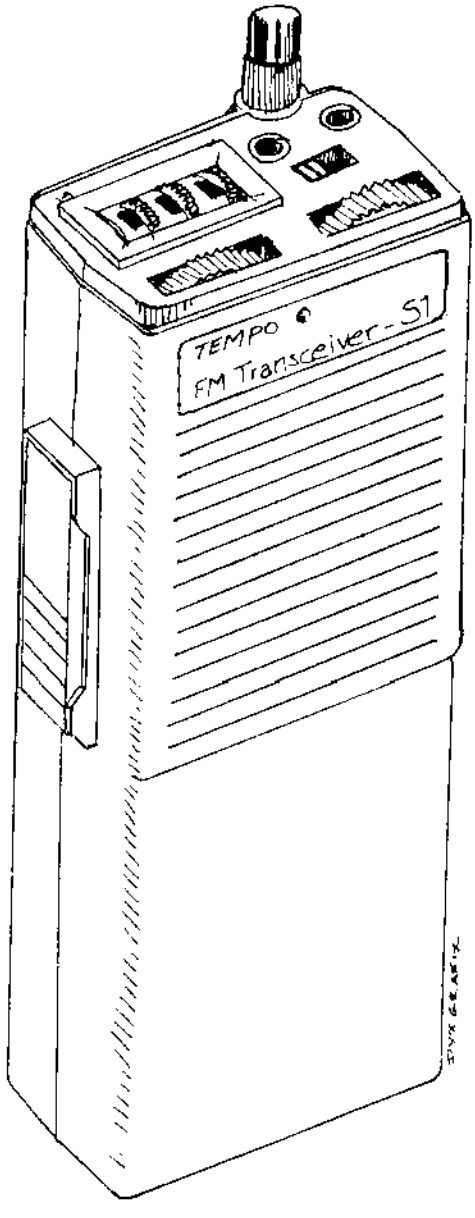
TEMPO S 1

SERVICE MANUAL



HENRY RADIO
11240 W. OLYMPIC BLVD.
LOS ANGELES, CA 90064

CONTENTS

CONTENTS

TESTING PROCEDURE

SYNTHESIZER

1. Set the thumbwheel controls and slide switch to 4000 (144.000 MHz).
2. Connect the frequency counter to Q3 (transistor 2SC 1674) base or top of R 12 (220 K resistor). You should read exactly 133.300 MHz. If this result is not obtained the following two procedures are required.

*Connect a frequency counter to T.P. of IC 5 (NIS 104) pin 1, and adjust trimmer capacitor TC 1 for exactly 6.82666 MHz on your frequency counter.

*Connect a frequency counter to Q3 base again and adjust the T8 core for exactly 133.000 MHz on the frequency counter. This adjustment is for X2 (crystal unit 43.1 MHz).

RECEIVER

1. Connect a frequency counter to the Q5 (transistor 2SC 1675) collector or top of R 20 (220 K resistor), and check the reading of 10.245 MHz within the allowable tolerance of +/— 400 Hz. If it is not in the allowable range, the 10.245 MHz crystal unit must be replaced.
2. Connect a signal generator to the external antenna jack. Set the generator frequency with the counter to exactly 144.000 MHz. Connect an audio level meter with an 8 ohm dummy resistor of 1W in parallel to the earphone jack. Adjust T1 through the T5 cores for maximum level meter reading.
3. According to the above mentioned alignment, the receiver sensitivity should be around 0.3 microvolts for 20 dB SINAD.
4. Check that the squelch threshold point is less than 0.5 microvolts.

CARRIER TO NOISE RATIO

1. Connect a signal generator to the antenna jack and an audio level meter with an 8 ohm dummy resistor in parallel to the earphone jack.
2. Set the generator frequency the same as the transceiver frequency level of 30dB, 1 KHz modulation, 4.2 KHz deviation.
3. Measure the overall S/N ratio. More than 50 dB S/N should bring about enough C/N ratio. If this is not the case, Q7 (transistor 2SC 945) may be defective.

TRANSMITTER

1. Connect the RF wattmeter with a 50 ohm dummy load to the antenna jack, and the 9.6 VDC, 1 A power source to the battery plug as a substitute for the Ni-Cad battery pack.
2. Set the thumbwheel controls to 4000 (144.000 MHz) and the offset switch to the "S" (simplex) position. Hold the press-to-talk lever in order to transmit.
3. Adjust the eight cores of T16, 9, 10, 11, 12, 13 and 14 in turn for maximum power output as indicated on the wattmeter.
4. Set the thumbwheel controls to 5000 (145.000 MHz). Adjust carefully the three trimmer capacitors TC 2, 6 and 7 for maximum power output. An insulated screwdriver must be used for this alignment.
5. Set the thumbwheel controls to 4000 (144.000 MHz) again, and adjust T 9,10, 11, 12, 13 and 14 in turn for maximum power output. Repeat steps 3, 4 and 5 carefully until no further improvement can be obtained.
6. Measure the RF output power for the settings from 4000 to 7995 (144.000 to 147.995). Output power should be maximum at 145.000 MHz (about 2 watts) and more than 1.6 watts at any other point in the range. If the results have not be obtained, repeat numbers 3, 4 and 5.

OFFSET ADJUSTMENT

1. Connect a frequency counter with an attenuator to an RF dummy load which is connected to the antenna jack of the transmitter. Set the offset switch to the "S" position and adjust the TC 4 trimmer capacitor for exactly a 145.000 reading on the frequency counter, when the thumbwheel controls are set to 5000 (145.000 MHz).
2. Set the offset switch to the −600 position, and adjust the TC 5 trimmer capacitor for exactly 144.000 MHz on the counter.
3. Set the offset switch to the +600 position, and adjust the TC 3 trimmer capacitor for exactly 145.600 MHz on the counter.

DEVIATION ADJUSTMENT

1. Connect the deviation meter to the RF dummy load which is connected to the antenna jack.
2. Check the setting of VR 3, variable resistor for the center position, and set the thumbwheel controls to 7995 (147.995).
3. Connect an audio generator to terminal 12 of the 15 pin connector, and set the generator for a frequency of 1 KHz, and an output level of 100 mV.
4. Adjust VR 4 for a 5 KHz indication on the deviation meter.
5. Set the generator output level to 2 mV, and adjust VR 3 for 4.2 KHz indication on the deviation meter.
6. Remove the audio generator from the transceiver. Check that the deviation does not exceed 5 KHz at a single tone input such as a whistle from the built-in microphone.

TROUBLESHOOTING

PLL NON-LOCK

1. Connect a frequency counter to the IC 5 (NIS 104) T.P. and check the 6.82666 MHz oscillation.
2. Connect an oscilloscope to IC 5 (NIS 104) pin 4 and observe the 6.82666/1024 waveforms.
3. Connect an oscilloscope to IC 3 (NIS 105) pin 7 and observe the same waveform as 2.
4. Connect an RF millivolt meter to R 78 (resistor 2.7 K), and check the stop of the oscillations by rotating the T8 core counter-clockwise until the core is 5 mm out of the transformer case. Restore the core to the original position.
5. Connect the oscilloscope to IC 7 (NIS 103) pin 1, and observe the waveform of 0 - 3 MHz according to the thumbwheel control settings. Check the variation of frequency at the rotation of the T6 core. If there is no waveform at IC 7, pin 1, try to touch Q 11, 12 (2SC1675's) bases and check the amplification of Q 11 by comparing the signal levels.
6. Connect the RF millivolt meter to A 12 (2SC 1675) bases, and check the oscillation of Q 8 (2SK61) VCO. It is necessary for this measurement to stop oscillations of X2 by rotating the T 8 core CCW until it stops oscillating.
7. Connect a DC voltmeter to IC 3 (NIS 103) pin 1. If the reading is 0 volts and a signal exists at IC 7 (NIS 103) pin 1, non-lock is caused by a defective IC 7.
8. Set thumbwheel controls to 5000 (145.000 MHz), and measure the voltage of IC 7 (NIS 103) pin 7, 8, 9 and 10. Voltages at pins 8 and 10 should be close to 6.5 VDC. At pins 7 and 9 it should be 0 VDC. If this is not the case, the thumbwheel control is defective.

NON-LOCKING AT HIGHER FREQUENCIES

1. If there is a low-level of the X2 (43.1 MHz) output, then the X2 crystal may be defective.
2. NIS 103 may not work on higher frequencies.
3. Measure the voltage at pin 11, 13, 14 and 24 of IC 7 (NIS 103). It should be nearly 6.5 VDC. If this is not the case, then D 15 (RD7.5EB), the zener diode must be replaced.

LOW SENSITIVITY OF THE RECEIVER

1. Connect the RF voltmeter to the Q 3 (2SC 1674) base, and check if the level is more than 0.85 V rms local injection.
2. Connect the signal generator through a 0.001 uF ceramic capacitor to the Q 3 base, and set the frequency to 144.000 and the level to +10 dB.
3. If 20 dB SINAD is obtained in this condition, the RF amplifier stage is defective.
4. If 20 dB SINAD is NOT obtained in the above condition, the later stage should be defective. The defective later stage will be cured by normal troubleshooting procedures.
5. Low sensitivity can be caused very rarely by a defective Q 6 (2SA 733).

SQUELCH

1. Measure a noise level of more than 0.1 V rms at pin 1 of IC 6 (NIS 102), and more than 0.75 V rms at pin 2 of IC 6. If this is not the case, IC 6 is defective.

TOUCH-TONE PAD

1. In the case of only a single tone generation, suspect a defective keyboard, defective IC MK 5087, or RF feedback caused by too long battery leads.
2. In the case of no tone, suspect a defective wiring or short, defective crystal unit or IC MK 5087 or defective IC 4 (uPC 57711).

BATTERY CHARGER VOLTAGE

Unloaded voltage reading is 7 - 8 VAC rms. Under load, the battery filters the output, and the voltage reads 11 - 12 VDC.

RECEIVER BIRDIES

Sometimes RECEIVER BIRDIES may appear in the S-1 or S-1T on even numbered megahertz. Birdies of less than one microvolt (equivalent to the antenna input) are allowed within normal tolerance.

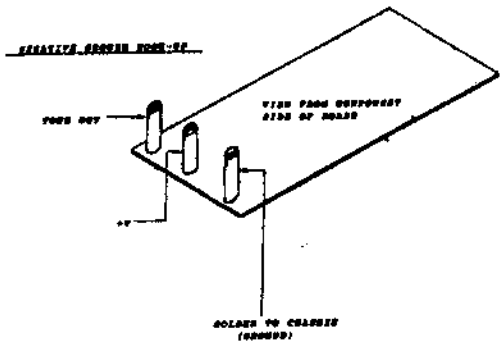
Should you want to eliminate more, place .01 uf ceramic disc capacitors from Pin 11, 13, 14 and 24 to ground of NIS-103. No additional shield cover is needed.

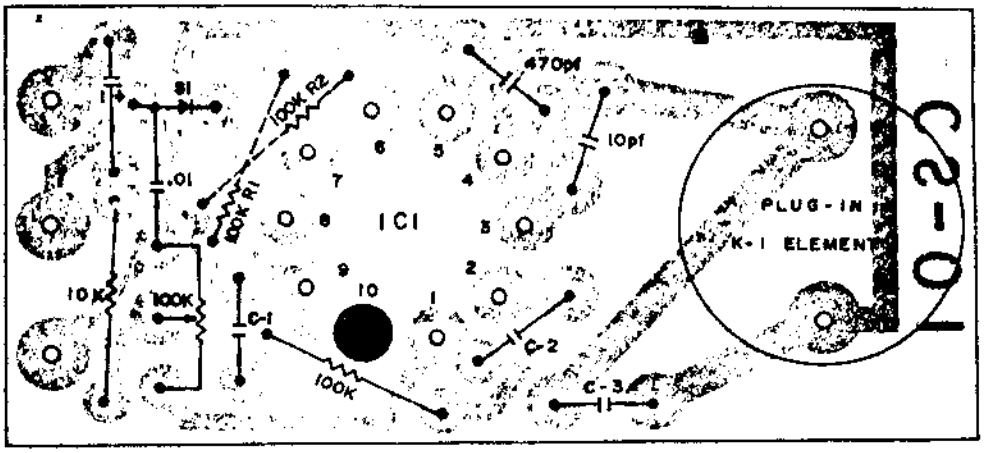
This modification should cure RECEIVER BIRDIES on even numbered megahertz (such as 144, 145, 146 and 147 MHz).

ELIMINATING UNWANTED TONES AND PINGS ON EARLY MODELS

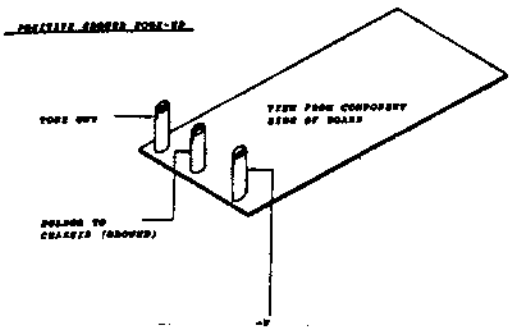
To eliminate a continuous 1666 Hz tone during transmit and receiver on early models, and to eliminate turn-on ping, install a 4.7 mfd capacitor from Pin 1 of IC 3 (NIS 105) to ground. This modification applies to serial numbers below 5,000.

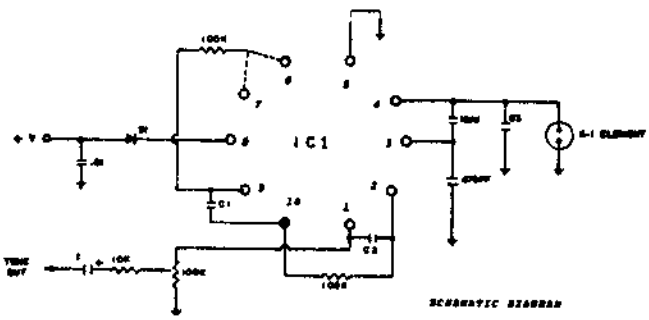
ME-3 MICROMINIATURE TONE ENCODER





VIEW FROM COMPONENT SIDE OF BOARD





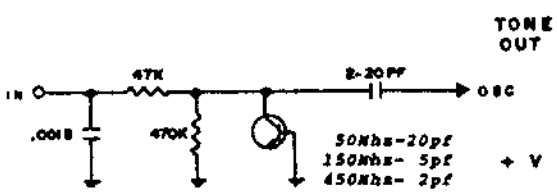
SCHEMATIC DIAGRAM

BAND CHANGE VALUES

	67.0-131.8Hz	136.5-203.5Hz
C2	.015uf	.01uf
C3	NONE	NONE-56pf
R1	IN	OUT
R2	OUT	IN

PARTS LIST

1-	10k 1/8w	.25ea
2-	100k "	.25ea
1-	100k pot	1.75ea
1-	10pf CN15 "NPO"ceramic	1.00ea
1-	470pf " " "	1.00ea
1-	4700pf CN15 "W" " C1	1.25ea
1-	.01uf " " " C2	1.50ea
or	.015uf " " " C2	1.75ea
1-	0-56pf CN15 "NPO" " C3	1.00ea
1-	luf-35v tant. cap.	.85ea
1-	Silicon diode	.15ea
1-	Drilled,plated PCB	2.00ea
1-	Microcircuit	15.00ea
1-	K-1 element	3.00ea
2-	Socket pins	.25ea



CRYSTAL MODULATOR CIRCUIT

MOUNTING

The unit is mounted with a 1/2w resistor lead (not supplied) about 1/2" long. Solder one end to the terminal of the correct polarity desired. The other end of the lead is soldered to the PCB or chassis in the radio unit. See above diagram for correct hook-up. In portable units, the encoder may be insulated with tape or its equivalent and placed inside unit with no mounting. The unit is immune to RF.

POWER HOOK-UP

The voltage to the encoder MUST be keyed with the transmitter in most mobile units. This is because the encoder operates in the fundamental mode around the IF frequencies of some receivers. If keyed voltage is not available, an RF choke of 10uh to 100uh may be placed in series with the voltage supply to the encoder to eliminate the problem. Use the above diagram to apply correct polarity to the unit. If the polarity is reversed,the unit will not operate but it will NOT be damaged. If it is necessary to operate the encoder off supplies greater than 16vdc, use the following formula to determine the correct series dropping resistor value. R= Supply voltage-12 divided by .008. If "T" whine, vibrator hash, or AC hum are present in the tone output, add a 220 ohm 1/4w resistor in series with the supply lead and the encoder and bypass this point to the negative supply (or GND) with a 100uf-16v capacitor. For base operation in tube-type units, the -20v bias supply will provide adequate voltage with a 1k series dropping resistor.

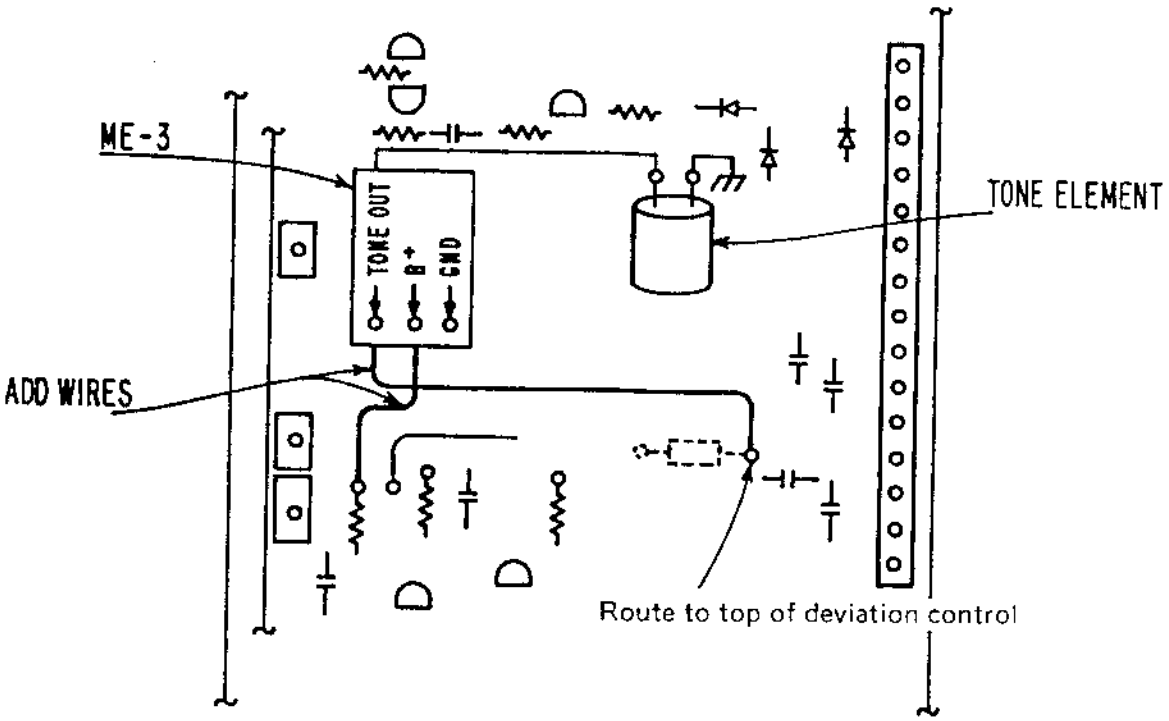
TONE OUTPUT

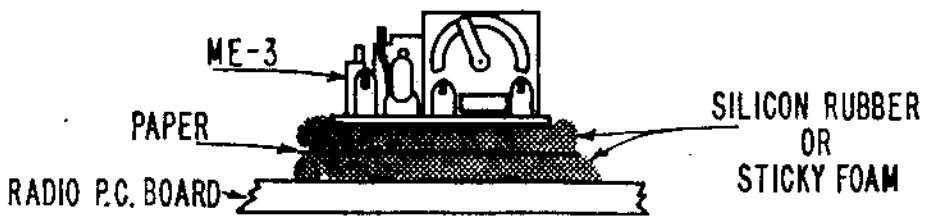
Tone may be added to most transmitters directly to the center of the mod pot or directly to the modulator grid (or base in a transistorized transmitter). Note that a 10k series resistor is provided internally in the encoder so no other series resistance should be needed. If more tone level is required, the input voltage may be raised to a level closer to 15vdc. Some of the older tube type transmitters accept sub-audible tone more readily if injected with a crystal modulator circuit as shown above. Various values of coupling capacitance are shown for the different frequency ranges of the transmitter. The VARICAP (or transistor base to collector junction with the emitter cut off) changes as voltage into changing capacitance which truely FM modulates the transmitter. No intermoding or distortion of the voice will be noted with this method.

GENERAL

Be sure the terminals are soldered to the foil. If it is necessary to change tone frequency outside the band the unit was shipped on, use the list above for the proper band change parts values. Also note that C3 should be cut out (if it is present) anytime tone frequency is changed in the field. Any K-1 elements shipped for field replacement will NOT require C3. Band change parts may be ordered from the parts list for field changes in frequency. The entire encoder may be returned to the factory for a flat $7.00 charge which includes band parts change, new K-1 element, and return Air Mail postage. All encoders will be processed and shipped the same day received.

ME-3 FOR TEMPO S1





OBSERVATIONS OF THE S 1 SYNTHESIZER AND TRANSMITTER CHAIN

1. SYNTHESIZER

1. Heterodyne Reference XTAL oscillator — XTAL Number 2 and Q 13.

   Set Singer* to .125 mv. Touch probe to case of Q 15 for a reading of 43.1 MHz.
   (* SINGER GERTSCH FM 10CS FREQUENCY METER/SIGNAL GENERATOR.)

2. Loop Reference: IC Number 5 T.P. 200 mv. PEP 6.82666 MHz.

   Use TC 1 for frequency adjust (trimcap). IC Number 5 is NIS 104. Pin 4 voltages: 5 volt logic square wave, 1.667 KHz going to Pin 7 of phase comparator, IC 3.

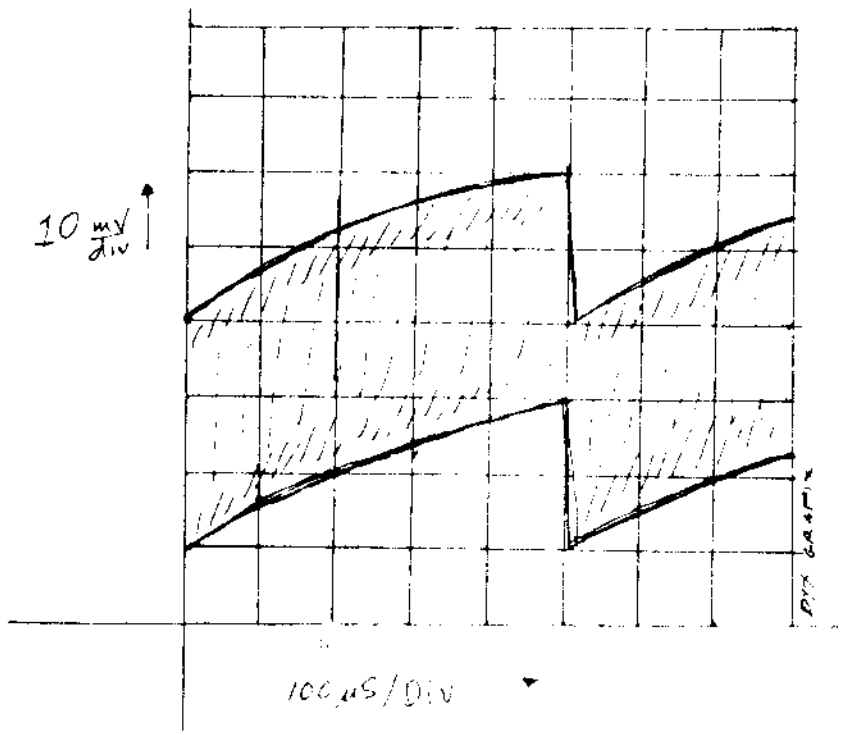
3. Divide by N: IC Number 9 (NIS 103) Pin 1 input, from heterodyned VCO output, 1 volt PEP.

$$N = \frac{\text{Frequency of Pin 1}}{1.667\ \text{KHz}}$$

MHz (Dialed frequency)	MHz (Pin 1 frequency)	N
144.000	1.333	800
145.000	1.666	1000
146.000	2.000	1200
147.000	2.333	1400
148.000	2.666	1600

Pin 23 Output complex waveform is 50 mv. PEP.

"N" program select consists of 3 sets of BCD. LSB is 2 (1), Brown wire. 2 (2) Red wire. 2 (3) Yellow wire. MSB — 2 (4) gray wire.



4. Phase comparator and low pass filter. (IC number 3 NIS 105)

Pin 8 input of phase comparator is fed by the same signal as illustrated. (Pin 23 output divided by N.)

Pin 7 input of phase comparitor fed by a 5 volt PEP 1.666 KHz signal from the reference oscillator.

Pin 1 output of low pass filter controls the VCO through D8 varactor. This potential tunes the receiver and the transmitter sections.

See the lines which connect to balloon 9 (i.e. 9 in the schematic.)

	F MHz (Dialed frequency)	V Volts (Pin 1 IC Number 3 - low pass output)
$\frac{dv}{df}$ = .34 volts/MHz	144.000	3.09
	145.000	3.42
	146.000	3.76
	147.000	4.10

Pin 2 voltage. 1 volt spike 1.666 KHz. Pin 3 voltage. 3 volt spike 1.666 KHz.

Pin 4 voltage. 5.49 volts DC.

5. Voltage Controlled Oscillator (V.C. O.) Q 8 (2SK61), D8, D9 Varicaps and T8.

Set Singer to 2.4 microvolts receive sensitivity. Touch probe to slug of T8 and observe the following:

	Fd = Dialed freq. of S 1 in MHz.	Fm = Singer measured freq. in MHz.
$fm = \frac{fd - 10.7}{3}$	144.000	44.433333
	145.000	44.766666
	146.000	45.100000
	147.000	45.333333

6. Tripler: Q9 (2SC 1674) D10, D11, D12, T7.

Set Singer to 8 microvolts receive sensitivity. Touch probe to slug of T7 and observe the following:

	Fd = dialed freq. of S 1 in MHz.	F'm = Singer measured freq. in MHz.
F'm = Fd — 10.7	144.000	133.3
	145.000	134.3
	146.000	135.3
	147.000	136.3

COMMENT: The PLL may still work even though the tripler is disabled.

7. Mike Amplifier: IC 4 (NPC 577 H)

   Pin 1 voltage: .4 volts DC.

   Pin 2 voltage: 20 mv. audio-in adjusted by VR 3. Pin 3 is the same as Pin 2.

   Pin 5 voltage: 2 volts PEP audio output to be adjusted by VR 4.

   Pin 6 voltage: 2.16 VDC.

   Pin 7 voltage: 4.9 VDC when XMIT.

II. TRANSMITTER SECTION

1. Tripler amplifier: Q 26 (2SC 1674) T 16, D 26

   Set Singer to maximum sensitivity. Touch probe to T 16 and observe the same as for the tripler.

2. Offset Oscillator Q 25 (2SC 1675). Set Singer to 64 microvolts. Touch probe to case of Q 25, and observe the following:

OFFSET SWITCH	MEASURED FREQUENCY	"MEASURED" Voltage
+ 600 KHz	11.3 MHz	2.64
zero	10.7 MHz	1.60
— 600 KHz	10.1 MHz	.81

   The "measure" voltage is taken from the second wire of the offset switch with respect to the charge jack.

3. Amplfier chain: Measurements with an RF Probe.

   D 19 = .15 volts transmit, D 18 = .22 volts transmit, D20 = .06 volts transmit.

   D 21 = .6 volts transmit, D 22 = 3.2 volts transmit.

   Collector of Q 23 measures 5.5 volts. Collector of Q 24 (Final Amplifier) measures 2 volts.

TRANSISTORS

2SC1674	Q1, Q3, Q9, Q26
2SC1070	Q2
2SC1675	Q4, Q5, Q10 Q11, Q12, Q13, Q25
2SA733	Q6, Q34
2SC945	Q7, Q14, Q17, Q18, Q28, Q29, Q30, Q31, Q33
2SK61	Q8, Q19, Q20
2SC536	Q15, Q16
2SC2026	Q21, Q22, Q23
2SC2221	Q24
N13T1	Q27
2SC2001	Q32
2SA962	Q35

INTEGRATED CIRCUITS

NIS101	IC1, IC3
uPD 4028	IC2
uPC 577H	IC4
NIS104	IC5, IC8
NIS102	IC6
NIS103	IC7

DIODES

1S1588	D1, D2, D4, D11, D12, D27, D28, D30
1S2208	D3, D5, D6, D7, D9, D10, D17, D18, D19, D20, D21, D22, D26
1SV50	D8, D23
1N60	D13, D14
RD7.5EB	D15
RD8.2EC	D16
RD6.8EB	D24
MI301	D25
M8513AR	D29

CAPACITORS

.01	C1, C8, C15, C16, C17, C18, C20, C21, C27, C28, C37, C40, C44, C48, C60, C67, C70, C72, C75, C81 C93, C98, C106, C114, C116, C137
10 pf	C2, C3, C7, C10, C12, C19, C36, C39, C76, C82, C85, C87, C91, C94, C99, C102, C117, C118, C130
.001	C4, C5, C6, C13, C23, C29, C38, C42, C50, C55, C58, C68, C79, C80, C83, C89, C90, C96, C97, C101 C103, C104, C107, C119, C120, C123, C129, C131, C138, C147
0.5 pf	C9, C11, C84, C86, C92
5 pf	C14, C33, C124
10 mf Electr.	C22, C24, C43, C61, C62
47 mf Electr.	C25, C26, C41, C145
220 pf	C30, C112, C113
100 pf	C31, C115
33 pf	C32, C46, C108, C109, C110, C111, C136
47 pf	C34, C56, C57, C78
1 pf	C35, C73
0.47 mf Electr.	C45, C54
470 pf	C47
1 mf Electr.	C49, C133, C141
0.1 mf Electr.	C51, C53, C59, C64, C139, C143, C144
0.0047 mf Electr.	C52, C140
0.047 mf Electr.	C63

15 pf	C65, C66, C77, C88, C135
20 pf	C69, C71, C74, C121, C125, C126, C128, C132
7 pf	C95, C100
47 mf Electr. 35V	C105
100 mf Electr.	C122, C146
39 pf	C127
4.7 mf Electr.	C134
22 mf Electr.	C142

RESISTORS

10K	R1, R25, R42, R46, R50, R55, R87, R88, R96, R102, R106, R121
220K	R2, R7, R9, R10, R12, R16, R20, R32, R33, R34, R36, R40, R47, R49, R73, R75, R80, R92 R93, R94, R97, R100, R104, R109, R113, R114, R124, R125, R130, R134, R137, R140
3.3K	R3, R15, R38, R126
470	R4, R48
15K	R5, R11, R26, R139
22K	R6, R24, R43, R57, R81, R128, R136
1K	R8, R13, R14, R19, R22, R37, R53, R54, R71
330	R17, R89, R90, R138
100	R18, R29, R98, R143
2.2K	R21, R35, R86
100K	R23, R58 through R70, R118
47K	R27, R28, R76, R83, R141
470	R30, R77
1M	R31
4.7K	R39, R41, R123
5.6K	R44, R45
33K	R56, R82, R84, R85, R117, R131, R132, R133, R135
2.7K	R72, R78
3.9K	R74
220	R79, R99, R103, R146
560	R91, R111, R144
1.5K	R95, R101, R105
10	R107, R122
47	R108
1.2K	R110
680	R112
82K	R115, R120
120K	R116
12K	R119
470K	R127
150K	R129
1.8K	R142
150	R145
8.2K	R147

TRANSFORMERS

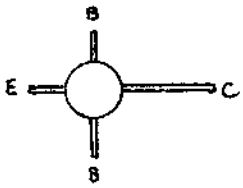
T1	330 - 01
T2	330 - 01
T3	330 - 01
T4	330 - 01
T5	01 - 500
T6	330 - 06
T7	330 - 01
T8	COPPER WINDINGS ON A BRWOWN FORM.
T9	330 - 03

Off/On Volume Control
Squelch Control
Frequency Thumbwheel Switch
0/+5 KHz Switch
Earphone/Antenna Jack
Speaker
Microphone
PTT Switch
LD1 LED
Multi-pin Connector
Crystal Filter 10.7 MHz
SFE 10.7 MHz
CFG 455G
SFD 455

TRANSISTOR PIN POSITIONS

2SC2221

2SC 945
2SC1674
2SC1675
2SC2001
2SA 733
2SA 952

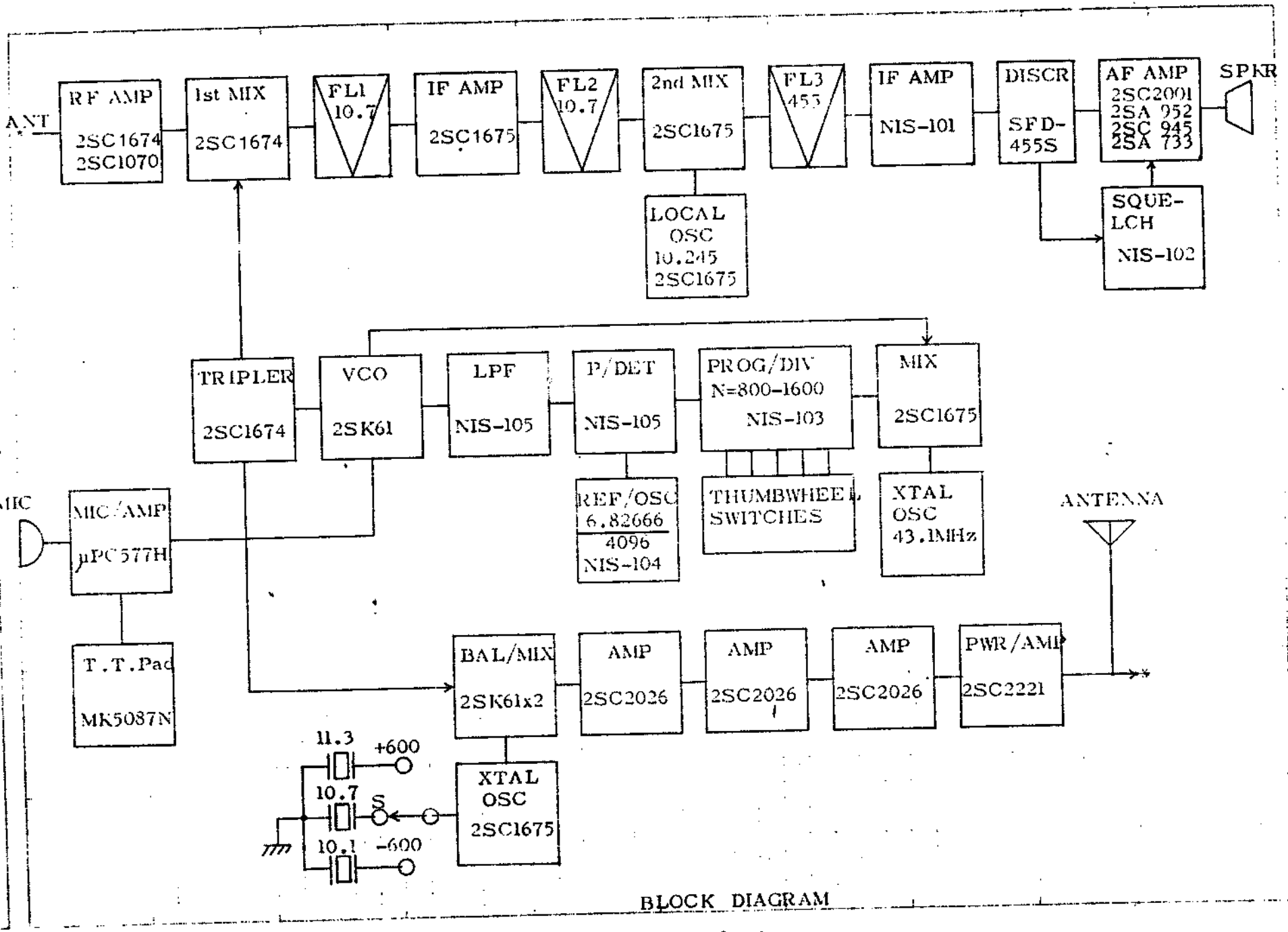


2SC1070

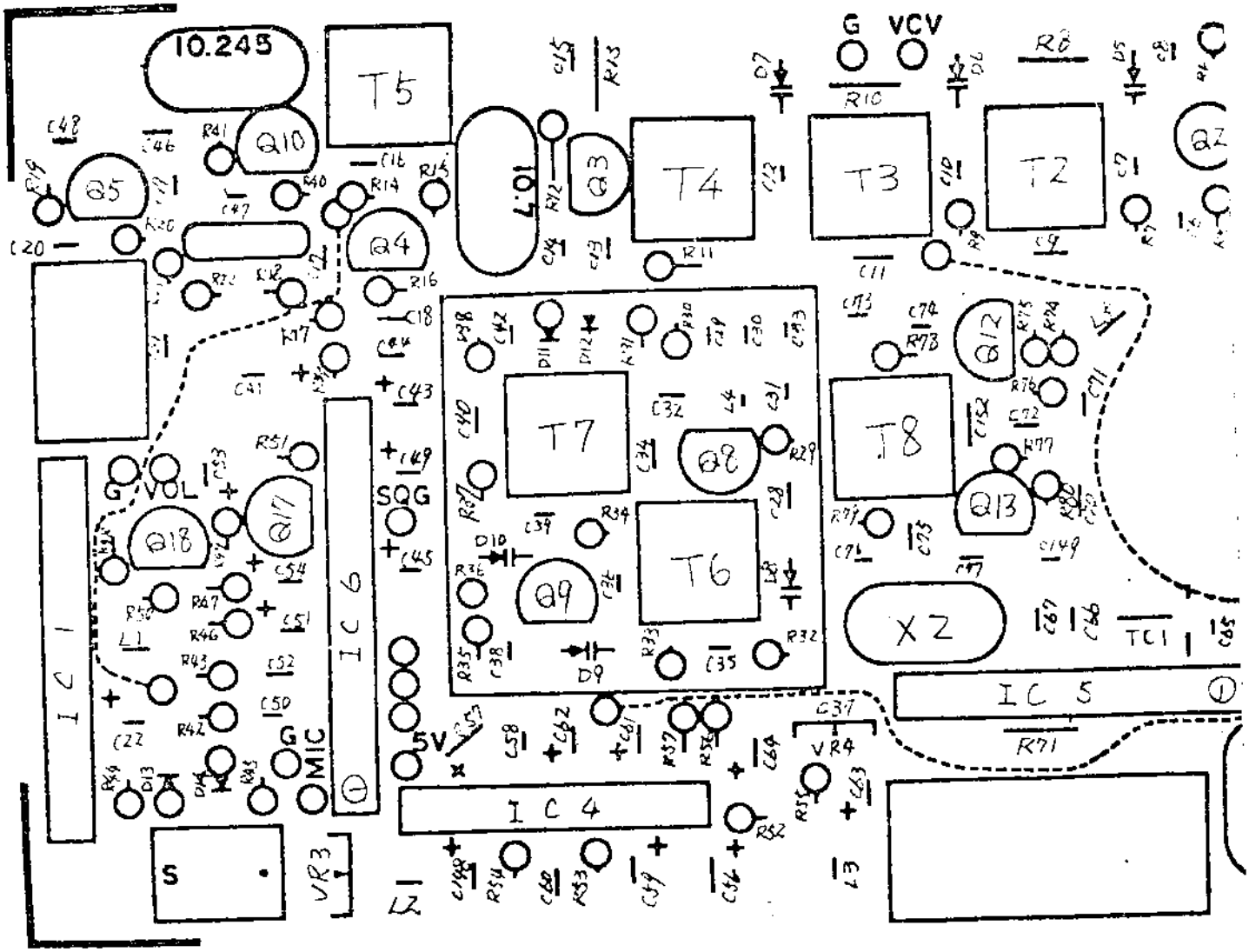
2SC202

2SC536

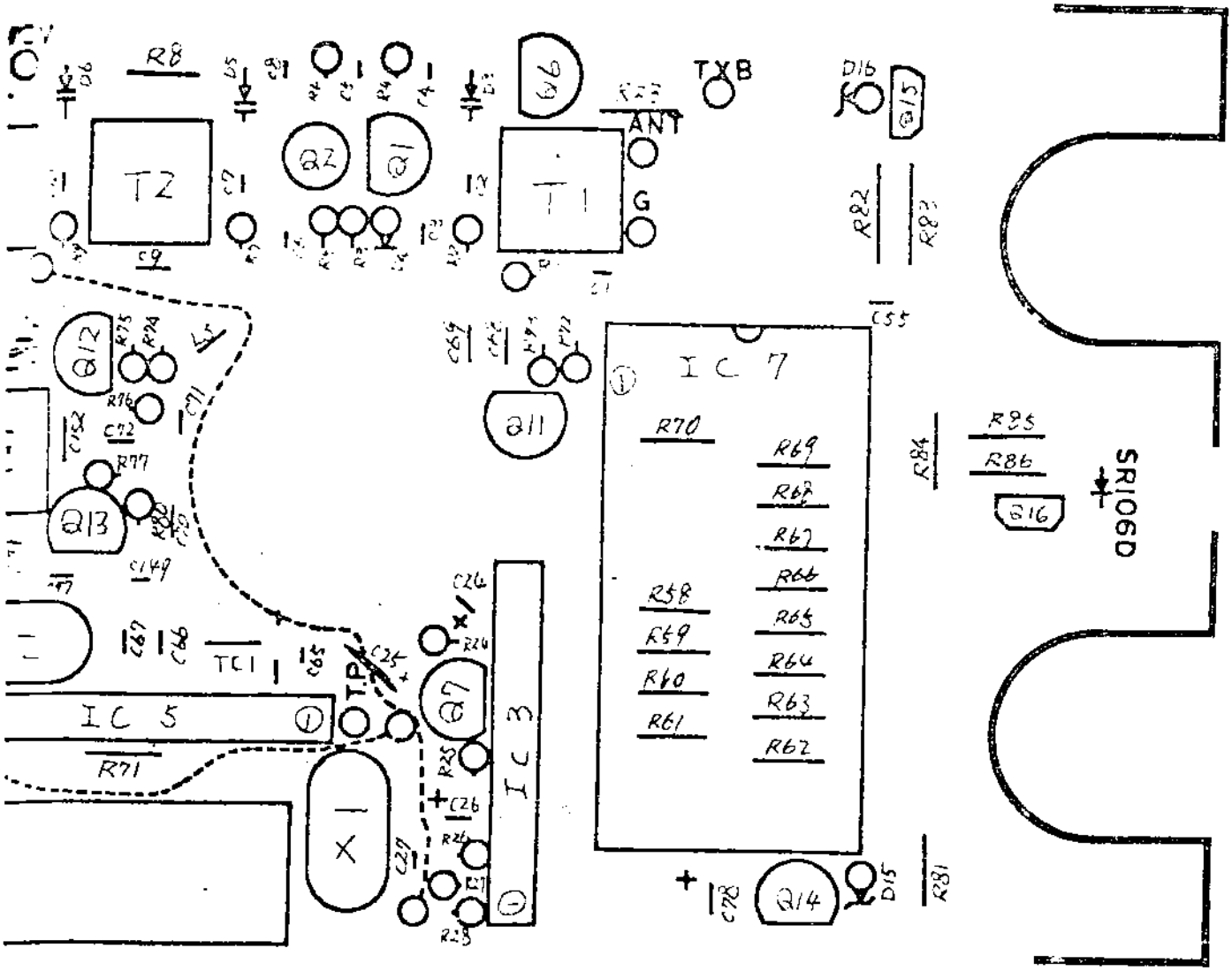
2SK61



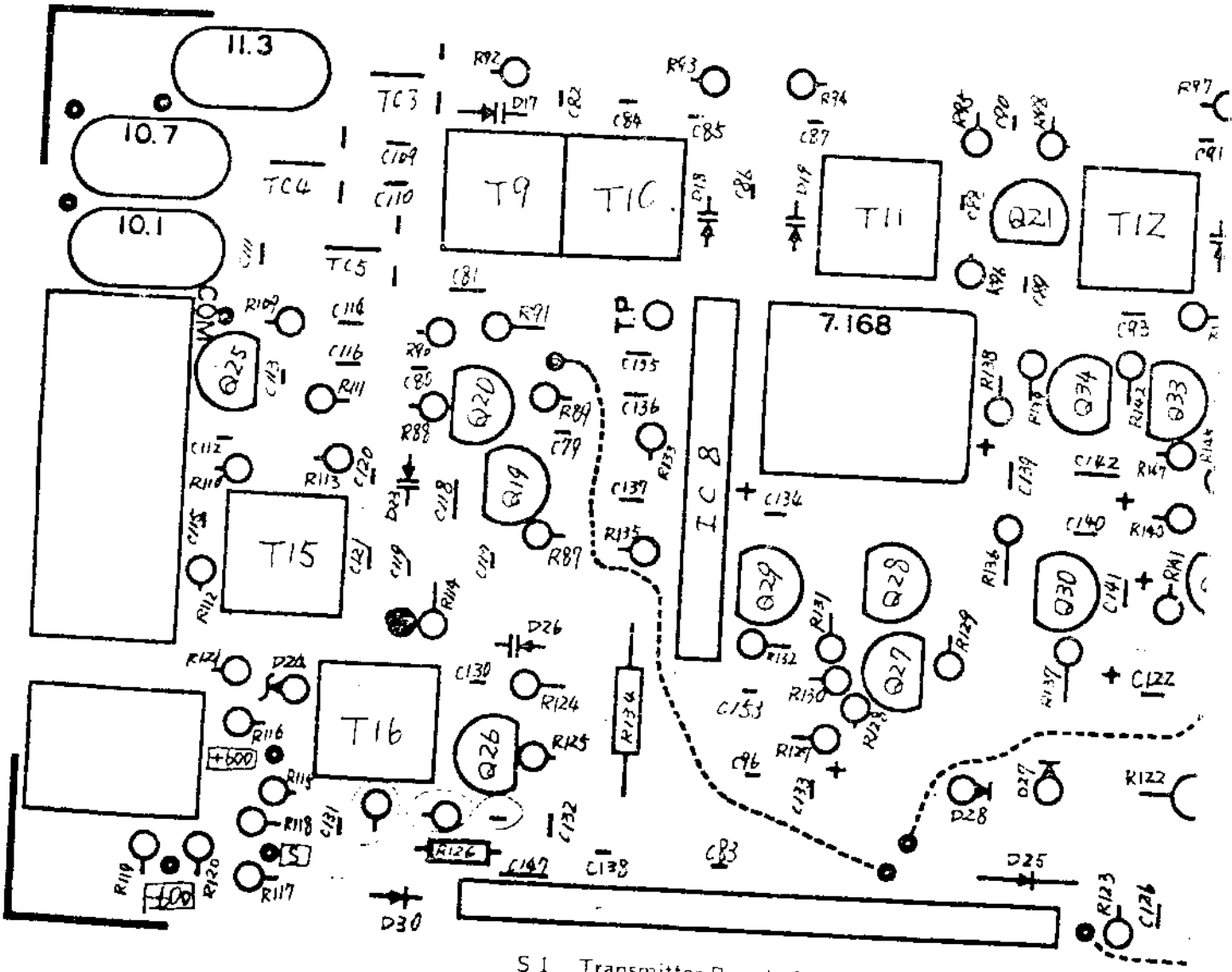
BLOCK DIAGRAM



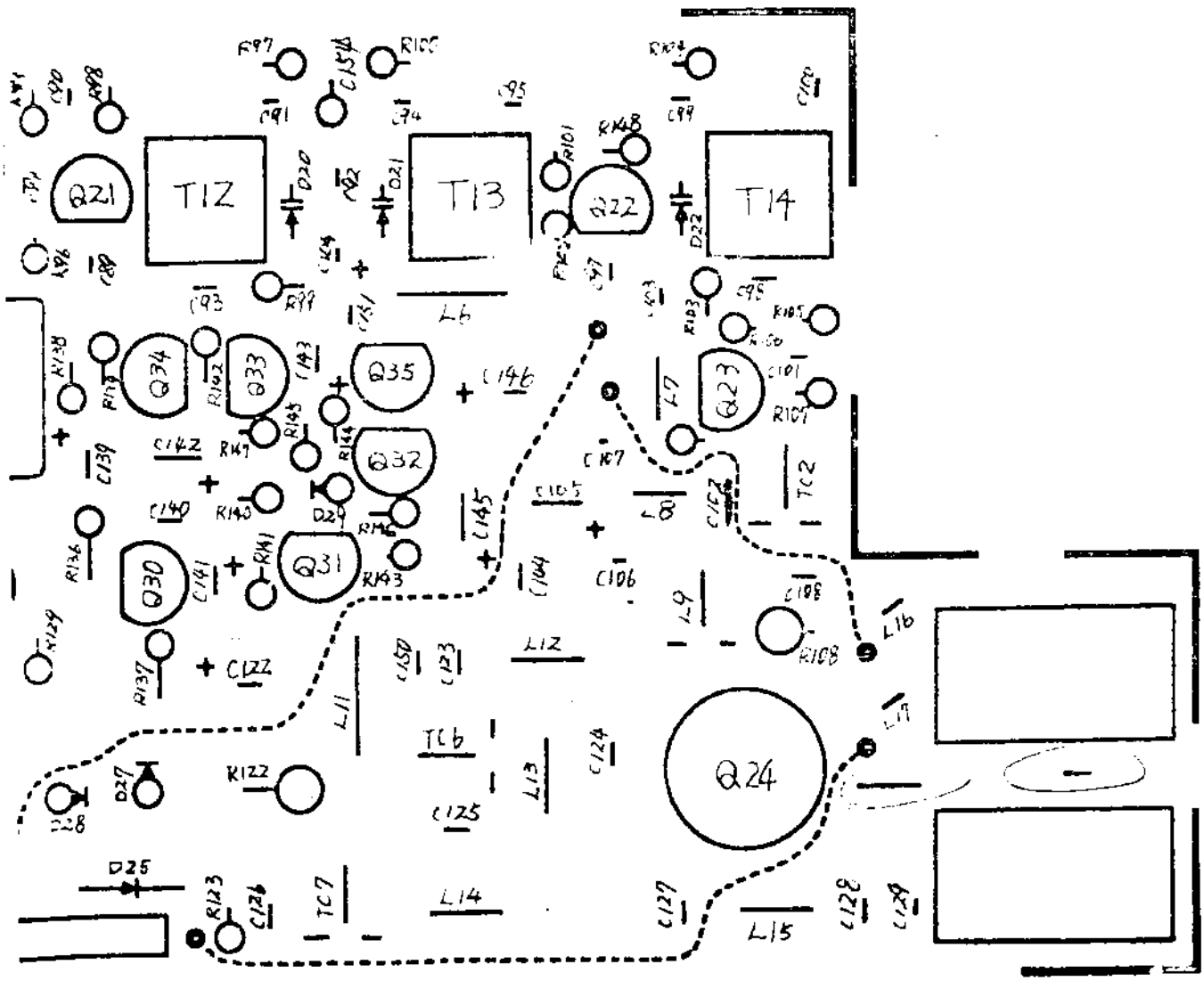
S 1 Synthesizer Board - Parts Layout


R8
TXB
ANT
G
T2
T1
Q2
Q1
Q6
Q5
Q15
Q16
Q12
Q13
Q11
Q7
Q14
IC 7
IC 5
IC 3
TP1
X1
R70
R69
R68
R67
R66
R65
R64
R63
R62
R58
R59
R60
R61
R71
R82
R83
R84
R85
R86
SR106D

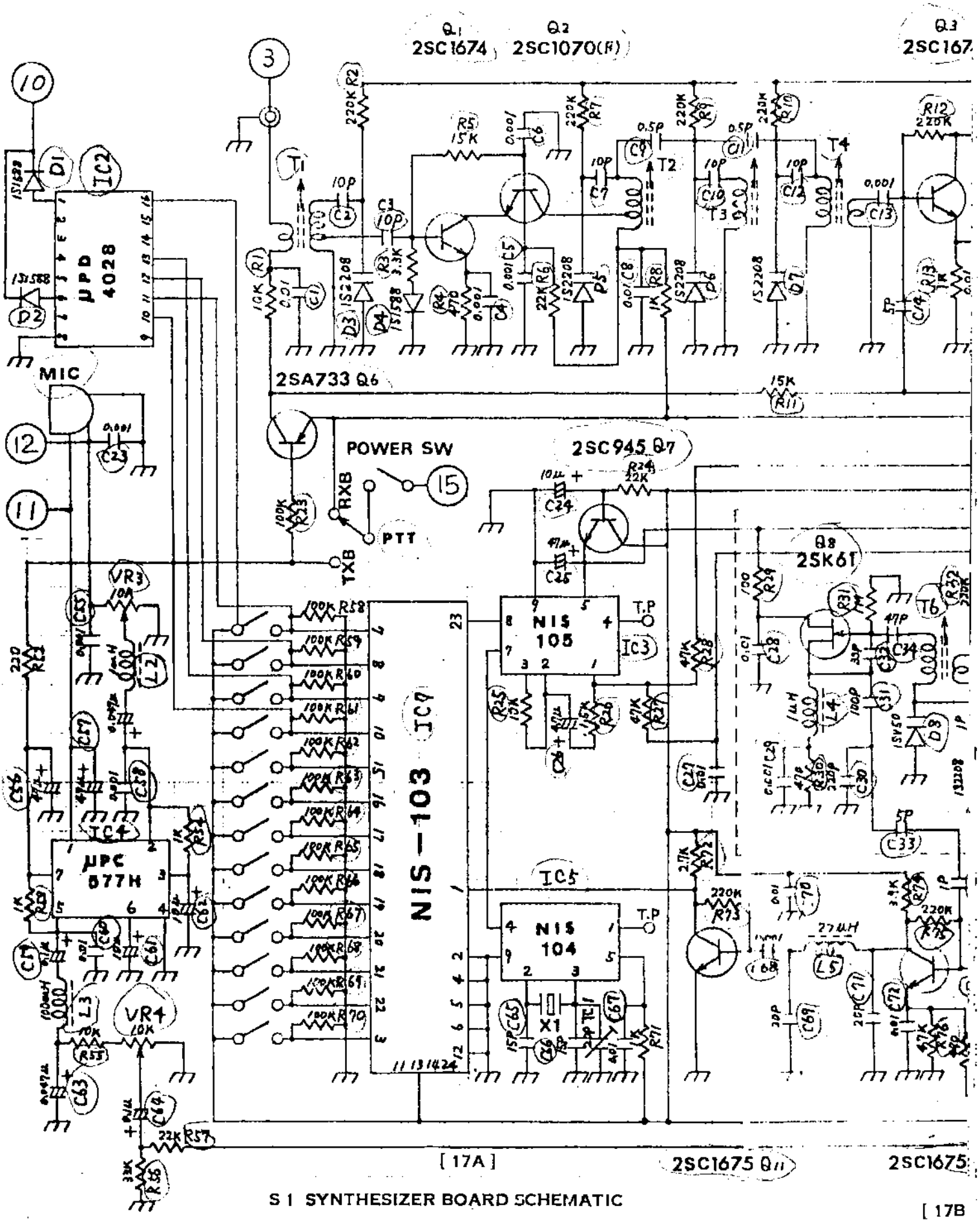
[15B]



S 1 Transmitter Board - Parts Layout


Q21
T12
T13
Q22
T14
Q34
Q33
Q35
Q32
Q23
Q30
Q31
Q24
L6
L7
L9
L11
L12
L13
L14
L15
L16
L17
TC2
TC6
TC7
D25
D27
D28

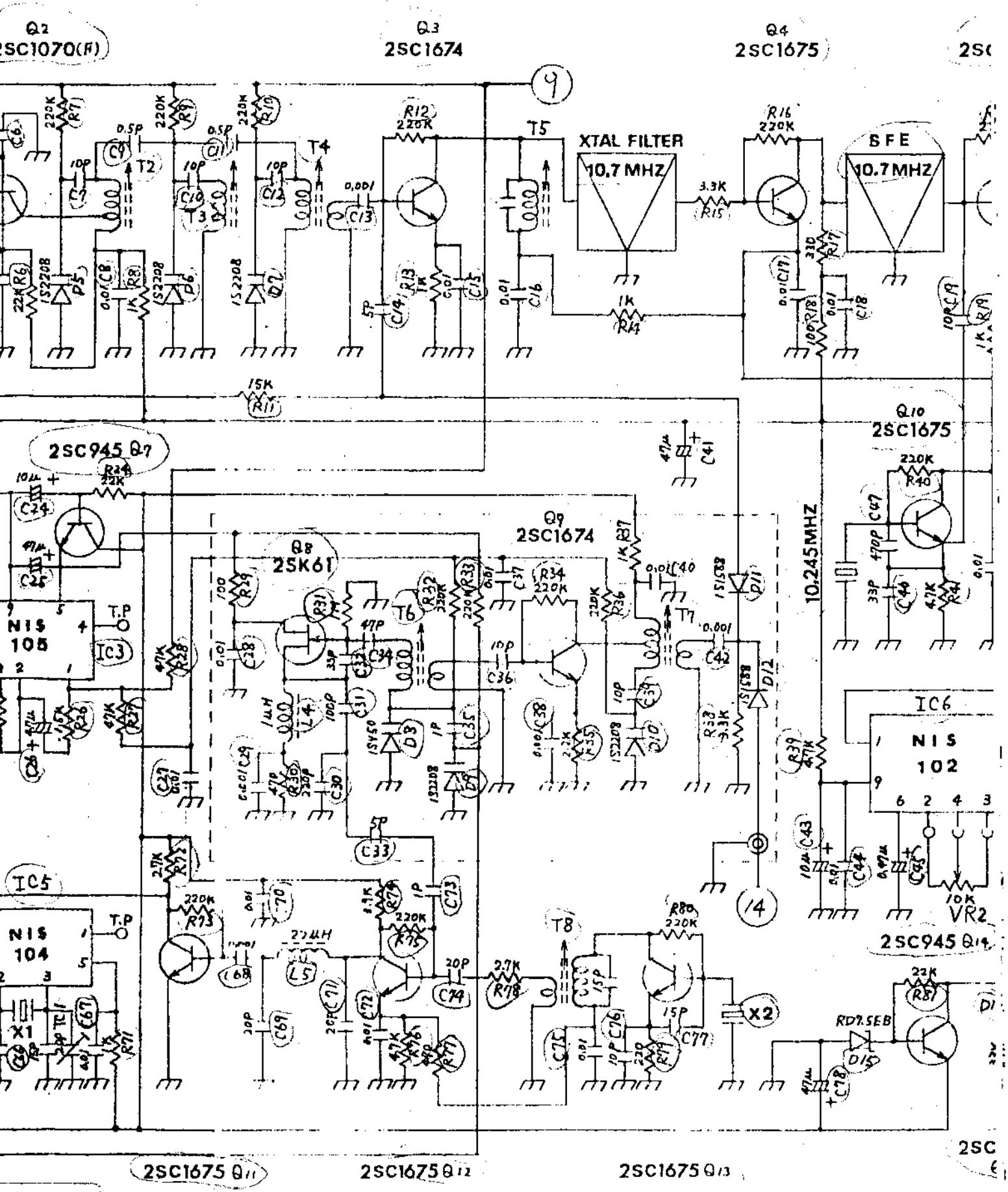
[16B]



[17A]

S 1 SYNTHESIZER BOARD SCHEMATIC

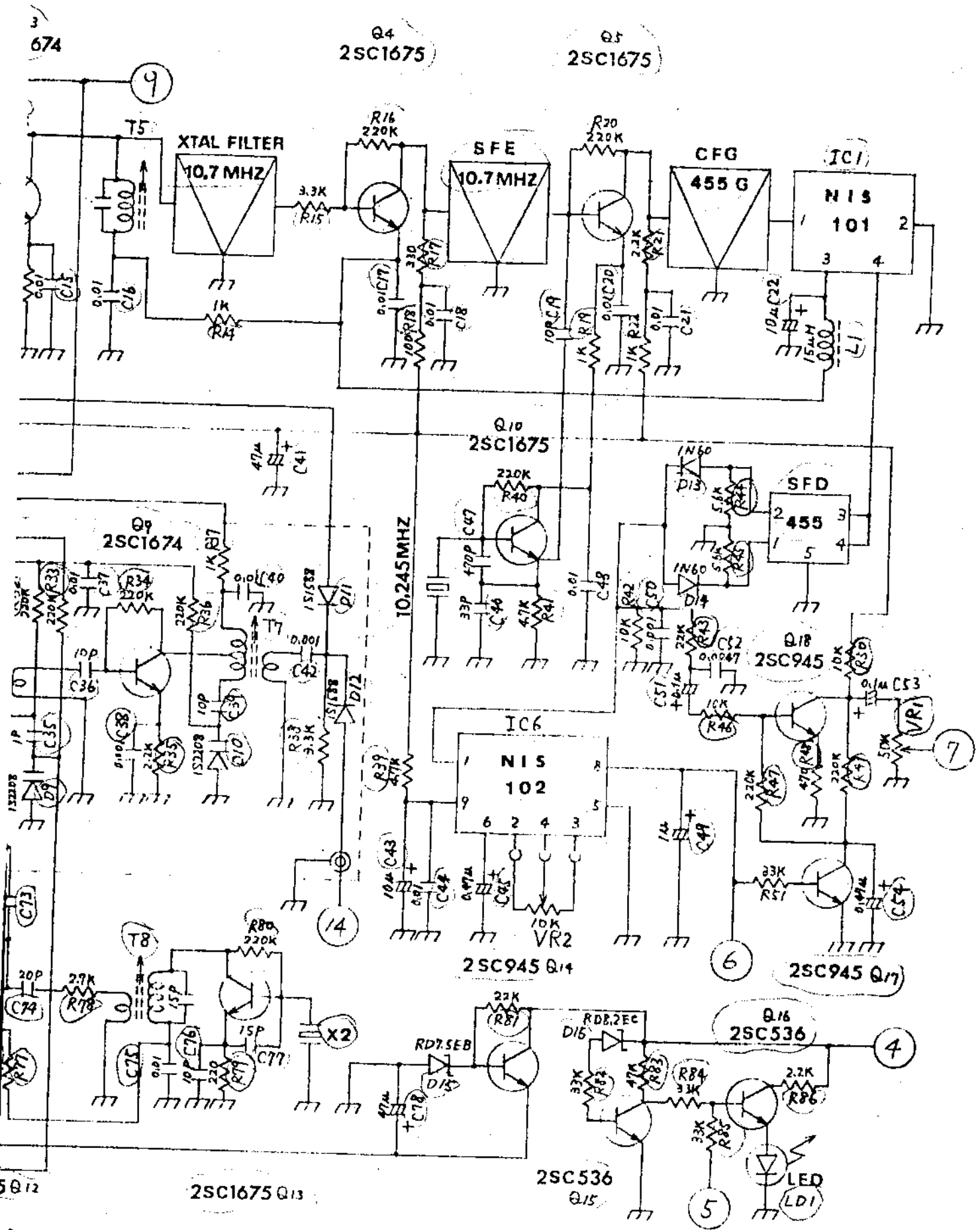
[17B

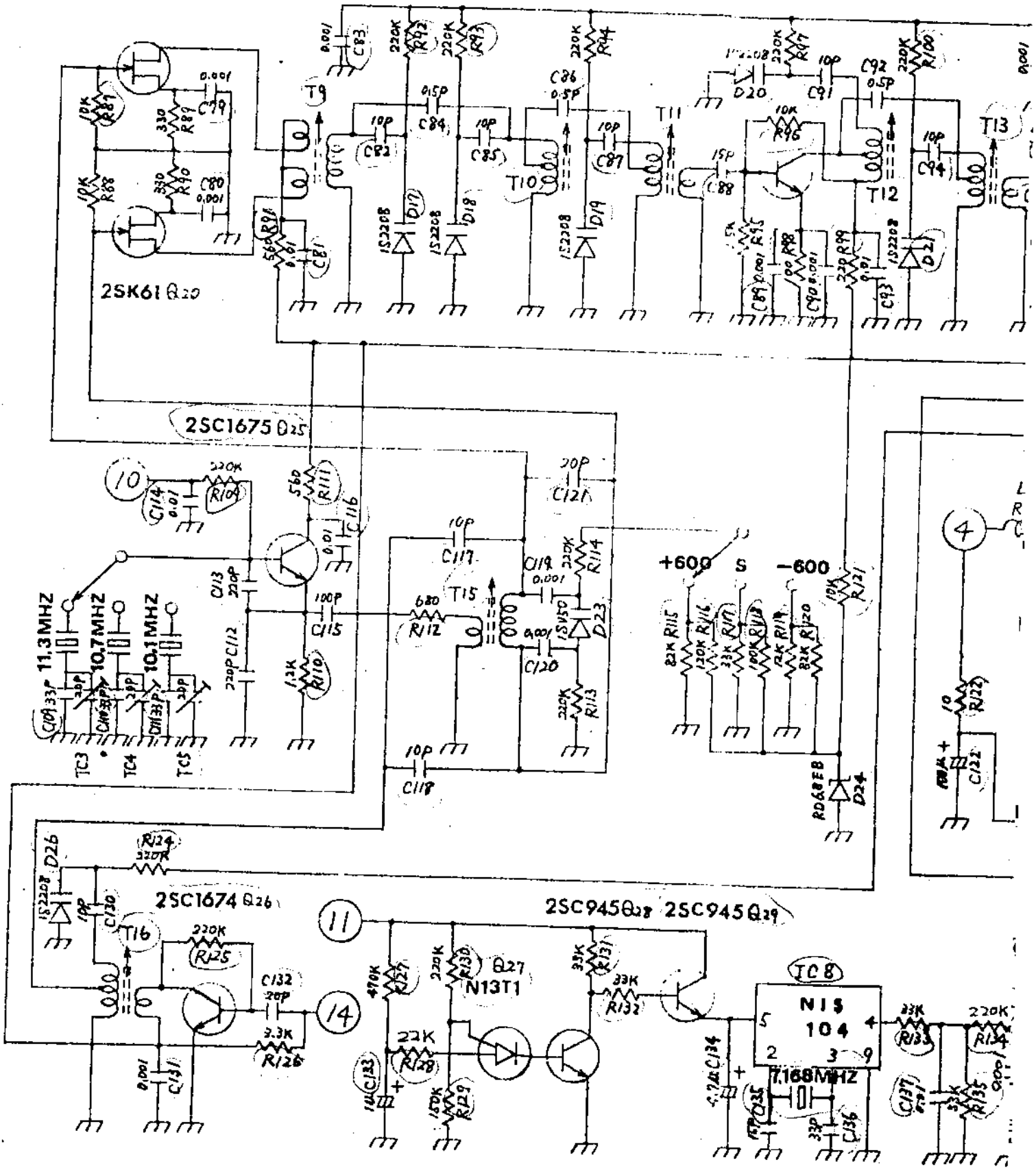


CHEMATIC

[17B]

[17C]

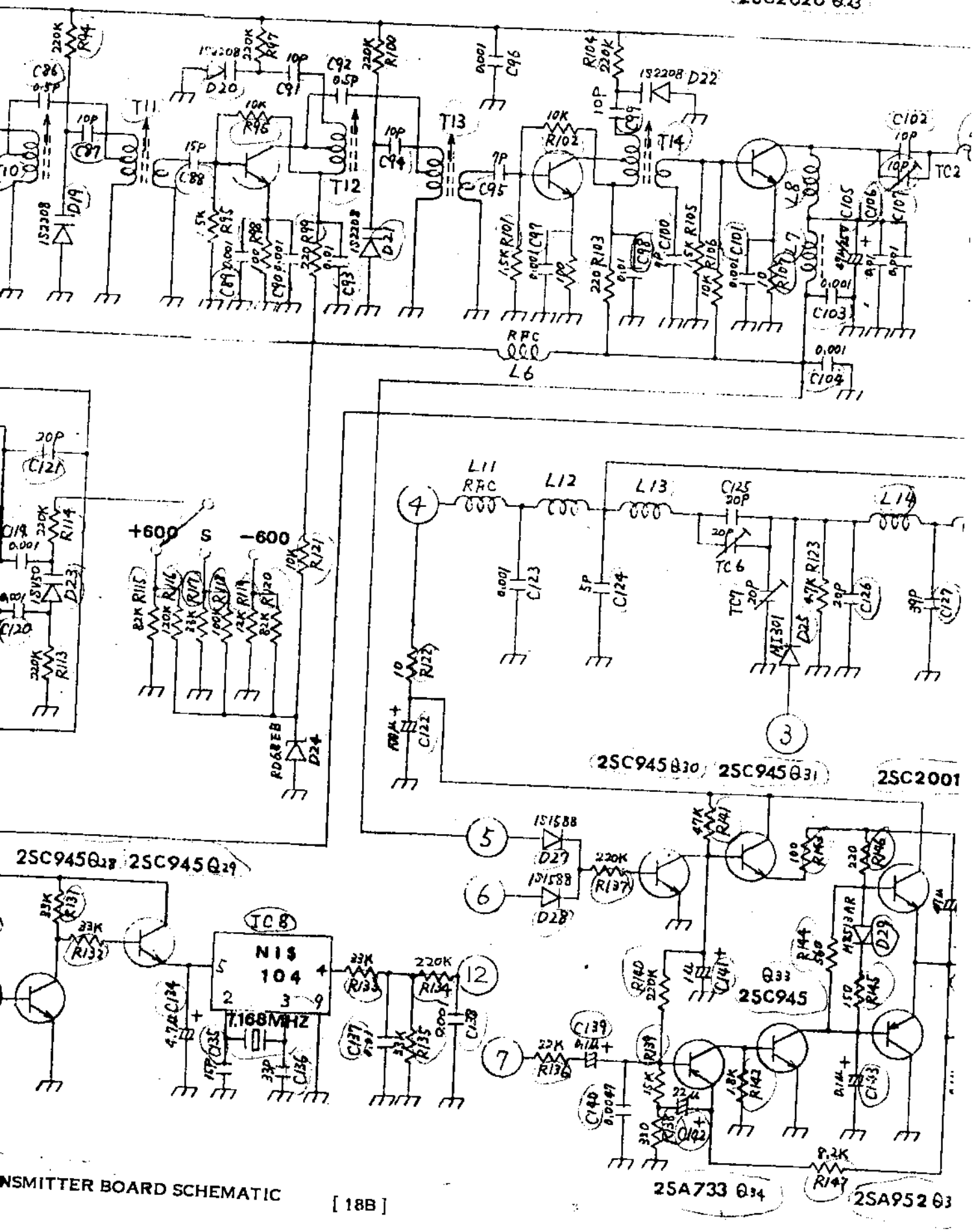

Q4
2SC1675
Q5
2SC1675
XTAL FILTER
10.7 MHZ
SFE
10.7MHZ
CFG
455 G
IC1
NIS
101
Q10
2SC1675
Q9
2SC1674
10.245MHZ
SFD
455
IC6
NIS
102
Q18
2SC945
2SC945 Q14
2SC945 Q17
Q16
2SC536
2SC536
Q15
2SC1675 Q13
LED
LD1
VR1
VR2



S 1 TRANSMITTER BOARD SCHEMATIC

[18A]

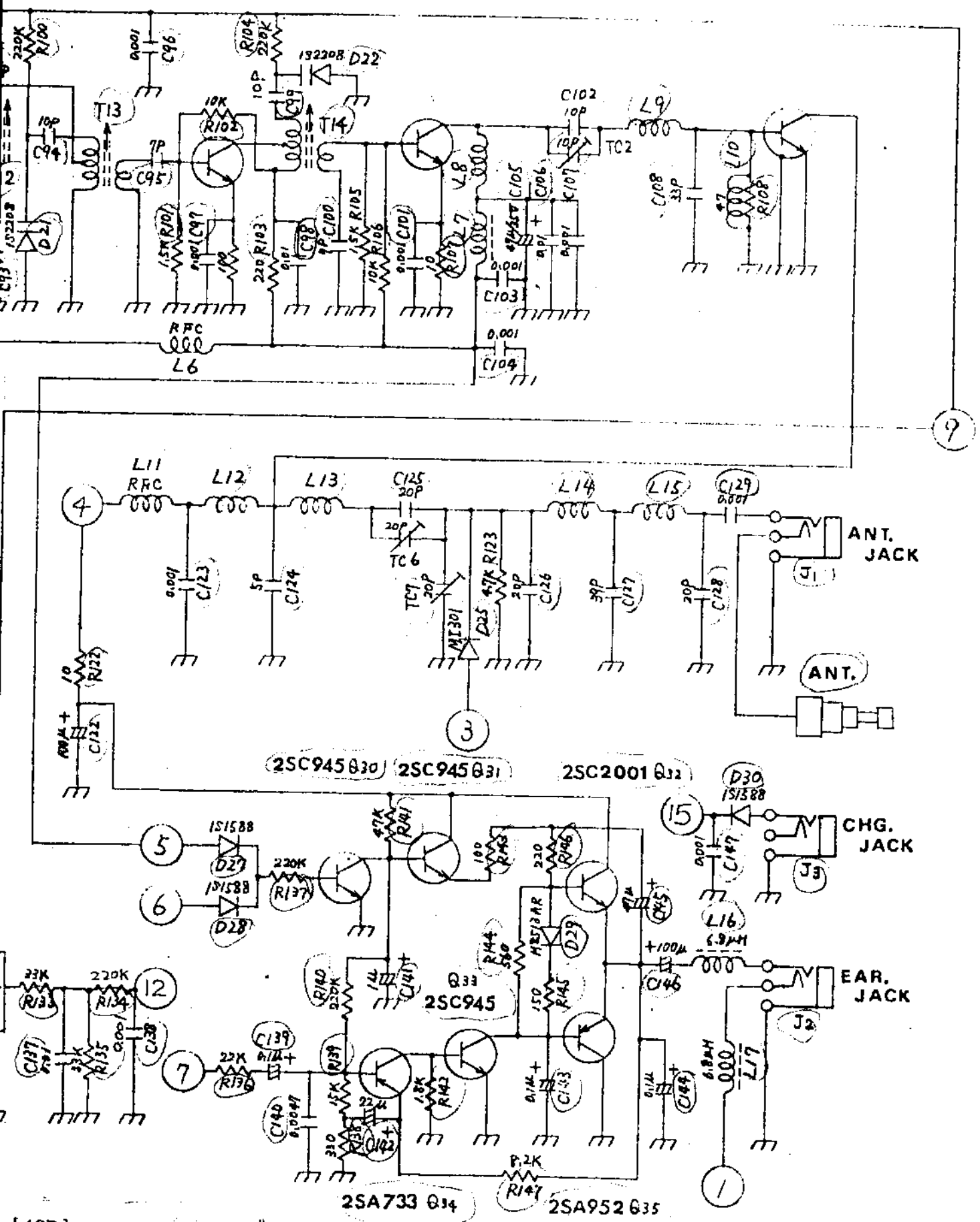
[18B]



NSMITTER BOARD SCHEMATIC

[18B]

[18C]


2SC2026 Q22
2SC2026 Q23
2SC2221 Q24
T13
T14
L6
L7
L8
L9
L10
TC2
TC6
TC7
L11
L12
L13
L14
L15
L16
ANT. JACK
ANT.
CHG. JACK
EAR. JACK
2SC945 Q30
2SC945 Q31
2SC2001 Q32
Q33 2SC945
2SA733 Q34
2SA952 Q35
D22
D23
D25
D27
D28
D29
D30
1S1588
MI301
MR1JAR

[18B]

[18C]