Assembly Manual for the

Dick Smith Commander VHF AMATEUR TRANSCEIVER

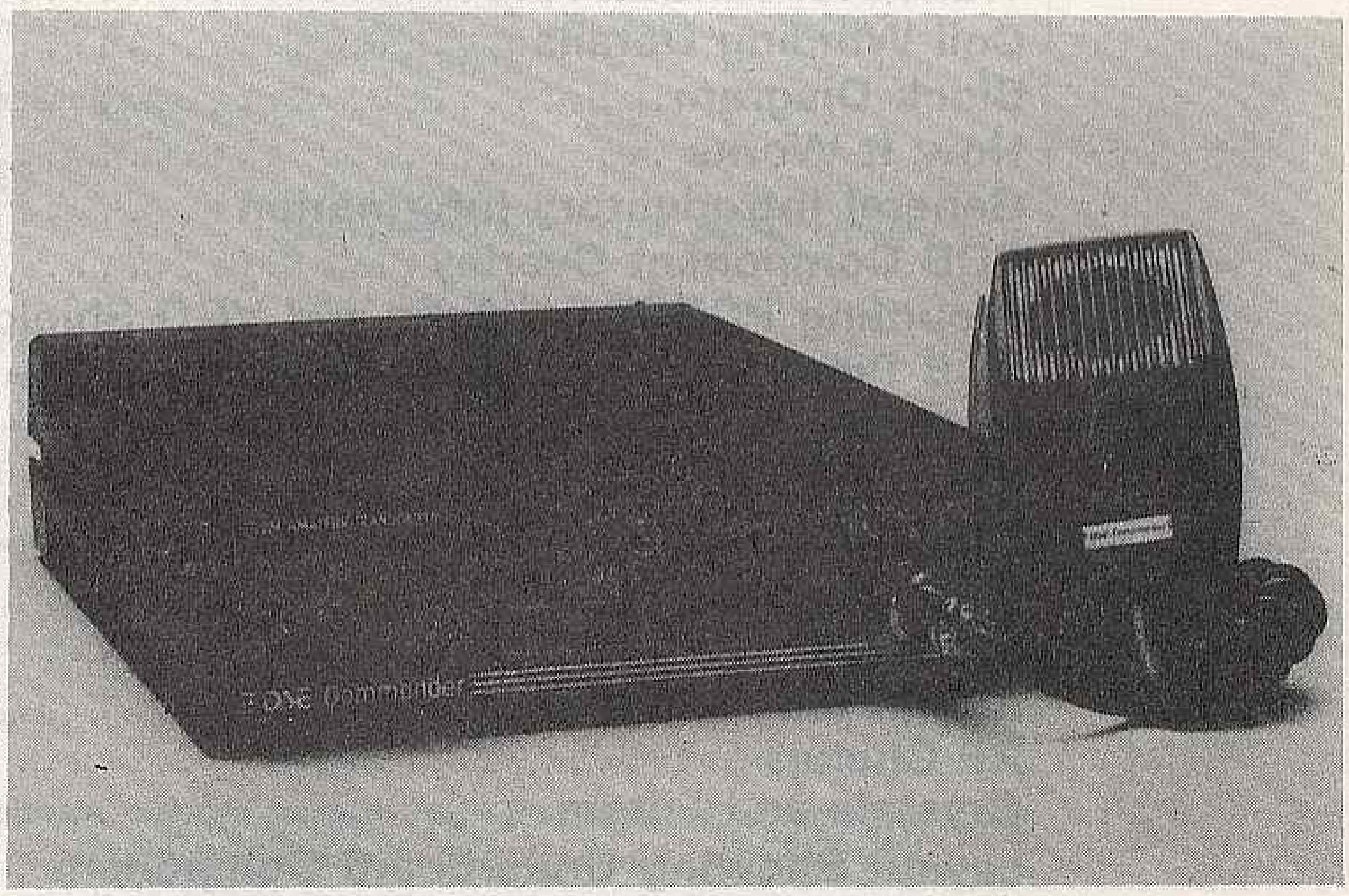
PLEASE READ DISCLAIMER CAREFULLY AS WE CAN ONLY GUARANTEE PARTS AND NOT THE LABOUR CONTENT YOU PROVIDE.

K-6308

ANOTHER Hi-TECH DICK SMITH KIT

Reprinted in part by arrangement with Electronics Australia from the June, 1984 edition

Are you an amateur wanting to upgrade your two-metre gear? Then here's your chance to do it by putting together this up-to-the-minute transceiver which has all the most wanted features.



By any standard, the UHF transceiver described in the September, October and November 1983 issues of EA has been an outstanding success. Many hundreds have been successfully built and the kit supplier responsible, Dick Smith Electronics, has not been able to keep up with the demand.

As the reputation of the UHF transceiver has grown, more and more amateurs have decided to have a go at building a really worthwhile piece of gear for themselves. At the same time, they can save a substantial amount of money over the price of an equivalent commercial unit.

We're very glad to be able to report this development because it signals a resurgence in the construction of gear amongst amateurs who, for a long time, have been content to buy rather than build.

In fact, the UHF transceiver kit has been hailed both here and overseas as being perhaps the most significant amateur radio construction project to be published anywhere for a long time!

Just as night follows day, there was bound to be a call for a two-metre version of the transceiver. We ourselves remarked that the VHF version was just crying out to be produced.

Well now it has happened. The same team that produced the UHF kit, Garry Crapp VK2YBX/T, and Gill McPherson, VK2ZGE, have put their thinking caps on and produced a two-metre transceiver that will certainly set any keen amateur longing.

Features

As the accompanying spec panel shows, this new two-metre transceiver from Dick Smith Electronics has very good performance which is matched by the features that most amateur radio operators want. Note also that there are very few options available because they are all built in to the basic price.

Topping the list of features is, of course, the price. One hundred and ninety-nine dollars buys you a complete transceiver with all the features pictured, including the press-to-talk dynamic microphone. That has to be a really good deal.

And Dick Smith Electronics has gone one step further in providing a basic antenna kit so that there will be no temptation to switch on the transmitter with no load as soon as it is completed. The antenna kit comprises a quarter-wave vertical radiator, gutter-grip mounting base and feed, a PL-259 connector and three metres of good quality coax cable, all for $24.95.

For those amateurs not in a club and not sure of their ability to complete the transceiver successfully, DSE have their "Sorry Dick, it doesn't work" service coupon. This costs an additional $50 and may take up to three weeks service time if the constructor decides to take advantage of the offer but at least it is a sure way of getting an operational unit, if all else fails.

Operating facilities on the new transceiver are all that most amateurs would want without all the "bells and whistles" of some of the fancy imported models. There are none of those hard-to-remember-how-to-use memories and the frequency readout and selection is via no-nonsense push-button type "thumbwheel" switches.

As is usual practice with two-metre amateur transceivers, the two most significant digits of the frequency section are omitted which means that there is an assumed decimal point between the first and second digits of the three-digit

R93	C11,	1.2K	(brn-red-red).........	☐
R94	D9 ,	1ØØR	(brn-blk-brn).........	☐
R95	C1Ø,	1ØØR	(brn-blk-brn).........	☐
R96	D9 ,	15ØR	(brn-grn-brn).........	☐
R97	E8 ,	2.2K	(red-red-red).........	☐
R98	D8 ,	1.5K	(brn-grn-red).........	☐
R99	C9 ,	15R	(brn-grn-blk).........	☐
R1ØØ	D7 ,	2.2K	(red-red-red).........	☐
R1Ø1	C6 ,	27ØR	(red-vio-brn).........	☐
R1Ø2	E7 ,	1ØR	(brn-blk-blk).........	☐
R1Ø3	D5 ,	22ØR	(red-red-brn).........	☐
R1Ø4	C5 ,	1ØR	(brn-blk-blk).........	☐
R1Ø5	F5 ,	47R	(yel-vio-blk).........	☐
R1Ø6	I5 ,	47R	(yel-vio-blk).........	☐
R1Ø7	P14,	82ØR	(gry-red-brn).........	☐
R1Ø8	O1 ,	4.7K	(yel-vio-red).........	☐
R1Ø9	P2 ,	15K	(brn-grn-org).........	☐
R11Ø	K14,	1.2K	(brn-red-red).........	☐
R111	K11,	1ØØK	(brn-blk-yel).........	☐
R112	I12,	15K	(brn-grn-org).........	☐
R113	K12,	47K	(yel-vio-org).........	☐
R114	J13,	1K	(brn-blk-red).........	☐
R115	K13,	1ØØR	(brn-blk-brn).........	☐
R116	A15,	2.2K	(red-red-red).........	☐
R117	B15,	2.2K	(red-red-red).........	☐
R118	C16,	4.7K	(yel-vio-red).........	☐
R119	A18,	2.2K	(red-red-red).........	☐
R12Ø	A16,	2.2K	(red-red-red).........	☐
R121	C14,	2.2K	(red-red-red).........	☐
R122	D16,	4.7K	(yel-vio-red).........	☐
R123	E15,	1.2K	(brn-red-red).........	☐
R124	D14,	22R	(red-red-blk).........	☐
R125	D15,	6.8K	(blu-gry-red).........	☐
R126	D13,	2.2K	(red-red-red).........	☐
R127	E14,	15ØK	(brn-grn-yel).........	☐
R128	G14,	1.5K	(brn-grn-red).........	☐
R129	H15,	22ØK	(red-red-yel).........	☐
R13Ø	G15,	1.5K	(brn-grn-red).........	☐
R131	I15,	22ØK	(red-red-yel).........	☐
R132	H16,	47ØR	(yel-vio-brn).........	☐
R133	H15,	47ØR	(yel-vio-brn).........	☐
R134	J15,	1K	(brn-blk-red).........	☐
R135	E15,	56K	(grn-blu-org).........	☐
R136	E16,	56K	(grn-blu-org).........	☐
R137	E16,	56K	(grn-blu-org).........	☐
R138	D16,	56K	(grn-blu-org).........	☐
R139	D16,	56K	(grn-blu-org).........	☐
R14Ø	E18,	56K	(grn-blu-org).........	☐
R141	G16,	56K	(grn-blu-org).........	☐
R142	G18,	56K	(grn-blu-org).........	☐
R143	G18,	56K	(grn-blu-org).........	☐
R144	L16,	33K	(org-org-org).........	☐
R145	K16,	33K	(org-org-org).........	☐
R146	H1Ø,	4.7K	(yel-vio-red).........	☐
R147	E1Ø,	1ØØR	(brn-blk-brn).........	☐
R148	K1Ø,	1ØR	(brn-blk-blk).........	☐
R149	K17,	3.3K	(org-org-red).........	☐
R15Ø	O2Ø,	2.2K	(red-red-red).........	☐

CAPACITORS

Due to supply problems some NPO capacitors may have been supplied as standard ceramic capacitors. However, these changes will have minimal effect on the circuit operations.

C1	C3 ,	Ø.Ø47uF	(ceramic)........	☐
C2	C1 ,	Ø.Ø47uF	(ceramic)........	☐
C3	B5 ,	47ØuF 16V	(electro)........	☐
C4	B7 ,	Ø.1uF	(ceramic)........	☐
C5	B7 ,	4.7uF 25V	(tantalum).......	☐
C6	C6 ,	1ØuF 25V	(tantalum).......	☐
C7	B1Ø,	Ø.Ø1uF	(ceramic)........	☐
C8	B11,	4.7uF 25V	(tantalum).......	☐
C9	B11,	Ø.Ø1uF	(ceramic)........	☐
C1Ø	A6 ,	Ø.ØØ1uF	(ceramic)........	☐
C11	M6 ,	47ØpF	(ceramic)........	☐
C12	M6 ,	Ø.ØØ1uF	(ceramic)........	☐
C13	K6 ,	12pF	(ceramic)........	☐
C14	K7 ,	Ø.Ø1uF	(ceramic)........	☐
C15	M7 ,	Ø.Ø1uF	(ceramic)........	☐
C16	I6 ,	1pF	(ceramic)........	☐
C17	I6 ,	12pF	(ceramic)........	☐
C18	M8 ,	Ø.Ø1uF	(ceramic)........	☐
C19	H6 ,	1pF	(ceramic)........	☐
C2Ø	H6 ,	1ØpF	(ceramic)........	☐
C21	H8 ,	Ø.Ø1uF	(ceramic)........	☐
C22	H8 ,	Ø.Ø1uF	(ceramic)........	☐
C23	K9 ,	Ø.Ø1uF	(ceramic)........	☐
C24	-- ,	Not Allocated...........		☐
C25	L1Ø,	Ø.1uF	(ceramic)........	☐
C26	M13,	Ø.1uF	(greencap).......	☐
C27	M9 ,	56pF	(ceramic)........	☐
C28	L1Ø,	82pF	(ceramic)........	☐
C29	O9 ,	1ØuF 25V	(tantalum).......	☐
C3Ø	L12,	Ø.Ø1uF	(ceramic)........	☐
C31	O1Ø,	Ø.1uF	(greencap).......	☐
C32	O11,	Ø.ØØ1uF	(greencap).......	☐
C33	O11,	Ø.ØØ1uF	(greencap).......	☐
C34	O12,	Ø.Ø1uF	(greencap).......	☐
C35	N12,	1uF 25V	(tantalum).......	☐
C36	M11,	Ø.Ø47uF	(greencap).......	☐
C37	M11,	1ØpF	(ceramic)........	☐
C38	L12,	Ø.Ø47uF	(greencap).......	☐
C39	M9 ,	Ø.1uF	(greencap).......	☐
C4Ø	N9 ,	Ø.1uF	(ceramic)........	☐
C41	P19,	Ø.22uF 25V	(tantalum).......	☐
C42	M17,	Ø.1uF	(ceramic)........	☐
C43	O19,	1ØuF 25V	(tantalum).......	☐
C44	O18,	Ø.1uF	(greencap).......	☐
C45	O19,	Ø.Ø1uF	(greencap).......	☐
C46	L17,	47ØuF 16V	(electro)........	☐
C47	M19,	22ØuF 16V	(electro)........	☐
C48	N17,	Ø.ØØ1uF	(ceramic)........	☐
C49	N17,	Ø.22uF 35V	(tantalum).......	☐
C5Ø	H11,	Ø.ØØ1uF	(ceramic)........	☐
C51	P15,	1ØuF 25V	(tantalum).......	☐
C52	O16,	22uF 25V	(tantalum).......	☐
C53	O16,	Ø.Ø1uF	(ceramic)........	☐
C54	O14,	Ø.ØØ22uF	(ceramic)........	☐
C55	M15,	27ØpF	(ceramic)........	☐
C56	I13,	Ø.ØØ1uF	(ceramic)........	☐
C57	I12,	Ø.ØØ22uF	(ceramic)........	☐
C58	I11,	18pF	(ceramic).NPO....	☐
C59	H11,	Ø.Ø1uF	(ceramic)........	☐
C6Ø	I14,	1uF 25V	(tantalum).......	☐
C61	F9 ,	47uF 16V	(electro)........	☐
C62	G9 ,	Ø.Ø1uF	(ceramic)........	☐
C63	H9 ,	Ø.ØØ47uF	(ceramic)........	☐
C64	I1Ø,	5.6pF	(ceramic).NPO....	☐
C65	H1Ø,	4.7pF	(ceramic).NPO....	☐
C66	H1Ø,	3.3pF	(ceramic).NPO....	☐
C67	G9 ,	68pF	(ceramic)........	☐
C68	H1Ø,	12pF	(ceramic).NPO....	☐
C69	G11,	Ø.Ø1uF	(ceramic)........	☐
C7Ø	G13,	Ø.Ø1uF	(ceramic)........	☐
C71	F1Ø,	Ø.Ø1uF	(ceramic)........	☐
C72	E1Ø,	Ø.Ø1uF	(ceramic)........	☐
C73	E11,	Ø.Ø1uF	(ceramic)........	☐
C74	F1Ø,	15pF	(ceramic)........	☐
C75	F12,	1pF	(ceramic)........	☐
C76	E11,	1ØpF	(ceramic)........	☐
C77	F12,	Ø.ØØ22uF	(ceramic)........	☐
C78	H13,	Ø.Ø1uF	(ceramic)........	☐
C79	F14,	3.3pF	(ceramic)........	☐
C8Ø	E8 ,	Ø.Ø1uF	(ceramic)........	☐
C81	D9 ,	Ø.Ø1uF	(ceramic)........	☐
C82	B1Ø,	Ø.Ø1uF	(ceramic)........	☐
C83	C1Ø,	4.7pF	(ceramic)........	☐
C84	D9 ,	15pF	(ceramic)........	☐
C85	E8 ,	47uF 6.3V	(tantalum).......	☐
C86	D9 ,	68pF	(ceramic)........	☐
C87	E8 ,	18pF	(ceramic)........	☐
C88	C9 ,	Ø.Ø1uF	(ceramic)........	☐
C89	C8 ,	Ø.Ø1uF	(ceramic)........	☐
C9Ø	B8 ,	4.7uF 25V	(tantalum).......	☐
C91	C6 ,	15ØpF	(ceramic)........	☐
C92	C6 ,	Ø.Ø1uF	(ceramic)........	☐
C93	D7 ,	18pF	(ceramic)........	☐
C94	E7 ,	Ø.ØØ47uF	(ceramic)........	☐
C95	D7 ,	Ø.ØØ1uF	(ceramic)........	☐

C96	D4	0.001uF	(ceramic)
C97	D4	0.001uF	(ceramic)
C98	E5	82pF	(ceramic)
C99	D5	47pF	(ceramic)
C100	E4	39pF	(ceramic)
C101	F4	47pF	(ceramic)
C102	F5	47pF	(ceramic)
C103	H2	150pF	(ceramic)
C104	G2	0.001uF	(ceramic)
C105	G2	47uF 16V	(electro)
C106	H3	8.2pF	(ceramic)
C107	H4	22pF	(ceramic)
C108	G3	22pF	(ceramic)
C109	I3	22pF	(ceramic)
C110	I4	22pF	(ceramic)
C111	J4	47pF	(ceramic)
C112	J4	47pF	(ceramic)
C113	M1	470uF 16V	(electro)
C114	M2	0.001uF	(ceramic)
C115	M2	0.001uF	(ceramic)
C116	M3	27pF	(ceramic)
C117	M4	15pF	(ceramic)
C118	M4	39pF	(ceramic)
C119	N3	22pF	(ceramic)
C120	N3	27pF	(ceramic)
C121	N4	33pF	(ceramic)
C122	P8	0.01uF	(ceramic)
C123	O6	22pF	(ceramic)
C124	O7	47pF	(ceramic)
C125	O6	0.0047uF	(ceramic)
C126	P6	0.001uF	(ceramic)
C127	P4	15pF	(ceramic)
C128	P4	12pF	(ceramic)
C129	P4	15pF	(ceramic)
C130	P3	4.7pF	(ceramic)
C131	O3	12pF	(Ceramic)
C132	O3	8.2pF	(ceramic)
C133	N1	4.7pF	(ceramic)
C134	P2	0.001uF	(ceramic)
C135	B16	0.001uF	(ceramic)
C136	A19	68pF	(ceramic) .NPO
C137	B19	56pF	(ceramic) .NPO
C138	A18	0.01uF	(ceramic)
C139	A16	0.01uF	(ceramic)
C140	C17	0.01uF	(ceramic)
C141	C15	0.0047uF	(ceramic)
C142	D15	27pF	(ceramic) .NPO
C143	D15	47pF	(ceramic) .NPO
C144	D14	15pF	(ceramic)
C145	D14	0.01uF	(ceramic)
C146	H15	180pF	(ceramic)
C147	F14	180pF	(ceramic)
C148	F15	0.047uF	(ceramic)
C149	H15	0.047uF	(ceramic)
C150	I15	0.01uF	(ceramic)
C151	I16	0.01uF	(ceramic)
C152	F15	0.047uF	(ceramic)
C153	H12	0.022uF	(greencap)
C154	---	Not Allocated	
C155	J17	0.047uF	(ceramic)
C156	H12	3.3uF 25V	(tantalum)
C157	J17	1uF 25V	(tantalum)
C158	J18	0.047uF	(ceramic)
C159	J19	0.047uF	(ceramic)
C160	J20	33pF	(ceramic)
C161	K20	56pF	(ceramic)
C162	K11	220pF	(ceramic)
C163	J12	5.6pF	(ceramic)
C164	K12	0.047uF	(greencap)
C165	J13	0.001uF	(ceramic)
C166	K13	10uF 25V	(tantalum)
C167	J14	1uF 25V	(tantalum)
C168	L19	100uF 16V	(electro)
C169	O1	See Text	(Page 40)
C170	E13	0.047uF	(ceramic)
C171	L16	0.1uF	(ceramic)
C172	J11	0.01uF	(ceramic)
C173	E11	0.01uF	(ceramic)
C174	L20	15pF	(ceramic)
C175	L20	15pF	(ceramic)

DIODES

D1	B4	IN4002	(diode)
D2	A8	5.6V 400mW	(zener)
D3	A9	IN914	(diode)
D4	B12	IN914	(diode)
D5	B7	IN914	(diode)
D6	N13	5.6V 400mW	(zener)
D7	P10	IN914	(diode)
D8	N19	IN914	(diode)
D9	O16	IN914	(diode)
D10	P16	IN914	(diode)
D11	I11	BB122	(diode)
D12	G10	BB122	(diode)
D13	O7	BA243/244/282	(diode)
D14	P1	OA95/1N60	(diode)
D15	K15	IN914	(diode)
D16	K16	IN914	(diode)
D17	J16	IN914	(diode)
D18	K15	IN914	(diode)
D19	J15	IN914	(diode)
D20	K15	IN914	(diode)
D21	H13	IN914	(diode)
D22	B15	BA243/244/282	(diode)
D23	B15	BA243/244/282	(diode)
D24	B17	BA243/244/282	(diode)
D25	B17	BA243/244/282	(diode)
D26	G15	5.6V 400mW	(Zener)
D27	E17	IN914	(diode)
D28	---	NOT ALLOCATED	
D29	F17	IN914	(diode)
D30	---	NOT ALLOCATED	
D31	J13	IN914	(diode)
D32	I13	0A95/1N60	(diode)
D33	J13	0A95/1N60	(diode)

TRANSISTORS

Q1	A7	BD140	(transistor)
Q2	A8	BC547	(transistor)
Q3	B6	BC327/328/BC640	(transistor)
Q4	A10	BC337/639	(transistor)
Q5	B11	BC557	(transistor)
Q6	L6	BFY90	(transistor)
Q7	G8	3SK40/MFE131	(transistor)
Q8	L12	BC548	(transistor)
Q9	O19	BC548	(transistor)
Q10	N18	BC558	(transistor)
Q11	N18	BC337/BC639	(transistor)
Q12	N20	BC327/BC640	(transistor)
Q13	N16	BC548	(transistor)
Q14	N15	BC548	(transistor)
Q15	N14	BC558	(transistor)
Q16	H10	2SK125	(transistor)
Q17	F10	3SK40/MFE131	(transistor)
Q18	D10	2SC1674	(transistor)
Q19	D8	2N3948	(transistor)
Q20	E6	2N3948	(transistor)
Q21	G4	MRF629	(transistor)
Q22	K4	2N5590	(transistor)
Q23	K15	BC548	(transistor)
Q24	K16	BC548	(transistor)
Q25	G13	3SK40/MFE131	(transistor)
Q26	D15	2SC1674	(transistor)
Q27	F14	2SC1674	(transistor)
Q28	H15	BC548	(transistor)
Q29	I15	BC548	(transistor)
Q30	J17	BC547	(transistor)

INDUCTORS

L1	B2	Power Choke
L2	N6	Can 10GP004S
L3	J6	Can 10GP004S
L4	I6	Can 10GP004S

L5 G6 , Can 10GP004S..............□
L6 J8 , Can 10MA015S..............□
L7 L13, Can 455KHZ.(wht/blk/yel)....□
L8 I9 , Red Plastic Coil...........□
L9 F11, Can 10GP004S..............□
L10 C9 , Can 10GP004S..............□
L11 C8 , Red Plastic Coil...........□
L12 F13, Choke 2.5mH...............□
L13 G13, Air Coil 4T 25B&S En/Cu.....□
L14 A17, 1.5uH (wht&blk Plastic Coil)□
L15 B18, 1.5uH (wht&blk Plastic Coil)□
L16 C17, 1.5uH (wht&blk Plastic Coil)□
L17 C18, 1.5uH (wht&blk Plastic Coil)□
L18 E14, 10GP004S..................□
L19 G15, Choke 10uH.................□
L20 D5 , Air Coil 2.5T 18B&S En/Cu...□
L21 E5 , Hair Pin Link 25B&S Tin/Cu..□
L22 F4 , Air Coil 1T 18B&S En/Cu.....□
L23 H3 , Air Coil 1.5T 18B&S En/Cu...□
L24 I4 , Hair Pin Link 18B&S En/Cu...□
L25 M3 , Air Coil 1.5T 18B&S En/Cu...□
L26 M4 , Air Coil 1T 18B&S En/Cu.....□
L27 O4 , Air Coil 2.5T 18B&S En/Cu...□
L28 O7 , Air Coil 2.5T 18B&S En/Cu...□
L29 O3 , Air Coil 2.5T 18B&S En/Cu...□
L30 N2 , Air Coil 2.5T 18B&S En/Cu...□
L31 N2 , Air Coil 2T 25B&S En/Cu...□

IC's

IC1 N10, MC3357....................□
IC2 F16, 4560B/14560BC ....□
IC3 F19, 4560B/14560BC ....□
IC4 H17, 9122.......................□
IC5 J18, 5081.......................□
IC6 J19, 5082.......................□
IC7 J12, 592H2......................□

RF CHOKES

RFC1 ---, Not Allocated...............□
RFC2 C7 , Ferrite Bead/2T.............□
RFC3 F2 , 6 Hole Ferrite Bead.........□
RFC4 P8 , Layer Choke 5uH (L208)......□
RFC5 F3 , Layer Choke .22uH (L209)....□
RFC6 I3 , Layer Choke .22uH (L209)....□

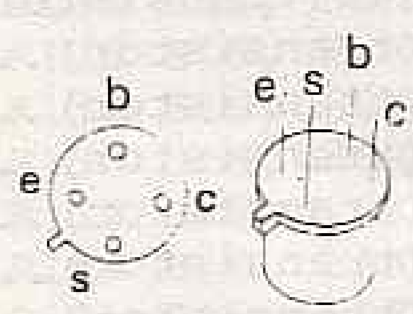
CRYSTALS

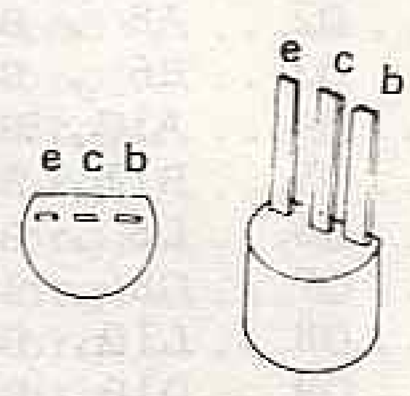
X1 L9 , 10.245 or 11.155MHz (xtal)...□
X2 K20, 10.240 MHZ (xtal).........□
X3 C15, 47.801 MHZ (xtal).........□
X4 A15, 44.234 MHZ (xtal).........□

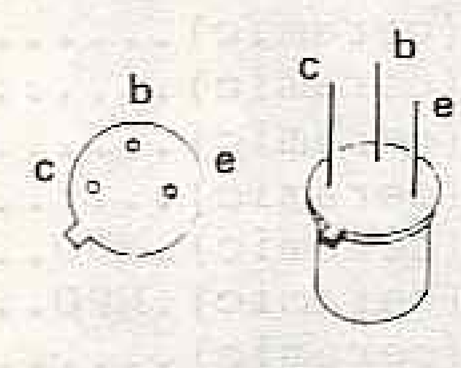
FILTERS

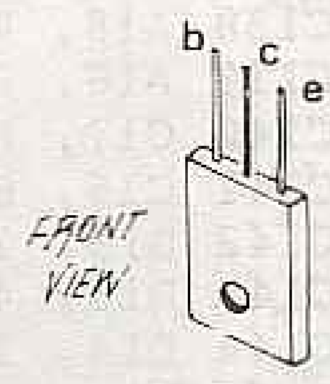
FL1 J8 , 10.7 MHZ 2 Pole Filter......□
FL2 ---, NOT ALLOCATED...............□
FL3 L11, 455 KHZ Filter..............□

TRANSISTOR PINOUTS

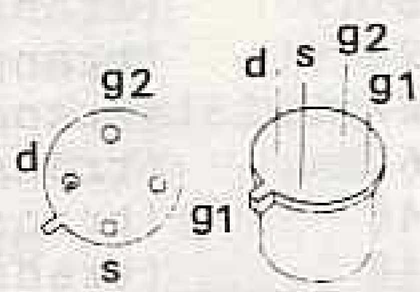

BFY90

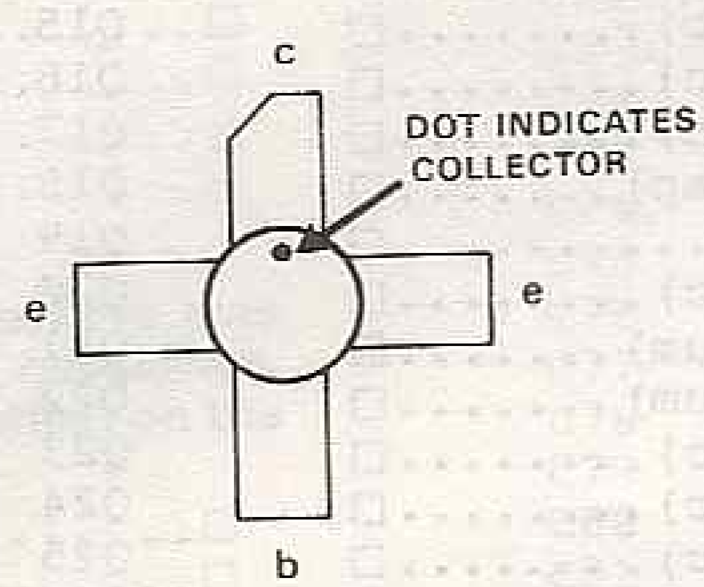

2SC1674


MRF629

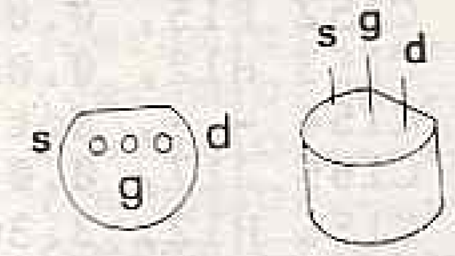


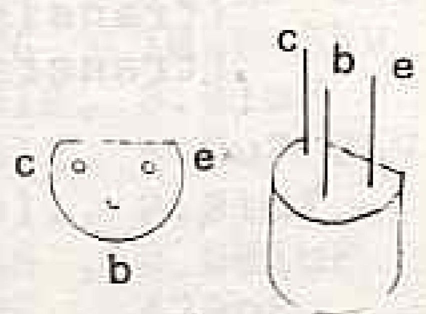
BD140

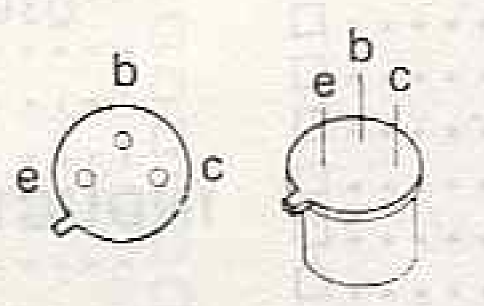

3SK40/MFE131

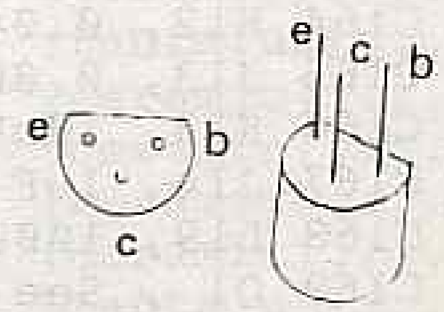


2N5590


2SK125

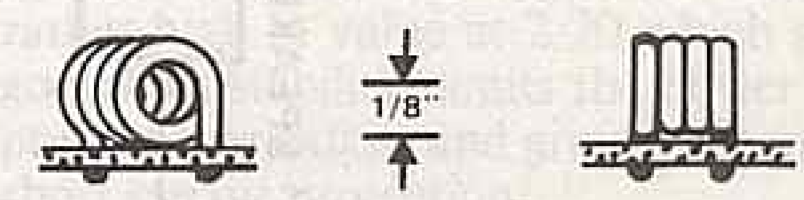
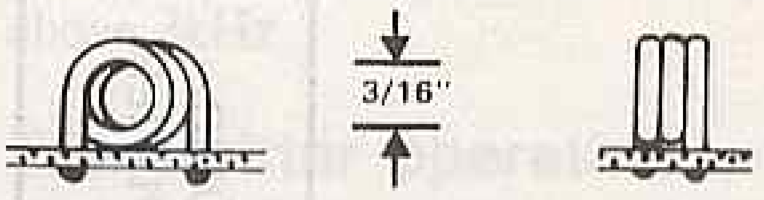
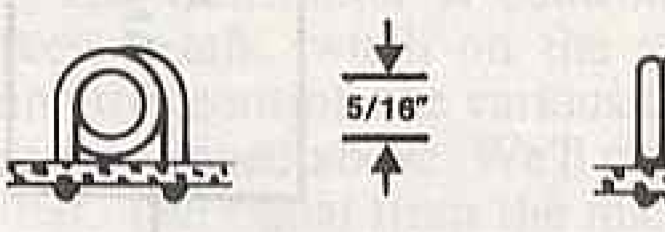
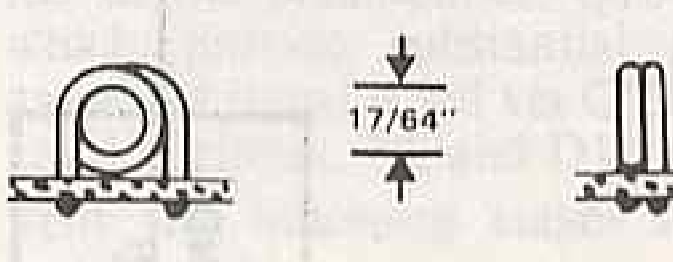
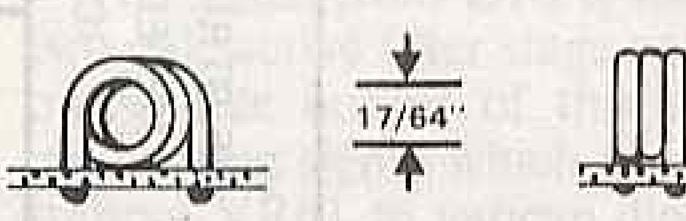
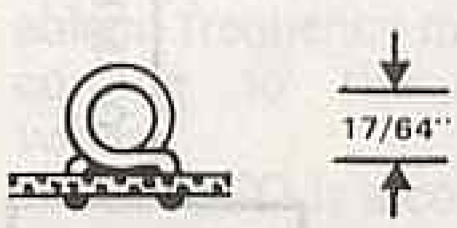
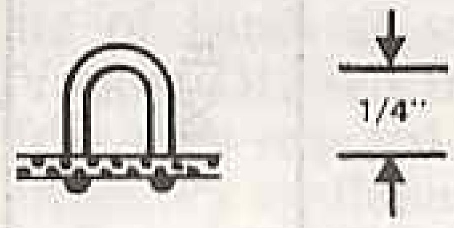
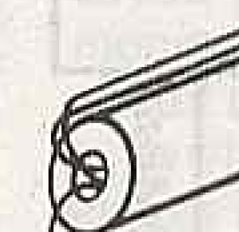
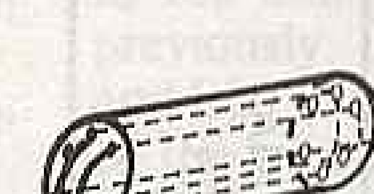
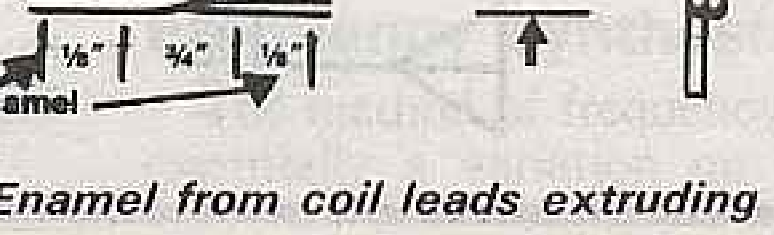

BC547/557/327 548/337/558


2N3948


BC640/BC639

Please note that if you have been supplied with a BC640/BC639 instead of BC327/BC337 respectively, pin orientations should be closely noted as they are different.

COIL WINDING DETAILS*

L13	25 B&S En/Cu 1/8" (3.2mm) diam. close wound	4T	
L20 L30	18 B&S En/Cu 3/16" (4.7mm) diam. close wound	2½T	
L23	**18 B&S En/Cu** **5/16" (7.94mm) diam** **close wound**	**1½T**	
L25	18 B&S En/Cu 17/64" (6.7mm) diam. close wound	1½T	
L27 L28 L29	18 B&S En/Cu 17/64" (6.7mm) diam. close wound	2½T	
L22	18 B&S En/Cu 17/64" (6.7mm) diam.	1T	
L24	18 B&S En/Cu 1/4" (6.4mm) diam.	Hairpin	
L26	**18 B&S En/Cu** **7/16" (11.1mm) diam.**	1T	
L21	25 B&S Tin/Cu 1/8" (3.2mm) diam.	Hairpin	
RFC2	Ferrite bead 25 B&S En/Cu	2T	
RFC3	6-hole ferrite choke 25 B&S Tin/Cu		
L31	**25 B&S En/Cu** **3/16" (4.7mm) diam** **close wound**	2T	

**Coils with more than one turn are shown with both front and side views. Enamel from coil leads extruding through the board should be scraped clean before soldering.*

BLOCK DIAGRAM

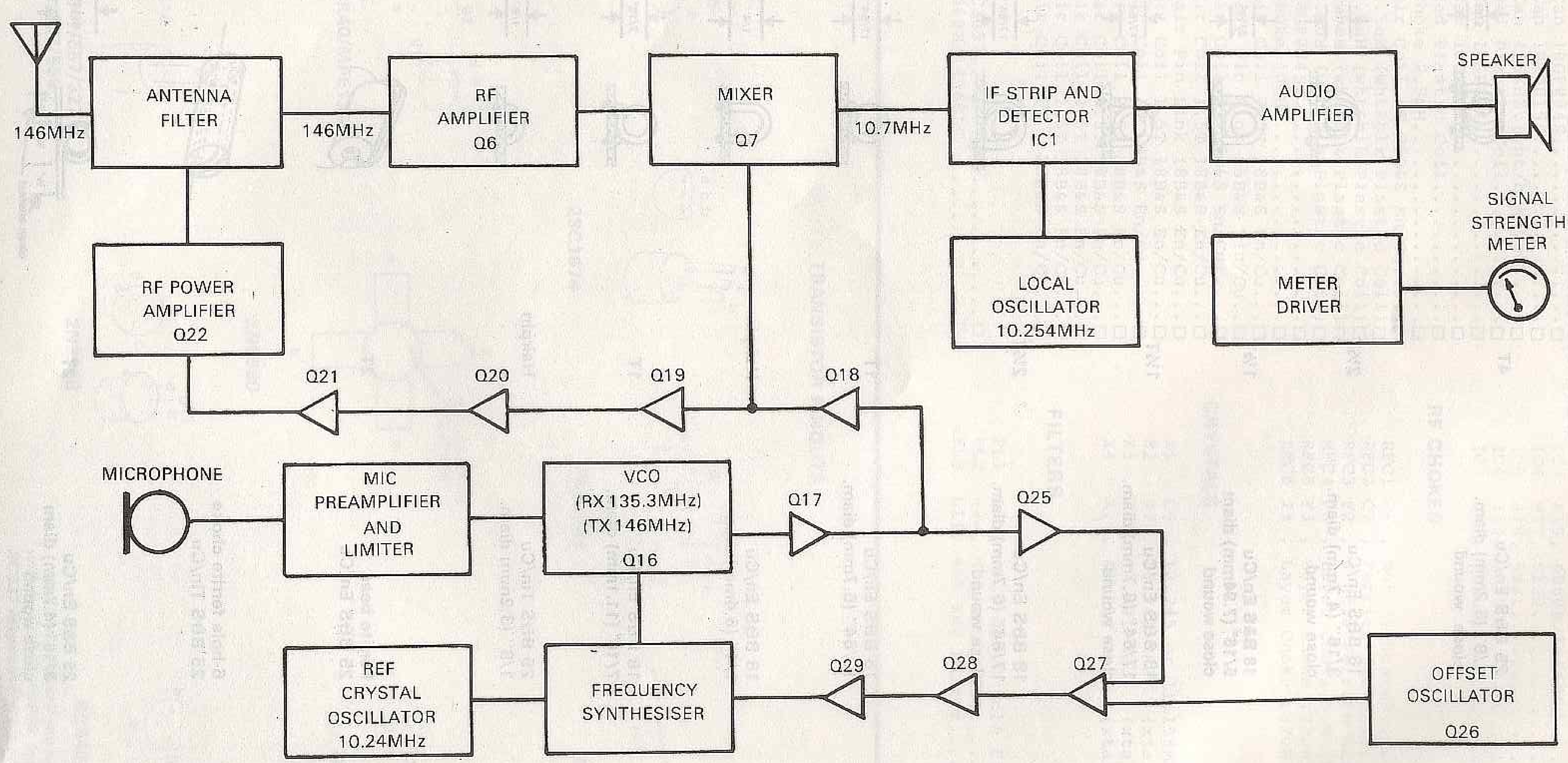


Figure 1.

How it works

Readers who have already taken a look at the circuit and block diagrams will have noted the similarities to the circuit of the abovementioned UHF transceiver described last year. Some sections of the circuit, notably the microphone preamplifier and audio power amplifier, are identical while other sections, such as the antenna filter, IF strip and power supply, are also very similar.

For those not familiar with the series of articles on the UHF transceiver, let's now go through the block diagram, before attacking the main circuit diagram. Refer now to Fig. 1.

The block diagram shows that the transceiver is split into two sections, receiver and transmitter, which come together in the antenna filter. Both these sections employ a common frequency synthesiser and voltage controlled oscillator.

The receiver is a conventional double conversion superheterodyne with intermediate frequencies at 10.7MHz and 455kHZ. The second conversion from 10.7MHz to 455kHz is achieved in an integrated circuit which also includes limiting amplifiers and an FM quadrature detector. From there the signal is passed to an audio amplifier.

The VCO (voltage controlled oscillator) has two modes and, as you might have guessed, these are transmit and receive. In the transmit mode, the VCO is set to an exact frequency within the range of 144 to 148MHz by the frequency synthesiser which, in turn, is controlled by the offset oscillator. The output of the VCO is fed via Q17 and Q18 to the RF power amplifier and thence via the antenna filter circuit to the output socket.

In the receive mode, the VCO is set at a frequency exactly 10.7MHz below the incoming frequency. This is necessary to give the 10.7MHz intermediate frequency at the output of the mixer, Q7. The lower VCO frequency is obtained by switching a different crystal into the offset oscillator.

Circuit details

Now let's have a look at the circuit diagram. Don't shudder. If you figured out the UHF transceiver described last year, this one is more straightforward in most respects. We'll consider the receiver circuitry first.

Input signals from the antenna are fed via the antenna filter and RF switching network on the extreme righthand side of the circuit diagram. The signals pass via L30, L29, L27, L26 and L28 and C123. From there they go to the input of Q6 via transformer L2 and C11 (on the extreme lefthand side of the circuit).

The RF switching is performed by D13 (near L28, on the RH side of circuitry). In the transmit mode, D13 is forward biased and thus shorts out any RF signal from the transmitter which would otherwise be fed into the receiver input.

Q6 is a conventional common emitter amplifier with L3 as its collector load. L3 is part of the three-stage bandpass filter which only accepts signals in the 144 to 148MHz range.

Mosfet Q7 is the mixer. Gate 1 of Q7 is the incoming RF signal while gate 2 is the VCO (local oscillator) signal. L6 is the drain load of Q7 and the mixer output is the difference frequency, 10.7MHz. This is passed via FL1, a two-pole filter, to IC1.

IC1 is a Motorola MC3357 device specifically designed for use in a narrowband FM dual conversion communications receiver which is exactly what this circuit is. We have already talked about the first conversion which is from 144 (to 148MHz) down to 10.7MHz which takes place in mixer Q7. The MC3357 handles the second conversion using an internal 10.245MHz local oscillator.

This gives a second intermediate frequency signal of 455kHz which is amplified, limited and detected by IC1. IC1 also provides the squelch function.

In greater detail, crystal X1 at pin 1 of IC1 sets the local oscillator frequency to 10.245MHz. This is internally mixed with the 10.7MHz signal from Q7 to produce a 455kHz IF which is then fed to an external filter at pin 3. Transistor Q8 amplifies the filtered 455kHz signal and feeds it back into the limiting amplifier input at pin 5.

The limiting amplifier is a five-stage differential amplifier which boosts the 455kHz signal well into clipping, at its output. That is, we say the signal is limited. This effectively removes any amplitude variations (AM) so that the signal only contains frequency modulation.

The limited signal is then fed to the internal FM quadrature detector associated with coil L7 and capacitor C37 at pins 7 and 8.

The detected audio is extracted from pin 9 and fed via R33 and C35 to VR40, the volume control. At the same time, a sample of the signal is coupled via R32 and C33 to an internal amplifier between pins 10 and 11.

This amplifies any noise signal (hiss) above the expected audio passband which is then rectified by D7 and used to "squelch" the audio output via control pin 12. VR39 is the squelch control.

Transistor Q8 feeds a portion of the 455kHz signal (before limiting is applied) to IC7, the meter amplifier. This produces an indication of signal strength when in the receive mode.

Transistors Q9 to Q12 form a conventional audio amplifier. Q9 is a straightforward common emitter stage with negative feedback applied to the emitter via R44. Q10 is a class-A driver with bootstrapping via the output capacitor, C47. Its collector load is R49 and the speaker itself.

If the speaker is disconnected for any reason the whole amplifier will latch up which is how it manages to withstand open-circuits continuously (see specs).

Q11 and Q12 form a fully complementary output pair with quiescent current set by R46 and D8. R47 and R48 are rather high in value at 2.2Ω which gives good bias stability, limits the power output to some extent and gives momentary short circuit protection.

Resistors R44 and R43 set the audio amplifier gain to around 25 (ie, 5600/220 = 25) while C45 rolls off the response above 3kHz.

Transmitter operation

The transmitter is controlled by the press-to-talk switch on the microphone and this controls the various supply rails, as mentioned above. We'll come back to that. The signal from the microphone is fed to the preamplifier, Q13 and Q14, which provide substantial gain. The amplified signal is fed via C52 to a diode limiting circuit, D9 and D10, which prevent the following stages from being overloaded.

The signal from D10 is fed to Q15, a two pole active filter stage with a gain of unity. The output of this stage is the modulating signal which is applied from trimpot VR61 to varicap diode D11 via R62, C57 and R64. D11 is in the tank circuit of the VCO (Q16), and thus is able to frequency modulate the VCO according to the microphone signal voltage.

The VCO is a conventional grounded gate oscillator using an N-channel FET. It oscillates at a nominal 146MHz (centre of band) as set by L8 and C64. Varicap D12 sets the VCO to the exact frequency required, as controlled by the frequency synthesiser.

The main VCO output signal is taken from its source and fed to Q17 and Q18, which are transformer coupled, and thence to Q19 and Q20 which are more or less conventional common emitter amplifier stages. Q21 and Q22, on the other hand, are class-C power amplifier stages which operate without forward bias at their bases.

By way of explanation, in a class-C amplifier such as Q22, the collector current flows for substantially less than every alternate half cycle with the tuned circuit preventing the generation of harmonics. In effect, a class-C amplifier tank circuit can be considered as the analog of a flywheel which has a short burst of energy applied to it during every cycle. It is a highly efficient amplifier.

The output power from Q22 is coupled to the antenna filter circuit mentioned previously. The path is via L26, L27, L29 and L30 to the output socket. A measure of the transmitter output is provided as follows: Gimmick capacitor C169 (two wires twisted together) feeds a small portion of the transmitter output to D14 which rectifies the signal and applies the resultant DC to the signal meter via R109 and filter capacitor C134.

Frequency synthesis

The method of frequency synthesis is essentially a variation on the conventional phase lock loop (PLL) circuit. A PLL normally comprises a voltage controlled oscillator (VCO), a reference oscillator, a programmable frequency divider (fed by the VCO), and a phase comparator which compares the frequency divided output of the VCO with the reference oscillator.

For a VHF transceiver it is usual to have three oscillators: a VCO, a reference oscillator and an offset oscillator. In this case the VCO is Q16, the reference oscillator is associated with IC6 and the offset oscillator is Q26. IC5 is the phase comparator and IC4 is the programmable divider.

Let's start by looking at IC6. This IC is a combined oscillator and divider with a division ratio of 1024. It drives crystal X2 at a frequency of 10.24MHz which when divided by 1024 produces a reference frequency of 10kHz at pin 7.

IC5, the phase comparator, compares the 10kHz reference frequency from IC6 against the 10kHz output from the programmable frequency divider, IC4. The output at pin 3 of IC5 is the PLL error voltage which is a series of pulses. These are filtered to produce smooth DC by R91, C156, R87, R86 and C153. This DC error voltage is then applied to D12 in the VCO (Q16) to maintain control over the VCO output.

As shown on the circuit, when the PLL is in the lock condition and the VCO output is 144MHz, then the error voltage at TP3 is 2.7 volts DC (after setting up).

Where the frequency synthesiser circuit diverges from normal PLL practice is that the programmable divider does not merely "divide down" the output of the VCO. Instead, IC4 divides the difference between the VCO output and the third harmonic of the offset oscillator.

The reason for this indirect procedure is that it is not possible to easily provide for programmable division directly from 144MHz.

What happens is this. The offset oscillator, Q26, operates at 44.234966MHz in receive mode and at 47.801666MHz in transmit mode. The relevant crystals, X4 and X3, are switched into circuit by diodes D23 or D22.

The collector output circuit of Q26 is tuned to the third harmonic of these frequencies ie, 132.704898MHz and 143.404998MHz.

Depending on whether the transceiver is in receive or transmit mode, one or other of these offset frequencies will be substracted from the VCO output frequency by the offset mixer, Q27. The difference frequency will range from 595kHz (eg, 144-143.405) to 4.595MHz (148-143.405).

It is this range of difference frequencies which is applied to the programmable frequency divider, IC4, via Q28 and Q29.

So IC4 is programmed by the thumbwheel switches to divide the relevant difference frequency from Q27 to provide a 10kHz output which is applied to the phase comparator, IC5.

Note, by the way, that the difference between the transmit and receive offset frequencies is 10.7MHz which is the required intermediate frequency.

So far so good. But now we have to backtrack a little. There is a problem in that IC4 cannot precisely divide frequencies that are not an exact multiple of 10kHz. Therefore that example of 595kHz (the lowest difference frequency) is not valid. And in fact, those offset oscillator frequencies given above are not quite correct.

Because of the provision for 5kHz channel spacing, the offset oscillator crystals are in fact 1666Hz too high. When the third harmonic of each crystal is considered it will be 5kHz high. So in normal operation, the crystals are pulled low by L14 and L15 for X4 and L16 and L17 and X3. So the normal offset transmit frequency is 47.8MHz (143.4MHz 3rd harmonic) and the offset receive frequency is 44.2333MHz (3rd harmonic is 132.7MHz).

When these offset frequencies are subtracted from the VCO the range of difference frequencies will be 600kHz to 4.6MHz. And note that 600kHz is an exact multiple of 10kHz.

When the +5kHz facility is switched on, L15 and L17 are switched out of circuit by diodes D24 and D25, so that now the crystals do run 1666Hz high and so the VCO frequency is shifted up by 5kHz.

Band protection

Note that when the 10kHz outputs of IC6 and IC4 (the programmable divider) are locked together IC5 turns on Q30. This turns on Q18 and Q19 and thus allows the transmitter to operate. Thus the transmitter is prevented from producing signals which are outside the 144 to 148MHz band.

But what about that +5kHz offset we have just discussed. When that is applied it would be possible for the VCO to operate at 148.005MHz and still produce a lock condition. The circuit design takes care of this possibility too since the thumbwheels are wired to only permit a maximum VCO frequency of 147.99MHz. When the 5kHz is added this gives a maximum VCO frequency of 147.995MHz which is still inside the band limits.

Strictly speaking then, this means that only 399 channels are available with 10kHz spacing and 798 channels with 5kHz spacing (144.005 to 147.995MHZ).

±600kHz offset

Yet another factor has to be taken care of by the frequency synthesiser circuitry. For repeater operation, the transmitter frequency usually has to be offset by minus 600kHz from the receive frequency. Less often, it may have to be changed by plus 600kHz. This condition could be met by adding more crystals to the offset oscillator circuitry but in this circuit it has been achieved digitally.

As well as avoiding the expense of extra crystals, the decimal method of offset does not require any alignment. IC2 and IC3 are digital adders. They add a code of 60 or 120 to the code applied by IC4. In the normal simplex mode, the addition of the 60 code is the standard. For −600kHz repeater operation, this code is removed (controlled by D18 and IC2).

For +600kHz operation, IC2 and IC3 are brought into play by D29 and D27 to add a code of 120 to IC4.

A neat advantage of this scheme is that it allows the "anti-repeater" operation whereby the receiver only can be shifted by ±600kHz. This is achieved by the pushbutton in conjunction with Q23, Q24 and associated diodes. The advantage of the anti-repeater function is that it allows the operator to listen directly to his contact instead of via the repeater.

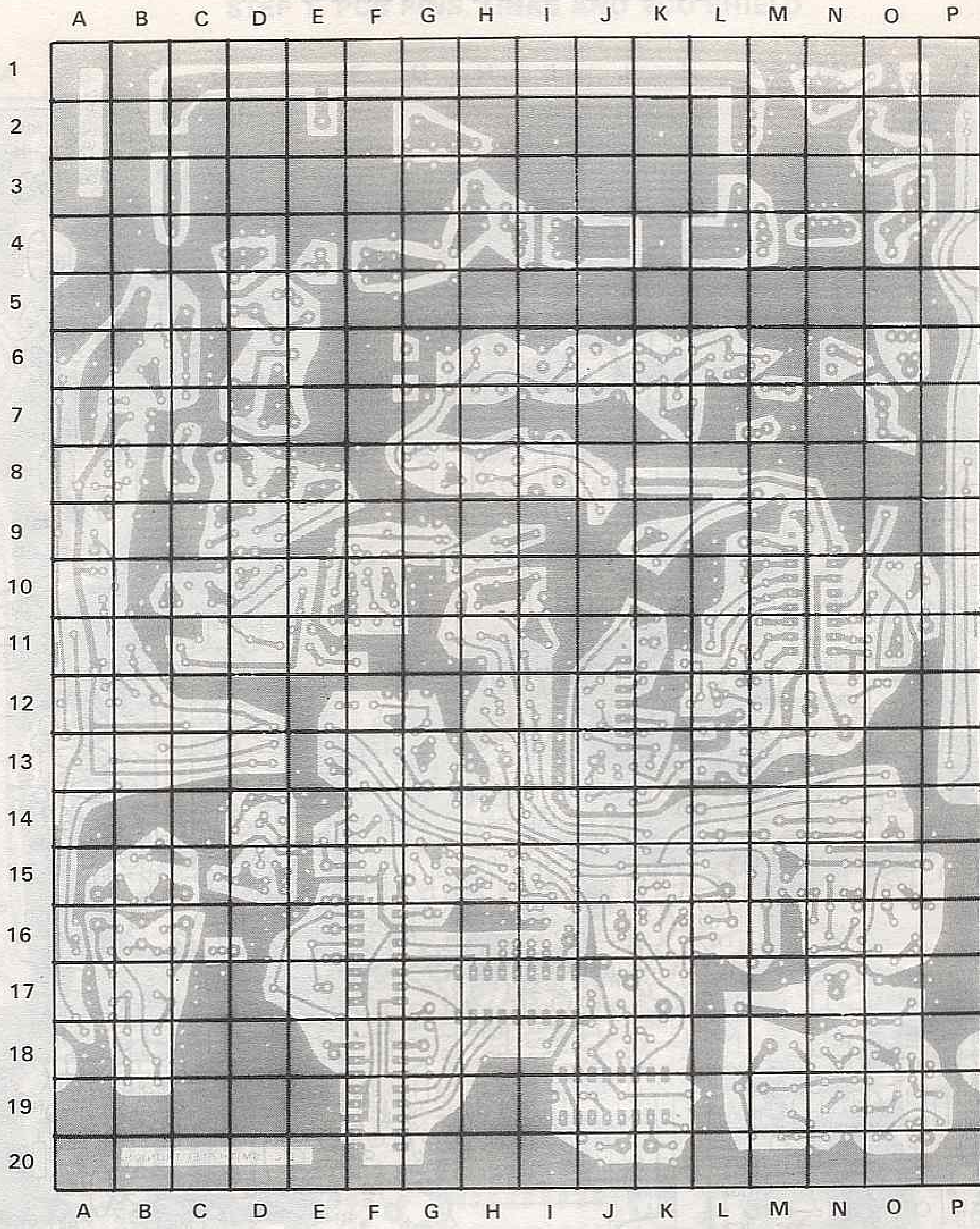
Note that when the 600kHz offset facility is in use, the out-of-band protection circuitry does not prevent transmission outside the band limits. In this case it is up to the operator to make sure he or she does not transgress.

Power supply

A +10V regulated supply derived from Q1, Q2 and D2 supplies power directly to the VCO, offset oscillator, frequency synthesiser circuitry and mix down amplifier (Q28 and Q29). The +10V regulated rail is also switched to various other sections of the circuit by Q4 and Q5, depending on whether the transceiver is in the receive or transmit mode.

When in the receive mode, the press-to-talk switch is open and D3, D4 and D5 cannot conduct. Therefore Q4 supplies the +10V Rx rail. When the PTT switch is closed for transmit mode, D3 and D4 conduct, turning off Q4 and turning on Q5 to supply the +10V Tx rail. D5 also conducts, turning on Q3 to supply the +12V Tx rail.

The final two stages of the RF power amplifier, Q21 and Q22, are powered directly from the 13.8V (battery) supply, as is the audio amplifier. This is OK since Q21 and Q22 are normally biased off and can only operate when Q19 and Q20 are turned on by the +12V Tx rail.



GENERAL INTRODUCTORY INFORMATION

As the diagram above shows, the overlays used in this manual are set out the same as any street directory. (Be it a Melway's, UBD or Gregory's.)

This has been done for a number of reasons, the main one being it will make it easier for the constructor to find his way around the circuit board. Because of the number of components used in this project it would be no problem at all to insert a component into the wrong hole only to discover it at a much later date.

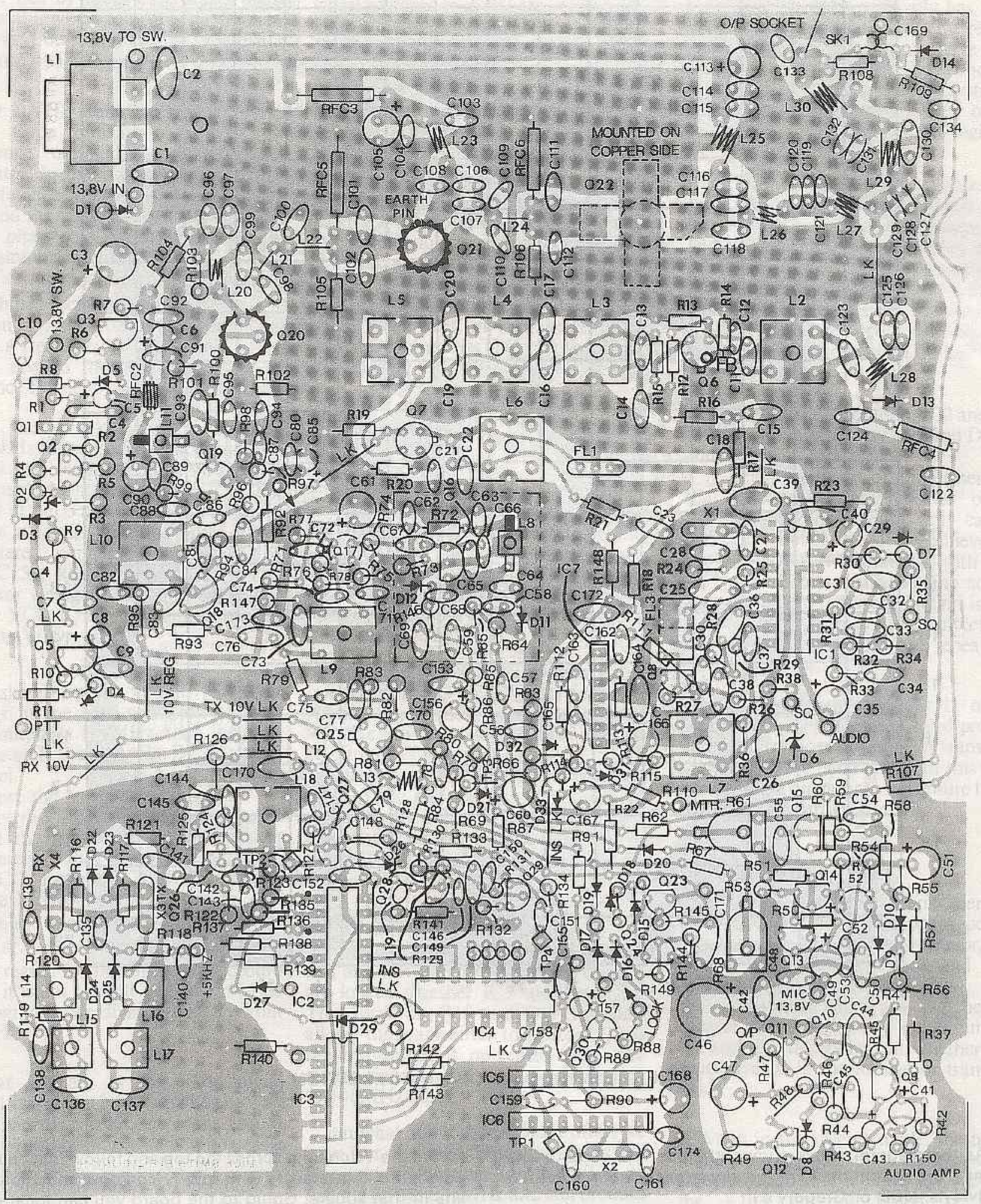
As you can see, the grid we are using is very much like a street directory, with the alphabetic co-ordinates along the horizontal and the numeric co-ordinates along the vertical axis. All references to a location are in the form of alphabet followed by a numeral. If you care to look back at the parts list, you will see the component number followed by the location and value ,e.g., R1 A7,1K (brn-blk-red).

To locate this particular component location you first locate the 'A' column across the top and follow that column down until it intersects with row 7. You now know that R1 sits in that square. Going to the board you can locate the area quickly and referring to the screen you have the exact location for that part.

Now that you know how to get around this board we might explain some of the other aspects of this project.

The insertion of the components follow the same sequence as any other kit, in that the components that sit closest to the board are inserted first. We insert resistors, capacitors, diodes, transistors, inductors, integrated circuits, chokes, crystals and then the filters. The overlays on the following pages show various stages of construction, broken up to provide easy to handle sections along with a checklist to make sure all parts are inserted as needed. This should prove invaluable to all constructors.

PCB COMPONENT OVERLAY



F/B = Ferrite Bead

MOUNTING PCB PINS, LINKS AND VCO SHIELD.

This is the first stage of construction, and as you can see, it involves only PCB pins, links (note position of insulated links) and VCO shield.

1. First of all, we will start by mounting the VCO shield. The four PCB pins used in holding the shield together should be inserted into the PCB holes from the copper side of the board. The long side of the pins should be inserted first (refer to Fig.1). This insures that the collars of the pins do not splay the sides of the shield.

2. Supplied in your kit is a small piece of thin PCB material. This should then be cut into four equal lengths (approx-

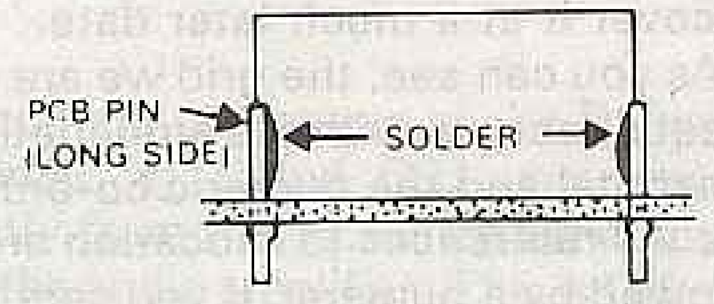
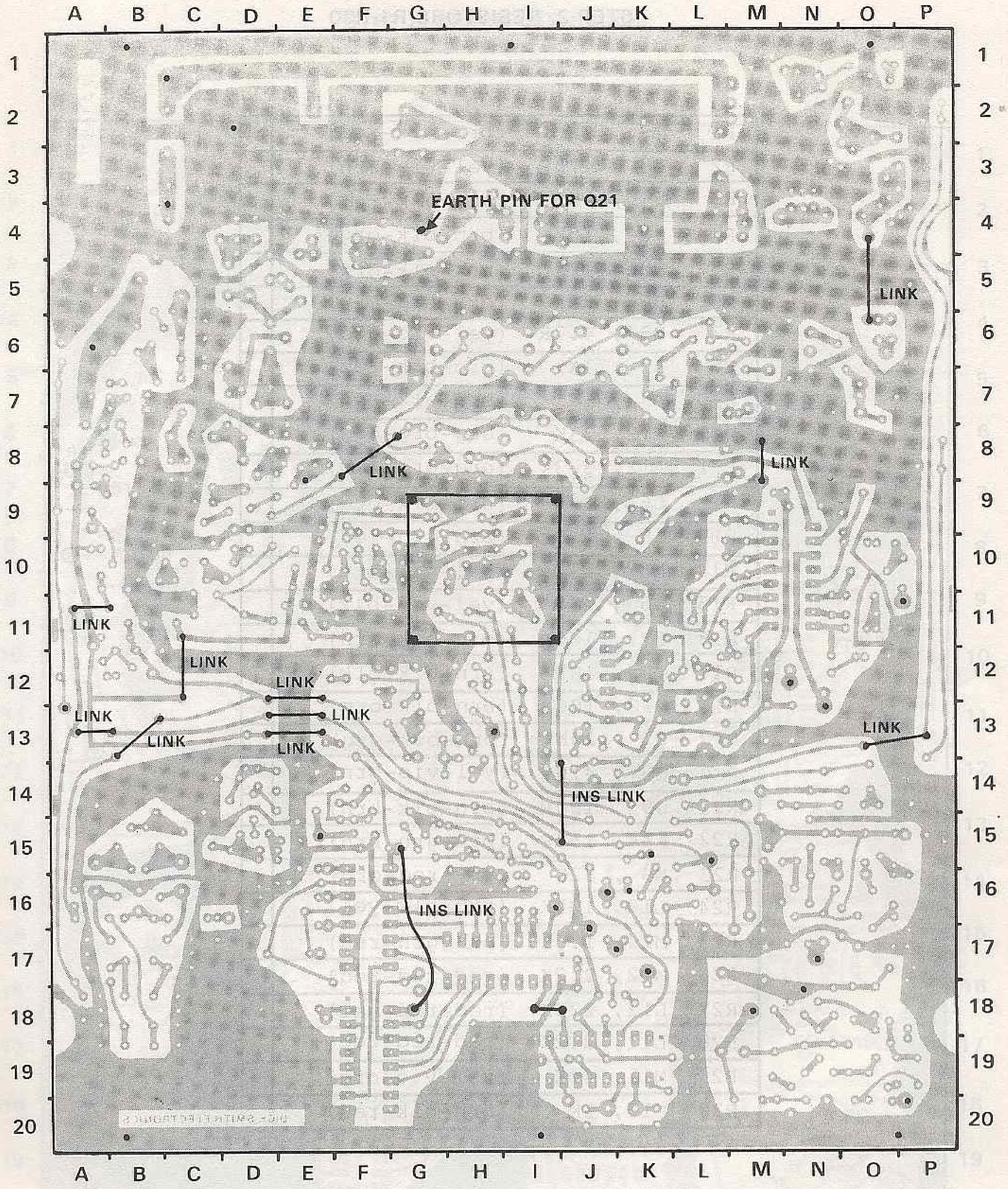


FIG.1

STEP 1. PCB PINS, LINKS AND VCO SHIELD



imately 25mm each) and soldered to the above pins, forming a shield for the VCO (refer to Fig. 2.).

3. Insert and solder all PCB pins and links as shown on layout. Use 25B&S Tin/Cu wire supplied for all links except those shown as insulated links (use telephone wire).

4. Earth pin for Q21 should be inserted from the copper side of the PCB and soldered to the transistor case once the transistor is fitted (please refer to Page 44).

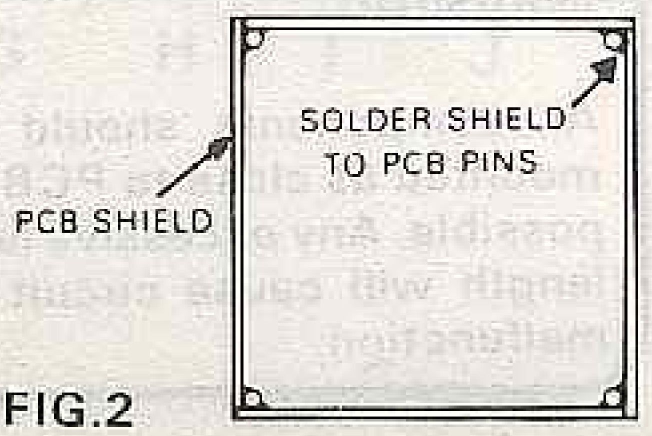


FIG.2

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

readout (ie, 14-.--MHz). In the photos, this means that the transceiver is set for a frequency of 145.49MHz

Standard controls for volume and squelch require little comment as does the signal strength-cum-power meter. The microphone socket is a standard configuration allowing press-to-talk operation.

In addition, there is a three-position switch for simplex and plus or minus 600kHz transmitter offset for working into repeaters and there is also an anti-repeater button so that the transceiver can be used to listen in on the repeater receiving frequency.

Finally, there is the 5kHz offset switch which effectively doubles the number of channels from 400 to 800, albeit with 5kHz channel spacing.

INDEX

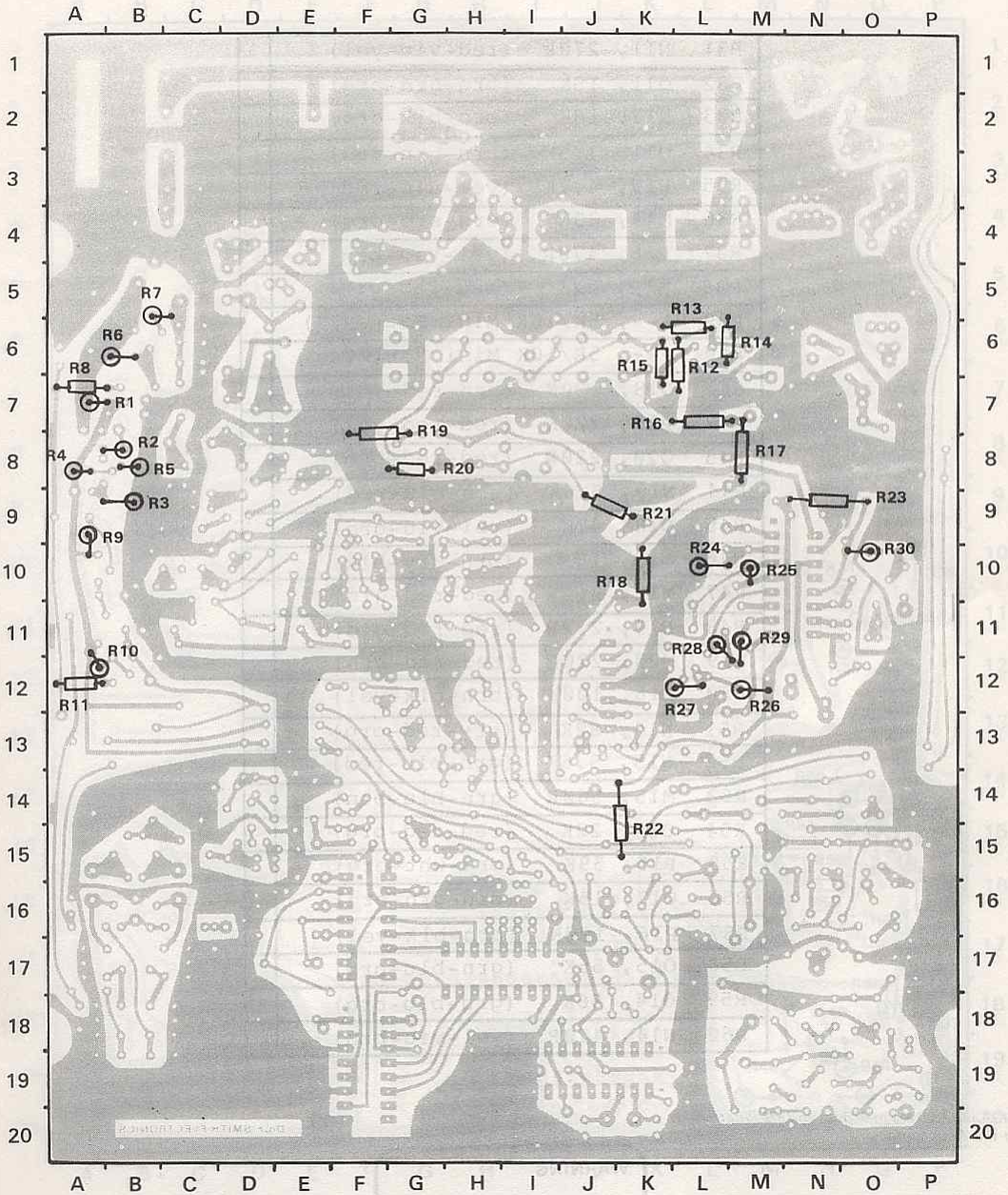
STEP 2. RESISTORS R1-R30

R1	A7 ,	1K	(brn-blk-red)	
R2	B8 ,	470R	(yel-vio-brn)	
R3	B9 ,	1K	(brn-blk-red)	
R4	A8 ,	10K	(brn-blk-org)	
R5	B8 ,	10k	(brn-blk-org)	
R6	B6 ,	33K	(org-org-org)	
R7	B5 ,	4.7R	(yel-vio-gld)	
R8	A7 ,	1K	(brn-blk-red)	
R9	A9 ,	1K	(brn-blk-red)	
R10	A12,	33K	(org-org-org)	
R11	A12,	3.3k	(org-org-red)	
R12	L6 ,	10k	(brn-blk-org)	
R13	L6 ,	1.5k	(brn-grn-red)	
R14	M6 ,	470R	(yel-vio-brn)	
R15	K6 ,	47R	(yel-vio-blk)	
R16	L7 ,	100R	(brn-blk-brn)	
R17	M8 ,	10R	(brn-blk-blk)	
R18	K10,	100R	(brn-blk-brn)	
R19	F7 ,	10K	(brn-blk-org)	
R20	G8 ,	470R	(yel-vio-brn)	
R21	J9 ,	100R	(brn-blk-brn)	
R22	K14,	150R	(brn-grn-brn)	
R23	N9 ,	82K	(gry-red-org)	
R24	L10,	100K	(brn-blk-yel)	
R25	M10,	1.5K	(brn-grn-red)	
R26	M12,	2.2K	(red-red-red)	
R27	L12,	220K	(red-red-yel)	
R28	L11,	2.2K	(red-red-red)	
R29	M11,	47K	(yel-vio-org)	
R30	O10,	1K	(brn-blk-red)	

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 2. RESISTORS R1-R30



STEP 3. RESISTORS R31-R60

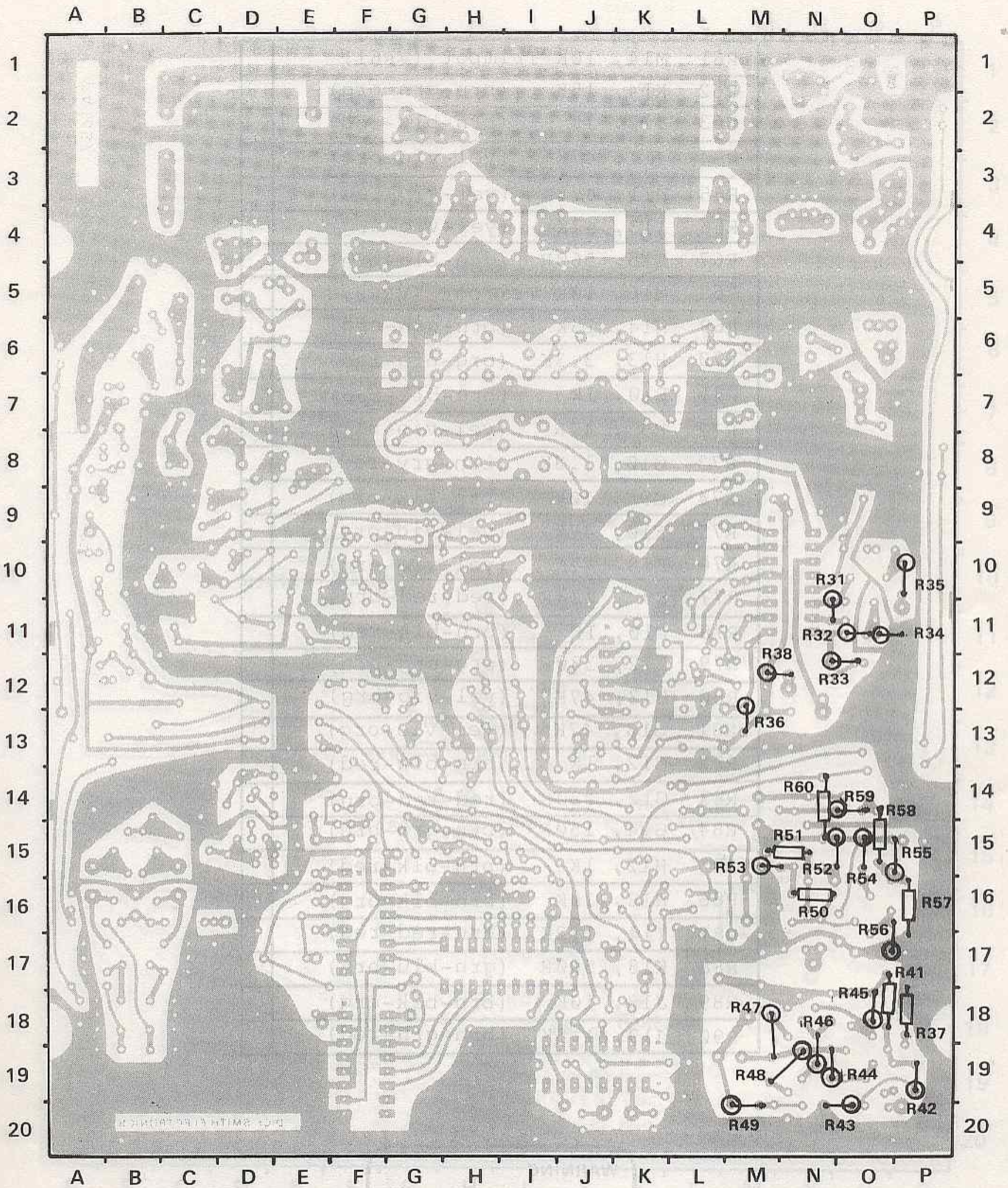
	R31	N11,	270k	(red-vio-yel)	
	R32	O11,	15K	(brn-grn-org)	
	R33	N12,	10K	(brn-blk-org)	
	R34	O11,	1.5K	(brn-grn-red)	
	R35	P10,	4.7K	(yel-vio-red)	
	R36	M13,	33K	(org-org-org)	
	R37	P18,	470R	(yel-vio-brn)	
	R38	M12,	22K	(red-red-org)	
*	R39	---,	5K/10K	Mini Pot(VR39)	
*	R40	---,	5K/10K	Mini Pot(VR40)	
	R41	O18,	120K	(brn-red-yel)	
	R42	P19,	220K	(red-red-yel)	
	R43	O20,	220R	(red-red-brn)	
	R44	N19,	5.6K	(grn-blu-red)	
	R45	O18,	47K	(yel-vio-org)	
	R46	N19,	18R	(brn-gry-blk)	
	R47	M18,	2.2R	(red-red-gld)	
	R48	N19,	2.2R	(red-red-gld)	
	R49	M20,	220R	(red-red-brn)	
	R50	N16,	100K	(brn-blk-yel)	
	R51	N15,	82K	(gry-red-org)	
	R52	N15,	5.6K	(grn-blu-red)	
	R53	M15,	560R	(grn-blu-brn)	
	R54	O15,	22K	(red-red-org)	
	R55	P15,	39K	(org-wht-org)	
	R56	O17,	15K	(brn-grn-org)	
	R57	P16,	100K	(brn-blk-yel)	
	R58	O15,	56K	(grn-blu-org)	
	R59	O14,	56K	(grn-blu-org)	
	R60	N14,	470R	(yel-vio-brn)	

* *R39 and R40 are mini pots and are located on the front panel.*

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 3. RESISTORS R31-R60



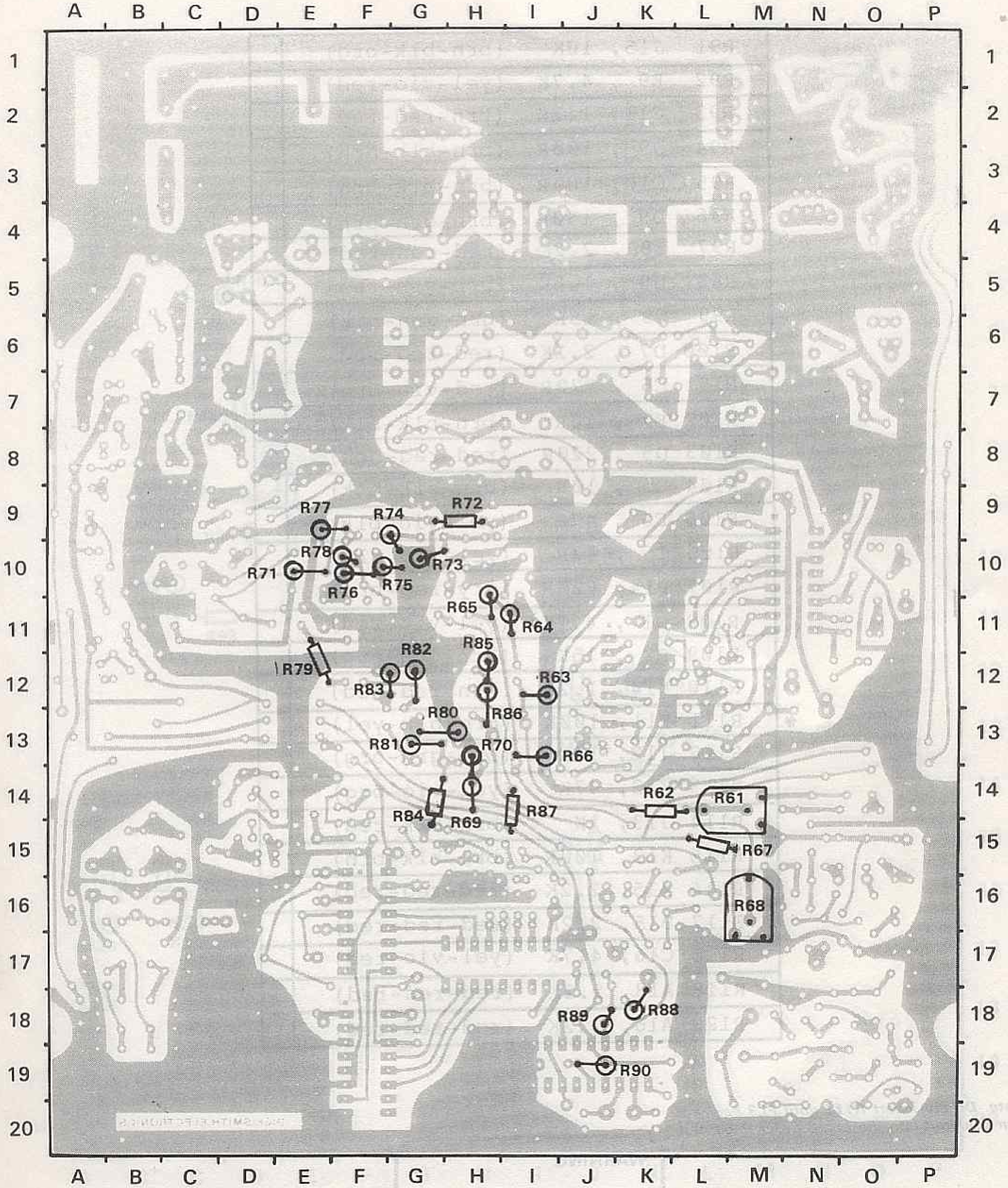
STEP 4. RESISTORS R61-R90

R61	M14, 10K Trimpot (VR61)	
R62	K14, 15K (brn-grn-org)	
R63	I12, 1K (brn-blk-red)	
R64	I11, 47K (yel-vio-org)	
R65	H11, 4.7K (yel-vio-red)	
R66	I13, 47K (yel-vio-org)	
R67	L15, 560R (grn-blu-brn)	
R68	M16, 10K Trimpot (VR68)	
R69	H14, 15k (brn-grn-org)	
R70	H13, 3.3K (org-org-red)	
R71	E10, 1k (brn-blk-red)	
R72	H9 , 47R (yel-vio-blk)	
R73	G10, 1.8K (brn-gry-red)	
R74	G9 , 10K (brn-blk-org)	
R75	F10, 47K (yel-vio-org)	
R76	F10, 47K (yel-vio-org)	
R77	E9 , 220R (red-red-brn)	
R78	F10, 1K (brn-blk-red)	
R79	E12, 330R (org-org-brn)	
R80	H13, 47K (yel-vio-org)	
R81	G13, 47K (yel-vio-org)	
R82	G12, 1K (brn-blk-red)	
R83	G12, 220R (red-red-brn)	
R84	G14, 150R (brn-grn-brn)	
R85	H12, 1K (brn-blk-red)	
R86	H12, 10K (brn-blk-org)	
R87	I14, 1.2K (brn-red-red)	
R88	K18, 560R (grn-blu-brn)	
R89	J18, 10K (brn-blk-org)	
R90	J19, 1.5K (brn-grn-red)	

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 4. RESISTORS R61-R90



STEP 5. RESISTORS R91-R120

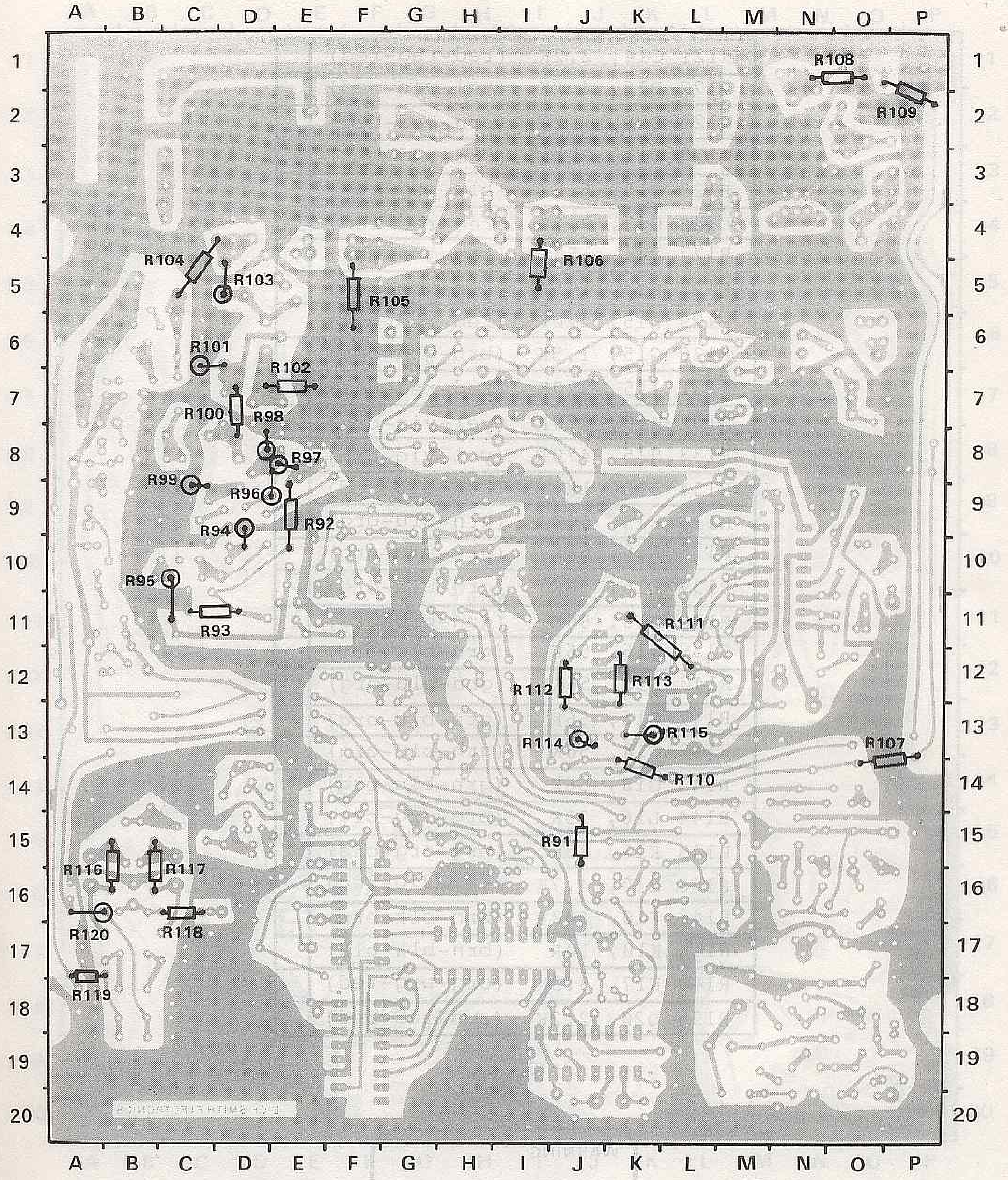
R91	J15,	1ØK	(brn-blk-org)	
R92	E9 ,	4.7K	(yel-vio-red)	
R93	C11,	1.2K	(brn-red-red)	
R94	D9 ,	1ØØR	(brn-blk-brn)	
R95	C1Ø,	1ØØR	(brn-blk-brn)	
R96	D9 ,	15ØR	(brn-grn-brn)	
R97	E8 ,	2.2K	(red-red-red)	
R98	D8 ,	1.5K	(brn-grn-red)	
R99	C9 ,	15R	(brn-grn-blk)	
R1ØØ	D7 ,	2.2K	(red-red-red)	
R1Ø1	C6 ,	27ØR	(red-vio-brn)	
R1Ø2	E7 ,	1ØR	(brn-blk-blk)	
R1Ø3	D5 ,	22ØR	(red-red-brn)	
R1Ø4	C5 ,	1ØR	(brn-blk-blk)	
R1Ø5	F5 ,	47R	(yel-vio-blk)	
R1Ø6	I5 ,	47R	(yel-vio-blk)	
R1Ø7	P14,	82ØR	(gry-red-brn)	
R1Ø8	O1 ,	4.7K	(yel-vio-red)	
R1Ø9	P2 ,	15K	(brn-grn-org)	
R11Ø	K14,	1.2K	(brn-red-red)	
* R111	K11,	1ØØK	(brn-blk-yel)	
R112	I12,	15K	(brn-grn-org)	
R113	K12,	47K	(yel-vio-org)	
R114	J13,	1K	(brn-blk-red)	
R115	K13,	1ØØR	(brn-blk-brn)	
R116	A15,	2.2K	(red-red-red)	
R117	B15,	2.2K	(red-red-red)	
R118	C16,	4.7K	(yel-vio-red)	
R119	A18,	2.2K	(red-red-red)	
R12Ø	A16,	2.2K	(red-red-red)	

** Note. Do not insert R111 until FL3 has been soldered into the board (refer Page 52).*

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 5. RESISTORS R91-R120



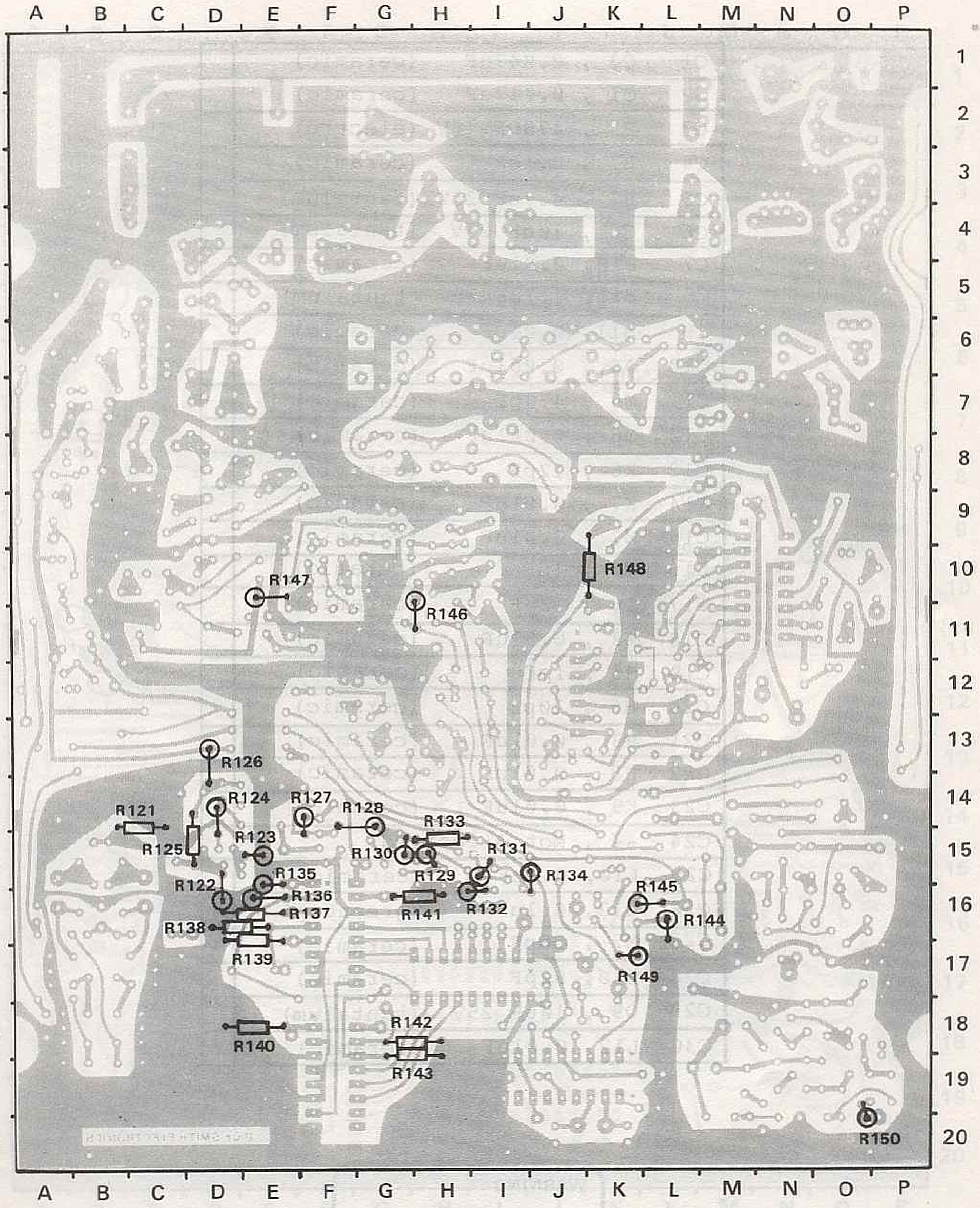
STEP 6. RESISTORS R121-R150

R121	C14,	2.2K	(red-red-red)	
R122	D16,	4.7K	(yel-vio-red)	
R123	E15,	1.2K	(brn-red-red)	
R124	D14,	22R	(red-red-blk)	
R125	D15,	6.8K	(blu-gry-red)	
R126	D13,	2.2K	(red-red-red)	
R127	E14,	15ØK	(brn-grn-yel)	
R128	G14,	1.5K	(brn-grn-red)	
R129	H15,	22ØK	(red-red-yel)	
R13Ø	G15,	1.5K	(brn-grn-red)	
R131	I15,	22ØK	(red-red-yel)	
R132	H16,	47ØR	(yel-vio-brn)	
R133	H15,	47ØR	(yel-vio-brn)	
R134	J15,	1K	(brn-blk-red)	
R135	E15,	56K	(grn-blu-org)	
R136	E16,	56K	(grn-blu-org)	
R137	E16,	56K	(grn-blu-org)	
R138	D16,	56K	(grn-blu-org)	
R139	D16,	56K	(grn-blu-org)	
R14Ø	E18,	56K	(grn-blu-org)	
R141	G16,	56K	(grn-blu-org)	
R142	G18,	56K	(grn-blu-org)	
R143	G18,	56K	(grn-blu-org)	
R144	L16,	33K	(org-org-org)	
R145	K16,	33K	(org-org-org)	
R146	H1Ø,	4.7K	(yel-vio-red)	
R147	E1Ø,	1ØØR	(brn-blk-brn)	
R148	K1Ø,	1ØR	(brn-blk-blk)	
R149	K17,	3.3K	(org-org-red)	
R15Ø	O2Ø,	2.2K	(red-red-red)	

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 6. RESISTORS R121-R150



SPECIFICATIONS

GENERAL

Frequency Coverage	144 to 148MHz (see text)
Channel Spacing	10kHz; with 5kHz offset
Number of Channels	400 @ 10kHz; 800 @ 5kHz (see text)
Frequency Stability	within ±10ppm from 0 to 60°C
Modulation	Frequency Modulation
Temperature Range	from 5 to 50°C
Duty Cycle	two minutes transmit, two minutes receive
Supply Voltage	12 to 15V DC; test voltage 13.8V DC
Polarity	negative chassis
Current Drain	Receive: muted, 110mA; unmuted, 300mA Transmit: 1.9A at 10W; 2.5A at 15W
Protection	(a) 3A in-line fuse (b) diode reverse polarity protection (D1) (c) RF power amplifier can withstand up to 5:1 VSWR and open or short-circuit conditions for at least two minutes (d) audio power amplifier can withstand open circuit continuously and momentary short circuits

TRANSMITTER

Power Output	10 watts nominal; 15 watts maximum
Maximum Deviation	limited to 5kHz under normal operation; up to 10kHz with overdrive
Distortion	less than 10% at 3kHz deviation
Spurious Emissions	less than 60dB with respect to carrier
Harmonics	less than 60dB
Microphone Sensitivity	5mV RMS

RECEIVER

Sensitivity	0.5μV into 50Ω for 12dB SINAD; typically 0.4μV
Selectivity	better than 60dB at ± 25kHz
Audio power	1W at 1% THD into 8Ω
Frequency response	6dB/octave rolloff above 1kHz

Dear Customer,

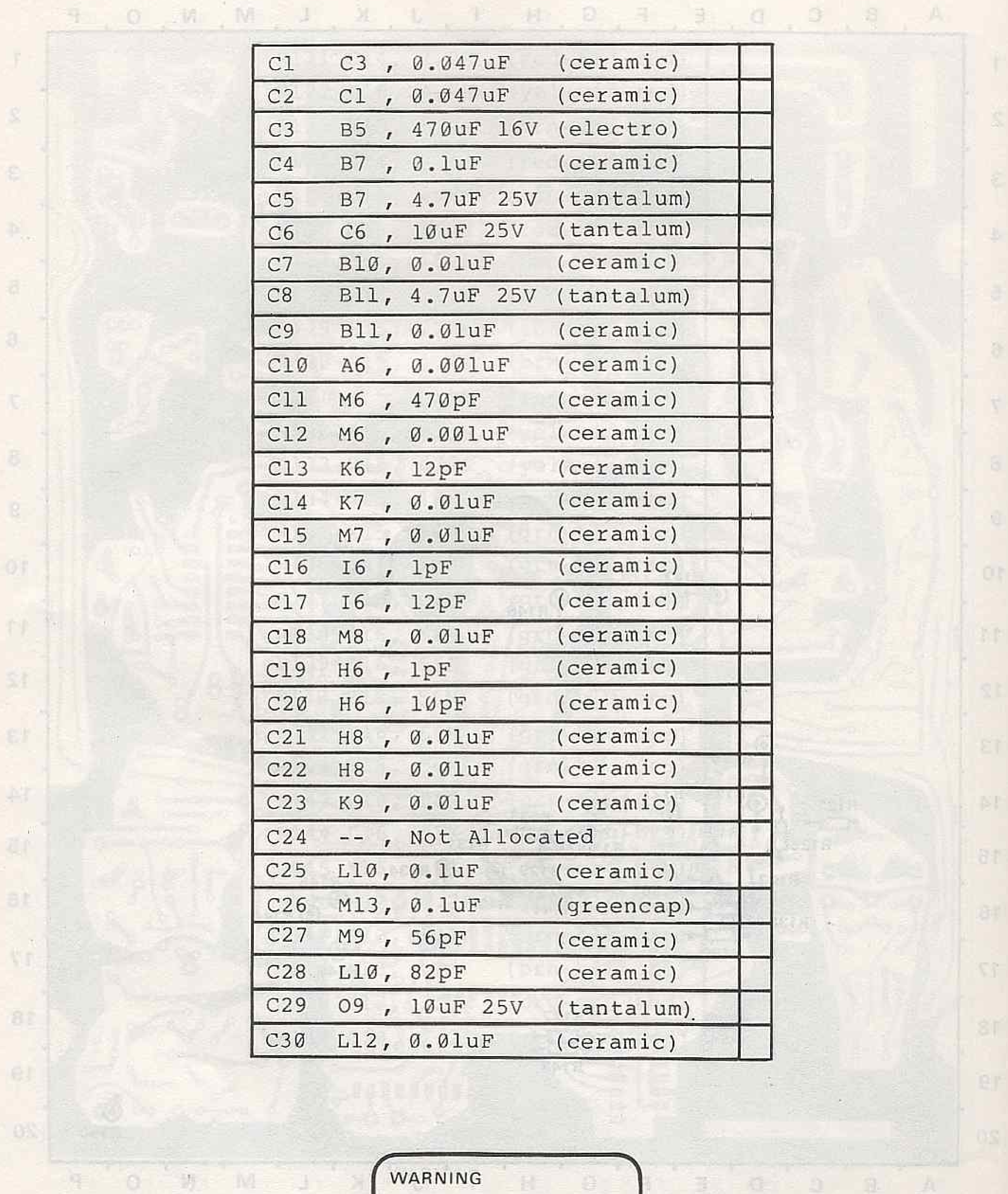
We are pleased that this company is the first Australian company to release a kit as sophisticated and as functional as the Commander VHF Transceiver kit. It is bound to bring great satisfaction to you in constructing it.

We would also like to give a word of warning. This kit is complex, and so we feel that it should not be undertaken by anyone who does not have considerable experience in constructing RF equipment. Most 'Amateurs' will have the skills necessary to complete this project without great difficulty, but for the inexperienced may we suggest you gain qualified assistance or else return the kit to us in its original packing for a full refund.

Thanking you,

Dick Smith and Staff

STEP 7. CAPACITORS C1-C30

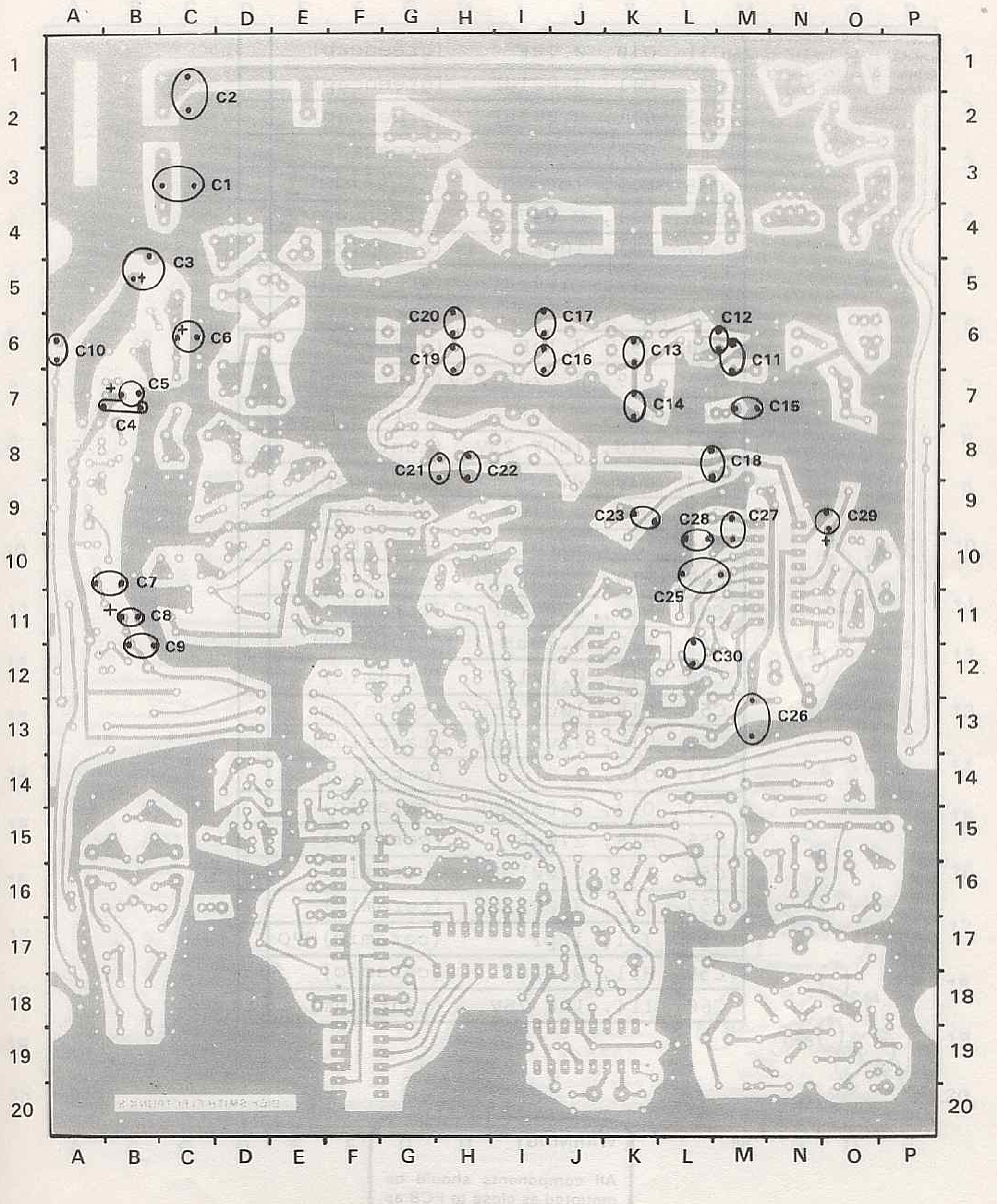


C1	C3 ,	Ø.Ø47uF	(ceramic)	
C2	C1 ,	Ø.Ø47uF	(ceramic)	
C3	B5 ,	47ØuF 16V	(electro)	
C4	B7 ,	Ø.1uF	(ceramic)	
C5	B7 ,	4.7uF 25V	(tantalum)	
C6	C6 ,	1ØuF 25V	(tantalum)	
C7	B1Ø,	Ø.Ø1uF	(ceramic)	
C8	B11,	4.7uF 25V	(tantalum)	
C9	B11,	Ø.Ø1uF	(ceramic)	
C1Ø	A6 ,	Ø.ØØ1uF	(ceramic)	
C11	M6 ,	47ØpF	(ceramic)	
C12	M6 ,	Ø.ØØ1uF	(ceramic)	
C13	K6 ,	12pF	(ceramic)	
C14	K7 ,	Ø.Ø1uF	(ceramic)	
C15	M7 ,	Ø.Ø1uF	(ceramic)	
C16	I6 ,	1pF	(ceramic)	
C17	I6 ,	12pF	(ceramic)	
C18	M8 ,	Ø.Ø1uF	(ceramic)	
C19	H6 ,	1pF	(ceramic)	
C2Ø	H6 ,	1ØpF	(ceramic)	
C21	H8 ,	Ø.Ø1uF	(ceramic)	
C22	H8 ,	Ø.Ø1uF	(ceramic)	
C23	K9 ,	Ø.Ø1uF	(ceramic)	
C24	-- ,	Not Allocated		
C25	L1Ø,	Ø.1uF	(ceramic)	
C26	M13,	Ø.1uF	(greencap)	
C27	M9 ,	56pF	(ceramic)	
C28	L1Ø,	82pF	(ceramic)	
C29	O9 ,	1ØuF 25V	(tantalum)	
C3Ø	L12,	Ø.Ø1uF	(ceramic)	

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 7. CAPACITORS C1-C30



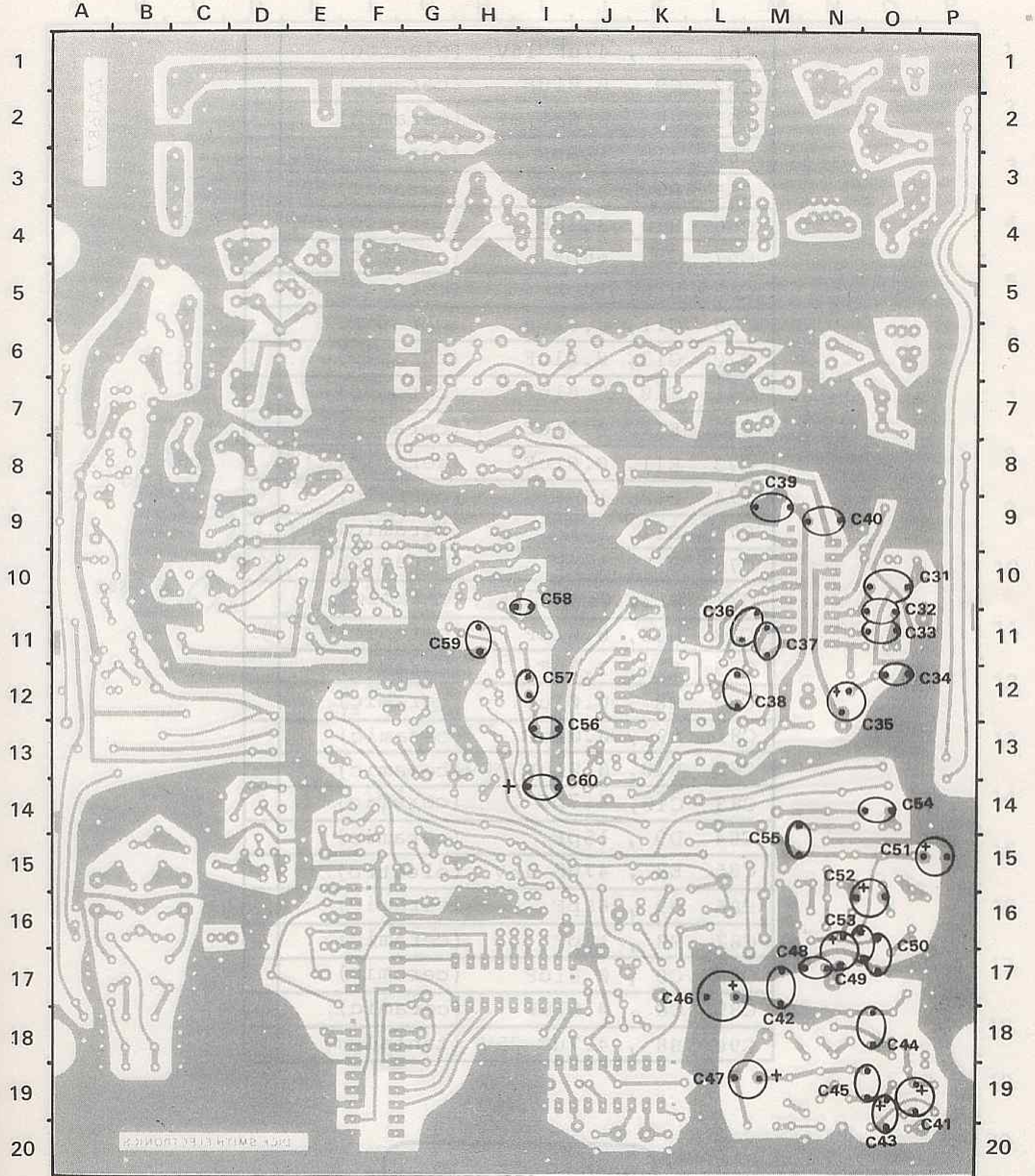
STEP 8. CAPACITORS C31-C60

C31	O10,	0.1uF	(greencap)	
C32	O11,	0.001uF	(greencap)	
C33	O11,	0.001uF	(greencap)	
C34	O12,	0.01uF	(greencap)	
C35	N12,	1uF 25V	(tantalum)	
C36	M11,	0.047uF	(greencap)	
C37	M11,	10pF	(ceramic)	
C38	L12,	0.047uF	(greencap)	
C39	M9 ,	0.1uF	(greencap)	
C40	N9 ,	0.1uF	(ceramic)	
C41	P19,	0.22uF 25V	(tantalum)	
C42	M17,	0.1uF	(ceramic)	
C43	O19,	10uF 25V	(tantalum)	
C44	O18,	0.1uF	(greencap)	
C45	O19,	0.01uF	(greencap)	
C46	L17,	470uF 16V	(electro)	
C47	M19,	220uF 16V	(electro)	
C48	N17,	0.001uF	(ceramic)	
C49	N17,	0.22uF 35V	(tantalum)	
C50	H11,	0.001uF	(ceramic)	
C51	P15,	10uF 25V	(tantalum)	
C52	O16,	22uF 16V	(tantalum)	
C53	O16,	0.01uF	(ceramic)	
C54	O14,	0.0022uF	(ceramic)	
C55	M15,	270pF	(ceramic)	
C56	I13,	0.001uF	(ceramic)	
C57	I12,	0.0022uF	(ceramic)	
C58	I11,	18pF	(ceramic)NPO	
C59	H11,	0.01uF	(ceramic)	
C60	I14,	1uF 25V	(tantalum)	

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 8. CAPACITORS C31-C60



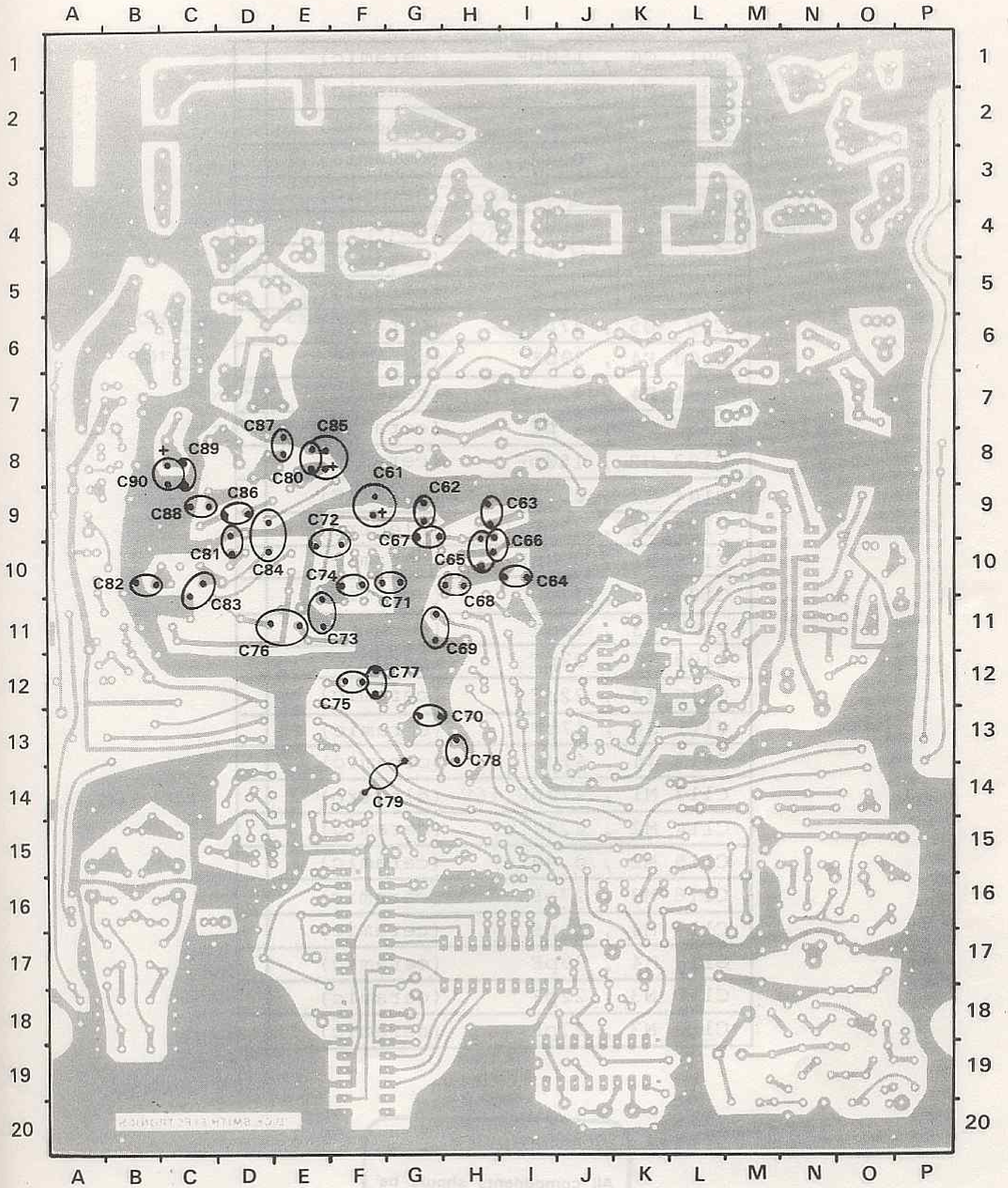
STEP 9. CAPACITORS C61-C90

C61	F9 ,	47uF 16V	(electro)	
C62	G9 ,	0.01uF	(ceramic)	
C63	H9 ,	0.0047uF	(ceramic)	
C64	I10,	5.6pF	(ceramic) NPO	
C65	H10,	4.7pF	(ceramic) NPO	
C66	H10,	3.3pF	(ceramic) NPO	
C67	G9 ,	68pF	(ceramic)	
C68	H10,	12pF	(ceramic) NPO	
C69	G11,	0.01uF	(ceramic)	
C70	G13,	0.01uF	(ceramic)	
C71	F10,	0.01uF	(ceramic)	
C72	E10,	0.01uF	(ceramic)	
C73	E11,	0.01uF	(ceramic)	
C74	F10,	15pF	(ceramic)	
C75	F12,	1pF	(ceramic)	
C76	E11,	10pF	(ceramic)	
C77	F12,	0.0022uF	(ceramic)	
C78	H13,	0.01uF	(ceramic)	
C79	F14,	3.3pF	(ceramic)	
C80	E8 ,	0.01uF	(ceramic)	
C81	D9 ,	0.01uF	(ceramic)	
C82	B10,	0.01uF	(ceramic)	
C83	C10,	4.7pF	(ceramic)	
C84	D9 ,	15pF	(ceramic)	
C85	E8 ,	47uF 16V	(electro)	
C86	D9 ,	68pF	(ceramic)	
C87	E8 ,	18pF	(ceramic)	
C88	C9 ,	0.01uF	(ceramic)	
C89	C8 ,	0.01uF	(ceramic)	
C90	B8 ,	4.7uF 25V	(tantalum)	

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 9. CAPACITORS C61-C90



All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

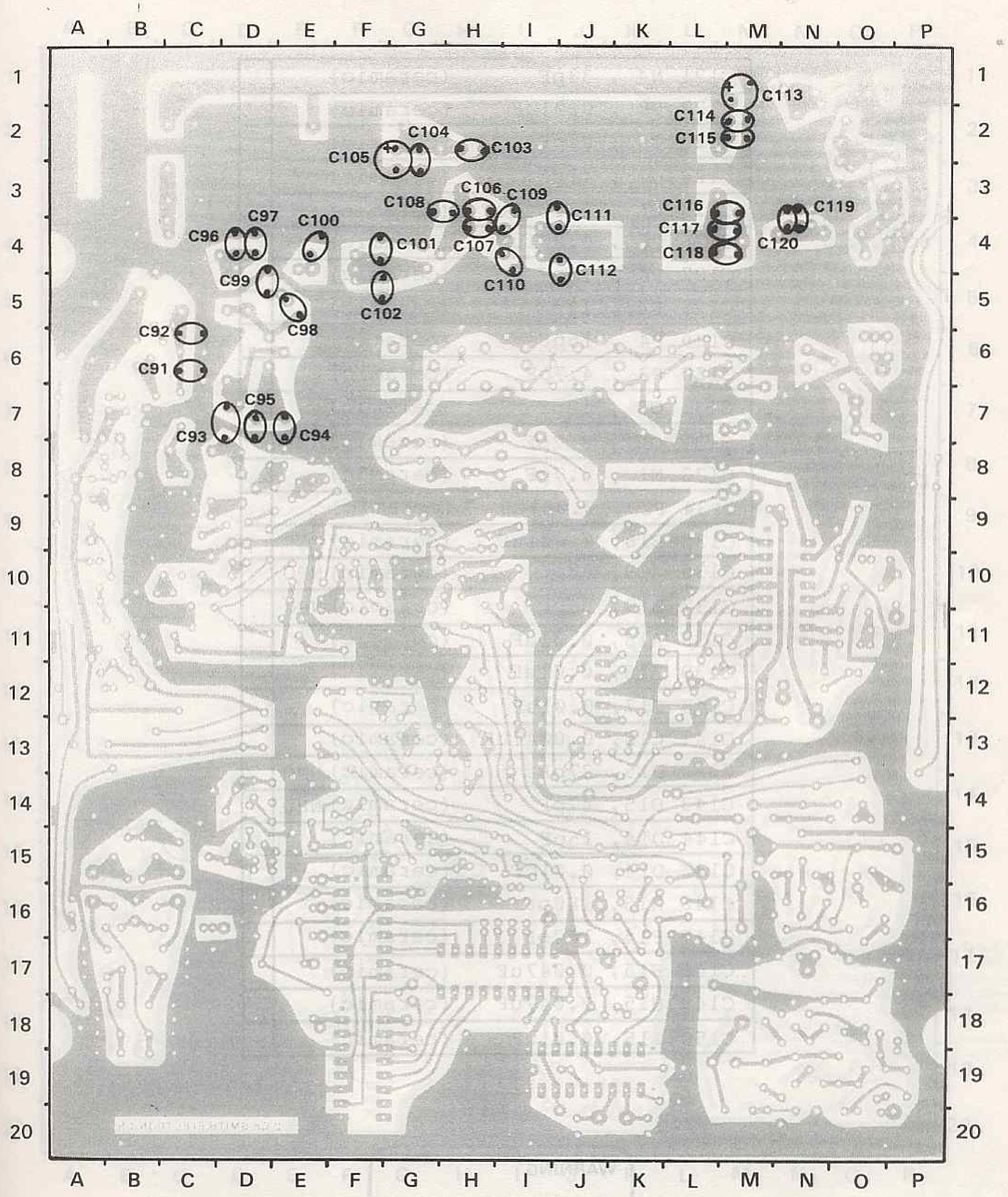
STEP 10. CAPACITORS C91-C120

C91	C6	,	15ØpF	(ceramic)	
C92	C6	,	Ø.Ø1uF	(ceramic)	
C93	D7	,	18pF	(ceramic)	
C94	E7	,	Ø.ØØ47uF	(ceramic)	
C95	D7	,	Ø.ØØ1uF	(ceramic)	
C96	D4	,	Ø.ØØ1uF	(ceramic)	
C97	D4	,	Ø.ØØ1uF	(ceramic)	
C98	E5	,	82pF	(ceramic)	
C99	D5	,	47pF	(ceramic)	
C1ØØ	E4	,	39pF	(ceramic)	
C1Ø1	F4	,	47pF	(ceramic)	
C1Ø2	F5	,	47pF	(ceramic)	
C1Ø3	H2	,	15ØpF	(ceramic)	
C1Ø4	G2	,	Ø.ØØ1uF	(ceramic)	
C1Ø5	G2	,	47uF 16V	(electro)	
C1Ø6	H3	,	8.2pF	(ceramic)	
C1Ø7	H4	,	22pF	(ceramic)	
C1Ø8	G3	,	22pF	(ceramic)	
C1Ø9	I3	,	22pF	(ceramic)	
C11Ø	I4	,	22pF	(ceramic)	
C111	J4	,	47pF	(ceramic)	
C112	J4	,	47pF	(ceramic)	
C113	M1	,	47ØuF 16V	(electro)	
C114	M2	,	Ø.ØØ1uF	(ceramic)	
C115	M2	,	Ø.ØØ1uF	(ceramic)	
C116	M3	,	27pF	(ceramic)	
C117	M4	,	15pF	(ceramic)	
C118	M4	,	39pF	(ceramic)	
C119	N3	,	22pF	(ceramic)	
C12Ø	N3	,	27pF	(ceramic)	

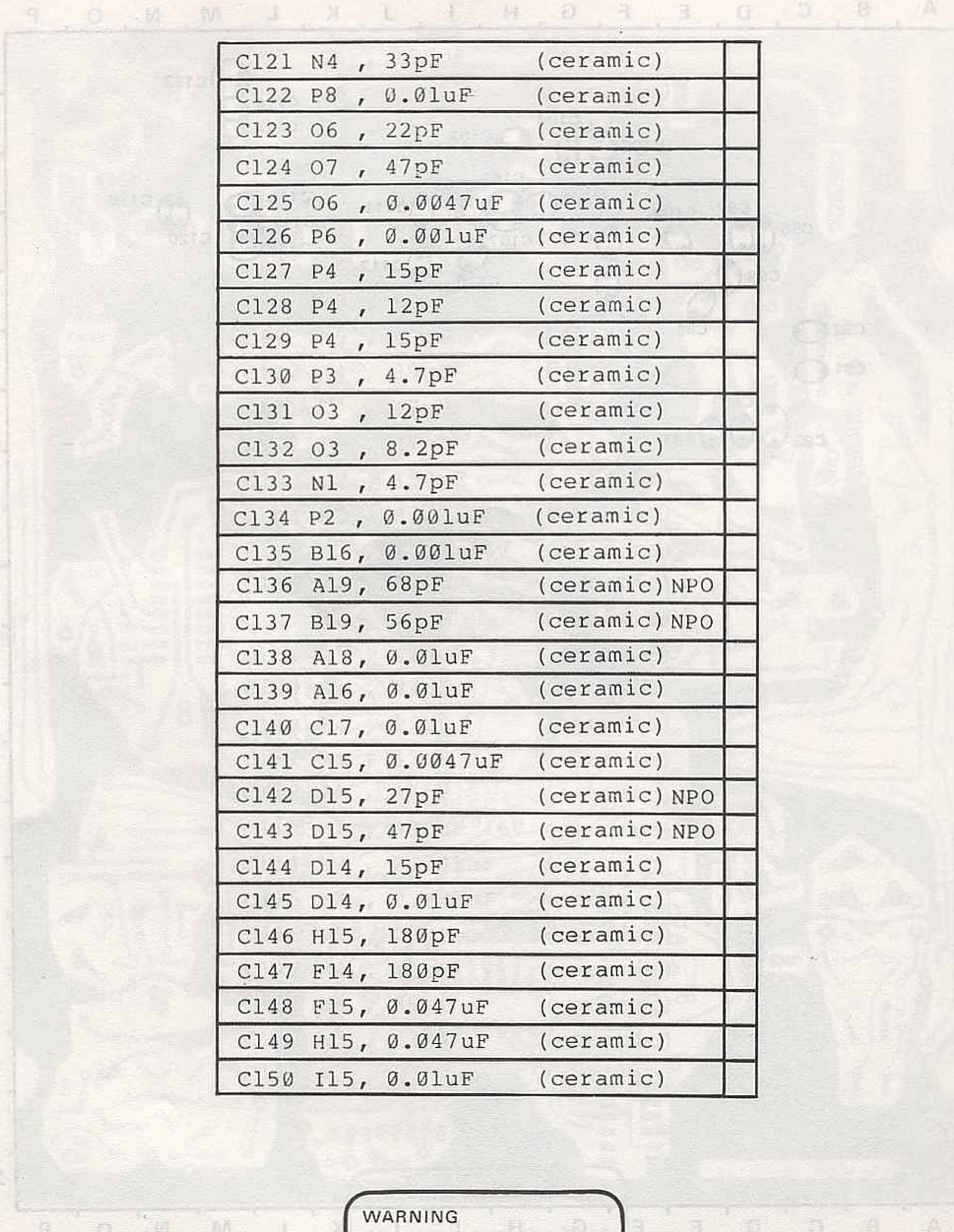
WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 10. CAPACITORS C91-C120



STEP 11. CAPACITORS C121-C150

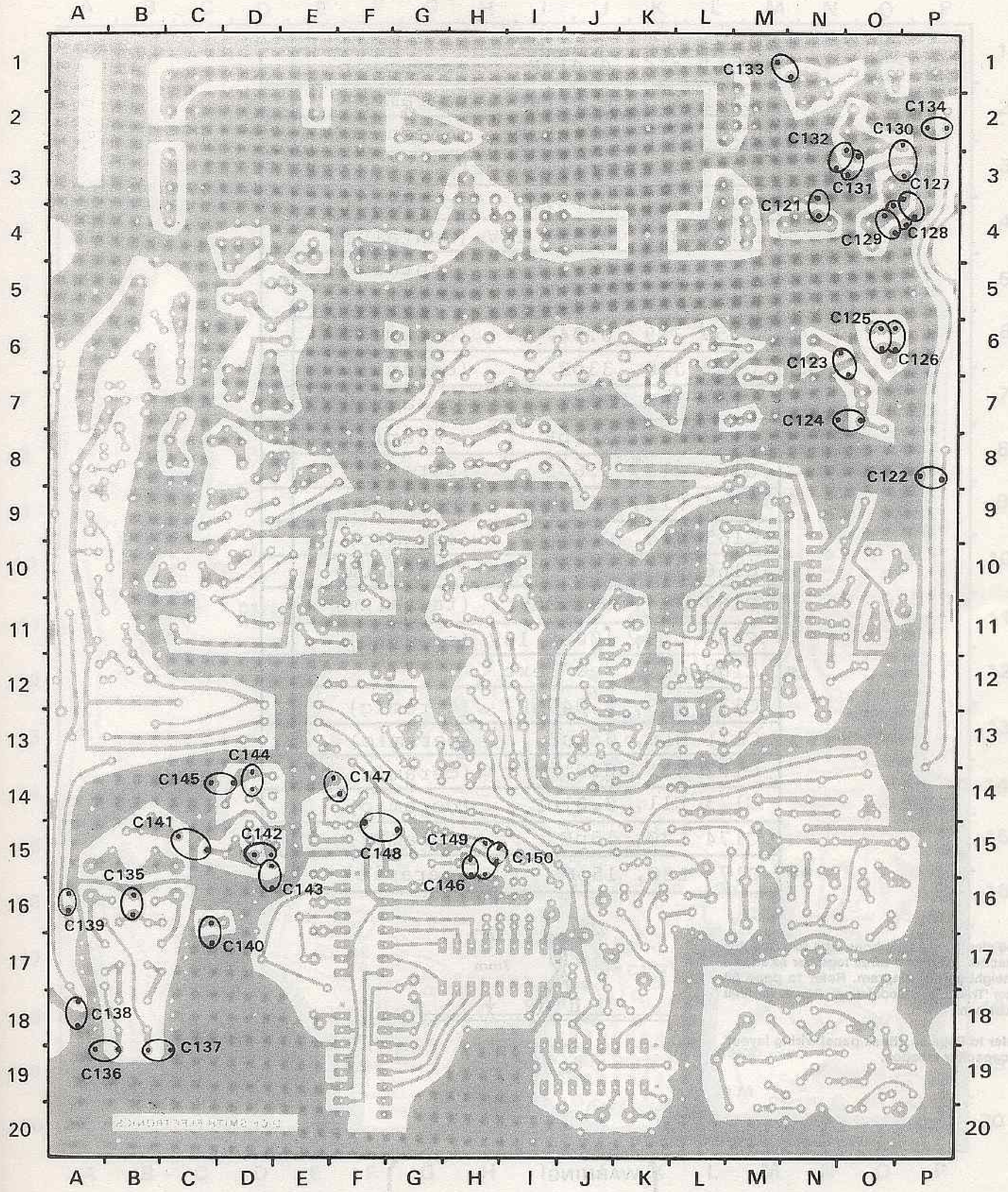


C121	N4	33pF	(ceramic)	
C122	P8	0.01uF	(ceramic)	
C123	O6	22pF	(ceramic)	
C124	O7	47pF	(ceramic)	
C125	O6	0.0047uF	(ceramic)	
C126	P6	0.001uF	(ceramic)	
C127	P4	15pF	(ceramic)	
C128	P4	12pF	(ceramic)	
C129	P4	15pF	(ceramic)	
C130	P3	4.7pF	(ceramic)	
C131	O3	12pF	(ceramic)	
C132	O3	8.2pF	(ceramic)	
C133	N1	4.7pF	(ceramic)	
C134	P2	0.001uF	(ceramic)	
C135	B16	0.001uF	(ceramic)	
C136	A19	68pF	(ceramic) NPO	
C137	B19	56pF	(ceramic) NPO	
C138	A18	0.01uF	(ceramic)	
C139	A16	0.01uF	(ceramic)	
C140	C17	0.01uF	(ceramic)	
C141	C15	0.0047uF	(ceramic)	
C142	D15	27pF	(ceramic) NPO	
C143	D15	47pF	(ceramic) NPO	
C144	D14	15pF	(ceramic)	
C145	D14	0.01uF	(ceramic)	
C146	H15	180pF	(ceramic)	
C147	F14	180pF	(ceramic)	
C148	F15	0.047uF	(ceramic)	
C149	H15	0.047uF	(ceramic)	
C150	I15	0.01uF	(ceramic)	

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 11. CAPACITORS C121-C150



A GENERAL GUIDE TO KIT CONSTRUCTION

FOLLOW THE MANUAL

Read each step completely — before starting. Make sure you understand everything that's involved.

TAKE YOUR TIME

Allow yourself plenty of time to build the kit. Set aside an area where you can work undisturbed, and can leave the kit between sessions.

CHECK YOUR WORK

Refer frequently to the kit's instruction manual, check each step as it is completed.

SOLDERING

Poor soldering is the major cause of kits not working. This is simply because most people do not take the time to learn how to solder properly and practise it.

THE IRON

The soldering iron used should be suited to electronic work. A wattage of from 10 to 30 watts is ideal, with a tip size from 1.5 to 4mm across. A chisel shape is usually best.

The tip should be kept clean at all times. The best way is to keep a damp sponge or cloth handy and wipe the iron on it occasionally. If the tip is pitted it will have to be reshaped by filing (except iron plated tips which must not be filed).

THE SOLDER

The best solder for general electronics use is 60/40 multicore (60% tin/40% lead with inbuilt resin flux). SAVBIT is a variation of this type with 2% copper added to improve tip life. 'Acid core' solders must not be used.

METHOD

The joint must be clean and free from tarnish, lacquers etc. for the solder to adhere properly. If necessary, use sandpaper or a fine file to clean the joint.

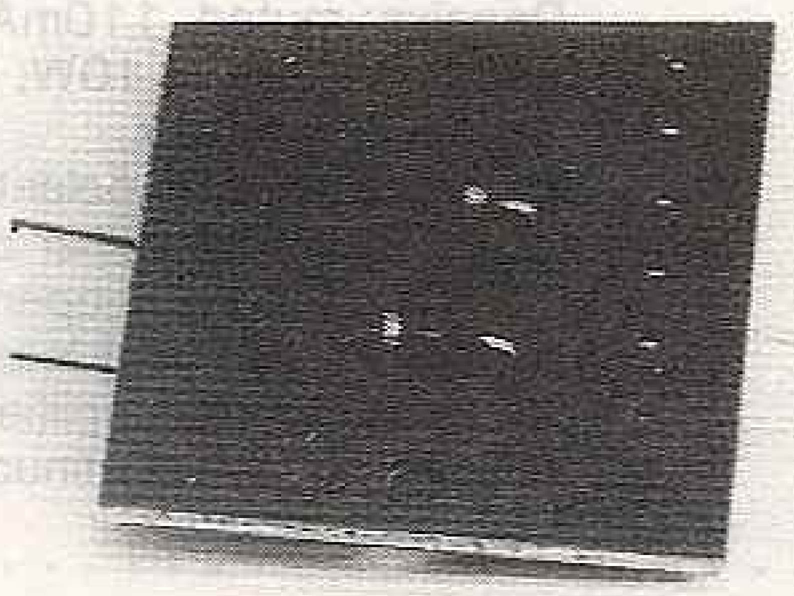
Make a good mechanical connection: bend leads of components mounted on printed circuit boards at 45^{o} once inserted; and on wires connecting to switches, terminals etc. at 90^{o}.

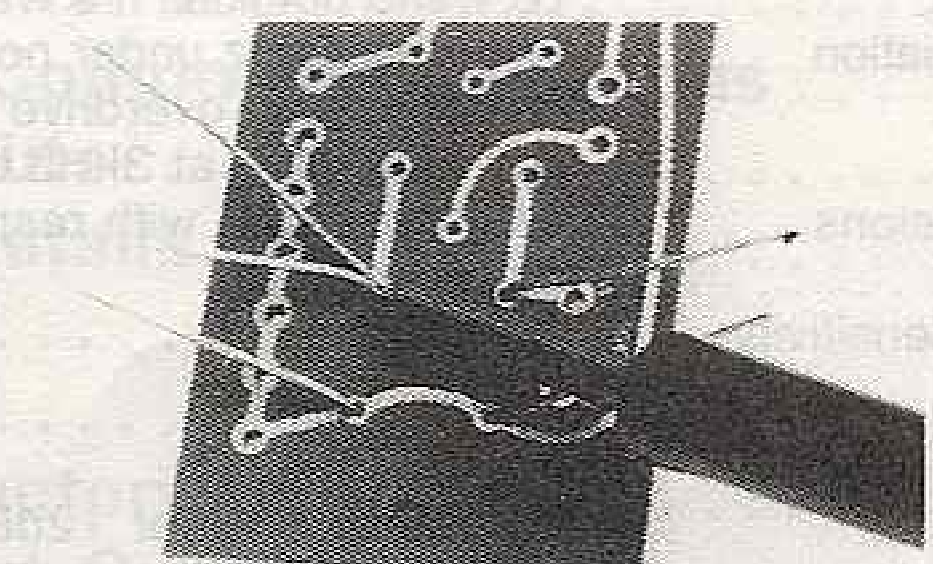
Hold the iron as you hold a pencil and apply it to the joint before the solder to pre-heat the joint (about one second for PC boards) then apply the solder to the joint and the iron. The solder will flow freely when the joint is hot enough. Remove the iron and and solder when the solder has flowed across the whole joint. If the solder forms a ball the joint needs more heat.

Don't move anything while the solder is cooling. If you do, re-heat and add a little more solder to ensure a clean joint.

The connection should be shiny and the solder should flow smoothly into it. If it looks cracked or frosty, the joint is dry and must be re-done.

If you've never used an iron before, do some practise runs first. Get the feel of the solder flow, and when to apply and remove the solder and the iron.





When soldering semiconductors and other sensitive components it is a good idea to hold the lead with pliers or a heatsink clip to prevent damage by overheating. This isn't necessary once you can solder fast and reliably.

When it is cool, inspect each joint carefully; look for solder 'bridges' shorting across PC tracks, pinholes and cracks in the joints.

COMPONENT IDENTIFICATION

One of the biggest problems for the beginning constructor is identifying the components correctly. The main trap is in the maze of numbers put on components by manufacturers. There will normally be a drawing of the parts in the kit manual, but identifying numbers may not be easy to find on the components themselves. As an example, what's described as a '741' IC may be marked LM741CN, N5741T, 741TC, MC1741CP1 or SN52741N. Confusing, isn't it? Notice though, that there is a '741' somewhere in all the numbers. The other numbers and letters indicate the manufacturer, and various batch and variety codes of the particular manufacturer. All these may be ignored as any of these ICs would work equally well in a circuit.

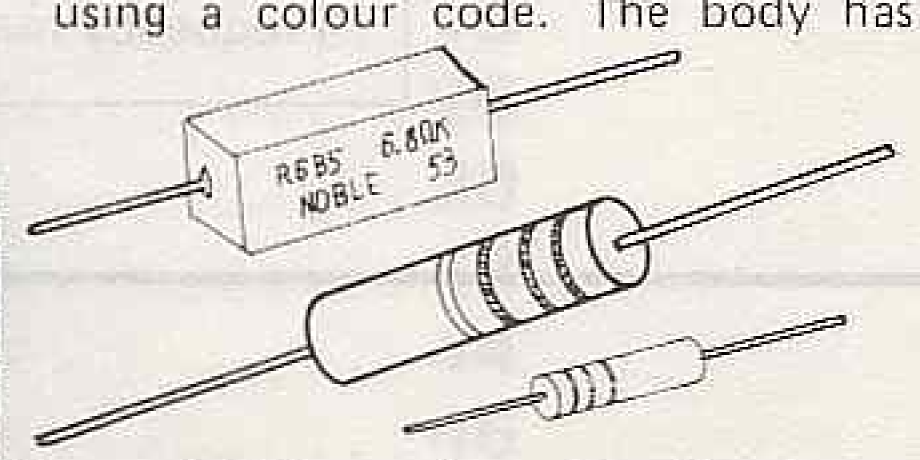
We will now go through the common components in our kits.

RESISTORS

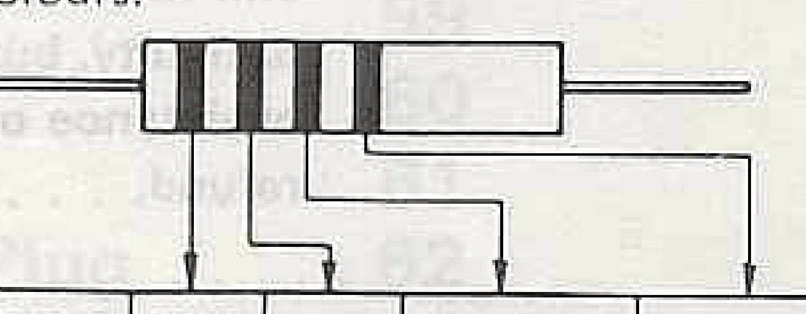
So called because they 'resist' the flow of current. They are normally in the form of small cylinders about 10mm long. Some high wattage types are rectangular.

Resistance is measured in ohms, abbreviated to Ω or R. Thousands are indicated by 'k', millions by 'M'. Thus a 12k resistor has a resistance of 12 000 ohms.

This value is marked on the resistors using a colour code. The body has



(normally) four stripes. The first three indicate the resistance, the last the tolerance - how much the resistor may vary from its quoted resistance. The last band need not concern us as it is normally gold (5%) in our kits, which is accurate for most uses. To read the colour code, start with the band closest to the end. The first two are the significant figures, and the third is the number of zeroes following. The chart below shows the value of the different colours.

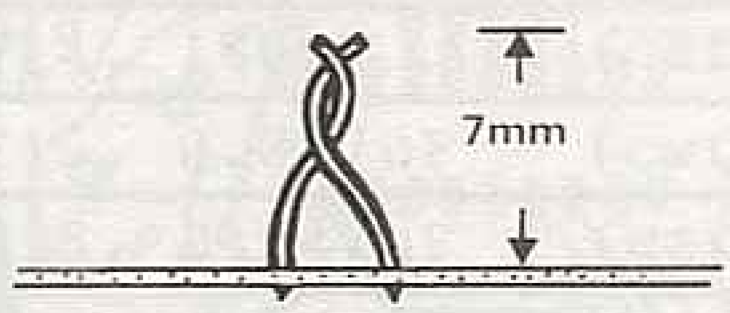


COLOUR	TENS	UNITS	MULTIPLIER	TOLERANCE
BLACK	0	0	1	20% (M)
BROWN	1	1	10	1% (F)
RED	2	2	100	2% (G)
ORANGE	3	3	1000	—
YELLOW	4	4	10000	—
GREEN	5	5	100000	—
BLUE	6	6	1000000	—
VIOLET	7	7	—	—
GREY,	8	8	—	—
WHITE	9	9	—	—
GOLD	—	—	0 1	5% (J)
SILVER	—	—	0 01	10% (K)

STEP 12. CAPACITORS C151-C174

	C151 I16, 0.01uF (ceramic)	
	C152 F15, 0.047uF (ceramic)	
	C153 H12, 0.022uF (greencap)	
	C154 ---, Not Allocated	
	C155 J17, 0.047uF (ceramic)	
	C156 H12, 3.3uF 25V (tantalum)	
	C157 J17, 1uF 25V (tantalum)	
	C158 J18, 0.047uF (ceramic)	
	C159 J19, 0.047uF (ceramic)	
	C160 J20, 33pF (ceramic)	
	C161 K20, 56pF (ceramic)	
	C162 K11, 220pF (ceramic)	
	C163 J12, 5.6pF (ceramic)	
	C164 K12, 0.047uF (greencap)	
	C165 J13, 0.001uF (ceramic)	
	C166 K13, 10uF 25V (tantalum)	
	C167 J14, 1uF 25V (tantalum)	
	C168 L19, 100uF 16V (electro)	
*	C169 O1 , See Text *	
	C170 E13, 0.047uF (ceramic)	
	C171 L16, 0.1uF (ceramic)	
	C172 J11, 0.01uF (ceramic)	
	C173 E11, 0.01uF (ceramic)	
	C174 L20, 15pF (ceramic)	
**	C175 L20, 15pF (ceramic)	

* Use single core telephone wire to make this capacitor. Twist two wires together as shown in neighbouring diagram. Refer to page 60 under 'Tranceiver Modulation', Part 2. for final adjustment.

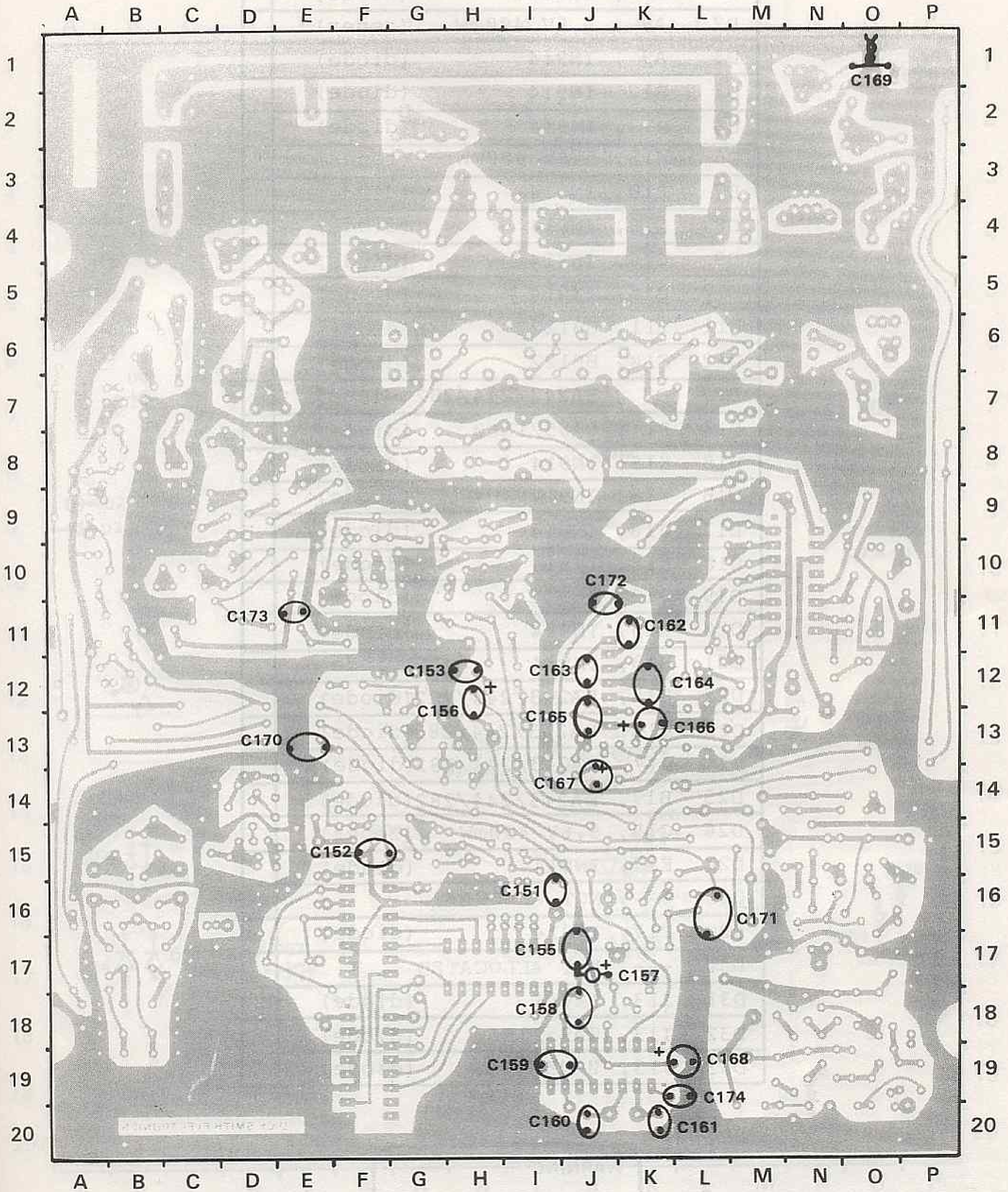


** Refer to Page 59, 'Back panel wiring layout' for capacitor location.

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 12. CAPACITORS C151-C174



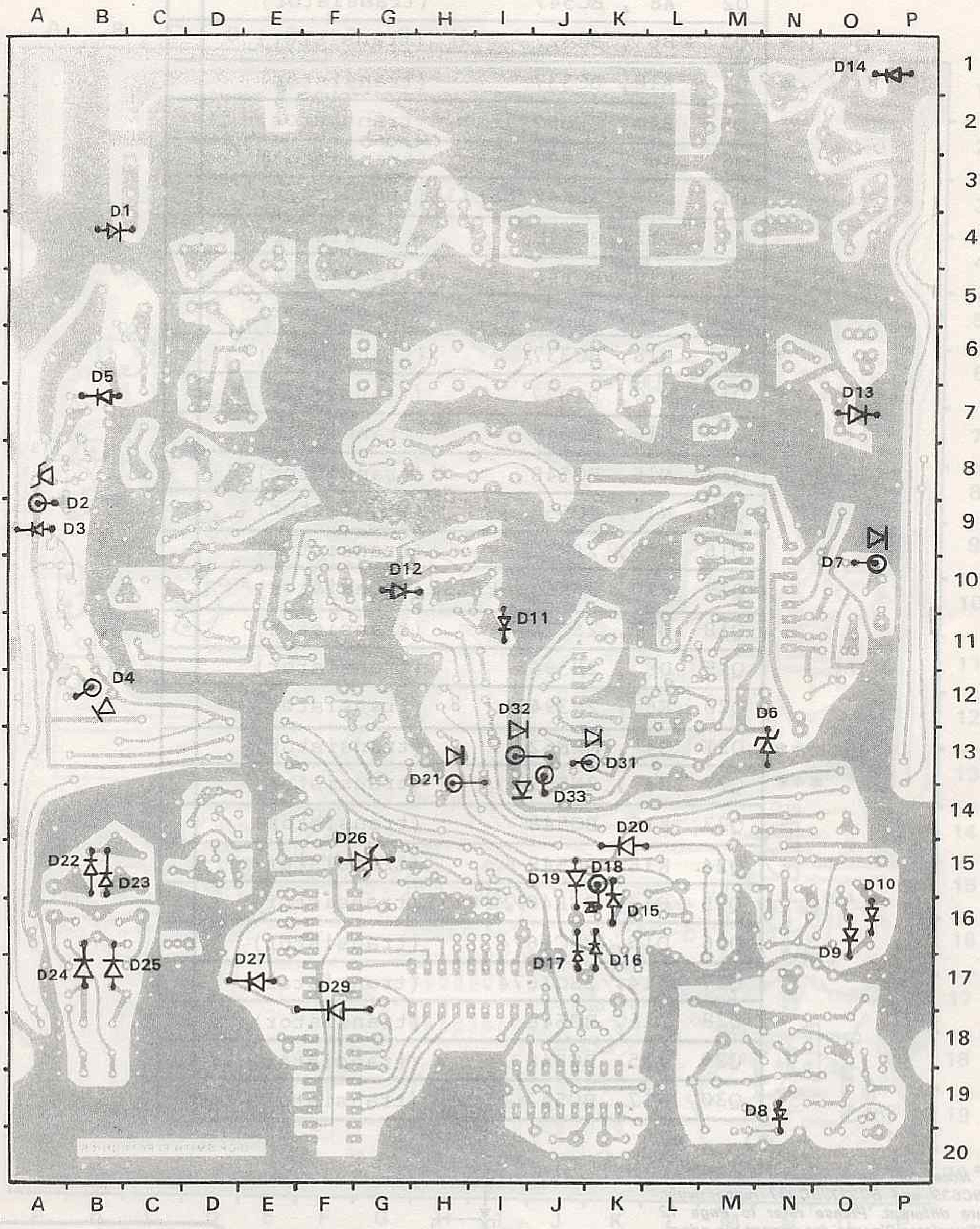
STEP 13. DIODES D1 - D33

D1	B4 ,	IN4002	(diode)	
D2	A8 ,	5.6V 400mW	(zener)	
D3	A9 ,	IN914	(diode)	
D4	B12,	IN914	(diode)	
D5	B7 ,	IN914	(diode)	
D6	N13,	5.6V 400mW	(zener)	
D7	P10,	IN914	(diode)	
D8	N19,	IN914	(diode)	
D9	O16,	IN914	(diode)	
D10	P16,	IN914	(diode)	
D11	I11,	BB122	(diode)	
D12	G10,	BB122	(diode)	
D13	O7 ,	BA243/244/282	(diode)	
D14	P1 ,	OA95/1N60	(diode)	
D15	K15,	IN914	(diode)	
D16	K16,	IN914	(diode)	
D17	J16,	IN914	(diode)	
D18	K15,	IN914	(diode)	
D19	J15,	IN914	(diode)	
D20	K15,	IN914	(diode)	
D21	H13,	IN914	(diode)	
D22	B15,	BA243/244/282	(diode)	
D23	B15,	BA243/244/282	(diode)	
D24	B17,	BA243/244/282	(diode)	
D25	B17,	BA243/244/282	(diode)	
D26	G15,	5.6V 400mW	(Zener)	
D27	E17,	IN914	(diode)	
D28	---,	NOT ALLOCATED		
D29	F17,	IN914	(diode)	
D30	---,	NOT ALLOCATED		
D31	J13,	IN914	(diode)	
D32	I13,	0A95/1N60	(diode)	
D33	J13,	0A95/1N60	(diode)	

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 13. DIODES D1 - D33



STEP 14. TRANSISTORS Q1-Q30

	Q1	A7 ,	BD14Ø	(transistor)	
	Q2	A8 ,	BC547	(transistor)	
*	Q3	B6 ,	BC327	(transistor)	
*	Q4	A1Ø,	BC337	(transistor)	
	Q5	B11,	BC557	(transistor)	
	Q6	L6 ,	BFY9Ø	(transistor)	
	Q7	G8 ,	3SK4Ø/MFE131	(transistor)	
	Q8	L12,	BC548	(transistor)	
	Q9	O19,	BC548	(transistor)	
	Q1Ø	N18,	BC558	(transistor)	
*	Q11	N18,	BC337	(transistor)	
*	Q12	N2Ø,	BC327	(transistor)	
	Q13	N16,	BC548	(transistor)	
	Q14	N15,	BC548	(transistor)	
	Q15	N14,	BC558	(transistor)	
	Q16	H1Ø,	2SK125	(transistor)	
	Q17	F1Ø,	3SK4Ø/MFE131	(transistor)	
	Q18	D1Ø,	2SC1674	(transistor)	
	Q19	D8 ,	2N3948	(transistor)	
	Q2Ø	E6 ,	2N3948	(transistor)	
**	Q21	G4 ,	MRF629	(transistor)	
***	Q22	K4 ,	2N559Ø	(transistor)	
	Q23	K15,	BC548	(transistor)	
	Q24	K16,	BC548	(transistor)	
	Q25	G13,	3SK4Ø/MFE131	(transistor)	
	Q26	D15,	2SC1674	(transistor)	
	Q27	F14,	2SC1674	(transistor)	
	Q28	H15,	BC548	(transistor)	
	Q29	I15,	BC548	(transistor)	
	Q3Ø	J17,	BC547	(transistor)	

**Note that pin orientations of BC640/BC639 and BC327/BC337 respectively, are different. Please refer to Page 12 'Transistor Pinouts' for correct pin orientation.*

***Q21 should have an earth pin soldered to its case (please refer to neighbouring diagram).*

****Please do not insert as yet (see text on Page 54 for installing Q22).*

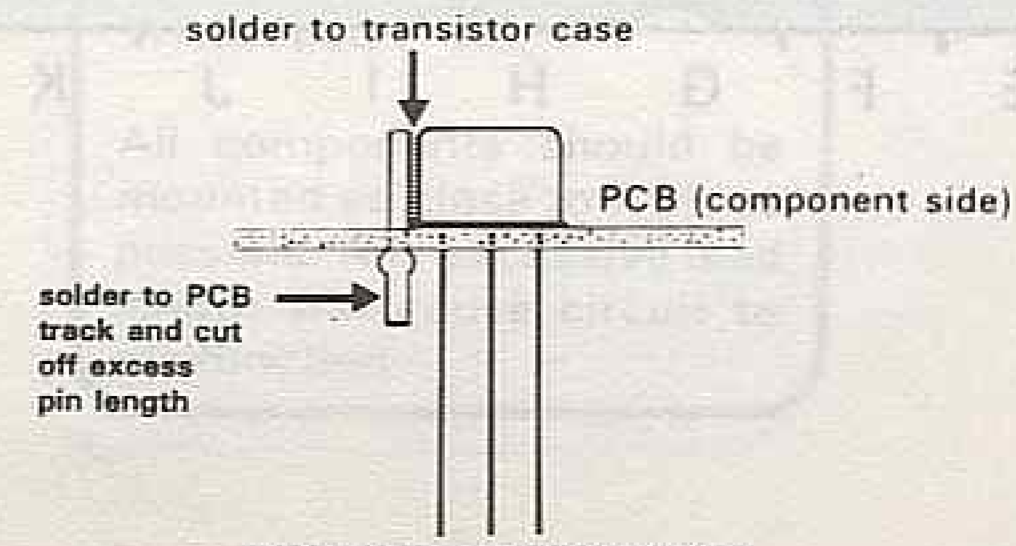
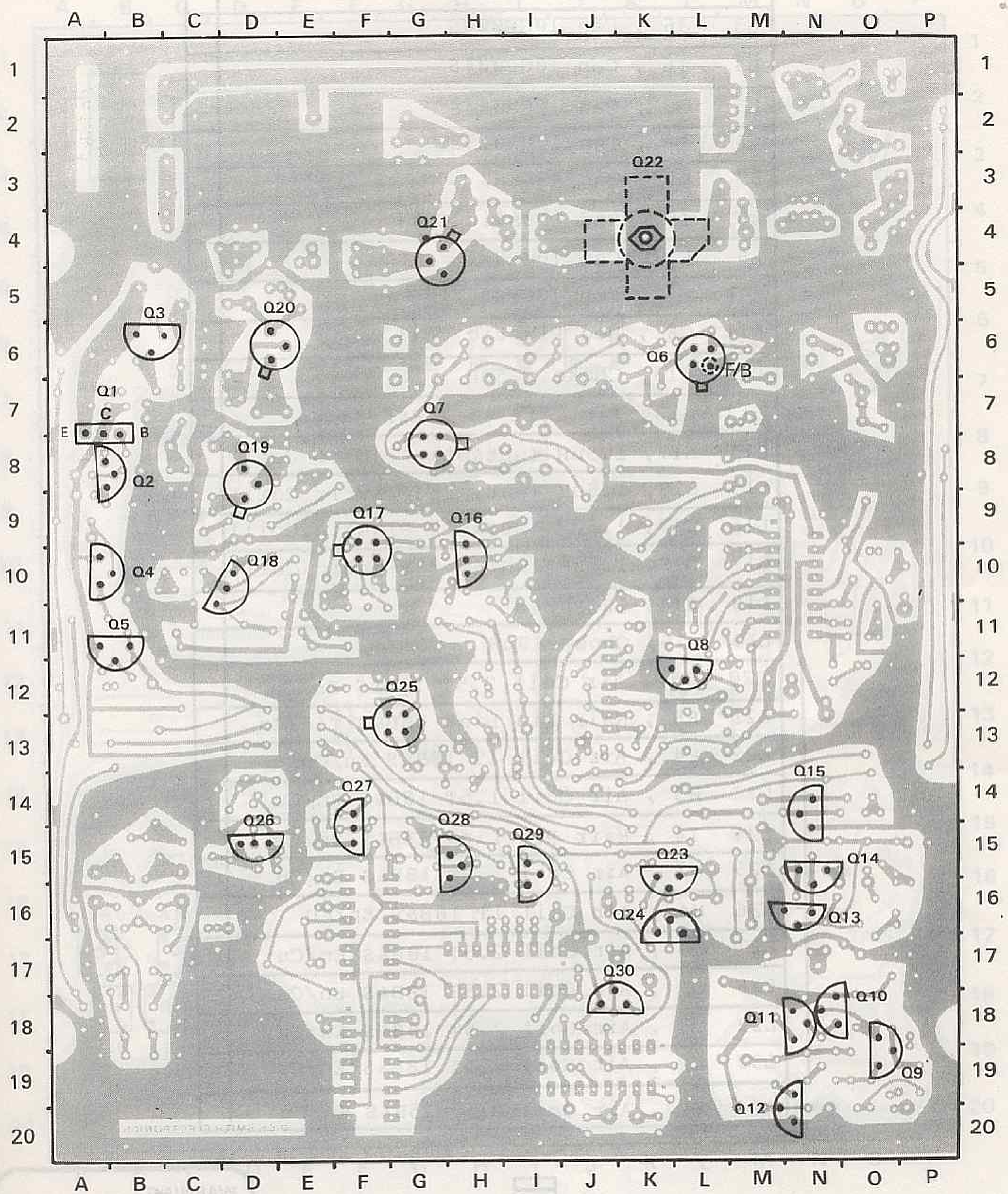


DIAGRAM SHOWING PIN

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 14. TRANSISTORS Q1-Q30



F/B = Ferrite Bead

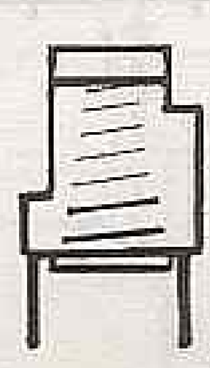
STEP 15. INDUCTORS L1-L30

	L1 B2 , Power Choke	
	L2 N6 , Can 10GP004S	
	L3 J6 , Can 10GP004S	
	L4 I6 , Can 10GP004S	
	L5 G6 , Can 10GP004S	
	L6 J8 , Can 10MA015S	
	L7 L13, Can 455KHZ (wht/blk/yel)	
*	L8 I9 , Red Plastic Coil	
	L9 F11, Can 10GP004S	
	L10 C9 , Can 10GP004S	
*	L11 C8 , Red Plastic Coil	
	L12 F13, Choke 2.5mH	
**	L13 G13, Air Coil 4T 25B&S En/Cu	
	L14 A17, 1.5uH (wht&blk Plastic Coil)	
	L15 B18, 1.5uH (wht&blk Plastic Coil)	
	L16 C17, 1.5uH (wht&blk Plastic Coil)	
	L17 C18, 1.5uH (wht&blk Plastic Coil)	
	L18 E14, 10GP004S	
	L19 G15, Choke 10uH	
	L20 D5 , Air Coil 2.5T 18B&S En/Cu	
	L21 E5 , Hair Pin Link 25B&S Tin/Cu	
	L22 F4 , Air Coil 1T 18B&S En/Cu	
	L23 H3 , Air Coil 1.5T 18B&S En/Cu	
	L24 I4 , Hair Pin Link 18B&S En/Cu	
** (L20–L30)	L25 M3 , Air Coil 1.5T 18B&S En/Cu	
	L26 M4 , Air Coil 1T 18B&S En/Cu	
	L27 O4 , Air Coil 2.5T 18B&S En/Cu	
	L28 O7 , Air Coil 2.5T 18B&S En/Cu	
	L29 O3 , Air Coil 2.5T 18B&S En/Cu	
	L30 N2 , Air Coil 2.5T 18B&S En/Cu	
***	L31 N2 , Air Coil 2T 25B&S En/Cu	

*Please note that on L8 and L11, the dark side of the coil is the long side.

**Please refer to Page 13 for winding details of Coils L13 and L20 through to L30.

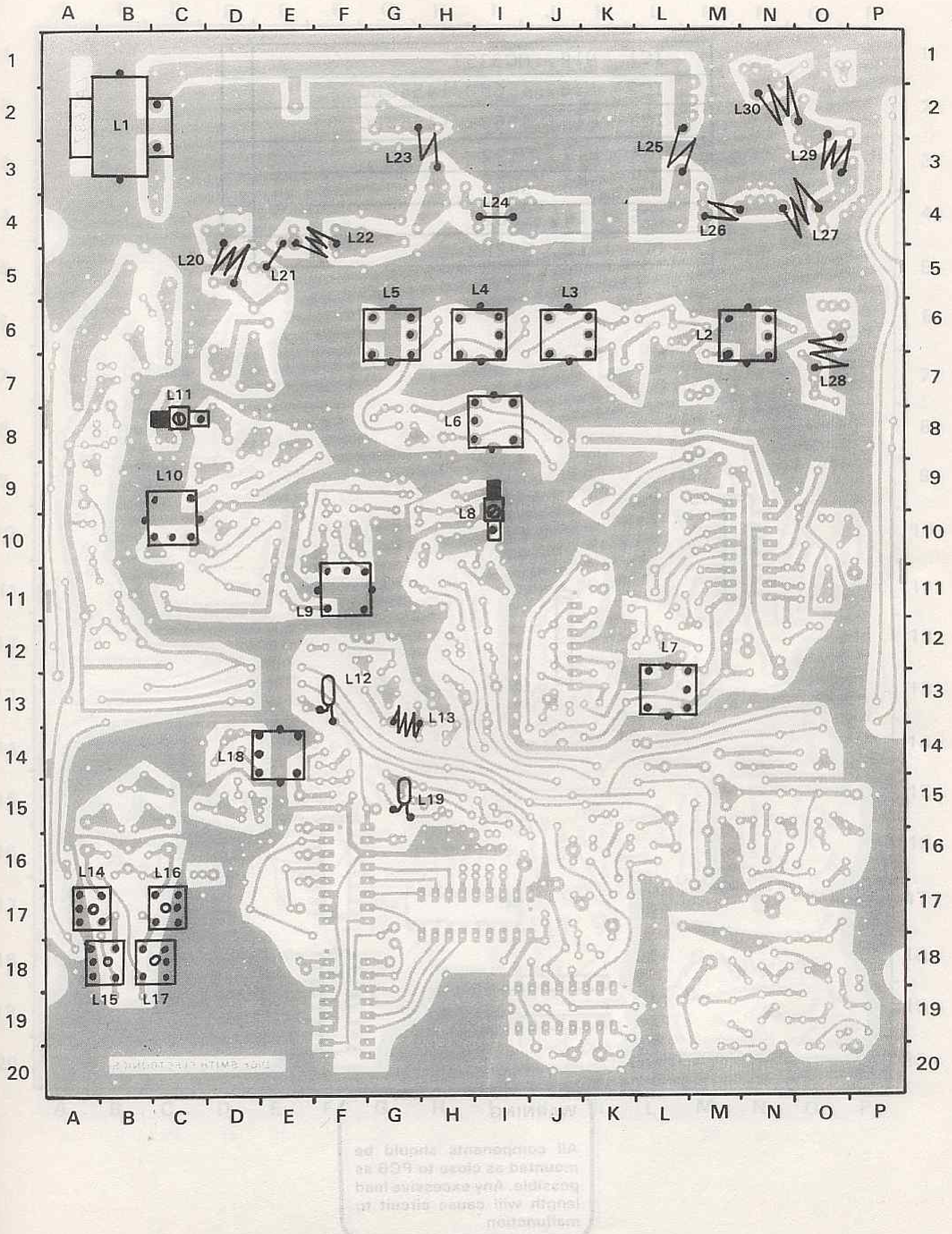
***Please refer to page 59 for mounting details.



WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 15. INDUCTORS L1-L30



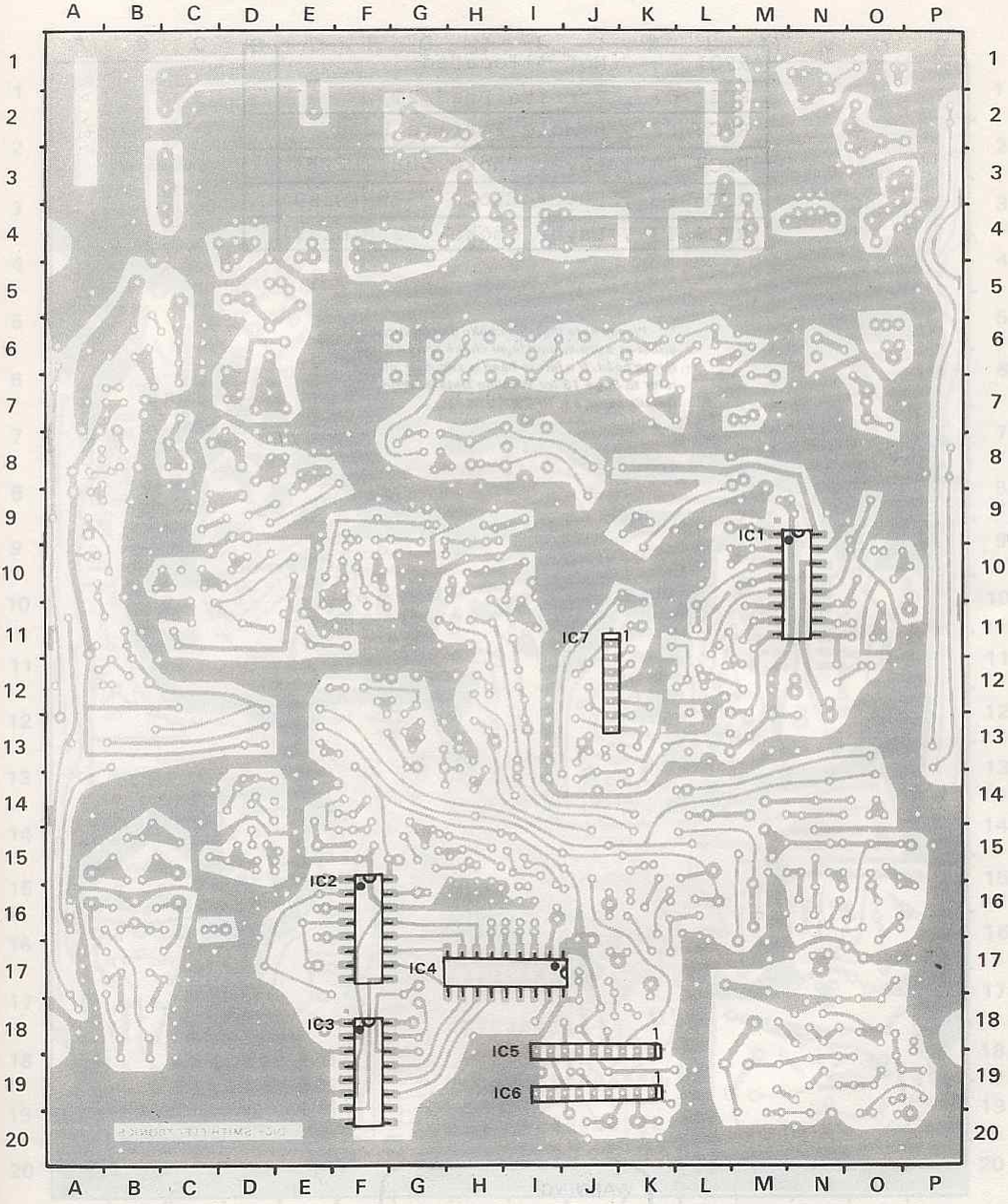
STEP 16. INTEGRATED CIRCUITS IC1-IC7

IC1	N1Ø, MC3357	
IC2	F16, 456ØB/1456ØBC	
IC3	F19, 456ØB/1456ØBC	
IC4	H17, 9122	
IC5	J18, 5Ø81	
IC6	J19, 5Ø82	
IC7	J12, 592H2	

WARNING

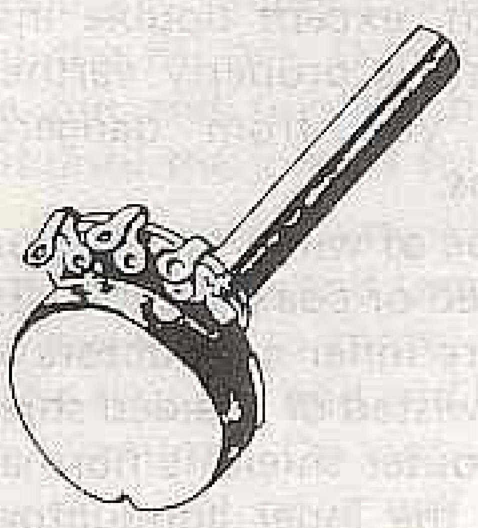
All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

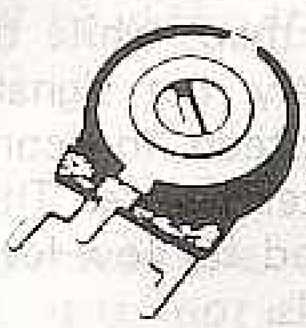
STEP 16. INTEGRATED CIRCUITS IC1-IC7



POTENTIOMETERS

Potentiometers are variable resistors. There are two main types in kits: normal potentiometers (often called pots) which are used as front panel controls for volume, speed or whatever; and 'trimpots' which are smaller devices mounted on the circuit board. These





are used for initial adjustment of frequencies, levels etc. and are not normally adjusted once set.

CAPACITORS

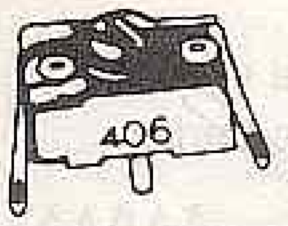
Capacitors store a charge. They come in an enormous range of sizes and types with the most confusing identification of all the components

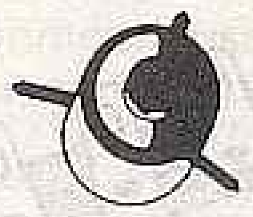
The'most common types are mylar (greencaps), ceramic, electrolytic and tantalum. Some kits also use polystyrene and polyester. Electrolytic and tantalum capacitors are 'polarised', that is, have a positive and negative end which must be installed in the correct direction for the circuit to work.

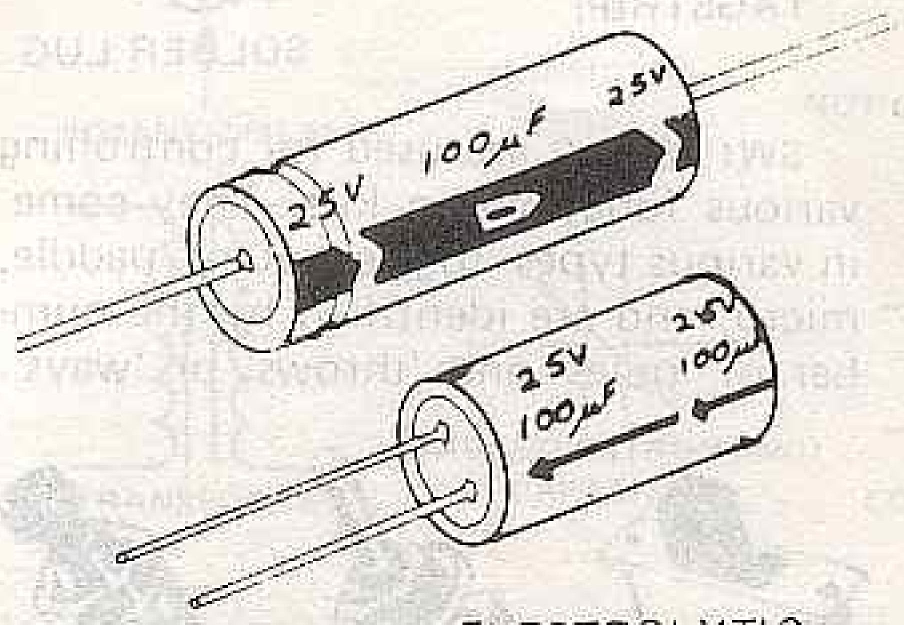
Capacitance is measured in Farads. This is too large a unit for most uses so various fractions are used: microFarad (uF)- a millionth of a Farad; nanoFarad (nF)- a thousandth of a microFarad; picoFarad (pF)- a thousandth of a nanoFarad. So 0.01uF= 10nF = 10 000pF.

Capacitors are marked in all these units - often without indicating which one! Electrolytics and some tantalum capacitors are marked in uF with the working voltage; ceramics in pF and mylar in pF or uF.

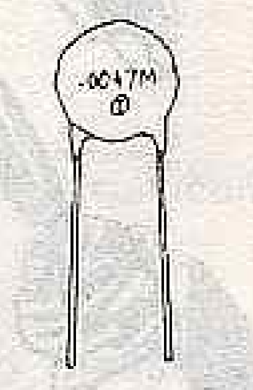
Many ceramic and mylar capacitors are marked using the IEC capacitor code, a system of three numbers and a letter giving the value and tolerance of a capacitor. The first two numbers are the significant figures, and the third the number of zeroes following (value in picoFarads). The letter indicates the tolerance - M = 20%; K = 10%: J = 5%. So a 123K is a 12 000pF or 12nF or 0.012uF 10% capacitor.



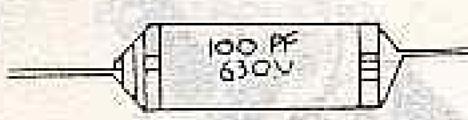




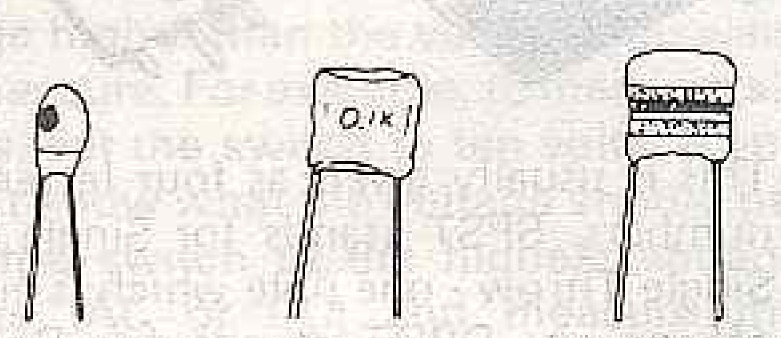
ELECTROLYTIC
Note arrow pointing to negative



CERAMIC



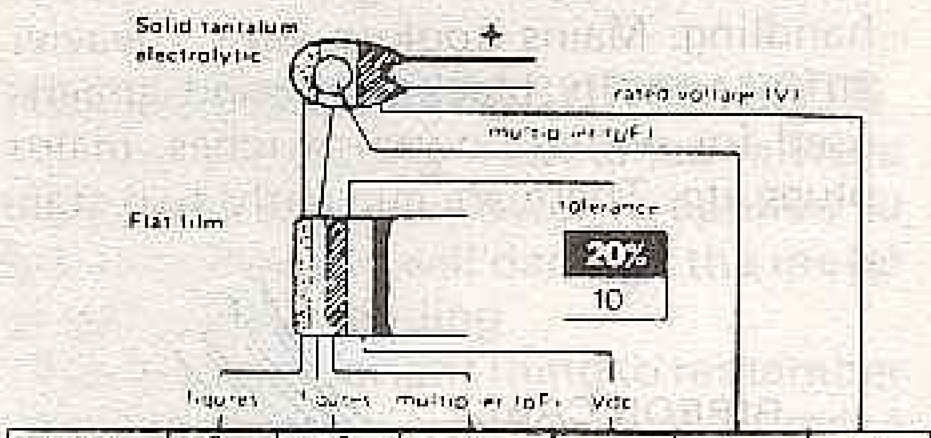
POLYSTYRENE



TANTALUM MYLAR POLYESTER

Some of the larger value greencaps are marked in uF (usually 0.1uF and larger). Smaller ceramics are usually marked in pF. This is why many constructors find capacitors confusing!

One more method is used to identify capacitors. Some polyester and tantalum capacitors are marked with a colour code similar to resistors.



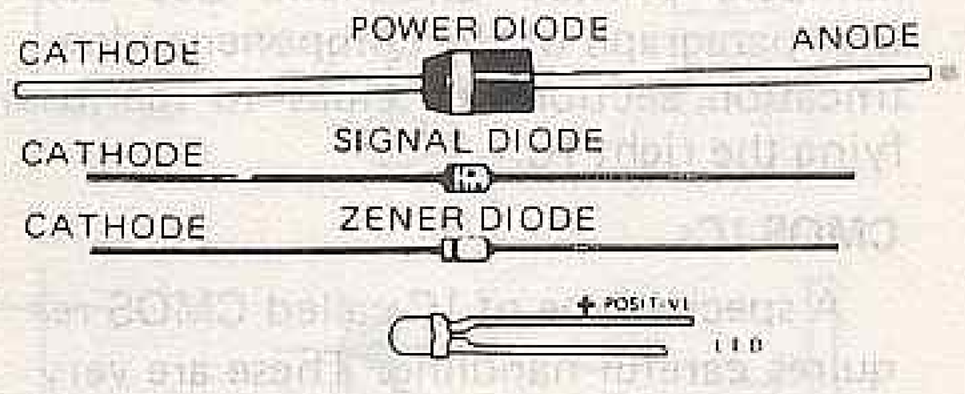
BLACK	0	0	1		1	10
BROWN	1	1	1	1		1.6
RED	2	2	100	250		4
ORANGE	3	3	1k			40
YELLOW	4	4	10k	400		6.3
GREEN	5	5	100k			16
BLUE	6	6		630		
VIOLET	7	7			10^{3}	
GREY	8	8	0.01		10^{2}	25
WHITE	9	9	0.1		10^{1}	2.5

CAPACITOR COLOUR CODE

DIODES

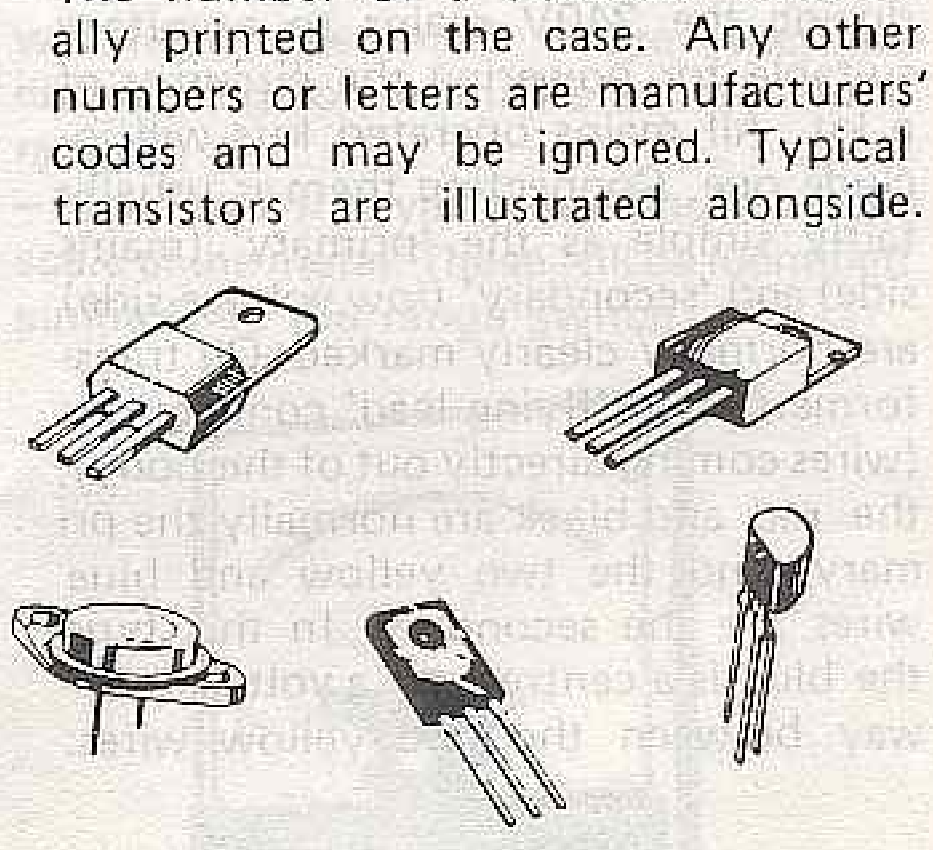
Diodes are used to convert AC current to DC (rectify), or to detect signals. Most are in the form of a black or clear cylinder 3 - 10mm long. Diodes are also polarised, with a cathode end (k), and an anode (a) end. The cathode is marked with a black or silver stripe, or in some small signal diodes, a white end. Always check that they are installed the right way round.

Light emitting diodes (LEDs) are a special type of diode which lights up red, green or yellow when voltage is applied. These are also polarised, and must be fed the correct voltage, with an appropriate resistor to limit the current.



TRANSISTORS

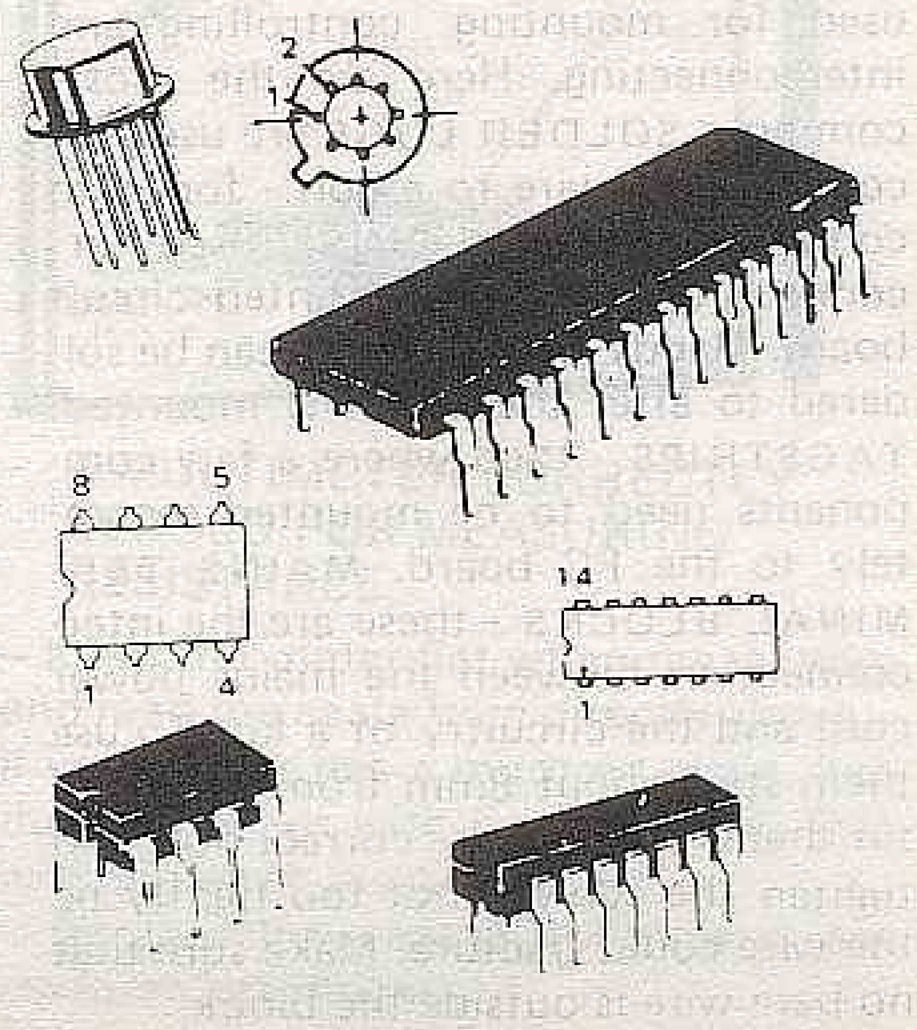
Transistors are the heart of most solid state equipment. They are used to amplify and switch signals. Transistors generally have three leads called emitter (e), base (b) and collector (c) and come in a wide variety of different cases. Always check that the leads are installed in the correct positions - two transistors may look the same, they may even work the same, but their leads could be differently oriented. The number of a transistor is normally printed on the case. Any other numbers or letters are manufacturers' codes and may be ignored. Typical transistors are illustrated alongside.



ALWAYS FOLLOW THE PIN CONNECTIONS ON THE CIRCUIT DIAGRAMS CAREFULLY

INTEGRATED CIRCUITS (IC)

Integrated circuits are just what their name indicates: a complete circuit in a single package. They perform a wide variety of functions - amplifying, timing, switching, counting - the list is enormous. They are usually packaged in a dual-in-line (DIL) package with from eight to forty pins.



STEP 17. RF CHOKES RFC1 - RFC6

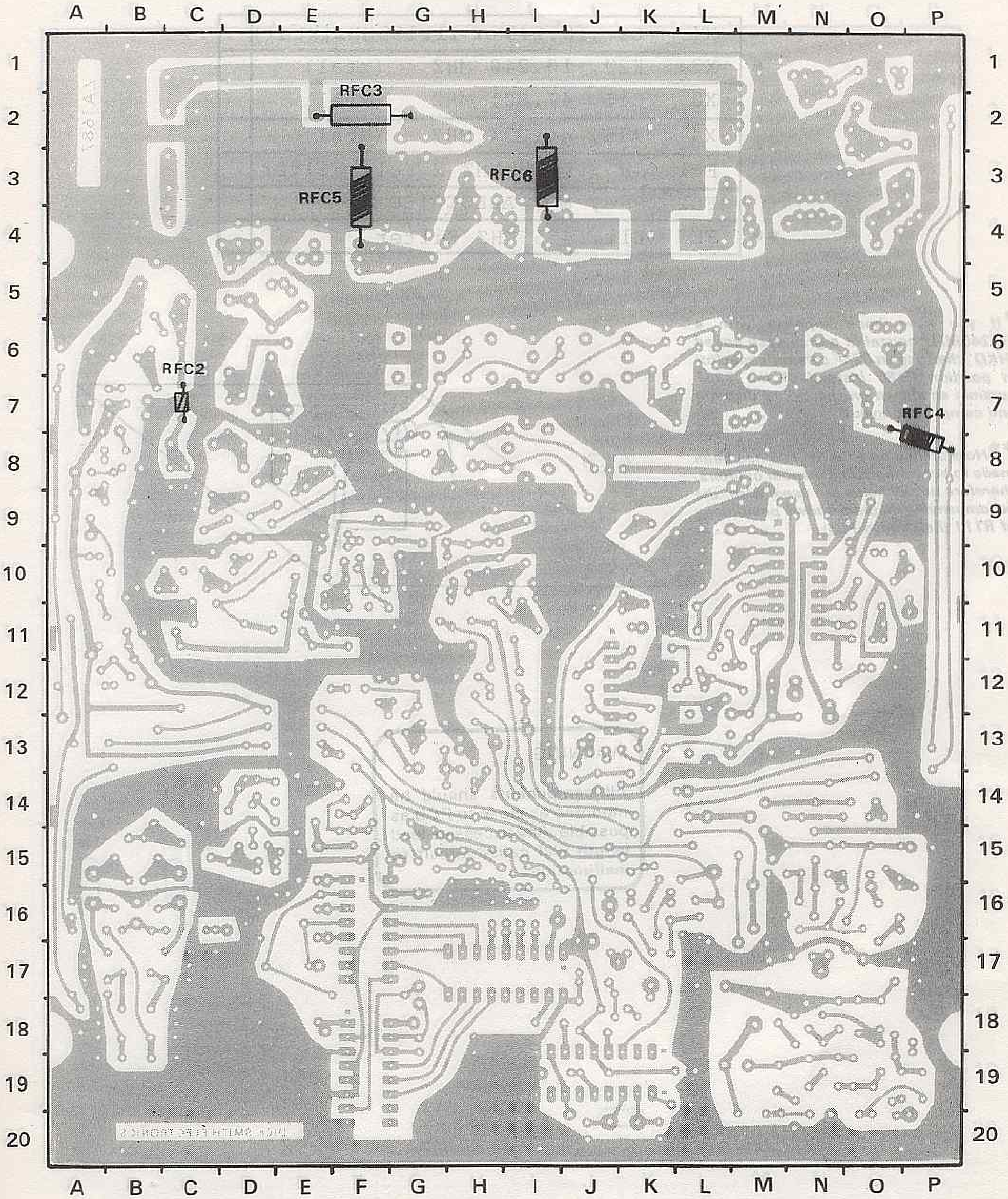
	RFC1 ---, Not Allocated	
	RFC2 C7 , Ferrite Bead/2T	
	RFC3 F2 , 6 Hole Ferrite Bead	
*	RFC4 P8 , Layer Choke 5uH (L208)	
	RFC5 F3 , Layer Choke .22uH(L209)	
	RFC6 I3 , Layer Choke .22uH(L209)	

** Please note that this choke can be supplied either as a pre-wound layer choke or as a 6 hole ferrite bead. If a ferrite bead is supplied, please refer to Page 13 for Winding Details. (Winding Details same as RFC3).*

WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 17. RF CHOKES RFC1 - RFC6

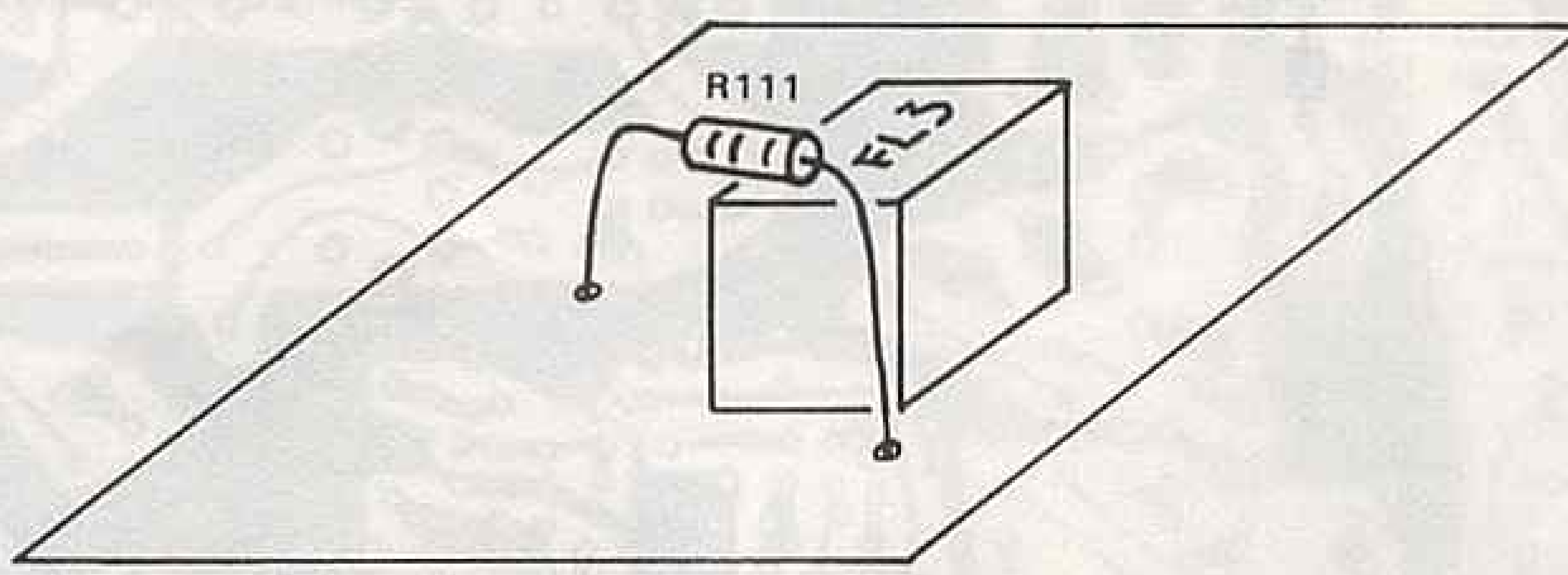


STEP 18. CRYSTALS X1 - X4 AND FILTERS FL1 - FL3

	X1	L9 ,10.245 or 11.155MHz(xtal)	
*	X2	K20, 10.240 MHZ (xtal)	
	X3	C15, 47.801 MHZ (xtal)	
	X4	A15, 44.234 MHZ (xtal)	
	FL1	J8 , 10.7 MHZ 2 Pole Filter	
	FL2	---, NOT ALLOCATED	
**	FL3	L11, 455 KHZ Filter	

****If you have been supplied with a 10.240MHz crystal in a grey case coded 'HKD', then use an 82pF ceramic capacitor in position C160 instead of the 33pF ceramic as shown on the circuit diagram and component layout.***

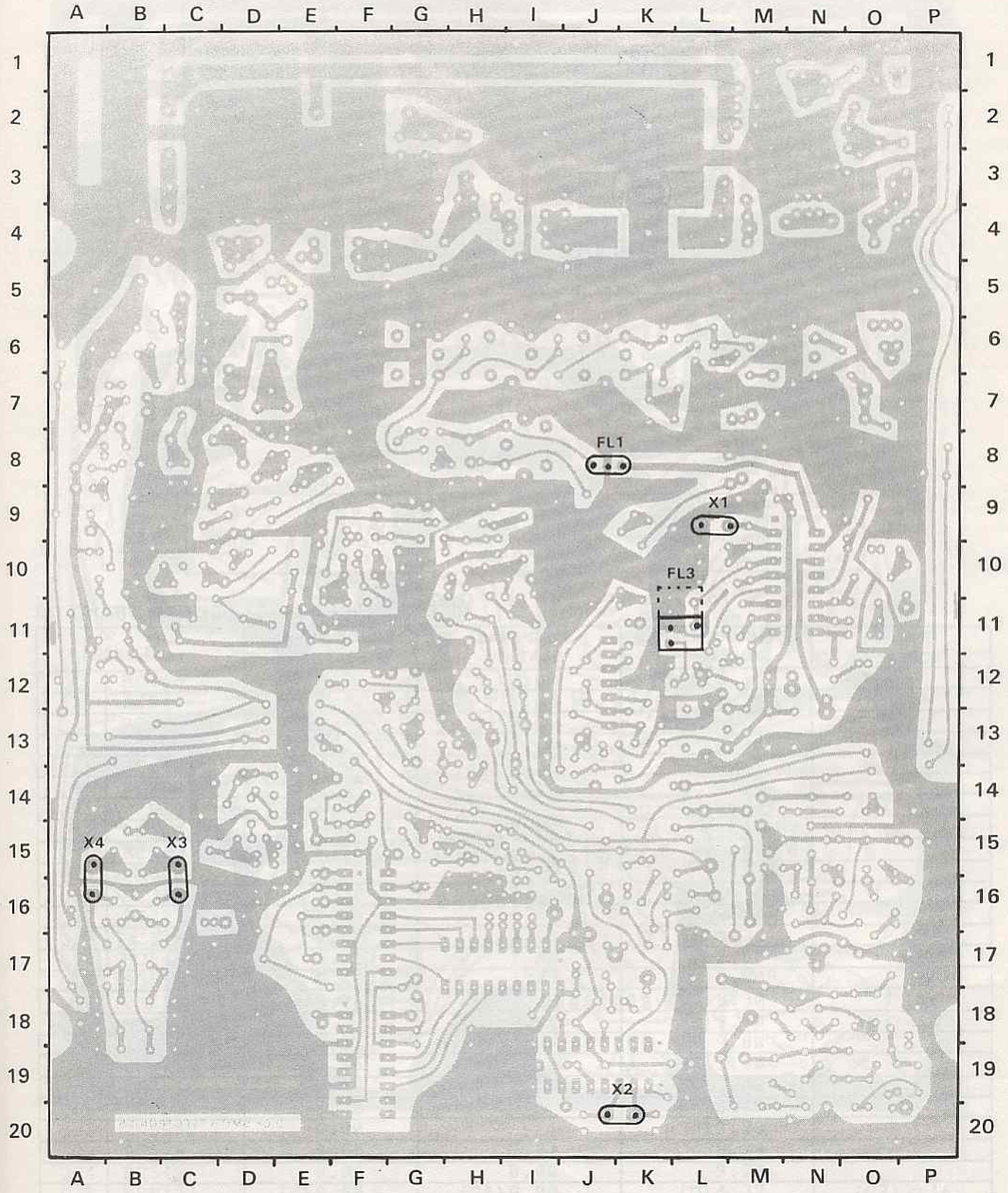
*** **Hole drilling on PCB for FL3 has been made to accommodate a number of filters, therefore not all holes are used. Also, the accompanying diagram shows positioning of R111 (i.e., above FL3).***



WARNING

All components should be mounted as close to PCB as possible. Any excessive lead length will cause circuit to malfunction.

STEP 18. CRYSTALS X1 - X4 AND FILTERS FL1 - FL3



LAYOUT SHOWING UNDERBOARD COMPONENT

Prepare Q22 (2N5590 transistor) for soldering. Cut transistor fins (E,C,B,E) approximately 6mm from transistor body.

Please note that this transistor is mounted after both heatsinks have been secured to the back panel (see Page 56, Step D under 'Assembly of Back Panel').

TRANSISTOR AND IC VOLTAGES

DC CHART (IC'S) SUPPLY @ 13.8V

DEVICE	PIN VOLTAGE	
IC1 3375	1. 5.65V 2. 5.13V 3. 5.4V 4. 5.68V 5. 1.02V 6. 1.02V 7. 1.04V 8. 5.68V	9. 2.7V 10. 2.0V 11. 2.12V 12. 1.25V 13. - 14. 15. - 16. 2.05V
IC2 & IC3 4560	8. 0.00 16. 10.00V	Other pins depend upon program.
IC4 9122	1. 9.75 2. 3.67 3.–9. Depends Upon Program	10.–16. Depends Upon Program 17. 0.8V 18. 0.00V
IC5 5081	1. 8.28V 2. - 3. 2.61V 4. 9.78V 5. 9.76V	6. - 7. 0.81V 8. 3.02V 9. 0.00V
IC6 5082	1. 1.63V 2. 2.73V 3. 2.46V 4. 3.03V 5. 6.07V	6. 3.03V 7. 3.03V 8. 3.00V 9. 0.00V
IC7 592H2	1. 2.01V 2. 0.63 3. 0.02V 4. 0.00V	5. 0.69V 6. 1.30V 7. 5.50V

DC CHART (TRANSISTORS) SUPPLY @13.8V

DEVICE		EMITTER/SOURCE VOLTAGE	BASE/GATE VOLTAGE	COLLECTOR/DRAIN VOLTAGE	GATE 2 VOLTAGE
Q1	BD140	13.78	13.07	10.15	
Q2	BC547	4.44	5.04	12.78	
Q3	BC327	13.78	-	-	
Q4	BC337	8.29	9.99	10.15	
Q5	BC557	10.15	9.50	10.20	
Q6	BFY90	0.38	1.10	8.90	
Q7	MFE131	(S) 0.40	(G1) 0.00	(D) 9.00	(G2) 0.00
Q8	BC548	0.00	0.65	1.59	
Q9	BC548	8.20	8.76	13.00	
Q10	BC558	7.80	13.00	13.77	
Q11	BC337	7.20	7.80	13.77	
Q12	BC327	7.14	6.55	0.00	
Q13	BC548	0.00	0.57	1.30	
Q14	BC548	0.65	1.30	2.50	
Q15	BC558	5.40	4.77	0.00	
Q16	2SK125	(S) 3.20	(G) 0.00	(D) 8.30	
Q17	MFE131	(S) 1.20	(G1) 0.00	(D) 9.60	(G2) 4.75
Q18	2SC1674	0.35	0.94	9.80	
Q19	2N3948	0.66	1.40	13.00	
Q20	2N3948	0.50	1.18	12.00	
Q21	MRF629	0.00	-	13.40	
Q22	2N5590	0.00	-	13.20	
Q23	BC548	8.65	9.22	9.29	
Q24	BC548	0.00	0.00	9.22	
Q25	MFE131	(S) 0.50	(G1) 0.00	(D) 4.37	(G2) 2.16
Q26	2SC1674	1.63	2.39	5.88	
Q27	2SC1674	0.00	0.70	3.60	
Q28	BC548	0.00	0.65	1.65	
Q29	BC548	2.28	2.94	5.00	
Q30	BC547	8.98	9.66	9.75	

ASSEMBLY OF FRONT AND BACK PANELS

ASSEMBLY OF FRONT PANEL

STEP A. First mount the two toggle switches, the push-on switch, microphone socket and pots to the front panel.

STEP B. Once all the above have been properly secured, slide the front panel and the main PCB into the case. Align the front panel so that it sits at 90° to the main board.

Now solder the three PCB pins closest to the edge of the main board to the front panel. It may be necessary to bend these pins forward a little so that the pins can be easily soldered to the front panel.

The copper side of the main PCB can be tack soldered to the front panel. This should only be done when the unit has been finished, tuned and tested, as it will be very difficult to unsolder the front panel to rectify a neighbouring fault.

STEP C. Now, you may proceed to wire the items in Step A. to the main PCB.

STEP D. Fit and glue the signal/power meter into position. Do not wire as yet - allow the glue to dry.

STEP E. Wire the thumbwheel switches to the main PCB. Note that the thumbwheel switches will have to be separated to allow you to solder wires to the inner pads. Figures 3 and 4 show how these switches are separated.

STEP F. You will notice that every individual thumbwheel will have its own PCB. On each PCB, a connection code (i.e., C, 1, 2, 4 and 8) will be found.

Solder a length of wire (approximately 70mm) to each copper pad located nearest to the switch body - coded C, 1, 2, 4 and 8 (see Fig. 5).

As you will note in Fig.6, the thumbwheel PCB nearest to the edge of the switch will only use two wires (i.e., to pads 1 and 2). Pads 4 and 8 are not used.

STEP G. Once all wires have been soldered in place, clip the switches together (back in their original state) and check that you have 10 wires (approximately 70mm) coming from it.

STEP H. Note that the common pad (coded 'C') of all three switches will have to be linked together. Run a common link and then solder a length of wire (approximately 70mm) to it. This will then be terminated to the main PCB together with the other 10 wires from Step G.

STEP I. Wire-up the meter to the main PCB .(Glue should be set, keeping the meter into place).

STEP J. WIRING THE THUMBWHEEL SWITCHES TO THE MAIN PCB. Take note that the switch is mounted through the front of the panel. Insert all switch wires through the front panel slot and then solder to the correct locations. Do not slide the switch completely through the slot and clip until all thumbwheel wires have been terminated to the main board.

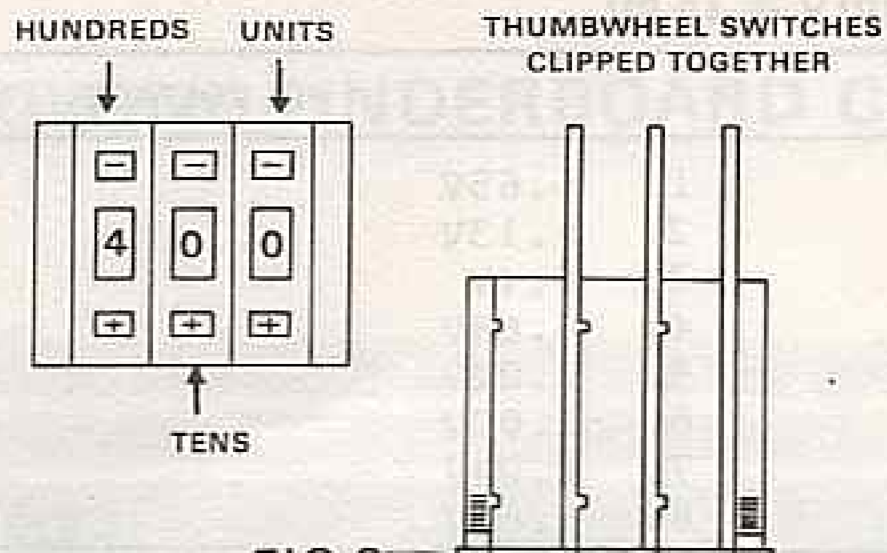


FIG.3

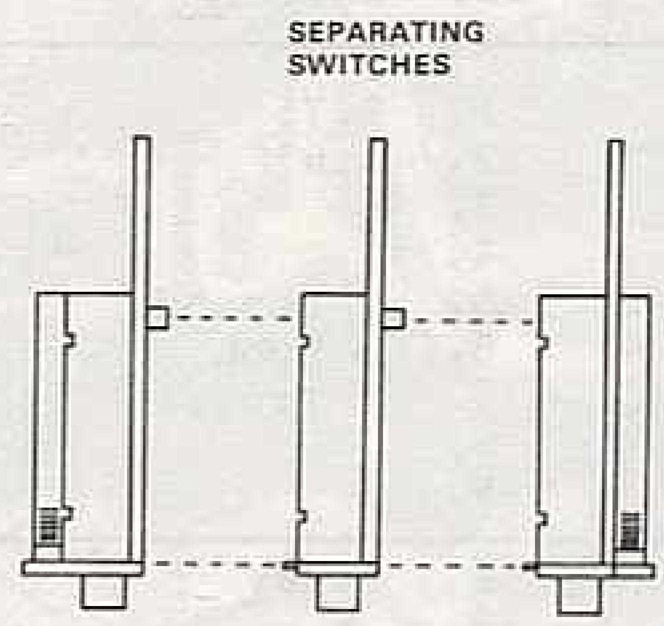


FIG.4

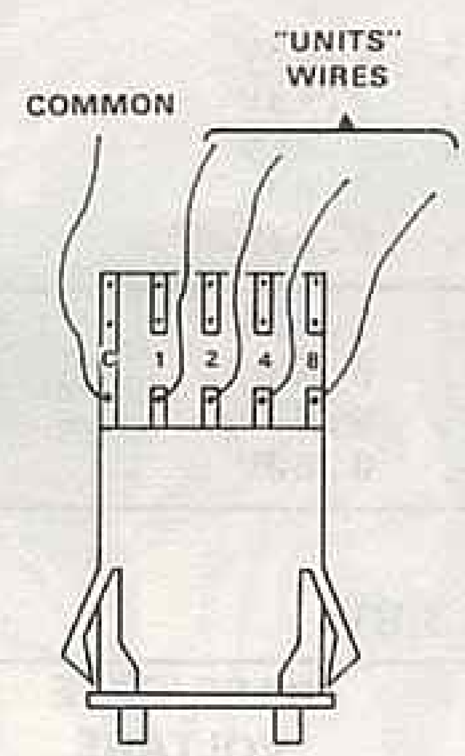


FIG.5

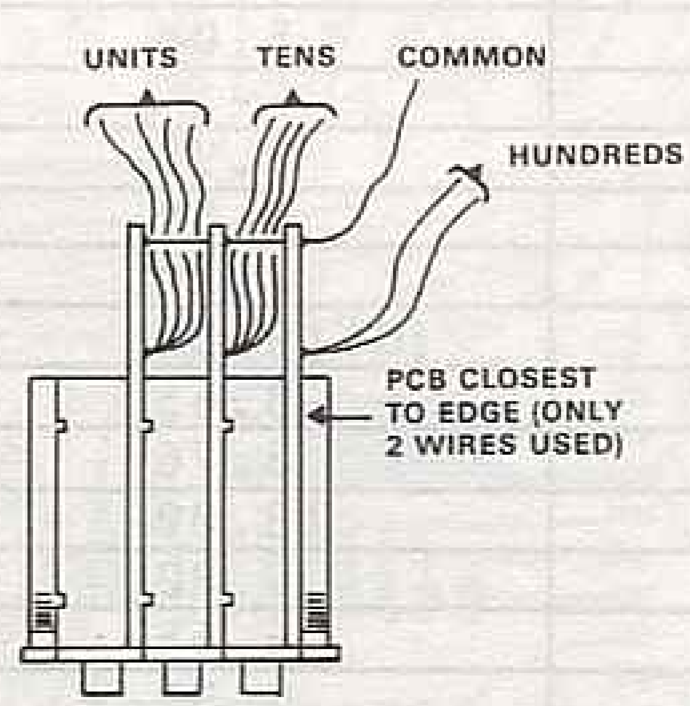


FIG.6

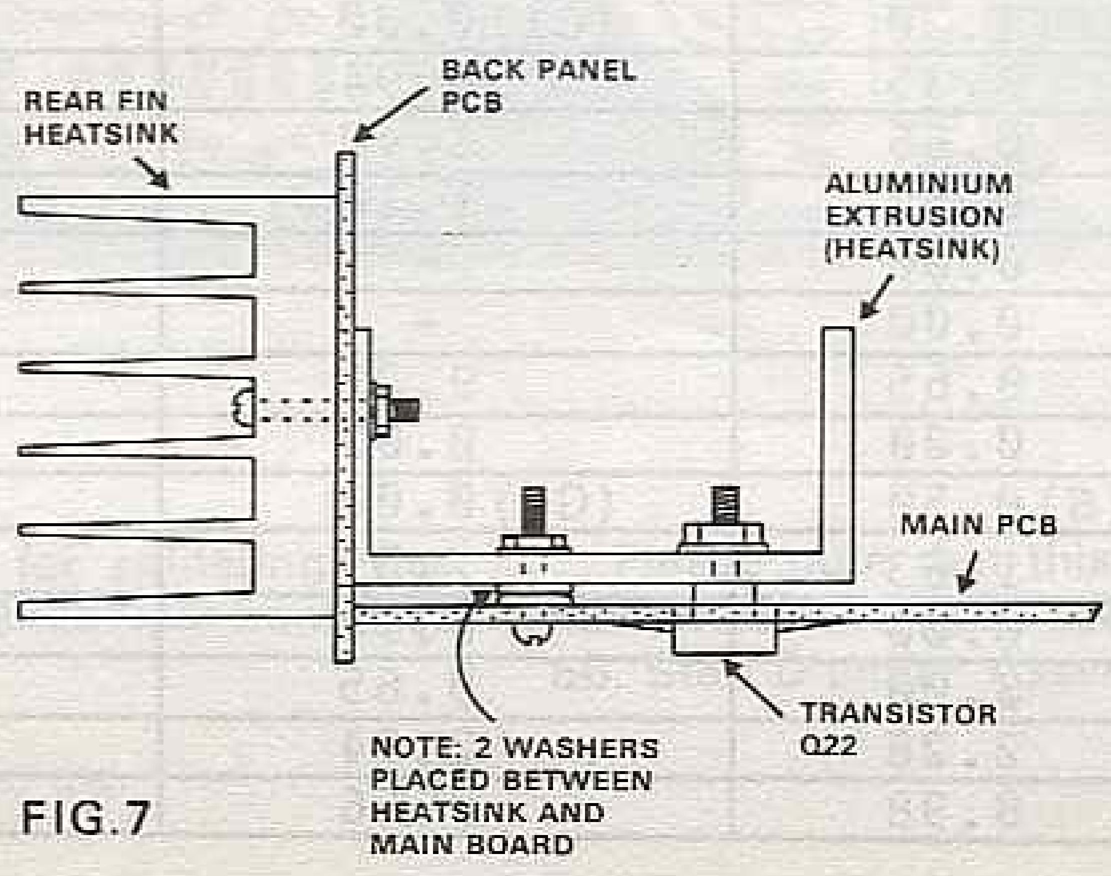


FIG.7

ASSEMBLY OF BACK PANEL

STEP A. Secure cable grommet, 3.5mm DC socket and antenna output socket to the back panel.

STEP B. Align and solder the back panel to the main board, in the same mannner as explained in Step B of the 'Assembly of Front Panel'.

STEP C. Mount the heatsinks to the back panel as shown in Fig.7).

STEP D. Once the heatsinks have been tightly secured, Q22 (2N5590) transistor can be mounted to the heatsink and then soldered to the copper side of the main board (as shown in Fig.7).

Please note that silicon grease should be used in the area where both the heatsinks are secured together and also beneath the aluminium extrusion where Q22 touches the heatsink.

STEP E. Final wiring of speaker socket, output socket, and power lead may proceed.

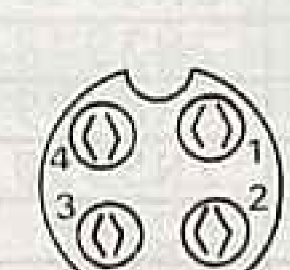
OPERATION OF THUMBWHEEL

Because there is no mechanical stop in the X1 MHz thumbwheel, the following digits correspond to:

	X1 MHz DISPLAY DIGIT	FREQUENCY
	0	144MHz
	1	145MHz
	2	146MHz
	3	147MHz
Normal Display	4	144MHz
Normal Display	5	145MHz
Normal Display	6	146MHz
Normal Display	7	147MHz
	8	144MHz
	9	145MHz

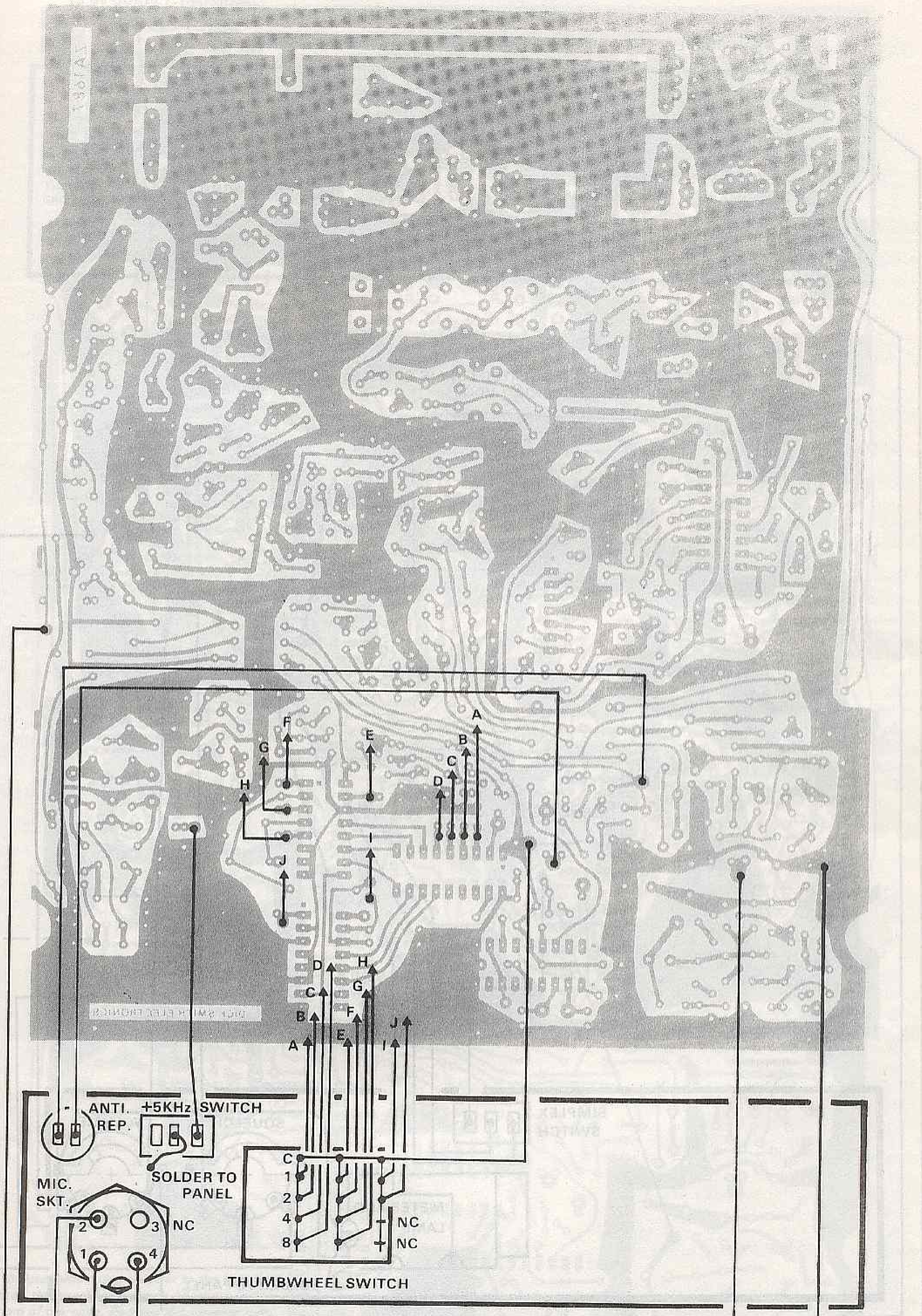
From the above, it can be seen that the sequence of 144, 145, 146 and 147MHz is repeated no matter what digit is selected by the X1 MHz thumbwheel. This is to ensure that any transmission is within the 2 metre Amateur Band.

MICROPHONE WIRING DETAILS
(Front View of Microphone Plug)

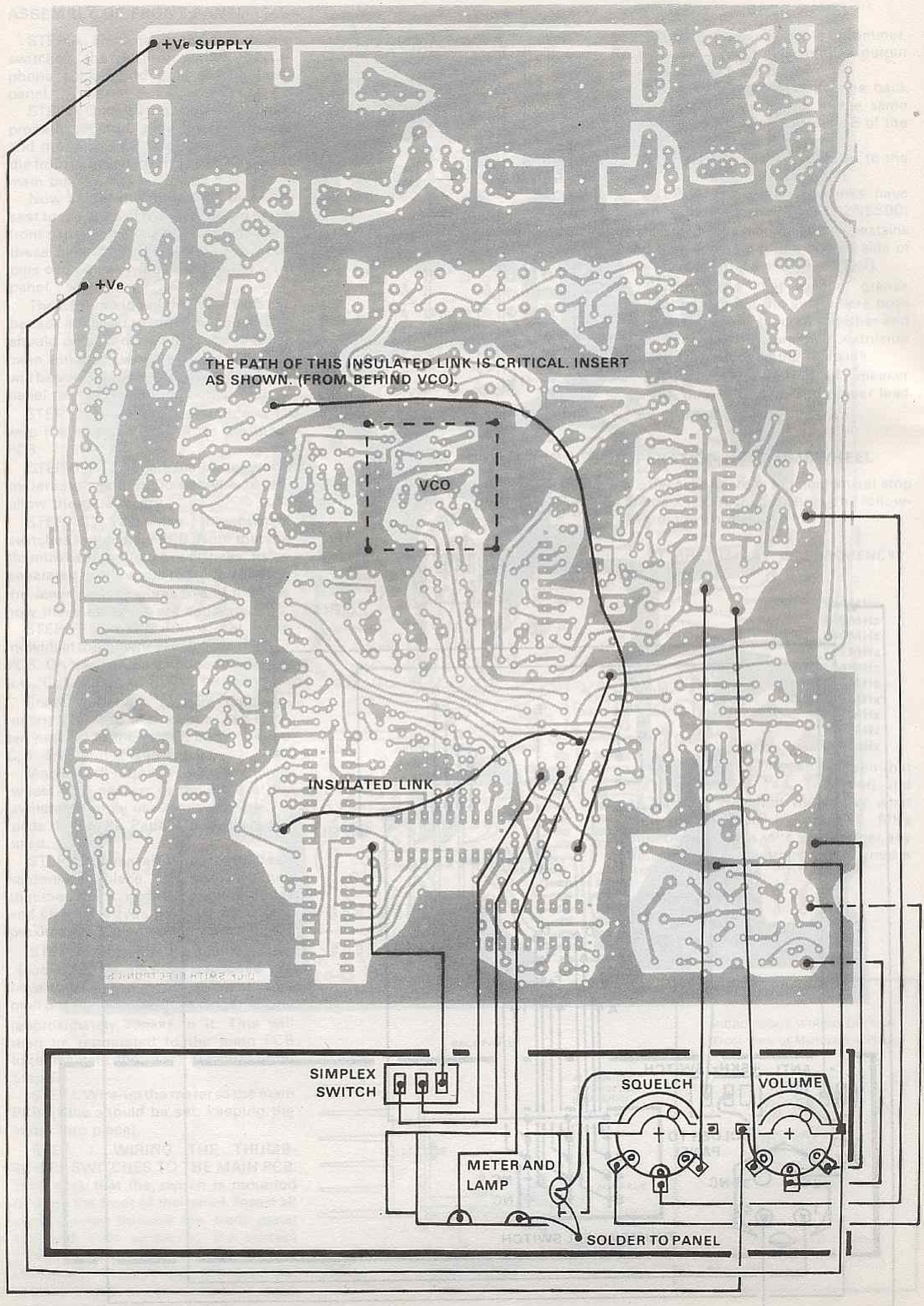


1-------yellow
2-------black and braid (earth)
3-------not used
4-------red

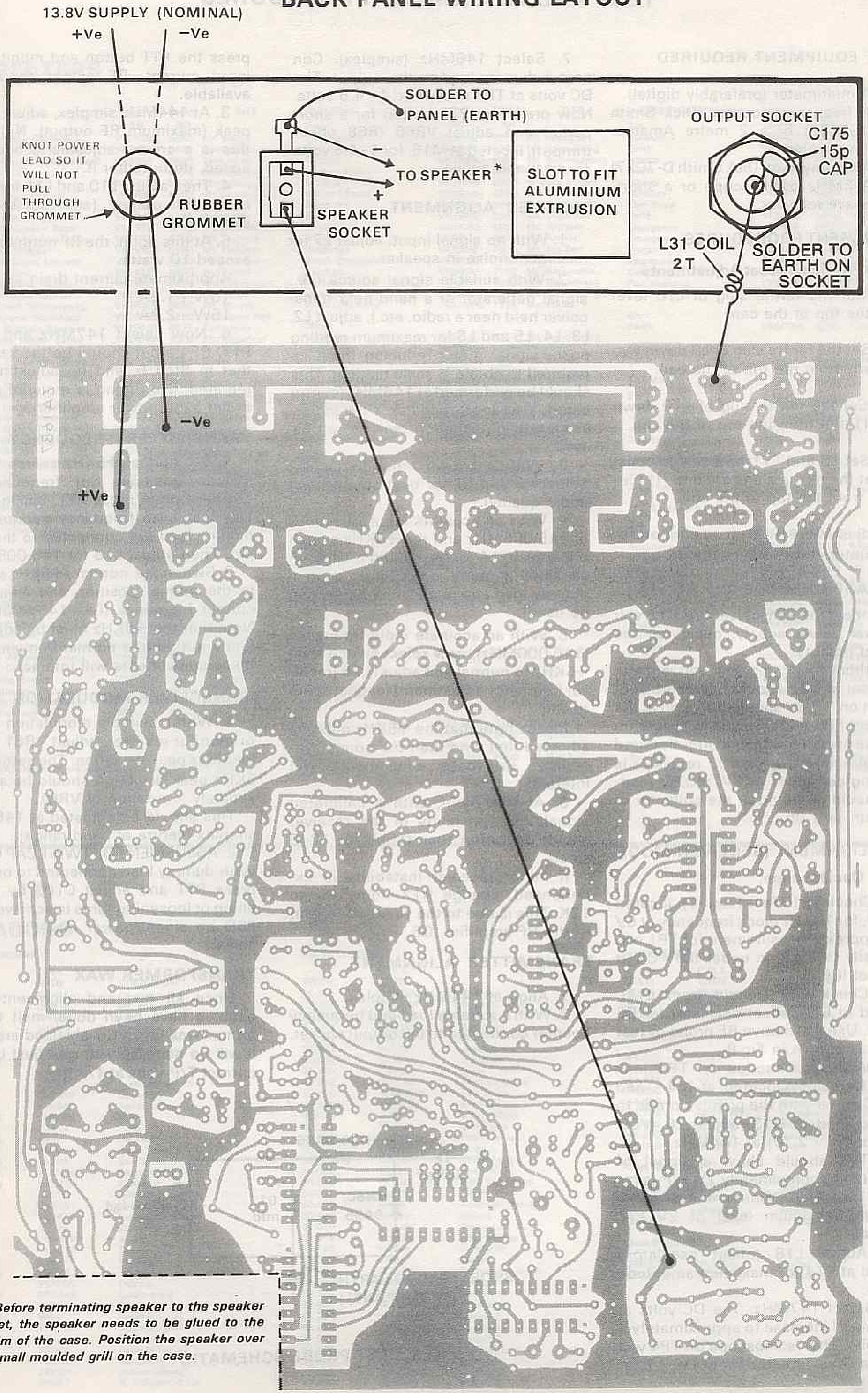
PART A. FRONT PANEL WIRING LAYOUT



PART B. FRONT PANEL WIRING LAYOUT



BACK PANEL WIRING LAYOUT



** Before terminating speaker to the speaker socket, the speaker needs to be glued to the bottom of the case. Position the speaker over the small moulded grill on the case.*

PARTS LIST

Please check all the parts in this kit against the parts list. In the unlikely event of a part being missing or incorrectly supplied, you MUST use the Quality Control Card included with your kit. You can send the card directly to the Kit Department at Head Office or drop it in at your nearest Dick Smith store.

RESISTORS

Resistor	2.2	ohm	1/4W	x 2
Resistor	4.7	ohm	1/4W	x 1
Resistor	1Ø	ohm	1/4W	x 4
Resistor	15	ohm	1/4W	x 1
Resistor	18	ohm	1/4W	x 1
Resistor	22	ohm	1/4W	x 1
Resistor	47	ohm	1/4W	x 4
Resistor	1ØØ	ohm	1/4W	x 7
Resistor	15Ø	ohm	1/4W	x 3
Resistor	22Ø	ohm	1/4W	x 5
Resistor	27Ø	ohm	1/4W	x 1
Resistor	33Ø	ohm	1/4W	x 1
Resistor	47Ø	ohm	1/4W	x 7
Resistor	56Ø	ohm	1/4W	x 3
Resistor	82Ø	ohm	1/4W	x 1
Resistor	1k	ohm	1/4W	x 12
Resistor	1.2k	ohm	1/4W	x 4
Resistor	1.5k	ohm	1/4w	x 7
Resistor	1.8k	ohm	1/4W	x 1
Resistor	2.2k	ohm	1/4W	x 11
Resistor	3.3k	ohm	1/4W	x 3
Resistor	4.7k	ohm	1/4W	x 7
Resistor	5.6k	ohm	1/4W	x 2
Resistor	6.8k	ohm	1/4W	x 1
Resistor	1Øk	ohm	1/4W	x 9
Resistor	15k	ohm	1/4W	x 6
Resistor	22k	ohm	1/4W	x 2
Resistor	33k	ohm	1/4W	x 5
Resistor	39k	ohm	1/4W	x 1
Resistor	47k	ohm	1/4W	x 9
Resistor	56k	ohm	1/4W	x 11
Resistor	82k	ohm	1/4W	x 2
Resistor	1ØØk	ohm	1/4W	x 4
Resistor	12ØK	ohm	1/4W	x 1
Resistor	15Øk	ohm	1/4W	x 1
Resistor	22Øk	ohm	1/4W	x 4
Resistor	27Øk	ohm	1/4W	x 1
Trimpot	1Øk	ohm		x 2
Mini Pot	5k/1Øk			x 2

CAPACITORS

Greencap	.ØØ1uf		x 2
Greencap	.Ø1uf		x 2
Greencap	.Ø22uf		x 1
Greencap	.Ø47uf		x 3
Greencap	.1uf		x 4
Ceramic	1pf		x 3
Ceramic	3.3pf	NPO	x 2
Ceramic	4.7pf	NPO	x 4
Ceramic	5.6pf	NPO	x 2
Ceramic	8.2pf		x 2
Ceramic	1Øpf		x 3
Ceramic	12pf	NPO	x 5
Ceramic	15pf		x 8
Ceramic	18pf	NPO	x 3
Ceramic	22pf		x 6
Ceramic	27pf	NPO	x 3
Ceramic	33pf	NPO	x 2
Ceramic	39pf		x 2
Ceramic	47pf	NPO	x 7
Ceramic	56pf	NPO	x 3
Ceramic	68pf	NPO	x 3
Ceramic	82pf	NPO	x 2
Ceramic	15Øpf		x 2
Ceramic	18Øpf		x 2
Ceramic	22Øpf		x 1
Ceramic	27Øpf		x 1
Ceramic	47Øpf		x 1
Ceramic	.ØØ1uf		x 15
Ceramic	.ØØ22uf		x 3
Ceramic	.ØØ47uf		x 4
Ceramic	.Ø1uf		x 33
Ceramic	.Ø47uf		x 9
Ceramic	.1uf		x 5
Electro	47uf	16V	x 3
Electro	1ØØuf	16V	x 1
Electro	22Øuf	16V	x 1
Electro	47Øuf	16V	x 3
Tant Cap	.22uf	25V	x 2
Tant Cap	1uf	25V	x 4
Tant Cap	3.3uf	25V	x 1
Tant Cap	4.7uf	25V	x 3
Tant Cap	1Øuf	16V	x 5
Tant Cap	22uf	16V	x 1
			1

TRANSISTORS

Transistor	BC547	x 2
Transistor	BC548	x 8
Transistor	BC557	x 1
Transistor	BC558	x 2
Transistor	BD14Ø	x 1
Transistor	3SK4Ø/MFE131	x 3
Transistor	BC337/BC639	x 2
Transistor	BC327/BC64Ø	x 2
Transistor	2N559Ø	x 1
Transistor	MRF629	x 1
Transistor	2SC1674	x 3
Transistor	2SK125	x 1
Transistor	BFY9Ø	x 1
Transistor	2N3948	x 2
Diode	OA95/IN6Ø	x 3
Diode	1N914	x 17
Diode	1N4ØØ2	x 1
Diode Zener	5.6V 4ØØmW	x 3
Diode	BA243/244/282	x 5
Diode	BA122	x 2
IC	MC3357	x 1
IC	592H2	x 1
IC	456ØB/1456ØBC	x 2
IC	TC9122	x 1
IC	TC5Ø82	x 1
IC	TC5Ø81	x 1
XTAL	47.8Ø1MHZ	x 1
XTAL	44.234MHZ	x 1
XTAL	1Ø.245 or 11.155MHZ	x 1
XTAL	1Ø.24ØMHZ	x 1
XTAL Filter	1Ø.7MHZ 2Pole	x 1
Filter	455KHZ (FILTER)	x 1

HARDWARE

Round Heatsink	x 2
Knob	x 2
Choke 1ØuH	x 1
Choke 2.5mH	x 1
Power Choke	x 1
Mic Plug (Panel)	x 1
Mic Socket (Line)	x 1
Ant. Socket (Panel)	x 1
Thumbwheel Switch	x 1
1.5uH Adj.Coil	x 4
Can 1ØMAØ15S	x 1
15ØMHZ Red Coil	x 2
Ferrite Bead	x 2
Can 1ØGPØØ4S	x 7
Can 455KHZ	x 1
Layer Choke 5uH (L2Ø8)	x 1
Layer Choke .22uH (L2Ø9)	x 2
Grommet A8	x 1
3.5mm DC Socket (Panel)	x 1
Switch SPDT	x 1
6 Hole Ferrite Bead	x 1

TEST AND ALIGNMENT PROCEDURES

TEST EQUIPMENT REQUIRED

1. A multimeter (preferably digital)
2. A frequency counter (Dick Smith K-3439) or a 2 metre Amateur Transceiver.
3. A dummy load (Dick Smith D-7027)
4. A 5MHz oscilloscope or a short-wave receiver

ALIGNMENT PROCEDURES

Initial Physical Preset Adjustments

1. Set the ferrite slug of L18 level with the top of the can.

2. Set the ferrite slug of L9 down two (2) turns from the top of the can.

3. Set the ferrite slug of L10 down one (1) turn from the top of the can.

4. Set L8 and L11 (red plastic coils) so that the ferrite slugs are one (1) turn down from the top of the coil.

5. Adjust VR68 (R68 offset trimpot) to ¾ counter clockwise position.

VOLTAGE CHECK

Connect the transceiver to a 13.8 volt nominal power supply, observing the correct polarity.

Without switching the unit on, the collector of Q22 should have 13.8V. At switch on, 13.8V should be found at the emitter of Q1 and Q3. This is to confirm that the switch has been correctly wired and terminated. If the 10V regulator is working correctly, a 10V, ±0.5V reading should be found at the collector of Q1. with unit on.

PLL ALIGNMENT (RECEIVER MODE)

Using Oscilloscope:

1. Check TP1 (Test Point 1), located at J20, for 10KHz clock frequency at 6V P/P (approx). Measurement for TP1 can be easily taken from under the PCB at Pin 7 of IC6.
2. Check TP2 (output from L18), located at E15, offset oscillator for RF output. Use a sensitive RF probe or test probe as shown in Fig.8.
3. With oscilloscope on TP4 (mix down frequency),located at IC4 , and the DC meter with the positive probe to TP3, located at H13, adjust L8 (VCO coil) for 2.5 - 2.7V) at 144MHz.
4. TP4 should show a signal of 600KHz at approximately 2V P/P (simplex - 144MHz). (Minimum level of 1V P/P and maximum level of 2V P/P nominal).
5. Adjust L18 (offset oscillator), located at E14 for maximum amplitude at TP4.
6. Select 147MHz. The DC volts at TP3 should increase to approximately 5 to 6 volts. The oscilloscope on TP4 will show a level greater than 1V P/P at 3.6MHz
7. Select 146MHz (simplex). Connect a dummy load to the output. The DC volts at TP3 should be 4 - 4.5 volts. Now press the PTT button for a short period and adjust VR68 (R68 offset trimpot), located at M16, for 4 - 4.5 volts as measured above.

RECEIVER ALIGNMENT

1. With no signal input, adjust L7 for maximum noise in speaker.
2. With suitable signal source (i.e., signal generator or a hand-held transceiver held near a radio, etc.), adjust L2, L3, L4, L5 and L6 for maximum reading on the signal meter, reducing input as required to obtain ½ scale reading. This should be performed at 146MHz (centre band). Your local repeater, slow morse beacon or propagation beacon can be used.
3. With a known input frequency, adjust L6 and L7 for best sound (best audio quality).
4. With an accurate input frequency of 146.005MHz and the +5KHz switch on, adjust L14 for best audio quality. (A separate 2 metre transceiver using a dummy load and in close proximity can be used).
5. With an accurate input frequency (146.000MHz), now select switch from +5KHz to normal and adjust L15 (receiver frequency adjustment) for best audio quality.

Please note that the +5KHz must be adjusted first, and then the normal frequency, as these adjustments will interact.

6. At this point, with a calibrated signal, the sensitivity of the receiver should be better than 0.5uV for 12dB sinad.

If minor receiver instability is experienced, change R12 from 10K to 12K. This is due to the variation in gain of the RF amplifier, Q6.

TRANSMITTER ALIGNMENT

1. Align at 144MHz simplex.
2. With a suitable load and frequency counter connected to the output socket, press the PTT button and monitor the input current. RF output should be available.
3. At 144MHz simplex, adjust L9 for peak (maximum RF output). Note that this is a critical adjusment, once adjusted, do not alter it.
4. Then adjust L10 and L11 for maximum RF output (still at 144MHz simplex).
5. At this point, the RF output should exceed 10 watts.

   Approximate current drain at:
   10W - 1.9A
   15W - 2.2A
6. Now select 147MHz and press PTT. RF output should be the same as that in Step 5, and no adjustment is required. (No tuning is required due to broad band power amplifier).

TRANSMITTER FREQUENCY

1. Set normal/+5KHz switch to the +5KHz position. Set frequency to 146MHz, then press PTT, making certain that both frequency counter and dummy load are connected to the output. Then adjust L16 for 146.005MHz.
2. Switch the normal /+5KHz switch in the normal position and adjust for correct frequency (i.e., 146.000MHz). Note that the +5KHz must be adjusted first and then the normal frequency, as these adjustments will interact.

TRANSCEIVER MODULATION

1. With a suitable modulation meter or monitor receiver, adjust VR61 (R61) for 5KHz peak deviation. The setting for 5KHz peak deviation should be approximately ½ rotation of VR61.

This should be adjusted at 146MHz simplex (centre of band range).

2. ADJUSMENT OF TWIST CAP C169. With dummy load connected to output, press PTT and adjust C169 by tightening or loosening turns to achieve 90% FSD on signal/power meter in transceiver.

TRANSFORMER WAX

Once all test and alignment procedures have been done, melt transformer wax into VCO shielded area.
It will be necessary to re adjust L8 for correct T/P volts at T/P3.

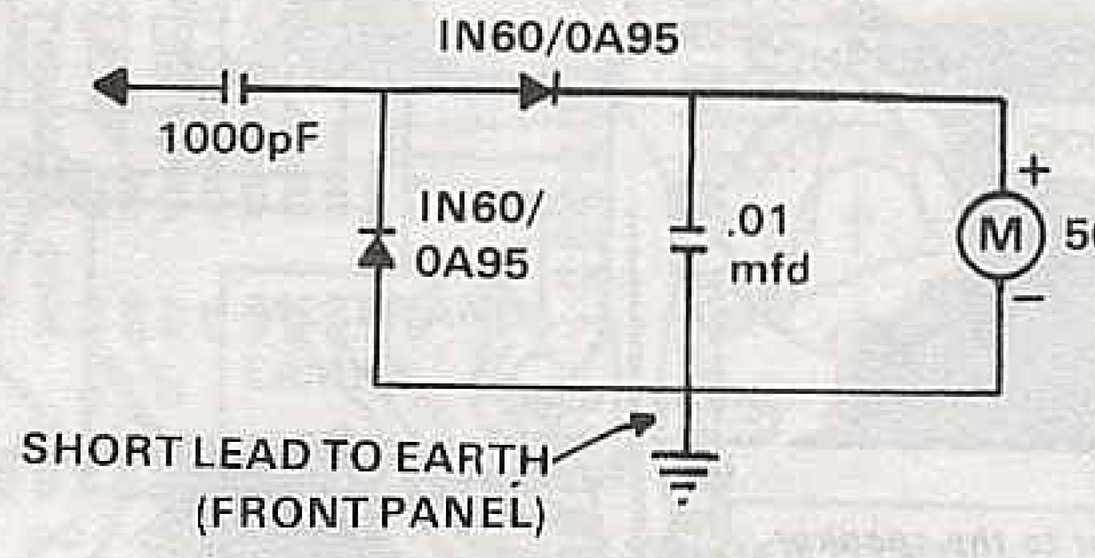


FIG.8 TEST PROBE SCHEMATIC

TC 9122 PROGRAM

9122 Divider Prog.	"N" Code	MSD * 100's		10's					LSD ** 1's				Mix Down Freq. MHz.
		400	200	100	80	40	20	10	8	4	2	1	
9122 Pin Number		13	12	11	10	9	8	7	6	5	4	3	
Freq. MHz.													
144.00	60					x	x						0.60
144.01	61					x	x					x	0.61
144.02	62					x	x				x		0.62
144.03	63					x	x				x	x	0.63
144.04	64					x	x			x			0.64
144.05	65					x	x			x		x	0.65
144.06	66					x	x			x	x		0.66
144.07	67					x	x			x	x	x	0.67
144.08	68					x	x		x				0.68
144.09	69					x	x		x			x	0.69
144.10	70					x	x	x					0.70
144.20	80				x								0.80
144.30	90				x			x					0.90
144.40	100			x									1.00
144.50	110			x				x					1.10
144.60	120			x			x						1.20
144.70	130			x			x	x					1.30
144.80	140			x		x							1.40
144.90	150			x		x		x					1.50
145.00	160			x		x	x						1.60
146.00	260		x			x	x						2.60
147.00	360		x	x		x	x						3.60
147.99	459	x				x		x	x			x	4.59

*MSD - Most Significant Digit

**LSD - Least Significant Digit

To find "N" code (simplex frequency) use formula:

N = 100 x (Freq. MHz - 144) + 60

Eg. If frequency is 145.62 MHz
Then N = 100 x (145.62 - 144) + 60
N = 100 x 1.62 + 60
N = 162 + 60
N = 222

To find Mix Down Frequency (MHz) use formula:

Mix Down Freq.(MHz) = "N"/100

Eg. If "N" Code is 222
Then Mix Down Freq.(MHz) = 222/100
M.D. Freq.(MHz) = 2.22

OFFSET

Note: For +600 KHz add 60 to "N" code.
For -600 KHz subtract 60 from "N" code.

7. When cool cut the leads off flush with the solder.

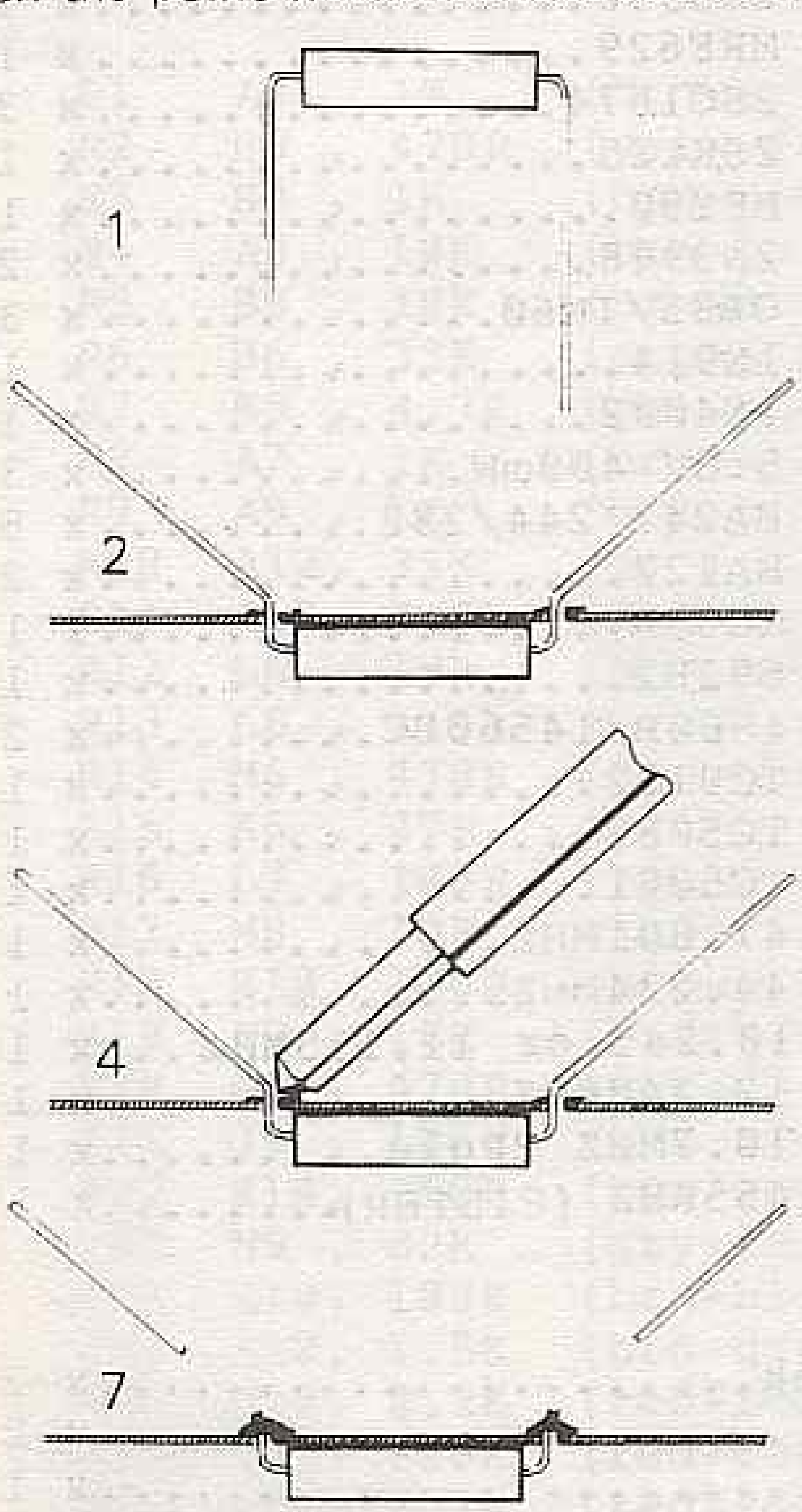
The printed circuit boards are connected to the other components using hookup wire. Usually PC pins will be used to simplify connection. To connect to these first strip 5mm of insulation from the wire, tin the end (tinning is simply coating with solder) and the PC pin. Hold the wire against the pin and re-melt the solder. Hold still until the joint is solid.

When connecting wires to switches, potentiometers and terminals first strip and tin them as above; put a 90° bend in the stripped end and hook it through the terminal. Do not wrap it around the terminal or it will be difficult to remove if necessary.

COMPONENT DRESS

Dress is the name given to the neat layout of parts. Whilst it is not essential, neat consistent layout and construction makes any fault-finding much simpler, as well as producing a more professional and reliable finished product.

Bend leads to fit their PCB holes accurately, using long-nose pliers. This means easier installation and less strain on the point where the lead enters the



component. All components except transistors should sit right on the board. Line up all resistors so that their colour codes can be easily read. Position capacitors so that their values can be read (except polarised types, which must go in the direction indicated).

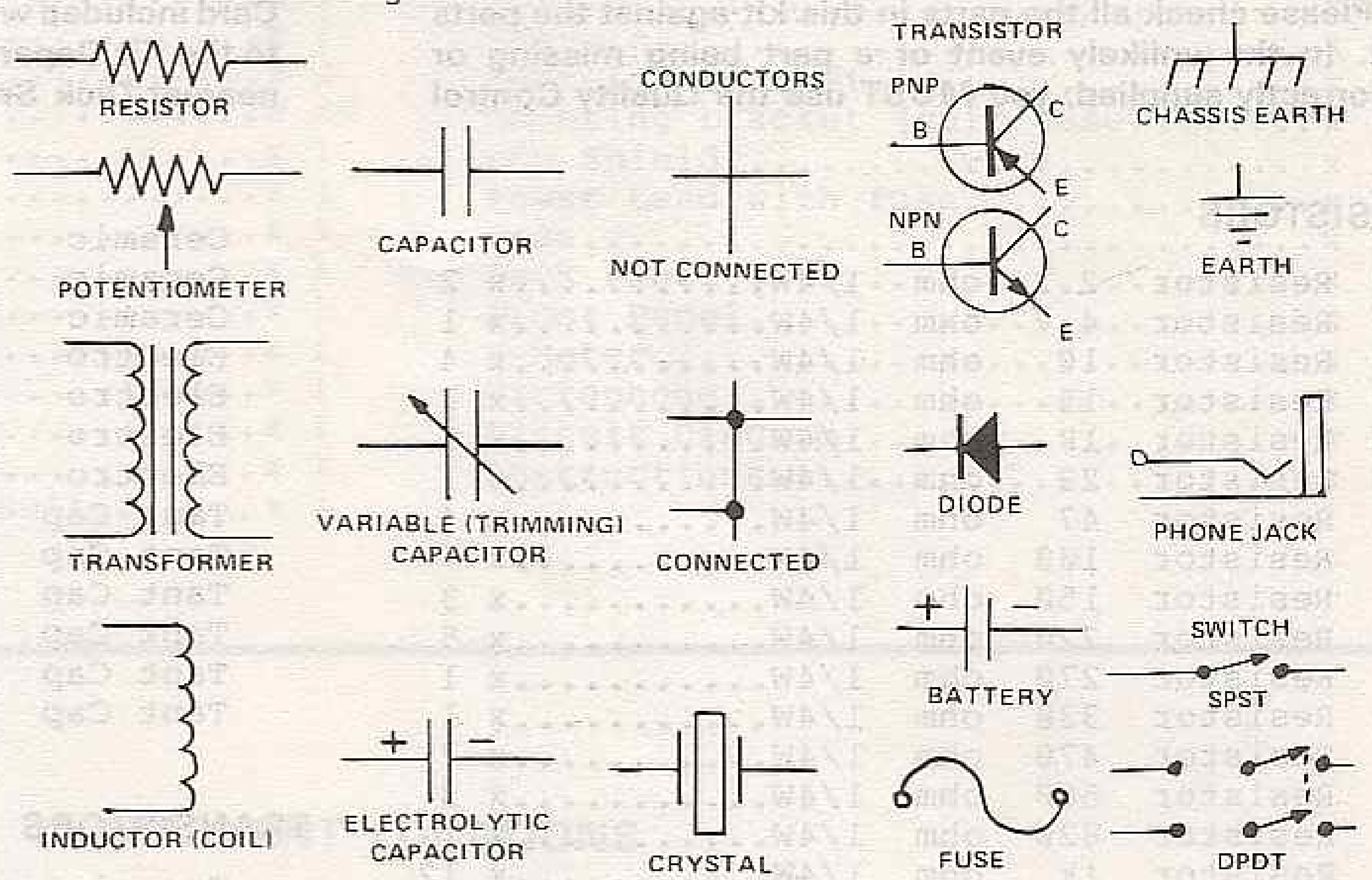
USING A MULTIMETER

A multimeter is indispensable for testing and troubleshooting circuits. These notes will help you to use it effectively.

A typical multimeter measures volt (AC & DC), resistance and DC current.

SCHEMATIC DIAGRAMS

These are the commonly used symbols for components on schematic diagrams.



To measure voltages, set the multimeter's range switch to the next voltage range higher than the voltage you want to measure. For example, to measure six volts, set the switch to ten volts. If you don't know what the voltage should be, set the switch to the highest voltage range (AC or DC) and measure the voltage. If it barely moves the needle, move the switch to the next range down. Do this until the needle falls around the middle of the scale.

Always make sure that you have set the meter to AC or DC as needed. Transformers and mains wiring are AC, transistor circuits are DC. When measuring DC, the red lead must be connected to the positive side, and the black to the negative. If the needle swings to the left, you have them the wrong way around.

RESISTANCE MEASUREMENTS

When measuring resistance always make sure that no power is applied to the circuit or you will damage the meter or get a false reading.

The most important thing to remember when measuring resistance is to make sure the meter is properly 'zeroed'. To zero the meter, set it in the appropriate range ('ohms x 1') and hold the two probe tips together. Now adjust the knob labelled 'ohms adjust' until the meter needle is sitting over the zero mark on the right hand side of the meter scale. Notice that the ohms scale reads from right to left.

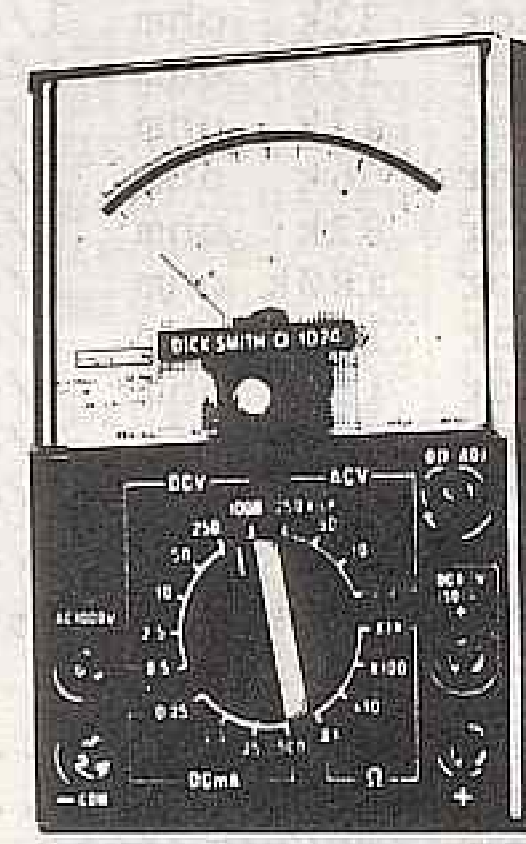
CURRENT MEASUREMENTS

To measure current, the point you wish to measure will have to be separated, as the meter will only measure current in series with the circuit. Adjust the range switch as for voltage measurements – start with the highest range and work down.

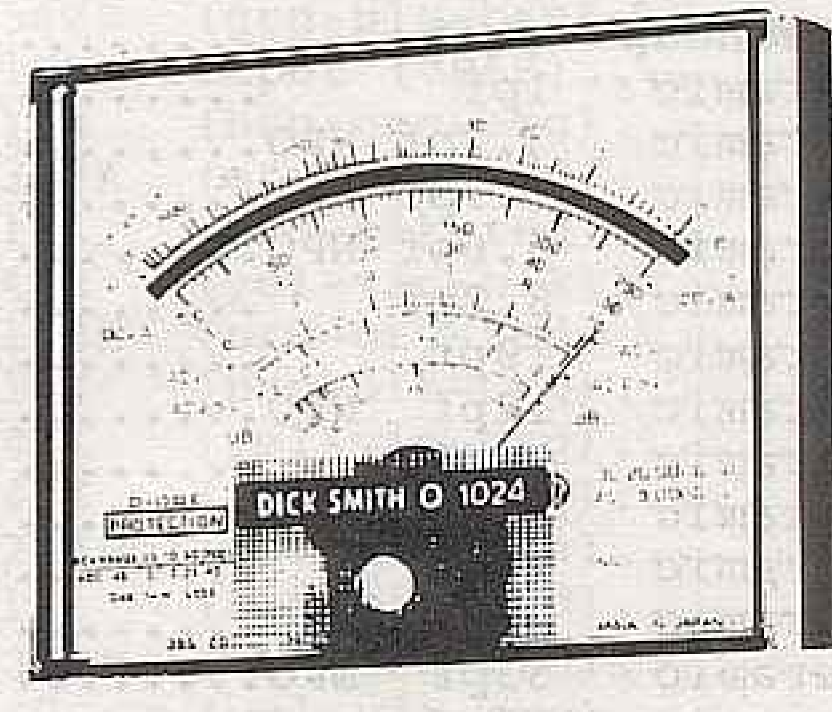
GENERAL RULES

– Check the position of the range switch before every measurement. Multimeters will NOT take much abuse (such as connecting to the mains on the ohms range!)

– Make sure that you're reading the right scale of the meter. These will be identified similarly to the range switch.



A TYPICAL MULTIMETER



A MULTIMETER CORRECTLY ZEROED FOR MEASURING RESISTANCE.

– Keep the meter flat when measuring, and read the scale from directly above – if your meter has a mirrored scale, line the needle up with its reflection. This will minimise reading errors.

– Re-zero the needle every time you measure resistance.

PARTS LIST

Please check all the parts in this kit against the parts list. In the unlikely event of a part being missing or incorrectly supplied, you MUST use the Quality Control Card included with your kit. You can send the card directly to the Kit Department at Head Office or drop it in at your nearest Dick Smith store.

RESISTORS

Resistor	2.2	ohm	1/4W	x 2
Resistor	4.7	ohm	1/4W	x 1
Resistor	10	ohm	1/4W	x 4
Resistor	15	ohm	1/4W	x 1
Resistor	18	ohm	1/4W	x 1
Resistor	22	ohm	1/4W	x 1
Resistor	47	ohm	1/4W	x 4
Resistor	100	ohm	1/4W	x 7
Resistor	150	ohm	1/4W	x 3
Resistor	220	ohm	1/4W	x 5
Resistor	270	ohm	1/4W	x 1
Resistor	330	ohm	1/4W	x 1
Resistor	470	ohm	1/4W	x 7
Resistor	560	ohm	1/4W	x 3
Resistor	820	ohm	1/4W	x 1
Resistor	1k	ohm	1/4W	x 12
Resistor	1.2k	ohm	1/4W	x 4
Resistor	1.5k	ohm	1/4w	x 7
Resistor	1.8k	ohm	1/4W	x 1
Resistor	2.2k	ohm	1/4W	x 11
Resistor	3.3k	ohm	1/4W	x 3
Resistor	4.7k	ohm	1/4W	x 7
Resistor	5.6k	ohm	1/4W	x 2
Resistor	6.8k	ohm	1/4W	x 1
Resistor	10k	ohm	1/4W	x 9
Resistor	15k	ohm	1/4W	x 6
Resistor	22k	ohm	1/4W	x 2
Resistor	33k	ohm	1/4W	x 5
Resistor	39k	ohm	1/4W	x 1
Resistor	47k	ohm	1/4W	x 9
Resistor	56k	ohm	1/4W	x 11
Resistor	82k	ohm	1/4W	x 2
Resistor	100k	ohm	1/4W	x 4
Resistor	120K	ohm	1/4W	x 1
Resistor	150k	ohm	1/4W	x 1
Resistor	220k	ohm	1/4W	x 4
Resistor	270k	ohm	1/4W	x 1
Trimpot	10k	ohm		x 2
Mini Pot	5k/10k			x 2

CAPACITORS

Greencap	.001uf		x 2
Greencap	.01uf		x 2
Greencap	.022uf		x 1
Greencap	.047uf		x 3
Greencap	.1uf		x 4
Ceramic	1pf		x 3
Ceramic	3.3pf	NPO	x 2
Ceramic	4.7pf	NPO	x 4
Ceramic	5.6pf	NPO	x 2
Ceramic	8.2pf		x 2
Ceramic	10pf		x 3
Ceramic	12pf	NPO	x 5
Ceramic	15pf		x 8
Ceramic	18pf	NPO	x 3
Ceramic	22pf		x 6
Ceramic	27pf	NPO	x 3
Ceramic	33pf	NPO	x 2
Ceramic	39pf		x 2
Ceramic	47pf	NPO	x 7
Ceramic	56pf	NPO	x 3
Ceramic	68pf	NPO	x 3
Ceramic	82pf	NPO	x 2
Ceramic	150pf		x 2
Ceramic	180pf		x 2
Ceramic	220pf		x 1
Ceramic	270pf		x 1
Ceramic	470pf		x 1
Ceramic	.001uf		x 15
Ceramic	.0022uf		x 3
Ceramic	.0047uf		x 4
Ceramic	.01uf		x 33
Ceramic	.047uf		x 9
Ceramic	.1uf		x 5
Electro	47uf	16V	x 3
Electro	100uf	16V	x 1
Electro	220uf	16V	x 1
Electro	470uf	16V	x 3
Tant Cap	.22uf	25V	x 2
Tant Cap	1uf	25V	x 4
Tant Cap	3.3uf	25V	x 1
Tant Cap	4.7uf	25V	x 3
Tant Cap	10uf	16V	x 5
Tant Cap	22uf	16V	x 1
			1

TRANSISTORS

Transistor	BC547	x 2
Transistor	BC548	x 8
Transistor	BC557	x 1
Transistor	BC558	x 2
Transistor	BD140	x 1
Transistor	3SK40/MFE131	x 3
Transistor	BC337/BC639	x 2
Transistor	BC327/BC640	x 2
Transistor	2N5590	x 1
Transistor	MRF629	x 1
Transistor	2SC1674	x 3
Transistor	2SK125	x 1
Transistor	BFY90	x 1
Transistor	2N3948	x 2
Diode	OA95/IN60	x 3
Diode	1N914	x 17
Diode	1N4002	x 1
Diode Zener	5.6V 400mW	x 3
Diode	BA243/244/282	x 5
Diode	BA122	x 2
IC	MC3357	x 1
IC	592H2	x 1
IC	4560B/14560BC	x 2
IC	TC9122	x 1
IC	TC5082	x 1
IC	TC5081	x 1
XTAL	47.801MHZ	x 1
XTAL	44.234MHZ	x 1
XTAL	10.245 or 11.155MHz	x 1
XTAL	10.240MHZ	x 1
XTAL Filter	10.7MHZ 2Pole	x 1
Filter	455KHZ (FILTER)	x 1

HARDWARE

Round Heatsink	x 2
Knob	x 2
Choke 10uH	x 1
Choke 2.5mH	x 1
Power Choke	x 1
Mic Plug (Panel)	x 1
Mic Socket (Line)	x 1
Ant. Socket (Panel)	x 1
Thumbwheel Switch	x 1
1.5uH Adj.Coil	x 4
Can 10MA015S	x 1
150MHZ Red Coil	x 2
Ferrite Bead	x 2
Can 10GP004S	x 7
Can 455KHZ	x 1
Layer Choke 5uH (L208)	x 1
Layer Choke .22uH (L209)	x 2
Grommet A8	x 1
3.5mm DC Socket (Panel)	x 1
Switch SPDT	x 1
6 Hole Ferrite Bead	x 1

Fuse 3Amp 3AG	x 1
Switch SPDT C/Off	x 1
Switch P/On	x 1
Mounting Bracket Supp	x 2
Wing Nuts	x 2
P.C.B. Pins	x 40
Solder	x 1
12 Core Telephone cable	x 1
2 Col. H/U Wire	x 1
SC1 Shielded Cable	x 1
Silicon Grease	x 1
En/Cu. Wire 18B&S	x 1
En/Cu. Wire 25B&S	x 1
Tin/Cu.Wire 25B&S	x 1
Transformer Wax	x 1
Set of Nuts & Screws to suit	x 1

MISCELLANEOUS

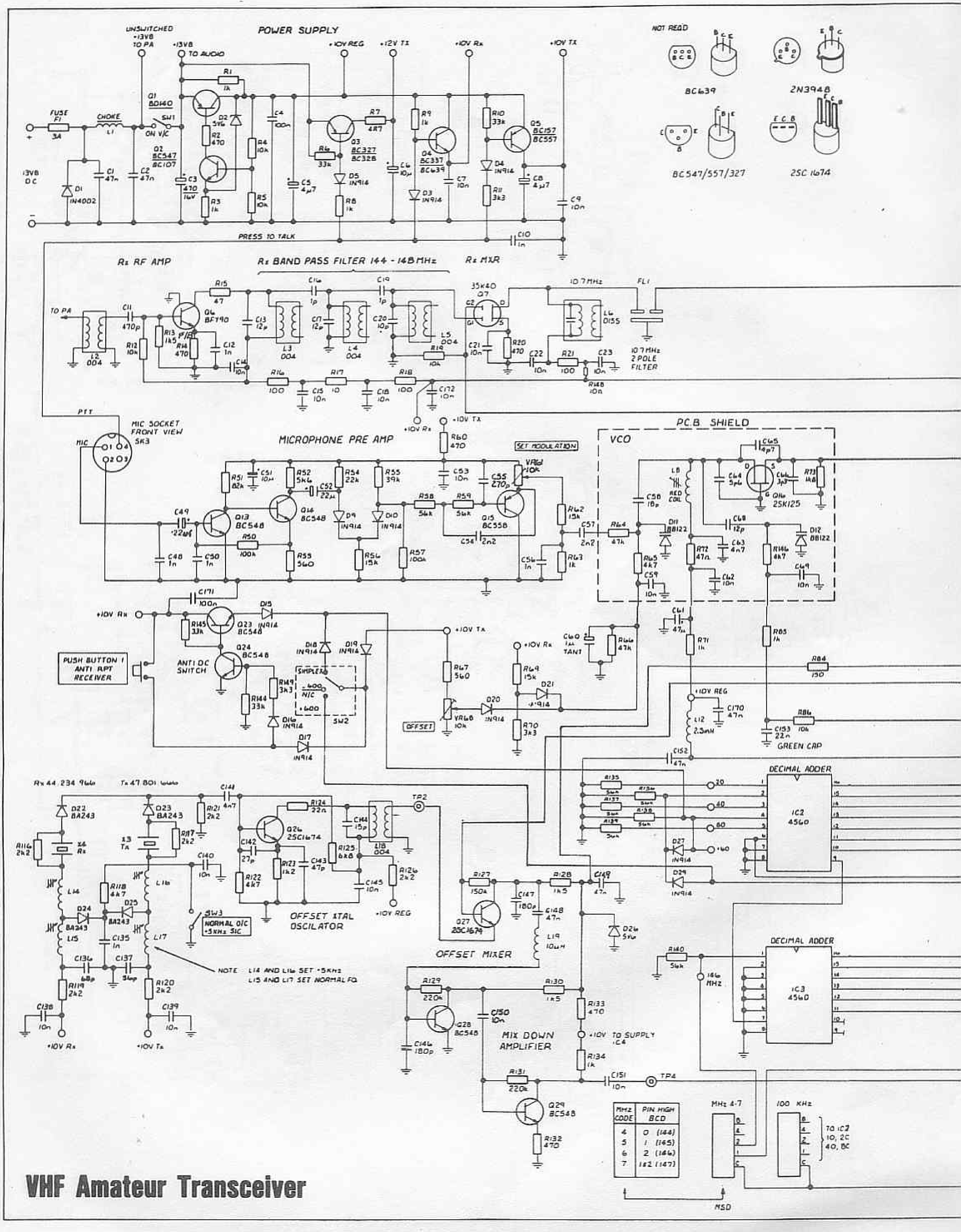
VHF Transceiver P.C.B.	x 1
Speaker	x 1
Heatsink	x 1
Heatsink Bracket	x 1
Mounting bracket (suit case)	x 1
VCO Shield	x 1
Power Lead with fuse	x 1
Case	x 1
Back Panel	x 1
Front Panel	x 1
S-Meter	x 1
Microphone	x 1
Circuit Diagram	x 1
Instructions	x 1

COMPONENT LOCATIONS

All components in this parts list are listed as follows: component number, location on PCB, value and colour code or type, respectively. Please note that all resistors are ¼W unless specified otherwise.

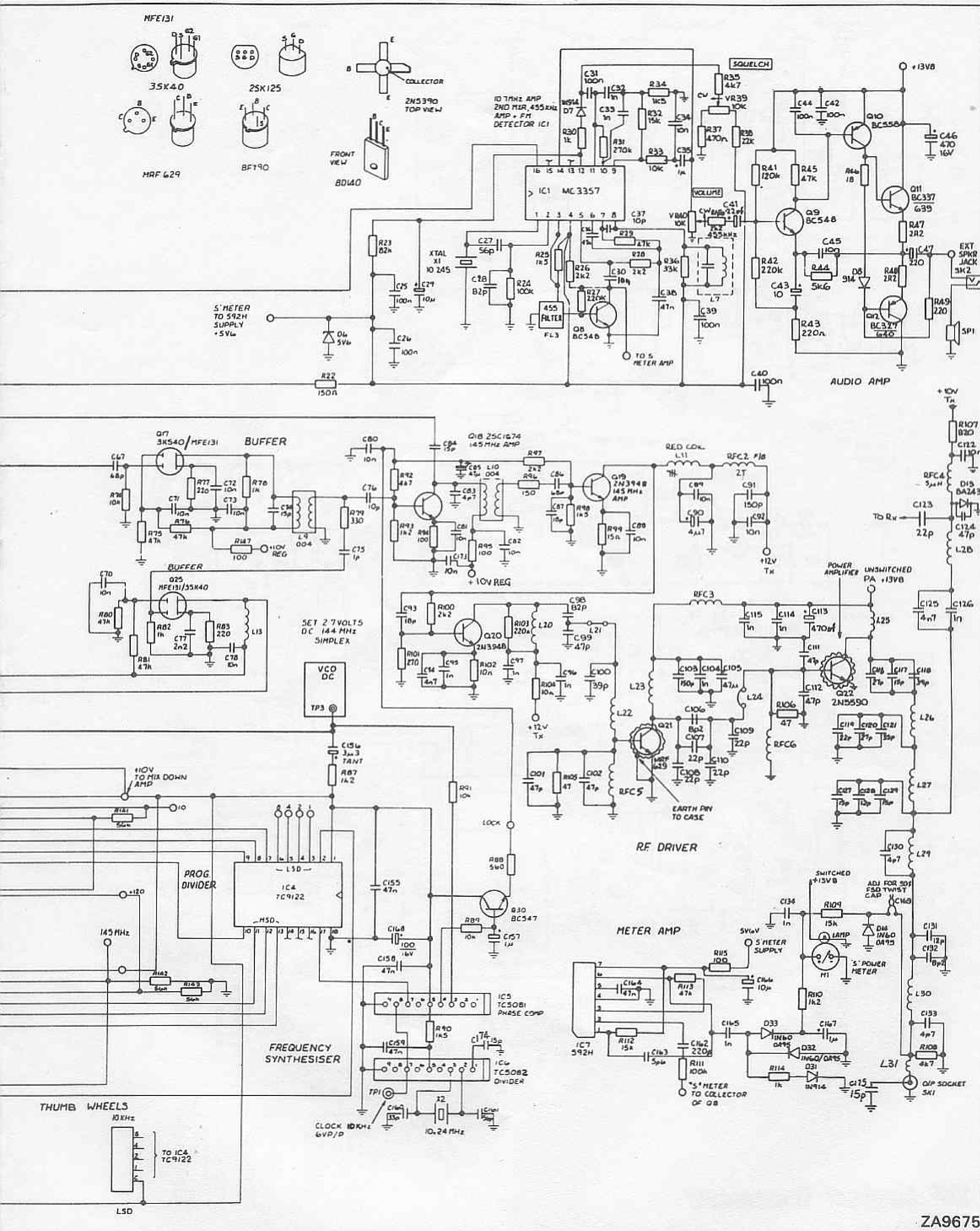
RESISTORS

R1	A7	1K	(brn-blk-red)	☐
R2	B8	470R	(yel-vio-brn)	☐
R3	B9	1K	(brn-blk-red)	☐
R4	A8	10K	(brn-blk-org)	☐
R5	B8	10k	(brn-blk-org)	☐
R6	B6	33K	(org-org-org)	☐
R7	B5	4.7R	(yel-vio-gld)	☐
R8	A7	1K	(brn-blk-red)	☐
R9	A9	1K	(brn-blk-red)	☐
R10	A12	33K	(org-org-org)	☐
R11	A12	3.3k	(org-org-red)	☐
R12	L6	10k	(brn-blk-org)	☐
R13	L6	1.5k	(brn-grn-red)	☐
R14	M6	470R	(yel-vio-brn)	☐
R15	K6	47R	(yel-vio-blk)	☐
R16	L7	100R	(brn-blk-brn)	☐
R17	M8	10R	(brn-blk-blk)	☐
R18	K10	100R	(brn-blk-brn)	☐
R19	F7	10K	(brn-blk-org)	☐
R20	G8	470R	(yel-vio-brn)	☐
R21	J9	100R	(brn-blk-brn)	☐
R22	K14	150R	(brn-grn-brn)	☐
R23	N9	82K	(gry-red-org)	☐
R24	L10	100K	(brn-blk-yel)	☐
R25	M10	1.5K	(brn-grn-red)	☐
R26	M12	2.2K	(red-red-red)	☐
R27	L12	220K	(red-red-yel)	☐
R28	L11	2.2K	(red-red-red)	☐
R29	M11	47K	(yel-vio-org)	☐
R30	O10	1K	(brn-blk-red)	☐
R31	N11	270k	(red-vio-yel)	☐
R32	O11	15K	(brn-grn-org)	☐
R33	N12	10K	(brn-blk-org)	☐
R34	O11	1.5K	(brn-grn-red)	☐
R35	P10	4.7K	(yel-vio-red)	☐
R36	M13	33K	(org-org-org)	☐
R37	P18	470R	(yel-vio-brn)	☐
R38	M12	22K	(red-red-org)	☐
R39	---	5K/10K	Mini Pot (VR39)	☐
R40	---	5K/10K	Mini Pot (VR40)	☐
R41	O18	120K	(brn-red-yel)	☐
R42	P19	220K	(red-red-yel)	☐
R43	O20	220R	(red-red-brn)	☐
R44	N19	5.6K	(grn-blu-red)	☐
R45	O18	47K	(yel-vio-org)	☐
R46	N19	18R	(brn-gry-blk)	☐
R47	M18	2.2R	(red-red-gld)	☐
R48	N19	2.2R	(red-red-gld)	☐
R49	M20	220R	(red-red-brn)	☐
R50	N16	100K	(brn-blk-yel)	☐
R51	N15	82K	(gry-red-org)	☐
R52	N15	5.6K	(grn-blu-red)	☐
R53	M15	560R	(grn-blu-brn)	☐
R54	O15	22K	(red-red-org)	☐
R55	P15	39K	(org-wht-org)	☐
R56	O17	15K	(brn-grn-org)	☐
R57	P16	100K	(brn-blk-yel)	☐
R58	O15	56K	(grn-blu-org)	☐
R59	O14	56K	(grn-blu-org)	☐
R60	N14	470R	(yel-vio-brn)	☐
R61	M14	10K	Trimpot (VR61)	☐
R62	K14	15K	(brn-grn-org)	☐
R63	I12	1K	(brn-blk-red)	☐
R64	I11	47K	(yel-vio-org)	☐
R65	H11	4.7K	(yel-vio-red)	☐
R66	I13	47K	(yel-vio-org)	☐
R67	L15	560R	(grn-blu-brn)	☐
R68	M16	10K	Trimpot (VR68)	☐
R69	H14	15k	(brn-grn-org)	☐
R70	H13	3.3K	(org-org-red)	☐
R71	E10	1k	(brn-blk-red)	☐
R72	H9	47R	(yel-vio-blk)	☐
R73	G10	1.8K	(brn-gry-red)	☐
R74	G9	10K	(brn-blk-org)	☐
R75	F10	47K	(yel-vio-org)	☐
R76	F10	47K	(yel-vio-org)	☐
R77	E9	220R	(red-red-brn)	☐
R78	F10	1K	(brn-blk-red)	☐
R79	E12	330R	(org-org-brn)	☐
R80	H13	47K	(yel-vio-org)	☐
R81	G13	47K	(yel-vio-org)	☐
R82	G12	1K	(brn-blk-red)	☐
R83	G12	220R	(red-red-brn)	☐
R84	G14	150R	(brn-grn-brn)	☐
R85	H12	1K	(brn-blk-red)	☐
R86	H12	10K	(brn-blk-org)	☐
R87	I14	1.2K	(brn-red-red)	☐
R88	K18	560R	(grn-blu-brn)	☐
R89	J18	10K	(brn-blk-org)	☐
R90	J19	1.5K	(brn-grn-red)	☐
R91	J15	10K	(brn-blk-org)	☐
R92	E9	4.7K	(yel-vio-red)	☐



MHz CODE	PIN HIGH BCD
4	0 (144)
5	1 (145)
6	2 (146)
7	1&2 (147)

VHF Amateur Transceiver



MFE131
3SK40
2SK125
MRF 629
BF190
2N5390 TOP VIEW
COLLECTOR
FRONT VIEW
BD140
10.7MHz AMP 2ND MIX, 455kHz AMP + FM DETECTOR IC1
IC1 MC3357
SQUELCH
VOLUME
XTAL X1 10 245
455 FILTER
FL3
Q8 BC548
TO S METER AMP
S'METER TO 592H SUPPLY +5V6
AUDIO AMP
Q9 BC548
Q10 BC558
Q11 BC337
Q12 BC327
EXT SPKR JACK SK2
SP1
+13V8
Q17 3SK40/MFE131
BUFFER
Q18 2SC1674 145MHz AMP
Q19 2N3948 145MHz AMP
RED COL
RFC2 F18
+10V REG
+12V Tx
+10V Tx
TO Rx
Q25 MFE131/3SK40
SET 2.7 VOLTS DC 144 MHz SIMPLEX
Q20 2N3948
POWER AMPLIFIER
UNSWITCHED PA +13V8
Q21 MRF 629
EARTH PIN TO CASE
Q22 2N5590
R.F. DRIVER
VCO DC
TP3
+10V TO MIX DOWN AMP
PROG DIVIDER
IC4 TC9122
LSD
MSD
LOCK
Q30 BC547
145MHz
+120
IC5 TC5081 PHASE COMP
IC6 TC5082 DIVIDER
FREQUENCY SYNTHESISER
TP1
CLOCK 10KHz 6VP/P
X2 10.24 MHz
THUMB WHEELS
10KHz
TO IC4 TC9122
METER AMP
IC7 592H
S'METER SUPPLY
SWITCHED +13V8
ADJ FOR 50% FSD TWIST CAP
LAMP
M1
'S' POWER METER
'S' METER TO COLLECTOR OF Q8
O/P SOCKET SK1
ZA9675