-1. Mixer-

Technical description

The HF signal goes via the Hf input from the protector or preselector to the 1st Mixer. This is fitted with a +17 dBm high level Schottky diode mixer module. A ring mixer module, three low pass filters and the amplifier for the oscillator signal are installed in their own housing with individual chambers, called the MIXER MODULE. A 30 MHz low pass filter in front of the ring mixer and is fitted so that neither VHF and UHF frequencies can reach the input. The other two ports of the mixer are also equipped with low pass filters. The low pass filter for the oscillator must allow frequencies up to 93.078 MHz to pass, while the IF output must pass the IF frequencies up to 63.078 MHz. The high stop band attenuation of the low passes and the decoupling of the three mixer ports are accomplished by the chamber construction of the MIXER MODULE.

The oscillator signal from the VCO B reaches the 1st MIXER MODULE at a level of +7 dBm, where it is amplified up to the nominal level of 17 dBm. Amplification is by means of the transistors, T3 and T4 which operate in C mode and are connected in parallel.

The output level of this amplifier is monitored in the IC B by rectification and comparison with the reference voltage generated with D6. If the oscillator signal drops below the specified level, the IC B sends a fault signal to the microprocessor.

To minimize intermodulation, the mixer ports are terminated with 50 ohms. The transistors T5 and T6 as the first IF amplifiers, are connected in parallel. Due to the gate circuit and selected FETs, this stage has an input impedance of 50 ohms.

Immediately after this first amplifier follows the quartz filter OF with 63.078 MHz center frequency and a bandwidth of around 12 kHz. For gain control, a pin diode regulator with the diodes D7, D8 and D9 is inserted after the quartz filter. This pin diode regulator has a max. attenuation of 40 dB. The control threshold and the regulation gain is determined by the two operation amplifiers in IC A. At a control voltage U_{AGC} = 2.0 V, no attenuation should take place but if the control voltage U_{AGC} is 3.2 V, the signal coming from the quartz filter should be attenuated by 40 dB.

The control voltage is generated on the DEMODULATOR module. The influence of high frequency interference on control voltage is dealt with by the two stage low pass filter at the input of the first op amp. (IC A).

The pin diode attenuator is followed by a low noise amplifier with the dual gate MOSFET T9. Its bias is stabilized by the Z-diode in the source line and the voltage dividers at gates 1 and 2, and the bias temperature stability within the working temperature range of the receiver is achieved by the diodes D15 to D18.

-1. Mixer-

The amplified signal is coupled via the resonant circuit L11, C23, C28, C29. The resistance R13 in the drain line of the transistors stops spurious oscillations in the UHF range.

At 12 kHz the filter bandwidth of the 63.068 MHz quartz filter is relatively large but also necessary in order to be able to demodulate double side band modulated signals without distortion. When single side band modulated signals are received, only a bandwidth < 3 kHz is necessary, this bandwidth is obtained in the RX 1001 M / RX 5001 only by the SSB filter on the FILTER BOARD after the 2nd mixer.

The receiver RX 1001 M / RX 5001 should also have high sensitivity in the VLF frequency range (VLF = very low frequency). Increasing mixer attenuation caused by too low frequencies, however reduces the sensitivity. Specs of the Schottky diode ring mixer itself is guaranteed down to the input frequency of 50 kHz, but it also functions at lower frequencies. Due to the limited isolation between local oscillator port and IF-port of 40 dB there is an local oscillator interfering signal at the IF port of +17 dBm -40 dBm = -23 dBm.

The outside bands of this local oscillator signal (phase noise) are not sufficiently suppressed by the 1st quartz filter in the case of low input frequencies and thus also reduce sensitivity of the RX 1001 M / RX 5001 when it receives low frequencies.

So when frequencies in the 10 kHz to 80 kHz range are received, the relays A and B connect a VLF amplifier between antenna signal and the input (RF port) of the mixer module. At the input of this amplifier is a 2 stage pass filter, with a roll off frequency of 100 kHz. The amplifier is composed of the transistors T2, T7 and T8. Amplification is around 25 dB in the frequency range 10 - 80 kHz. T7 and T8 are a complementary emitter follower in order to generate a low output impedance.

Gain of T2 is set by the negative feedback of R39/C72 and R17. At very low input frequencies negative feedback of R39/C72 decreases and T2 gain will increase, this effect gives the desired frequency response as described earlier.

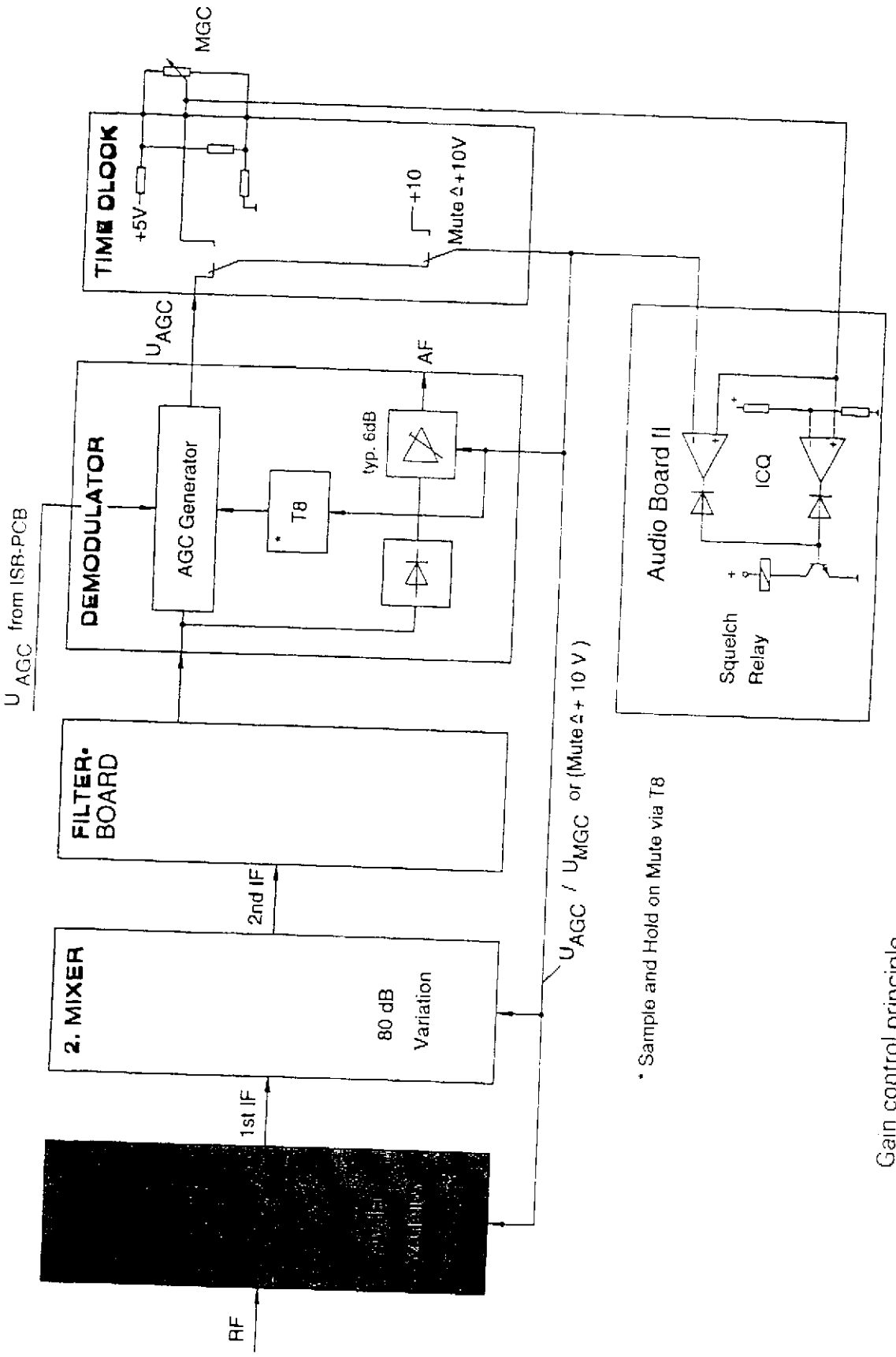
Diodes D2 and D3 protect the amplifier input against too high input voltages. Due to the VLF amplification, the dynamic range of the receiver in the frequency range from 10 - 80 kHz is reduced by the amount of the VLF amplifier gain.

The amplification of the entire 1st MIXER without the VLF amplifier should be 24 dB ±3 dB. When the self-test (BITE) is triggered, the test signal of 1 MHz and -54 dBm level is inserted via the PROTECTOR or PRESELECTOR from the BFO cassette. The oscillator signal of the VCO B is then 64.078 MHz (set by the microprocessor).

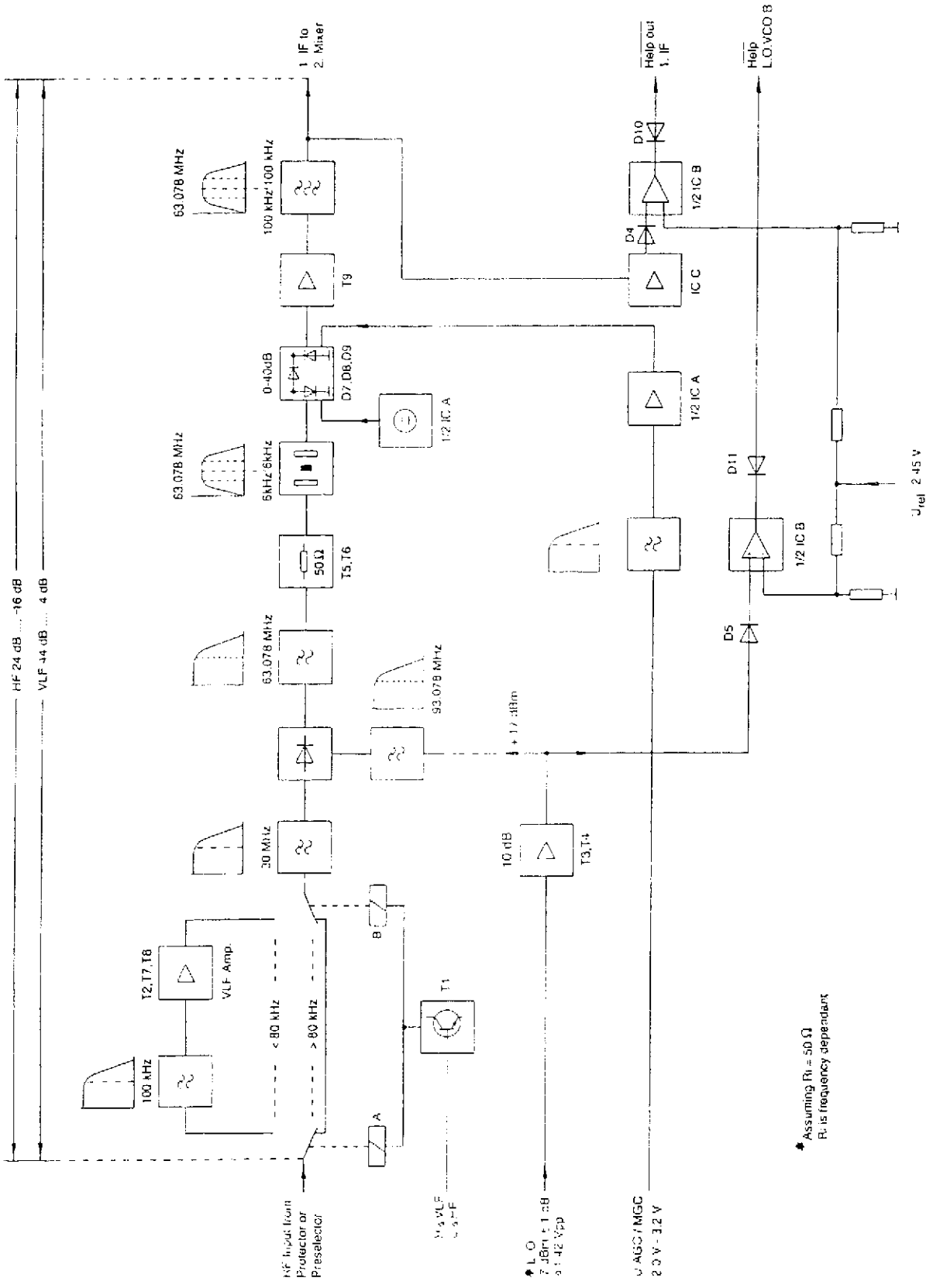
-1. Mixer-

During BITE test the control voltage U_{AGC} is set to 2.0 V (no attenuation). Thus the IF output of the 1st MIXER (ST6) a 63.078 MHz signal should have a level of -54 dBm +24 dBm = -30dBm ±3 dBm when the 1st MIXER is in order. This signal is amplified with the broad band amplifier IC C, rectified with D4 and compared in the comparator IC B with a highly accurate temperature controlled reference voltage generated by D4. If the rectified voltage drops below the reference voltage, which signals a faulty 1st MIXER, the output of IC A changes to LOW. This fault condition is read by the microprocessor.

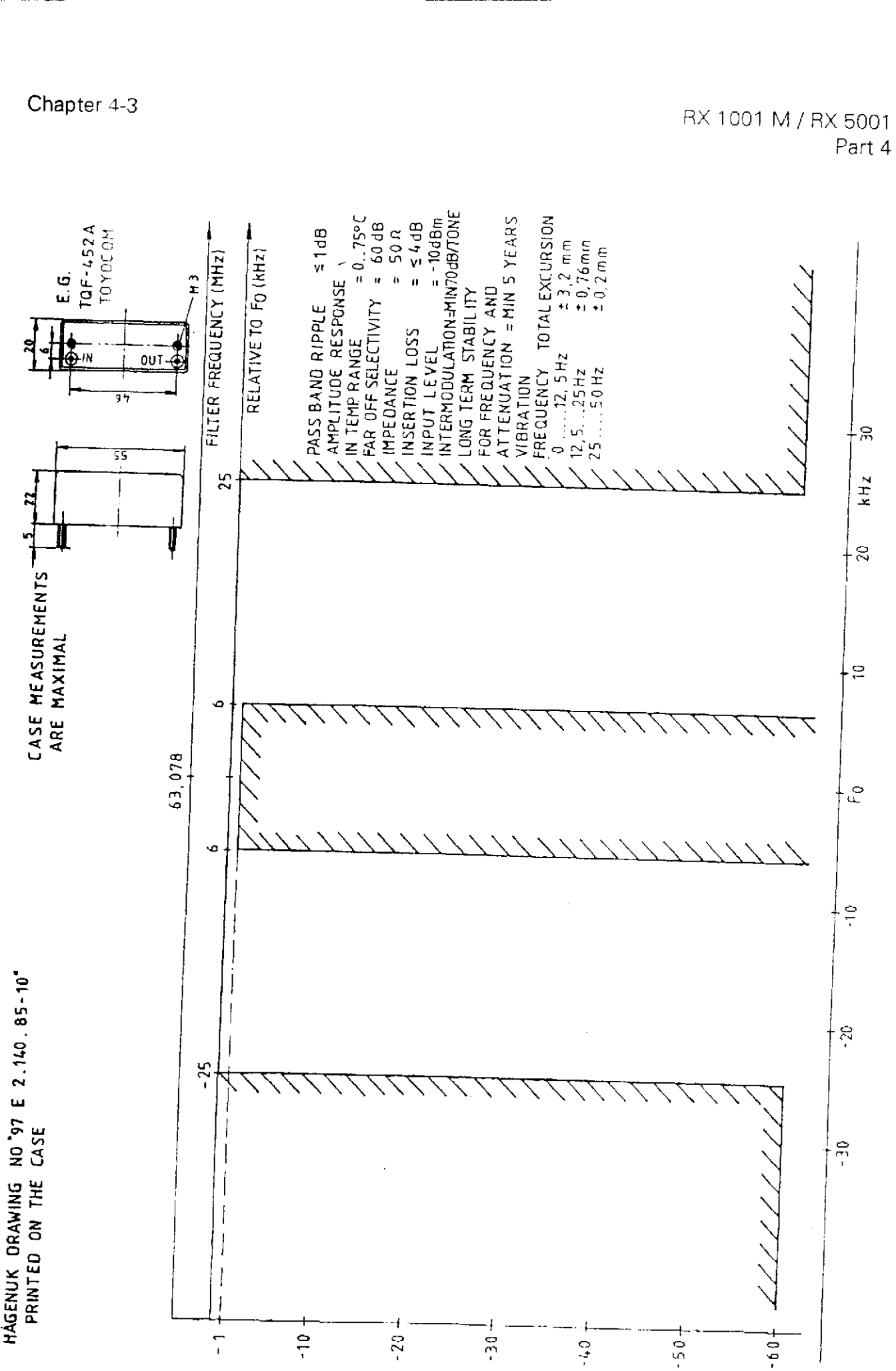
-1. Mixer-



Gain control principle



Blockdiagram 1. MIXER



HÄGENUK ORAWING NO '97 E 2.140.85-10'
PRINTED ON THE CASE

HAG/ROD 016-09.92

-1. Mixer-

Test and alignment instructions

Required: Circuit diagram 1st MIXER - Hagenuk Drawing No. 97 Sa B 2.155.83
Power supply 5 V/18 V, digital voltmeter, milliampmeter, two RF generators, spectrum analyser, tracking generator

Test configuration: The 1st MIXER module must be removed.

instruments:		
	RF generator 10 kHz - 30 MHz	to plug ST 1 RF INPUT
	RF generator	to plug ST 2 LO INPUT
	Spectrum analyser	to plug ST 6 IF OUTPUT
	Power supply:	
	ground	to plug ST 4 pins 1, 16
	+ 18 V	to plug ST 4 pins 3, 14, 15
	+ 5 V	to plug St 4 pins 2, 13

Measurement of current consumption
Current consumption measured without input signals.
Test values:

Current consumption	I = 190 mA ± 40 mA/18 V
	I = 70 mA ± 10 mA/5 V

Testing the gain of the VLF-amplifier
Switch the selector of the test equipment to position VLF, remove the connection between the test equipment and the LO - generator (socket LO-In). Solder a cable to measuring point MP 2, connect this cable to the input of the spectrum analyser. Connect the tracking generator to socket RF-In of the test equipment.

Spectrum analyser settings:		
	Centre frequency	280 kHz
	Span	50 kHz/div.
	Resulution bandwidth	10 kHz
	Video filter bandwidth	10 kHz
	Reference level	-10 dBm
	Tracking generator - level	-37 dBm

Test values:

Output level should be	10 ...80 kHz	- 20 dBm ± 2 dB
	400 kHz ...30 MHz	< - 65 dBm

Switch the selector of the test equipment to position HF.
Test value:
Output level should be constant -37 dBm.

-1. Mixer-

Testing the IF amplifiers
Plug ST 4 pin 12 to 0 V
Plug ST 4 pin 4: apply U_{AGC} = 2.00 V ± 5 mV
RF INPUT level -60 dBm
Spectrum analyser and tracking generator settings:

Centre frequency	63.078	MHz
Span	10	kHz
Resolution bandwidth	300	Hz
Ref. level	-27	dBm

Alignment of IF amplifier
- Set R 75 to centre position
- Set L 8 for minimum ripple at maximum output
- Set L 11 for maximum output
- Set L 10 for maximum output
- Using R 75, set output level to -31 dBm ± 0.5 dB at f = 63.078 MHz.
- If the ripple exceeds 1.7 dB, turn core further into L 10 until <1.7 dB ripple is achieved.
  NOTE
  The output level must not be reduced by more than 1.5 dB.
- Readjust R 75 to -31 dBm ± 0.5 dB.

Testing ripple (on AGC variation)

Test values	Settings
Ripple < 1.7 dB	RF INPUT level -60 dBm U_{AGC} 2.00 V
Ripple < 2.6 dB	RF INPUT level -50 dBm U_{AGC} 2.60 V
Ripple < 3.5 dB	RF INPUT level -20 dBm U_{AGC} 3.20 V

Testing the gain of the complete mixer
Plug ST 4 pin 4 U_{AGC} = 2.00 V
LO INPUT level +7 dBm f = 64.078 MHz
RF INPUT level -57 dBm f = 1 MHz
Connect IF OUTPUT to spectrum analyser.
Test values:
IF OUTPUT level -33 dBm (adjust with R 57) at f = 63.078 MHz
IF OUTPUT level <-48 dBm at f = 64.078 MHz

-1. Mixer-

Testing the control characteristic
LO INPUT level +7 dBm f = 64.078 MHz
RF INPUT level -50 dBm f = 1 MHz

Test values: IF OUTPUT level	Settings: U_{AGC}
-26 dBm ± 0.5 dB	2.00 V
-29 dBm ± 2 dB	2.20 V
-33 dBm ± 2.5 dB	2.40 V
-37 dBm ± 3 dB	2.60 V
-42 dBm ± 4 dB	2.80 V
-68 dBm ± 5 dB	3.00 V

Testing the filter frequency response
LO INPUT level +7 dBm f = 64.078 MHz
Plug ST 4 pin 4 U_{AGC} = 2.00 V

Test values IF OUTPUT leve	Settings RF INPUT level -40 dBm
> -19 dBm ripple < 3 dB	f = 1 MHz ± 6 kHz
< -45 dBm	f = 1 MHz ± 13 kHz
< -76 dBm	f = 1 MHz ± 25 kHz

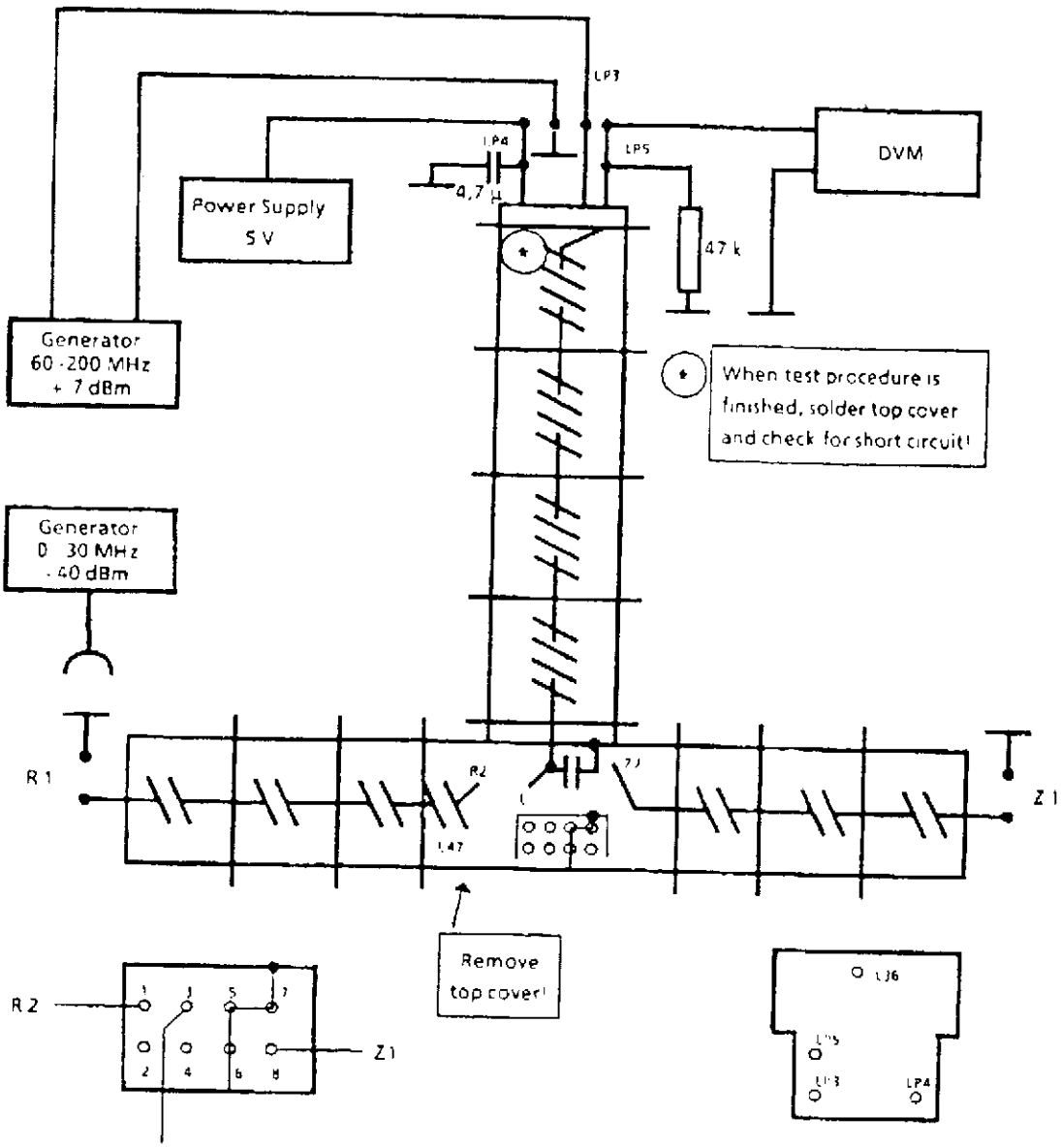
-1. Mixer-

Test and alignment instruction for 1st MIXER (mixer module)

Required: Signal generator 0 ... 30 MHz, signal generator 60 - 200 MHz, power supply, digital voltmeter, soldering iron

Test configuration: The mixer module is unsoldered from the 1st mixer board and removed.

Test configuration:



Assembly 1. MIXER (mixer module)

-1. Mixer-

Unsolder R 2, L and Z 2 from ring mixer. Solder LP 3, LP 4 and LP 5 according to drawing.
Measure frequency response of RF filter branch.
Connect tracking generator to R1 and the spectrum analyser input to R2.

Spectrum analyser settings:	Centre frequency	45 MHz
	Span	90 MHz
	Reference level	-10 dBm
	Tracking generator-level	-10 dBm

Measure levels at the following frequencies:

Specified levels: 0...	30 MHz	-10 dBm ± 0.7 dB
	60 MHz	< -45 dBm
	90 MHz	< -70 dBm

Measure frequency response of IF filter.

Spectrum analyser settings:	Centre frequency	63 MHz
	Span	0.5 MHz
	Reference level	-10 dBm
	Tracking generator-level	-10 dBm
Specified output level	-10 dBm ± 0.5 dB	

Spectrum analyser settings:	Centre frequency	150 MHz
	Span	200 MHz
	Reference level	-10 dBm
	Tracking generator-level	-10 dBm

Measure level at the following frequencies:

Frequency	Specified levels
63 ... 124 MHz	-10 dBm ± 1 dB
210 MHz	< -30 dBm
250 MHz	< -50 dBm

Test LO filter with amplifier.
Connect an RF generator (frequency range 63 - 200 MHz, level +7 dBm) to LP 3. Connect spectrum analyser to L. Measure output level at the following frequencies:

Frequency	Specified levels
63 MHz	+17 dBm ± 5 dB
79 MHz	+17 dBm ± 5 dB
94 MHz	+17 dBm ± 5 dB
140 MHz	< -20 dBm
180 MHz	< -45 dBm

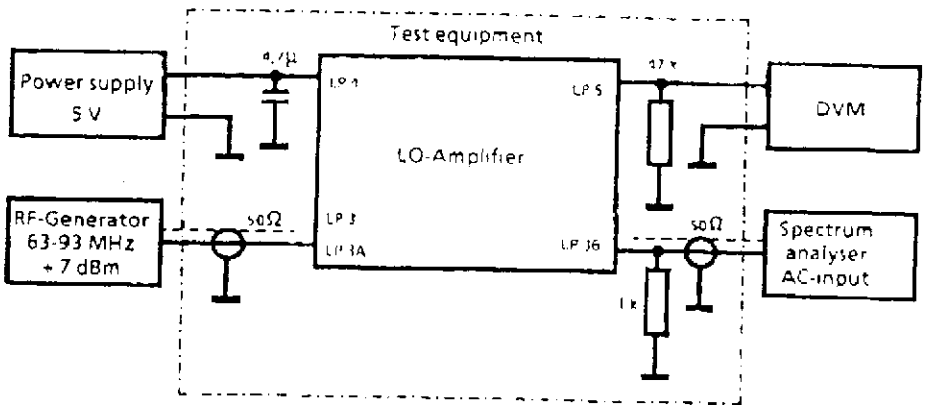
-1. Mixer-

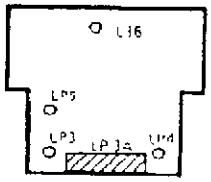
Overall test of module
Solder R 2 to pin 1, L to pins 3 and 4 and Z 2 to pin 8 of the mixer. Connect a generator (f = 0 - 30 MHz, level -40 dBm) to R 1 and a second generator (60 - 200 MHz, level +7 dBm) to LP 3. Measure levels on Z 1 with the spectrum analyser.

	Frequency LO generator 1 (MHz)	Frequency RF generator 2 (MHz)	Level on Z 1 (63.78 MHz)	Residual LO level	Voltage on LP 5
a)	93.078	30	-46 dBm ± 2 dB	-10 dBm	2.5 V
b)	85.078	22	-46 dBm ± 2 dB	-10 dBm	2.5 V
c)	73.078	10	-46 dBm ± 2 dB	-15 dBm	2.5 V
d)	63.178	0.1	-46 dBm ± 2 dB	-15 dBm	2.5 V

Test and alignment instructions (1st mixer LO amplifier)
Required: Power supply, signal generator 63 - 93 MHz, digital voltmeter, spectrum analyser

Test configuration: The LO amplifier is in the mixer module of the 1st mixer. For testing, the board is removed and placed in a screened test facility.





LO amplifier PCB

Measure current consumption with generator switched off. Specified value: 70 mA ± 10 mA.

NOTE
The two transistors are selected in groups according to current gain. The base series resistors R 68, R 69 have group-specific values.

-1. Mixer-

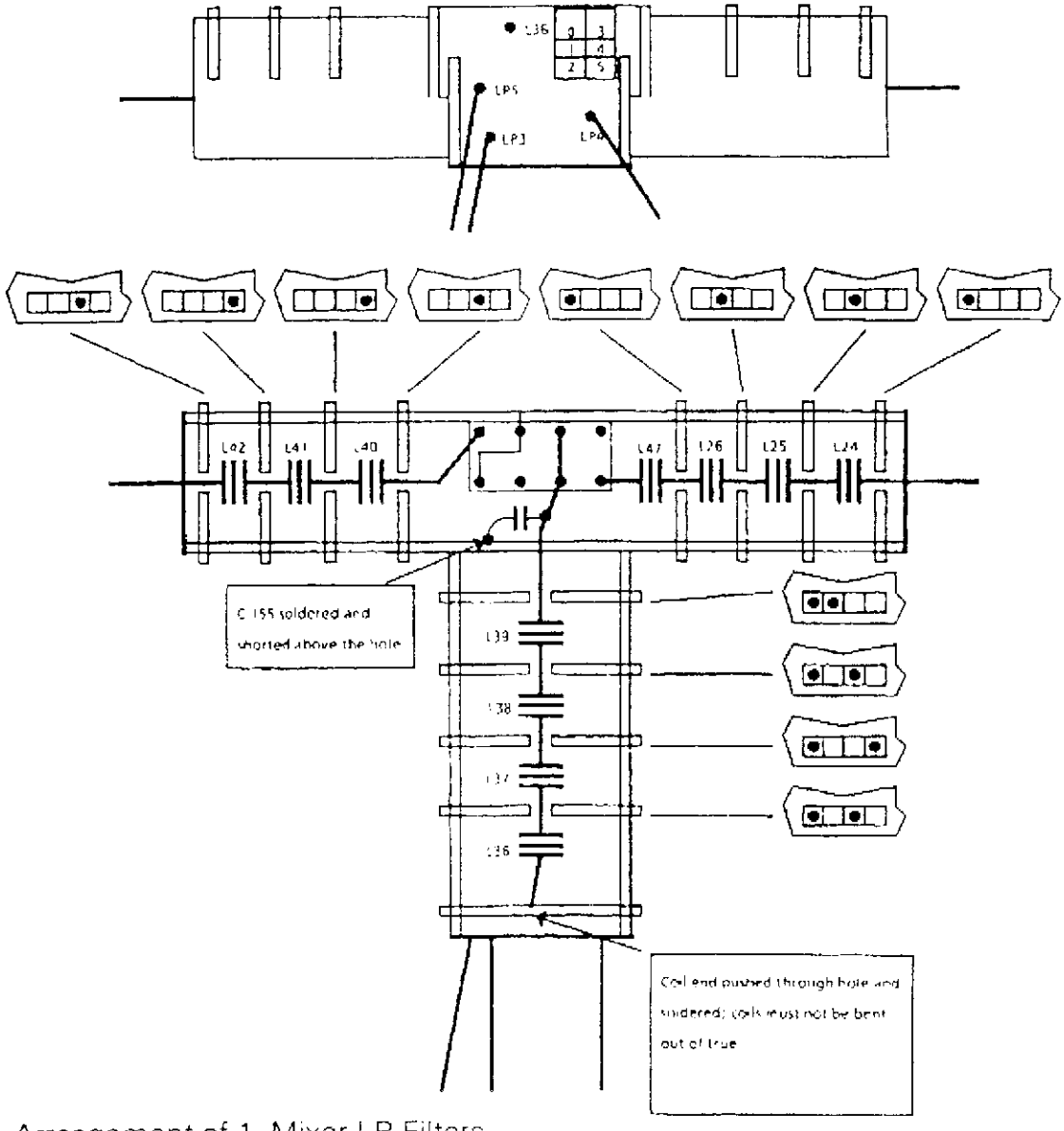
Measure the output signal of the LO amplifier with a generator input signal of +7 dBm and at frequencies of 63, 73, 83 and 93 MHz

Since the LO amplifier is a switching amplifier and its output contains many harmonics, the level must be measured by the spectrum analyser at the fundamental of the output.

Specified output level +20 dBm ± 2 dB.

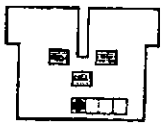
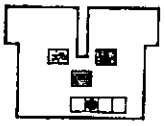
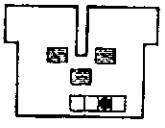
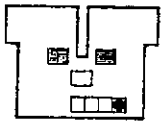
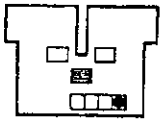
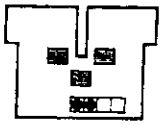
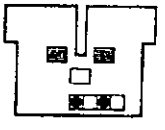
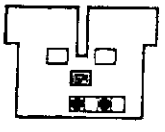
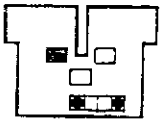
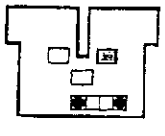
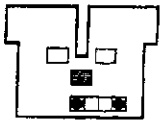
Take care not to overload the input of the spectrum analyser (if necessary connect a 10 dB attenuator in the circuit).

Measure the control voltage with a DVM at the four frequencies 63, 73, 83 and 93 MHz
Specified value: U 2.6 V.



Arrangement of 1. Mixer LP-Filters

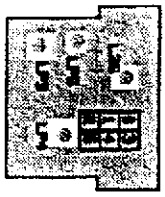
-1. Mixer-

97 E 2.155.178		27 pF/5/63 V KEFQ 0800519 NPO
97 E 2.155.179		56 pF/5/63 V KEFQ 0800519 NPO
97 E 2.155.180		2,7 pF/5/63 V KEFQ 0800519 NPO
97 E 2.155.181		10 pF/5/63 V KEFQ 0800519 NPO
		12 pF/5/63 V KEFQ 0800519 NPO
97 E 2.155.182		6,8 pF/5/63 V KEFQ 0800519 NPO
97 E 2.155.183		15 pF/5/63 V KEFQ 0800519 NPO
		22 pF/5/63 V KEFQ 0800519 NPO
97 E 2.155.184		15 pF/5/63 V KEFQ 0800519 NPO
		18 pF/5/63 V KEFQ 0800519 NPO
		22 pF/5/63 V KEFQ 0800519 NPO

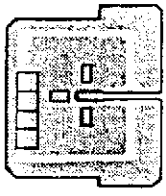
1. Mixer LP Filter module PCBs

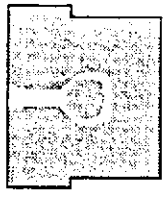
-1. Mixer-

see circuit diagram - 1. MIXER 97 Sa C 2.155.83

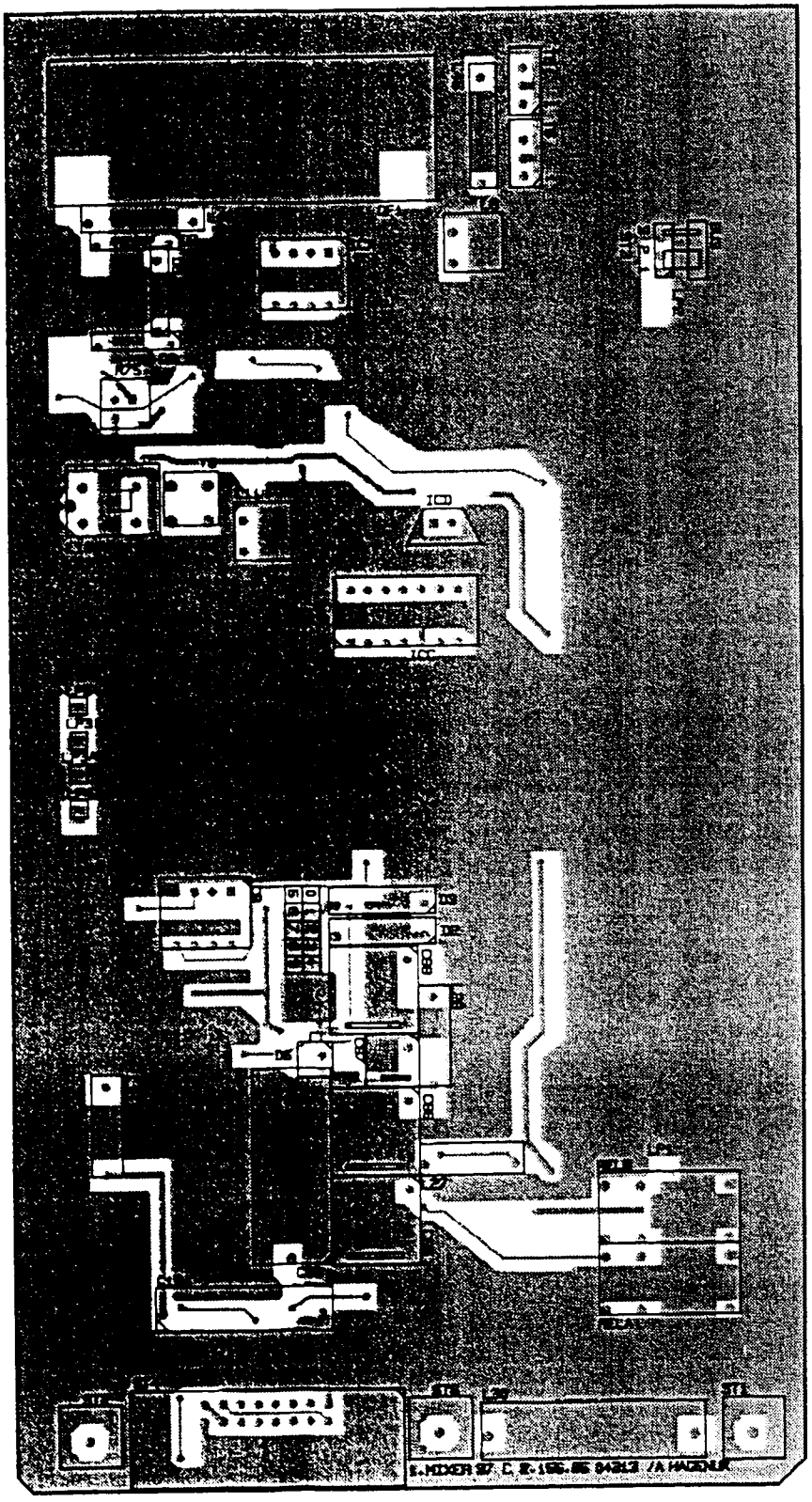


LO-Amplifier 1. MIXER PCB - 97 D 2.155.190

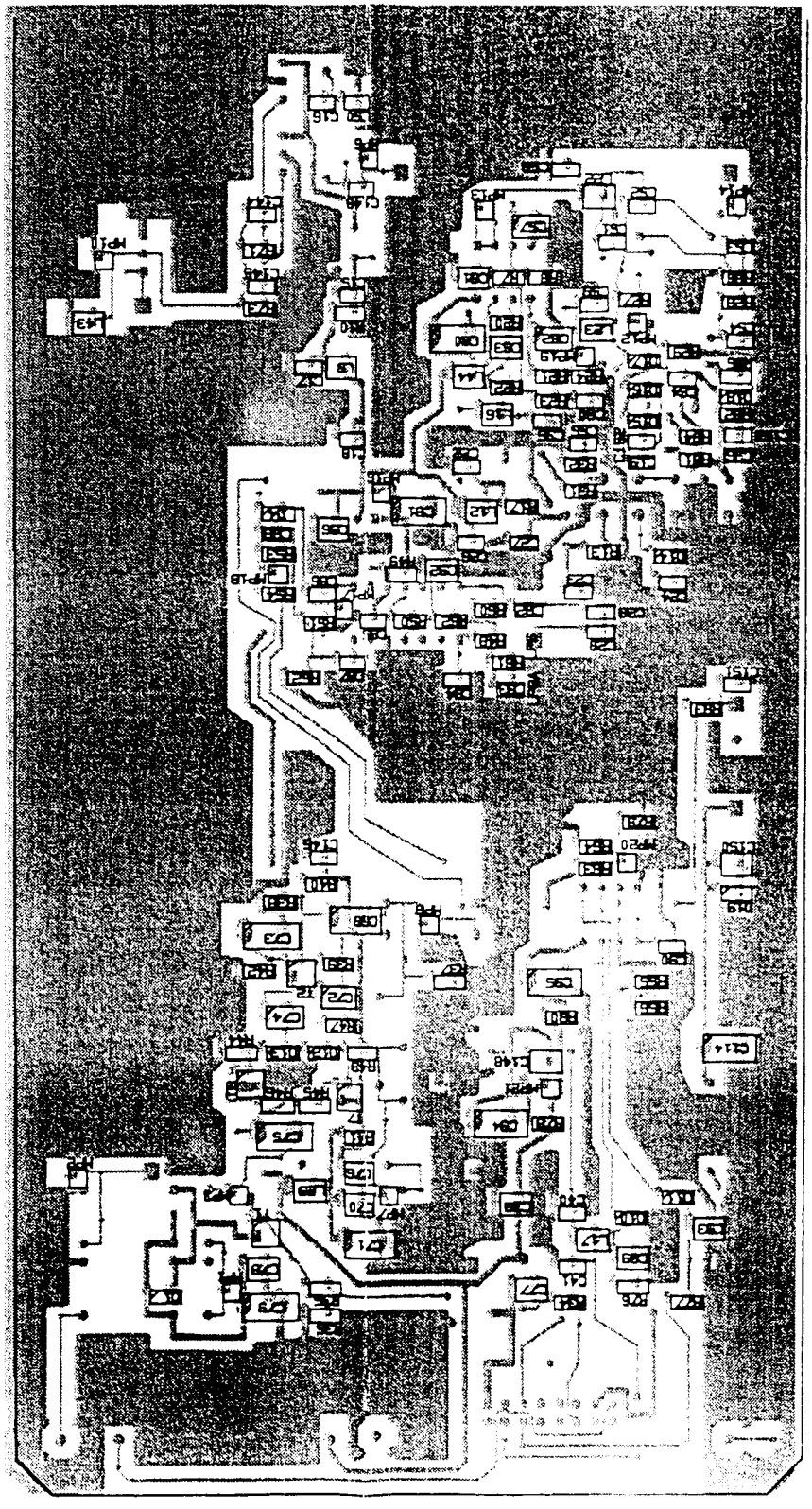




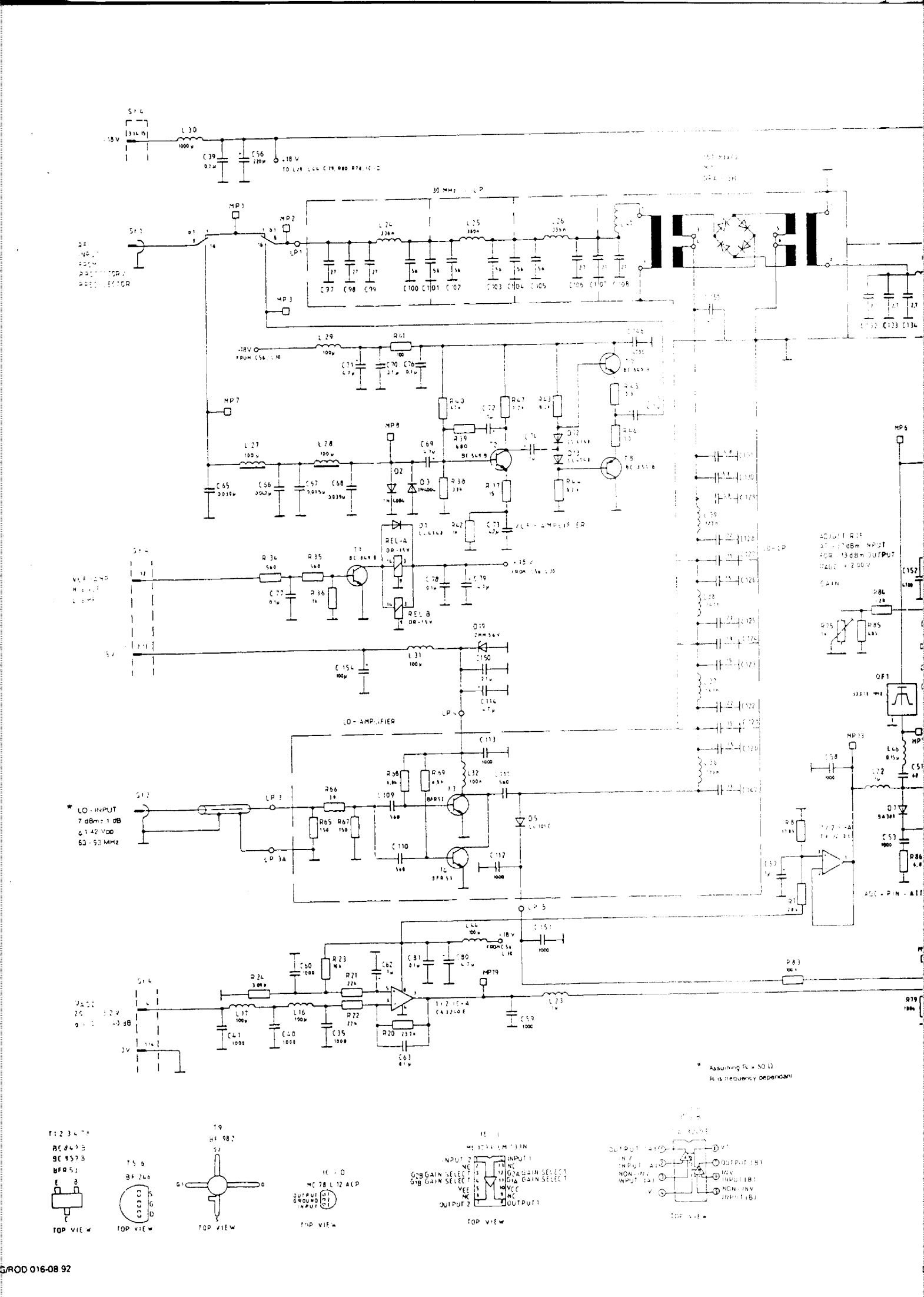
1. Mixer Module PCB - 97 E 2.155.178-184

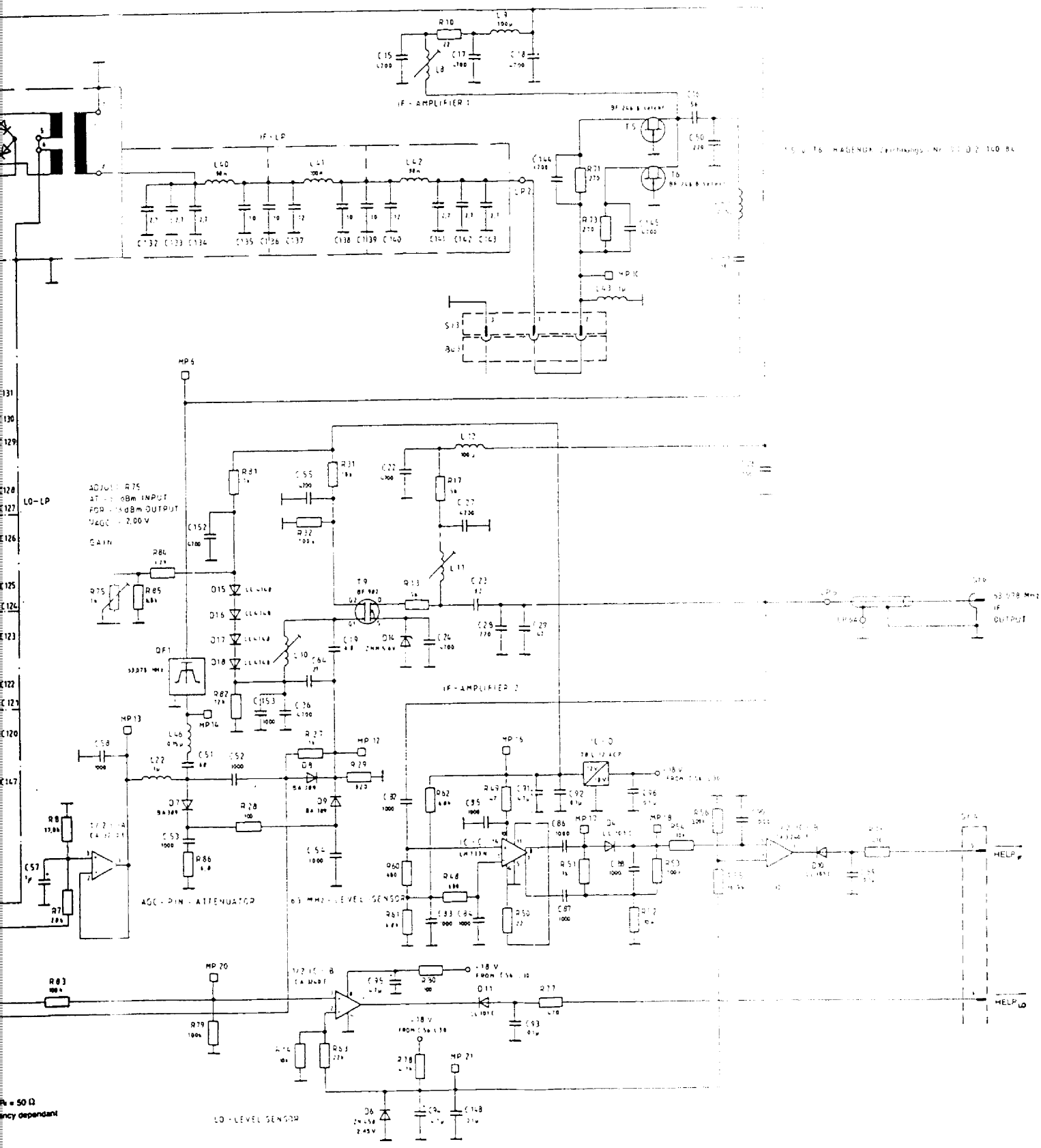


see circuit diagram - 1. MIXER 97 Sa B 2.155.83



Printed Circuit Board
1. Mixer
97 C 2.155.85


30 MHz - LP
LO - AMPLIFIER
LO - INPUT
7 dBm ± 1 dB
63 - 93 MHz
* Assuming RL = 50 Ω
RL is frequency dependant
TOP VIEW



1 MIXER
Circuit Diagram
97 Sa B 2.155.83

-1. Mixer-

Ident-No.	Mark	Electr. value	Identity
Capacitors:			
1647.067	C15	SMD 4700 pF/10/63 V	KEFQ 0805 X7R
1646.877	C16	SMD 56 pF/5/63 V	KEFQ 0805 NPO
1647.067	C17	SMD 4700 pF/10/63 V	KEFQ 0805 X7R
1647.067	C18	SMD 4700 pF/10/63 V	KEFQ 0805 X7R
1745.948	C19	SMD 6,8 pF/0,25/63 V	KEFQ 0805 N750
1647.067	C22	SMD 4700 pF/10/63 V	KEFQ 0805 X7R
1646.915	C23	SMD 82 pF/5/63 V	KEFQ 0805 NPO
1647.067	C24	SMD 4700 pF/10/63 V	KEFQ 0805 X7R
1647.067	C26	SMD 4700 pF/10/63 V	KEFQ 0805 X7R
1647.067	C27	SMD 4700 pF/10/63 V	KEFQ 0805 X7R
1647.008	C28	SMD 220 pF/10/63 V	KEFQ 0805 NPO
1643.932	C29	SMD 47 pF/5/63 V	KEFQ 0805 X7R
1646.885	C35	SMD 1000 pF/5/63 V	KEFQ 0805 NPO
1647.067	C36	SMD 4700 pF/10/63 V	KEFQ 0805 X7R
1646.990	C39	SMD 0,1 µF/10/63 V	KEFQ 1212 X7R
1646.885	C40	SMD 1000 pF/5/63 V	KEFQ 0805 NPO
1646.885	C41	SMD 1000 pF/5/63 V	KEFQ 0805 NPO
1647.008	C50	SMD 220 pF/5/63 V	KEFQ 0805 NPO
1643.967	C51	SMD 68 pF/5/63 V	KEFQ 0805 NPO
1646.885	C52	1000 pF/5/63 V	KEFQ 0805 NPO
1646.885	C53	1000 pF/5/63 V	KEFQ 0805 NPO
1646.885	C54	1000 pF/5/63 V	KEFQ 0805 NPO
1647.067	C55	4700 pF/10/63 V	KEFQ 0805 NPO
1067.923	C56	ELIKO AA 220-25 GPF	DIN 41316 G
1887.580	C57	SMD 1 µF/10/35 V	267L3502105 KF
1646.885	C58	SMD 1000 pF/5/63 V	KEFQ 0805 NPO
1646.885	C59	SMD 1000 pF/5/63 V	KEFQ 0805 NPO
1646.885	C60	SMD 1000 pF/5/63 V	KEFQ 0805 NPO
1887.580	C62	SMD 1 µF/10/63 V	Typ 267 3,4x2,8
1646.990	C63	SMD 0,1 µF/10/63 V	KEFQ 0805 NPO
1646.966	C64	SMD 27 pF/5/63 V	KEFQ 0805 NPO
1887.629	C65	0,039 µF/1/63 V	B 31531 B 5393 F
1887.637	C66	0,047 µF/1/63 V	B 31531-B 5473-F
1887.610	C67	0,015 µF/1/63 V	B 31531-B 5153 F
1887.629	C68	0,039 µF/1/63 V	B 31531-B 5393-F
1916.076	C69	SMD 4,7 µF/10/25 V	267L2502475 KF
1646.990	C70	0,1 µF/10/63 V	KEFQ 1210 X7R
1916.076	C71	SMD 4,7 µF/10/25 V	Typ 267 5,6x3,3
1887.580	C72	SMD 1 µF/10/35 V	TyP 267 3,4x2,8
1916.076	C73	SMD 4,7 µF/10/25 V	Typ 267 5,6x3,3
1887.580	C74	SMD 1 µF/10/35 V	Typ 267 3,4x2,8
1916.076	C75	SMD 4,7 µF/10/25 V	Typ 267 5,6x3,3

-1. Mixer-

Ident-No.	Mark	Electr. value	Identity	Manufacturer
1646.990	C76	SMD 0,1 µF/10/63 V	KEFQ 1210 X7R	
1646.990	C77	SMD 0,1 µF/10/63 V	KEFQ 1210 X7R	
1646.990	C78	SMD 0,1 µF/10/63 V	KEFQ 1210 X7R	
1916.076	C79	SMD 4,7 µF/10/25 V	Typ 267 5,6x3,3	
1916.076	C80	SMD 4,7 µF/10/25 V	TYP 267 5,6x3,3	
1646.990	C81	SMD 0,1 µF/10/63	KEFQ 1210 X7R	
1646.885	C82	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1646.885	C83	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1646.885	C84	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1646.885	C85	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1646.885	C86	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1646.885	C87	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1646.885	C88	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1646.990	C89	SMD 0,1 µF/10/63	KEFQ 1210 X7R	
1646.885	C90	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1916.076	C91	SMD 4,7 µF/10/25 V	Typ 267	
1646.990	C92	SMD 0,1 µF/10/63	KEFQ 1210 X7R	
1646.990	C93	SMD 0,1 µF/10/63	KEFQ 1210 X7R	
1916.076	C94	SMD 4,7 µF/10/25 V	Typ 267	
1916.076	C95	SMD 4,7 µF/10/25 V	Typ 267	
1646.990	C96	SMD 0,1 µ1F/10/63	KEFQ 1210 X7R	
1646.966	C97	SMD 27 pF/5/63 V	KEFQ 0805 NPO	
1646.966	C98	SMD 27 pF/5/63 V	KEFQ 0805 NPO	
1646.966	C99	SMD 27 pF/5/63 V	KEFQ 0805 NPO	
1646.877	C100	SMD 56 pF/5/63 V	KEFQ 0805 NPO	
1646.877	C101	SMD 56 pF/5/63 V	KEFQ 0805 NPO	
1646.877	C102	SMD 56 pF/5/63 V	KEFQ 0805 NPO	
1646.877	C103	SMD 56 pF/5/63 V	KEFQ 0805 NPO	
1646.877	C104	SMD 56 pF/5/63 V	KEFQ 0805 NPO	
1646.877	C105	SMD 56 pF/5/63 V	KEFQ 0805 NPO	
1646.966	C106	SMD 27 pF/5/63 V	KEFQ 0805 NPO	
1646.966	C107	SMD 27 pF/5/63 V	KEFQ 0805 NPO	
1646.966	C108	SMD 27 pF/5/63 V	KEFQ 0805 NPO	
1643.983	C109	SMD 560 pF/5/63 V	KEFQ 0805 NPO	
1643.983	C110	SMD 560 pF/5/63 V	KEFQ 0805 NPO	
1643.983	C111	SMD 560 pF/5/63 V	KEFQ 0805 NPO	
1646.885	C112	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1646.885	C113	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1916.076	C114	SMD 4,7 µF/10/25 V	Typ 267	
1647.032	C120	15 pF/5/63 V	KEFQ 0805 NPO	
1647.032	C121	15 pF/5/63 V	KEFQ 0805 NPO	
1647.172	C122	22 pF/5/63 V	KEFQ 0805 NPO	
1647.032	C123	15 pF/5/63 V	KEFQ 0805 NPO	
1650.157	C124	18 pF/5/63 V	KEFQ 0805 NPO	

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Ident-No.	Mark	Electr. value	Identity	Manufacturer
1647.172	C125	22 pF/5/63 V	KEFQ 0805 NPO	
1647.032	C126	15 pF/5/63 V	KEFQ 0805 NPO	
1647.032	C127	15 pF/5/63 V	KEFQ 0805 NPO	
1647.172	C128	22 pF/5/63 V	KEFQ 0805 NPO	
1646.834	C129	6,8 pF/5/63 V	KEFQ 0805 NPO	
1646.834	C130	6,8 pF/5/63 V	KEFQ 0805 NPO	
1646.834	C131	6,8 pF/5/63 V	KEFQ 0805 NPO	
1672.681	C132	2,7 pF/5/63 V	KEFQ 0805 NPO	
1672.681	C133	2,7 pF/5/63 V	KEFQ 0805 NPO	
1672.681	C134	2,7 pF/5/63 V	KEFQ 0805 NPO	
1646.982	C135	10 pF/0,25/63 V	KEFQ 0805 NPO	
1646.982	C136	SMD 10 pF/5/63 V	KEFQ 0805 NPO	
1672.703	C137	SMD 12 pF/5/63 V	KEFQ 0805 NPO	
1646.982	C138	SMD 10 pF/5/63 V	KEFQ 0805 NPO	
1646.982	C139	SMD 10 pF/5/63 V	KEFQ 0805 NPO	
1672.703	C140	SMD 12 pF/5/63 V	KEFQ 0805 NPO	
1672.681	C141	SMD 2,7 pF/0,25/63 V	KEFQ 0805 NPO	
1672.681	C142	SMD 2,7 pF/0,25/63 V	KEFQ 0805 NPO	
1672,681	C143	SMD 2,7 pF/0,25/63 V	KEFQ 0805 NPO	
1647.067	C144	SMD 4700 pF/10/63 V	KEFQ 0805 X7R	
1647.067	C145	SMD 4700 pF/10/63 V	KEFQ 0805 X7R	
1647.067	C146	SMD 4700 pF/10/63 V	KEFQ 0805 X7R	
1650.181	C147	SMD-KO 33p/5/63	KEFQ 0805 NPO	
1646.990	C148	SMD 0,1 µF/10/63 V	KEFQ 1210 X7R	
1643.967	C149	SMD 68 pF/5/63 V	KEFQ 0805 NPO	
1646.990	C150	SMD 0,1 µF/10/63 V	KEFQ 1210 X7R	
1646.885	C151	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1647.067	C152	SMD 4700 pF/10/63 V	KEFQ 0805 X7R	
1646.885	C153	SMD 1000 pF/5/63 V	KEFQ 0805 NPO	
1423.010	C154	Elko AA 100-10 GPF	DIN 41316-G	ROE
0921.882	C155	47 pF/2/63 V	EDPU/NPO	

Diodes:

1613.162	D1	LL 4148	1,5x3,5
0763.764	D2	1 N 4004	
0763.764	D3	1 N 4004	
1760.068	D4	LL 101 C	1,5x3,5
1760.068	D5	LL 101 C	1,5x3,5
1865.668	D6	ZN 458 2,45 V	
1744.240	D7	BA 389	
1744.240	D8	BA 389	
1744.240	D9	BA 389	

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Ident-No.	Mark	Electr. value	Identity	Manufacturer
1760.068	D10	LL 101 C	1,5x3,5	
1760.068	D11	LL 101 C	1,5x3,5	
1613.162	D12	LL 4148	1,5x3,5	
1613.162	D13	LL 4148	1,5x3,5	
1916.084	D14	ZMM 5,6 V		
1613.162	D15	LL 4148		
1613.162	D16	LL 4148		
1613.162	D17	LL 4148		
1613.162	D18	LL 4148		
1916.084	D19	ZMM 5,6 V		

Resistors:

1887.734	R7	SMD 28k-1-0,125 W	HN 329 T.3	
1795.104	R8	SMD 17,8k-1-0,125 W	HN 329 T.3	
1643.304	R10	SMD 22-5-0,125 W	HN 239 T.4	
1878.050	R13	SMD 56-5-0,125 W	HN 239 T.4	
1878.050	R17	SMD 56-5-0,125 W	HN 329 T.4	
1930.885	R20	SMD 23,7k-1-0,125 W	HN 329 T.3	
1650.130	R21	SMD 22k-5-0,125 W	HN 329 T.4	
1642.391	R22	SMD 22k-1-0,125 W	HN 329 T.3	
1670.611	R23	SMD 10k-1-0,125 W	HN 329 T.3	
1647.482	R24	SMD 3,09-1-0,125 W	HN 329 T.3	
1643.460	R27	SMD 1k-5-0,125 W	HN 329 T.4	
1647.105	R28	SMD 100-5-0,125 W	HN 329 T.4	
1649.086	R29	SMD 820-5-0,125 W	HN 329 T.4	
1663.828	R31	SMD 18k-5-0,125 W	HN 329 T.4	
1612.980	R32	SMD 100k-5-0,125 W	HN 329 T.4	
1643.428	R34	SMD 560-5-0,125 W	HN 329 T.4	
1643.428	R35	SMD 560-5-0,125 W	HN 329 T.4	
1643.460	R36	SMD 1k-5-0,125 W	HN 329 T.4	
1643.630	R38	SMD 33k-5-0,125 W	HN 329 T.4	
1647.075	R39	SMD 680-5-0,125 W	HN 329 T.4	
1643.673	R40	SMD 47k-5-0,125 W	HN 329 T.4	
1647.105	R41	SMD 100-5-0,125 W	HN 329 T.4	
1643.460	R42	SMD 1k-5-0,125 W	HN 329 T.4	
1709.569	R43	SMD 8,2k-5-0,125 W	HN 329 T.4	
1709.569	R44	SMD 8,2k-5-0,125 W	HN 329 T.4	
1887.696	R45	SMD 3,3-5-0,125 W	HN 329 T.4	
1887.696	R46	SMD 3,3-5-0,125 W	HN 329 T.4	
1808.524	R47	SMD 1,2k-5-0,125 W	HN 329 T.4	
1647.075	R48	SMD 680-5-0,125 W	HN 329 T.4	
1647.180	R49	SMD 47-5-0,125 W	HN 329 T.4	

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Ident-No.	Mark	Electr. value	Identity	Manufacturer
1643.304	R50	SMD 22-5-0,125 W	HN 329 T.4	
1643.460	R51	SMD lk-5-0,125 W	HN 329 T.4	
1612.948	R52	SMD 10k-5-0,125 W	HN 329 T.4	
1612.980	R53	SMD 100k-5-0,125 W	HN 329 T.4	
1612.948	R54	SMD 10k-5-0,125 W	HN 329 T.4	
1677.764	R55	SMD 16,9k-1-0,125 W	HN 329 T.3	
1647.482	R56	SMD 3,09-1-0,125 W	HN 329 T.3	
1647.075	R60	SMD 680-5-0,125 W	HN 329 T.4	
1647.091	R61	SMD 6,8k-5-0,125 W	HN 329 T.4	
1647.091	R62	SMD 6,8k-5-0,125 W	HN 329 T.4	
1642.391	R63	SMD 22k-5-0,125 W	HN 329 T.3	
1670.611	R64	SMD 10k-1-0,125 W	HN 329 T.4	
1930.915	R65	SMD 150-5-0,062 W	HN 329 T.2	
1930.907	R66	SMD 39-5-0,062 W	HN 329 T.2	
1930.915	R67	SMD 150-5-0,062 W	HN 329 T.2	
1995.677	R68	9,1k/5/0805	DBL 6160000/C01B	
1995 677	R69	9,1k/5/0805	DBL 6160000/C01B	
1612.875	R71	SMD 270-0-0,125 W	HN 329 T.4	
1612.875	R73	SMD 270-5-0,125 W	HN 329 T.4	
1930.893	R75	Potentiometer 1k	typ 170/6 MOL	
1704.621	R76	SMD 470-5-0,125 W	HN 329 T.4	
1704.621	R77	SMD 470-5-0,125 W	HN 329 T.4	
1612.913	R78	SMD 4,7k-5-0,125 W	HN 329 T.4	
1678.752	R79	SMD 100k-1-0,125 W	HN 329 T.3	
1647.105	R80	SMD 100-5-0,125 W	HN 329 T.4	
1643.460	R81	SMD 1k-5-0,125 W	HN 329 T.4	
1647.202	R82	SMD 12k-5-0,125 W	HN 329 T.4	
1678.752	R83	SMD 100k-1-0,125 W	HN 329 T.4	
1808.524	R84	SMD 1,2K-5-0,125 W	HN 329 T.4	
1647.091	R85	SDM 6,8K-5-0,125 W	HN 329 T.4	
1612.816	R86	SDM 6,8-10-0,125 W	3,2 x 1,6	
1612.832	R87	SMD 15-5-0,125 W	3,2 x 1,6 x 0,58	

Coils:

1871.854	L8	Spule 291 GNS-2089 FSK		
1916.106	L9	SMD 100 µH/10 %	FA 101 K	
1422.545	L10	Spule 0,34 µH/5 %	97 E 2.140.86	HAGENUK
1871.854	L11	Spule 291 GNS-2089 FSK		
1916.106	L12	SMD 100 µH/10 %	FA 101 K	
1916.106	L16	SMD 100 µH/10 %	FA 101 K	
1916.106	L17	SMD 100 µH/10 %	FA 101 K	
1916.092	L22	SMD 1 µH/20 %	FA 1 ROM	

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Ident-No	Mark	Electr. value	Identity	Manufacturer
1916.092	L23	SMD 1 µH/20 %	RA 1 ROM	
	L24	Spule 336 nH		
1915.967	L25	Spule 380 nH	97 E 2.155.175-7	
	L26	Spule 336 nH		
1965.387	L27	100 µH	97 E 2.155.87	
1965.387	L28	100 µH	97 E 2.155.87	
1916.106	L29	SMD 100 µH/10 %	FA 101 K	
1887.688	L30	1000 µH/20 %	Typ 77.50	
1929.879	L31	100 µH/5 %	B 78108-S1104 J	
1930.877	L32	100 nH	97 E 2.155.190-2	
	L36	123 nH		
	L37	141 nH		
1915.983	L38	141 nH	97 E 2.155.175-9	
	L39	123 nH		
	L40	88 nH		
1915.975	L41	100 nH	97 E 2.155.175-8	
	L42	88 nH		
1916.092	L43	SMD 1 µH/20 %	FA 1 ROM	
1916.106	L44	SMD 100 µH/10 %	FA 101 K	
1068.105	L45	0,15 µH/10 %	Typ 72.0	
1068.105	L46	0,15 µH/10 %	Typ 72.0	
	L47		97 E 2.155.175-10	

Integrated circuits:

1427.156	IC A	CA 3240 E	
1427.156	IC B	CA 3240 E	
1815.105	IC C	IC UA 733 N	
1865.676	IC D	IC LM 78 L 12 AC	

Transistors:

1710.575	T1	BC 849 B 23 A3	
1710.575	T2	BC 849 B 23 A3	
1916.122	T3	BFR 53	
1916.122	T4	BFR 53	
1478.834	T5	2xBF 246 B	
1478.834	T6	97 D 2.140.84	
1710.575	T7	BC 849 B 23 A3	
1740.520	T8	BC 859 B 23 A3	
1887.742	T9	BF 982	

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Ident-No.	Mark	Electr. value	Identity	Manufacturer
Connectors:				
1705.504	ST1		11,1520,001	
1705.504	ST2		11,1520,001	
1827.642	ST3		0-826629-3. 3-polig	
1826.514	ST4		609-1604 E 16polig	
1705.504	ST6		11,1520,001	
Supplements:				
1420.836	QF1	63,078 MHz	97 E 2.140.85-10	
1420.828	M1		SRA-3H	
1930.761	BU3		97 E2.155.86	
1521.446	REL.A	DR-15 V		
1521.446	REL.B	DR-15 V		