

-VCO-B-

Technical description

The VCO B consists of the following modules:

- a) Three VCOs with buffer stages (VCO B1)
- b) A mixer stage with low pass, amplifier stage, pulse shaper stage and divider:4
- c) A programmable divider
- d) A phase comparison stage

VCOs with buffer stages (VCO B1)

The VCO B1 is designed on its own PCB, which is encapsulated in a steel panel housing to protect it from magnetic interferences. It is linked with the PCB VCO B via an 11 pole connector.

Each of the three oscillators covers a frequency range of 10 MHz for the receive range 0 - 9.999 MHz (VCO - frequency 63 - 73 MHz) the oscillator T1 is switched on, for the range 10 - 19.999 MHz, the oscillator T4 is switched on and for the range 20 - 29.999 MHz, the oscillator T7 is switched on. Selection is made by the microprocessor via the two lines -10 MHz, -20 MHz and the decoding logic, comprising of IC A. The respective oscillator is switched on with transistors T3, T8, T5. Each oscillator has its own buffer stage (with T2, T6, T9) whose outputs are connected together with coupling capacitors. The signal is decoupled with buffers T10/T12, amplified with T11, low pass filtered and fed on to the 1st mixer.

Mixer stage

In mixer M1, the signal of the VCO A1 cassette is mixed with the output signal of the VCO A.

The differential frequency 4.4 ... 34.4 MHz at the output (pin 34) of the mixer is filtered out by a low pass filter and amplified with T15/T16. IC E is buffering the signal to TTL level.

Since the programmable frequency divider cannot safely process 34.4 MHz, the frequency 4.4 ... 34.4 MHz in IC F is divided by 4.

Since in VCO B 100 kHz is the smallest tuning step, the reference frequency would also have to be 100 kHz. The reference frequency is also reduced by the same division factor 4, (in other words $U_{ref} = 25 \text{ kHz}$).

-VCO-B-**Programmable divider**

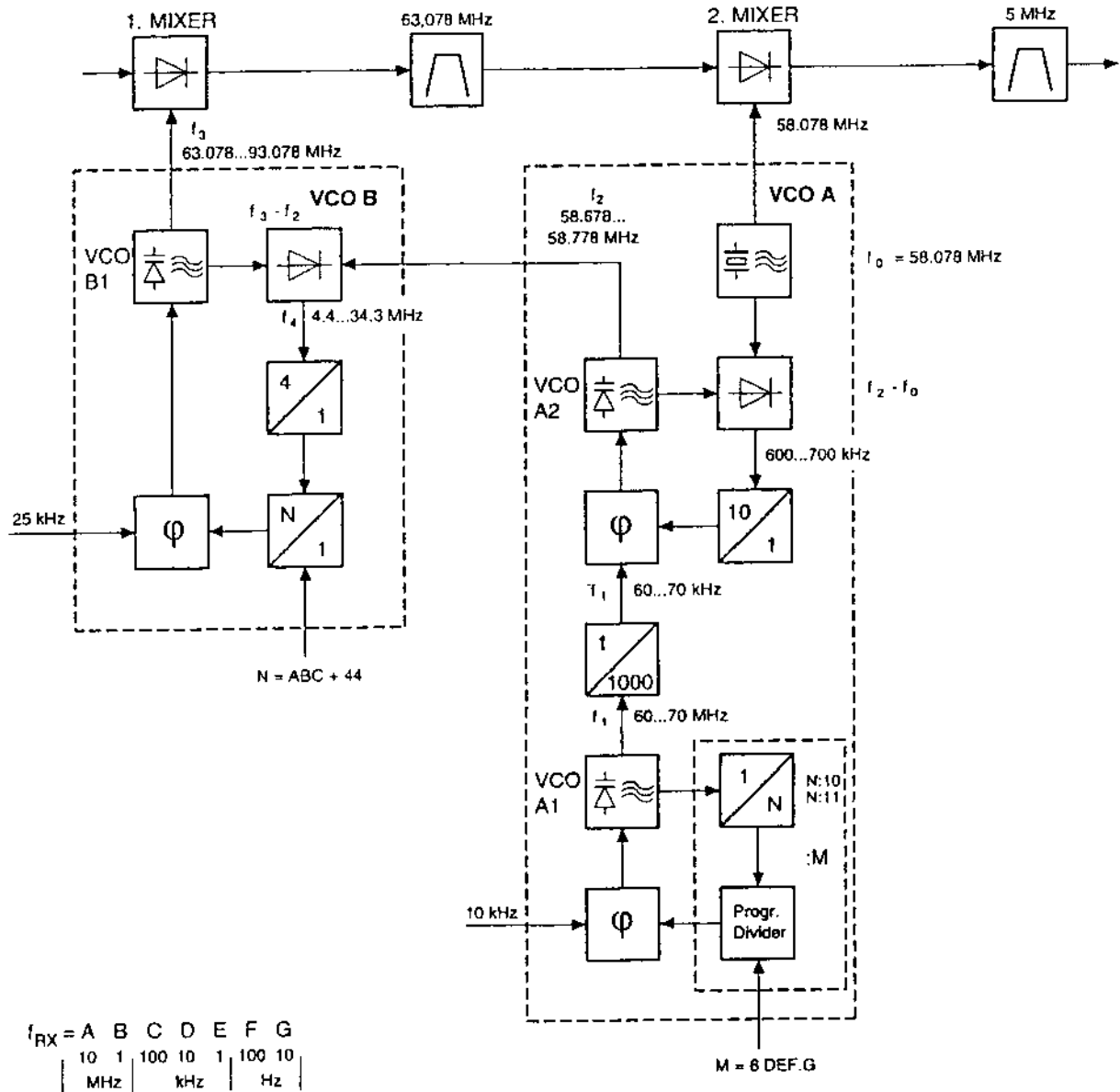
The data lines for the VCO A and B are designed as a common bus, they are therefore loaded digit-wise into the three registers IC G, I, J. The address counter IC O selects the respective register. The data are inverted with the gates of IC K, since the programmable divider consisting of IC P, Q, R, T and S in contrast to VCO A, must be loaded with non-inverted data. Inversion of the data for the VCO B would be possible from the microprocessor but for reasons of simplification, the hardware solution was selected.

Phase detector

The output signal of the programmable divider is fed via the transistor T14 (level conversion TTL - CMOS) to the phase comparator IC C, the 25 kHz reference frequency comes from the BFO cassette. The passive loop filter consists of R75/C79, R74/C 46/R 73. The lock detect signal of the phase comparator is evaluated with the components R52/R 55/C 58/D 7/T 17. When the PLL is locked, the LED D6 on the back of the cassette lights up. The microprocessor of the receiver is advised of the locked status of the VCO B via D13.

The voltage controller IC B supplies the VCO B1 module and phase detector with a well-filtered supply voltage.

-VCO-B-



Blockdiagram - VCO A and VCO B

VCO A/B Frequencysynthesis calculating schedule

	A	B	C	D	E	F	G
f _{RX}	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	10	1	100	10	1	100	10
	MHz		kHz		Hz		

M = 6000.0 + DEF.G

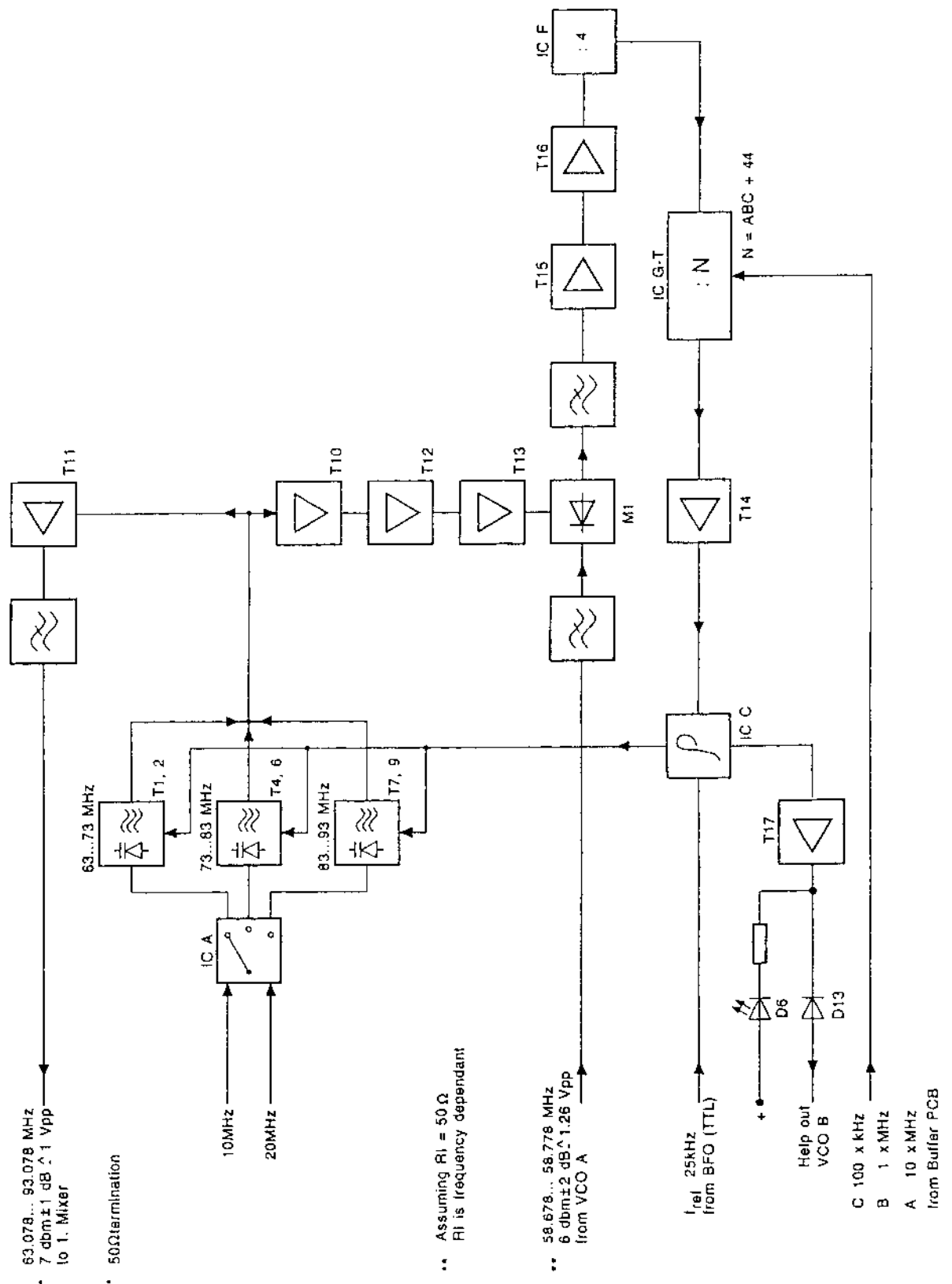
N = ABC + 44

	MHz		kHz		Hz		
	10	1	100	10	1	100	10

f ₁ (VCO A ₁) = 10 kHz x M	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
f ₁ = f ₁ : 1000	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
f ₂ (VCO A ₂) = f ₁ x 10 + 58.078 MHz	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
f ₄ = 25 kHz x N x 4	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
f ₃ (VCO B) = f ₂ + f ₄	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
1. IF = f ₃ - f _{RX}	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
2. IF = 1. IF - 58.078 MHz	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Above example only valid in USB mode (Filters 0.1 ... 2.4 kHz)
or DSB mode (Filter 6 kHz)

-VCO-B-



Blockdiagram VCO-B

-VCO-B-**Test and alignment instructions**

Required: Circuit diagram VCO-B - Hagenuk Drawing No.
97 Sa B2.155.63
digital multimeter, frequency counter, spectrum analyser

Measurement procedure: The VCO-B is removed and the cassette is opened.
The module is reconnected to the receiver.

Switch on the receiver, any setting is OK.

Checking the voltage controller

Measure the voltage on MP 1 IC - B with the digital multimeter.

Test values:

Voltage should be: $15\text{ V} \pm 0.75\text{ V}$.

Measure the voltage at MP 6 IC - H with the multimeter.

Test values:

Voltage should be: $10\text{ V} \pm 0.5\text{ V}$.

NOTE

A special test device is used for testing the PLL of the oscillators VCO B 1.
The tuning voltage is around 12.5 V with oscillator frequency f_{\max} and around
3.5 V with oscillator frequency f_{\min} . (applies for all three ranges).

Checking the 100 kHz Steps

Connect frequency counter to Bu 3 VCO OUT.

Modify the frequency in 100 kHz steps at the receiver.

Functional test:

The frequency should change from 63.078 to 63.178 to 63.278 (MHz) .. etc.

Checking the 1 MHz Steps

Alter the frequency at the receiver in 1 MHz steps.

Functional test:

The frequency should change from 63.078 to 64.078 to 65.078 (MHz) ... etc.

-VCO-B-

Test and alignment instructions (VCO B 1)

Required: Circuit diagram - VCO-B - Hagenuk drawing No.
97 Sa B 2.155.63
frequency counter, spectrum analyser, termination
resistor, power supply

Measurement procedure: The VCO B module is withdrawn the cassette is
opened, so that the VCO B 1 can be removed from the
VCOB base board.

Power supply +15 V \pm 750 mV at Bu 1 pin 7
ground/0 V at Bu 1 pin 2,8,10

NOTE

The voltage at Bu 1 pin 7 must be free of spurious signals.

Testing the oscillators

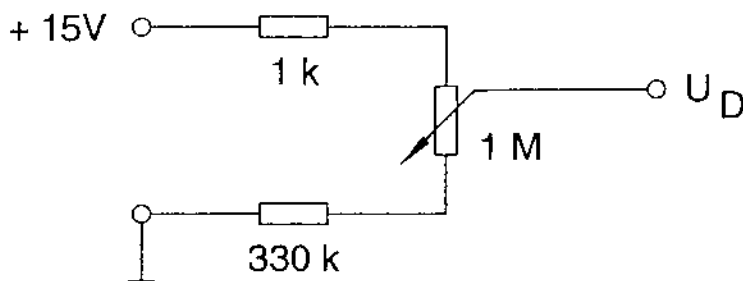
Connect frequency counter to Bu 1 pin 1 and terminate Bu 1 pin 11 with
50 Ohm.

Test values:

Measure the power consumption;
should be: 10 mA \pm 5 mA.

Setting the oscillator tuning range

Switch on the VCO with the 63/73 MHz tuning range by connecting Bu 1 pin
5 to 0 V. Set tuning voltage U_D at Bu 1 pin 9 to +12.5 V \pm 0.1 V



Test values:

The oscillator frequency should be 73 MHz \pm 100 kHz; tuning is possible
with the core in the coil L 1.

Set tuning voltage U_D at Bu 1 pin 9 to 3.5 V \pm 0.1 V.

Test values:

The oscillator frequency should be < 63 MHz.

Switch on the VCO with the tuning range 83/93 MHz by leaving Bu 1 pins 4
and 5 open.

Set tuning voltage U_D at Bu 1 pin 9 to 12.5 V \pm 0.1 V.

-VCO-B-

Test values:

The oscillator frequency should be $93 \text{ MHz} \pm 100 \text{ kHz}$, adjustment is possible with the core in coil L 5.

Set tuning voltage UD at Bu 1 pin 9 to $3.5 \text{ V} \pm 0.1 \text{ V}$.

Test values:

The oscillator frequency should be 83 MHz .

Switch on the VCO with tuning range 73/83 MHz by connecting Bu 1 pin 4 to 0 V. Set tuning voltage UD at Bu 1 pin 9 to $12.5 \text{ V} \pm 0.1 \text{ V}$.

Test values:

The oscillator frequency should be $83 \text{ MHz} \pm 100 \text{ kHz}$, adjustment is possible with the core in coil L 3.

Set tuning voltage UD at Bu 1 pin 9 to $3.5 \text{ V} \pm 0.1 \text{ V}$.

Test values:

The oscillator frequency should be 73 MHz .

Check output level of the oscillators

Connect the spectrum analyser to Bu 1 pin 1 and terminate Bu 1 pin 11 with 50 Ohm.

Switch on the VCO for 63/73 MHz.

Test values:

The output level should be $> 4.5 \text{ dBm}$ (full tuning range).

Set the VCO 73/83.

Test values:

The output level should be $> 4.5 \text{ dBm}$ (full tuning range).

Set the VCO 83/93 MHz.

Test values:

The output level should be $> 4.5 \text{ dBm}$ (full tuning range).

Connect the spectrum analyser to Bu 1 pin 11 and terminate Bu 1 pin 1 with 50 ohm. Repeat test.

Test values:

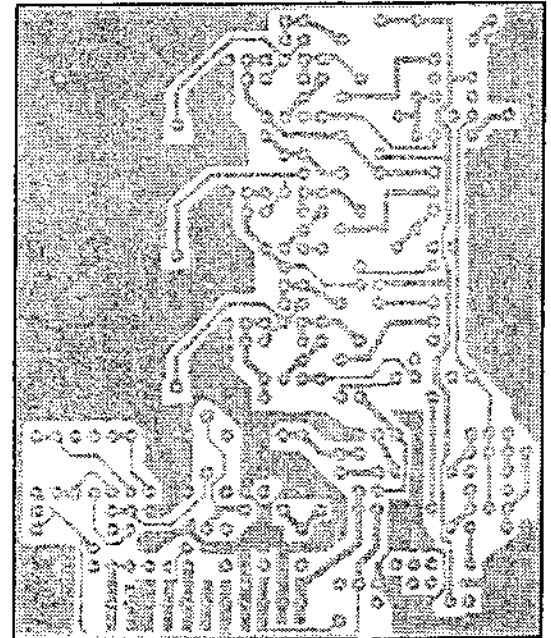
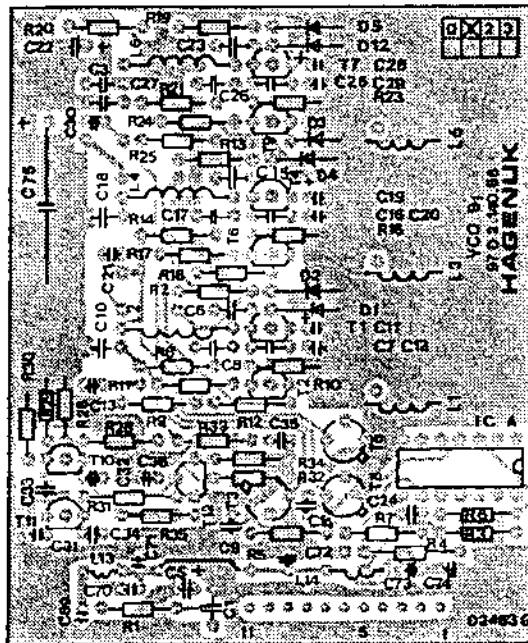
Output level in all ranges $> 4 \text{ dBm}$.

NOTE

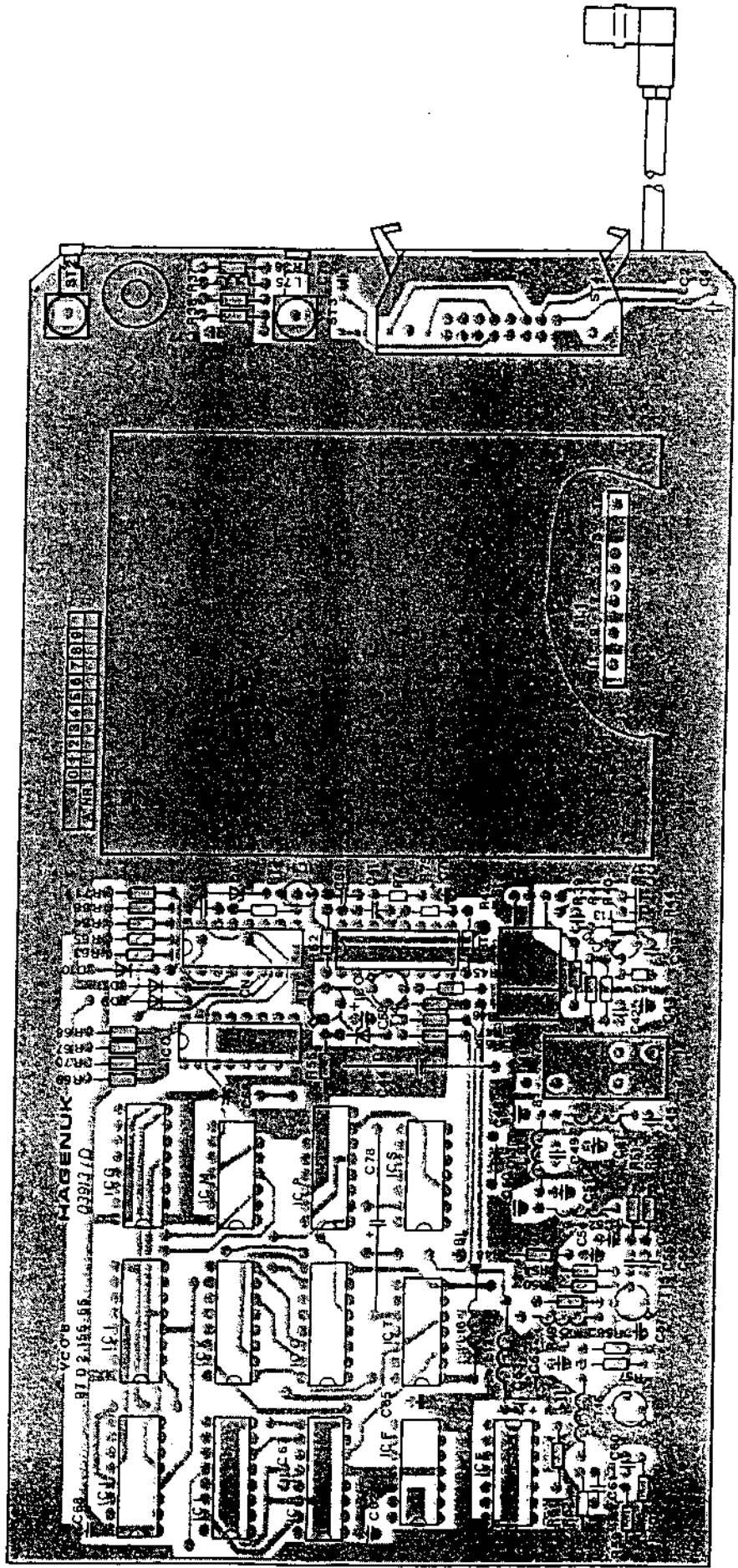
All the test values can differ from the one measured in the receiver. For flawless functioning with VCO B 1 installed, the output level on at Bu 1 pin 1 must be $7 \text{ dBm} \pm 1 \text{ dB}$. (Termination in receiver is not 50 Ohm)

-VCO-B-

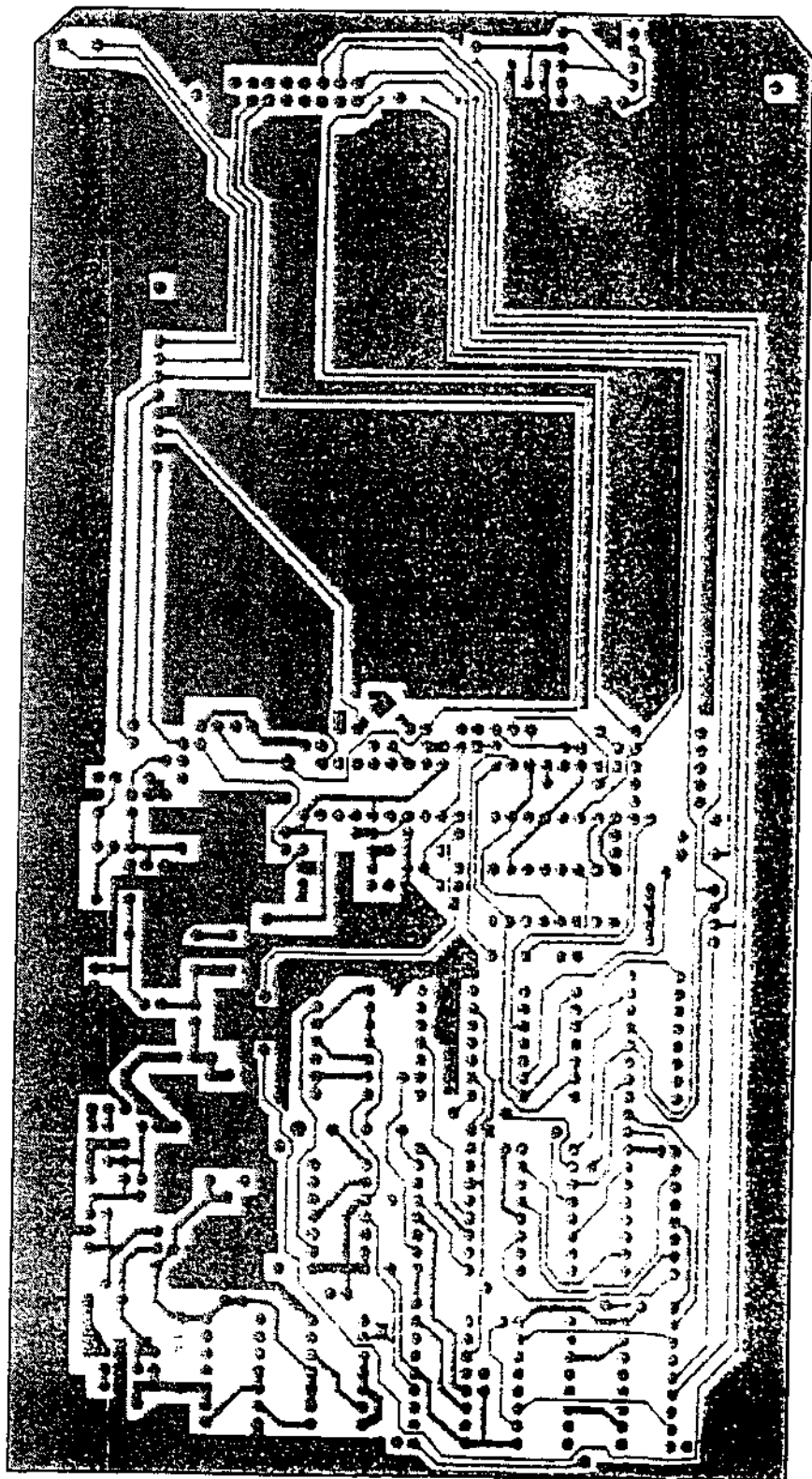
see circuit diagram - VCO-B 97 Sa B 2.155.63



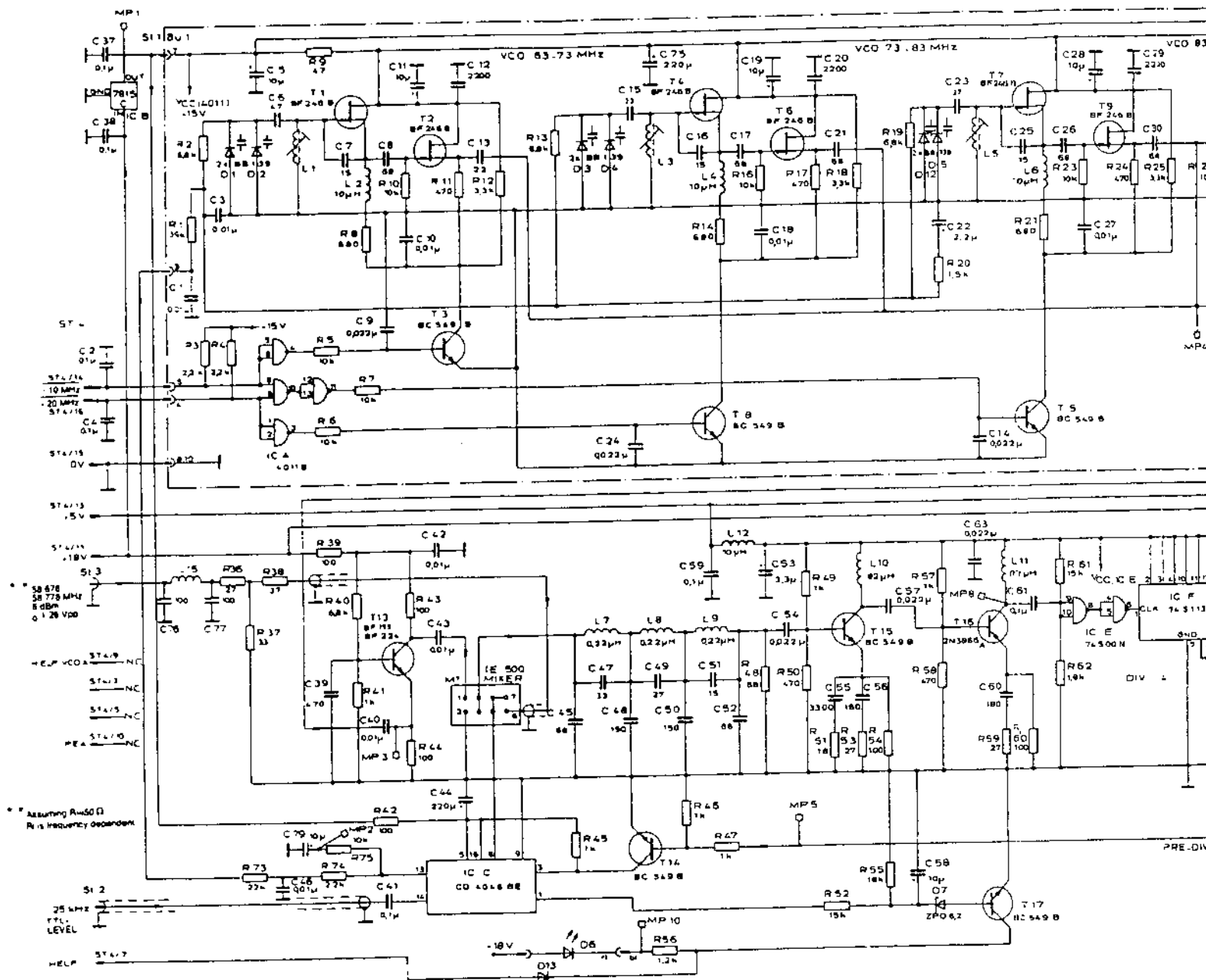
VCO-B1 - 97 D 2.140.66



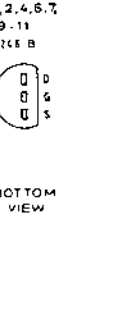
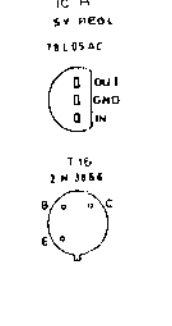
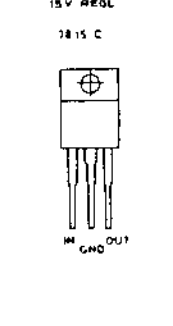
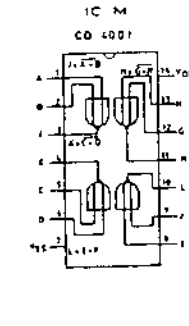
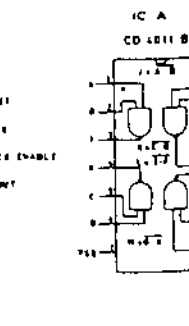
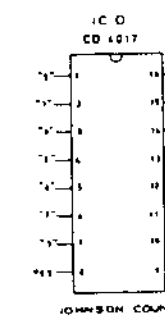
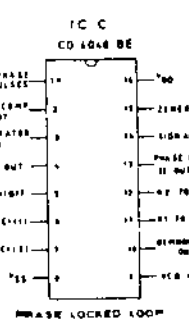
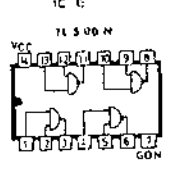
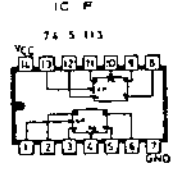
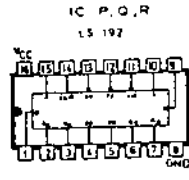
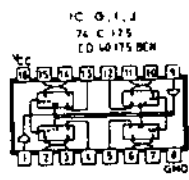
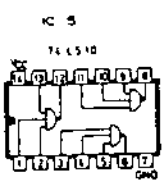
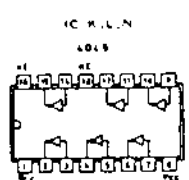
see circuit diagram - VCO B 97 Sa B 2.155.63

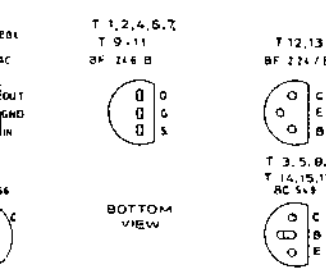
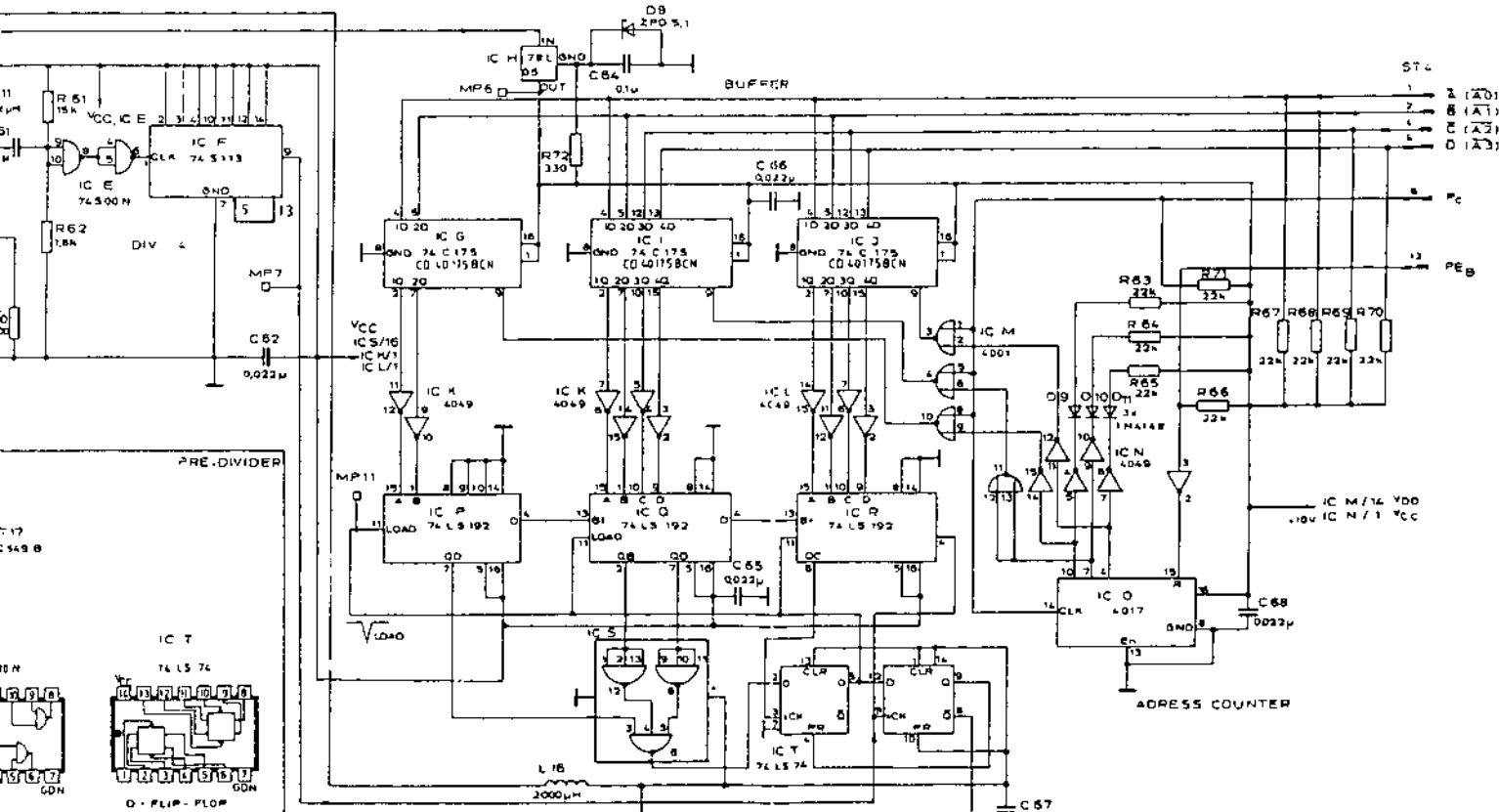
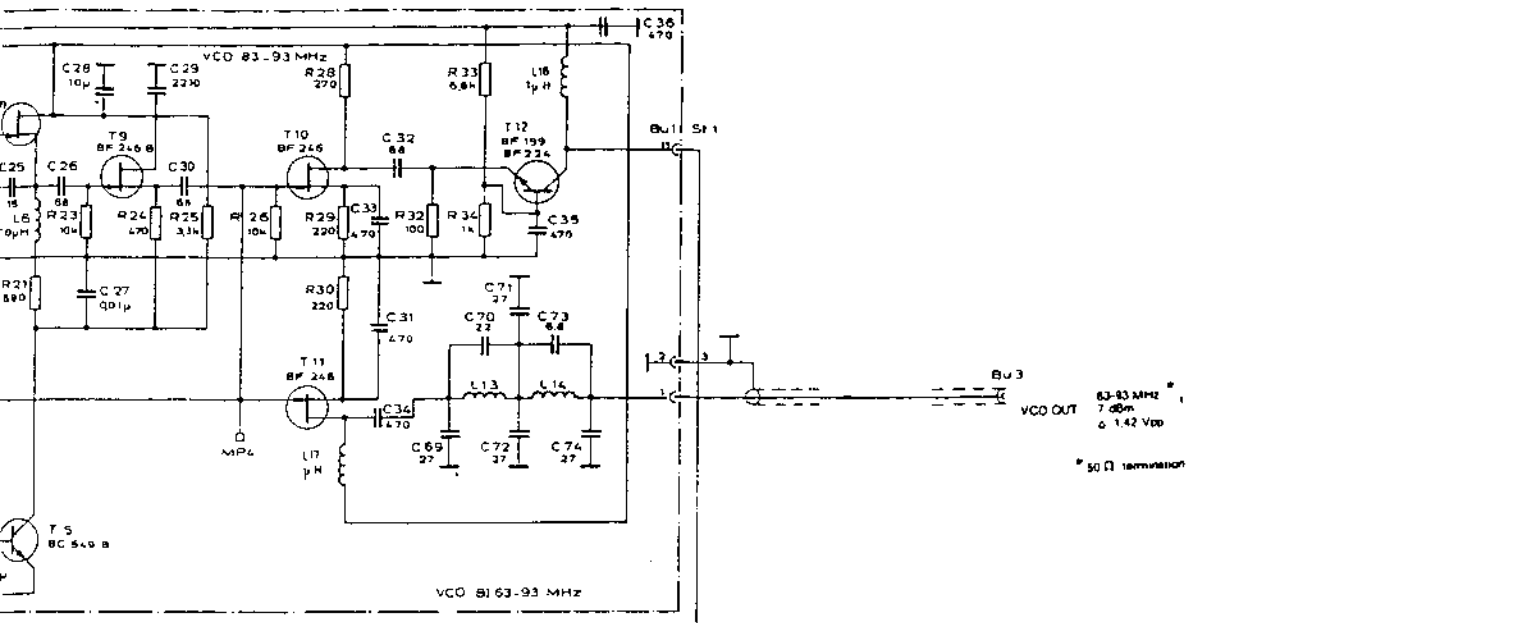


Printed Circuit Board
VCO-B
97 C 2.155.65



* Assuming $R_{in} = 50 \Omega$
 R's frequency dependent





-VCO-B-

Parts lists No.
97 Sa 2.155.63

Ident-No.	Mark	Electr. value	Identity	Manufacturer
Capacitors:				
1078.607	C1	0,01 μ F/100 V	CK 05 BX 103 K	SEC
1307.053	C2	0,1 μ F/50 V	CK 05 BX 104 K	SEC
1078.607	C3	0,01 μ F/100 V	CK 05 BX 103 K	SEC
1307.053	C4	0,1 μ F/50 V	CK 05 BX 104 K	SEC
1204.521	C5	10 μ F/35 V	ETQ 4	ROE
1430.920	C6	47 pF/200 V	CK 05 BX 470 K	SEC
1430.890	C7	15 pF/200 V	CK 05 BX 150 K	SEC
1430.939	C8	68 pF/200 V	CK 05 BX 680 K	SEC
1116.207	C9	0,022 μ F/40 V	EDPU/0,6 K10000	VALVO
1078.607	C10	0,01 μ F/100 V	CK 05 BX 103 K	SEC
1204.521	C11	10 μ F/35 V	ETQ 4	ROE
0945.064	C12	2200 pF/63 V	EDPU/0,6 K2000	VALVO
0945.161	C13	22 pF/63 V	EDPU NPO	VALVO
1116.207	C14	0,022 μ F/40 V	EDPU K10000	
1430.912	C15	33 pF/200 V	CK 05 BX 330 K	SEC
1430.890	C16	15 pF/200 V	CK 05 BX 150 K	SEC
1430.939	C17	68 pF/200 V	CK 05 BX 680 K	SEC
1078.607	C18	0,01 μ F/100 V	CK 05 BX 103 K	SEC
1204.521	C19	10 μ F/35 V	ETQ 4	ROE
0945.064	C20	2200 pF/63 V	EDPU K2000	VALVO
0944.998	C21	68 pF/63 V	EDPU NPO	VALVO
1199.528	C22	2,2 μ F/35 V	ETP 1 A	ROE
1430.904	C23	27 pF/200 V	CK 05 BX 270 K	SEC
1116.207	C24	0,022 μ F/40 V	EDPU K 10000	VALVO
1430.890	C25	15 pF/200 V	CK 05 BX 150 K	SEC
1430.939	C26	68 pF/200 V	CK 05 BX 680 K	SEC
1078.607	C27	0,01 μ F/50 V	CK 05 BX 103 K	SEC
1204.521	C28	10 μ F/35 V	ETQ 4	ROE
0945.064	C29	2200 pF/63 V	EDPU K 2000	VALVO
0944.998	C30	68 pF/63 V	EDPU NPO	VALVO
1067.877	C31	470 pF/63 V	EDPU N 1500	VALVO
0944.998	C32	68 pF/63 V	EDPU NPO	VALVO
1067.877	C33	470 pF/63 V	EDPU N 1500	VALVO
1067.877	C34	470 pF/63 V	EDPU N 1500	VALVO
1067.877	C35	470 pF/63 V	EDPU N 1500	VALVO
1067.877	C36	470 pF/63 V	EDPU N ISOO	VALVO
1307.053	C37	0,1 μ F/50 V	CK 05 BX 104 K	SEC
1307.053	C38	0,1 μ F/50 V	CK 05 BX 104 K	SEC
0945.757	C39	470 pF/63 V	N 1500-1B EDPU	
0904.988	C40	0,01 μ F/40 V	EDPU NPO	VALVO
1307.053	C41	0,1 μ F/50 V	CK 05 BX 104 K	SEC
0904.988	C42	0,01 μ F/40 V	EDPU K 10000	VALVO

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Ident-No.	Mark	Electr. value	Identity	Manufacturer
0904.988	C43	0,01 μ F/40 V	EDPU NPO	VALVO
1067.923	C44	220 μ F/25 V	B41283-B5227T	SIEMENS
0944.998	C45	68 pF/63 V	EDPU NPO	VALVO
1556.029	C46	0,01 μ F/10 %/63 V	X7R 1206	
0945.021	C47	33 pF/63 V	EDPU NPO	VALVO
1083.147	C48	150 pF/63 V	EDPU N 750	VALVO
1186.078	C49	27 pF/63 V	EDPU NPO	VALVO
1083.147	C50	150 pF/63 V	EDPU N 750	VALVO
0945.188	C51	15pF/63 V	EDPU NPO	VALVO
0944.998	C52	68 pF/63 V	EDPU NPO	VALVO
0973.602	C53	3,3 μ F/35 V	TAP-F	ITT
1116.207	C54	0,022 μ F/40 V	EDPU K 10000	VALVO
0945.765	C55	3300 pF/63 V	EDPU K 2000	VALVO
1116.193	C56	180 pF/63 V	EDPU N 750	VALVO
1116.207	C57	0,022 μ F/40 V	EDPU K 10000	VALVO
1204.521	C58	10 μ F/35 V	ETQ 4	ROE
1307.053	C59	0,1 μ F/50 V	CK 05 BX 104 K	SEC
1116.193	C60	180 pF/63 V	EDPU N 750	VALVO
1307.053	C61	0,1 μ F/50 V	CK 05 BX 104 K	SEC
1116.207	C62	0,022 μ F/40 V	EDPU K 10000	VALVO
1116.207	C63	0,022 μ F/40 V	EDPU K 10000	VALVO
1307.053	C64	0,1 μ F/50 V	CK 05 BX 104 K	SEC
1116.207	C65	0,022 μ F/40 V	EDPU K 10000	VALVO
	C66	0,022 μ F/40 V	EDPU K 10000	VALVO
	C67	0,022 μ F/40 V	EDPU K 10000	VALVO
	C68	0,022 μ F/40 V	EDPU K 10000	VALVO
1186.078	C69	27 pF/63 V	EDPU NPO	VALVO
0945.161	C70	22 pF/63 V	EDPU NPO	VALVO
1186.078	C71	27 pF/63 V	EDPU NPO	VALVO
1186.078	C72	27 pF/63 V	EDPU NPO	VALVO
0945.137	C73	6,8 pF/63 V	EDPU NPO	VALVO
1186.078	C74	27 pF/63 V	EDPU NPO	VALVO
1067.923	C75	220 μ F/25 V	B41283-B5227 T	SIEMENS
0945.048	C76	100 μ F/2 %/63 V	NPO/1 B EDPU 06	VALVO
0945.048	C77	100 μ F/2 %/63 V	NPO/1 B EDPU 06	VALVO
1457.594	C78	1000 μ F/6,3 V		
1204.521	C79	10 μ F/35 V	ETQ 4	ROE

Diodes:

1062.131	D1		BB 139	ITT
1062.131	D2		BB 139	ITT
1062.131	D3		BB 139	ITT

Part 4

Parts lists No.
97 Sa 2.155.63

-VCO-B-

Ident-No.	Mark	Electr. value	Identity	Manufacturer
1062.131	D4		BB 139	ITT
1062.131	D5		BB 139	ITT
0943.940	D7		ZPD 6,2	
0758.353	D8		ZPD 5,1	
0745.677	D9		1 N 4148	
0745.677	D10		1 N 4148	
0745.677	D11		1 N 4148	
1062.131	D12		BB 139	ITT
1465.740	D13		SD 1001 C	ITT

Resistors:

0799.300	R1	39 K 5 % 1/8 W	DIN 44052
0767.220	R2	6,8 K 5 % 1/8 W	DIN 44052
0744.808	R3	2,2 K 5 % 1/8 W	DIN 44052
0744.808	R4	2,2 K 5 % 1/8 W	DIN 44052
0179.701	R5	10 K 5 % 1/8 W	DIN 44052
0179.701	R6	10 K 5 % 1/8 W	DIN 44052
0179.701	R7	10 K 5 % 1/8 W	DIN 44052
0698.172	R8	630 5 % 1/8 W	DIN 44052
0626.694	R9	47 5 % 1/8 W	DIN 44052
0179.701	R10	10 K 5 % 1/8 W	DIN 44052
0554.898	R11	470 5 % 1/8 W	DIN 44052
0530.352	R12	3,3 K 5 % 1/8 W	DIN 44052
0767.220	R13	6,8 K 5 % 1/8 W	DIN 44052
0698.172	R14	680 5 % 1/8 W	DIN 44052
0179.701	R16	10 K 5 % 1/8 W	DIN 44052
0554.898	R17	479 5 % 1/8 W	DIN 44052
0530.352	R18	3,3 K 5 % 1/8 W	DIN 44052
0767.220	R19	6,8 K 5 % 1/8 W	DIN 44052
0480.444	R20	1,5 K 5 % 1/8 W	DIN 44052
0689.172	R21	680 5 % 1/8 W	DIN 44052
0179.701	R23	10 K 5 % 1/8 W	DIN 44052
0554.898	R24	470 5 % 1/8 W	DIN 44052
0530.352	R25	3,3 K 5 % 1/8 W	DIN 44052
0179.701	R26	10 K 5 % 1/8 W	DIN 44052
0179.663	R28	270 5 % 1/8 W	DIN 44052
0542.938	R29	220 5 % 1/8 W	DIN 44052
0542.938	R30	220 5 % 1/8 W	DIN 44052
0179.639	R32	100 5 % 1/8 W	DIN 44052
0767.220	R33	6,8 K 5 % 1/8 W	DIN 44052
0179.698	R34	1 K 5 % 1/8 W	DIN 44052
0830.119	R36	27 5 % 1/8 W	DIN 44052

-VCO-B-

Parts lists No.
97 Sa 2.155.63

Ident-No.	Mark	Electr. value	Identity	Manufacturer
0542.822	R37	33 5 % 1/8 W	DIN 44052	
0830.119	R38	27 5 % 1/8 W	DIN 44052	
0179.639	R39	100 5 % 1/8 W	DIN 44052	
0767.220	R40	6,8 K 5 % 1/8 W	DIN 44052	
0179.698	R41	1 K 5 % 1/8 W	DIN 44052	
0179.639	R42	100 5 % 1/8 W	DIN 44052	
0179.639	R43	100 5 % 1/8 W	DIN 44052	
0179.639	R44	100 5% 1/8 W	DIN 44052	
0179.698	R45	1 K 5 % 1/8 W	DIN 44052	
0179.698	R46	1 K 5 % 1/8 W	DIN 44052	
0179.698	R47	1 K 5 % 1/8 W	DIN 44052	
0653.853	R48	68 5 % 1/8 W	DIN 44052	
0179.698	R49	1 K 5 % 1/8 W	DIN 44052	
0554.898	R50	470 5 % 1/8 W	DIN 44052	
0779.778	R51	18 5 % 1/8 W	DIN 44052	
0791.733	R52	15 K 5% 1/8 W	DIN44052	
0830.119	R53	27 5 % 1/8 W	DIN 44052	
0179.639	R54	100 5 % 1/8 W	DIN 44052	
0744.786	R55	18 K 5 % 1/8 W	DIN 44052	
0744.794	R56	1,2 K 5 % 1/8 W	DIN 44052	
0179.698	R57	1 K 5 % 1/8 W	DIN44052	
0554.898	R58	470 5 % 1/8 W	DIN 44052	
0830.119	R59	27 5 % 1/8 W	DIN 44052	
0179.639	R60	100 5 % 1/8 W	DIN 44052	
0791.733	R61	15 K 5 % 1/8 W	DIN 44052	
0745.782	R62	1,8 K 5 % 1/8 W	DIN 44052	
0767.204	R63	22 K 5 % 1/8 W	DIN 44052	
0767.204	R64	22 K 5 % 1/8 W	DIN 44052	
0767.204	R65	22 K 5 % 1/8 W	DIN 44052	
0767.204	R66	22 K 5 % 1/8 W	DIN 44052	
0767.204	R67	22 K 5 % 1/8 W	DIN 44052	
0767.204	R68	22 K 5 % 1/8 W	DIN 44052	
0767.204	R69	22 K 5 % 1/8 W	DIN 44052	
0767.204	R70	22 K 5 % 1/8 W	DIN 44052	
0767.204	R71	22 K 5 % 1/8 W	DIN 44052	
0744.859	R72	330 5 % 1/8 W	DIN 44052	
1650.130	R73	22 K 5 % 0,125	RC 01	VALVO
1650.130	R74	22 K 5 % 0,125	RC 01	VALVO
0179.701	R75	10 K 5 % 1/8 W	DIN 44052	

-VCO-B-

Parts lists No.
97 Sa 2.155.63

Ident-No.	Mark	Electr. value	Identity	Manufacturer
Coils:				
	L1	7 Wdg.	97 Bv 2.140.122	HAGENUK
1076.140	L2	10 μ H	10 μ H 72.00	JAHRE
	L3	7 Wdg.	97 Bv 2.140.122	HAGENUK
1076.140	L4	10 μ H	10 μ H 72.00	JAHRE
	L5	6 Wdg.	97 Bv 2.140.123	HAGENUK
1076.140	L6	10 μ H	10 μ H 72.00	JAHRE
0955.779	L7	0,22 μ H	0,22 μ H 72.00	JAHRE
0955.779	L8	0.22 μ H	0,22 μ H 72.00	JAHRE
0955.779	L9	0,22 μ H	0,22 μ H 72.00	JAHRE
1427.105	L10	82 μ H	82 μ H 72.00	JAHRE
1427.105	L11	82 μ H	82 μ H 72.00	JAHRE
1076.140	L12	10 μ H 10 %	10 μ H 72.00	JAHRE
1468.995	L13	5 Wdg.	97 E 2.140.66-3	HAGENUK
1469.002	L14	8 Wdg.	97 E 2.140.66-4	HAGENUK
1545.337	L15	9Wdg.	97 E 2.140.65-5	HAGENUK
0745.650	L16	2000 μ H	2500-42	AMPHENOL
1078.569	L17	1 μ H 10 %	1 μ H MICC - 1 ROK	FASTRON
1078.569	L18	1 μ H 10 %	1 μ H MICC - 1 ROK	FASTRON

Integrated circuits:

1303.422	IC A	4011 B	
1427.091	IC B	7815 C ro/220	
1417.622	IC C	4046 B	RCA
1427.075	IC E	SN 74 S 00	
or		SN 74 S 00 N	
1381.342	IC F	SN 74 S 113 N	
1427.067	IC G	74 C 175	
or			
1464.515		CD 40175 BCN	
1427.083	IC H	78 L 05 AC	
1427.067	IC I	74 C 175	
or			
1464.515		CD40175 BCN	
1427.067	IC J	74 C 175	
or			
1464.515		CD40175 BCN	
1410.237	IC K	4049 B	
1410.237	IC L	4049 B	
1303.414	IC M	4001 BE	

-VCO-B-

Parts lists No.
97 Sa 2.155.63

Ident-No.	Mark	Electr. value	Identity	Manufacturer
1410.237	IC N		4049 B	
0973.521	IC O		4017 AE	
1120.433	IC P		SN 74 LS 192	
1120.433	IC Q		SN 74 LS 192	
1120.433	IC R		SN 74 LS 192	
1120.441	IC S		SN 74 LS 10	
1186.787	IC T		SN 74 LS 74	

Transistors:

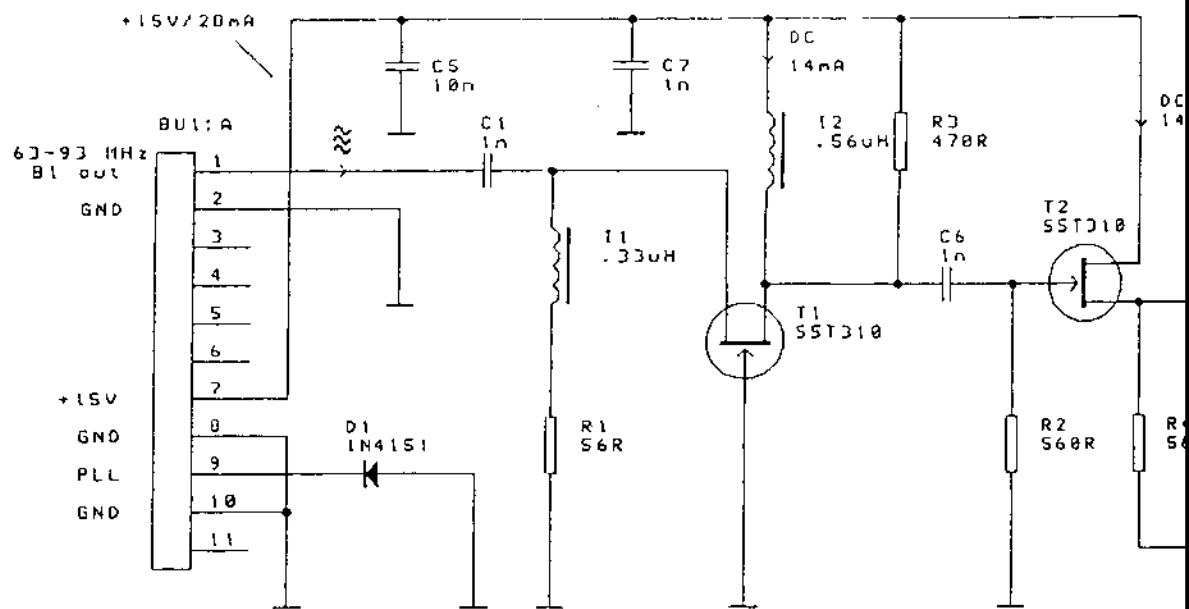
1238.949	T1		BF 246 B	
1233.949	T2		BF 246 B	
1291.033	T3		BC 549 B	
1238.949	T4		BF 246 B	
1291.033	T5		BC 549 B	
1238.949	T6		BF 246 B	
1238.949	T7		BF 246 B	
1291.033	T8		BC 549 B	
1238.949	T9		BF 246 B	
1717.499	T10		BF 246 B	
1717.499	T11		BF 246 B	
1025.015	T12		BF 199	
1025.015	T13		BF 199	
1291.033	T14		BC 549 B	
1291.033	T15		BC 549 B	
1168.207	T16		2 N 3866 A	MOTOROLA
1291.033	T17		BC 549 B	

Connectors:

1288.814	St1	11 pins	5.11.021007.011.00	ODU
1422.693	St2		R 114665	RADIALL
1422.693	St3		R 114665	RADIALL
1478.397	St4		RTM 12 H 629	BURKLIN
1478.397	St5		RTM 12 H 629	BURKLIN
1290.513	Bu1	11 pins	5.17.020.008.011.00	ODU
1189.743	Bu2	16 pins	DIL B 16-P108	BURNDY

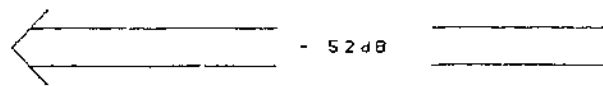
Supplements:

1078.577	M1	IE 500	IE	
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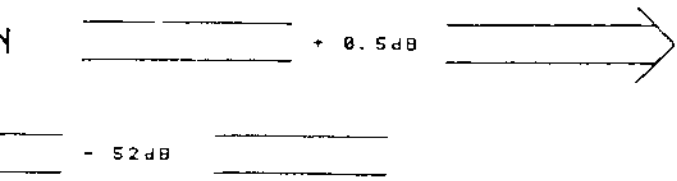
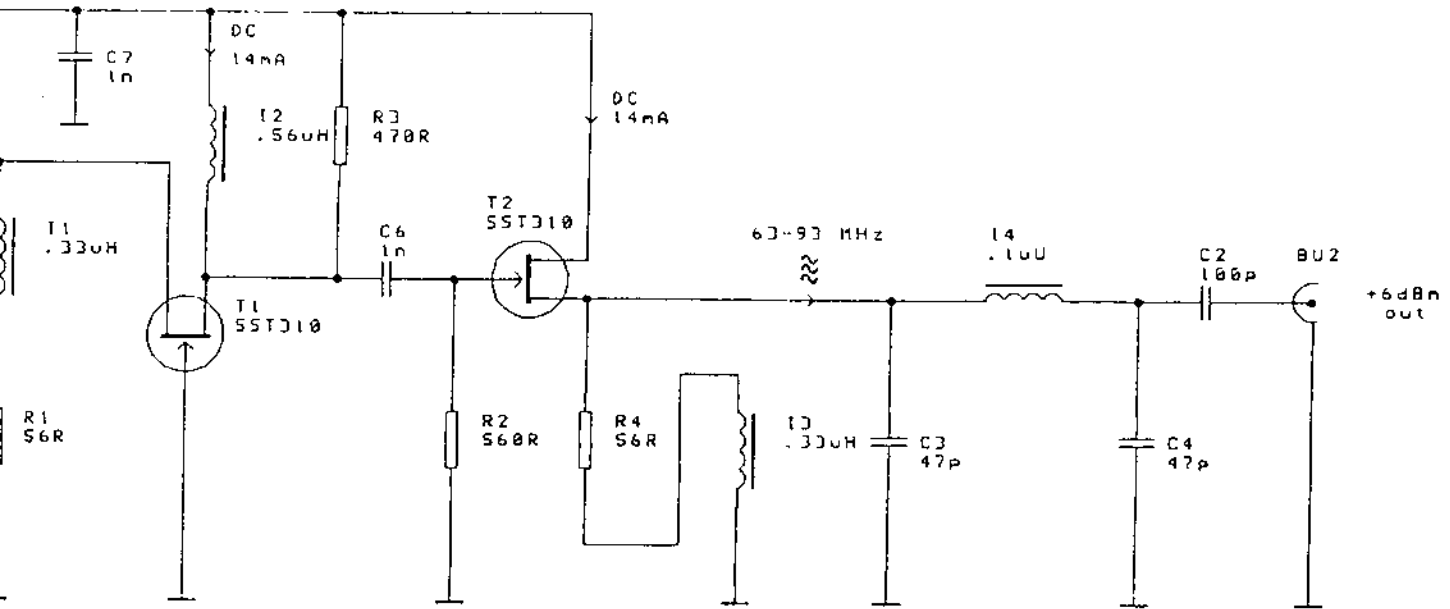
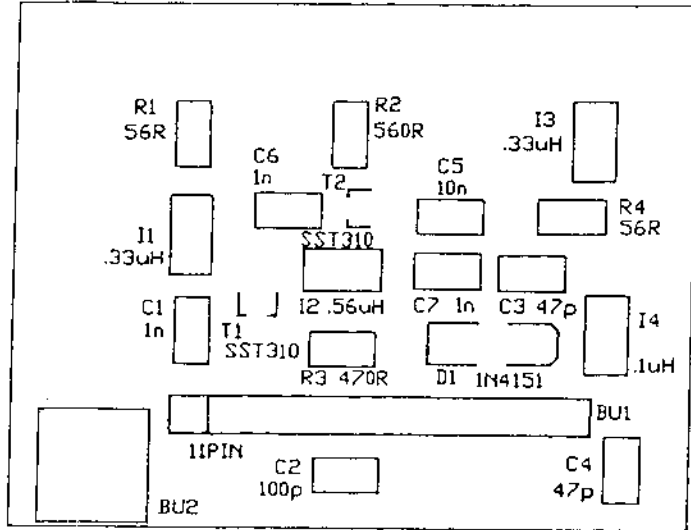


GAIN

+ 0.5dB



- 52dB



VCO-B2
Circuit Diagram
and Layout