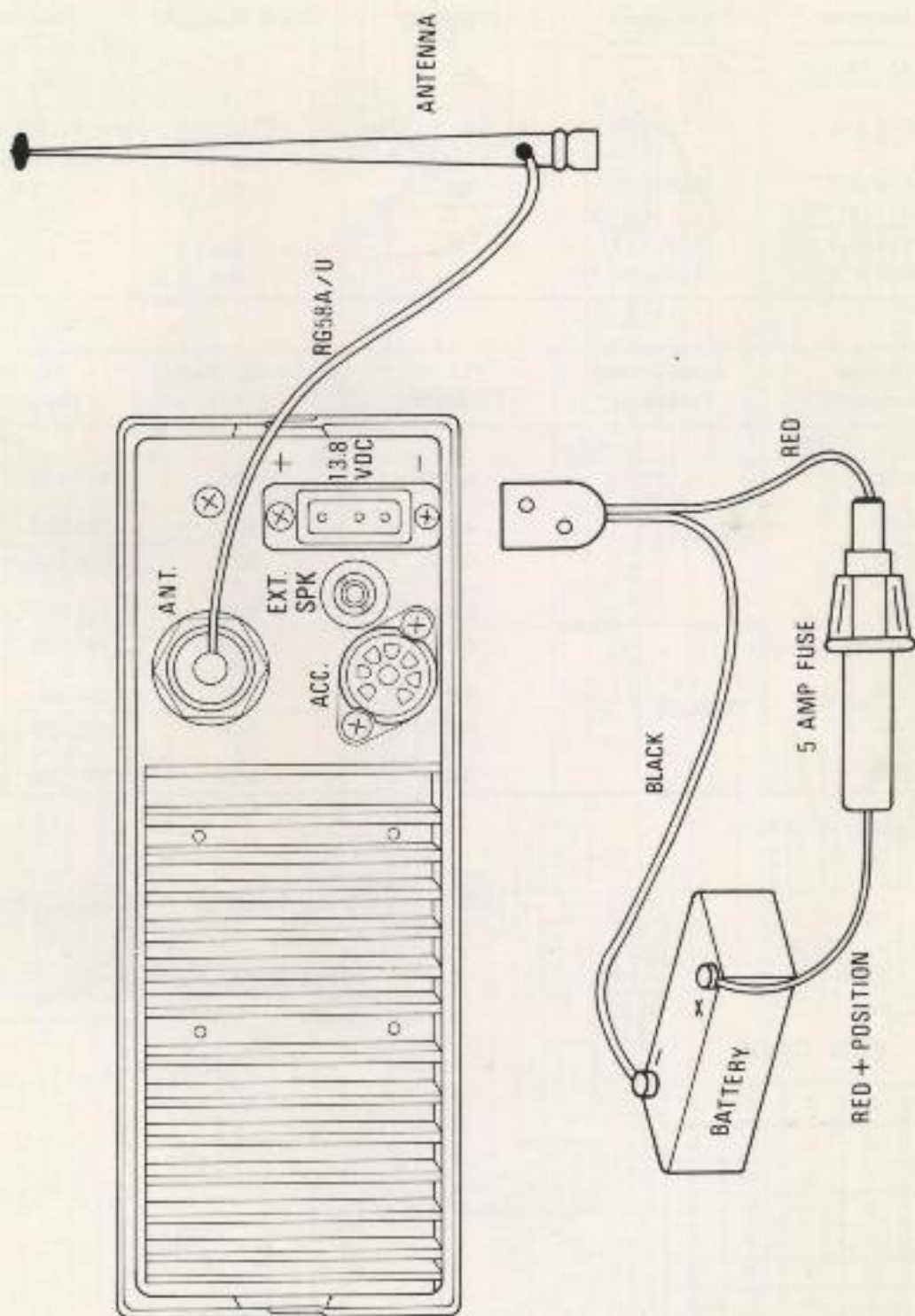
Channel Designator	Local Crystal Frequency	PLL IF Frequency	Divided & BCD CODE Ratio [N]	Out put Frequency
<u>14[A] . [B] [C]</u>				
A-4 or 5	13.67778	[A] . [B] [C] MHz	[A] [B] [C]	14[A] . [B] [C] MHz
A-6 or 7	13.90000	do.	do.	do.
<u>14[A] . [B] [C] 5</u>				
A-4 or 5	13.67833	do.	do.	do.
A-6 or 7	13.90056	do.	do.	do.

Channel Designator	Local Crystal Frequency	PLL IF Frequency	Divided Ratio [N]	Out put Frequency
	+5K	+5K		+5K
144.00 ? 144.99	13.67778	4.000 ? 4.990	400 ? 499	127.100 ? 128.090
145.00 ? 145.99		+556Hz	5.000 ? 5.990	500 ? 599
146.00 ? 146.99	13.90000		4.000 ? 4.990	400 ? 499
147.00 ? 147.99			5.000 ? 5.990	500 ? 500

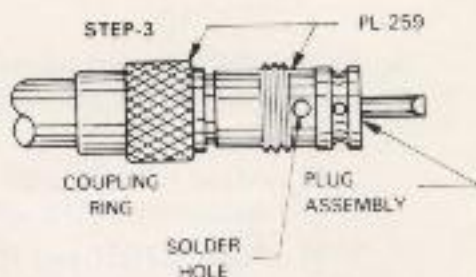
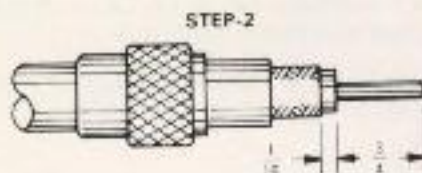
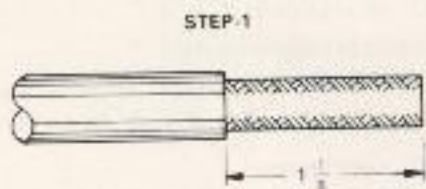
*Frequencies are in MHz.



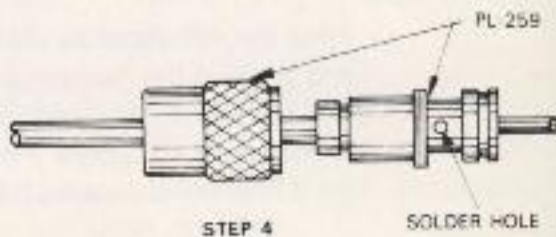
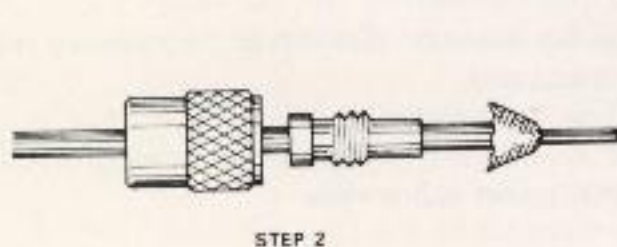
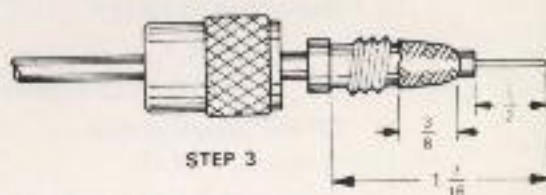
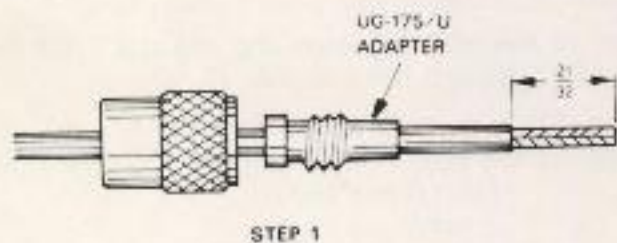
INSTALLATION DIAGRAM



COAXIAL CONNECTOR ASSEMBLY DETAIL



ASSEMBLING ANTENNA PLUG TO RG-58U OR EQUIVALENT



ASSEMBLING ANTENNA PLUG TO RG-58U OR OTHER 1/4" COAXIAL CABLE

- g) Feed the output power of feed through dummy load to the spectrum analyzer through the RF attenuator.
- h) Connect J502 (APC output in APC unit) to the DC volt meter.
- i) Repeat the following adjustments several times respectively.
(Set the channel to the SIMPLEX of 146.00 MHz).
 - i-1) Adjust RT551 for 27 watts on RF power meter.
 - i-2) Adjust CT501 and RT501 for the minimum swing on DC volt meter.
 - i-3) Adjust CT452, CT453 and CT454 for the maximum power on the RF power meter.
 - i-4) Adjust RT502 for the middle reading of Red mark on P/S meter of the unit.
- j) Adjust CT701 and set the frequency to the 146.00 MHz.
- k) Press the DUPLEX-SIMPLEX switch and set the TX OFF SET switch to the -600 position, and adjust CT702 for the 145.400 MHz.
- l) Set the TX OFFSET switch to the +600 position and adjust CT703 for the 146.600 MHz.
- m) Set in the HI-LOW switch to the low position and adjust RT551 for 1.5W on RF power meter.
- n) Feed AF 1KHz 100mV from the microphone connector and adjust RT 351 for 5 KHz on FM linear detector.
- o) Feed the AF signal to the pin No. 5 and 6 (Ground) in the accessory jack and check if the modulation is activated.
- p) Remove the RF power meter from the antenna connector and adjust RT553 for 2.5 amperes on the 13.6VDC power source meter.
- q) Again, connect the RF power meter to the antenna connector and just adjust CT454 to minimize the power difference during 144 to 147.900 MHz.

7.4.2 Set-up:

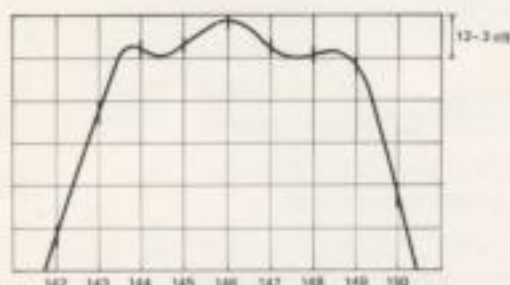
- a) Initial front panel controls should be set in the following manner:
 - * POWER SWITCH (Off-volume) : Off
 - * HI-LOW SWITCH : HI Position
 - * DUPLEX-SIMPLEX SWITCH : Simplex
 - * OTHER SWITCHES : Any position
- b) Connect the power cable to the 13.8V DC power source.
- c) Connect the power meter to the antenna terminal.
- d) Connect the FM linear detector and the frequency counter.
- e) Connect the TX switch, the AF oscillator and the VTVM to the microphone connector (Mike connector pin No. 1 - Audio, 2 & 3 - Ground, 4 - PTT.).

7.4.3 Procedure:

- a) Before the power switch is on, make the preliminary adjustment as follows:
 - a-1) Adjust L401 through L407 so that the core enters about 1.2mm below the can.
 - a-2) Turn the semi-fixed resistors as follows:
 - RT551 and RT553 : Fully clockwise
 - RT351 and RT552 : Fully counterclockwise
 - RT401 : Middle position
 - a-3) Set the trimmer CT401, CT402, CT451, CT452, CT453, CT454 and CT501 at the position of half capacitance.
- b) Turn on the power switch and set the channel to the 146.00MHz.
- c) Keep the unit in TX with the microphone or the TX switch and adjust L401 through L406 for the maximum voltage at the TP401.
- d) Adjust L407, CT401 and CT402 for the maximum reading on the 13.8VDC power source meter.
- e) Adjust CT451, CT452 and CT453 for the maximum reading on the RF power meter.
- f) Repeat the above step c) through e) adjustments repeatedly.

7.3.3 Procedure:

- Apply power to the unit and turn on power switch.
- Adjust L101, L102 and FT101 to obtain a wave form as illustrated below on the following measurement conditions.



- * Input level 5.6mV rms
- * Marker Increment by 1 MHz
- * Center frequency 146 MHz
- * Oscilloscope x 1 range (max.)

- Then, detach the sweep generator and remove the cable from the top of Q102 in RF unit, and connect the signal generator (146.00MHz, 3.3KHz deviation at AF 1 KHz) with the antenna terminal and also connect again J351 in VCO unit.
- Increase the power of the signal generator for one third reading of indicator on the S-Meter scale and adjust L103, L104, L151 and L152 several times respectively for the peak power.
- Adjust the signal generator for the 60dB input and adjust RT152 to make the meter indicator stay at the center position between the full-scale point and the maximum point.
- Keep the squelch control at the tight position and obtain the 4 dB output of the signal generator, and adjust RT151 for no AF output power.

7.4 TRANSMITTER

7.4.1 Equipment Required:

- 13.8VDC power source (8A)
- RF power meter (Bird Watt Meter 50W 150MHz)
- Frequency Counter (More than 150MHz)
- FM Linear detector
- AF distortion meter
- VTVM
- AF oscillator
- Spectrum analyzer (1.2G Hz)
- Microphone or TX Switch
- DC volt meter
- Feed through dummy load (more than 30 watts)
- RF attenuator

2) Measure and adjust frequency on following channels.

• 144.005MHz	: f = 127.105MHz	CT254
• 144.000 MHz	: f = 127.100	CT251
• 147.005 MHz	: f = 130.105	CT253
• 147.000 MHz	: f = 147.000	CT252

Note: Repeat the procedures 144.005MHz, 144.000MHz and 147.005MHz, 147.000MHz respectively.

h) Adjust L352 for $5.5V \pm 0.2$ Volts on TP351 by VTVM at the frequency of 147.990 MHz.

7.3 RECEIVER

7.3.1 Equipment Required:

- 13.8VDC Power Source (3A)
- VHF Sweep generator and all accessories
- Signal generator (144 – 148MHz)
- AF measurement equipments —4 ohm dummy load
V.T.V.M.
Oscilloscope
Distortion Meter
Audio Oscillator
- DC Volt Meter

7.3.2 Set-up:

- Initial front panel controls should be set in the following manner :
 - POWER SWITCH (Off-volume) : Off
 - SQUELCH CONTROL : Fully counterclockwise
 - OTHER SWITCHES : Any position

Connect the power cable to the 13.8VDC power source.

- Connect all of AF measurement equipments (See 7.3.1 – d) to external speaker jack.
- Connect the top of Q102 in RF unit to the RF input of sweep generator.
- Adjust the Helical Resonator FT101, but be sure to detach J351 in VCO unit.

7.2.2 Set-up:

- a) Initial front panel controls should be set in the following manner:
 - * POWER SWITCH (OFF-Volume) : Off
 - * 10KHz & 100KHz SELECTOR SWITCH : Any position
 - * BAND MHz SELECTOR SWITCH : Any position
 - * 5 KHz SWITCH : Either position
 - * DUPLEX-SIMPLEX SWITCH : Simplex
 - * TX OFFSET SWITCH : Any position
 - * HI-LOW SWITCH : Either position
- b) Connect the power cable to the 13.8VDC power source.
- c) In the VCO unit.
 - c-1) Remove the wire of either J353 or J303
 - c-2) Remove the connector plug of J352 and connect to Synchroscope using coaxial cable with 2-P connector to be fitted to the terminals, 6 (HOT) and 7 (GROUND).
 - c-3) Connect VTVM and 200K ohm variable resistor to TP351 as described below:

7.2.3 Procedure:

- a) Apply power to the unit.
- b) Adjust 200K ohm variable resistor connected to TP351 for 5.5 Volt VTVM reading and L352 for 131.1MHz \pm 0.2MHz frequency counter reading.
- c) Adjust 200Kohm variable resistor for 129.1 MHz \pm 0.2 MHz frequency counter reading and L354 for maximum synchroscope amplitude.
- d) Remove the connector for J352 6 and 7 and reconnect it to J352 4 and 5. Then, adjust L353 for maximum.
- e) Connect TP251 to 10 : 1 probe of synchroscope and adjust L253 and 254 for maximum synchroscope amplitude, and also adjust them so as to be within 20% of amplitude difference in case 145 and 146MHz bands are switched over each other.
- f) As for TP-252, adjust L255 and 256, the same to above.
- g) Conduct frequency adjustment in the following manner:
 - 1) Connect frequency counter to the plug (P401) of J401.

6.3.3 VCO Unit: The difference output from the counter unit passes through the active low pass filter (Q351 through Q353), and goes into the VCO D351, D352 and Q354, and controls the VCO frequency. The output of the VCO is amplified by Q356, and fed into the local unit PLL mixer Q256. On the other hand, the output of the VCO is also amplified by Q355, which produces the local frequency for both transmit and receive.

6.3.4 Display Unit: The desired BCD code is selected by the channel selector, and decoded by IC651 through IC653, and it drives the LED display.

6.4 POWER SUPPLY CIRCUIT

DC input from the power connector is regulated by Q551 through Q553, and 13.6V DC is selected for transmit and receive. Q557 and Q558 are worked as protector circuit. When the excessive power happens to be supplied in transmit or receive, Q558 is automatically cut off and protects the circuits from the damage. IC801 is used for a 5V regulator for the TTL and C-MOS. Q554, Q555 and Q801 regulate the final unit as high-low power controller. D553, D554 and Q556 are activated by APC unit, and unlock signal of the counter unit, and regulate Q555 to shut down the transmit power.

SECTION 7. ALIGNMENT PROCEDURE

7.1 GENERAL

THE 13-510 HAS BEEN FACTORY ALIGNED USING TECHNIQUES AND TEST EQUIPMENTS NOT NORMALLY AVAILABLE TO THE SERVICE TECHNICIAN. IT SHOULD NOT BE NECESSARY TO PERFORM ANY ALIGNMENT ON THE UNIT AS RECEIVED FROM THE FACTORY. IN THE EVENT OF COMPONENT FAILURE, ANY REALIGNMENT WILL BE MINIMAL. IF IT APPEARS THAT ANY LARGE DEGREE OF REALIGNMENT IS REQUIRED, THOROUGHLY CHECK THE REPLACEMENT COMPONENT BEFORE PROCEEDING.

7.2 PHASE LOCKED LOOP CIRCUIT

7.2.1 Equipment Required:

- a) 13.8V DC Power Source (3A).
- b) Synchroscope (DC to more than 150MHz)
- c) Frequency Counter (More than 150MHz)

SECTION 6. CIRCUIT DESCRIPTION

6.1 RECEIVER CIRCUIT

- 6.1.1 RF Unit:** Signal from the antenna connector passes through the dual-tuned band pass filter, and is amplified by Q101, and fed into FT101 a 3-section helical resonator. The signal is then mixed with signal from the VCO unit by Q102 first mixer, and produces first IF 16.9MHz.
- 6.1.2 IF Unit:** Signal from the RF unit passes through FT151 4-section monolithic crystal filter, and is amplified by Q151 first IF AMP., and is mixed with signal from Q153, 16.445 MHz. Second IF passes through FT152 ceramic filter, and is limited in amplification by IC151 and 152. The AF signal is detected by FT153 ceramic discriminator, and fed into the AF unit.
- 6.1.3 AF Unit:** AF signal from the IF unit is amplified by Q203 and IC202, and drives the speaker, while noise signal from the IF unit is amplified by IC201 and Q201, and detected by D201 and D202, and drives switching transistor. Q202 controls Q203 AF amplifier and activates squelch.

6.2 TRANSMITTER CIRCUIT

- Tx Driver Stage Unit:** Signal from the VCO and Signal which is selected from X701 to X705 and oscillated by Q706 in IF unit are mixed with balanced mixer Q401 and Q402, and produce mixer output in the 146 MHz band. That signal is then amplified by Q403, Q404 and Q405, and drives the final unit.
- 6.2.2 Final Unit:** Output from the transmit driver unit is amplified by Q451, Q452 and Q453 into a 25 watt output which is supplied into the APC unit. Signal from the final unit passes through the SWR bridge, diode switch D503 and D504, and also passes through 3-section low pass filter, and produces 25 watt output which is supplied into the APC unit.

6.3 PHASE LOCKED LOOP CIRCUIT

- 6.3.1 Local Unit:** Crystals X251 and X252 are selected by switching transistors Q251 and Q252, and are oscillated by Q253. Oscillation output is multiplied three times by Q254, and again multiplied three time by Q255, and then it is fed into PLL mixer Q256. Simultaneously fed into Q256 is the output of VCO unit, and PLL IF (4.000 – 5.995MHz) is produced.
- 6.3.2 Counter Unit:** The PLL IF is amplified by Q304 generated by Q303 and fed into IC304. This signal is divided in half by IC304. It is then program-divided by 301, to produce an output of 25KHz. On the other hand, X301(10.24MHz) is oscillated by Q306, and fed into IC304 through driver Q305. Here again, the signal frequency is divided in half by IC304, and fed into IC301, where the output of 1/1024 (5 KHz) is produced.

5.3.2 Carefully adjust the squelch control clockwise until the audio noise just disappears. This is the proper squelch threshold setting and must be done when no signal is present. Your transceiver will now remain silent until an incoming signal is received which opens the squelch. If the squelch is unstable due to the reception of weak or unstable stations, adjust the squelch control further until the proper threshold is obtained.

5.3.3 The S meter indicates the signal strength of the incoming stations and is calibrated in S units. An input signal of approximately 5 μ V will provide an S9 reading.

5.4 TRANSMITTER

The operation of the transmitter and receiver is controlled by the push-to-talk switch located on the side of the microphone. When depressed, the transmitter is placed into operation and the receiver becomes inoperative. When released, the receiver is automatically restored to operation and, at the same time, the transmitter becomes inoperative.

5.4.1 Place the DUPLEX/SIMPLEX switch in either the DUPLEX or SIMPLEX position at your desire. In the DUPLEX position, TX OFFSET switch activates and DUPLEX INDICATOR LIGHT illuminates. In the -600 position on TX OFFSET switch, the transceiver transmits at the frequency of -600kHz than Receiver frequency and in the +600 position, the transceiver transmits at the frequency of +600 kHz.

5.4.2 Place the HI-LOW power switch in either the HI or LOW position dependent on the range of desired communications. In the HI position, the transceiver operates at full 25 watt power for maximum output. In the LOW position, the transceiver operates at one watt of power. When using the transceiver as a driver or exciter for a linear amplifier the HI-LOW power switch can be set to the LOW power position and the power output adjusted as described in the Power Supply section. This will provide the required amount of drive for the linear amplifier without wasting power in swamping resistors, etc.

5.4.3 When pushing the PTT (push-to-talk) button on the microphone, The TX INDICATOR LIGHT is illuminated and the METER provides an indication of relative power output of the transmitter. The pointer will be on or near the red mark on the meter scale when on high power and just a little over one on low power.

NOTE: Do not attempt to transmit unless your antenna is properly connected.

4.2.1 ANTENNA CONNECTOR: Accepts standard PL-259 coaxial connector.

Note: Some transceivers may come with a metric threaded connector. If this is the case, a mating metric PL-259 is supplied also. Most PL-259 connectors will mate satisfactorily if care is taken to seat them properly. If you have difficulty, try a different make of PL-259.

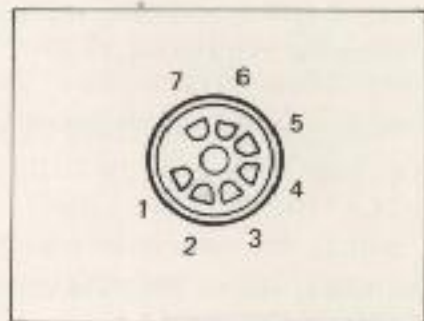
4.2.2 POWER CONNECTOR: For use with supplied power cord.

4.2.3. EXTERNAL SPEAKER JACK: This jack mates with the accessory Ext. Speaker plug supplied for external 8 ohm speaker on headset use. The use of this jack will disable the internal speaker.

4.2.4. ACCESSORY JACK: Accepts accessory 7 prong plug supplied for tone-burst and discriminator meter.

It would have as connections.

1. Blank
2. Transmit keyed 12 VDC positive
3. Discriminator meter connection
4. Ground
5. Tone audio input (10 mV)
6. Ground
7. Blank



SECTION 5. OPERATING INSTRUCTIONS

5.1 INITIAL PREPARATIONS

- 5.1.1 Connect the microphone to the microphone jack.
- 5.1.2 Connect the antenna to the antenna coax connector. Make sure the coax line is of the correct impedance (50 ohms) and is neither shorted nor open circuited.
- 5.1.3 Make sure the volume control is in the off position and the squelch control is in the maximum counterclockwise position. The red lead should be connected to the positive side of the power source and the black lead to the negative side. In the even that these leads are improperly connected, the 13-510 will not function. No damage will be incurred since protection is provided in the 13-510 for this purpose.

5.2 OPERATION

- 5.2.1 Rotate the volume control clockwise a few degrees until the switch snaps into the ON position, and LED frequency display on the channel window and S/Rf meter will be illuminated.
- 5.2.2 Adjust BAND MHz, 100kHz and 10kHz selector switches to the desired frequency.

5.3 RECEIVER

- 5.3.1 Advance the volume control to the desired audio level, if no signal is present.

4.1.6 BAND MHz SELECTOR SWITCH: This four position rotary switch selects the desired frequency digit on MHz from 4 to 7 and simultaneously activates LED display on the channel window. Note that the digits "14" are fixed and back-lighted when the power is "ON".

4.1.7 TX OFFSET SWITCH: In the DUPLEX position on DUPLEX/SIMPLEX switch, this switch activates and is used for Repeater operation and different frequency operation. "-600" position shifts Transmit frequency by -600 KHz against Receiver frequency. Note, in this case, that the frequency on the LED display coincide Receiver frequency. Also, "+600" position shifts Transmit frequency by +600 KHz against Receiver frequency. "A" and "B" positions make it possible to set optional shifting frequencies by putting additional crystals. The following is computation of additional crystal frequency.

$16.900 \text{ MHz} \pm \text{desired shifting frequency} = \text{crystal frequency}$

Ex: In case of "-800 KHz" of shifting frequency,

$16.900 \text{ MHz} - 800 \text{ KHz} = 16.100 \text{ MHz (crystal frequency)}$

4.1.8 DUPLEX/SIMPLEX SWITCH:

"DUPLEX" position: The unit is set to DUPLEX operating which activates TX OFFSET SWITCH.

"SIMPLEX" position: The unit is set to SIMPLEX operation which communicates on the same frequency of Transmit and Receive.

4.1.9 5 KHz SWITCH: This switch increases operating frequency by 5 KHz and simultaneously activates LED display on the channel window.

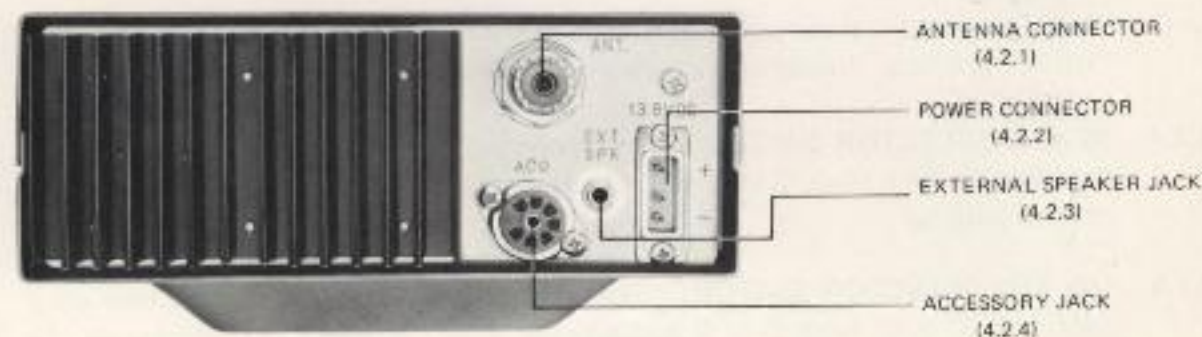
4.1.10 S/R F PWR METER: Shows field strength of the signal when receiving and relative transmitter RF output power.

4.1.11 DUPLEX INDICATOR LIGHT: Lights brightly when DUPLEX switch is activated.

4.1.12 TX INDICATOR LIGHT: Lights brightly when transmitting.

4.1.13 MICROPHONE JACK: Accepts 4 prong mike plug supplied on microphone.

4.2 REAR PANEL CONTROLS



SECTION 4. CONTROL FUNCTIONS

4.1 FRONT PANEL CONTROLS



- 4.1.1 ON-OFF/VOLUME CONTROL:** Applies power to receiver and adjusts desired level of sound.
- 4.1.2 SQUELCH CONTROL:** Silences background noise in the absence of a received signal when properly adjusted.
- 4.1.3 HI-LOW SWITCH:**
"LOW" position: transmitter is powered at the 1 watt level
"HIGH" position: transmitter is powered at the 25 watts level
- 4.1.4 10 KHz SELECTOR SWITCH:** The inner switch selects the desired frequency digit on 10 KHz from 0 to 9 and simultaneously activates LED display on the channel window.
- 4.1.5 100 KHz SELECTOR SWITCH:** The outer switch selects the desired frequency digit on 100 KHz from 0 to 9 and simultaneously activates LED display on the channel window.

3.4 Antenna:

The most important single item that will influence the performance of any communication system is the antenna. For that reason, a good, high-quality, gain antenna of 50 ohms impedance is recommended. When adjusting your antenna, whether mobile or fixed, by all means follow the manufacturer's instructions. There are some pitfalls to be aware of. For example, do not attempt to adjust an antenna for lowest VSWR when using a diode VSWR meter not engineered for VHF applications. Such readings will invariably have an error of 40% or more. Rather, use an in line watt meter similar to the Drake WV-4 or Bird Model 23 with VHF cartridge. Further, when adjusting a mobile antenna, do so with the motor running preferably above normal idling speed. This will insure proper voltage level to the transceiver.

Do not become alarmed if your transceiver fails to transmit at time during the antenna tune up procedure. Remember, your transceiver has a built-in Automatic Protection Circuit (APC) that will disable the transmitter if excessive VSWR, a short coaxial line or connector, or other antenna deficiency is present. A quick check on a good 50 ohm dummy load will show the transceiver to be working. The difficulty will lie with the antenna or its transmission line.

The RF coaxial connector on the rear chassis mates with a standard PL-259 connector.

3.5 Microphone:

A high quality dynamic microphone is supplied with your transceiver. Merely plug it into the proper receptacle on the front panel. Should you wish to use a different microphone, make certain it is of the low impedance type (600 ohms). Particular care should be exercised in wiring also, as the internal electronic switching system is dependant upon it. See the schematic for the proper hook up. Under no circumstances use a "gain pre-amp" type microphone. The audio system in your transceiver is more than adequate and additional pre-amplification is unnecessary. To use this class of microphone is to invite distortion and possible damage to the transceiver.

SECTION 3. INSTALLATION

3.1 Unpacking:

Carefully remove your transceiver from the packing carton and examine it for signs of shipping damage. Should any shipping damage be apparent, notify the delivering carrier or dealer immediately, stating the full extent of the damage. It is recommended you keep the shipping carton. In the event storage, moving, or reshipment becomes necessary, they come in handy. Accessory hardware, cables, etc., are packed with the transceiver. Make sure you have not overlooked anything.

3.2 Location:

Where you place the transceiver in your automobile is not critical and should be governed by convenience and accessibility entirely. Since the unit is so compact, many mobile possibilities present themselves. In general, the mobile mounting bracket will provide you with some guide as to placement. Any place where it can be mounted with metal screws, bolts, or pop-rivets will work. For base station operation, the bracket for desk-top use is useful.

3.3 Power Requirements:

The transceiver is supplied ready to operate from any regulated 13.8V DC, 7.0 ampere negative ground source. An automobile, 12 volt, negative ground, system is usually more than adequate. Some note must be taken, however, to the condition of the vehicle's electrical system. Problems such as low battery, worn generator/alternator, poor voltage regulator, etc., will impair operation of your transceiver as well as the vehicle.

High noise generation or low voltage delivery can be traced to these deficiencies. If an AC power supply is used with your transceiver, make certain it is adequately regulated for both voltage and current. Low voltage while under load will not produce satisfactory results from your transceiver. Receiver gain and transmitter output will be greatly impaired.

Caution: Excessive Voltage (above 16VDC) will cause damage to your transceiver. Be sure to check the source voltage before connecting the power cord.

Included with your transceiver is a DC power cable. The red wire is positive (+), and the black wire is negative (-). If your mobile installation permits, it is best to connect these directly to the battery terminals. This arrangement eliminates random noise and transient spikes sometimes found springing from automotive accessory wiring. If such an arrangement is not possible, then any convenient B+ lead in the interior of the vehicle and the negative frame can be utilized. Your transceiver provides an internal DC filter that will take out the large amount of transient difficulties anyway. Remember, the unit operates on a negative ground system only-it cannot be used in a positive ground automobile.

ACCESSORIES

The following accessories for the model 13-510 are included.

1) Microphone (dynamic type)	1
2) Microphone hanger	1
3) Spare fuse (7A)	1
4) Mounting bracket	1
5) Instruction manual	1
6) Product information card	1
7) EXT Speaker plug	1
8) Accessory plug	1

SECTION 2. GENERAL INFORMATION

The 13-510 is a sophisticated solid state amateur radio transceiver employing phase Locked Loop circuitry. Operating on full 2 meter bands between 144 to 148 MHz, this unit offers many advanced, modern features. Its entire construction is modular with all major electronic circuits built on separated circuits boards. The 13-510 includes many features found as extras on other transceivers. Included in the equipment are 25 watts RF output power on "HI" position, no channel crystals required, 800 channels selectable for both transmit and receive in 5 KHz steps, LED frequency display, automatic repeater sprit with ± 600 KHz transmit frequency shift for duple operations. As other special feature, it provides an accessory of bracket for desk-top use, which makes the transceiver ideal for base station operation by using an external power supply, as well as mobile operation.

SECTION 1. SPECIFICATIONS

GENERAL

Frequency Coverage	144.00 to 148.00 MHz
Number of Transistors	Transistors.....39
	FET.....10
	IC.....14
	Diodes.....28
Modulation Type	F3
Power Voltage	DC 13.8V \pm 15% Negative ground
Current Drain	Transmit:
	Hi (25W) Average.....7A
	Low (1W) Average.....2A
	Receive Average.....0.8A
Antenna Impedance	50 ohms
Size	2-3/5" (H) x 6-4/5" (W) x 9-3/5" (D)
Weight	3.0 kg, 6.6 lbs

TRANSMITTER

RF Power Output	Hi.....25W
	Low.....1W
Frequency Control	Phase Locked Loop (PLL)
Channels	800 channels in 144 to 148 MHz (10 KHz steps +5 KHz shift up)
Duplex Operations	+600 KHz or -600 KHz Transmitter shift
Frequency Deviation	Adjustable between 3 to 16 KHz Normal 5 KHz
Audio Input	600 ohms
Modulation System	Direct FM (Reactance)
Microphone	600 ohms - Dynamic microphone with push button switch

RECEIVER

Reception Frequencies	800 channels in 144 to 148 MHz
Reception System	Double Superheterodyne
Intermediate Frequencies	1st I.F. 16.9 MHz 2nd I.F. 455 KHz
Sensitivity	(a) Better than 0.5 μ V 20 dB quieting (b) S+N/N at 0.3 μ V input 12dB or more
Spurious Response	-60dB
Squelch Threshold	Less than 0.3 μ V
Band Width	\pm 7.5KHz at 6dB down
Selectivity	\pm 15KHz at 70dB down
Audio output power	1.5W
Audio output impedance	8 ohms
Frequency Controls	PLL (VCO) 127.1MHz to 131.1MHz, No Dubbing

LIMITED WARRANTY

Midland International Corporation will repair or replace, at its option, without charge, any Midland citizens band, marine and amateur transceiver, citizens band test meter, weather monitor, and scanning receiver which fails due to a defect in material or workmanship within 90 days following the initial consumer purchase.

This warranty does not include any carrying cases, earphones, or telescoping antennas which may be a part of or included with the warranted product, or the cost of labor for removal or reinstallation of the product in a vehicle or other mounting.

Performance of any obligation under this warranty may be obtained by returning the warranted product, freight prepaid, along with proof of the purchase date, to Midland International Corporation, Warranty Service Department, 1690 North Topping, Kansas City, Missouri 64120, or to any MIDLAND AUTHORIZED WARRANTY SERVICE STATION. Warranty information and the location of the nearest MIDLAND AUTHORIZED WARRANTY SERVICE STATION, may be obtained by writing Midland International Corporation, Warranty Service Department.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.



MIDLAND
INTERNATIONAL CORPORATION

Communications Division

P.O. Box 1908, Kansas City Missouri 64141
Phone: 913/384-4200 • Telex: 04 2536
Cable Address: MICO

General Offices:

1900 Johnson Drive at State Line Road
Shawnee Mission, Kansas 66205

Distribution and Service Center:

1690 North Topping Avenue, Kansas
City, Missouri 64120

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