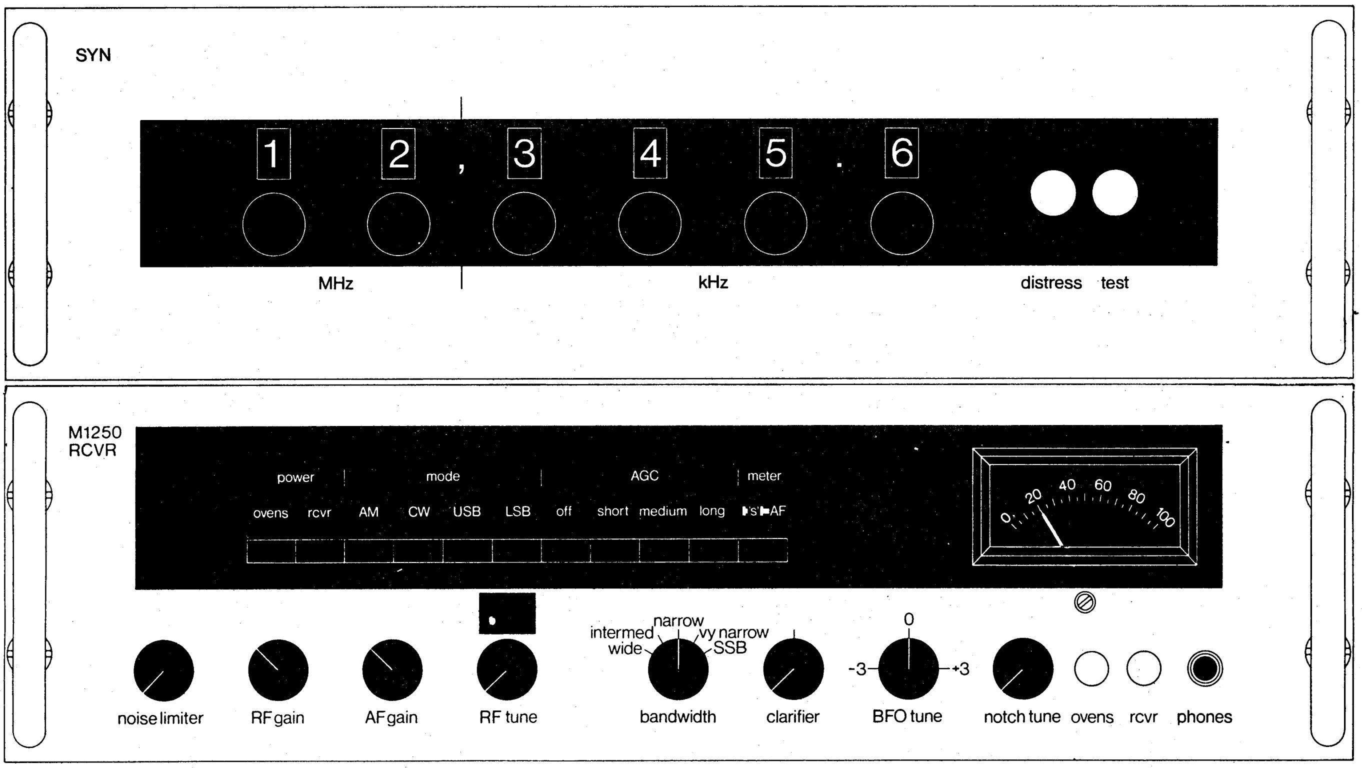
instruction manual

MARINE MAIN RECEIVER

part 1. receiver chassis (1973-05)

elektromekano M1250



dansk radio aktieselskab

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M 1250 Receiver

Appendix to instruction manual.

In addition to what is stated about the RF TUNE control in the instruction manual chapters CONTROL FUNCTIONS AND OPERATION and OPERATION please note:

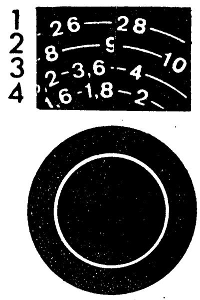
The RF tuned circuits are band-switched from the synthesizer and the tuning bands are:

20 - 30 MHz
10 - 20 MHz
4 - 10 MHz
2 - 4 MHz
1 - 2 MHz
400 - 1000 kHz
200 - 400 kHz
100 - 200 kHz
below 100 kHz no RF tuning

The RF TUNE control dial has the following scales:

20 30	(1)	see the attached sketch
4 10	(2)	
2 4	(3)	
1 2	(4)	

Use the scales as follows:



Synthesizer frequency setting:	Scale
20 to 30 MHz	(1)
10 to 20 MHz	(4)
4 to 10 MHz	(2)
2 to 4 MHz	(3)
1 to 2 MHz	(4)
400 to 1000 kHz	(2)
200 to 400 kHz	(3)
100 to 200 kHz	(4)
below 100 kHz	RF TUNE not to be used.

The normal operating procedure should with regard to the RF TUNE control be:

1. Setting of frequency synthesizer for the desired frequency.
2. Setting of the RF TUNE control as accurately as the scale permits.
3. Setting of other receiver controls.
4. Peaking of the RF TUNE control for signal maximum.

1972-11-08

TECHNICAL DATA.

The M 1250 is a precision Marine Radio Receiver, primarily intended for use as a ship's main receiver.

An exceptionally high degree of frequency stability and frequency setting accuracy is achieved by Synthesizer Frequency Control. Frequency setting and read-out are digital, with a minimum frequency increment of 100 Hz. A tuneable VXCO provides a resolution better than 5 Hz.

The M 1250 receiver's wholly solid-state circuitry, with only modern silicon integrated circuits, transistors and diodes offers the advantage of high reliability, long life and lower power consumption. All circuits are built on exchangeable printed circuit boards.

The M 1250 receiver consists of two units, one frequency synthesizer unit and a receiver circuitry unit. The units are designed to conform to standard 19" rack dimensions.

Specifications:

Frequency Range	10 kHz - 30 MHz
Frequency Control	Synthesizer with digital display in increments to 100 Hz.
Speech Clarifier (VXCO)	Crystal controlled, continuous variable, very fine tuning control ± 100 Hz, for SSB telephone reception, resolution 5 Hz.
Frequency Stability	10 Hz or better, short term (15 min.) 30 Hz or better, long term (3 months)
Modes of Reception	Telegraphy: A1, A2, A2H Telephony: A3, A3H, A3A, A3J (upper sideband)
Sensitivity	At frequencies above 1.6 MHz typically: Better than 1 μV for 10 dB SINAD at 1 kHz bandwidth (A1) Better than 3.5 μV for 20 dB SINAD at 2.4 kHz bandwidth (A3A) Better than 18 μV for 20 dB SINAD at 8 kHz bandwidth (A3)
Selectivity	"Wide" 8 kHz at 6 dB, 40 kHz at 60 dB "Intermediate" 2 kHz at 6 dB, 12 kHz at 60 dB "Narrow" 1 kHz at 6 dB, 7 kHz at 60 dB "Very Narrow" 0.2 kHz at 6 dB, 4 kHz at 60 dB "SSB" 2.4 kHz at 6 dB, 4.25 kHz at 60 dB
Cross Modulation	For a wanted A3A/A3J signal of 1 mV emf. an interfering A2 signal of 32 mV emf. at 20 kHz removed, produces no cross modulation products higher than 33 dB below the wanted standard signal.
Intermodulation	When the receiver is adjusted to give standard output with a wanted signal of 30 μV, the level of any two interfering A0 signals must each be at least 10 mV emf. to give intermodulation products of not more than the standard output level.
Blocking	For a wanted signal of 1 mV emf. an interfering signal of 100 mV emf., 20 kHz removed, causes a change in the standard output of less than 3 dB.

Image Rejection Ratio	70 to 100 dB
IF Rejection Ratio	70 to 80 dB
Spurious Rejection Ratio	66 to 80 dB outside 60 dB bandwidth
Non-Linear Distortion	Max. 10 % at maximum output
Fidelity	At bandwidth pos. "SSB" the audio output response is within a range of 6 dB for all modulation frequencies between 350 and 2400 Hz.
Automatic Gain Control	A change in the input signal of 100 dB produces less than 6 dB change in the receiver output.

Time constants	Attack	Decay
1.	20 m.sec.	800 m.sec.
2.	20 m.sec.	2.5 sec.
3.	20 m.sec.	5 sec.

Beat Frequency Oscillator	Variable within ± 6 kHz for CW (A1) reception.
Metering	"s"-meter indicating line as well as signal levels.
Audio Frequency Notch Filter	Notch greater than 40 dB variable from 300 to 3000 Hz, to tune out an interfering beat.
Power Output	Max. 2 watts for 3-5 ohms loudspeaker Max. 10 mW for 600 ohms line Max. 10 mW for 100 ohms headphones
Front End Protection	The receiver withstands an emf. of 30 volts rms applied to its antenna terminals.
Muting	Fast acting, electronic, built-in
Temperature Range	0°C to +55°C
Relative Humidity	Up to 95 % at +40°C
Operating Voltages	220 V AC ± 10 %, 50 or 60 Hz
Power Consumption	55 watts

Dimensions and Weight

	with cabinet	for 19" rack
Height	320 mm	265 mm
Width	530 mm	483 mm
Depth	550 mm	425 mm
Weight	25 kg	20 kg

Controls

Six knobs for direct digital frequency selection and display to nearest 100 Hz.

Speech clarifier:	Very fine tuning control		
Power switch:	OVENS	=	stand-by
	RCVR	=	operate
Mode switch:	AM		
	CW		
	USB		
	LSB (optional)		

Selectivity switch: WIDE
INTERMEDIATE
NARROW
VERY NARROW
SSB

AGC: off, short, medium, long time constant

Meter switch: "s"/AF switch

RF gain control

AF gain control

RF input tuning control

BFO tuning control

Notch filter tuning control with on/off switch

Noise limiter adjustable with off position

Headphone jack

600 ohms line output (at rear)

External loudspeaker connection (at rear)

CONTROL FUNCTIONS AND OPERATION

Mode of operation depends largely upon application of the receiver. This description will contribute to optimise reception in the desired mode.

References to the controls are in capitals and in accordance with the front panel titles adjacent to them.

CONTROL FUNCTIONS

Controls:

POWER	Latched push-button switch OVEN for switching the receiver to a stand-by condition. Latched push-button switch RCVR for switching the receiver into operation.
BFO	Potentiometer control to tune the Variable Beat frequency oscillator. In zero position the BFO frequency coincides with the i.f. frequency (1400 kHz). In plus or minus position the BFO frequency is $\pm$ 6 kHz respectively to the i.f. center frequency.
AF GAIN	Potentiometer control to adjust the output power to loudspeaker and headphones.
AGC	Push-button switch with the positions: OFF, manual r.f. gain control and no a g c and SHORT, MEDIUM and LONG with no manual r.f. gain control and automatic gain control with various time constants.
MODE	Push-button switch for selecting the mode of operation: AM with envelope detection for A2, A3 or A3H reception, CW with a product detector for A1 and A2 reception, USB with the product detector for upper sideband A3A or A3J reception and LSB (normally locked) for optional lower sideband reception.
RF TUNE	This control works a ganged variable capacitor to tune the RF pre-circuits. A dial is provided to indicate when the control is tuned to the desired frequency.
METER	This control switches the meter to monitor, either r.f. signal strength or a.f. signal level on a 600 ohms line, connected to the 10 mW line amplifier.
RF GAIN	Potentiometer control, for manual setting of the desired gain in the RF and IF amplifiers. This control is operative only with the a g c switch in position OFF.
NOTCH TUNE	Potentiometer control with an ON/OFF switch. In position ON tuning is possible of a notch of appr. -40 dB from 300-3000 Hz, to attenuate undesired interfering frequencies in the audio spectrum.
CLARIFIER	A fine tuning control to off-set the VXCO frequency $\pm$200 Hz. This control provides the continuity in frequency setting from 10 kHz to 30 MHz, with a resolution of appr. 5 Hz.
NOISE LIMITER	Potentiometer control to reduce atmospheric and man-made noise.

OPERATION

It is assumed that the M 1250 Receiver has been properly installed before operation is attempted. Check to make certain that the antenna and speaker are properly connected, and that the power is correct.

1. **Brief Operating Instructions**

The following instructions will enable the operator to adjust quickly and accurately the M 1250 receiver for reception of SSB, CW or DSB signals.

1.1 **Preliminary setting of the controls:**

Power switch	buttons pressed
AF GAIN	midway
AGC switch	in position SHORT
METER	in position "s"
NOISE LIMITER	in position OFF
NOTCH TUNE	in position OFF
BANDWIDTH	in position WIDE

1.2 **AM Operation**

(a) Push the mode AM button
(b) Set the synthesizer to the desired frequency
(c) Adjust the RF TUNE knob until the dial indicates the chosen frequency
(d) Rotate the RF GAIN control clockwise until a comfortable listening level is achieved
(e) Readjust the RF TUNE knob for maximum deflection on the front panel meter

1.3 **CW Operation**

It is assumed that the M 1250 has been previously adjusted for AM operation.

(a) Push the mode CW button
(b) Rotate the BFO TUNE knob until a comfortable tone of signals is achieved (approx. 1000 Hz)
(c) Select a suitable receiving bandwidth

1.4 **SSB Operation**

It is assumed that the M 1250 has been previously adjusted for CW operation.

(a) Push the mode USB button
(b) Set the bandwidth switch in the SSB position
(c) Push the a g c button LONG
(d) If necessary, tune the CLARIFIER control for improved intelligibility

2. **Detailed use of M 1250 controls:**

2.1 Synthesizer controls, and CLARIFIER:

In the digital type frequency synthesizer an h.f. oscillator is phase-locked to the reference frequency of a high precision standard oscillator. Frequency setting and read-out are digital, with a minimum frequency increment of 100 Hz. To select the desired frequency, six switches on the synthesizer unit have to be operated. When the synthesizer is set to one of the distress frequencies, 500 or 2182 kHz, the red DISTRESS indicator will light. If the synthesizer signal is out of phase as compared to the standard oscillator, the TEST indicator will light, i.e. the synthesizer does not work as it should.

To obtain a resolution of 5 Hz, it is necessary to operate the CLARIFIER. This control is a potentiometer, permitting a ±200 Hz adjustment of the VXCO. This control also serves the purpose of tuning the pitch in SSB reception mode.

2.2 RF TUNE

The RF Tune control operates a ganged capacitor which tunes the RF precircuits. With the synthesizer set to the desired frequency, strong signals will be received even with the precircuits detuned. Tuning of these circuits will, on the other hand, by virtue of the improved S/N ratio, improve the readability of the intelligence considerably. The dial connected to this control is calibrated in MHz. The dial indication is only approximate. Tune for max. deflection on the panel instrument to obtain an accurate tuning of the precircuits.

2.3 Operating mode

The MODE push buttons provided selection of detectors and oscillators for different types of reception. For A2, A3 and A3H reception an envelope detector is selected with the AM button. The CW button provides reception with a product detector and a variable beat frequency oscillator for A1 and A2 signals. The USB button connects a crystal-controlled beat frequency oscillator to the product detector for single-sideband (upper sideband) reception. The LSB button is for lower sideband use, this is an optional facility and the push button is normally blocked.

2.4 Selectivity

Intermediate frequency crystal bandpass filters provide five different receiving bandwidths, to be selected with the BANDWIDTH switch. An 8-kHz passband, WIDE, is for A3-reception and for 500 kHz-watchkeeping. INTERMEDIATE bandwidth, 2 kHz, is mainly for A1- and A2-reception. NARROW and VERY NARROW with bandwidths of 1 kHz and 0.2 kHz, respectively, are for A1-reception. SSB provides a 2.4 kHz wide passband for single sideband reception.

2.5 AGC

The AGC amplifier operates in a reversed system with attack and decay time optimized for SSB, CW and DSB reception, without any disablements on account of noise pulses. The AGC control switches either between different time constants, i.e. different decay times (Short, Medium and Long) or the control switches the AGC amplifier off. In OFF position, all AGC is removed from the receiver.

To prevent overloading the receiver it is recommended to set the RF GAIN control so that the received signal does not drive the AF LEVEL instrument off scale. In the three other positions the

AGC system works and decay times short, medium and long are appr. 0.8, 2.5 and 5 sec.

2.6 METER switch.

This switch operates the panel instrument in two positions:
In "s"-position the instrument indicates the incoming signal strength The read-out is a linear scale, calibrated from 0 to 100. Normal deflection is from 60 to 80.

In position AF the instrument indicates the power output from the a.f. line amplifier, terminated to a 600 ohms line. The indication scale is calibrated in dBm from 0 to 10. Normal meter deflection will be appr. 0 dBm, i.e. 1 mW into 600 ohms.

2.7 AF Gain

The audio gain control on the upper right hand side of the receiver unit varies the audio output of the a.f. amplifier, but confined to the output to the headphones and loudspeaker. The 10 mW line amplifier has a preset output level.

2.8 RF Gain

The RF Gain control of M 1250 operates on both r.f. amplifier and i.f. amplifier. This control works only when the a g c is turned off by the AGC switch. When the strength of the received signals is on approximate sensitivity level, the RF Gain control should be adjusted fully clockwise. When signals of higher strength are received, the RF GAIN should be operated to give a deflection on the panel instrument of 60-80. (RF level)

2.9 BFO Tune

In receiving mode CW, a variable oscillator is used to give the desired beat. This oscillator (a modified Colpitts) has a basic frequency of 1400 kHz. The operator may vare this frequency ± 6 kHz by adjusting the BFO Tune control. The frequency offset is achieved by varying the d.c. voltage across a varactor.

2.10 Noise Limiter

This is a potentiometer control to adjust the bias of the diodes in a double diode limiter. The purpose of this control is to limit atmospheric noise superimposed on the signal.

2.11 Notch Tune

The notch filter is a modified Wien-bridge, working as an active filter and tuneable in the range 300 to 3000 Hz by the NOTCH TUNE control. The filter will attenuate frequencies inside the narrow notch, appr. -40 dB. The filter is thus enabled to attenuate undesired interfering signals in the audio output without impairing the intelligence.

2.12 Audio Frequency Outputs

The front panel headphone jack serves as a loudspeaker switch. The external loudspeaker will be switched off when a plug is inserted into the headphone plug.

2.13 Power

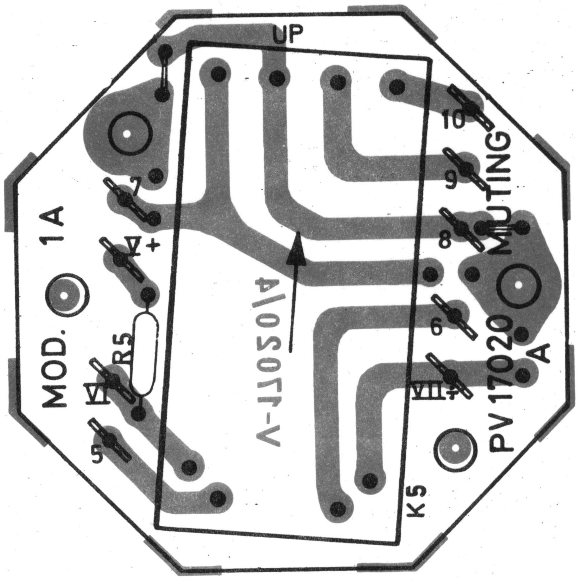
The latched push button marked OVENS is the "stand-by" switch. When activated, it switches on the quarz crystal ovens of the receiver and the synthesizer. The stand-by condition is indicated by an appropriate lamp on the front panel. The push button RCVR is the "operate" switch and the "operate" condition is, too, indicated by a front panel lamp.

Description of the separate Modules.

Contents:

Contents (cont'd) Page:

Module 1A R.F. Input Protection and Muting Circuit.



PVs 17020 and 17012

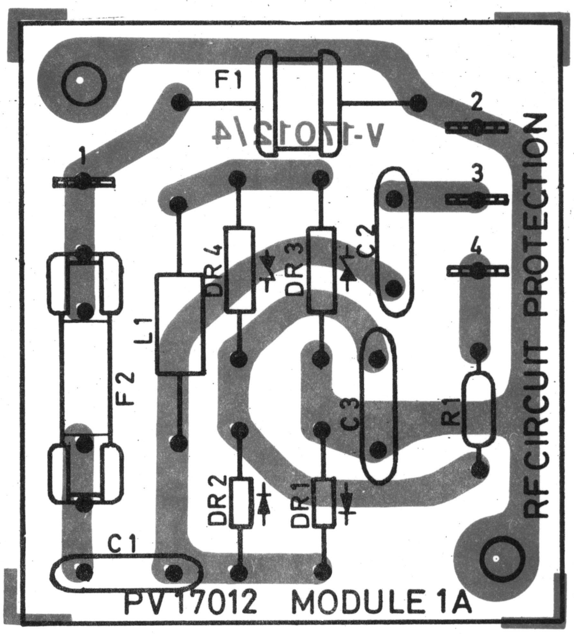
Circuit Diagram S-5836/4

Circuit Description:

The R.F. input protection circuit consists of a gas-filled surge arrester F1, a 0.5-amp fuse F2 and a pair of back-biased fast high-current silicon diodes DR1 and DR2.

The surge arrester will protect against static and high transient voltages. The fuse and the diodes will protect against excessive R.F. voltages from a near-by transmitter. For moderate voltages the diodes will conduct and thus limit the voltage to the receiver input. In the case of higher voltages the fuse may blow.

The muting relay K5, when energized, disconnects the antenna from the receiver input tuned circuits and at the same time provides desensitizing by interrupting the 12-volt supply for the receiver's I.F. amplifier.



PARTS LIST

Module 1A: RF Circuit Protection

PV-17012

Symbol	Description		Stock No.
C1	Cond., cer. disc	0.1 uF 16V	CKS 86
C2	same as C1		
C3	same as C1		
DR1	Diode,	type 1N4448	Philips
DR2	same as DR1		
DR3	Zener Diode	type 1N4729	Motorola
DR4	same as DR3		
F1	Overload fuse	90V	F0 100
F2	Glass tube fuse	0.5A	FGB 0.50

PARTS LIST

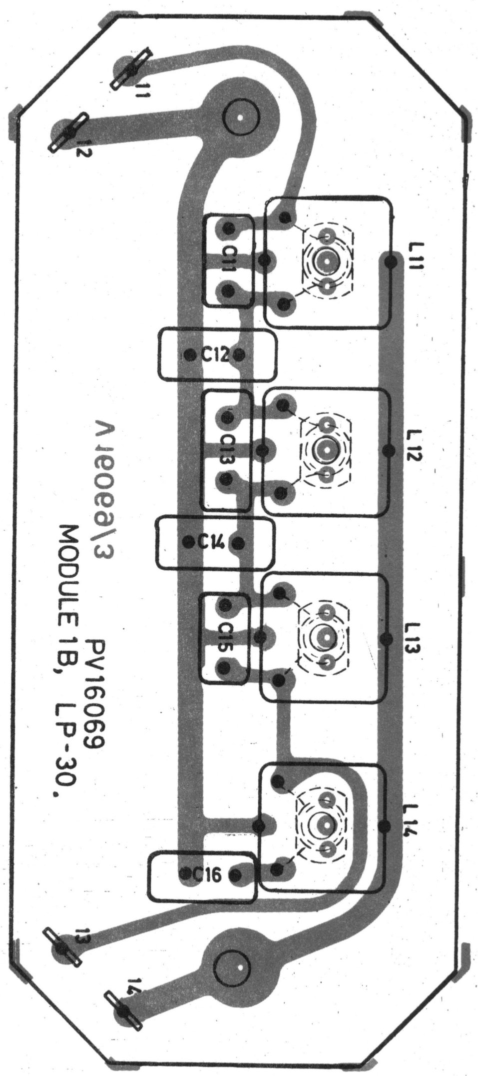
Module 1A: Muting

PV-17020A

Symbol	Description	Stock No.
K5	Mercury Relay	KR-17027-1
R5	Resistor, 180 ohm 5% 1/4W	RK00-181

Module 1B Lowpass Filter LP-30

PV 16069 Circuit Diagram S-5564/4



Circuit Description.

The purpose of this filter is to provide sufficient image and i.f. rejection ratio.

The filter also prevents radiation of 1st and 2nd local oscillator frequencies from the antenna.

0-30 MHz is the passband of the filter, which also has a trap, providing extra attenuation at the 1st i.f. frequency.

PARTS LIST

Module 1B - LP-30

PV-16069

Symbol	Description					Stock No.	
C11	Condenser,	Mica	33 pF	$\pm 2\%$	500V	CGSR5N-330	
C12	"	"	100 "	"		"	101
C13	"	"	47 "	"		"	470
C14	"	"	120 "	"		"	121
C15	"	"	22 "	"		"	220
C16	"	"	56 "	"		"	560
L11	Coil					V-16046/4-501	
L12	Coil					"	-502
L13	Coil					"	-503
L14	Coil					"	-504

Module 1B Lowpass Filter LP-30

TEST PROCEDURE

Test Equipment:

Polyscope

HF Signal Generator

Heterodyne Voltmeter

1. Connect the LP-30 to the Polyscope. The LP-30 should have a 50 ohms termination.

2. Set the core of L13 so that its lower end reaches the bottom edge of the former, and then adjust five turns upwards.

3. Set the core of L11 so that the top of the core reaches the level of the screening can. Make sure that the screening can is mounted close to the P. C. board.

4. The core of L14 should be at the top of the former, as far out as possible.

5. Adjust the core of L12 to the filter cut-off frequency, f_c (-3 dB) is 30 MHz (see Fig. 1.) This image should appear before the core is midway in the former. Lock the cores of L11, L12 and L13.

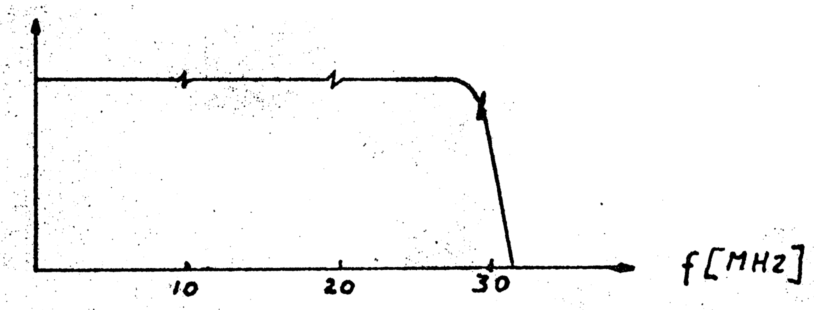


Fig. 1: Filter response curve LP-30, partially adjusted.

6. Connect the LP-30 between a Heterodyne Voltmeter and an H. F. Signal Generator. 50 ohms termination is important.

7. Calibrate the generator to 35 MHz. The output signal should be 10-20 mV.

8. Adjust the core of L14 to minimum reading on the Heterodyne Voltmeter. Lock the core.

Module 2: RF Amp., 1st and 2nd Mixer

PV-17947 Circuit Diagram S-5941/4

Circuit Description

The module incorporates r.f. amplifier, 1st mixer, 1st i.f. amplifier and 2nd mixer.

The r.f. amplifier is a two-stage selective amplifier, consisting of two dual-gate MOS-FET transistors, V21 and V22 in common source configuration.

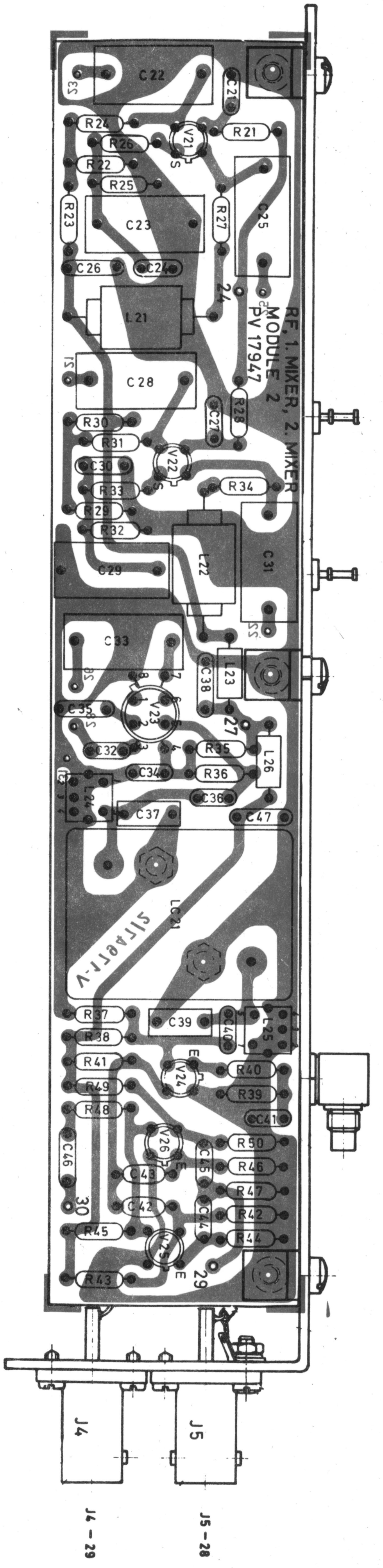
The amplifier load consists of tunable r.f. circuits (module 3), placed outside this module. Both stages are gain-controlled.

The 1st mixer employs an integrated circuit V23 in a double-balanced mixer configuration. The output is balanced as far as the 1st oscillator signal from the synthesizer is concerned.

The first i.f. (35 MHz) amplifier employs a 35 MHz crystal filter and a single RC-coupled amplifier stage, consisting of transistor V24.

The only difference between the 1st and 2nd mixer is that the latter consists of the two transistors V25 and V26. Both appear in a double-balanced mixer configuration.

The output of 1.4 MHz, i.e. 2nd i.f., is fed to selectable crystal filters which determine the receiver selectivity.



PARTS LIST

Module 2: RF 1. Mixer, 2. Mixer (second type)

PV-17947

Symbol	Description					Stock No./Supplier
C21	Cond.,	cer. disc	0.01 µF	-20 +80 %	30V	CKS 83
C22	"	polyester	1 "	+20 %	100V	CQF0B-105
C23	"	polyester	1 "	+20 %	100V	"
C24	"	cer. disc	0.01 "	-20 +80 %	30V	CKS 83
C25	"	polyester	1 "	+20 %	100V	CQF0B-105
C26	"	cer. disc	0.1 "	-20 +80 %	20V	CKS 86
C27	"	cer. disc	0.01 "	-20 +80 %	30V	CKS 83
C28	"	polyester	1 "	+20 %	100V	CQF0B-105
C29	"	polyester	1 "	+20 %	100V	"
C30	"	cer. disc	0.01 "	-20 +80 %	30V	CKS 83
C31	"	polyester	1 "	+20 %	100V	CQF0B-105
C32	"	cer. disc	0.01 "	-20 +80 %	30V	CKS 83
C33	"	polyester	1 "	+20 %	100V	CQF0B-105
C34	"	cer. disc	0.01 "	-20 + 80 %	30V	CKS 83
C35	"	cer. disc	0.1 "	-20 +80 %	20V	CKS 86
C36	"	cer. disc	0.01 "	-20 +80 %	30V	CKS 83
C37	"	ceramic	10 pF	±0.5 pF	500V	CKR 227
C38	"	cer. disc	0.1 µF	-20 +80 %	20V	CKS 86
C39	"	ceramic	12 pF	±5 %	500 V	CKR 230
C40	"	cer. disc	0.01 µF	-20 +80 %	30V	CKS 83
C41	"	cer. disc	0.01 "	-20 +80 %	30V	"
C42	"	cer. disc	0.01 "	-20 +80 %	30V	"
C43	"	cer. disc	0.01 "	-20 +80 %	30V	"
C44	"	cer. disc	0.01 "	-20 +80 %	30V	"
C45	"	cer. disc	0.01 "	-20 +80 %	30V	"
C46	"	cer. disc	0.1 "	-20 +80 %	20V	CKS 86
C47	"	cer. disc	0.1 "	-20 +80 %	20V	"
L21	Choke		2.5 mH			LH-6471
L22	"		2.5 "			"
L23	"		100 µH			LH-16080-17
L24	Coil					V-18041/4-501
L25	"					"
L26	Choke		100 µH			LH-16080-17
LC21	Filter, 35 MHz, 10 kHz bandwidth,					VS YF 102-5
R21	Resistor		10 Kohm	5 %, 1/4W		RK00 103
R22	"		5.1	"		RK00 512
R23	"		33 "	"		RK00 333
R24	"		39 "	"		RK00 393
R25	"		560 "	"		RK00 561
L27	Choke		2.5 mH			LH-6471
L28	"		100 µH			LH-16080-17

Symbol		Description		Stock No./Supplier
R27	Resistor	1 Kohm,	5%, 1/4W	RK00 102
R28	"	10 "	"	RK00 103
R29	"	4.7 "	"	RK00 472
R30	"	33 "	"	RK00 333
R31	"	39 "	"	RK00 393
R32	"	360 "	"	RK00 361
R33	"	180 "	"	RK00 181
R34	"	1 Kohm	"	RK00 102
R35	"	680 ohm	"	RK00 681
R36	"	1 Kohm	"	RK00 102
R37	"	1 "	"	RK00 102
R38	"	10 "	"	RK00 103
R39	"	330 ohm	"	RK00 331
R40	"	100 "	"	RK00 101
R41	"	470 "	"	RK00 471
R42	"	10 Kohm	"	RK00 103
R43	"	18 "	"	RK00 183
R44	"	4.7 "	"	RK00 472
R45	"	820 ohm	"	RK00 821
R46	"	4.7 Kohm	"	RK00 472
R47	"	56 ohm	"	RK00 560
R48	"	220 "	"	RK00 221
R49	"	18 Kohm	"	RK00 183
R50	"	10 "	"	RK00 103
V21	Transistor	40673		RCA
V22	"	40673		"
V23	Integrert krets	SL 641C		Plessey
V24	Transistor	40245		RCA
V25	"	40245		"
V26	"	40245		"

Module 2: RF Amp., 1st and 2nd Mixer

TEST PROCEDURE

Test Equipment:

HF Signal Generator, range 2 - 4 MHz
Heterodyne Voltmeter
Frequency Synthesizer
Universal instrument, Ri 20 000 ohm/Volt
2 resistors, 560 ohm 1/4 W

Preliminary Procedure:

1. Connect the cables from the synthesizer marked P4 and P5 to the jacks on module 2, marked J4 and J5, respectively.
2. Connect the Heterodyne Voltmeter to J60.
3. Remove module 2 from the chassis, to permit connection of the HF signal generator directly to the printed circuit. Proper earth connection must be maintained between module 2 and the chassis.
4. Unsolder the leads from points 21, 22, 23, 25 and 26 on the P. C. board.
5. Connect the signal generator to point 23.
6. Solder the two resistors of 560 ohm between points 21 and 25 and between points 22 and 26 respectively.
7. Set the controls as follows:
   (a) Power Switch in position ON.
   (b) AGC Switch in position OFF
   (c) RF Gain control clockwise (max gain)

Test Procedure:

8. Set the frequency synthesizer to 3 MHz.
9. Tune the signal generator to 3 MHz and 20 μV output.
10. Tune the heterodyne voltmeter to 1. 4 MHz.
11. Adjust the core of L24 and L25 to maximum output. The heterodyne voltmeter should read about 1 mV (+34 dB).

Module 3: RF Coil Boards and RF Relay Boards

PV-17935 to
PV-17946 inclusive

Circuit diagram: S-5952/4 to S-5959/4 incl.

CIRCUIT DESCRIPTION

Receiver M1250 covers all frequencies within the range 100 kHz - 30 MHz. The frequency range is divided into 8 bands and selection of band is controlled from the frequency synthesizer.

Module 3 is made up by 12 sub-modules, of which 6 are P. C. boards with r. f. coils and 6 P. C. boards with reed relays. A coil board and a relay board mounted one on top of the other form one unit.

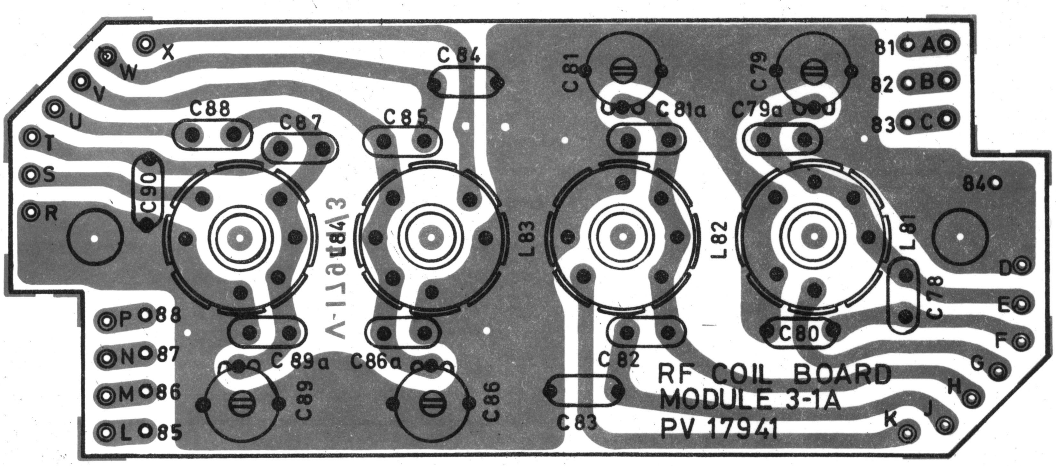
A coil board contains four coils and four adjustable capacitors which constitute four resonant circuits, each representing different bands. Three units form the complete pre-circuits of four different bands.

A relay board contains four reed relays, each with three working contacts. The reed relays switch the signal and the tunable capacitor (r. f. tune) to the resonant circuits for the band selected.

Assembly of sub-modules is shown on the following pages.

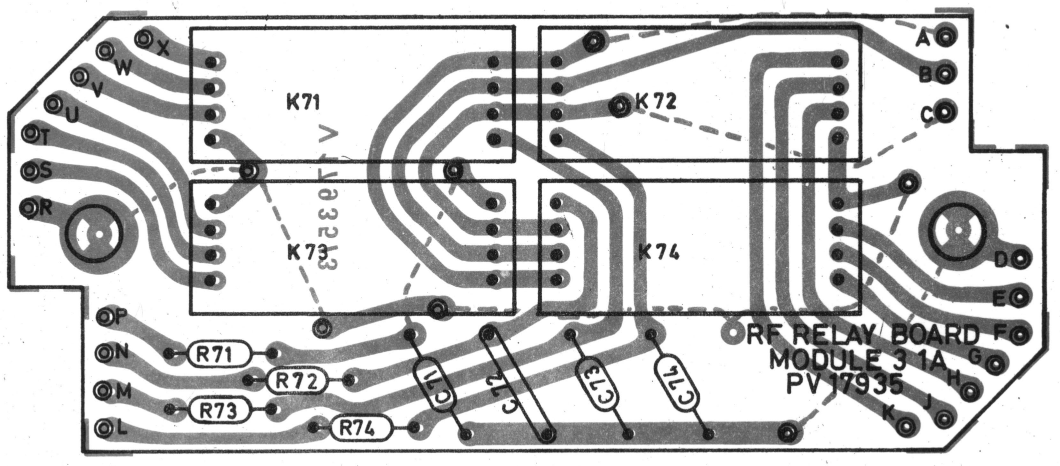
Module 3: RF COIL BOARD 1A

PV-17941



Module 3: RF RELAY BOARD 1A

PV-17935



Module 3: RF COIL BOARD 1A

PV-17941

Parts List

Symbol		Description				Stock No.
C78	Capacitor	Mica,	22 pF	±2%	500V	CGSR5N 220
C79	"	tuning, foil 2-20 pF				CT 06
C80	"	Mica,	200 pF			CGSR5N 201
C81	"	tuning, foil 2-20 pF				CT 06
C81a	"	Mica,	18 pF	±2%	500V	CGSR5N 180
C82	"	Mica,	68 pF	"	"	CGSR5N 680
C83	"	Mica,	33 pF	"	"	CGSR5N 330
C86	"	tuning, foil 2-20 pF				CT 06
C86a	"	Mica,	68 pF	"	"	CGSR5N 680
C88	"	Mica,	220 "	"	"	CGSR5N 221
C89	"	tuning, foil 2-20 pF				CT 06
C89a	"	Mica,	39 pF	"	"	CGSR5N 390
L81	Coil					V-18093/4-2
L82	"					V-18092/4-7
L83	"					V-18092/4-4
L84	"					V-18092/4-1

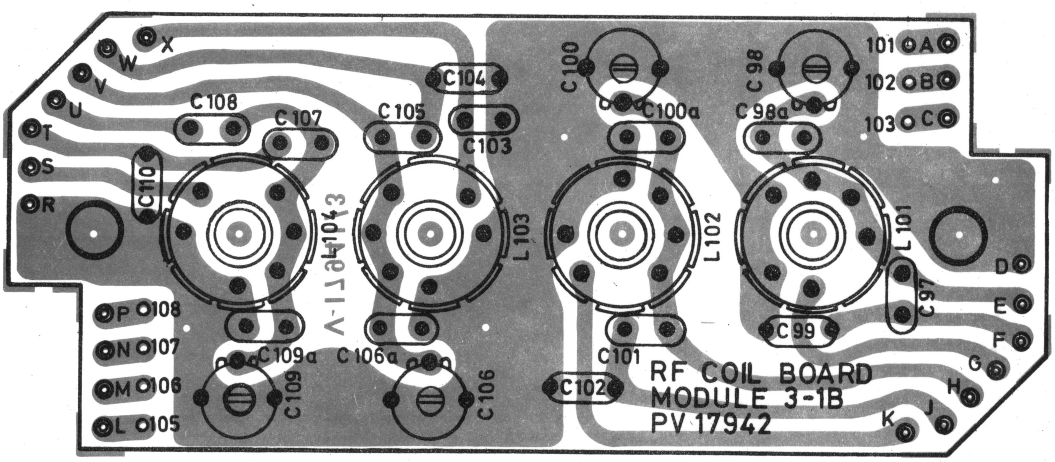
Module 3: RF RELAY BOARD 1A

PV-17935

C71	Capacitor	ceramic,	0.01 µF	-20+80%	30V	CKS 83
C72	"	"	0.1 "	"	50V	CKS 96
C73	"	"	0.01 "	"	30V	CKS 83
C74	"	"	0.01 "	"	30V	"
K71	Relay	24 V				KR-15081
K72-						
K73-						
K74	same as K71					
R71	Resistor	100 ohm,	5%,	1/4W		RK00 101
R72-						
R73-						
R74	same as R71					

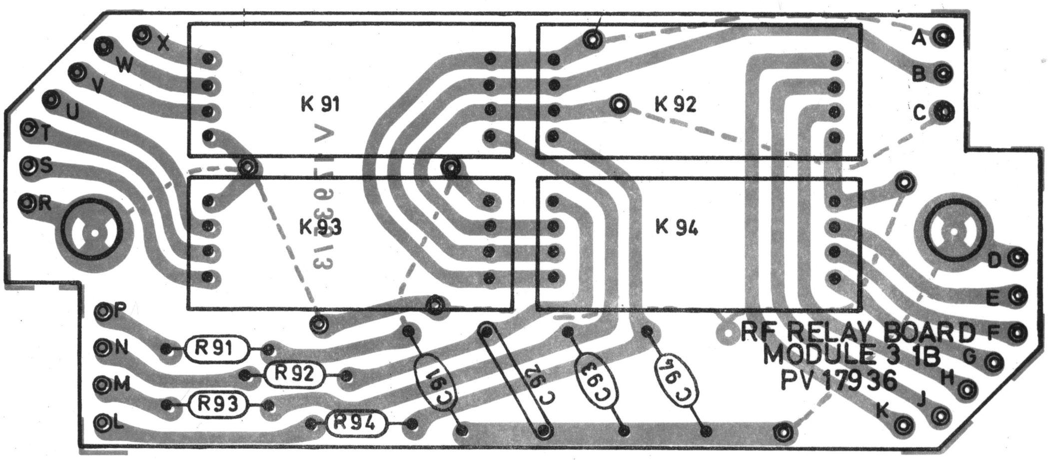
Module 3: RF COIL BOARD 1B

PV-17942



Module 3: RF RELAY BOARD 1B

PV-17936



Module 3: RF COIL BOARD 1B

PV-17942

Parts List

Symbol		Description				Stock No.
C 97	Capacitor	Mica	10 pF ±2%		500V	CGSR5N 100
C98	"	tuning, foil	2-10 "			CT 06
C99	"	Mica,	82 "	"	500V	CGSR5N 820
C100	"	tuning, foil	2-20 "			CT 06
C101a	"	Mica,	56 "	"	500V	CGSR5N 560
C101	"	Mica,	33 "	"	500V	CGSR5N 330
C102	"	Mica,	33 "	"	500V	"
C103	"	Mica,	82 "	"	500V	CGSR5N 820
C105a	"	Mica,	150 "	"	500V	CGSR5N 151
C106	"	tuning, foil	2-20 pF			CT 06
C108	"	Mica,	220 "	"	500V	CGSR5N 221
C109	"	tuning, foil	2-20 "			CT 06
L101	Coil					V-18093/4-3
L102	"					V-18093/4-1
L103	"					V-18092/4-5
L104	"					V-18092/4-2

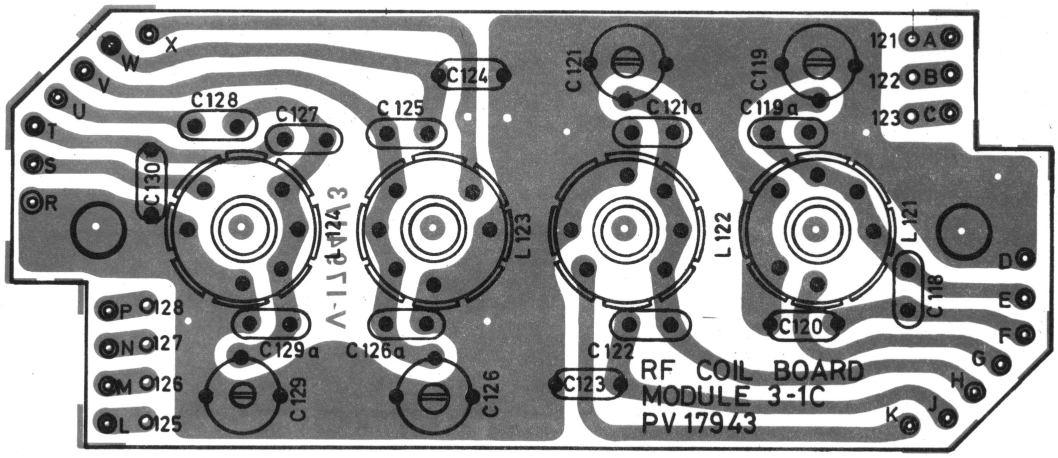
Module 3: RF RELAY BOARD 1B

PV-17936

C91	Capacitor,	ceramic,	0.01 µF	-20+80%	30V	CKS 83
C92	"	"	0.1 "	"	50V	CKS 96
C93	"	"	0.01 "	"	30V	CKS 83
C94	"	"	0.01."	"	30V	CKS 83
K91	Relay		24 V			KR 15081
K92-						
K93-						
K94	same as K91.					
R91	Resistor		100 ohm	5%	1/4 W	RK00-101
R92-						
R93-						
R94	same as R91					

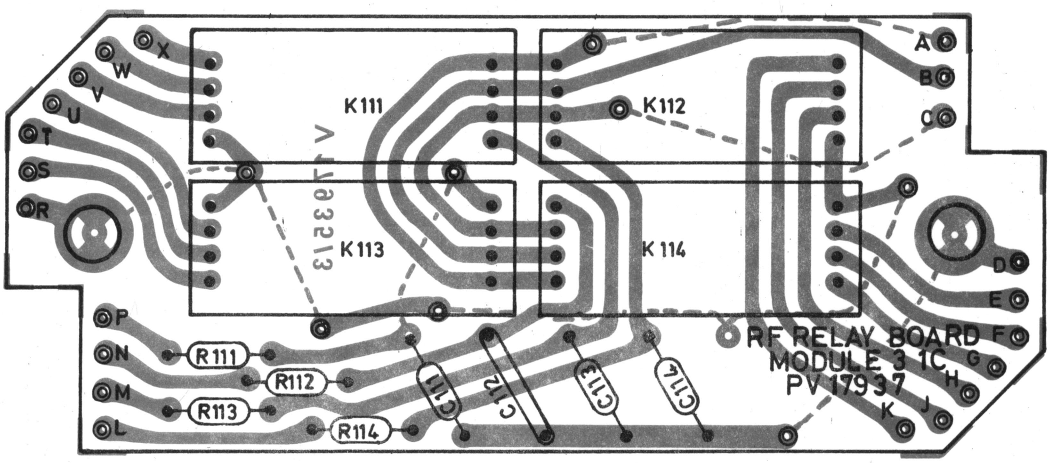
Module 3: RF COIL BOARD 1C

PV-17943



Module 3: RF RELAY BOARD 1C

PV-17937



Module 3: RF COIL BOARD 1C

PV-17 943

Parts List

Symbol		Description					Stock No.
C118	Capacitor	Mica	10 pF	±2 %	500V		CGSR5N 100
C119	"	tuning, foil	2-20 "				CT 06
C120	"	Mica	47 "	"	"		CGSR5N 470
C121	"	tuning, foil	2-20 "				CT 06
C121a	"	Mica	18 pF	"	"		CGSR5N 180
C122	"	Mica	22 "	"	"		CGSR5N 220
C123	"	Mica	10 "	"	"		CGSR5N 100
C126	"	tuning, foil	2-20 "				CT 06
C126a	"	Mica	47 "	"	"		CGSR5N 470
C128	"	Mica	220 "	"	"		CGSR5N 221
C129	"	tuning, foil	2-20 "				CT 06
C129a	"	Mica,	10 "	"	"		CGSR5N 100
L121	Coil						V-18093/4-4
L122	"						V-18092/4-8
L123	"						V-18092/4-6
L124	"						V-18092/4-3

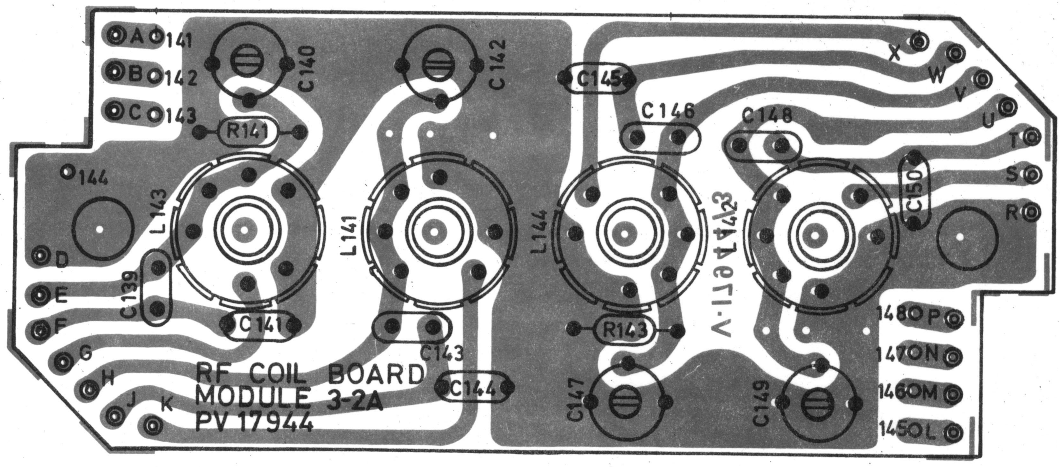
Module 3: RF RELAY BOARD 1C

PV-17937

C111	Capacitor	ceramic,	0.01 µF	-20+80 %,	30V	CKS 83
C112	"	"	0.1 "	"	50V	CKS 96
C113	"	"	0.01 "	"	30V	CKS 83
C114	"	"	0.01 "	"	30V	CKS 83
K111	Relay		24V			KR 15081
K112-						
K113-						
K114	same as K111					
R111	Resistor		100 ohm	5 %	1/4W	RK00 101
R112-						
R113-						
R114	same as R111					

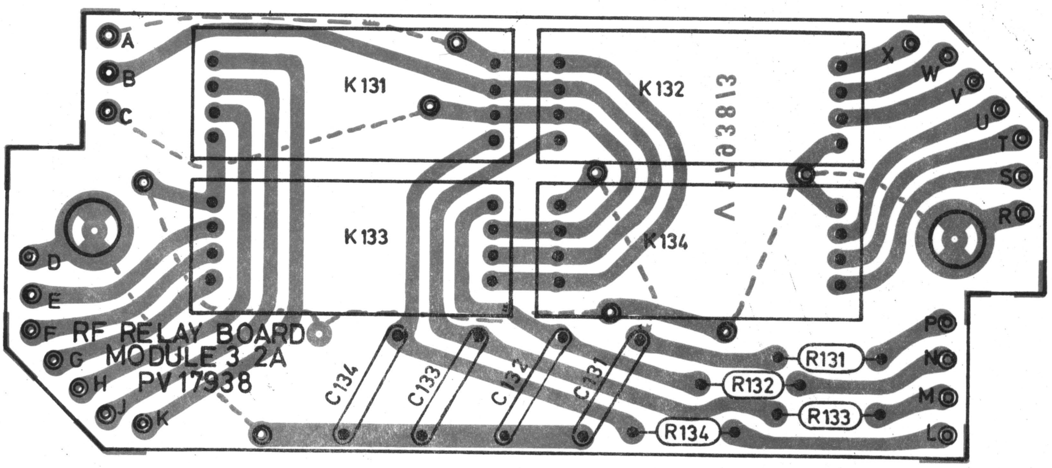
Module 3: RF COIL BOARD 2A

PV-17944



Module 3: RF RELAY BOARD 2A

PV-17938



Module 3: RF COIL BOARD 2A

PV-17944

Parts List

Symbol		Description			Stock No.
C139	Capacitor,	Mica	15 pF ±2 %	500V	CGSR5N 150
C140	"	tuning, foil	2-20 pF		CT 06
C141	"	Mica	56 pF ±2 %	500V	CGSR5N 560
C142	"	tuning, foil	2-20 pF		CT 06
C143	"	Mica	22 pF ±2 %	500V	CGSR5N 220
C144	"	Mica	68 pF ±2 %	500V	CGSR5N 680
C145	"	Mica	68 pF ±2 %	500V	CGSR5N 680
C146	"	Mica	22 pF ±2 %	500V	CGSR5N 220
C147	"	tuning, foil	2-20 pF		CT 06
C148	"	Mica	10 pF ±2 %	500V	CGSR5N 100
C149	"	tuning, foil	2-20 pF		CT 06
C150	"	Mica	320 pF ±2 %	500V	CGSR5N 321
L141	Coil				V-18093/4-5
L142	"				V-18093/4-8
L143	"				V-18093/4-11
L144	"				V-18093/4-14

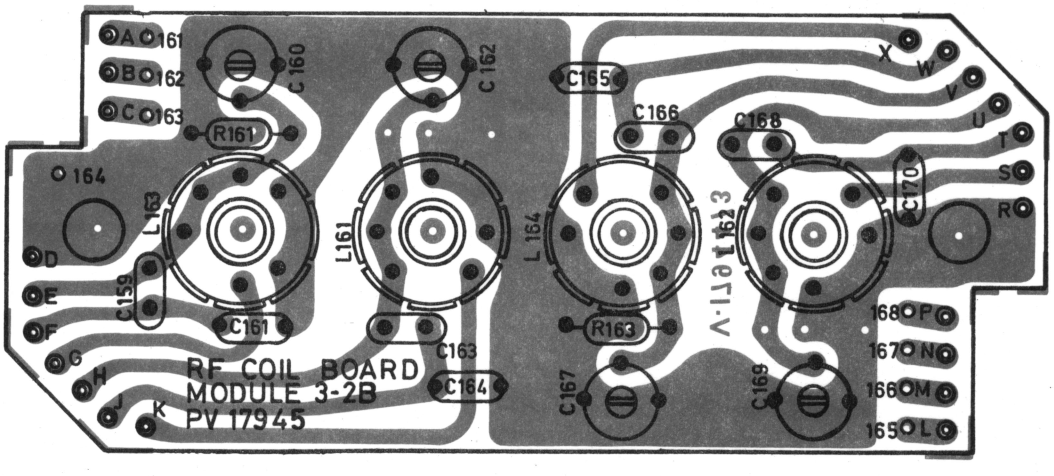
Module 3: RF RELAY BOARD 2A

PV-17938

C131	Capacitor,	ceramic,	0.1 µF	-20+80 %	50V	CKS 96
C132	"	"	0.1 "	"	50V	CKS 96
C133	"	"	0.1 "	"	50V	CKS 96
C134	"	"	0.1 "	"	50V	CKS 96
K131	Relay				24V	KR 15081
K132	"				24V	KR 15081
K133	"				24V	KR 15081
K134	"				24V	KR 15081
R131	Resistor		100 ohm	5 %	1/4W	RK00-101
R132	"		100 "	"	"	"
R133	"		100 "	"	"	"
R134	"		100 "	"	"	"

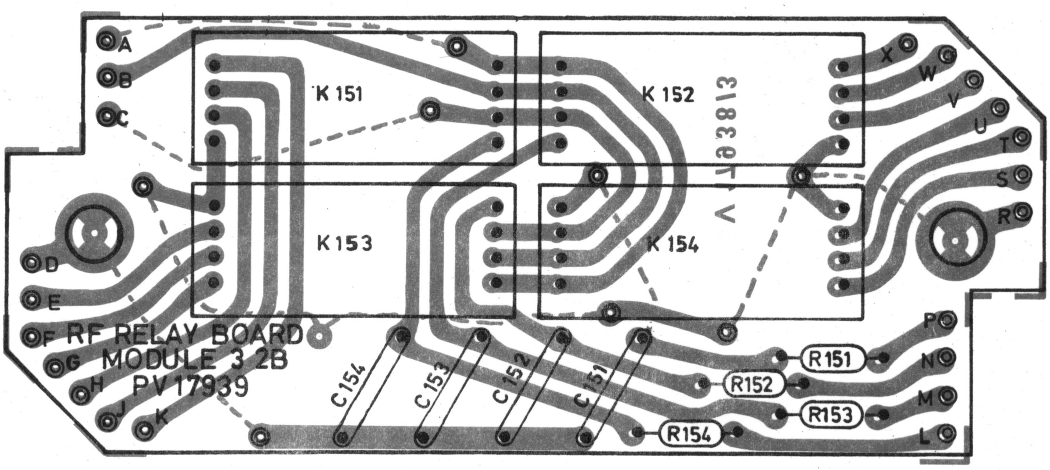
Module 3: RF COIL BOARD 2B

PV-17945



Module 3: RF RELAY BOARD 2B

PV-17939



Module 3: RF COIL BOARD 2B

PV-17945

Parts List

Symbol		Description				Stock No.
C159	Capacitor,	Mica	22 pF +2 %		500V	CGSR5N 220
C160	"	tuning, foil	2-20 pF			CT 06
C161	"	Mica,	56 pF +2 %		"	CGSR5N 560
C162	"	tuning, foil	2-20 pF			CT 06
C163	"	Mica,	22 pF +2 %		"	CGSR5N 220
C164	"	Mica	320 pF	"	"	CGSR5N 321
C165	"	Mica,	56 pF	"	"	CGSR5N 560
C166	"	Mica,	47 pF	"	"	CGSR5N 470
C167	"	tuning, foil	2-20 pF			CT 06
C168	"	Mica,	10 pF	"	"	CGSR5N 100
C169	"	tuning, foil	2-20 pF			CT 06
C170	"	Mica,	320 pF	"	"	CGSR5N 321
L161	Coil					V-18093/4-6
L162	"					V-18093/4-9
L163	"					V-18093/4-12
L164	"					V-18093/4-15
R161	Resistor	100 Kohm	5%,	1/4W		RK00-104
R162	"	100 "	5%	"		RK00-104
R163	"	33 "	5%	"		RK00-333

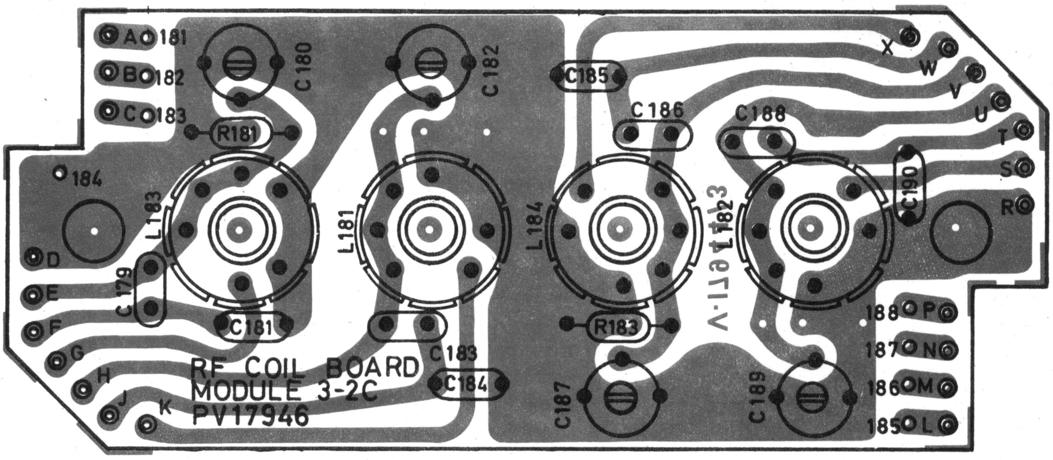
Module 3: RF RELAY BOARD 2B

PV-17939

C151	Capacitor,	ceramic, 0.1 μF -20+80% 50V	CKS 96
C152-			
C153-			
C154	same as C151		
K151	Relay,	24V	KR 15081
K152-			
K153-			
K154	same as K151		
R151	Resistor	100 ohm 5% 1/4W	RK00-101
R152-			
R153-			
R154	same as R151		

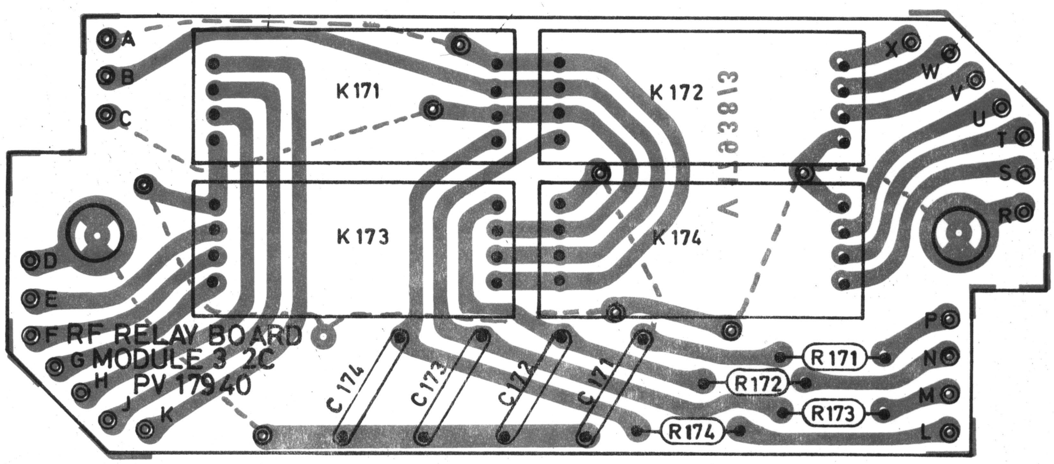
Module 3: RF COIL BOARD 2C

PV-17946



Module 3: RF RELAY BOARD 2C

PV-17940



Module 3: <u>RF COIL BOARD 2C</u>

PV-17946

Parts List

Symbol	Description					Stock No.
C179	Capacitor,	Mica,	18 pF ±2%		500V	CGSR5N 180
C180	"	tuning, foil	2-20 pF			CT 06
C181	"	Mica,	47 pF ±2%		"	CGSR5N 470
C182	"	tuning, foil	2-20 pF			CT 06
C183	"	Mica,	22 pF ±2%		"	CGSR5N 220
C184	"	Mica,	320 pF "		"	CGSR5N 321
C185	"	Mica,	56 pF "		"	CGSR5N 560
C186	"	Mica,	22 pF "		"	CGSR5N 220
C187	"	tuning, foil	2-20 pF			CT 06
C188	"	Mica,	10 pF "		"	CGSR5N 100
C189	"	tuning, foil	2-20 pF			CT 06
C190	"	Mica,	150 pF "		"	CGSR5N 151
L181	Coil					V-18093/4-7
L182	"					V-18093/4-10
L183	"					V-18093/4-13
L184	"					V-18093/4-16
R181	Resistor		33 Kohm	5%,	1/4W	RK00-333
R182	"		100 "	"	"	RK00-104
R183	"		33 "	"	"	RK00-333

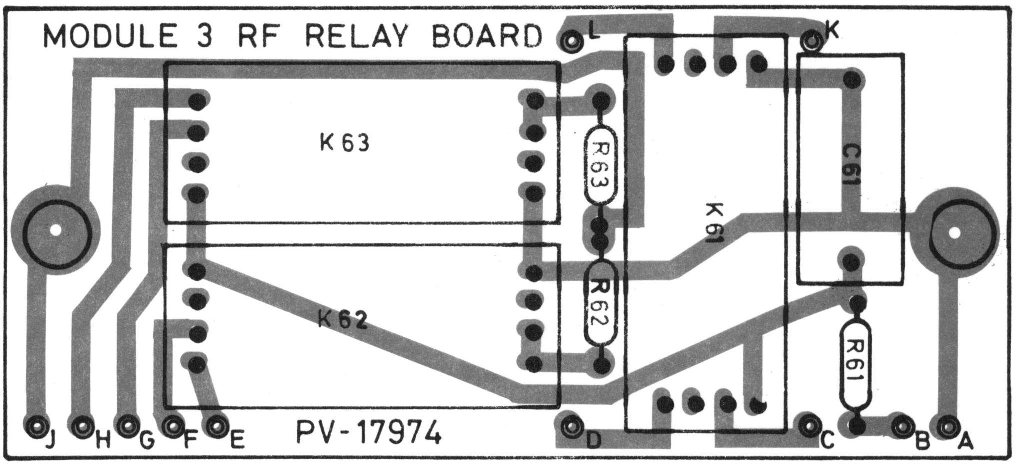
Module 3: <u>RF RELAY BOARD 2c</u>

PV-17940

C171	Capacitor, ceramic, 0.1 μF -20+80%, 50V	CKS 96
C172-		
C173-		
C174	same as C171	
K171	Relay 24V	
K172-		
K173-		
K174	same as K171	
R171	Resistor 100 ohm, 5%, 1/4W	RK00-101
R172-		
R173-		
R174	same as R171.	

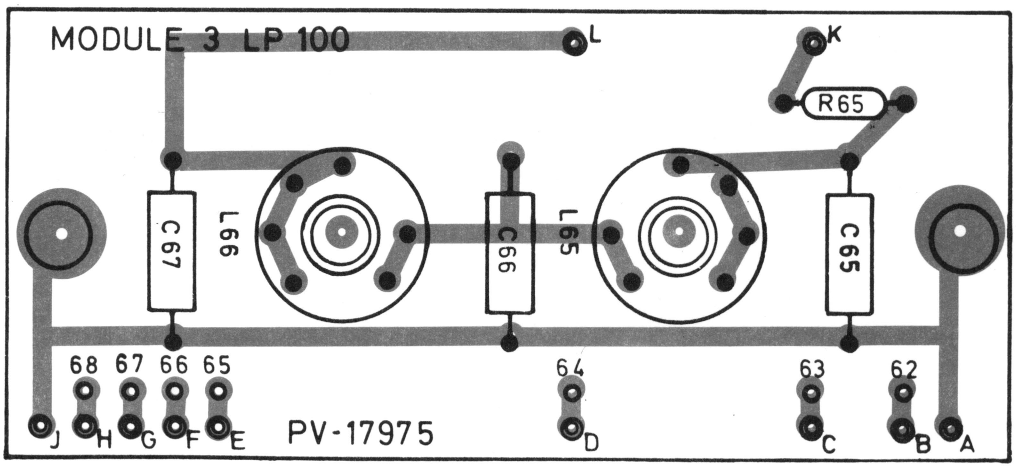
Module 3: RF RELAY BOARD
LP100

PV17974



Module 3: RF COIL BOARD
LP100

PV17975



Module 3

Parts List

Symbol		Description	Stock No.
PV-17974	RF RELAY BOARD LP100		
C61	Condenser, foil	1 µF ±20% 100V STC	CQFOB-105
K61	Relay	24 V	KR-15081
K62	Relay	24 V	"
K63	Relay	24 V	"
R61	Resistor	100 ohm 5%, 1/4W	RK00-101
R62	Resistor	1 Kohm 5% "	RK00-102
R63	Resistor	1 " 5% "	RK00-102
PV-17975	RF COIL BOARD LP100		
C65	Condenser, styroflex,	680 pF ±2.5%, 500V	CSR5681
C66	Condenser, "	1000 " "	CSR5102
C67	Condenser, "	680 " "	CSR5681
L65	Coil		V-16074/4-501
L66	Coil		V-16074/4-502
R65	Resistor	4.7 Kohm 5%, 1/4W	RK00-472

Module 4: 2nd i.f. amp., Noise Limiter

PV 16060 Circuit Diagram S-5498/3

Circuit Description:

The 2nd i.f. (1.4 MHz) signal reaches the 2nd i.f. amplifier input through a selectable 1.4 MHz crystal filter.

The 2nd i.f. amplifier is a 3-stage non-selective RC-coupled amplifier, using three IC's, V192, V193 and V194. Each IC is used in cascode mode and all three stages are gain-controlled.

At the input, the transistor V191 used as an emitter follower, provides correct ouput load for the crystal filter in use.

From the 2nd i.f. amplifier the signal is fed to the noise limiter as well as to the AGC circuit.

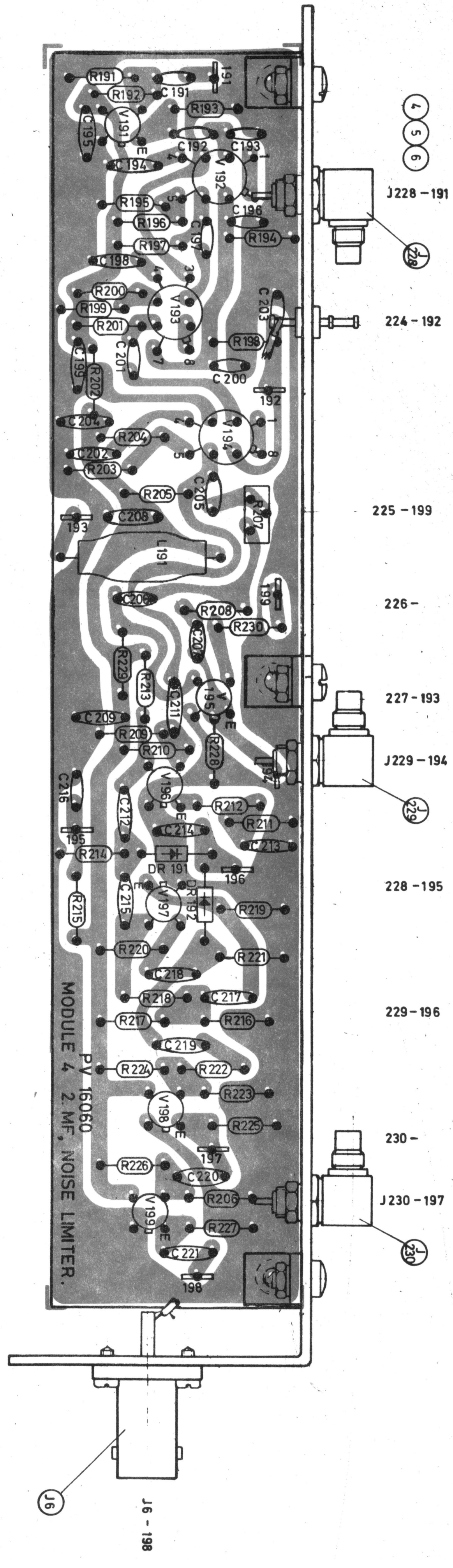
The part of the AGC circuit, located on this printboard, consists of the circuit employing transistor V195. It works as a switch controlling the signal output, which is passed on to the AGC circuit located on the module 7 printboard. The output is changed when alternating from DSB to SSB operation, or conversely.

The noise limiter is basically a circuit which provides symmetrical clipping or limiting of unwanted signals to the level of the wanted signal.

This is achieved in two diodes DR191 and DR192.

Transistors V196, V197 and V198 are used as amplifier, inverter and impedance transformer respectively.

Transistor V199 provides isolation between an external i.f. output and the i.f. output to the detector circuit (module 6).



PARTS LIST

Module 4: 2nd i. f. amp. - Noise Limiter

PV-16060

Symbol			Description			Stock No./Supplier
			Condensers:			
C191	Ceramic,	disc	0.01 uF	-20 + 80%	30 V	CKS 83
C192	"	"	0.01 "	"	30 V	CKS 83
C193	"	"	1500 pF	"		CKS 01
C194	"	"	0. 1 uF	"	20 V	CKS 86
C195	"	"	0. 1 uF	"	20 V	CKS 86
C196	"	"	0. 01 uF	"	30 V	CKS 83
C197	"	"	0. 01 uF	"	30 V	CKS 83
C198	"	"	0. 1 uF	"	20 V	CKS 86
C199	"	"	0. 1 uF	"	20 V	CKS 86
C200	"	"	0. 01 uF	"	30 V	CKS 83
C201	"	"	0. 01 uF	"	30 V	CKS 83
C202	"	"	0. 1 uF	"	20 V	CKS 86
C203	"	"	1500 pF	"		CKS 01
C204	"	"	0. 1 uF	"	20 V	CKS 86
C205	"	"	0. 01 uF	"	30 V	CKS 83
C206	"	"	0. 01 uF	"	30 V	CKS 83
C207	"	"	0. 01 uF	"	30 V	CKS 83
C208	"	"	0. 1 uF	"	20 V	CKS 86
C209	"	"	0. 1 uF	"	20 V	CKS 86
C211	"	"	0. 1 uF	"	20 V	CKS 86
C212	"	"	0. 1 uF	"	20 V	CKS 86
C213	"	"	0. 1 uF	"	20 V	CKS 86
C214	"	"	0. 1 uF	"	20 V	CKS 86
C215	"	"	0. 1 uF	"	20 V	CKS 86
C216	"	"	0. 01 uF	"	30 V	CKS 83
C217	"	"	0. 1 uF	"	20 V	CKS 86
C218	"	"	0. 1 uF	"	20 V	CKS 86
C219	"	"	0. 1 uF	"	20 V	CKS 86
C220	"	"	0. 1 uF	"	20 V	CKS 86
C221	"	"	0. 1 uF	"	20 V	CKS 86
DR191	Diode	type	1N4448			Philips
DR192	"	"	1N4448			"
L191	HF choke		250 uH			LH-6269

Parts List (cont'd)

Symbol	Description			Stock No. /Supplier
			Resistors :	
R191	1.8 Kohm	5%	1/4 W	RK00-182
R192	10 "	"	"	RK00-103
R193	470 ohm	"	"	RK00-471
R195	10 Kohm	"	"	RK00-103
R196	4.7 "	"	"	RK00-472
R197	150 ohm	"	"	RK00-151
R198	1.5 Kohm	"	"	RK00-152
R199	10 "	"	"	RK00-103
R200	4.7 "	"	"	RK00-472
R201	220 ohm	"	"	RK00-221
R202	100 "	"	"	RK00-101
R203	10 Kohm	"	"	RK00-103
R204	4.7 "	"	"	RK00-472
R205	220 ohm	"	"	RK00-221
R206	3.3 Kohm	"	"	RK00-332
R207	5 "		1/2 W potentiometer	
R208	2.2 Kohm	"	1/4 W	RK00-222
R209	3.3 "	"	"	RK00-332
R210	18 "	"	"	RK00-183
R211	1 "	"	"	RK00-102
R212	82 ohm	"	"	RK00-820
R213	3.3 Kohm	"	"	RK00-332
R214	10 Kohm	"	"	RK00-103
R215	22 "	"	"	RK00-223
R216	6.8 "	"	"	RK00-682
R217	15 "	"	"	RK00-153
R218	6.8 "	"	"	RK00-682
R219	1.5 "	"	"	RK00-152
R220	1.2 "	"	"	RK00-122
R221	10 "	"	"	RK00-103
R222	33 "	"	"	RK00-333
R223	3.3 "	"	"	RK00-332
R224	18 "	"	"	RK00-183
R225	1 "	"	"	RK00-102
R226	18 "	"	"	RK00-183
R228	6.8 "	"	"	RK00-682
R229	6.8 "	"	"	RK00-682
R230	100 "	"	"	RK00-104
V191	Transistor	type	40245	RCA
V192	Integrert krets		CA3028B	"
V193	"		"	"
V194	"		"	"
V195	Transistor	type	40245	"
V196	"	type	40245	"
V197	"	type	40245	"
V198	"	type	40245	"
V199	"	type	40245	"
R194	3.3 K	5%	1/4W	RK00-332
R227	1 K	5%	1/4W	RK00-102

Module 4: 2nd i.f. Amplifier, Noise Limiter

TEST PROCEDURE

Test Equipment:

HF Signal Generator, range 2 - 4 MHz
Heterodyne Voltmeter.

1. Begin test procedure by setting the controls as follows:

   (a) Power switch in position ON
   (b) AGC switch in position OFF
   (c) RF Gain control clockwise (max gain)
   (d) Noise Limiter control anticlockwise (min. limiting)

2. Apply a signal of 1400 kHz, 20 μV p.d. from the signal generator to J228. Connect the Heterodyne Voltmeter to either J230 or J6.

3. Adjust the Heterodyne Voltmeter to the h.f. generator frequency (1400 kHz), and the reading should be about 20 mV.

4. Turn the Noise Limiter control clockwise to max. limiting, and the signal level deflected by the Heterodyne Voltmeter will decrease 2-3 dB. Reset the Noise Limiter control to minimum value.

5. Advance the Heterodyne Voltmeter lead to J229, and the reading will be about 11 mV.

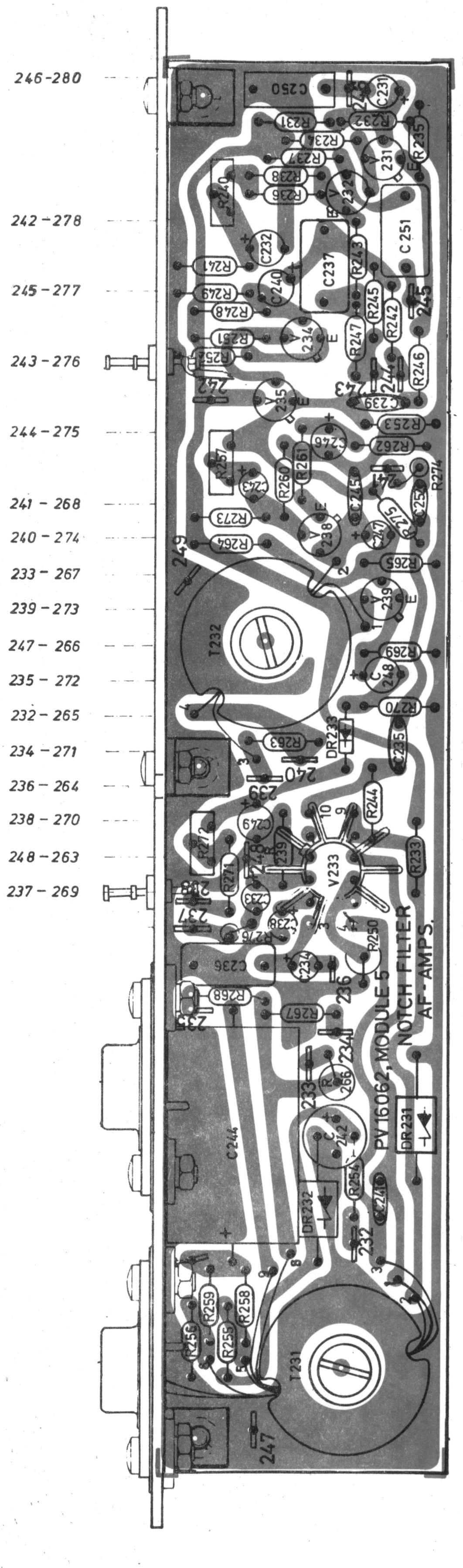
Module 5: Notch Filter, AF Amplifiers

PV 16062 Circuit Diagram S-5497/3.

Module 5 consists of an a. f. Notch Filter, one 2W and one 10 mW a. f. amplifier. The notch filter is a modified Wien-bridge, selective in the frequency range 300-3000 Hz. The Notch Tune on the front can be operated to attenuate any frequency in the range about 40 dB. This filter serves the purpose of eliminating interfering frequencies in the a. f. range.

The two a. f. amplifiers are connected in parallel to the output of the notch filter circuit. The 10 mW amplifier is intended for line connection and has a symmetrical output. A 600 ohms termination permits pre-adjustment of any output level from 0 to 10 mW. Generally, this output level is preset to 1 mW (0 dBm). The instrument on the front panel will indicate the power fed to the line in dBm.

The power amplifier employs the integrated circuit V233 in the capacity of driver, and two silicon power transistors V236 and V237 as a quasi-complementary output stage. With a 15 mV input signal this p. a. will deliver 2W into a 3 ohms loudspeaker, and 10 mW into 100 ohms headphones. The headphone connection is in parallel with the loudspeaker through a voltage divider network.



Module 5: LF Notch Filter

PV-16062

Parts List

Symbol	Description					Stock No./Supp
C231	Cond.	tantal	33 uF		10V	CET 1033
C232	"	"	33 "		"	"
C233	"	"	4.7 "		25V	CET 254.7
C234	"	"	4.7 "		"	"
C235	"	cer. disc	0.1 "	-20+80%	20V	CKS 86
C236	"	foil	0.1 "	±20%	100V STC	CQDOB-104
C237	"	"	0.22 "	±2%	160V	CQ1222.44
C328	"	tantal	4.7 "		25V	CET 254.7
C239	"	cer. disc	0.1 "	-20+80%	20V	CKS 86
C240	"	tantal	33 "		10V	CET 1033
C241	"	cer. disc	0.01 "	"	30V	CKS 83
C242	"	tantal	33 "		25V	CET 2533
C243	"	"	4.7 "		25V	CET 254.7
C244	"	el. lyte	1000 "		25V	CER 22
C245	"	cer. disc	0.01 "	"	30V	CKS 83
C246	"	tantal	100 "		3V	CET 3100
C247	"	"	4.7 "		25V	CET 254.7
C248	"	"	4.7 "		25V	"
C249	"	"	0.47 "		35V	CET 350.47
C250	"	foil	0.022 "	±20%	STC	CQF2B-223
C251	"	foil	0.22 "	±2%	160V	CQ122244
C252	Cond.	cer. disc	4700C pF			CKS40
DR231	Diode, Zener		type ZD 9.1			ITT
DR232	Diode, "		type ZD 18			ITT
DR233	Diode		type OA 200			Philips
R231	Resistor		10 Kohm	5%	1/4W	RK00-103
R232	"		10 "	"	"	RK00-103
R233	"		47 ohm	"	"	RK00-470
R234	"		4.7 Kohm	"	"	RK00-472
R235	"		4.7 "	"	"	TK00-472
R236	"		1.2 "	"	"	RK00-123
R237	"		1.5 "	"	"	RK00-152
R238	"		680 ohm	"	"	RK00-681
R239	"		10 Kohm	"	"	TK00-103
R240	Potentiometer		50 ohm		½W	RPA500V09
R241	Resistor		2.2 Kohm	"	1/4W	RK00-222
R242	"		3.3 "	"	"	RK00-332
R243	"		220 ohm	"	"	RK00-221
R244	"		470 Kohm	"	"	RK00-474
R245	"		1.8 "	"	"	RK00-182
R246	"		2.2 "	"	"	RK00-222
R247	"		560 ohm	"	"	RK00-561
R248	"		10 Kohm	"	"	RK00-103
R249	"		560 ohm	"	"	RK00-561
R250	"		1.5 ohm	"	1W	RT1-01(3)OB50
R251	"		4.7 Kohm	"	1/4W	RK00-472
R252	"		470 ohm	"	"	RK00-471
R253	"		8.2 Kohm	"	"	RK00-822
R254	"		220 ohm	"	"	RK00-221
R255	"		47 ohm	"	"	RK00-470

Parts List (Module 5)

Symbol		Description			Stock No/Supplier
R256	Resistor	33 ohm	5%	1/4W	RK00-330
R257	Potentiometer	25 Kohm		½W	RPA253V09
R258	Resistor	33 ohm	"	1/4W	RK00-330
R259	"	560 "	"	"	RK00-561
R260	"	4.7 Kohm	"	"	RK00-472
R261	"	5.6 ohm	"	"	RK00-5.60
R262	"	56 "	"	"	RK00-560
R263	"	3.3 Kohm	"	"	RK00-332
R264	"	39 "	"	"	RK00-393
R265	"	47 "	"	"	RK00-473
R266	"	1.5 ohm	"	1W	RT1-01(3)0B50
R267	"	270 "	"	1/4W	RK00-271
R268	"	270 "	"	"	RK00-271
R269	"	1 Kohm	"	"	RK00-102
R270	"	10 "	"	"	RK00-103
R271	"	68 "	"	"	RK00-683
R272	Potentiometer	100 "		½W	RPA104V09
R273	Resistor	22 "	"	1/4W	RK00-223
T231	Driver transformer				TD-16075
T232	Line output transf.				TL-16076
V231	Transistor	type 40233			RCA
V232	"	"			RCA
V233	Integrated circuit	type CA 3020			RCA
V234	Transistor	type 40233			RCA
V235	"	type 40233			RCA
V238	"	type 40233			RCA
V239	"	type 40233			RCA
R274	Resistor	4.3 Kohm	"	"	RK00-432
R275	"	1 "	"	"	RK00-103

Module 5 : Notch Filter, A.F.Amplifiers

TEST PROCEDURE

Test Equipment:

A.F. generator	range 300 - 3000 Hz
A.F. output power meter	range 10 mW, 3W
Distortion Meter	range d = 1%, d = 10%

Preceding positioning:

1. Connect the a.f. signal generator to point 280 and tune the generator to 1000 Hz with an output of 35 mV.

2. Connect the Power and the Distortion meter to the power amplifier output, point 267.

3. Operate the controls to the following positions:

   (a) Power switch in position ON
   (b) Notch Tune in position OFF
   (c) AF Gain to produce a reading of 2W on the power output meter
   (d) Instrument switch to position AF Level

Test procedure:

4. Calibrate the distortion meter and read distortion, which should be less than 4.5%.

5. Adjust AF Gain control to 50 mW on the power output meter.

6. Read distortion, whish should be less than 1.5%.

7. Tune the generator to 800 Hz and adjust the AF Gain control to 1W reading on the output meter.

8. Operate the Notch Tune control and tune to minimum reading on the power output meter.

9. Adjust potentiometer R240 on the P.C. board to obtain a better minimum reading on the output meter.

10. Switch the Range Selector on the power output meter down to the range 0-1 mW, alternatingly adjusting the Notch Tune control and potentiometer R240 to minimum reading. The true min. reading on the output meter in the range 0-1 mW should be better than -40 dB. Lock potentiometer R240.

11. Operate the Range Selector on the output meter to 1W range and reset the Notch Tube control in position OFF.

12. Connect the power output meter and the distortion meter to points 273 and 274. Set the range selector on the output meter to 10 mW/600 ohm.

13. Tune the a. f. signal generator to 1000 Hz.

14. Adjust the potentiometer R257 on the P. C. board until the output meter indicates 10 mW.

15. Calibrate the distortion meter. The distortion reading should be less than 1.5%.

16. Adjust potentiometer R272 on the P. C. board until the instrument on the front panel indicates 10 dBm.

17. Readjust the potentiometer R257 until the power output meter indicates 1 mW. Lock the two potentiometers.

Module 6: DSB Detector, SSB Detector and Carrier Oscillator.

PV-16066 Circuit Diagram S-5501/3

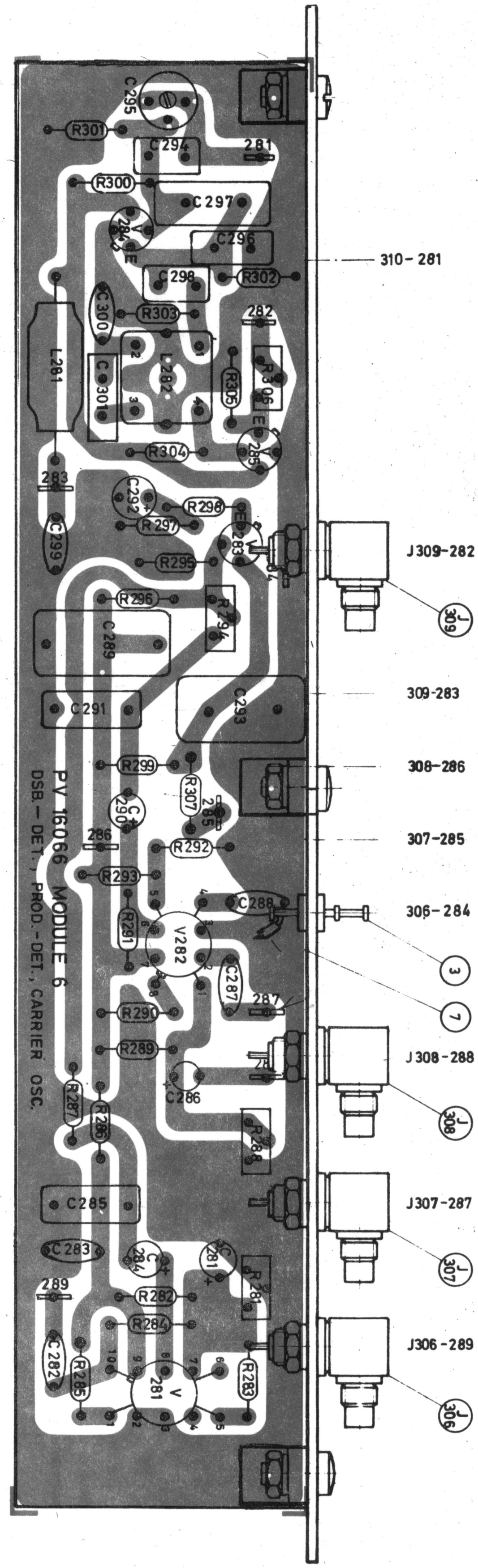
The DSB Detector, the SSB detector and the Carrier Oscillator make up module B. The DSB detector is an envelope detector, employing the I. c. V281 in a differential configuration with an emitter follower output stage. The emitter follower is biased almost to cut-off and provides non-linearity for detection. An external capacitor C285 is connected between terminal 8 and ground to remove r. f. signals from the detected audio output.

The SSB detector is a product detector employing the I. c. V282, which operates like a mixer circuit. The V292 consists of a differential pair of transistors, controlled by a constant current transistor. This circuit is operated in the linear region.

The a. f. signal from both the envelope and the product detector is fed to the base of transistor V283, which is a common emitter output stage.

The regenerated carrier, which is applied to the product detector, is generated in the carrier oscillator. The carrier oscillator is a modified crystal controlled Colpitts oscillator of high stability.

Transistor V284 forms the oscillator stage, and transistor V285 the emitter follower output stage.



Module 6: DSB Detector,
Product Detector and
Carrier Oscillator

PV-16066

Parts List.

Symbol	Description						Stock No.
C281	Cond.,	Tantal	33 µF,		10V		CET 1033
C282	"	cer. disc	0.1 "	-20+80%	20V		CKS 86
C283	"	"	"	"	20V		"
C284	"	tantal	4.7 "		25V		CET 2547
C285	"	foil	0.022 "	±20%	250V	STC	CQF2B-223
C286	"	tantal	0.47 "		35V		CET 350.47
C287	"	cer. disc	0.1 "	-20+80%	20V		CKS 86
C288	"	"	0.1 "	"	20V		"
C289	"	foil	1 "	±20%	100V	VSTC	CQF0B-105
C290	"	tantal	4.7 "		25V		CET 254.7
C291	"	foil	0.022 "	±20%	250V	STC	CQF2B 223
C292	"	tantal	100 "		3V		CET
C293	"	mica	2200 "	± 2%	500V		CGSR5N 222
C294	"	"	5 pF	"	500V		CGSR5N050
C295	"	tun. foil	2-20 pF				CT 06
C296	"	mica	220 pF	"	500V		CGSR5N 221
C297	"	mica	1500 pF	"	500V		CGSR5N-501
C298	"	mica	30 pF	"	500V		CGSR5N 300
C299	"	cer. disc	0.1 uF	-20+80%	20V		CKS 86
C300	"	"	0.1 "	"	20V		"
C301	"	mica	180 pF	± 2%	500V		CGSR5N 181
L281	HF choke		250 µH				LH-6269
L282	Coil						V-16046/4-505
R281	Pot. meter		1 Kohm		½W		RPA 102 V09
R282	Resistor		1 "	5%	1/4W		RK00-102
R283	"		10 "	"	"		RK00-103
R284	"		10 "	"	"		RK00-103
R285	"		8.2 "	"	"		RK00-822
R286	"		470 ohm	"	"		RK00-471
R287	"		5.6 Kohm	"	"		RK00-562
R288	Pot. meter		25 "	"	½W		RPA253 V09
R289	Resistor		4.7 "	"	1/4W		RK00-472
R290	"		470 ohm	"	"		RK00-471
R291	"		470 "	"	"		RK00-471
R292	"		10 Kohm	"	"		RK00-103
R293	"		4.7 "	"	"		RK00-472
R294	Pot. meter		10 "		½W		RPA103 V09
R295	Resistor		3.3 "	"	1/4W		RK00-332
R296	"		18 "	"	"		RK00-183
R297	"		680 ohm	"	"		RK00-681
R298	"		330 "	"	"		RK00-331
R299	"		4.7 Kohm	"	"		RK00-472

Symbol	Description				Stock No./Supplier
R300	Resistor,	12 Kohm	5%	1/4W	RK00-123
R301	"	12 "	"	"	RK00-123
R302	"	4.7 "	"	"	RK00-472
R303	"	12 "	"	"	RK00-123
R304	"	18 "	"	"	RK00-183
R305	"	1 "	"	"	RK00-102
R306	Pot. meter	1 "		$\frac{1}{2}$W	RPA 102 V09
R307	Resistor	10 "			RK00-104
V281	Integrated circuit		type CA 3002		RCA
V282	"		type CA 3028		RCA
V283	Transistor		type 40233		RCA
V284	"		type 40245		RCA
V285	"		type 40242		RCA

Module 6: AM Detector, Product Detector
and Carrier Oscillator

TEST PROCEDURE

Test Equipment

HF Signal Generator	range 2 - 4 MHz
Frequency Counter	range 2 - 4 MHz, sensitivity 100 mV
Heterodyne Voltmeter	
Universal Instrument	Ri 20 000 ohm/Volt
AC Millivoltmeter	Ri 1 Mohm
Distortion Meter	range d = 10%

Preceding positioning:

1. Connect HF signal generator to J306
2. Connect the frequency counter and the Heterodyne Voltmeter to J309
3. Connect the AC Millivoltmeter and distortion meter to point 308.
4. Operate the controls in positions as follows:

   (a) Power switch in position ON
   (b) Operating mode in position AM

5. Remove module 6 from the chassis to permit d. c. measurements on the transistor terminals. Proper earth connection must be maintained between module 6 and the chassis.

Test procedure:

6. Connect the universal instrument to terminal 5 and 10 respectively on the I. c. V281 and adjust potentiometer R281 until the voltages on these two terminals coincide. The reading should be about 2,8V.
7. Tune the signal generator to 1400 kHz with an output signal of 20 mV, 30% modulated with 1000 Hz.
8. Calibrate the distortion meter; the distortion should be less than 1. 5%.
9. With Operating Mode in position SSB, adjust potentiometer R306 to midway position.
10. Tune the Heterodyne Voltmeter to 1400 kHz and adjust the core of L282 to maximum output. Readjust R306 to a 100 mV deflection on the heterodyne voltmeter.
11. Adjust Capacitor C295 to exactly 1400 kHz on the counter.
12. Transfer the cable from the signal generator to J308 and turn off the modulation signal.
13. Disconnect the counter and the heterodyne voltmeter; connect the proper coaxial cable to J309.
14. Adjust the potentiometer R288 to max. output reading on the AC millivoltmeter.
15. Operate the distortion meter to 1000 Hz and adjust the signal generator to min. distortion reading. The distortion should be less than 1, 5%.
16. Adjust potentiometer R294 until the AC meter indicates appr. 50 mV.

Module 7: AGC Amplifier and VBFO

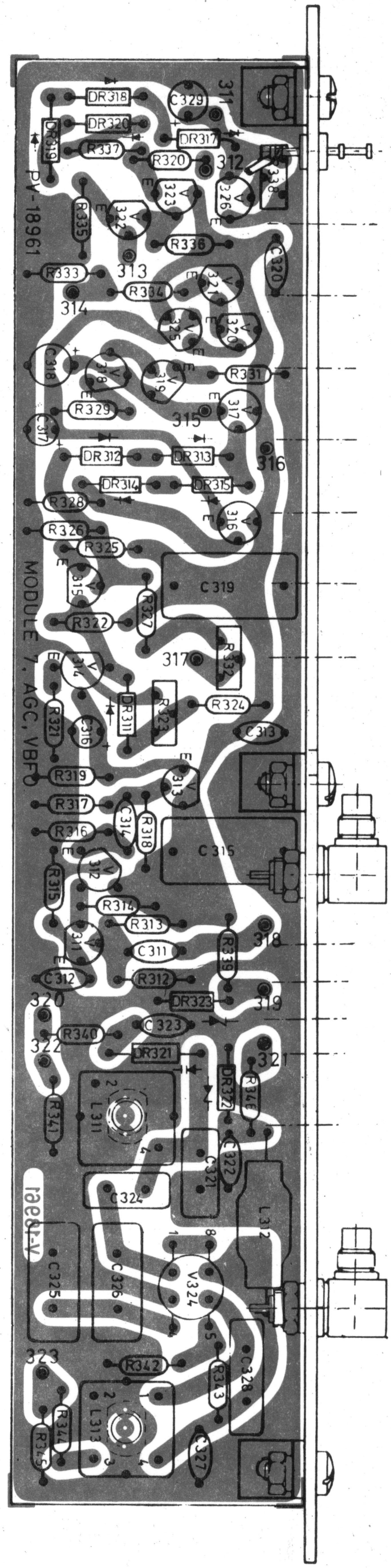
PV- Circuit diagram S-5499/3

Module 7 consists of two circuits, the a.g.c. amplifier and the variable beat frequency oscillator.

The a.g.c. amplifier supplies the d.c. voltages used to control the amplification in the r.f. and i.f. amplifiers. It is a reversed AGC system, i.e. an increasing signal strength will result in negative-going a.g.c. information to the r.f. and i.f. amplifiers. Negative information will make the amplifiers approach cut-off and thereby reduce the gain.

The a.g.c. amplifier circuit consists of one r.f. input amplifier, one detector and a number of d.c. amplifier stages. To provide the desired a.g.c. constants, the d.c. information is switched electronically. The r.f. and i.f. amplifiers are gain-controlled by different voltage ranges from the a.g.c. amplifier, 3 to 0.5V & 11 to 3.5V respectively. This voltage differentiation is performed by the diode divider network DR316-317-318-319-320.

The variable beat frequency oscillator employs the I.c. V324 in a modified Colpitt configuration. The oscillator is shunt-tuned by a varactor DR. 321. The basic frequency is 1400 kHz with a tuning range of ±6 kHz. The oscillator circuit has two stages, a common emitter stage as oscillator with a positive feedback from the emitter, and a common base as output stage. The output shunt circuit will shape the signal and match the low impedance load.



Module 7, AGC, VBFO

PV-16061

PARTS LIST

Symbol	Description					Stock No./Supplier
C311	Cond., ceramic disc	0.1 µF	-20+80%	20V		CKS 86
C312	"	0.1 "	"	"		"
C313	"	0.1 "	"	"		"
C314	"	0.1 "	"	"		"
C315	Cond., foil	1 "	±20%	100V	STC	CQFOB-105
C316	Cond, tantal	0.47 "		25V		CET 254.7
C317	"	0.47 "		25V		"
C318	"	33 "		25V		CET 2533
C319	Cond., foil	1 "	±20%	100V	STC	CQFOB-105
C320	Cond., cer. disc	0.1 "	-20+80%	20V		CKS 86
C321	Cond., mica	255 pF	±2%	500V		CGSR5N25(5)1
C322	Cond., cer. disc	0.1 µF	-20+80%	20V		CKS 86
C323	Cond., "	0.1 "	"	20V		"
C324	Cond., mica	120 pF	±2%	500V		CGSR5N 121
C325	Cond. "	1000 pF	"	"		CGSR5N 472
C326	Cond., "	4700 pF	"	"		"
C327	Cond., cer. disc	0.1 µF	-20+80%	20V		CKS 86
C328	Cond., mica	390 pF	±2%	500V		CGSR5N 391
C329	Cond., tantal	0.47 µF		25V		CET 254.7
DR311	Diode	type OA-200				Philips
DR312	Diode	"				"
DR313	Diode	"				"
DR314	Diode	"				"
DR315	Diode	"				"
DR317	Diode	"				"
DR318	Diode	"				"
DR319	Diode	"				"
DR320	Diode	"				"
DR321	Varactor	type MV 1638				Motorola
DR322	Zener diode	type ZF10				ITT
DR323	Zener diode	type ZF6.2				ITT
L311	Coil					V-16046/4-506
L312	HF choke	250 µH				LH-6269
L313	Coil					V-16046/4-507
R312	Resistor	3.3 Kohm	5%	1/4W		RK00-332
R313	"	27 "	"	"		RK00-273
R314	"	10 "	"	"		RK00-103
R315	"	1.2 "	"	"		RK00-122
R316	"	5.6 "	"	"		RK00-562
R317	"	3.3 "	"	"		RK00-332
R318	"	68 "	"	"		RK00-683
R319	"	1 "	"	"		RK00-222
R320	Pot. meter	2.5 "	"	"		
R321	"	6.8 Kohm	"	"		RK00-682
R322	"	15 "	"	"		RK00-153
R323	Pot. meter	10 "		½W		RPA103V09
R324	Resistor	1.2 "	5%	1/4W		RK00-122

Parts List (cont'd)

Symbol		Description				Stock No./Supplier
R325	Resistor	12 Kohm	5%	1/4W		RK00-123
R326	"	100 "	"	"		RK00-104
R327	"	150 Kohm	"	"		RK00-154
R328	"	560 "	"	"		RK00-564
R329	"	2.2 "	"	"		RK00-222
R330						
R331	"	10 "	"	"		RK00-103
R332	Pot. meter	50 "		½W		RPA503V09
R333	Resistor	1.5 "	"	1/4W		RK00-152
R334	"	1.5 "	"	"		RK00-152
R335	"	1.2 "	"	"		RK00-122
R336	"	10 "	"	"		RK00-103
R337	"	1.5 "	"	"		RK00-152
R338	"	2.2 "	"	"		RK00-222
R339	"	1 "	"	"		RK00-562
R340	"	330 "	"	"		RK00-334
R341	"	5.6 "	"	"		RK00-562
R342	"	10 "	"	"		RK00-103
R343	"	4.7 "	"	"		RK00-472
R344	"	1 "	"	"		RK00-102
R345	"	150 ohm	"	"		RK00-151
R346	"	100 "				RK00-101
V311	Transistor	type	40245			RCA
V312	"		"			"
V313	"		"			"
V314	"		40233			"
V315	"		2N4058			TI
V316	"		2N2895			RCA
V317	"		"			"
V318	"		2N4058			TI
V319	"		40233			RCA
V320	"		"			"
V321	"		"			"
V322	"		"			"
V323	"		"			"
V324	Integrated circuit		CA 3028			"
V325	Transistor		40233			"
V326	"		BC 183C			Texas

Module 7: AGC Amplifier and VBFO

TEST PROCEDURE

Test Equipment

HF Signal generator	range 2 – 4 MHz
Frequency Counter	range 2 – 4 MHz, sensitivity 100 mV
Heterodyne Voltmeter	
Universal Instrument	

Preceding positioning:

1. Connect the HF signal generator to J349
2. Connect the Universal Instrument to point 340
3. Connect the Frequency Counter and the Heterodyne Voltmeter to J350.
4. Remove Module 7 mechanically from the chassis
5. Operate the controls in position as follows:
   - (a) Power switch in position ON
   - (b) AGC switch in position Short
   - (c) Operating anode in position AM
   - (d) BFO Tune in midway position

Test Procedure:

6. Tune the HF Signal Generator to 1400 kHz with an output of appr. 5 mV.
7. The reading on the Universal instrument should be appr. 11 Volts
8. Connect the Universal instrument to the anode of DR311 and adjust potentiometer R323 to a meter deflection of 10.2 V
9. Reconnect the Universal instrument to point 340 and increase the output signal from the generator to 40 mV. The reading on the Universal instrument should now be appr. 3.5 V.
10. Set the Operating Mode in position CW.
11. Tune the Heterodyne voltmeter to 1400 kHz and adjust the core of L313 to maximum meter deflection (appr. 100 mV)
12. Adjust the core of L311 until the Frequency counter indicates 1400 kHz. Lock the cores of L313 and L311.

Module 8 : Lowpass Filter LP4

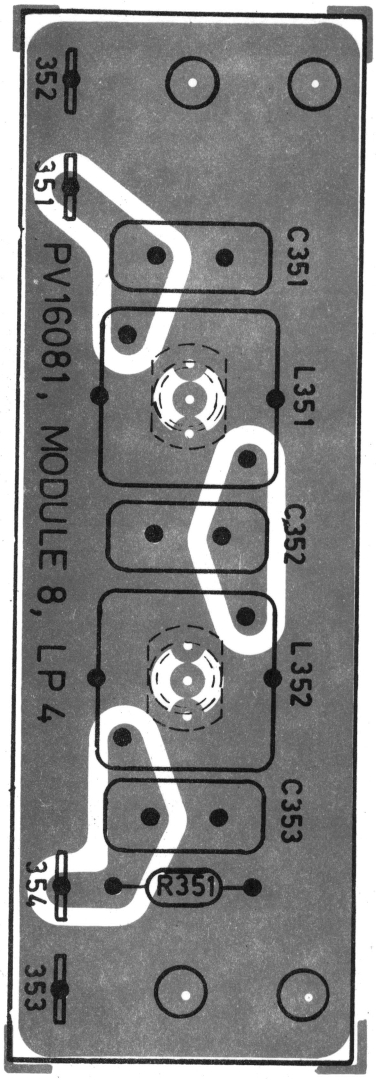
PV-16081 Circuit diagram S-5565/4

Circuit Description:

Module 8 LP4 is a low-pass filter with cut-off frequency f_C (-3 dB) at 4 MHz.

The filter is designed for Chebishev's response with a stop-band attenuation of more than 30 dB. The purpose of LP14 is to reject the 2nd local oscillator signal of 33.6 MHz.

LP4 need not be subjected to any testing other than an adjustment of the cores of L351 and L352, midway in the formers.



Module 8: Lowpass Filter LP4

PV-16081

Parts List.

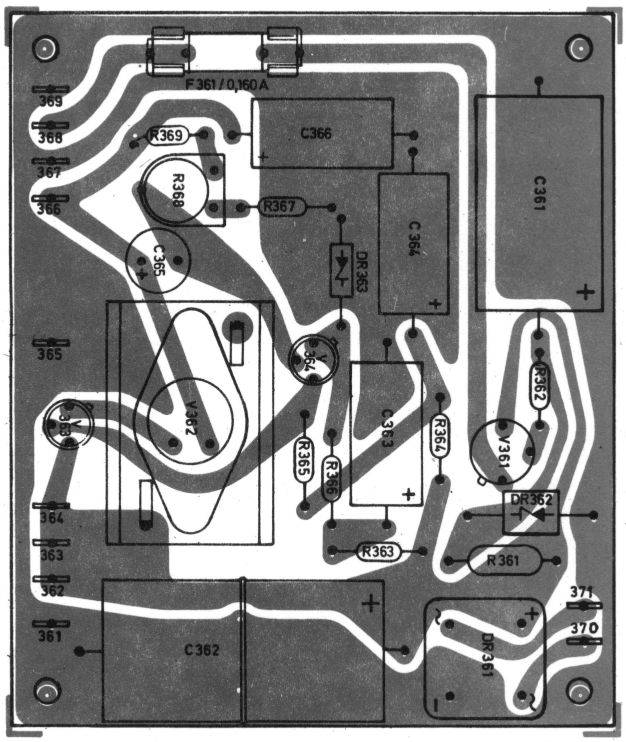
Symbol	Description	Stock No.
C351	Condenser, mica, 68 pF ±2% 500V	CGSR5N 680
C352	" 100 " " "	CGSR5N 101
C353	" 68 " " "	CGSR5N 680
L351	Coil	V-16046/4-508
L352	Coil	V-16046/4-509

Module 9 : Power Supply

PV-16065 Circuit diagram S-5503/4

Circuit Description:

The seccndary of the main transformer, T375, is connected to the power supply rectifier and, in turn, to the series electronic regulators. The output of the regulators is 12 and 19 Volts respectively.



The stabilization reference voltages are controlled by zener diodes DR362 and DR363. The 19V output is used in the muting circuit. The 12V output, which has a stability of 0.2% depending on the load, is used in most of the stages of the receiver. In addition, module 9 supplies 24 Volts unregulated voltage to the AF output stage, the crystal oven and the reed relays.

The main regulation circuit, which supplies the the 12-volt, has a feedback loop to improve stabilization, and reduce the ripple on the output voltage.

All three voltages from the power supply may be short-circuited without any damage to the circuits.

Module 9: Power Supply

PV-16065

PARTS LIST

Symbol	Description				Stock No.
C361	Condenser, el. lyte	1000 µF		25V	CER 22
C362	"	1000 "		35V	CER 22E
C363	"	100 "		35V	CER 32
C364	"	100 "		35V	"
C365	Cond., tantal	33 "		25V	CET 2533
C366	Cond., el. lyte	100 uF		35V	CER 32
DR361	Rectifier bridge				DR 6010
DR362	Zener Diode	type ZD 20			I T T
DR363	"	type ZF 6.2			"
F361	Glass tube fuse	0.16 A			FGB 0.16
R361	Resistor	220 ohm	5%	½W	RK0-221
R362	"	220 "	"	1/4W	RK00-221
R363	"	1.5 Kohm	5%	"	RK00-152
R364	"	5.6 "	"	"	RK00-562
R365	"	5.6 "	"	"	RK00-562
R366	"	1.5 "	"	"	RK00-152
R367	"	4.7 "	"	"	RK00-472
R368	Potentiometer	1 "		½W	RPA-102H09
R369	Resistor	2.7 "	5%	1/4W	RK00-272
V361	Transistor	type 40314			RCA
V362	"	40250V1			RCA
V363	"	2N3241A			RCA
V364	"	40233			RCA

Module 9: Power Supply

TEST PROCEDURE

Test Equipment

Universal Instrument Ri 20 000 ohm/Volt

Test Procedure:

1. Connect the Universal instrument to point 369

2. Set the Power Switch in position ON.
   The reading on the universal instrument should be 28 - 30 Volts.

3. Connect the universal instrument to point 362.

4. Adjust the potentiometer until the instrument deflection is 12 V, and lock the potentiometer.

5. Check the voltage in point 368, which should be about 19 Volts.

MAIN PARTS LIST

MODULE:	Description	Stock No.
1A	Antenna Transformer	V-17374/4
1A	Circuit Protection	V-17012/4
1A	Muting Protection	V-17020/4
1B	Lowpass Filter	V-16069/3
2	RF Amp., 1. and 2. Mixer	V-17950/2
3-1A	RF Coil and Relay Board	V-17948/3-501
3-1B	" " "	V-17948/3-502
3-1C	" " "	V-17948/3-503
3-2A	" " "	V-17949/3-501
3-2B	" " "	V-17949/3-502
3-2C	" " "	V-17949/3-503
3	" " "	V-18040/3
4	2. IF Amp., Noise Limiter	V-16084/2
5	AF Amp., Notch Filter	V-16082/2
6	Detectors and Carrier Osc.	V-16085/2
7	AGC Amp. and VBFO	V-16086/2
8	Lowpass Filter LP-4	V-16566/4
9	Power Supply	V-16065/3

MAIN PARTS LIST (cont'd)

Symbol	Description				Stock No.
C8	Cond., cer. disc	0.1 µF	16V		CKS 86
C9	same as C8				
C10	Cond., feed-thru	1000 pF	500V		CKG 06
C19	same as C10				
C20	same as C10				
C188	Cond., var.				V-16036/3
C189	same as C188				
C190	same as C188				
C330	Cond., foil	1 µF	63V		CQR00B-105
C375	Cond., feed-thru	1000 pF	500V		CKG 06
C376	Cond., el. lyte	250 F	16V		CER 23
LC228	Crystal filter, bandwidth	8 kHz			YF 102-9
LC229	Crystal filter, "	2 "			YF 102-10
LC230	Crystal filter, "	1 "			YF 102-11
LC231	Crystal filter, "	0.4 "			YF 102-12
LC232	Crystal filter, "	2.35 "			YF 102-8
L8	HF Choke	2.5 mH			LH-6471
L9	same as L8				
R277	Resistor	68 ohm	5 %	1/4W	RK00-680
R278	Resistor	3.3 "		4W	RT4 03(3)0B50
R279	Pot. meter	5 Kohm			RP-100-502-2
R280	Pot. meter, -log.	10 "		w/switch	RP-108-103-2
R356	Pot. meter	25 "			RP-100-253-2
R357	Pot. meter	5 "			RP-100-502-2
R358	Resistor	39 "		1/4W	RK00-393
R359	Resistor	68 "		"	RK00-683
R360	Resistor	150 "		"	RK00-154
R376	Pot. meter	10 "			RP-100-103-2
R377	Resistor	100 "		"	RK00-104
R378	Pot. meter	10 "		w/switch	RP-108-103-1
J1	Contact, 15-pole, female				KJE 15
	Clamp bolt				KJD 15-3
J4	Coax Contact				KJCB 2
J5	same as J4				
J6	same as J4				
J7	same as J4				
J8	Contact, 15-pole, male				KJD 15
	Locking lever				KJF 15-2
J9	Contact, 15-pole, male				KJD 15
	Clamp bolt				KJD 15-3
J60	Coax contact				KJC-M1
J228	Coax contact				"
J229	same as J228				
J230	same as J228				
J306	same as J228				
J307	same as J228				
J308	same as J228				
J309	same as J228				
J349	same as J228				
J350	same as J228				

MAIN PARTS LIST (cont'd)

Symbol	Description			Stock No.
M 1	Instrument	0-50 μA		20502
X310	Crystal oven type JK09S1, Cathodeon	75°, 24V		Y0-000
X309	Crystal	1400 Hz		Y6-1400
T375	Net Transformer			TN-15080
R379	Resistor	150 ohm	1W	RK1 151
R380	Resistor	430 "	2W	RK2 431
R381	Resistor	100 Kohm	1/4W	RK00-102
F3	Fuse, glass tube, 0.2 A			FGB 0.20
F4	Fuse, glass tube, 0.5 A			FGB 0.50
F5	Fuse, glass tube, 1 A			FGB 1
S230	Rotary switch	5-pos. 2-sect.		SD16993/4
S 1	Push-button Switch, type P11			23105/20540
V236	Transistor	40312		RCA
V237	Transistor	"		RCA
Q1	Lamp	6V, 0.05A		QL 603
Q2	Lamp	6V, 0.05A		QL 603
40	Fuse socket			KF 2
59	Lamp socket			4628
60	Lamp socket			4628

ALIGNMENT PROCEDURE

1. General:

Receiver M 1250 when delivered is correctly adjusted and the pre-circuits of all bands, covering the frequency range 10 kHz to 30 MHz, are correctly aligned. This factory alignment will last a considerable time and complete alignment is seldom necessary. Replacement of modules and/or components only calls for a minor angular adjustment of trimmers or tuning cores. Alignment and tuning must only be performed by a qualified person.

The alignment instructions must be followed in the sequence given below and typical readings are intended for guidance only. It is also assumed that the modules have been subjected to individual check and adjustment. Refer to SECTIONAL DESCRIPTION.

SECTIONAL DESCRIPTION

2. Procedure:

(a) Module 4, Module 6 and Module 5

(b) Module 1, Module 3 and Module 2

(c) Module 7 and Module 6

Test Equipment:

HF Signal Generator, range 10 kHz to 30 MHz, Rg = 50 ohm
AF Power Output Meter, range 3 ohm 10 W
Dummy Antenna

Preliminary procedure:

Connect the HF signal generator to J228 on module 4, and tune the generator to 1400 kHz, 20 mV output, modulated 30% with 1000 Hz.

Connect the AF output power meter to point 267 (to replace the loudspeaker).

Position the controls

(a)	NOISE LIMITER	off
(b)	RF GAIN	fully clockwise
(c)	METER	in the "s" position
(d)	AF GAIN	to give 50 mW output to the loudspeaker
(e)	CLARIFIER and BFO TUNE	to zero
(f)	MODE	to AM
(g)	AGC	to OFF
(h)	POWER	to RCVR

Initiate the checking procedure by turning the AF GAIN control fully clockwise for a moment. The power output meter should indicate 6– 8 watts. The amplifier will then be overloaded, as the max distortion loww power output is 2 watts. Reset the AF GAIN to a deflection of 50 mW on the power meter. Turn off modulation on the signal generator and read the S/N ratio on the power output meter. The S/N ratio should be better than 25 dB.

To determine the right position of the tuning scale, turn the RF TUNE counterclockwise, i. e. minimum capacity of C188, C189 and C190, and lock the dial in position just where the red marker line coincides with the latter half of 0 in 30.

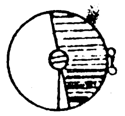
Alignment:

Transfer the cable from the generator to the antenna input connection J7 and reconnect the internal cable to J228. Preset all iron cores of the coils in module 3, so that the top end of the cores is flush with the edge of the coil forms.

1. Band 1 – 30 to 20 MHz:

   Capacitors C84, C104 and C124 are positioned to almost maximum capacity.

   Refer figure .....

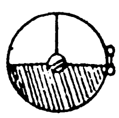
   Adjust RF TUNE to 22 (upper scale) and the synthesizer to 21 MHz. Tune the signal generator to 21 MHz, modulated 30% with 1000 Hz. The output signal from the generator should be 300-400 mV. Align the iron cores of L84, L104 and L124 to maximum reading on the outputmeter. To maintain 50 mW output signal, reduce the output from the generator to 100 µV. Further reduction of the output signal is obtained by decreasing the RF/IF GAIN. Adjust the cores to the second maximum.

   Tune the generator and set the synthesizer to 27 MHz. Operate the RF TUNE to maximum deflection on the power outputmeter. Adjust capacitors C84, C104 and C124 to a maximum reading on the power meter.

   Reset the signal generator and the synthesizer to 21 MHz and the RF TUNE control to 22 MHz and perform final adjustments of L84, L104 and L124 to obtain a true maximum output. Lock the cores.

2. Band 2 – 20 to 10 MHz

   Preset C83, C103 and C123.
   Refer figure ....

   Set RF TUNE to reference point ▲, to the right of digital 1 (scale 1–2). Tune the signal generator to 10 MHz, modulated 30% with 1000 Hz and an output of 300–400 mV.

Set the synthesizer to 10 MHz.

Push the cores of L83, L103 and L123 partly down the coil forms.

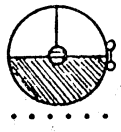
To maintain a 50 mW output signal, reduce the output from the generator to 100 µV. A still weaker output signal can be obtained by decreasing the RF/IF GAIN. Adjust the cores to the second maximum.

Tune the generator and set the synthesizer to 19.8 MHz. Operate the RF TUNE to max output reading and adjust the capacitors C83, C103 and C123 for max deflection on the outputmeter.

Retune the generator and reset the synthesizer to 10 MHz. Operate the RF TUNE to max output and finish by adjusting the cores of L83, L103 and L123 to true maximum. Lock the cores.

3. Band 3 - 10 to 4 MHz

Preset capacitors C82, C102 and C122, ref. fig. ....



Place RF TUNE on reference point ▲ to the right of digital 4 (scale 4-10).

Tune the signal generator to 4 MHz, modulated 30% with 1000 Hz. The output from the generator should be 300 to 400 mV.

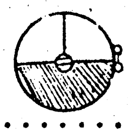
With the synthesizer to 4 MHz, adjust the cores of L82, L102 and L122 to max reading on the output power meter, which reading should be made before the cores inserted in the forms reach halfway.

To maintain 50 mW output, reduce the signal from the generator to 100 µV. A still weaker output signal can be obtained by operating the RF/IF GAIN.

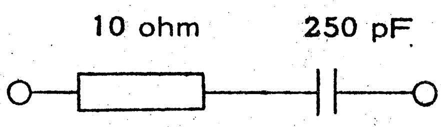
Tune the generator and set the synthesizer to 9.8 MHz. Operate the RF TUNE to max output reading and adjust the capacitors C82, C102 and C122 to a true max output. Lock the cores of the coils.

4. Band 4 - 4 to 2 MHz

Preset capacitors C81, C101 and C121, ref. fig. ....



Place the RF TUNE on reference point ▲ to the right of digital 2 (scale 2-4). Tune the signal generator to 2MHz, modulated 30% with 1000 Hz, and inject the signal to the antenna terminal of the receiver through a dummy antenna, shown in the figure.

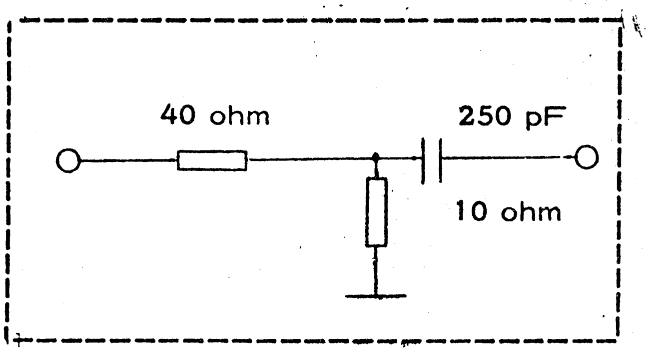


Dummy Antenna

The output signal from the generator should be about 1 V. Set the synthesizer to 2 MHz and insert the cores of the coils of L81, L101 and L121 to max deflection on the output power meter. To maintain the 50 mW output signal, reduce the signal from the generator to 1 mV. A still weaker signal can be obtained by operating the RF/IF GAIN.

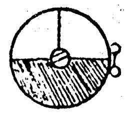
Tune the generator and set the synthesizer to 3.9 MHz. Operate the RF TUNE to max output reading. Adjust C81, C101 and C121 to a true max deflection on the output power meter.

If a signal generator with 50 ohms generator impedance is available, it is convenient to use a dummy antenna, as shown in the circuit diagram:



With this dummy antenna the generator will match 50 ohms and the receiver will match the dummy antenna. The insertion loss is abt. 20 dB.

5. Band 5 - 2 to 1 MHz



Preset capacitors C141, C164 and C181, ref. fig. ....

Place RF TUNE on digital 1 sharp (scale 1-2).

Tune the generator and set the synthesizer to 1 MHz. The output from the generator should be 1V, modulated 30% with 1000 Hz. It is assumed that the generator is connected to the receiver through the dummy antenna.

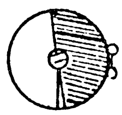
Adjust the cores of L141, L161 and L181 to max output reading. To maintain 50 mW output signal, reduce the generator output to 1 mV. To moderate the output (if necessary), operate the RF/IF GAIN.

Tune the generator and set the synthesizer to 1.95 MHz. Operate the RF TUNE to max output reading.

Adjust capacitors C141, C161 and C181 to max output.

Retune the generator and reset the synthesizer to 1 MHz. Operate RF TUNE for max output. Adjust the cores of L141, L161 and L181 for a true maximum and lock the cores.

6. Band 6 - 1000 - 400 kHz



Preset capacitors C142, C162 and C182, ref. fig. ....

Place the RF TUNE on reference point ▼ to the left of digital 4 (scale 4-10).

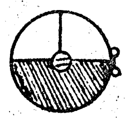
Tune the generator to 400 kHz, modulated 30% with 1000 Hz; the output should be 1 V. The generator is still connected to the receiver through the dummy antenna. Set the synthesizer to 400 kHz.

Adjust the cores of L142, L162 and L182 to max output reading. When inserted, the cores should now reach beyond the midway point of the forms, and be adjusted to the second maximum. Lock the cores.

To maintain a 50 mW output signal, reduce the generator output to 1 mV. If necessary, moderate the output by operating the RF/IF GAIN.

Tune the generator and set the synthesizer to 980 kHz. Operate the RF TUNE to max deflection on the output meter. Adjust capacitors C142, C162 and C182 to max output reading.

7. Band 7 - 400 - 200 kHz



Preset capacitors C143, C163 and C183, ref. fig. ....

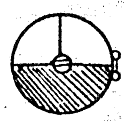
Place RF TUNE on reference point ▼ to the left of digital 2 (scale 2-4). Tune the signal generator to 200 kHz, modulated 30% with 1000 Hz. The output signal should be about 1V. The signal generator is connected to the receiver through the dummy antenna.

Set the synthesizer ro 200 kHz and adjust the cores of L143, L163 and L183 to max reading on the output meter.

To maintain a 50 mW output signal, reduce the generator output to 1 mV. Level the output as before by operating the RF/IF GAIN.

Tune the generator and set the synthesizer to 380 kHz. Operate the RF TUNE to max deflection on the output meter. Adjust capacitors C143, C163 and C183 to max output reading. Retune the generator and reset the synthesizer to 200 kHz. Operate the RF TUNE to max output and finish by adjusting the cores of L143, L163 and L183 to true maximum output. Lock the cores.

8. Band 8 - 200 - 100 kHz



Preset capacitors C144, C164 and C184, ref. fig. ....

Set the RF TUNE to reference point ▼, to the left of digital 1 (scale 1-2).

Tune the signal generator to 100 kHz, modulated 30% with 1000 Hz. It is assumed that the generator is connected to the receiver through the dummy antenna.

The output signal from the generator should be about 1V. Set the synthesizer to 100 kHz and adjust the cores of L144, L164 and L184 to max output reading. To maintain a 50 mW output signal, reduce the generator output to 1 mV and level still more by the RF/IF Gain, if necessary.

Tune the generator and set the synthesizer to 190 kHz. Operate the RF TUNE to max output reading. Adjust capacitors C144, C164 and C184 to max deflection on the output meter.

Retune the generator and reset the synthesizer to 100 kHz.

Operate the RF TUNE to max output and perform final adjustments of the L144, L164 and L184 cores to obtain true maximum output. Lock the cores.

9. Band 9 - 10 - 100 kHz
Lowpass Filter LP100.

The only alignment necessary for this band is to pretune the coils L65 and L66 to 8.7 mH.

10. Module 7 and Module 6 -
AGC Amplifier and Detectors

While aligning the bands, the gain in the RF and IF amplifiers has been manually controlled.

The final step of the procedure is to set the AGC range by adjusting the AGC amplifier and a slight adjustment of the output from the detectors.

Additional Test Equipment
Oscilloscope

Adjustment:

Connect the oscilloscope in parallel with the outputpower meter. Tune the generator to 21.8 MHz, modulated 30% with 1000 Hz. The output should be about 180 μV emf. The generator is connected directly to the receiver's antenna terminal (without dummy antenna).

Operate the M1250 to receive 21.8 MHz in AM mode with the AGC switch in position OFF. Adjust RF/IF GAIN to the very point where distortion just appears on the scope image. Set the AF GAIN to a deflection of 50 mW on the outputpower meter.

Operate the AGC switch to position SHORT and adjust potentiometer R207 until the deflection on the poweroutput meter is about 30 mW (2 dB below 50 mW).

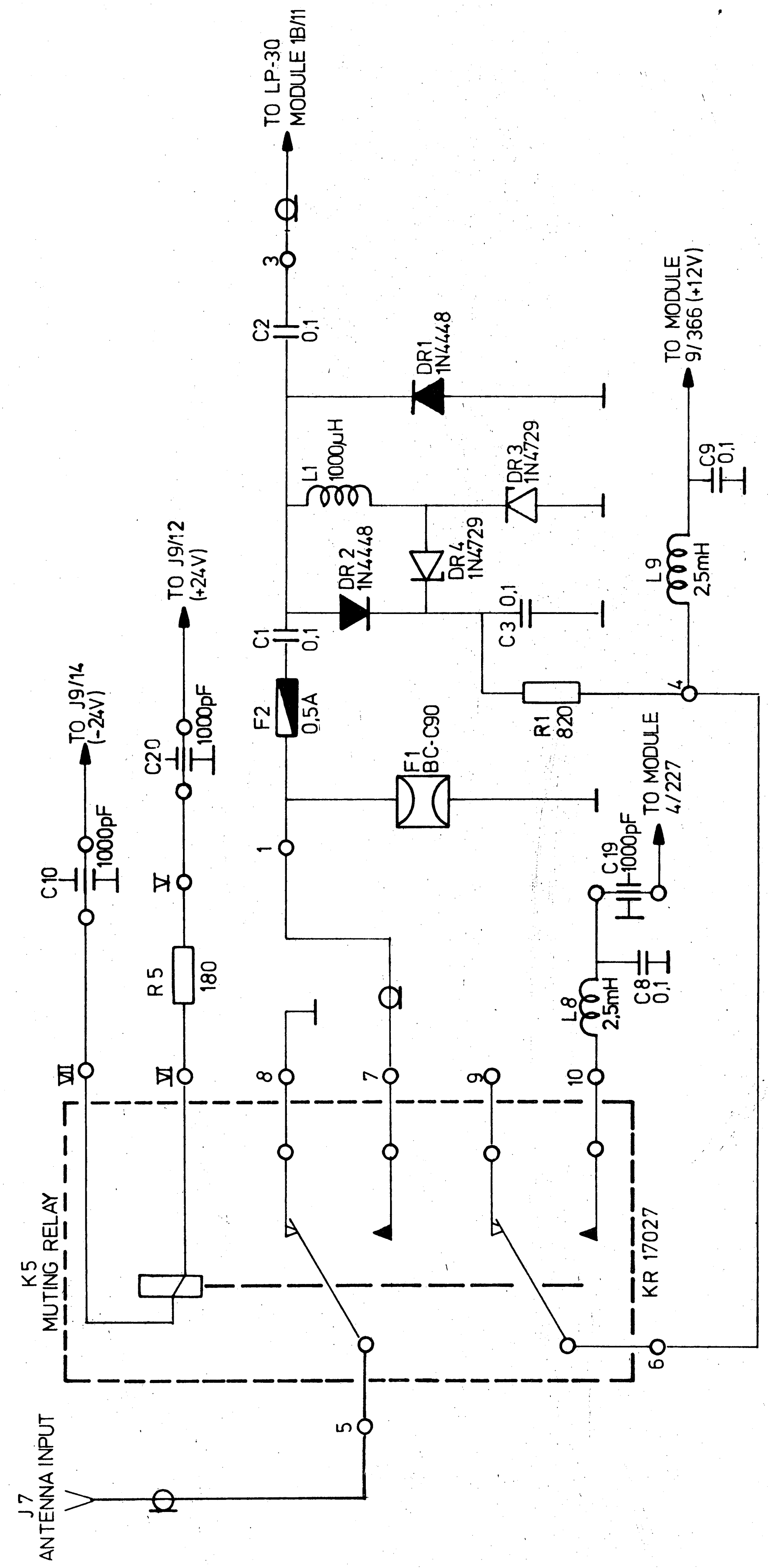
Turn off the modulator in the signal generator and set OPERATING MODE to position SSB. Adjust the potentiometer R294 until the reading on the outputpower meter is about 30 mW. Operate the receiver alternatingly in AM and SSB mode and adjust R294 until the reading on the output meter conforms in both modes.

***

Remember to modulate the generator signal whenever the receiver operates in the AM mode. Lock the potentiometers.

CIRCUIT DIAGRAM

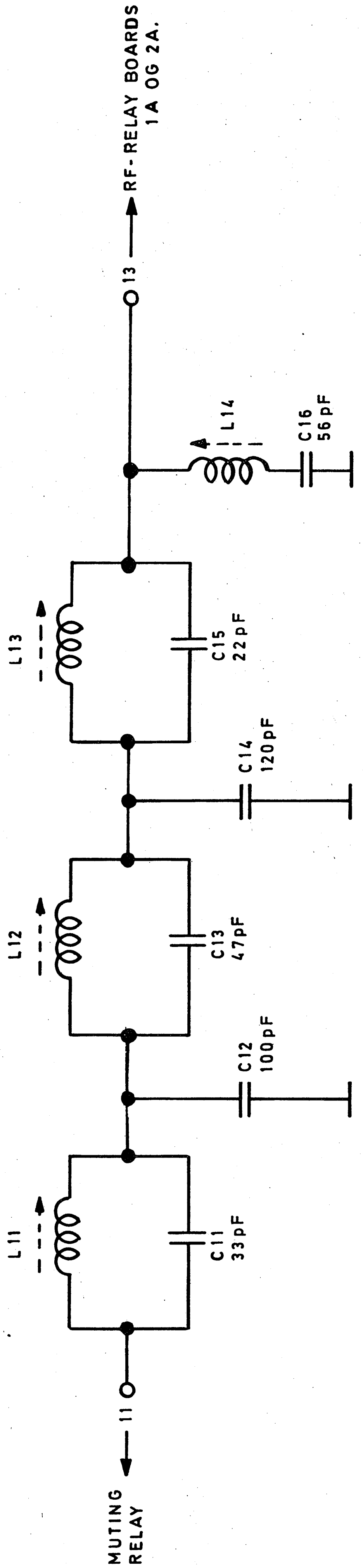
Contents

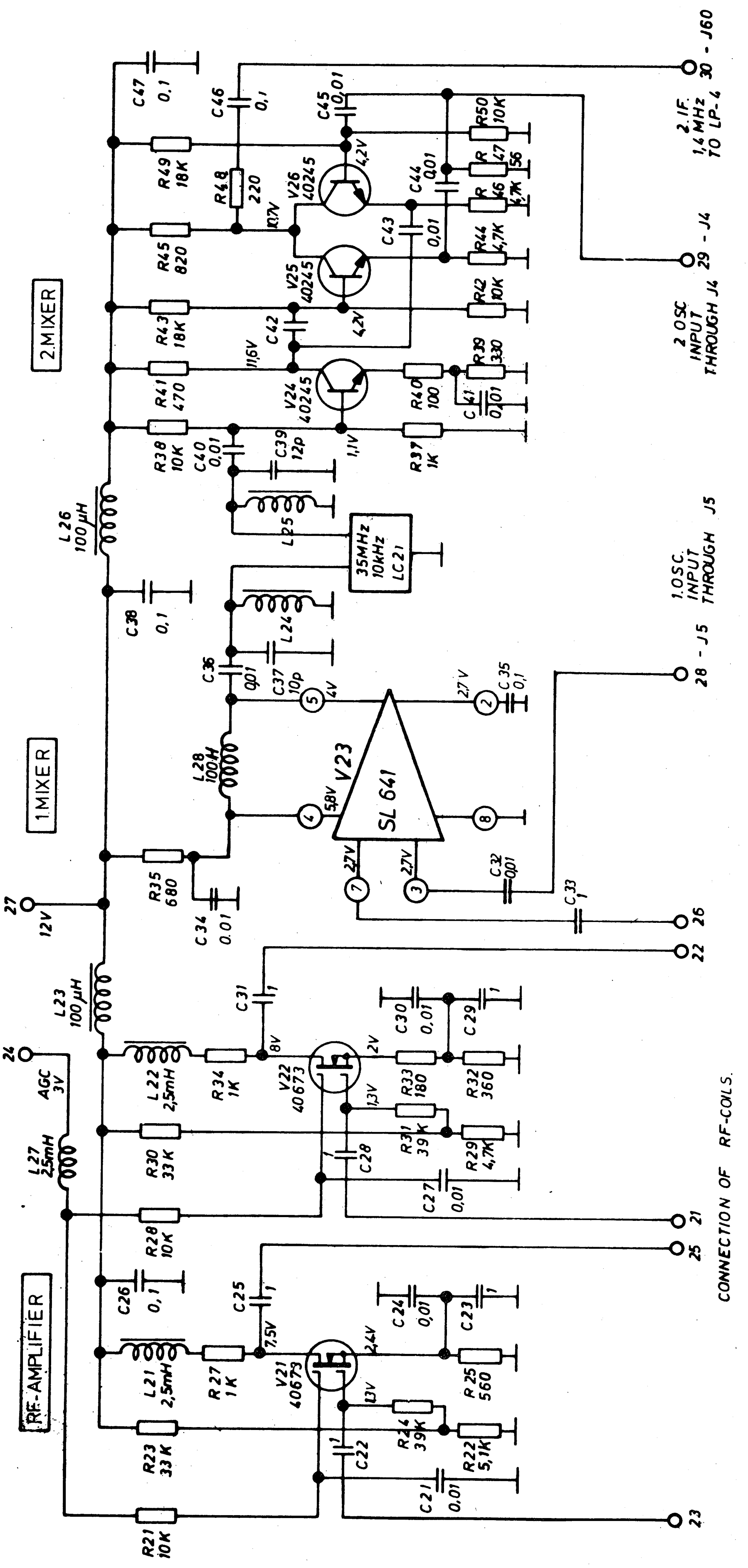


Note:
All resistors in ohms, except otherwise noted
All resistors in 1/4W, except otherwise noted
All capacitors in µF, except otherwise noted
The relay is operated.

M 1250 RCVR Diagr.S-6025/12.72

Module 1A: RF-Circuit Protection and Muting

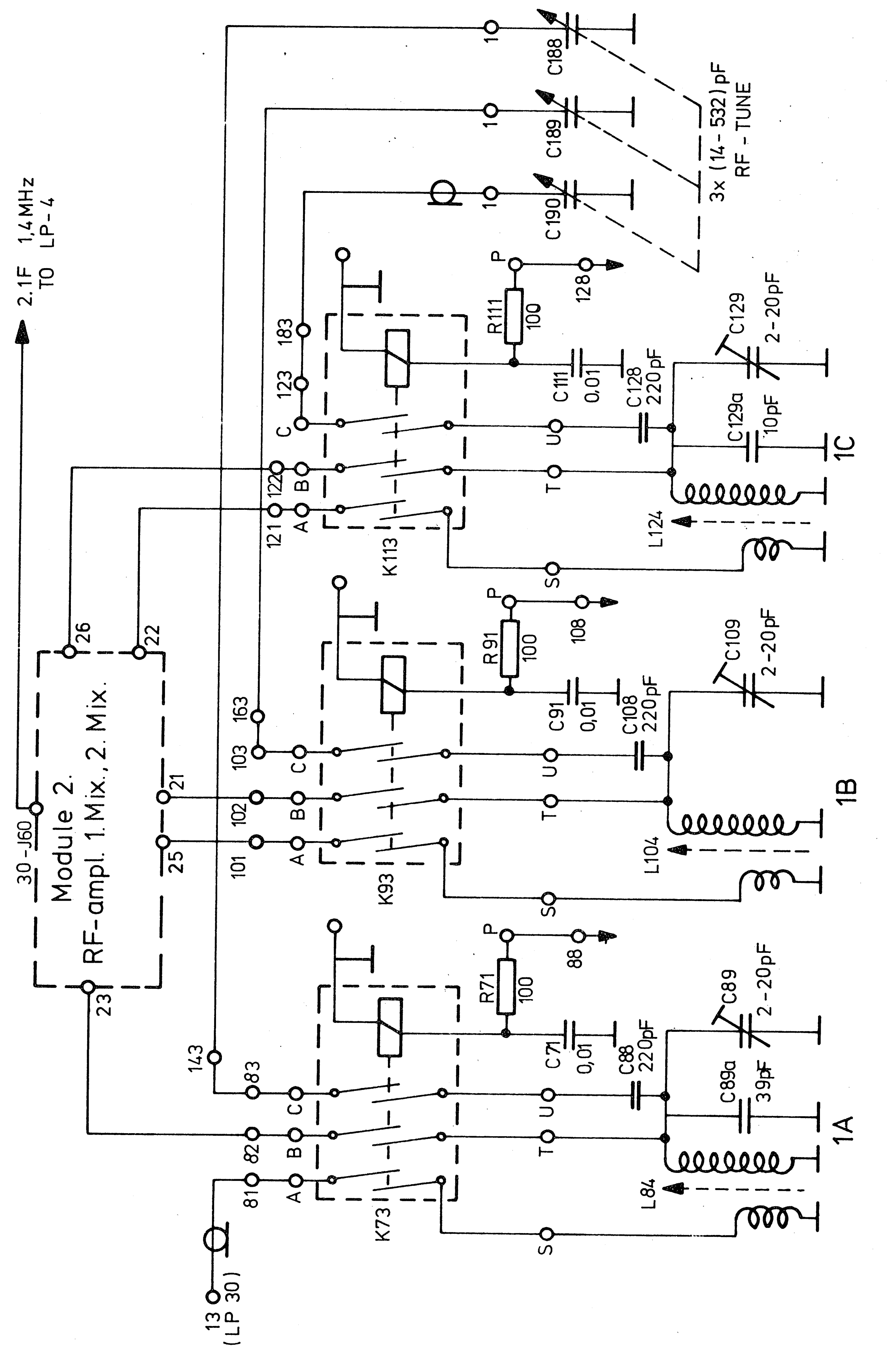

RF-RELAY BOARDS
1A OG 2A.
13
L14
C16
56pF
L13
C15
22pF
C14
120pF
L12
C13
47pF
C12
100pF
L11
C11
33pF
11
MUTING
RELAY



Note:
All capacitors in µF, except otherwise noted
All resistors 1/4W, except otherwise noted
All resistors in ohm, except otherwise noted

M 1250 RCVR Diagr.No.S-5941/12.72

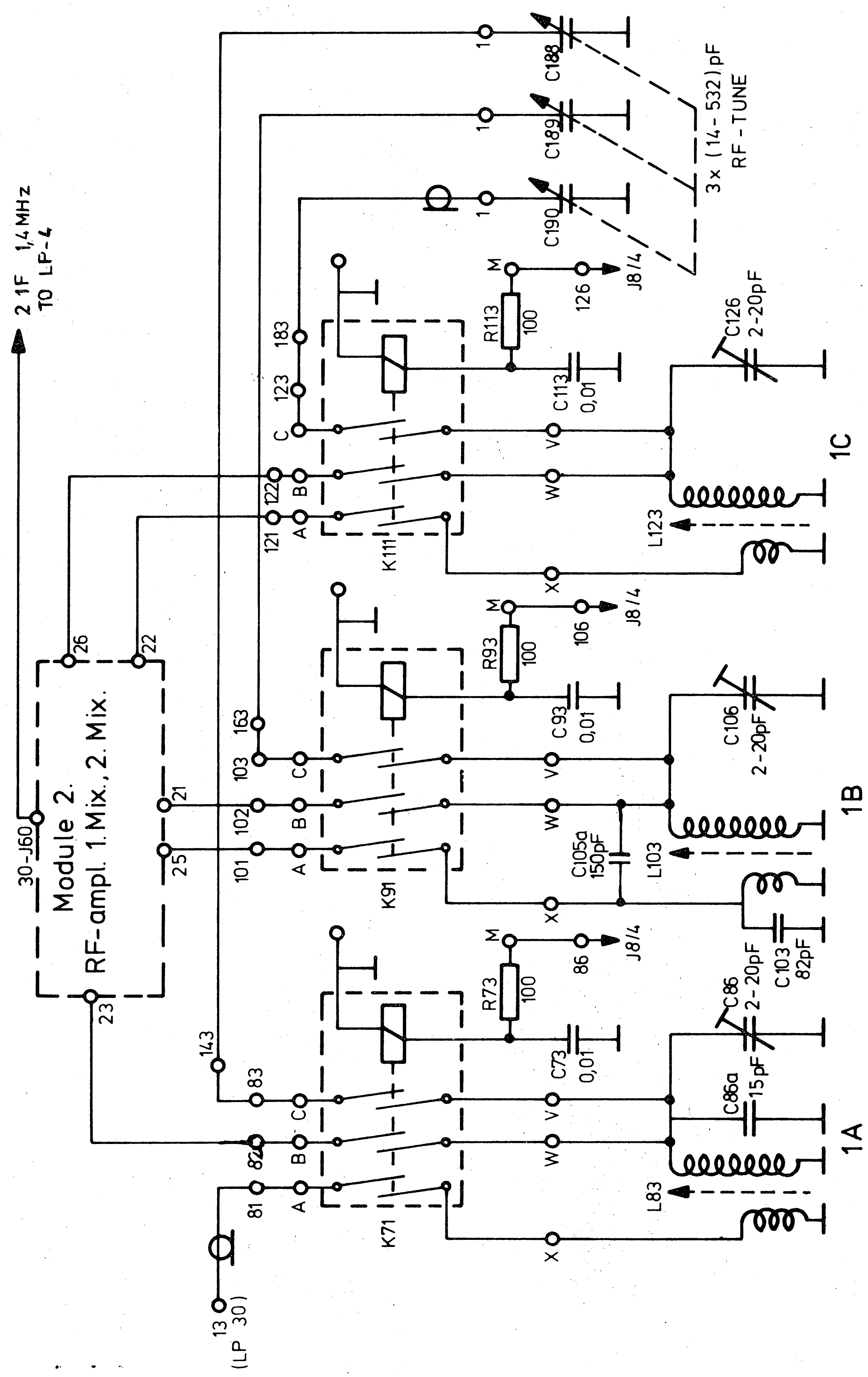
Module 2: RF-Amplifier, 1st Mixer and 2nd Mixer



Note:
The relays are controlled from the synthesizer
further wiring information see:
Detail wiring diagram S-5950

M 1250 RCVR Diagr. No. S-5958/12.72

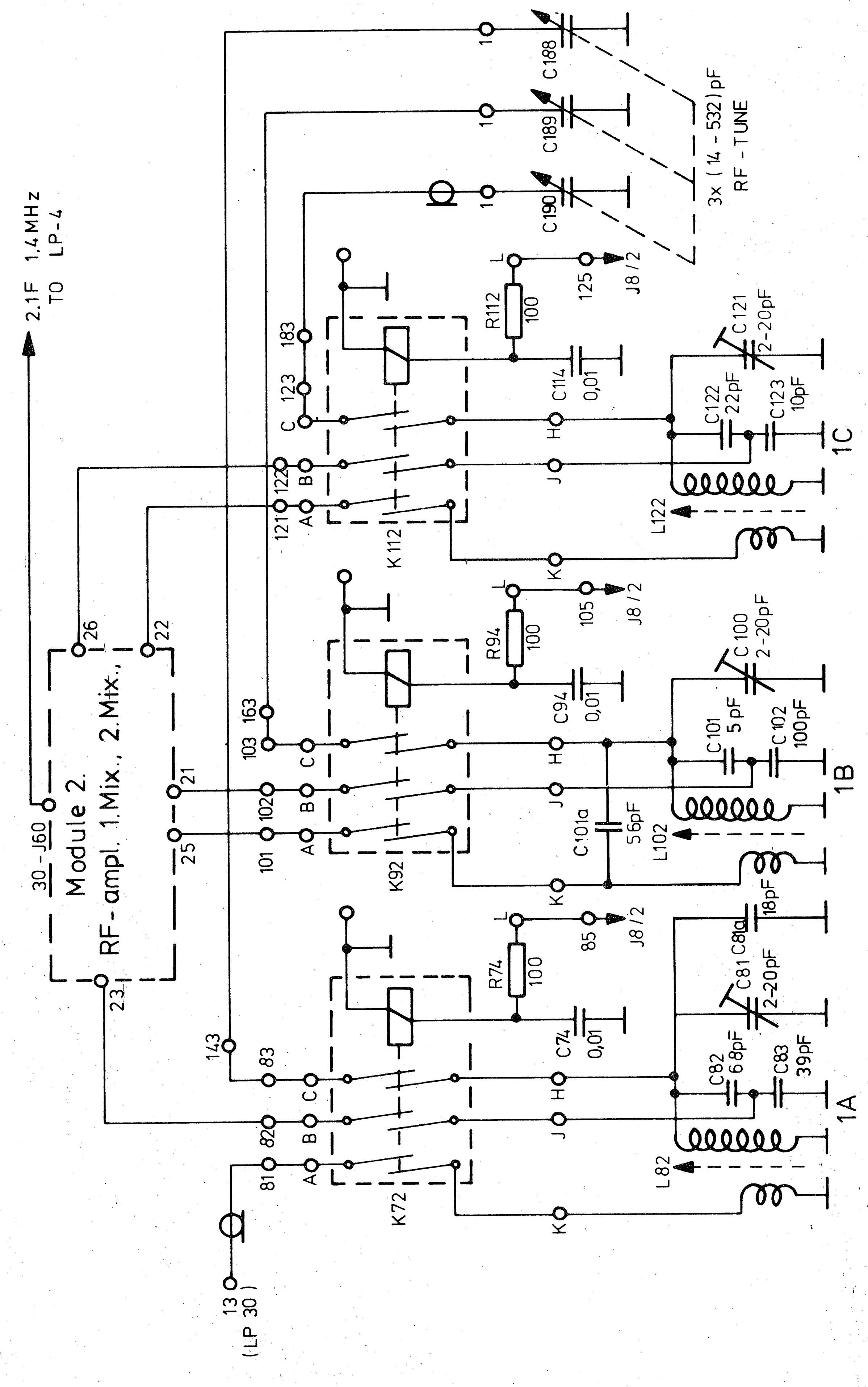
Module 3: Detail Diagram for Band 1, 30-20 MHz



Note:
The relays are controlled from the synthesizer
further wiring information see:
Detail wiring diagram S-5950

M 1250 RCVR Diagr. S-5959/12.72

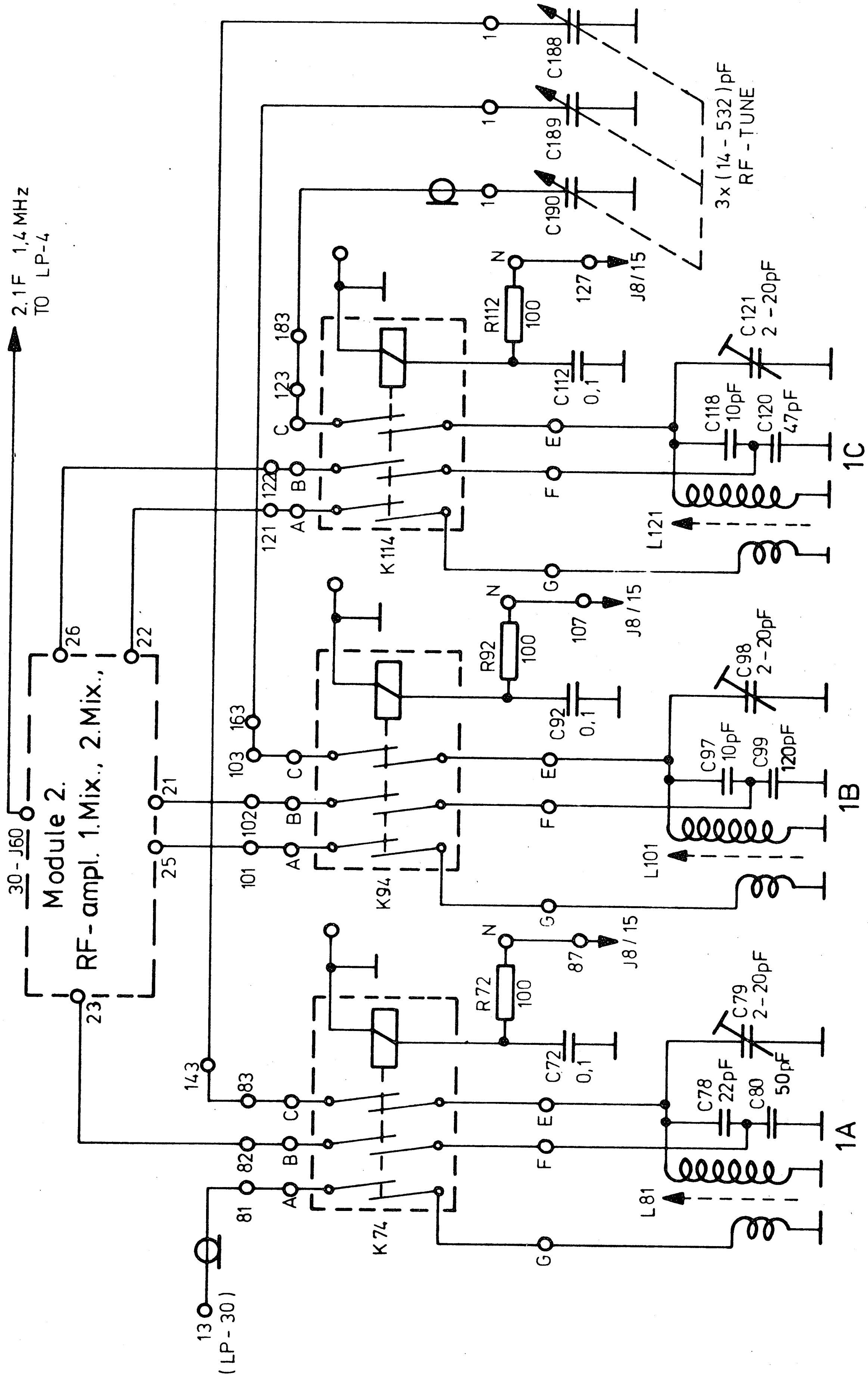
Module 3: Detail Diagram
for Band 2, 20-10 MHz



Note:
The relays are controlled from the synthesizer further wiring information see:
Detail wiring diagram S-5950

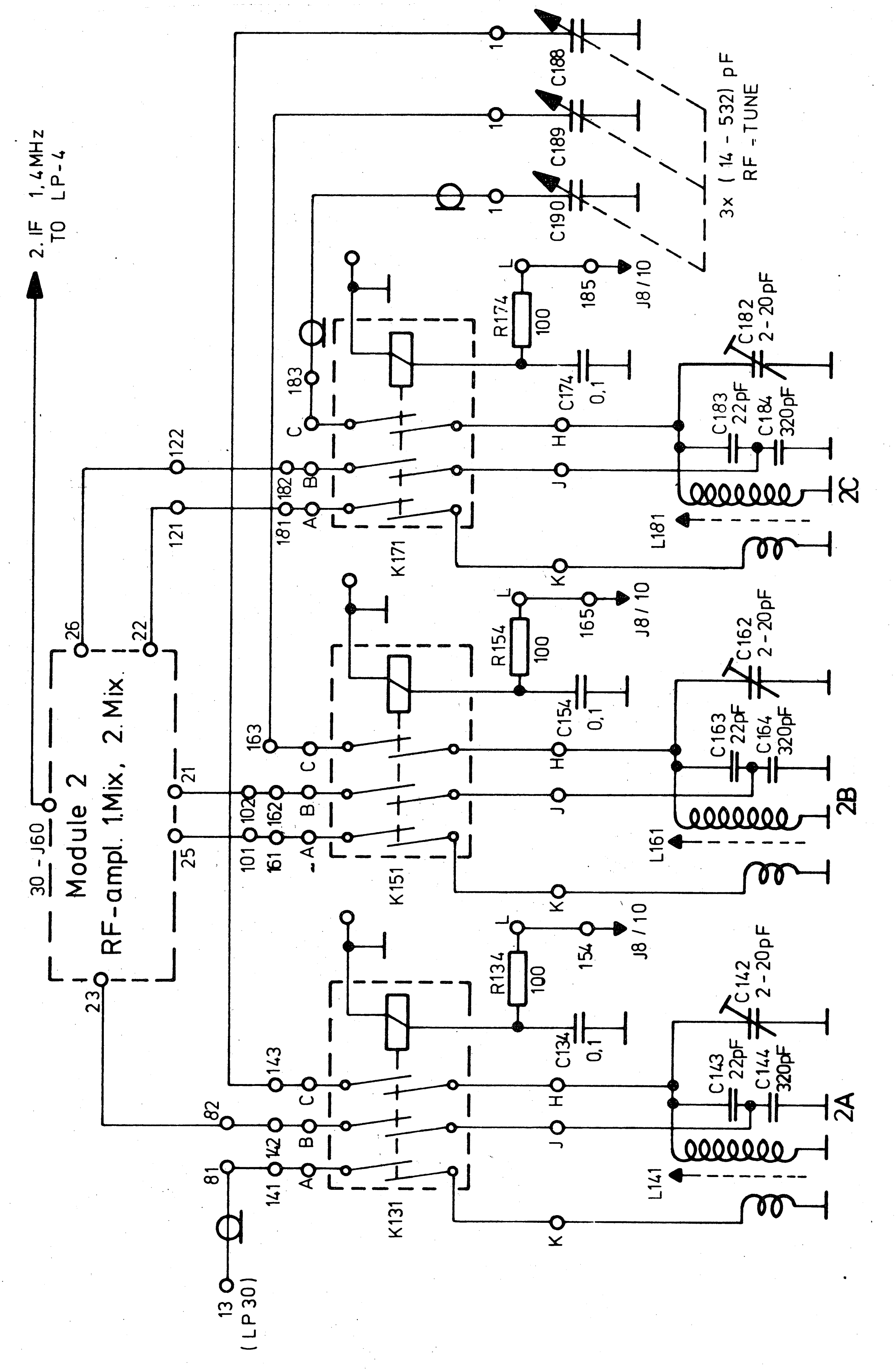
M 1250 RCVR Diagr.No.S-5957/12.72

Module 3: Detail Diagram for Band 3, 10–4 MHz



Note:
The relays are controlled from the synthesizer
further wiring information see:
Detail wiring diagram S-5950

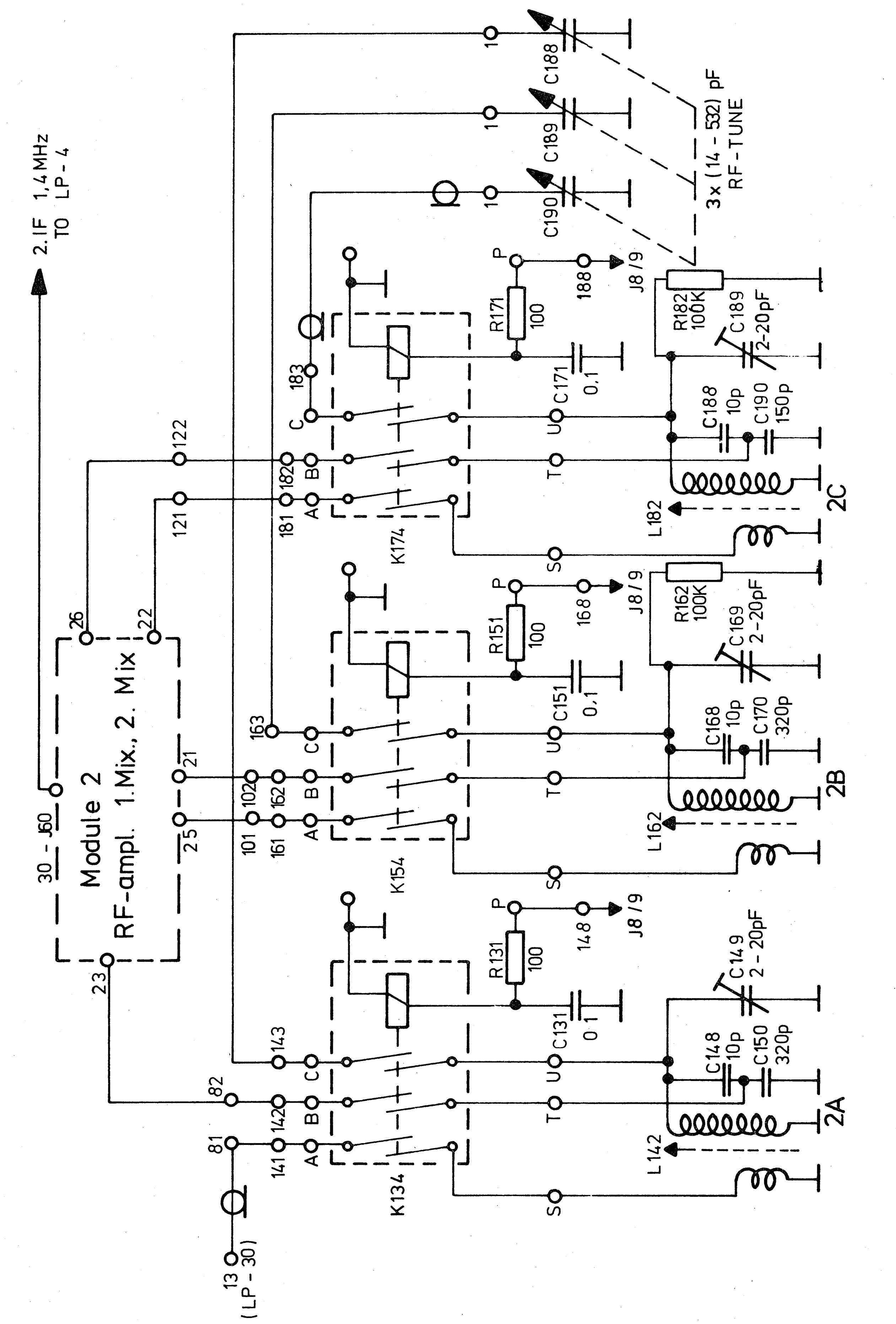
Module 3: Detail Diagram for Band 4, 4-2 MHz



Note:
The relays are controlled from the synthesizer
further wiring information see:
Detail wiring diagram S-5950

M 1250 RCVR Diagr. No. S-5954/12.72

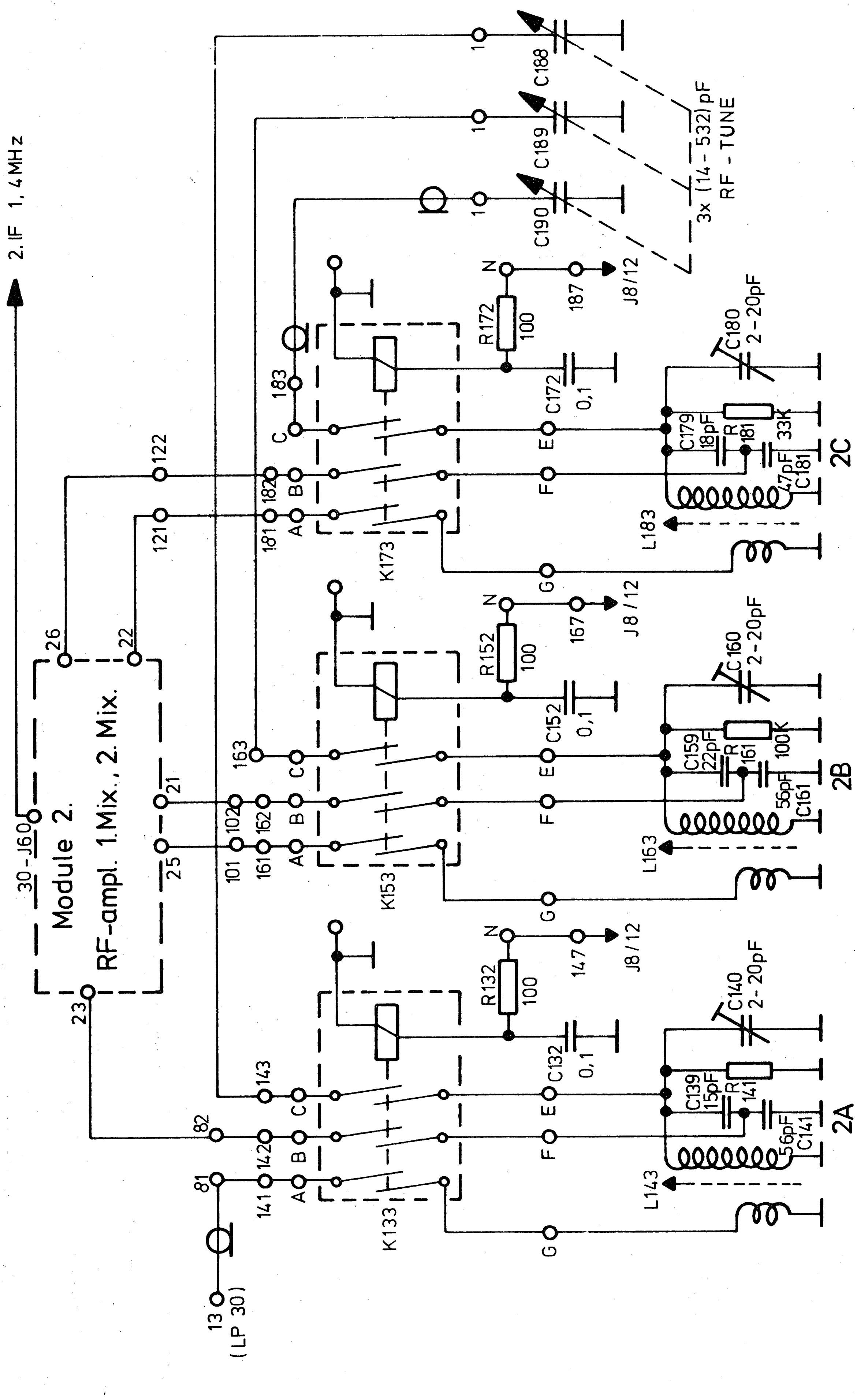
Module 3: Detail Diagram for Band 5, 2-1 MHz



Note:
The relays are controlled from the synthesizer
further wiring information see:
Detail wiring diagram S-5950

M 1250 RCVR Diagr.No.S-5953/12.72

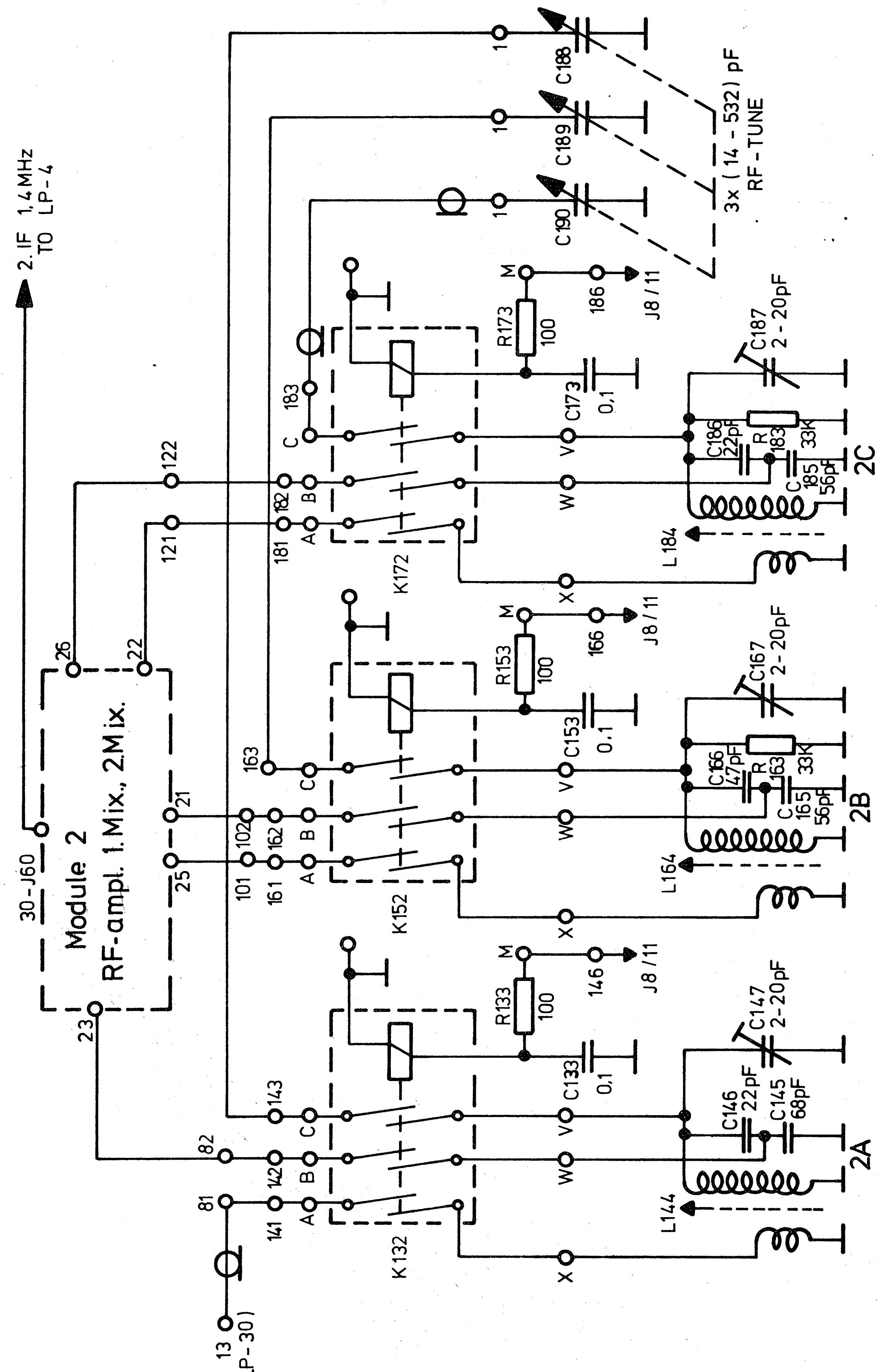
Module 3: Detail Diagram for Band 6, 1000–400 kHz



Note:
The relays are controlled from the synthesizer
further wiring information see:
Detail wiring diagram S-5950

M 1250 RCVR Diagr. No. S-5952/12.72

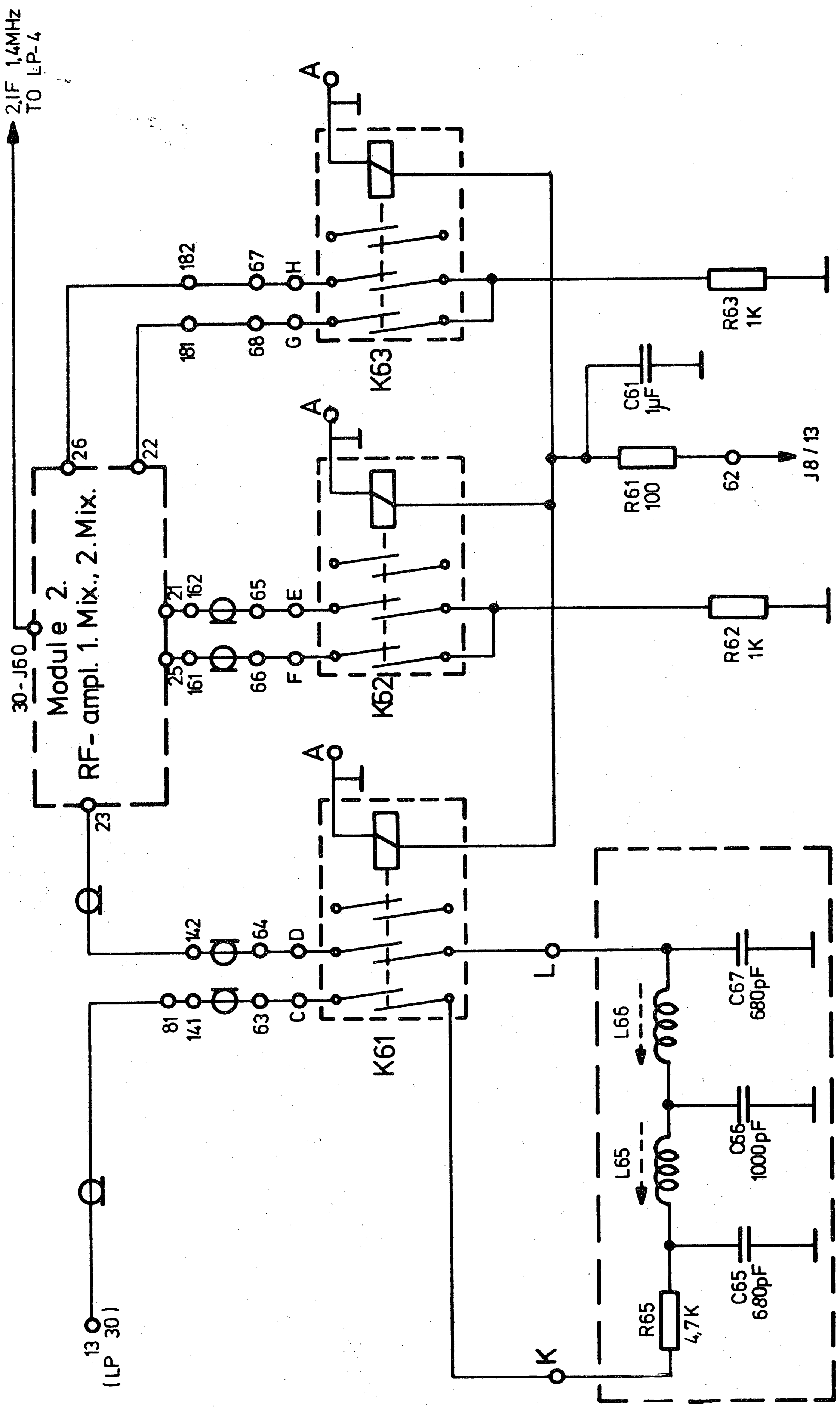
Module 3: Detail Diagram for Band 7, 400-200 kHz



Note:
The relays are controlled from the synthesizer
further wiring information see:
Detail wiring diagram S-5950

M 1250 RCVR Diagr. No. S-5955/12.72

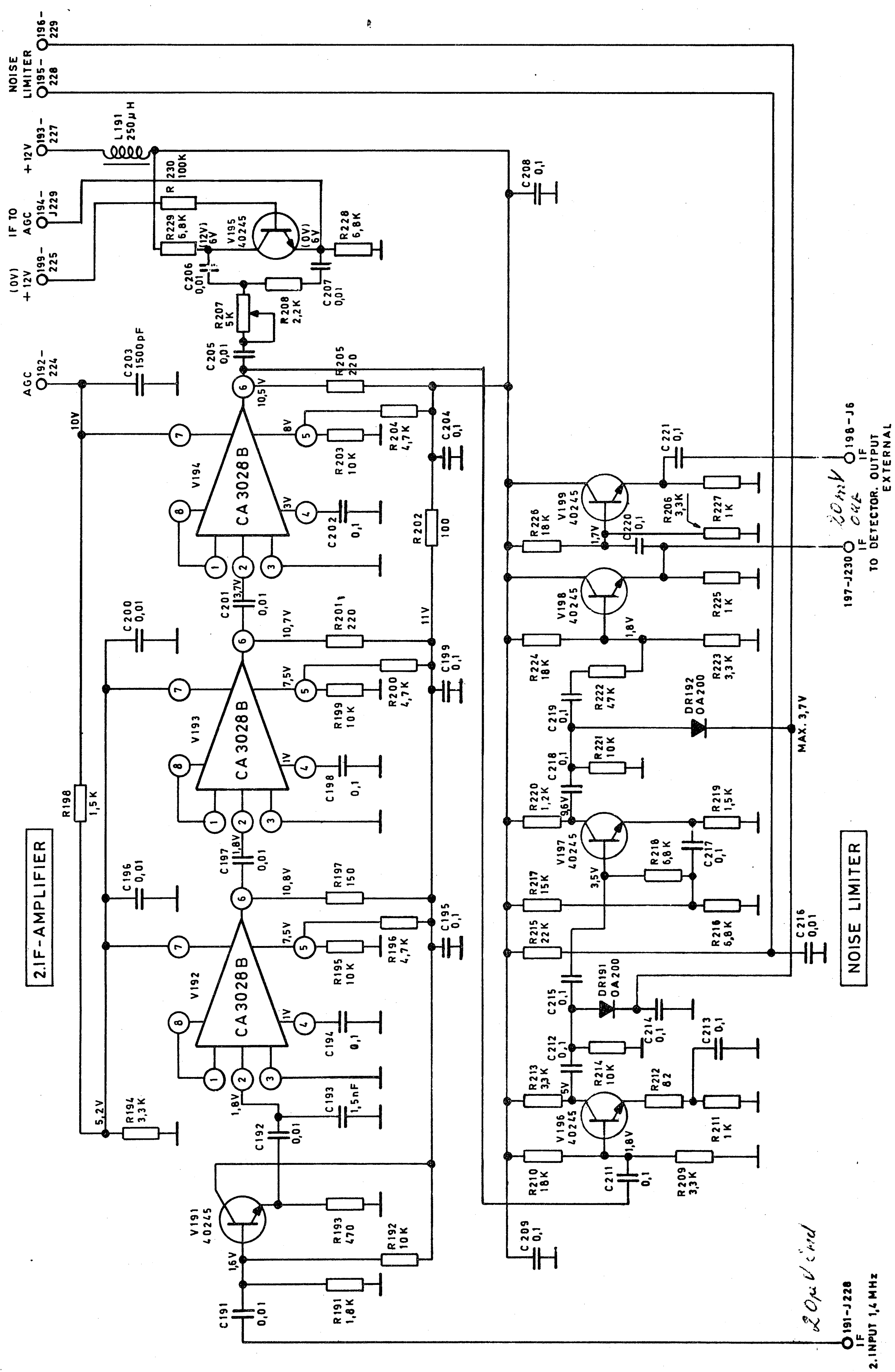
Module 3: Detail Diagram
for Band 8, 200-100 kHz



Note:
The relays are controlled from the synthesizer
further wiring information see:
Detail wiring diagram S-5950

M 1250 RCVR Diagr.No.S-5951/12 72

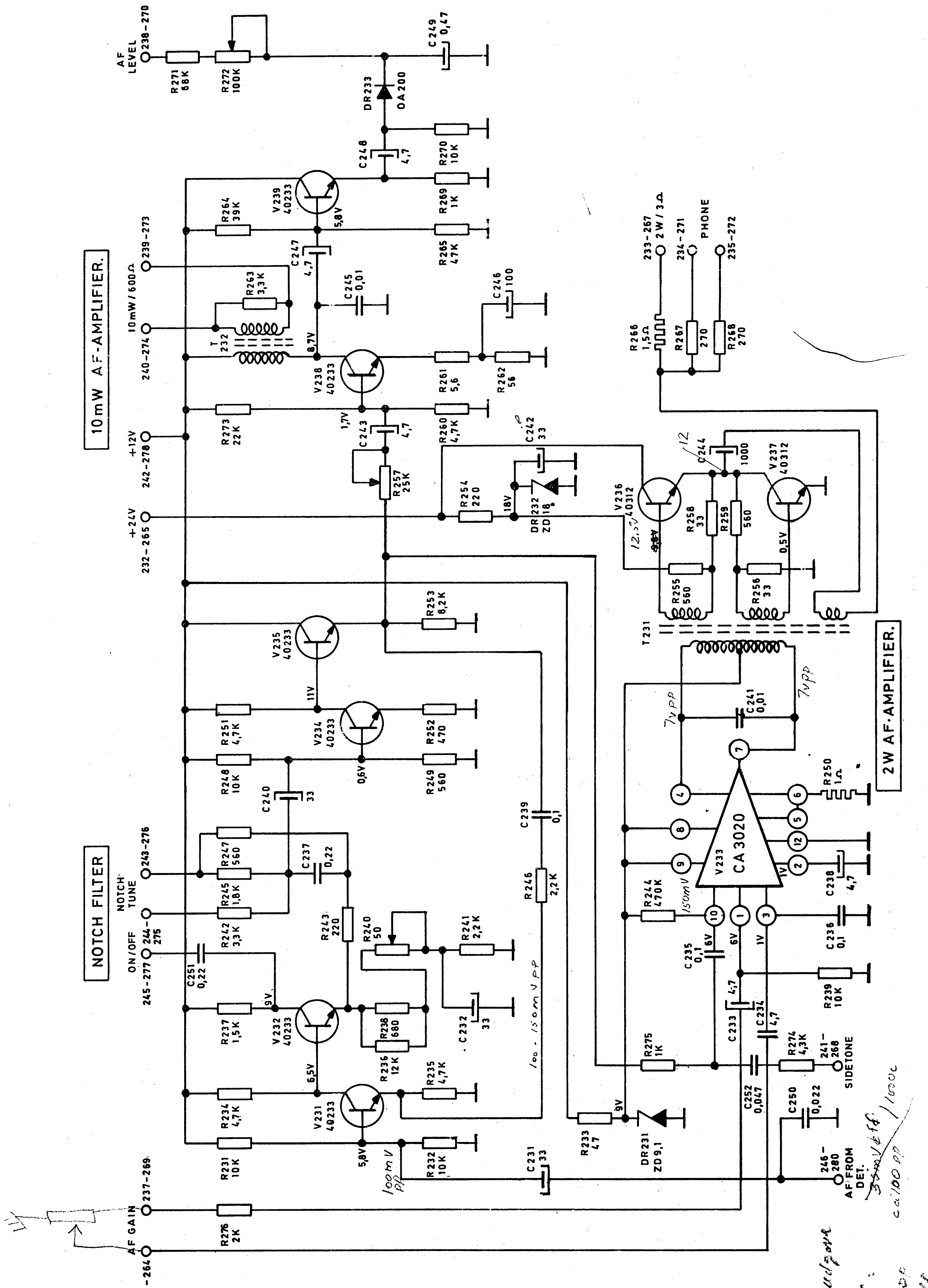
Module 3: Detail Diagram for Band 9, 100-10 kHz



Note:
All capacitors in µF, except otherwise noted
All resistors 1/4W, except otherwise noted
All resistors in ohm, except otherwise noted

M 1250 RCVR Diagr. No. S-5498/6.71

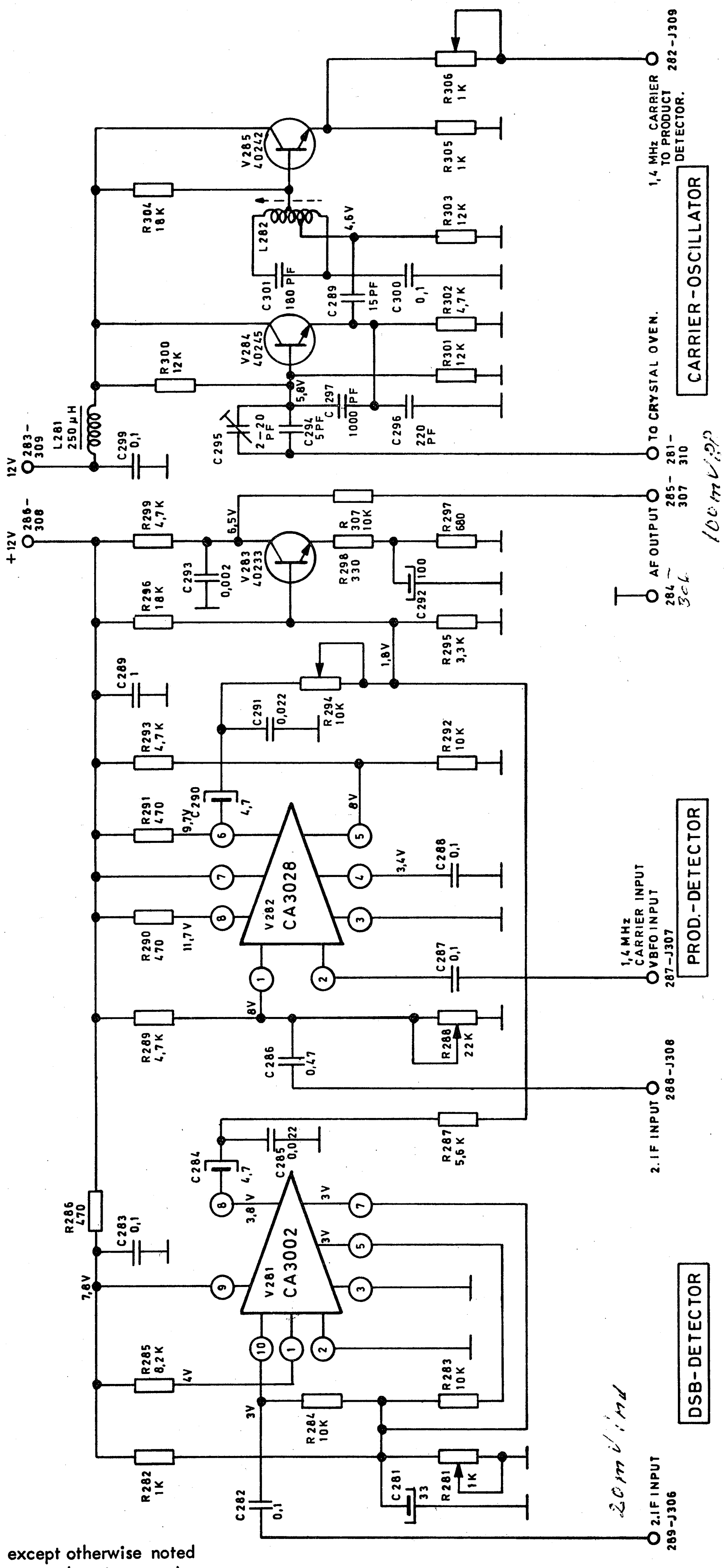
Module 4: IF-Amplifier, Noise Limiter



Note:
All capacitors in μF, except otherwise noted
All resistors 1/4W, except otherwise noted
All resistors in ohm, except otherwise noted

M 1250 RCVR Diagr.No.S-5497/6.71

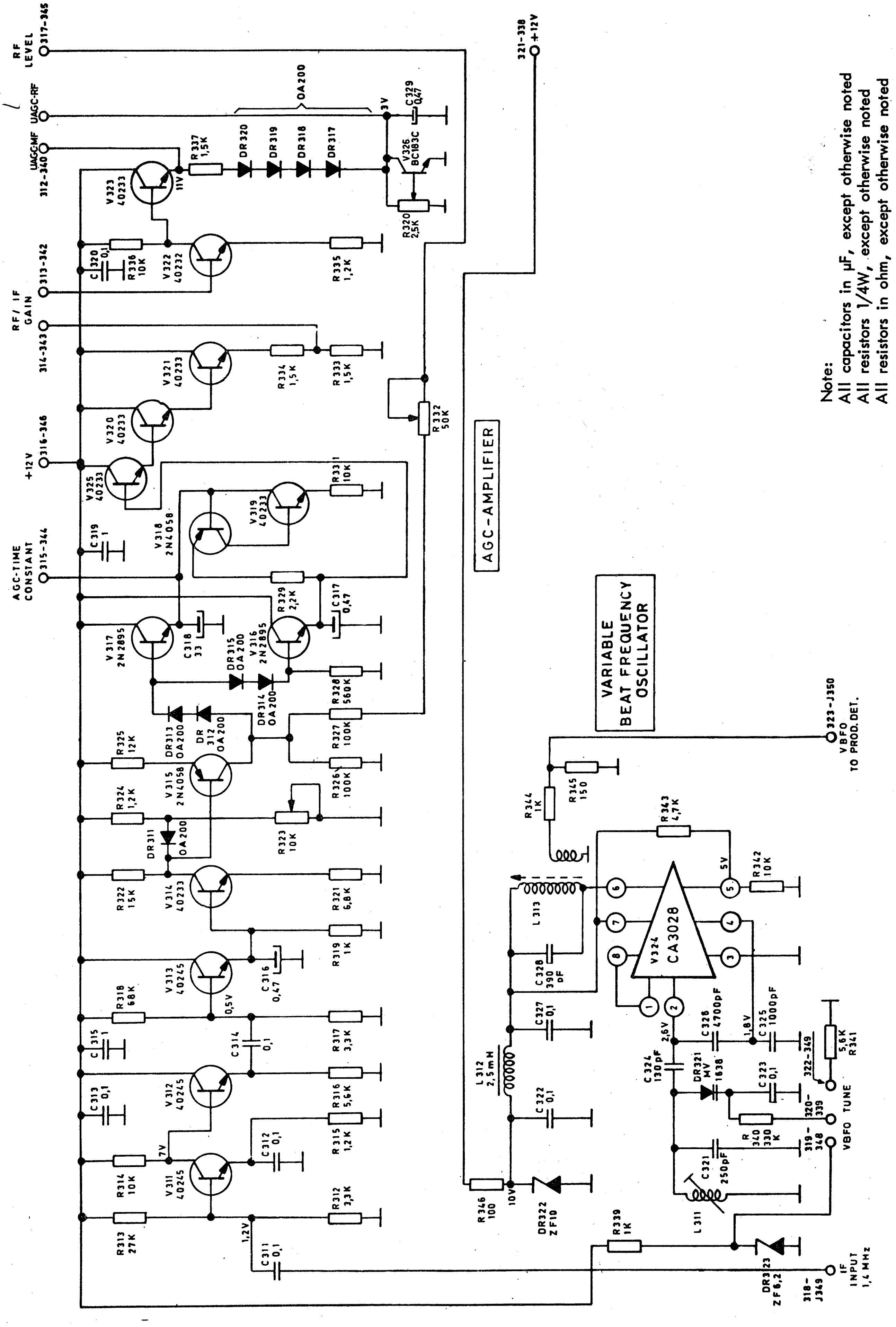
Module 5: Notch Filter, 2W AF-Amplifier and 10mW AF-Amplifier



Note:
All capacitors in µF, except otherwise noted
All resistors 1/4W, except otherwise noted
All resistors in ohm, except otherwise noted

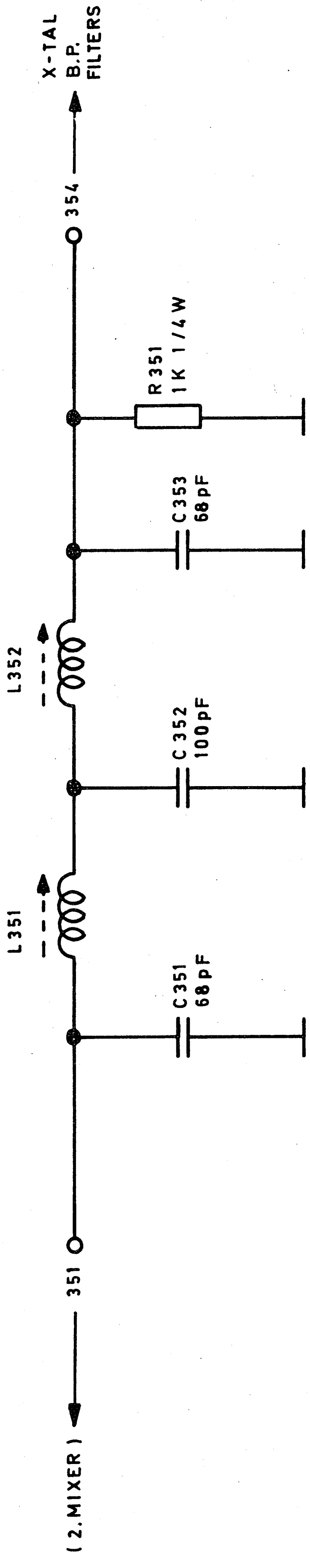
M 1250 RCVR Diagr. No. S-5501/6.71

Module 6: DSB-Detector, Product-Detector and Carrier-Oscillator



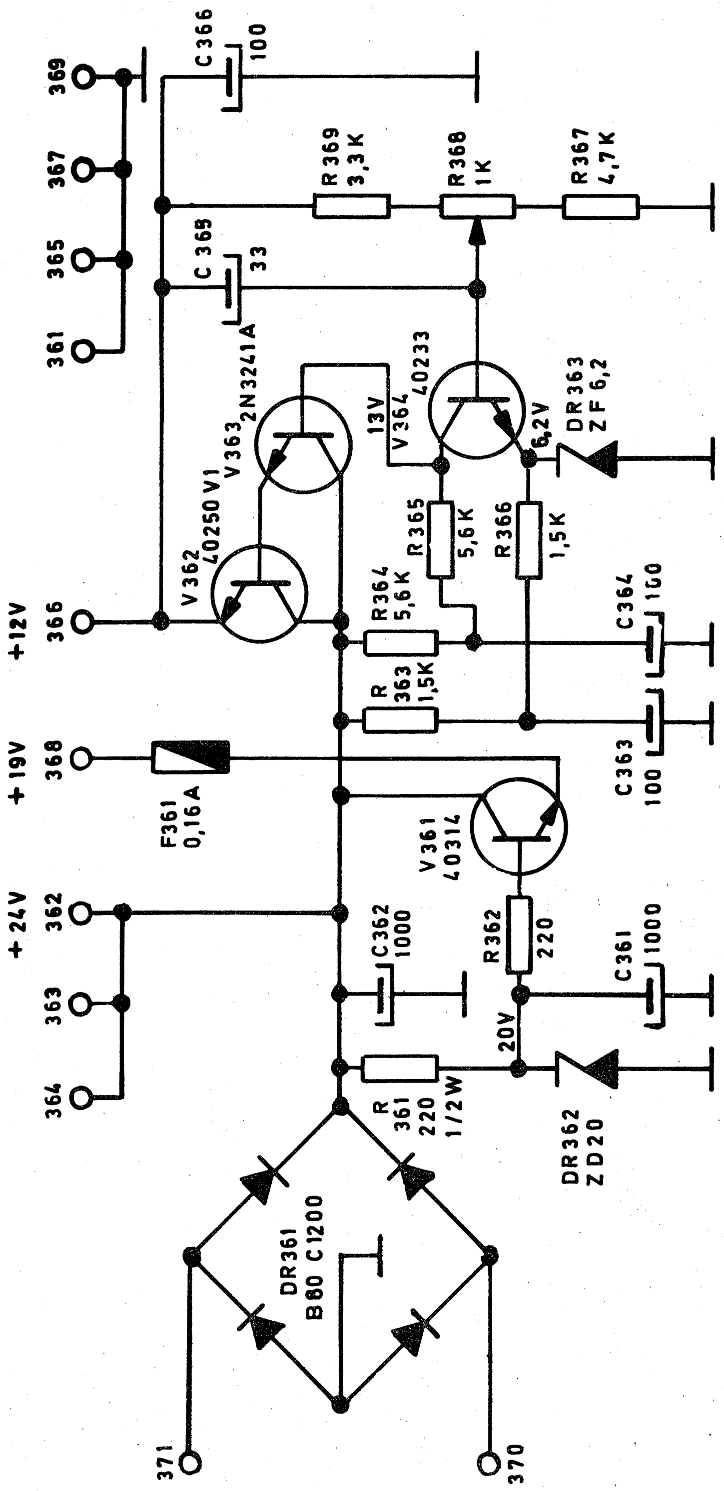
M 1250 RCVR Diagr. No. S-5499/12.72

Module 7: AGC, VBFO

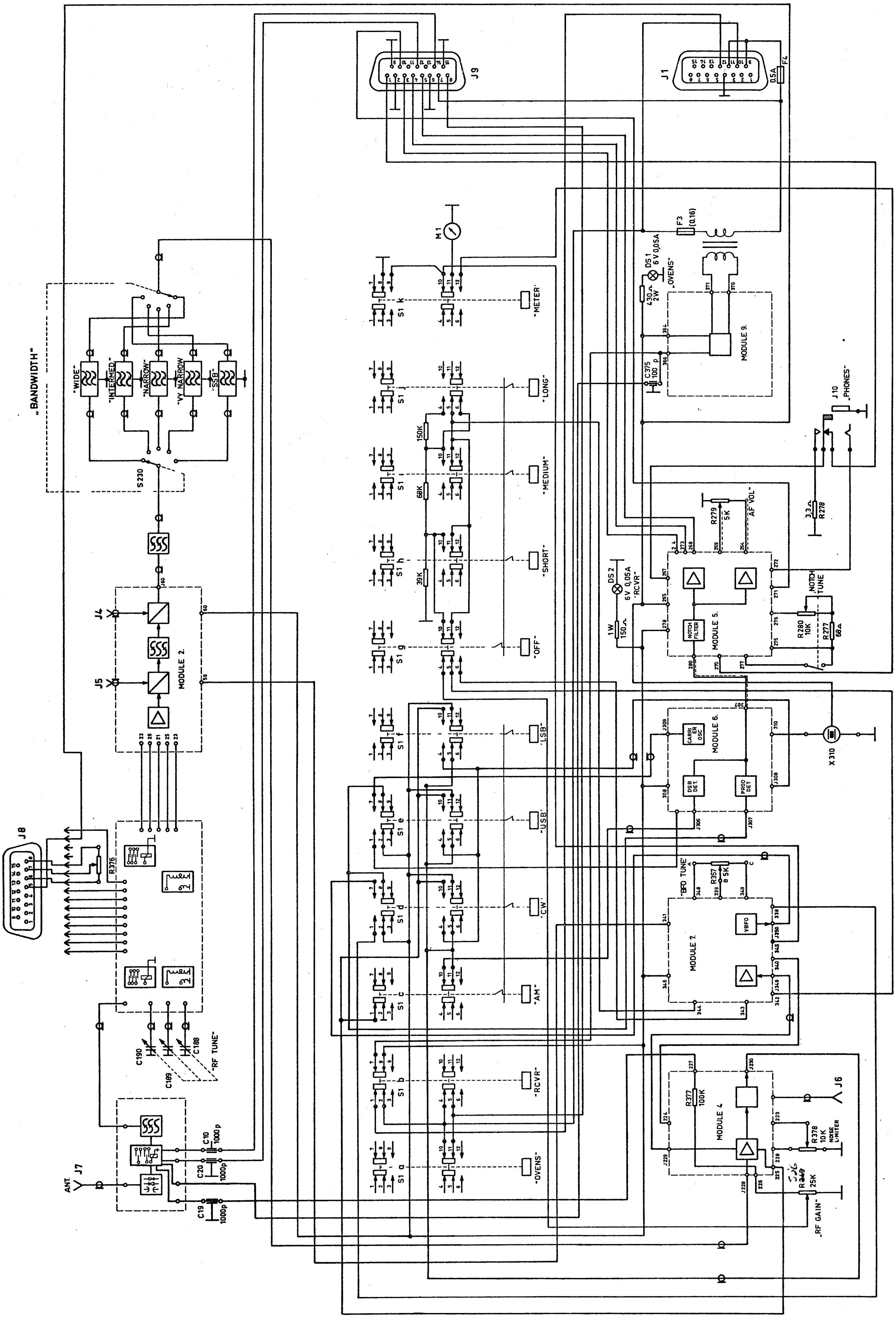


M 1250 RCVR Diagr. No. S-5565/9.71

Module 8: LP-4

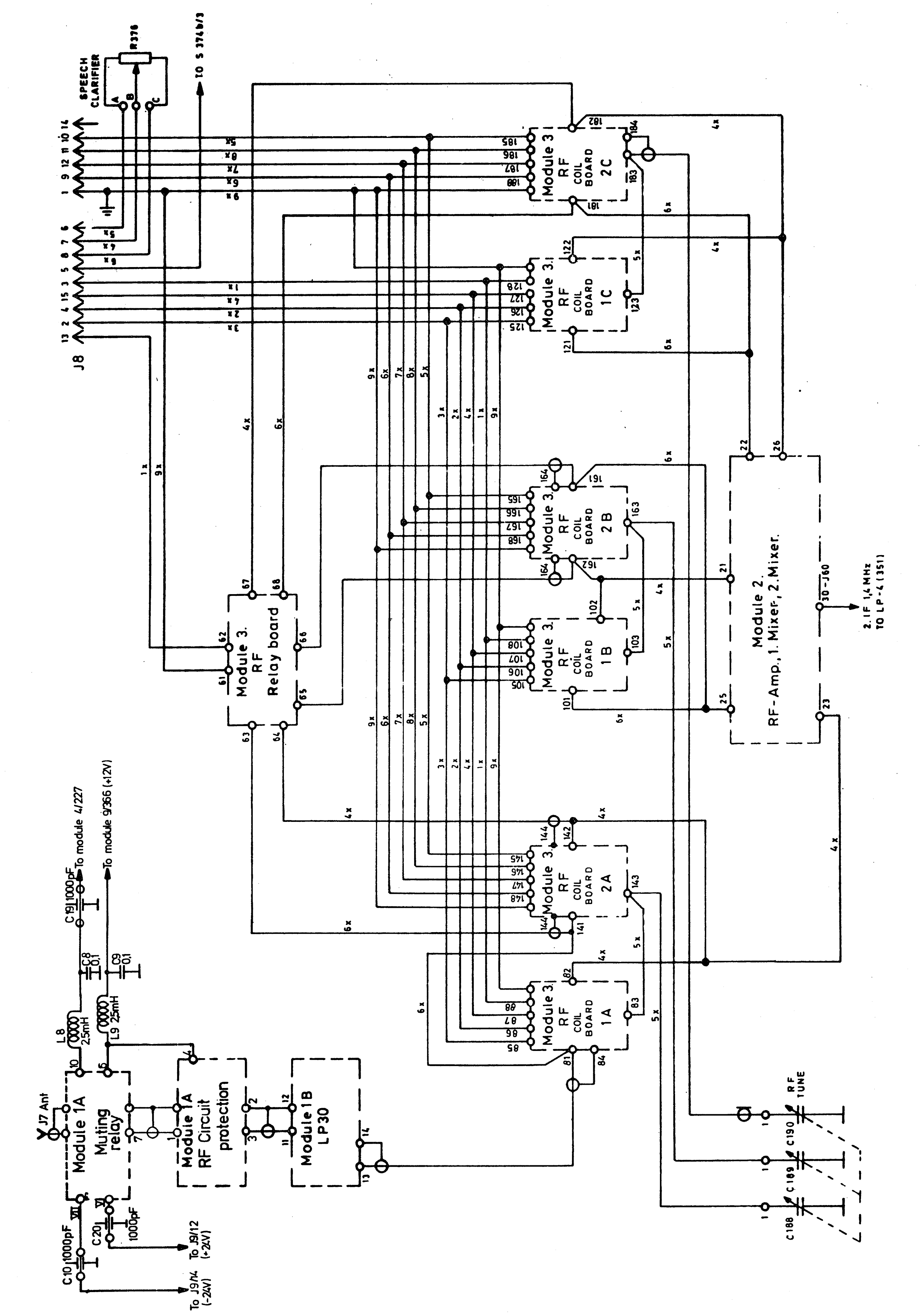


Note:
All capacitors in μF, except otherwise noted
All resistors 1/4W, except otherwise noted
All resistors in ohm, except otherwise noted

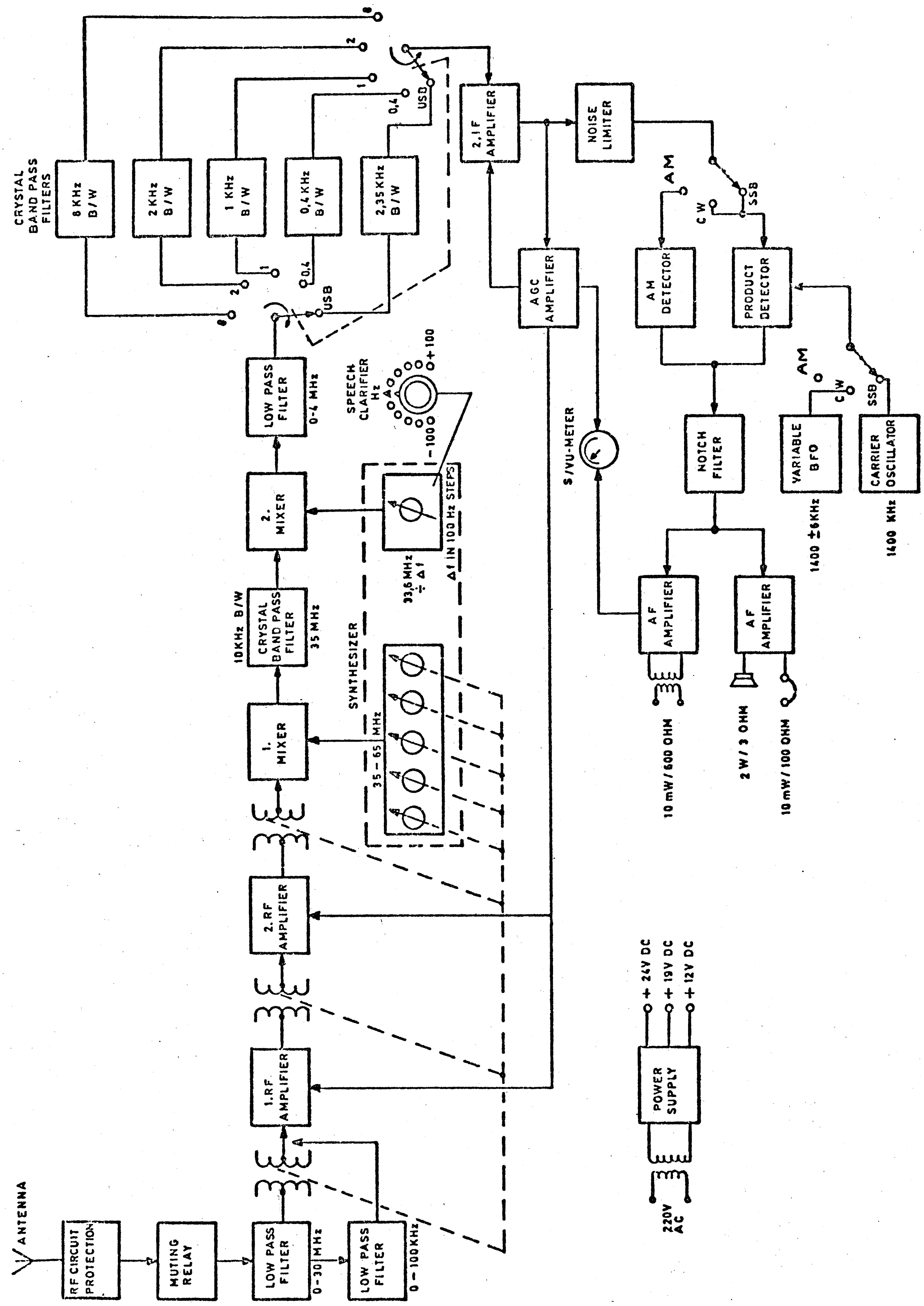


Main Receiver
Chassis Wiring Diagram

M1250 Diagr. No 4163/11.71



J8
SPEECH CLARIFIER
R378
TO S 374b/3
Module 3 RF COIL BOARD 2C
Module 3 RF COIL BOARD 1C
Module 3 RF COIL BOARD 2B
Module 3 RF COIL BOARD 1B
Module 3 RF COIL BOARD 2A
Module 3 RF COIL BOARD 1A
Module 3. RF Relay board
Module 2. RF-Amp., 1. Mixer, 2. Mixer.
2. IF 1,4 MHz TO LP-4 (351)
J7 Ant
Module 1A Muting relay
Module 1A RF Circuit protection
Module 1B LP30
To module 4/227
To module 9/366 (+12V)
To J9/12 (+24V)
To J9/14 (-24V)
L8 2,5mH
L9 2,5mH
C8 0,1
C9 0,1
C19 1000pF
C20 1000pF
C10 1000pF
RF TUNE
C188
C189
C190

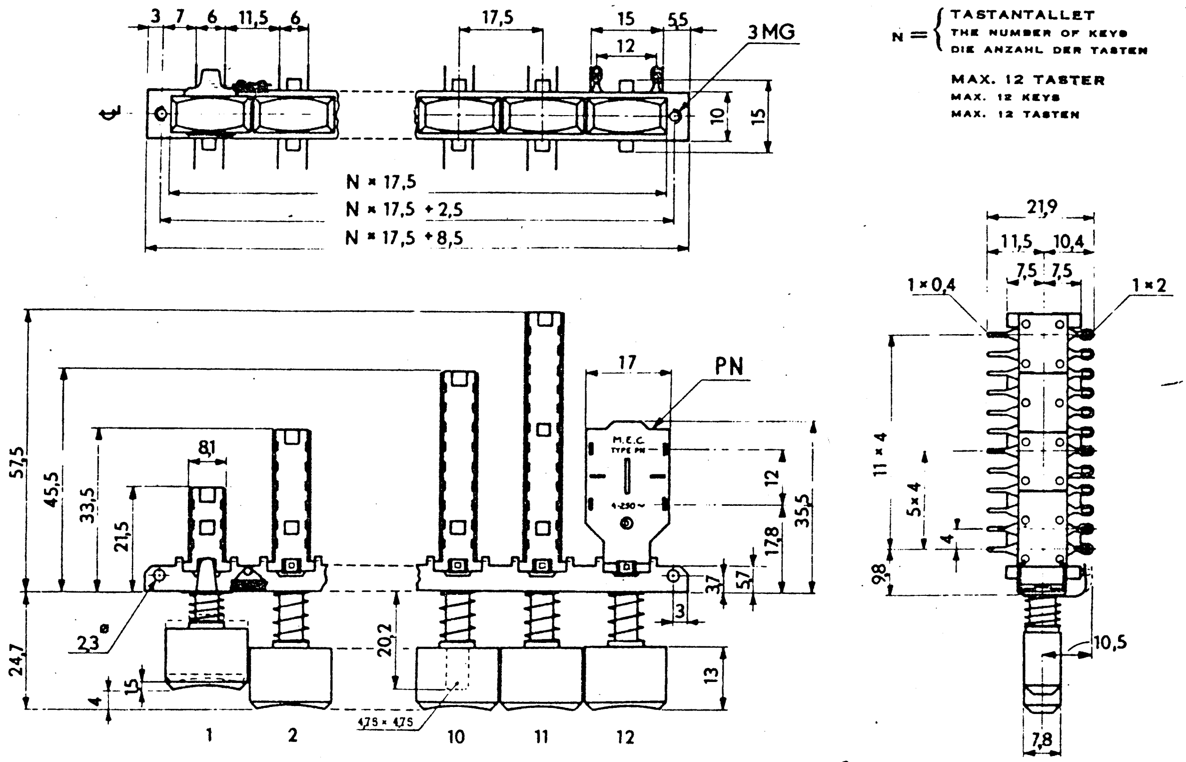


M 1250 RCVR Diagr. No. S-5575/6.71

Block Diagram

Vare nr 274801

mec A/S MEC. PRODUKTION INDUSTRIPARKEN 23-25 DK: 2750 BALLERUP DANMARK TELEFON (01) 97 33 66 TELEGRAM-ADRESSE: DANAMEC TELEX: 2 72 13-DANMEC DK	TRYKKNAPOMSKIFTER PUSH-BUTTON SWITCH DRUCKKNOPF-UMSCHALTER **TYPE P-11** 17,5mm



Hus: LN 2030-11/LN 2313 L=97,7

Delt låsestang

TASTFUNKTIONER			KEY FUNCTIONS				TASTENFUNKTIONEN					
NO.	1	2	3	4	5	6	7	8	9	10	11	12
X ELLER PN X or PN X oder PN	x) PN	PN	4	4	4	4	4	4	4	4	4	
A.D.T. ELLER U A.D.T. or U A.D.T. oder U	D	D	A	A	A	A	A	A	A	A	D	

X = ANTAL SKIFTEKONTAKTER / Number of changeover contacts / Anzahl Umschalterkontakte — (B.R. TAST 2-4-6 ELLER 8) (PER KEY 2-4-6 OR 8) (PRO TASTE 2-4-6 ODER 8) — NON SHORTING / NON SHORTING / UNTERBRECHEND

PN = NETAFBRYDER / Mainswitch / Netzschalter

A = GENSIDIG UDLØSNING / Interlock. (mutual release) / Gegenseitige Auslösung

D = DOBBELTTRYK / Double push / Doppeldruck

T = UDEN LÅS / Momentary / Moment

U = UDLØSER / Release / Auslöse

Låsestænger : LN 2031-6
LN 2031-5

Sikringsstænger: LN 2032-6
LN 2032-5

BEMÆRKNINGER: / REMARKS: / BEMERKUNGEN: x) Udføres som net-omskifter
· SORTE KNAPPER

FIRMA: / FIRM: / FIRMA: Dansk Radio Aktieselskab

DATO: / DATE: / DATUM: 11/12-74

KUNDENS OMSKIFTERNUMMER: / CUSTOMER'S NO. OF SWITCH: / SCHALTERNUMMER DES KUNDEN: 20540

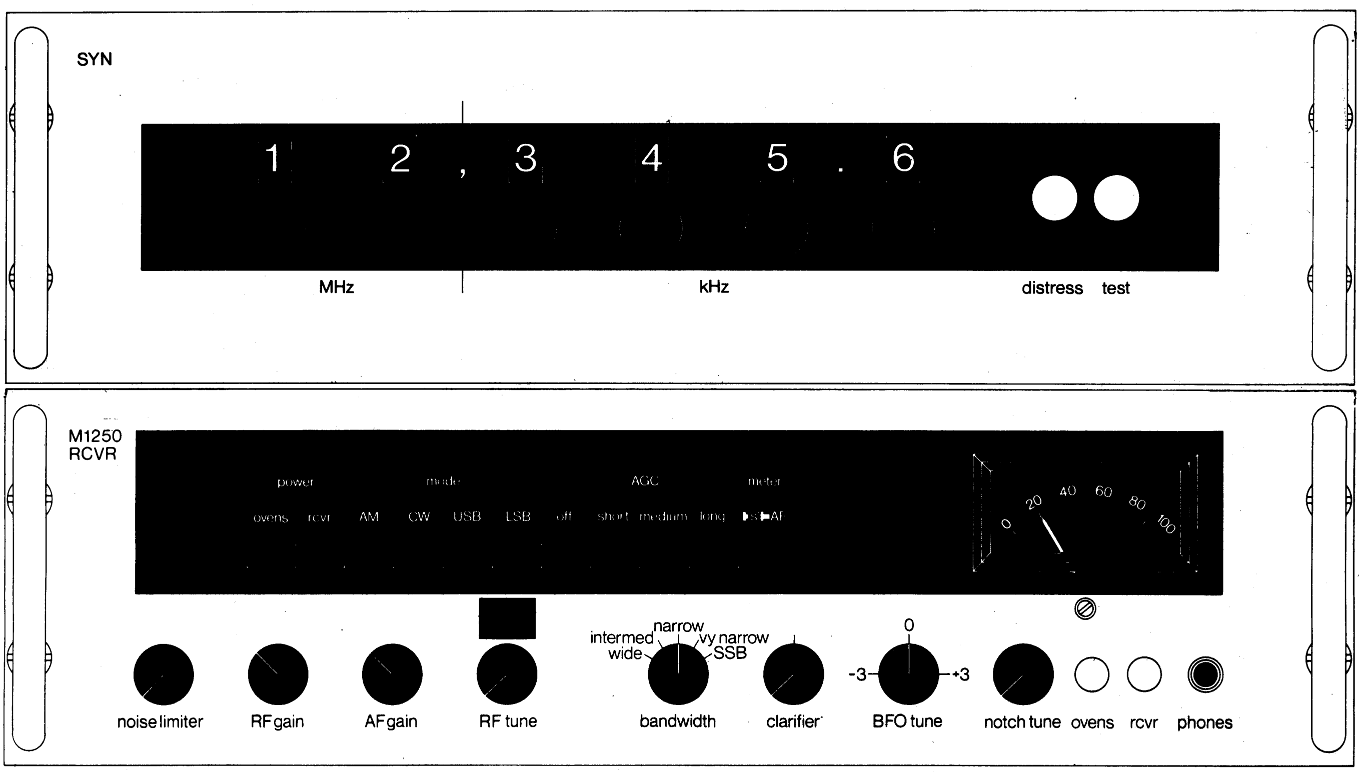
MEC NR. 2 PN

instruction manual

MARINE MAIN RECEIVER

part 2. synthesizer chassis

elektromekano M1250



CONTENTS

250 N 91

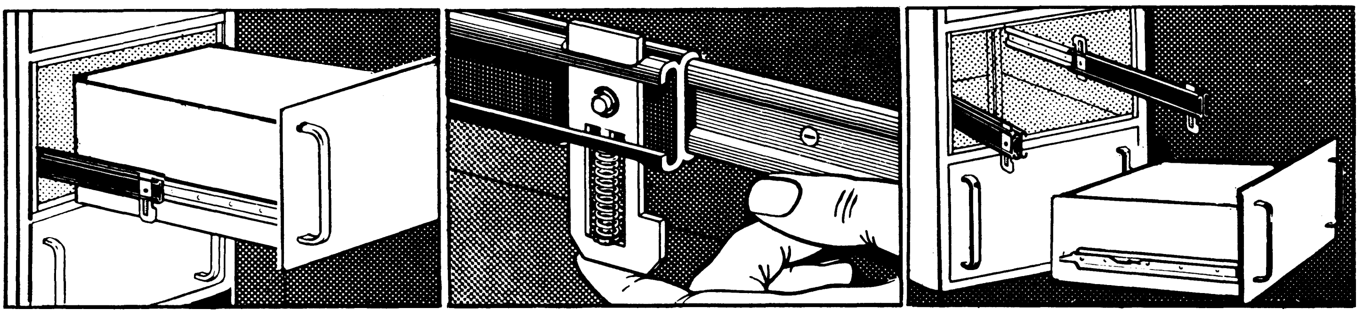
SECTION 1. - TECHNICAL SPECIFICATION.

General:	This frequency synthesizer, which provides one fixed and two variable output frequencies of very high stability, is intended for use as a frequency source for double superheterodyne receivers. In the table below the outputs are named "A", "B" and "C".		
Output Frequencies:	Signal "A": 1.5 MHz Fixed frequency Derived from standard oscillator	Signal "B": 35.000 MHz to 64.999 MHz in steps of 1 kHz Derived from synthesizer circuits	Signal "C": 33.599100 MHz to 33.600000 MHz in steps of 100 Hz, and cont. variable within ±90 Hz (ext. clarifier) Derived from VCXO
Frequency Selection:	-	5 digital switches	1 digital switch and ext. clarifier
Switching Time:	-	3 seconds	4 seconds
Output Signal Level:	600 mVpp to 700 mVpp into 50Ω resistive load	200 mVpp to 300 mVpp into 50Ω resistive load	500 mVpp to 700 mVpp into 50Ω resistive load
Spurious Signals:	< 80 dB	< 80 dB	< 80 dB
Harmonic Signals:	< 30 dB	< 10 dB	< 30 dB
Internal Frequency Standard:	7.5-MHz quartz oscillator in temperature-controlled oven Frequency tolerance, short term (15 minutes): ± 1 Hz long term (3 months): ± 30 Hz Aging rate less than 1 p.p.m. per 3 months		
Operating Temperature:	-15° C to +55° C		
Control Lines available for preselecting front-end tuned circuits in the associated receiver:	"0-100 kHz", "100-200 kHz", "200-400 kHz", "400-1000 kHz", "1000-2000 kHz", "2000-4000 kHz", "4000-10000 kHz", "10000-20000 kHz", and "20000-30000 kHz"		
Power Supply:	220V ± 10%, 50-60 Hz, approx. 70 VA		
Dimensions and Weight:	Standard 19" Rack Dimensions Panel Height: 5 1/4", 133 mm Panel Width: 19", 483 mm Chassis Width: 420 mm Depth behind panel: 416 mm Weight: approx. 11.4 kg		

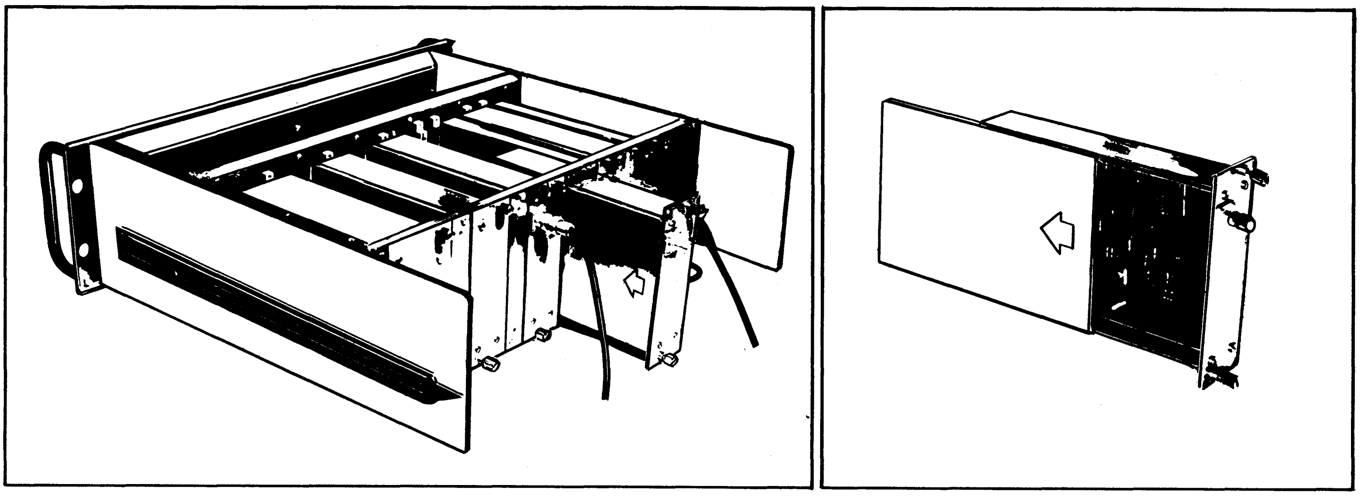
SECTION 2. - DESCRIPTION.

2.1. Mechanical Description.

The frequency synthesizer panel-and-chassis assembly (drawer) is designed to be mounted on telescopic slides in a standard 19-inch cabinet rack. The front panel is fastened to the cabinet rack by means of captive panel-mounting screws. The telescopic slides may be fitted with trigger latches which automatically and securely lock the unit in the withdrawn position, when fully extended. The projecting latches are pressed to release the lock so that the drawer can be closed or completely removed from the cabinet rack as shown below. Before removing a drawer from the cabinet all plugs on cables for connecting the unit to the cabinet wiring should be taken out of their sockets at the rear of the chassis.



The rear of the panel-and-chassis assembly is formed as a miniature rack into which plug-in modules (sub-assemblies) of various widths are inserted. The electrical connections between the modules and other parts of the synthesizer are made by means of printed-circuit board connectors, and for some of the modules coaxial-cable connectors or multi-conductor connectors are provided on the module panels. The modules are fastened to the frame of the drawer by means of captive panel-mounting screws. Slide-out side covers are provided on the modules for easy access to the circuit boards. See illustrations below.



2.2. Electrical Design.

2.2.1. Block Diagram.

A complete block diagram of the frequency synthesizer is shown in Fig. 2.2.1-2. This block diagram shows the overall relationship between all major circuits in the synthesizer. The identification number on each block is the same as that used in the text. The blocks are divided into groups corresponding to the assemblies and subassemblies of the synthesizer for which complete circuit diagrams are provided at the rear of this manual. The reference designations of the subassemblies corresponding to the groups are shown in the block diagram. Only the basic interconnections are shown. The power-supply units are omitted.

The principle of operation of a single-loop synthesizer is shown in Fig. 2.2.1-1. All the frequencies necessary for the single-sideband signal processing are derived from a single frequency standard which consists of a very stable crystal oscillator. The signal of frequency f_s produced by this oscillator is applied to a phase discriminator (comparator) via a frequency divider with a fixed division ratio M. The resulting frequency f_s/M, the reference frequency, is equal to the channel spacing. A tunable voltage-controlled oscillator can cover the desired range or can be switched in steps to cover various bands in the range. Coarse prepositioning information is supplied when the channel is selected. A digital divider, whose division ratio N is variable,

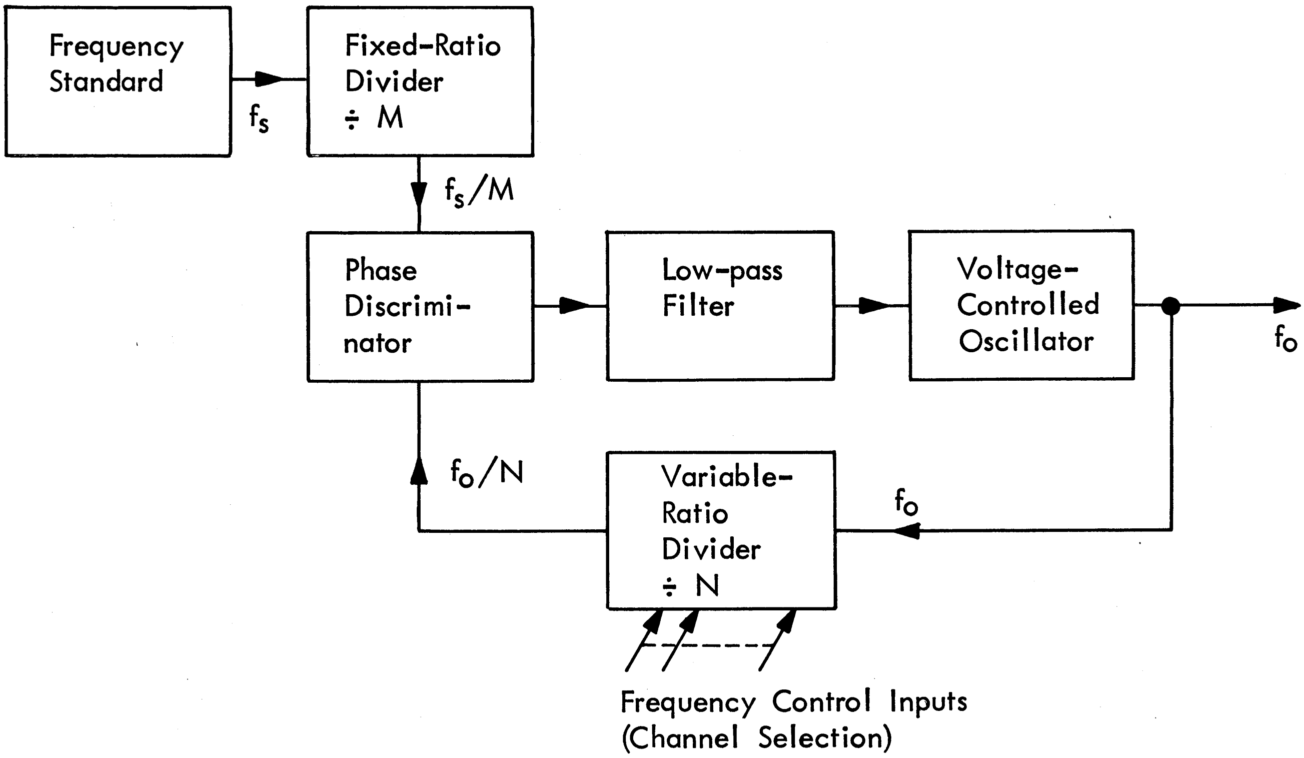


Fig. 2.2.1-1. Simplified Block Diagram of a Single-Loop Frequency Synthesizer.

divides the frequency f_o of the voltage-controlled oscillator by the proper ratio to provide an output at approximately the reference frequency. This output signal is compared with the reference frequency f_s/M in the phase discriminator. Any difference in phase between the two frequencies f_s/M and f_o/N will result in a d.c. error voltage which is fed back through a low-pass filter to the voltage-controlled oscillator. The low-pass filter serves to filter components of the input frequencies and their harmonics from the output in order to prevent frequency modulation of the voltage-controlled oscillator. When the output frequency of the voltage-controlled oscillator is corrected to provide the proper input frequency to the phase discriminator, it phase-locks the loop "(voltage-controlled oscillator)-(divider ÷ N)-(phase discriminator)-(low-pass filter)-(voltage-controlled oscillator)" to the reference input and, since $f_o/N = f_s/M$, the output frequency of the voltage-controlled oscillator can be expressed as

$$f_o = N\ (f_s/M).$$

From this equation it will be seen that any desired multiple of the reference frequency f_s/M can be produced by selecting the necessary division ratio N in the variable-ratio divider. This is done automatically by the channel selection switches. The stability of the produced frequencies will be equal to that of the frequency standard.

One of the main advantages of this method of synthesis is its freedom from spurious signals in the output, and in this respect it is superior to the conventional method in which the signal frequency is obtained by successive mixing and filtering. However, it may be difficult to obtain sufficient filtering of the components of the reference frequency in the system described above. If the time constant of the filter is long the short-term stability of the voltage-controlled oscillator must be high, and if the time constant of the filter is short the rejection of the components of the reference frequency will not be sufficiently effective. Therefore a compromise between the two points of view must be made. In the actual synthesizer a reference frequency of 500 Hz is used whereby the above mentioned problem has been solved.

The actual frequency synthesizer, which is intended for use as a frequency source for double superheterodyne receivers, provides one fixed and two variable output frequencies of very high stability, i.e. a fixed output frequency of 1.5 MHz, an output frequency which can be varied in steps of 1 kHz within the range 35.000 MHz to 64.999 MHz, and an output frequency which can be varied in steps of 100 Hz within the range 33.599100 MHz to 33.600000 MHz. The last mentioned frequency may also be continuously varied within ± 90 Hz by means of an external "clarifier" potentiometer, which should be located on the receiver front panel.

The standard-frequency signal of 7.5 MHz is produced by the crystal-controlled oscillator shown as block 1 in the complete block diagram of the synthesizer. The output frequency of this oscillator is divided by 5 in block 2 and the 1.5-MHz output is applied to block 3 as well as to block 4. Block 3 contains a 1.5-MHz selective amplifier from the output of which the fixed 1.5-MHz signal is obtained. Block 4 contains a frequency divider which divides the 1.5-MHz signal by 3. The 500-kHz output from this divider is applied to block 5 as well as to block 6. Block 5 contains a differentiating circuit which produces appropriate multiples of the 500-kHz signal for checking the frequency standard against one of the 5-, 10-, 15- or 20-MHz standard-frequency transmissions, e.g. the WWV transmissions. The 500-kHz signal from block 4 is also fed to block 6 which contains a frequency divider with a division ratio of 1000, and from this divider the required output frequency of 500 Hz, the reference frequency, if obtained. (The 7.5-MHz signal from the frequency standard, block 1, is also applied to block 7 which contains a frequency multiplier. In block 7 the 7.5-MHz signal is multiplied by 4 to produce an output signal of 30 MHz for signal processing in the 33.4991-33.5000 MHz loop system in a transmitter frequency synthesizer. Appropriate filtering of the 30-MHz output signal from the multiplier is provided by a band-pass filter contained in block 8.)

35-65 MHz loop system:- A voltage-controlled oscillator contained in block 19 is designed to produce a frequency which, by means of the loop feedback system, can be phase-locked in steps of 1 kHz within the range 35 MHz to 65 MHz. The output signal from this oscillator is applied to a dual-channel amplifier contained in block 20. In order to silence the receiver during frequency shift, this amplifier is so arranged that its output channel is blocked when the loop is not phase-locked. The oscillator output signal is fed to a prescaler contained in block 21 through one of the channels of the amplifier. In the prescaler the frequency of the signal is divided by 2 and the resulting signal, the frequency of which will lie within the range 17.5 MHz to 32.5 MHz, is applied to a 5-decade digitally coded frequency divider system contained in the blocks 22 to 26. This frequency divider can be preset to divide the

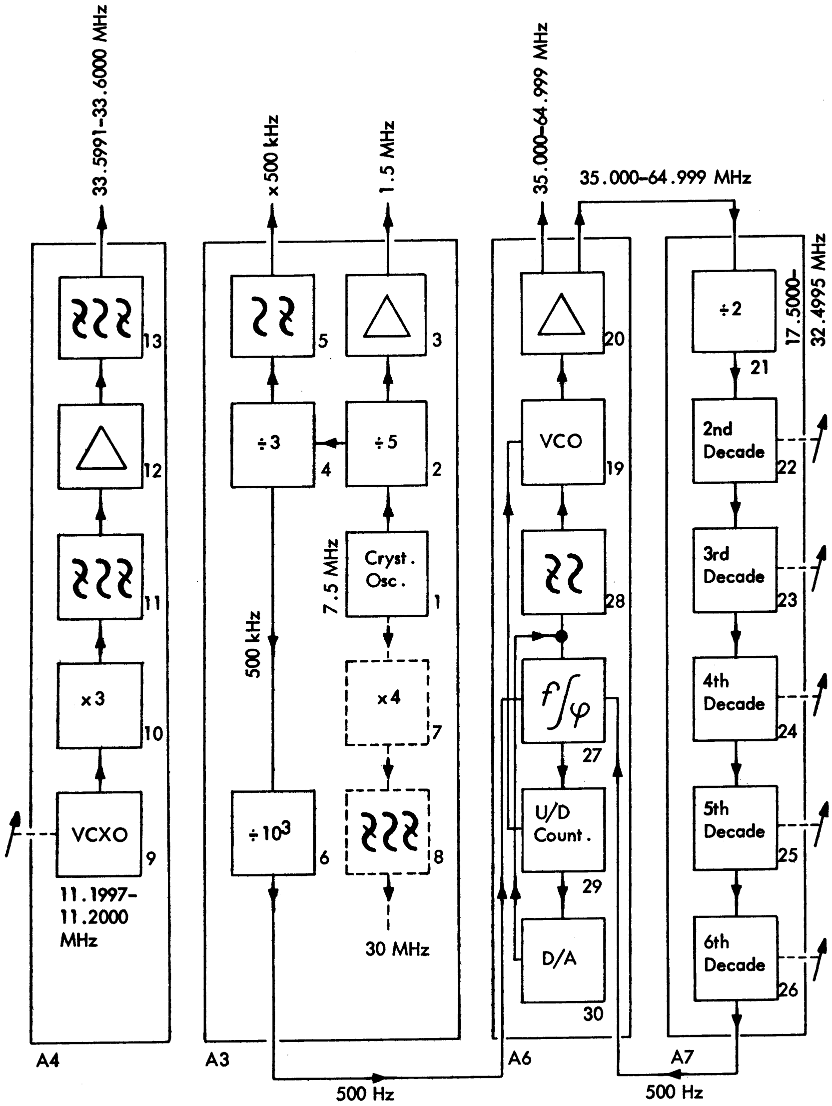


Fig. 2.2.1-2. Block Diagram of Frequency Synthesizer.

frequency by any integer between 35000 and 64999 by means of 5 binary coded switches controlling the 5 decades. The output signal from the 5-decade frequency divider is fed to a phase discriminator contained in block 27 where it is compared with the reference frequency of 500 Hz. The output from the phase discriminator is fed to the control terminal of the voltage-controlled oscillator via a low-pass filter contained in block 28, thus completing the loop. With this loop system the voltage-controlled oscillator can be phase-locked in steps of 1 kHz within the range 35.000 MHz to 64.999 MHz, the actual output frequency from the amplifier in block 20 being determined by the setting of the 5 decade switches.

Since the frequency range of the voltage-controlled oscillator is relatively wide in comparison with the capture range of the loop, special means for appropriate coarse tuning of the oscillator circuit must be provided. In order to fulfil this requirement an 8-bit binary up-down counter contained in block 29 and a digital-to-analogue converter contained in block 30 are introduced in the circuit. The phase discriminator is designed to produce clock pulses when the loop is not phase-locked. These clock pulses are applied to the 8-bit binary up-down counter. If the oscillator frequency is too low the counter counts down, and if the oscillator frequency is too high the counter counts up. The first 6 bits control the digital-to-analogue converter which produces the control signal for coarse tuning of the oscillator. This control signal is applied to the input of the low-pass filter contained in block 28 where it is added to the error signal from the phase discriminator. The last two bits of the binary up-down counter are decoded to control four switching diodes by means of which the proper tap on the oscillator inductor for coarse-tuning the voltage-controlled oscillator to the required frequency is selected. Thus, if the oscillator frequency is too low or too high, the counter will count down or up, respectively, until the oscillator frequency is brought inside the capture range of the loop, after which phase locking is established. It should be noted that the tuning procedure is completely controlled by electronic means whereby extremely high reliability is ensured.

A voltage-controlled crystal oscillator contained in block 9 is designed to produce a frequency which can be varied in steps by means of a decade switch on the front panel, and provisions are made for connecting an external "clarifier" potentiometer into the circuit so that the frequency may be varied continuously between the steps. The output frequency of this oscillator, which lies within the range 11.199700 MHz to 11.200000 MHz, is applied to a frequency tripler contained in block 10. Appropriate filtering of the output signal from the frequency tripler is provided by a band-pass filter contained in block 11. Extra amplification and filtering are provided by the amplifier in block 12 and the filter in block 13. The output frequency can be varied in steps of 100 Hz between 33.599100 MHz and 33.600000 MHz by means of the decade switch, and a variation of ± 90 Hz may be obtained by means of an external "clarifier" potentiometer as mentioned above.

A simplified block diagram of the frequency synthesizer used in connection with a double superheterodyne receiver is shown in Fig. 2.2.1-3. If N_1 is the setting of the decade switches for the 35.000-64.999 MHz loop (number of 1-kHz steps), N_2 the setting of the decade switch for the voltage-controlled oscillator and frequency tripler (number of 100-Hz steps), and Δ is the frequency deviation in Hz introduced by means of the "clarifier", then the receiver is adjusted for an input signal frequency of:

$$f_s = N_1 \times 1000 + N_2 \times 100 + \Delta \qquad [Hz]$$

The output frequency from the 35.000-64.999 MHz loop ("1st oscillator" for the receiver) is:

$$f_{osc1} = 35000000 + N_1 \times 1000 \qquad [Hz]$$

The 1st intermediate frequency of the receiver is:

$$f_{if1} = f_{osc1} - f_s = 35000000 - N_2 \times 100 - \Delta \qquad [Hz]$$

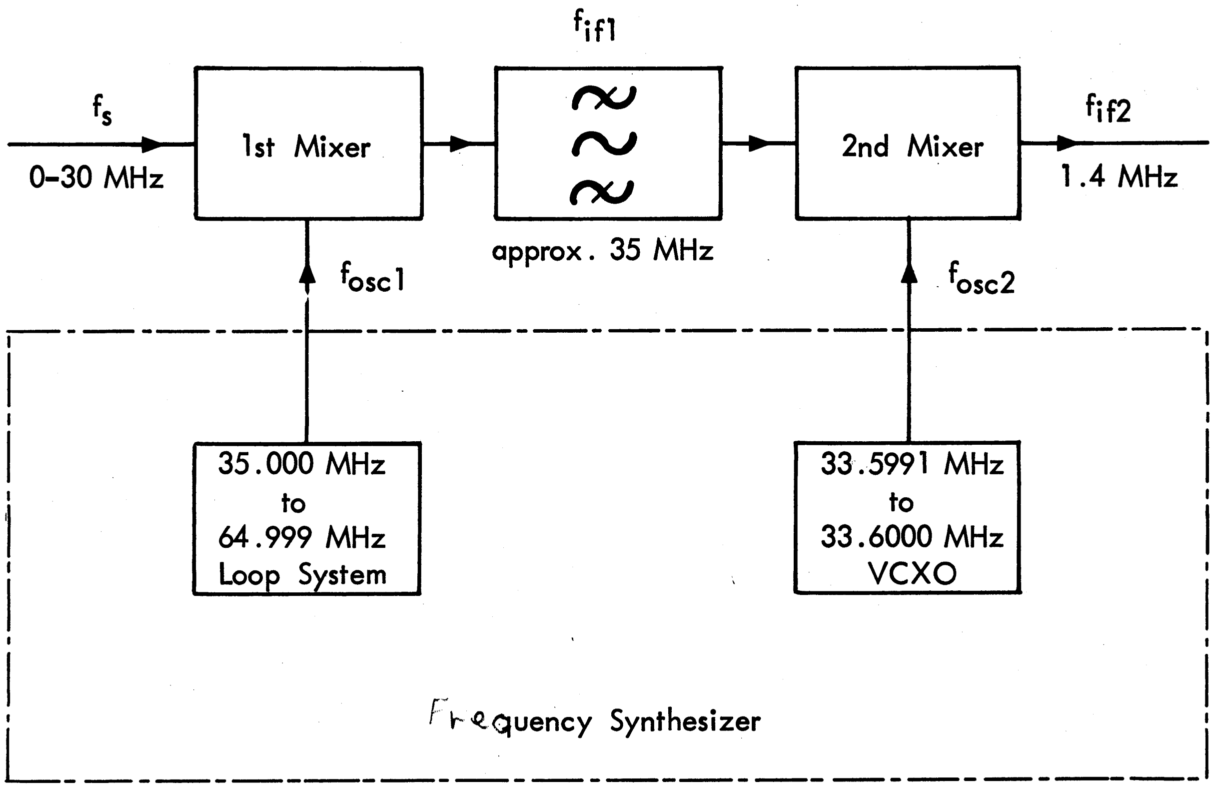


Fig. 2.2.1-3. Simplified Block Diagram of the Frequency Synthesizer Used in Connection with a Double Superheterodyne Receiver.

The output frequency of the voltage-controlled crystal oscillator and frequency tripler ("2nd oscillator" for the receiver) is:

$$f_{osc2} = 33.600000 - N_2 \times 100 - \Delta \qquad [Hz]$$

The 2nd intermediate frequency of the receiver is:

$$f_{if2} = f_{if1} - f_{osc2} = 1400000 \qquad [Hz]$$

2.2.2. Frequency Synthesizer Panel-and-Chassis Assembly.

This panel-and-chassis assembly (drawer) is designed to house up to eight plug-in modules or sub-assemblies (Ref. Designations A1 to A8) which are connected to the chassis wiring of the synthesizer through p.c. board connectors located on a common mother board. An extra sub-assembly (Ref. Designation A9) is connected to the mother board wiring by means of soldered terminals and wires. Connections between the plug-in modules or subassemblies and the cabinet wiring or other panel-and-chassis assemblies are made by means of flexible cables and plugs and sockets on the module panels. A power transformer, T1, providing a 24-volt a.c. supply is located on the chassis frame. A switch assembly containing six decade switches, S1 to S6, is mounted on the chassis so that the switch knobs can be operated from the front panel.

This assembly also contains two indicator lamps, DS1 ("distress") and DS2 ("test") which are visible from the front panel. The complete circuit diagram of the synthesizer chassis wiring is located in the diagram section at the rear of this manual together with the circuit diagrams of the plug-in modules and subassemblies.

It should be noted that the p.c. board-edge receptacles on the mother board and the p.c. board-edge contacts on the plug-in modules are so arranged that the row of contacts identified with numbers, starting with number "1", on a receptacle connect with the row of board-edge contacts on the component side of the p.c. board in the mating plug-in module, while the row of contacts identified with letters, starting with letter "A", on a receptacle connect with the row of board-edge contacts on the wiring side opposite the component side of the p.c. board in the mating module. Board-to-board connectors for a subassembly containing a gate-off circuit (Ref. Designation A8), or an automatic fault localization device (Ref. Designation A10), are provided on the wiring side of the mother board. A test-point jack, J10, and a potentiometer, R1, for adjustment of the standard-frequency oscillator are located on the component side of the mother board. These components are accessible through holes in the top cover.

The decade switch sections controlling the variable-ratio frequency divider are binary-coded, the switch functions being performed in accordance with the truth tables shown on the circuit diagram for the divider (Ref. Designation A7). Extra switch sections are provided for other control lines, which may be used for preselecting front-end tuned circuits in the associated receiver.

The indicator lamp DS1 is lighted when the synthesizer is set on 500 kHz or 2182 kHz, the lamp being fed from the 24-volt a.c. supply through the appropriate decade switch sections and a diode, CR2, (on 500 kHz) or CR3 (on 2182 kHz). The indicator lamp DS2 is connected to the gate-off circuit (Ref. Designation A8), or the automatic fault localization device (Ref. Designation A10), if provided.

2.2.2.1. Rectifier Circuits. Reference Designation A1.

The power supplies for the frequency synthesizer are contained in two plug-in modules, the rectifier circuits being contained in one module and the voltage-regulator circuits in the other. The two modules are located side by side in the synthesizer drawer. The complete circuit diagrams are located in the diagram section at the rear of this manual. The external primary-supply and control circuit wires are connected to the synthesizer through a plug inserted in the socket J1. Radio-frequency filters are provided at all terminals for the external wiring. The required supply voltages for the voltage-regulator circuit module are provided by the transformer T1 and the rectifiers CR1 to CR4.

An extra voltage regulator for a -12-volt supply is provided in the output circuit of rectifier CR2. It should be noted that this regulated supply of -12V will not be produced if the rectifier circuit module is withdrawn from the mother board, or if the regulator circuit module is withdrawn, because the output circuit of rectifier CR2 obtains its ground connection from the regulator-circuit module so that this ground connection will not be present unless the said rectifier and the +12-volt regulator circuit are interconnected.

2.2.2.2. Voltage-Regulator Circuits. Reference Designation A2.

This plug-in module contains the voltage regulators for the power supply rectifiers mentioned in the previous paragraph. The regulated power supplies are: A +17-volt supply, a +12-volt supply, a +5-volt supply and a -5-volt supply. As mentioned in the previous paragraph, a -12-volt regulator is contained in the rectifier circuit module.

The +17-volt regulator circuit consists of two cascaded series regulators. The first regulator is a conventional series regulator with short-circuit protection, while the second regulator is a special regulator in which most of the component parts are contained in the integrated circuit IC1. This regulator, which is also a series regulator with short-circuit protection, provides the extra high voltage stability for the +17-volt supply. The +12-volt, +5-volt and -5-volt regulators are conventional series regulators with short-circuit protection. Each of the four regulated power supplies is fed from a separate rectifier connected to a separate winding on the power transformer so that one of the output terminals of the regulator, the positive or the negative, may be grounded at choice. In the +17-volt, +12-volt and +5-volt regulators the negative terminals is grounded, while in the -5-volt regulator the positive terminal is grounded.

The shunt resistors R35, R23, R25 and R26 are factory selected parts. Appropriate resistors are inserted in the circuits at the factory in order to obtain the correct output voltages from the regulators.

2.2.2.3. Frequency Standard. Reference Designation A3.

The plug-in module containing the frequency standard is located in the frequency synthesizer drawer. The complete circuit diagram is located in the diagram section at the rear of this manual. The circuit can be divided into seven sections:- A 7.5-MHz standard-frequency oscillator, an oven-control circuit, a pulse shaper, a fixed-ratio frequency divider, a 1.5-MHz amplifier, a frequency multiplier, and a 1.5-MHz control circuit.

The standard-frequency oscillator is a modified Pierce oscillator employing one of the transistors in the integrated circuit IC1. The principal frequency-controlling element consists of a 7.5-MHz crystal unit, Y1, with high frequency stability and low aging rate. A trimmer capacitor, C6, for coarse tuning and a pair of varactor diodes, CR1, for fine tuning of the oscillator are incorporated in the capacitive loading circuit for the crystal unit. The control voltage for the varactor diodes is obtained from the arm of a potentiometer, R1, which is located on the mother board in the frequency synthesizer drawer and is accessible for adjustment by a screwdriver through a hole in the top cover. The potentiometer is fed from the stabilized 6-volt supply for the oscillator (through p.c. board-edge connector "B"). The collector of one of the four transistors in the integrated circuit, IC1, used for the oscillator is connected to the base to form a diode. This diode and the associated collector-to-substrate diode are connected as an amplitude limiter in the oscillator circuit. The two other transistors are used as buffer amplifiers for the 7.5-MHz oscillator output signal. The output signal from the first buffer amplifier is fed to a pulse shaper, Q1, which drives the fixed-ratio frequency divider, while the output signal from the second buffer amplifier is fed to the frequency multiplier.

The crystal unit and the oscillator circuitry are contained in a temperature-controlled oven with an operating temperature of 75°C. The heater winding, R22, is inserted in the output circuit of the oven-controlled output amplifier consisting of the Darlington-pair transistors Q3 and Q4. This amplifier, which is supplied directly from the unfiltered output of the 24-volt rectifier CR4, is controlled by a differential-input amplifier contained in the integrated circuit

IC8. The 24-volt rectifier is supplied from a transformer, T1, in the synthesizer drawer. The temperature-sensing device consists of a thermistor, RT1, mounted on the outside of the inner chamber of the oven near the heater winding. The thermistor RT1 is inserted in a resistance bridge connected to the differential input of the integrated circuit IC8, the internal balanced resistor pair being used as one side of the bridge. The integrated circuit IC8 and the external side of the resistance bridge consisting of the thermistor RT1, the potentiometer R18 and the resistor R19 are fed from the 24-volt rectifier through a filter, CR5 and C24, and a voltage-stabilizing circuit, R17 and CR6. The oven temperature is preadjusted to its correct value, 75°C, by means of the potentiometer R18. The oven takes about four to five minutes to reach the proper temperature from 20°C ambient. Due to the time delay in heat transfer the oven-control system operates as a form of on-off proportional control, the heater winding normally being on for about 6 seconds and off for about 24 seconds when the ambient temperature is about 20°C. The oven cycle and its duty factor vary with the ambient temperature.

The 7.5-MHz output signal from the pulse shaper, Q1, is applied to the divide-by-five frequency divider contained in the integrated circuit IC2. The 1.5-MHz output signal from this divider is applied to the base of the transistor Q2, which is operated as a 1.5-MHz selective amplifier with a tuned circuit, L3,C16. The 1.5-MHz output signal obtained from the secondary winding of the transformer L3 is applied to a coaxial-cable connector on the panel of the plug-in module.

The output signal from the frequency divider IC2 is also applied to a divide-by-three frequency divider contained in the integrated circuit IC3. The 500-kHz signal from the Q output of the first J-K flip-flop in this divider is applied to a differentiating circuit, C18-R16, which produces appropriate multiples of the 500-kHz signal (nx500 kHz) for checking the standard-frequency oscillator (the synthesizer frequency standard) against any suitable standard-frequency transmission. To facilitate checking of the oscillator frequency the nx500 kHz signal is brought out to a socket on the mother board in the synthesizer drawer. This socket is accessible through a hole in the top cover of the drawer. The 500-kHz output signal from the divider IC3 is applied to a frequency divider consisting of three cascaded decade dividers, IC4, IC5 and IC6, and a decoder gate, IC7. Most of the time during a complete division cycle the output of the gate IC7 is high (approx. +4.5V), but once during the cycle the output goes low for about 130 nanoseconds, i.e. negative-going output pulses are produced at a repetition rate of 500 per second. This signal is used as a 500-Hz reference signal and is applied to the phase and frequency discriminator for the phase-locked loop (Ref. Designation A6).

The 7.5-MHz output signal from the second buffer amplifier in the standard-frequency oscillator circuit is applied to the input circuit of the frequency multiplier, which is tuned to 30 MHz. The frequency multiplier employs four transistors contained in the integrated circuit IC9. (The 30-MHz output signal is used only for transmitter frequency synthesizer, and is out of circuit when the plug-in module is used in a receiver frequency synthesizer).

The output signal from the 1.5-MHz selective amplifier is also applied to a control circuit in which the signal is amplified and rectified. The rectified signal is then applied to an amplifier which provides means for driving a gate in a transistor-transistor logic circuit. The transistors used for amplification of the signal are contained in the integrated circuit IC10. The logic state of the output of the control circuit is high as long as the 1.5-MHz signal is present, and low when this signal disappears. The control circuit is intended for use in connection with an automatic fault localization device, which may be supplied on request.

2.2.2.4. Voltage-Controlled Crystal Oscillator. Reference Designation A4.

The plug-in module containing this oscillator is located in the frequency synthesizer panel-and-chassis assembly. The complete circuit diagram is located in the diagram section at the rear of this manual. The circuit can be divided into five sections:- A voltage-controlled crystal oscillator, a frequency-tripler circuit, a selective amplifier, a temperature-control circuit for the crystal oven, and a special control circuit which may be used in connection with an automatic fault localization circuit.

The voltage-controlled crystal oscillator is a modified Pierce oscillator employing two transistors contained in the integrated circuit IC1, the second transistor being used as an amplifier. The crystal Y1 is loaded by the inductor L5 and the pair of varactor diodes CR1 so that the oscillator frequency can be varied within the desired range from slightly below to slightly above the series resonant frequency of the crystal, which is approximately 11.2 MHz. The collector of one of the four transistors in the integrated circuit, IC1, used for the oscillator is connected to the base to form a diode. This diode and the associated collector-to-substrate diode are connected as an amplitude limiter in the oscillator circuit. The fourth transistor in the said integrated circuit is employed as a frequency tripler, the output circuit, L7 and C12, being tuned to approximately 33.6 MHz.

A simplified diagram of the oscillator control circuit is shown in Fig. 2.2.2.4-1. The potentiometers R2 and R3 are preadjusted so that the output frequency from the frequency tripler following the oscillator can be varied in steps of 100 Hz within the range 33.599100 MHz to 33.600000 MHz by means of the voltage-tapping switch S1 on the frequency synthesizer front panel, while the frequency can be varied continuously within ± 90 Hz by means of the "clarifier" potentiometer on the front panel of the associated receiver. The potentiometer R3 determines the upper frequency, while the potentiometer R2 determines the lower frequency.

The crystal unit and the oscillator circuitry are contained in a temperature-controlled oven with an operating temperature of 75°C. The heater winding, R17, is inserted in the output circuit of the oven-control output amplifier consisting of the Darlington pair transistors Q1 and Q2. This amplifier, which is supplied directly from the unfiltered output of the 24-volt rectifier CR5, is controlled by a differential-input amplifier contained in the integrated circuit IC3. The 24-volt rectifier is supplied from a transformer, T1, in the frequency synthesizer panel-and-chassis assembly. The temperature-sensing device consists of a thermistor, RT1, mounted on the outside of the inner chamber of the oven near the heater winding. The thermistor RT1 is inserted in a resistance bridge connected to the differential input of the integrated circuit IC3, the internal balanced resistor pair being used as one side of the bridge. The integrated circuit IC3 and the external side of the resistance bridge consisting of the thermistor RT1, the potentiometer R20 and the resistor R19 are fed from the 24-volt rectifier through a filter, CR6 and C23, and a voltage-stabilizing circuit, R18 and CR7. The oven temperature is preadjusted to its correct value, 75°C, by means of the potentiometer R20. The oven takes about four to five minutes to reach the proper temperature from 20°C ambient. Due to the time delay in heat transfer the oven-control system operates as a form of on-off proportional control, the heater winding normally being on for about 6 seconds and off for about 24 seconds when the ambient temperature is about 20°C. The oven cycle and its duty factor vary with the ambient temperature.

The output signal from the frequency tripler is applied to the input of a selective amplifier contained in the integrated circuit IC2. The output circuit is tuned to approximately 33.6 MHz. The secondary winding of the output transformer L8, which is connected to a coaxial-cable connector, J1, located on the panel of the module, provides a 50-Ω output, the signal frequency of which can be varied between 33.599100 MHz and 33.600000 MHz as described above.

The 33.6-MHz output signal from the frequency tripler is also applied to a control circuit em-

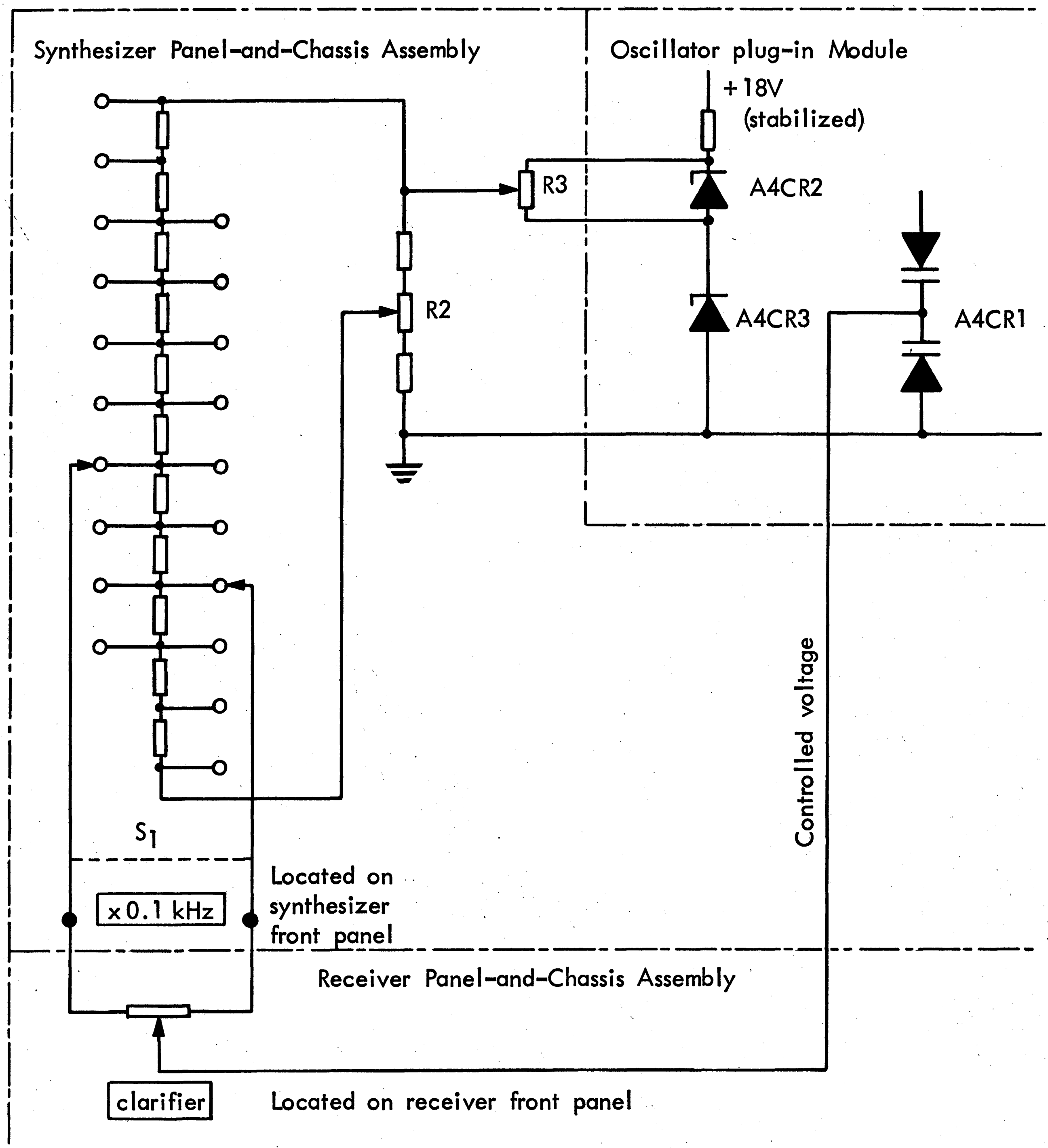


Fig. 2.2.2.4-1. Simplified Diagram of Oscillator Control Circuit.

ploying four transistors, which are contained in the integrated circuit IC4. The signal is amplified by means of the first transistor and then rectified by means of the diodes CR9 and CR10. The rectified signal is amplified by means of the other transistors. The logic state of the output of the control circuit is high as long as the 33.6-MHz signal is present at the input of the control circuit, and low when the signal disappears. The control circuit is intended for use in connection with an automatic fault localization device, which may be supplied on request.

2.2.2.5. 35.000-64.999 MHz Phase-Locked Loop. Reference Designation A6.

The plug-in module containing this loop circuit is located in the frequency synthesizer drawer. The complete circuit diagram is located in the diagram section at the rear of this manual. The circuit can be divided into ten sections:- A combined phase and frequency discriminator, an 8-bit up-down counter, a 2-bit binary to one-of-four decoder, a digital-to-analogue converter, a low-pass filter, a voltage-controlled oscillator, an output amplifier, and three voltage regulators for power supplies.

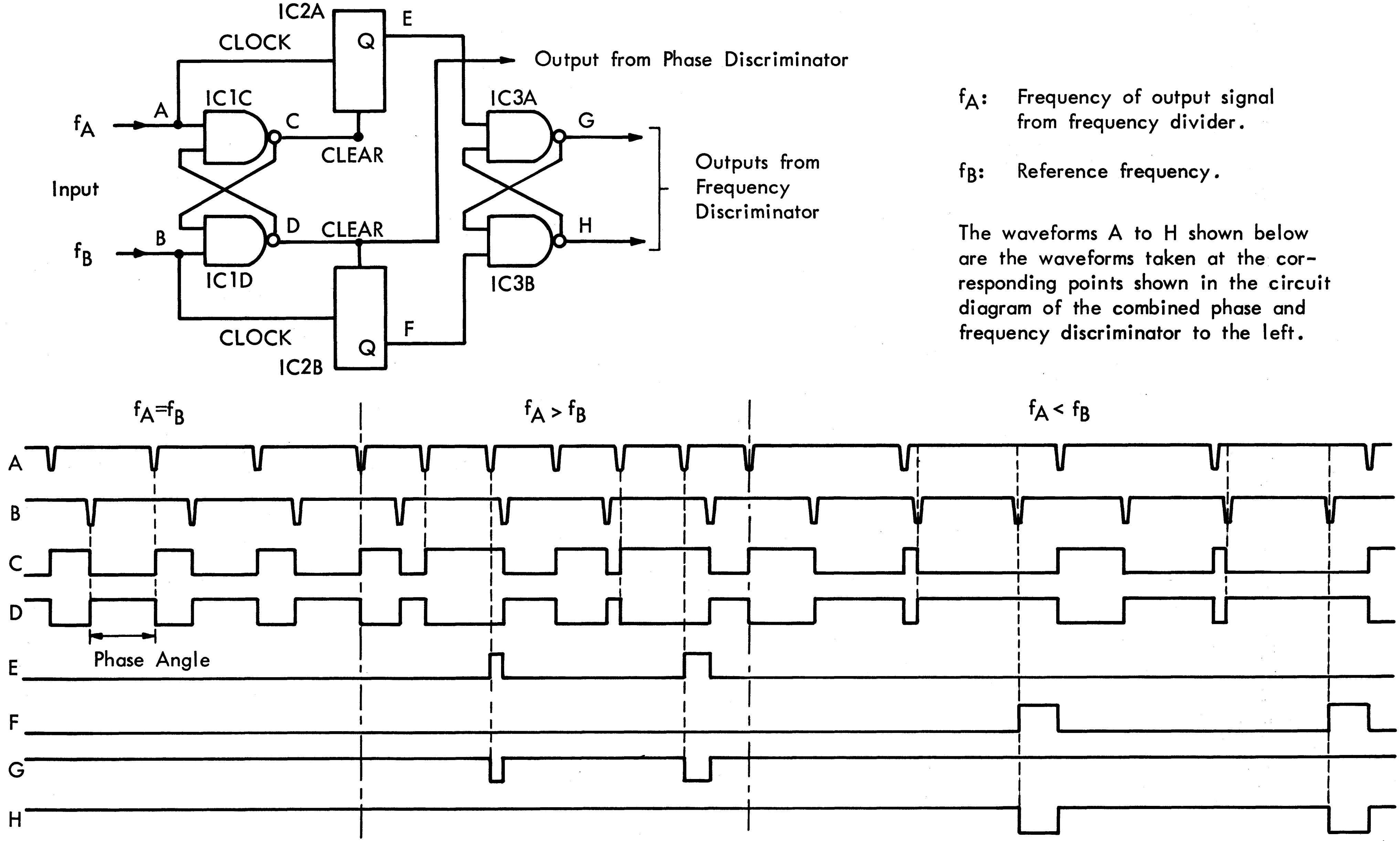
The 500-Hz reference-frequency signal obtained from the divider circuits in the standard-frequency oscillator assembly (Ref. Designation A3) is applied to the inputs of the flip-flop IC2B and the gate IC1D in the combined phase and frequency discriminator circuit. The output signal from the 35.000-64.999 MHz frequency divider circuit (Ref. Designation A7), which is to be compared with the 500-Hz reference-frequency signal, is applied to the inputs of the flip-flop IC2A and the gate IC1C in the phase and frequency discriminator circuit through the interface circuit Q37,C44,R86,R88 and the driver gates IC1A and IC1B. The timing diagram of the phase and frequency discriminator is shown in Fig. 2 2.2.5-1.

From this timing diagram it will be seen that when a pulse (waveform B) appears at the input B of the flip-flop IC1C,IC1D the output D of this flip-flop goes high, while when a pulse (waveform A) appears at the input A the output D goes low. Consequently, the duty factor of the rectangular wave (waveform D) at the output D is proportional to the phase difference between the input pulses at A and B (the pulse at A lagging behind the pulse at B) so that the average d.c. voltage obtained at the output D is also proportional to the said phase difference, i e. the transfer function is linear. The output C of the flip-flop IC1C,IC1D is connected to the reset (clear) terminal of the J-K flip-flop IC2A, the Q output of which flip-flop is indicated by E in the diagram. The output D is connected to the reset (clear) terminal of the J-K flip-flop IC2B, the Q output of which flip-flop is indicated by F in the diagram. The logic states of the Q outputs of the flip-flops IC2A and IC2B, the E and F outputs, depend on the relation between the frequency, f_A, of the signal applied to the input A and the frequency, f_B, of the signal applied to the input B.

If $f_A = f_B$, the Q outputs of the flip-flops IC2A and IC2B will be kept in state 0, i.e. E=0 and F=0. For instance, if a pulse appears at the input A of the flip-flop IC1C,IC1D while the output state of this flip-flop is C=0 and D=1, the flip-flop IC2A will not change state because C=0, i.e. it will remain in state Q=0 (E=0). But the flip-flop IC1C,IC1D will change state to C=1 and D=0, so that when the next pulse appears at the input B the flip-flop IC2B will not change state because D=0, i.e. it will remain in state Q=0 (F=0). However, the flip-flop IC1C,IC1D will change state to C=0 and D=1 so that when a pulse appears at the input A again, the above mentioned functions will be repeated. Consequently, the outputs E and F will remain in state 0 as long as $f_A = f_B$.

If $f_A > f_B$, the time between the arrival of two consecutive pulses at the input A will be shorter than the time between the arrival of two consecutive pulses at the input B. Before long the situation will arise where two consecutive pulses arrive at the input A during the time between the arrival of two consecutive pulses at the input B. The first pulse appearing at the input A during this time will cause the flip-flop IC1C,IC1D to change state to C=1 and D=0. When the next pulse appears at the input A the flip-flop IC2A will change state to Q=1, i.e. E=1, because the flip-flop IC1C,IC1D has remained in state C=1 and D=0. The flip-flop IC2A will remain in state Q=1 until the next pulse appears at the input B. This pulse will cause the flip-flop IC1C,IC1D to change state to C=0 and D=1, thereby causing the flip-flop IC2A to change state to Q=0, i.e. E=0. In this way pulses are produced at the output of the flip-flop IC2A (waveform E), the pulse repetition rate being increased as the difference $f_A - f_B$ is increased.

If $f_A < f_B$, pulses are produced at the output of flip-flop IC2B (waveform F) in a way similar to that described above, the circuit being symmetrical with respect to the inputs A and B.



f_A: Frequency of output signal from frequency divider.

f_B: Reference frequency.

The waveforms A to H shown below are the waveforms taken at the corresponding points shown in the circuit diagram of the combined phase and frequency discriminator to the left.

Fig. 2.2.2.5-1. Timing Diagram of Combined Phase and Frequency Discriminator.

The output signals from the flip-flops IC2A and IC2B are applied to the inputs of the flip-flop IC3A,IC3B which operates as an inverter. Input pulses of waveform E cause pulses of waveform G to be produced at output G of gate IC3A, while input pulses of waveform F cause pulses of waveform H to be produced at output H of gate IC3B. As long as the pulses of the inputs A and B of the flip-flop IC1C,IC1D do not appear simultaneously, the discriminator will operate as described above. But, since the duration of the pulses is finite, the situation may arise where the outputs of the flip-flops IC2A and IC2B go high simultaneously. However, only one of the outputs G and H can go low at a time because the two gates IC3A and IC3B are cross-coupled to form an R-S flip-flop circuit. The G and H outputs are connected to the two cascaded 4-bit binary up-down counters, the output G being connected to the count-up terminal and the output H being connected to the count-down terminal of the first 4-bit counter.

The up-down counter consists of two MSI (medium-scale integrated circuit) 4-bit binary counters, IC4 and IC5. The carry output of the first counter is connected to the count-up terminal of the second counter while the borrow output of the first counter is connected to the count-down terminal of the second counter, so that the circuit forms an 8-bit binary up-down counter. The six least significant bits of this counter control a digital-to-analogue converter. The two most significant bits, the 7th bit and the 8th bit, control the circuit for selecting the proper tap on the oscillator inductor L4. A "load" (data strobe) control circuit, C45,C38,C39,Q40, R89, is provided in the output circuit of the 7th stage of the up-down (U/D) counter. This "load" control circuit is so arranged that every time the 7th bit is changed the positive-going or negative-going output pulse edge thus produced by the 7th U/D counter stage will cause the "load" terminal to go low for about three microseconds, and the 5th bit and the 6th bit will then change from 0 and 0 to 1 and 0, or from 1 and 1 to 1 and 0. The 7th bit and the 8th bit will not be changed because the data inputs of the 7th and 8th stages of the U/D counter are connected to their respective Q outputs. These stages will remain in the states they reached when the oscillator inductor tap was selected until the 7th bit is changed again in order to select another inductor tap. As mentioned above, the U/D counter is set to a condition different from the full or the empty condition every time the 7th bit is changed, i.e. when the oscillator inductor tap is selected. This is a very important function, and the reason for using such an arrangement will be explained later. The taps on the oscillator inductor L4 are selected by means of the four switching diodes CR11 to CR14, which are controlled by the 2-bit binary to one-of-four decoder circuit. The four decoder gates IC6A to IC6D in this circuit are connected to the outputs of the 7th and 8th stages of the U/D counter through the gates IC3C and IC3D.

The digital-to-analogue (D/A) converter is used to coarse-tune the voltage-controlled oscillator. It translates the binary information obtained from the outputs of the first six stages of the U/D counter into an analogue information, i.e. a d.c. voltage, which is applied to the varactor diodes in the oscillator tuning circuit through a low-pass filter. All six stages in the D/A converter are equal except for the resistance values of the resistors R35 to R41. These values are: R35 = 2xR36, R36 = 2xR37, ... R39 = 2xR41. A simplified circuit diagram of the oscillator control circuit in which only two D/A converter stages are included is shown in Fig. 2.2.2.5-2. The transisistors and diodes in the D/A converter circuits perform the function of connecting the resistors R35 to R41 to the 10-kΩ resistor R28 in different combinations so that the d.c. voltage, i.e. the analogue information, at the output of the D/A converter corresponds to the binary information at the input, see the table in Fig. 2.2.2.5-3. If the output of the first U/D counter stage (the least significant bit) is Q=0, the current drawn by the n-p-n transistor Q17 will cause the base voltage of the p-n-p transistor Q6 to fall so that the last-mentioned transistor will be saturated. The collector voltage of the transistor Q6 will then be approx. +12V, and since the output voltage from the D/A converter (the voltage between the point K and the common lead in Fig. 2.2.2.5-2) is equal to or lower than +12V, the diode CR3 will be cut off. If the output of the first U/D counter stage is Q=1 the transistor Q17 will be cut off, thereby causing the transistor Q6 to be cut off too. The diode CR3 will

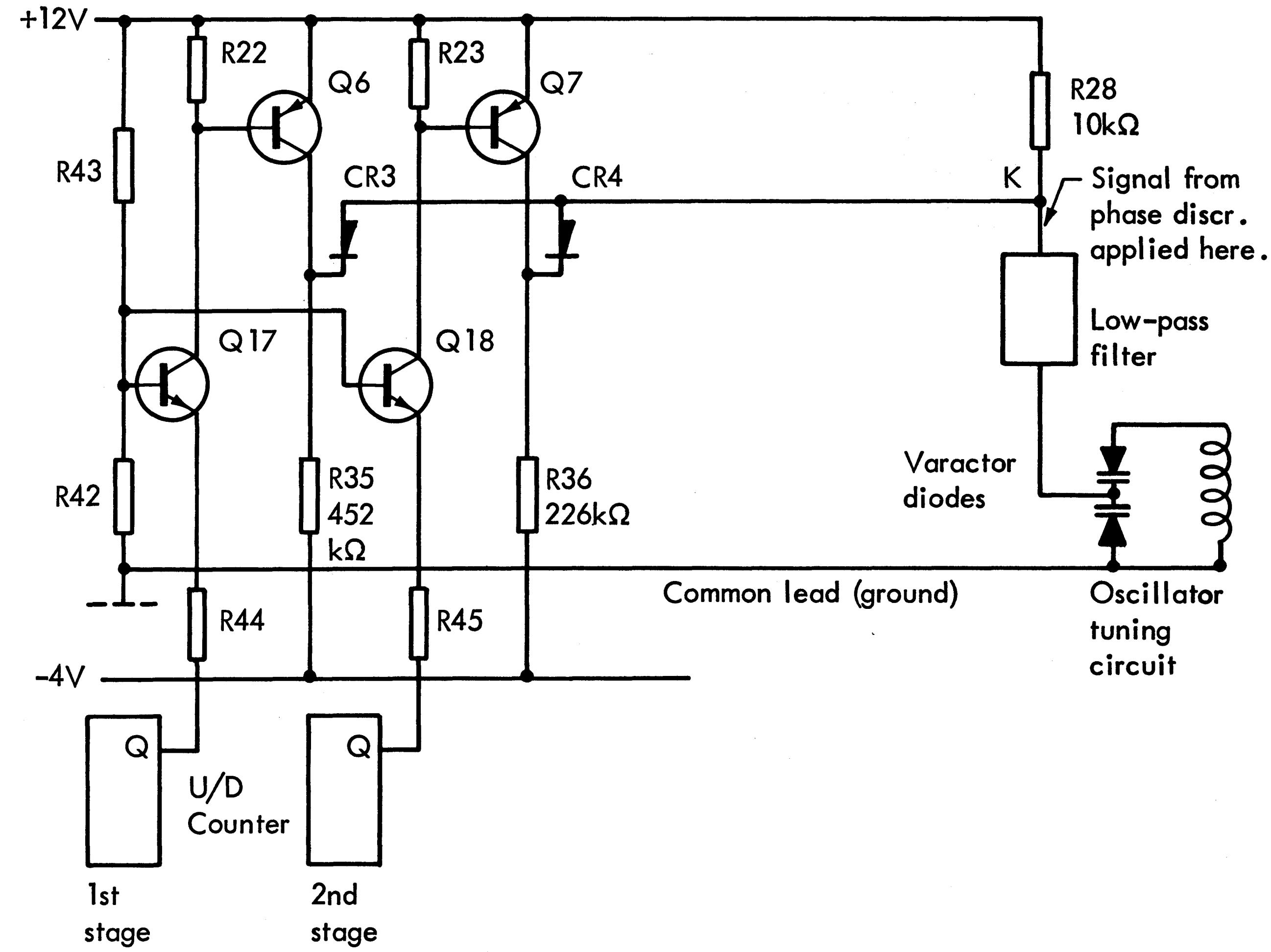


Fig. 2.2.2.5-2. Simplified Oscillator Control Circuit Diagram.
Only two D/A converter stages are shown.

then be conducting and a current will flow from the +12V lead through the 10-kΩ resistor R28, the diode CR3, and the 452-kΩ resistor R35 to the -4V lead. This current will cause a voltage drop of 0.35V in the 10-kΩ resistor R28, i.e. the output voltage from the D/A converter will be 11.65V.

The other stages in the D/A converter will operate in a way similar to that described above for the first stage. From the table in Fig. 2.2.2.5-3 it will be seen that a 2-bit D/A converter provides means for varying the output voltage in four steps. The equivalent circuits show that the operation performed when a bit is changed (one step) is equivalent to connecting, or disconnecting, a 452-kΩ resistor across the "lower" part of the voltage divider in the output circuit of the D/A converter. It will be seen that when the U/D counter counts up, i.e. the step number is increased, the output voltage is decreased, while when the U/D counter counts down, i.e. the step number is decreased, the output voltage is increased. A graph representing the output voltage as a function of the step number of the U/D counter is shown in Fig. 2.2.2.5-4. When the characteristics of the varactor diodes are taken into consideration it will be seen that the graph mentioned above has the desired curvature for meeting the requirements of a constant servo-loop gain.

The actual 6-bit D/A converter provides means for varying the output voltage in 64 steps (2^6 steps). If the oscillator frequency is not brought inside the capture range of the loop by means of the control voltage available within the 64-step range, another tap on the oscillator inductor will automatically be selected by means of the two last stages in the U/D counter as described above. Thus, if the oscillator frequency is too low or too high, the U/D

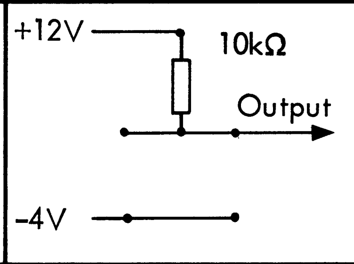
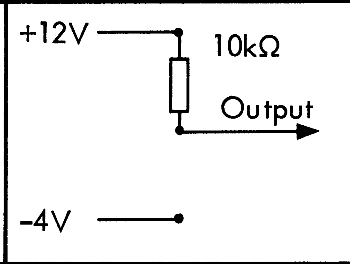
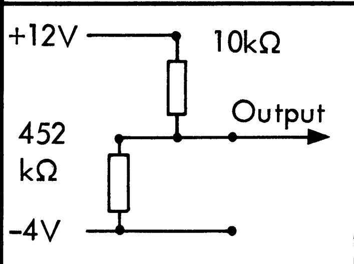
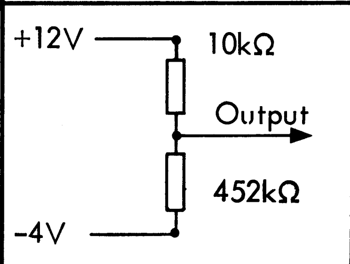
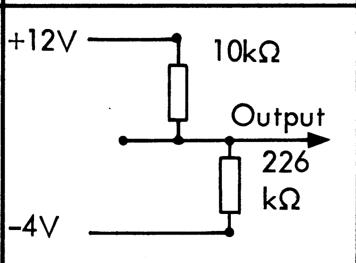
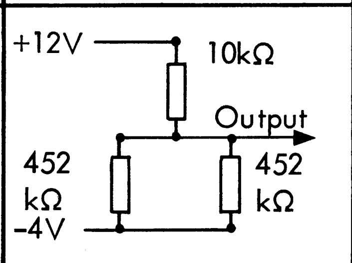
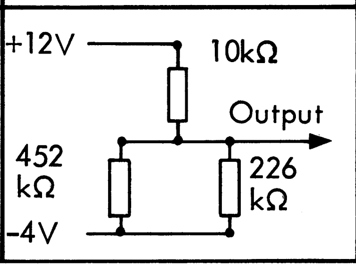
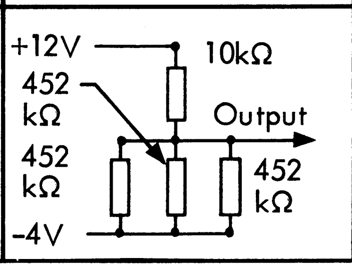
Step No.	Q Output of 1st U/D Counter Stage (least significant bit)	Q Output of 2nd U/D Counter Stage (next significant bit)	D/A Converter Output Circuit		
			Actual Circuit	Equivalent Circuit	Output Voltage (Volts)
0	0	0			12.00
1	1	0			11.65
2	0	1			11.32
3	1	1			11.02

Fig. 2.2.2.5-3. Principle of Operation of D/A Converter.
Only two stages are shown.

counter will count down or up, respectively, until the oscillator frequency is brought inside the capture range of the loop so that the phase locking can be established. A graph representing the oscillator frequency as a function of the step number of the U/D counter is shown in Fig. 2.2.2.5-5.

The output signal from the phase discriminator gate IC1D is applied to the emitter of the transistor Q2 via the diode CR1. The purpose of the transistor Q2 is to provide output signals the logic levels of which remain constant even if the logic levels of the signals from the phase discriminator vary slightly. The output signal from the collector of the transistor Q2 is fed to the input of the low-pass filter through the resistor R6 and added to the output signal from the D/A converter. It should be noted that the signal from the phase discriminator is attenuated in a voltage divider, the "upper" part of which consists of the resistor R6 while the "lower" part consists of the resistor R28 in parallel with the resistance in the output circuit

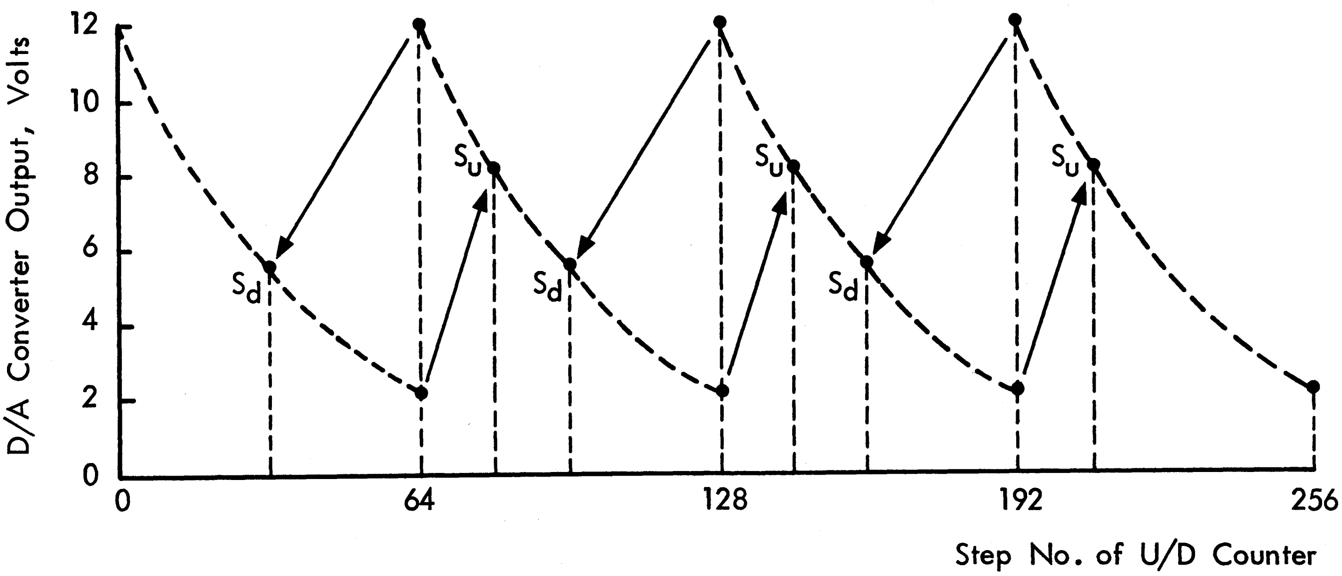


Fig. 2.2.2.5-4. Output Voltage of D/A Converter versus Step No. of U/D Counter.

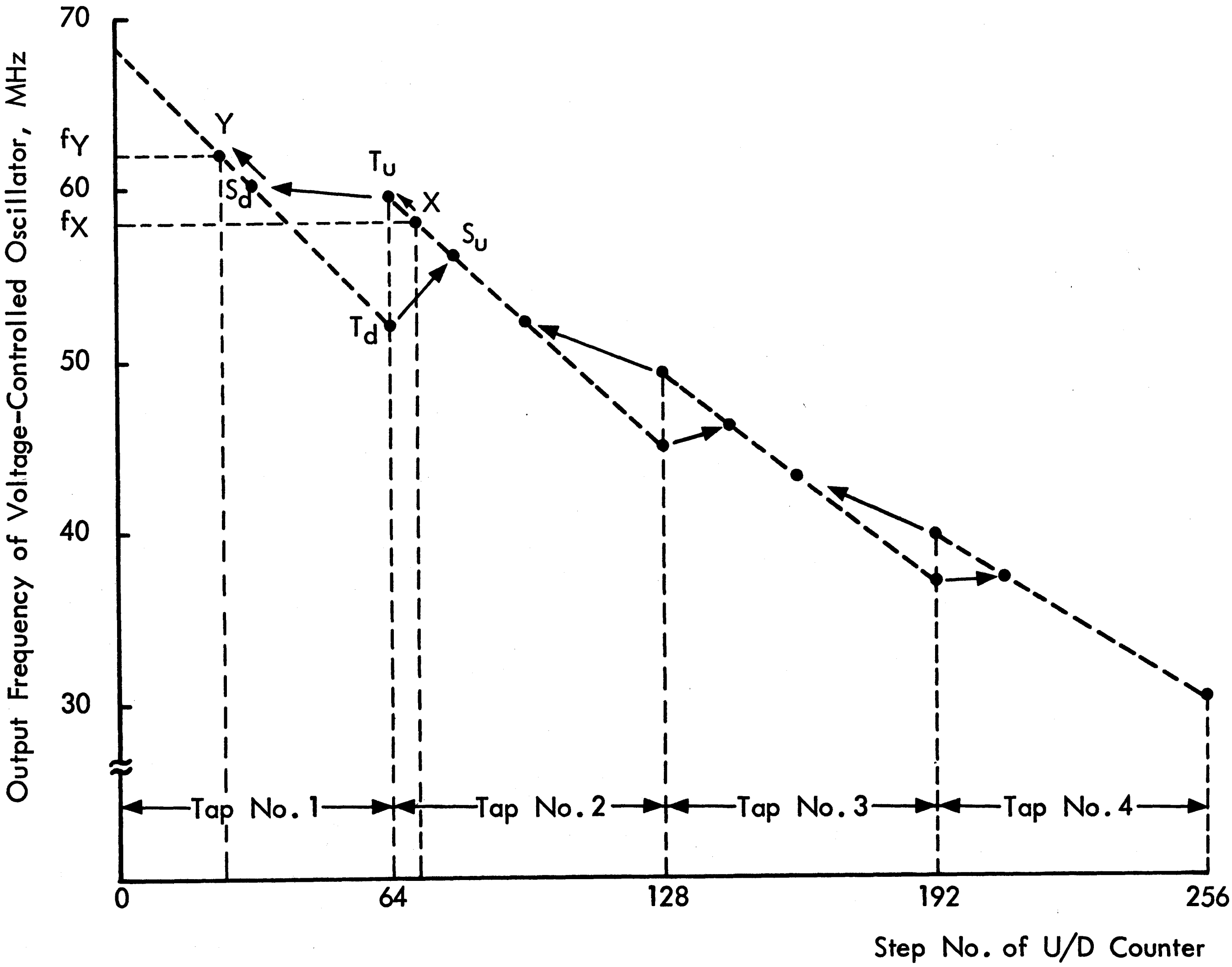


Fig. 2.2.2.5-5. Oscillator Frequency versus Step No. of U/D Counter.

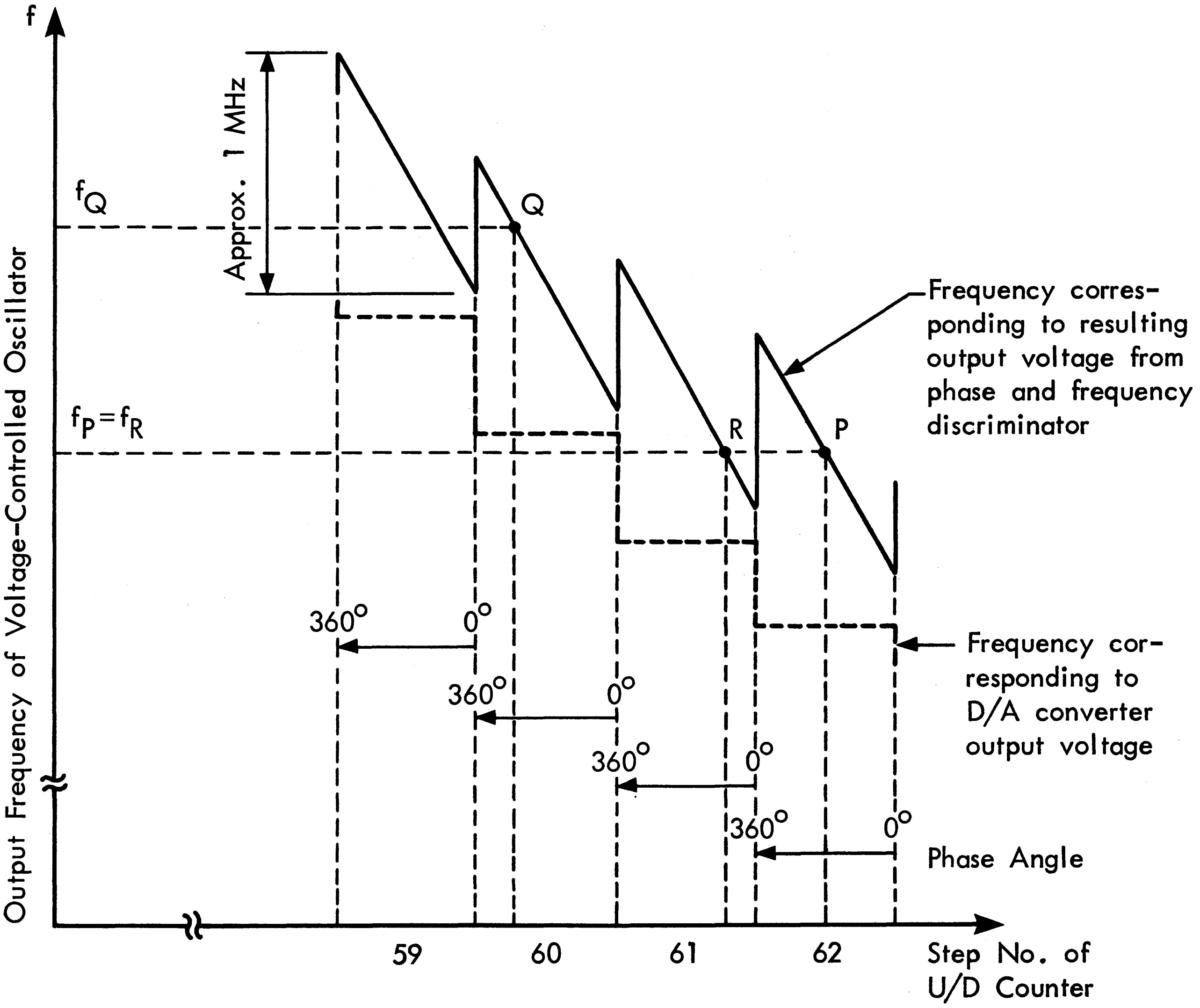


Fig. 2.2.2.5-6. Oscillator Frequency versus Phase Angle and Step No. of Up-Down Counter.

of the D/A converter, in such a way that the loop gain is kept substantially constant. The combined signal from the phase and frequency discriminator is applied to the varactor diodes CR15 and CR16 in the oscillator tuning circuit through a low-pass filter which incorporates a notch filter for suppressing the reference-frequency signal. A graph representing the oscillator frequency as a function of the phase angle and the step number of the U/D counter is shown in Fig. 2.2.2.5-6. The principle of operation of the loop system is illustrated by the following examples:-

Example 1. - Change of frequency from f_P to f_Q (see Fig. 2.2.2.5-6):
The setting of the frequency division ratio is altered from that corresponding to f_P to that corresponding to f_Q, and since $f_Q > f_P$ the output frequency from the frequency divider will be too low compared with the reference frequency. The U/D counter will then count down from step No.62 to step No.60 where the loop will be phase-locked.

Example 2. - Change of frequency from f_Q to f_R (see Fig. 2.2.2.5-6):
The setting of the frequency division ratio is altered from that corresponding to f_Q to that corresponding to f_R, and since $f_R < f_Q$ the output frequency from the frequency divider will be too high compared with the reference frequency. The U/D counter will then count up from step No.60 to step No.61 where the loop will be phase-locked. From the examples shown in Fig. 2.2.2.5-6 it will be seen that in this special case $f_R = f_P$, i.e. the same frequency is

obtained at different step numbers of the U/D counter. It should be noted that the frequency is decreased when the U/D counter counts up, and increased when the U/D counter counts down down.

Example 3. - Change of frequency from f_X to f_Y (see Fig. 2.2.2.5-5):
The frequency f_X (at the point X on the curve) lies in the range covered by the step numbers 64 to 128 where tap No.2 has been selected. The frequency f_Y (at the point Y on the curve) lies in the range covered by the step numbers 0 to 64 so that it is necessary to change from tap No.2 to tap No.1 in order to arrive at this frequency. When the setting of the frequency division ratio is altered from that corresponding to f_X to that corresponding to f_Y the U/D counter will count down and cause the tap No.1 to be selected instead of tap No.2. After the tap on the oscillator tuning inductor has been changed the U/D counter should count further down and reach the step number corresponding to the frequency f_Y, but due to the time constant of the low-pass filter the voltage controlling the varactor diodes cannot change quickly enough and the oscillator frequency will then be too high, it may even be so high that, if no precautions were taken, the U/D counter would count up again and cause a change from tap No.1 to tap No.2 after which the U/D counter would count down again, etc. To overcome this problem the U/D counter is so arranged that every time the 7th bit is changed, i.e. when the inductor tap is changed, the U/D counter is automatically set to a condition which in the graphs Fig. 2.2.2.5-4 and Fig. 2.2.2.5-5 is represented by the point S_d when the counter counts down, and by the point S_u when the counter counts up. These points are placed so many steps away from the points T_d and T_u, where the change of inductor taps takes place, that the U/D counter is prevented from running into the unstable condition mentioned above. Therefore, when the tap No.1 has been selected instead of tap No.2, as mentioned above, and the U/D counter is set to the condition represented by the point S_d on the curve, the counter will first count up a few steps after which it will count down and reach the point Y for the frequency f_Y where the loop will be phase-locked.

When changing from one frequency to another the U/D counter will at the beginning count relatively fast in order to change the oscillator frequency in the direction of the desired frequency because the repetition rate of the output pulses from the discriminator is relatively high, but as the oscillator frequency approaches the desired frequency the U/D counter will count slower according to the lower repetition rate of the input pulses. If, for instance, the difference between the oscillator frequency and the desired frequency is about 10 kHz, the difference between the output frequency from the divider and the reference frequency is only a fraction of a Hz so that the time between two output pulses from the discriminator will be several seconds. However, in this case the output frequency from the divider will be within the capture range of the discriminator, which is about ±3 Hz from the 500-Hz reference frequency, and therefore the loop will be phase-locked. The time it takes for the synthesizer to reach the desired frequency when changing from a higher to a lower frequency is longer than the time it takes when changing from a lower to a higher frequency. This is illustrated by the following examples:-

Case A. - Change of oscillator frequency from 60 MHz to 30 MHz:
When the division ratio of the divider is altered from that corresponding to 60 MHz to that corresponding to 30 MHz, the output frequency from the divider will at the beginning be 1000 Hz. This is 500 Hz above the 500-Hz reference frequency.

Case B. - Change of oscillator frequency from 30 MHz to 60 MHz:
When the division ratio of the divider is altered from that corresponding to 30 MHz to that corresponding to 60 MHz, the output frequency from the divider will at the beginning be 250 Hz. This is 250 Hz below the 500-Hz reference frequency.

In case A the difference between the output frequency from the divider and the 500-Hz reference frequency at the beginning of the change is twice as high as in case B. Therefore, it will take nearly twice as long time for the synthesizer to reach the desired frequency in case A as it will in case B.

The output signal from the voltage-controlled oscillator is applied to a dual-channel output amplifier. The one output signal from this amplifier is applied to the prescaler in the 35.000-64.999 MHz variable-ratio frequency divider (Ref. Designation A7), while the other output signal is applied to the 1st mixer in the associated double superheterodyne receiver.

In order to silence the receiver as the voltage-controlled oscillator searches to achieve lock-up, the output amplifier is so arranged that the last-mentioned output channel is blocked when the loop is not phase-locked.

Voltage regulators are inserted in the power supply leads to the D/A converter, and to the voltage-controlled oscillator and the output amplifier in order to provide the required high voltage stability. Two series regulators are used for the D/A converter, while a special series regulator with short-circuit protection is used for the voltage-controlled oscillator and the output amplifier.

2.2.2.6. 35.000-64.999 MHz Variable-Ratio Frequency Divider. Reference Designation A7.

The plug-in module containing this divider is located in the frequency synthesizer drawer. The complete circuit diagram of the divider is located in the diagram section at the rear of this manual. As shown in the circuit diagram the plug-in module also contains filters for the +5-volt supply and the -5-volt supply, L, C3, C5 and L2, C4, C6, four pull-down resistors, R8 to R11, fourteen pull-up resistors, R12 to R25, fourteen protecting zener diodes, CR8 to CR21, and an amplifier, ICB6, which is inserted in the input circuit to provide suitable clock pulses for driving a divide-by-two prescaler, ICA6, preceding the variable-ratio divider. The gate B6B operates as a linear amplifier while the following gate B6A provides a suitable amount of clipping. The input signal is obtained from the dual-channel amplifier in the 35-65 MHz loop circuit (Ref. Designation A6). The frequency of the input signal will lie within the range 35.000-64.999 MHz, i.e. the frequency of the input signal from the prescaler will lie within the range 17.5000-32.4995 MHz.

The variable-ratio frequency divider can be set to divide the frequency of the output signal from the prescaler by any integer between 35000 and 64999, the division ratio being determined by the positions of the binary-coded decade switches S2 ("0-9 kHz"), S3 ("0-90 kHz"), S4 ("0-900 kHz"), S5 ("0-9 MHz") and S6 ("0-20 MHz") on the frequency synthesizer front panel. This divider consists mainly of a synchronous decade divider, ICA1 to ICA5 and ICB1 to ICB5, which is controlled by the decade switch S2 (connections "A2", "B2", "C2" and "D2"), four cascaded asynchronous decade dividers, ICD2, ICE2, ICF1 and ICH1, which are controlled by the decade switches S3 (connections "A3", "B3", "C3" and "D3"), S4 (connections "A4", "B4", "C4" and "D4"), S5 (connections "A5", "B5", "C5" and "D5") and S6 (connections "A6", "B6", "C6" and "D6"), a decoder gate, ICE1, a strobe-input controlling flip-flop, ICD1, and fifteen adder gates, ICF2, ICF3, ICH2 and ICH3. Emitter-coupled logic (ECL) elements are used in the prescaler and the synchronous decade divider circuits, while transistor-transistor logic (TTL) elements are used in the asynchronous decade divider circuits. The logic levels for the two different logic systems are as follows:

For ECL elements: logic 0 ~ -1.5V and logic 1 ~ -0.7V
For TTL elements: logic 0 ~ 0V to +0.8V and logic 1 ~ +2.4V to +5V

Appropriate interface circuits are inserted in the divider circuit where logic elements of different families are interconnected, i.e. two ECL-to-TTL circuits, Q1, CR1, R2, R5, R26 and Q2, CR7, R4, R7, R27, and one TTL-to-ECL circuit, CR3 to CR6, R3, R6. It should be noted that the logic states 0 and 1 in the one logic system correspond to the respective logic states 0 and 1 in the other logic system so that the interface circuits may be ignored in the divider circuit diagram as regards the performance of logic functions.

The synchronous decade divider follows the 1-2-4-8 code. Its clock line is driven by the pre-

Table 2.2.2.6-1. Counting Sequence for Variable-Ratio Synchronous Decade Divider

Position of Decade Switch S2	'Divider State' preset by Decade Switch	Number of Input Pulses received after the condition of full has been reached in the four cascaded asynchronous decade dividers → 'Divider State'	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Number of 'Divider States' at end of sequence
0	9	0	1	2	3	4	5	6	7	[9]	9	0										10
1	8	0	1	2	3	4	5	6	7	[8]	8	9	0									11
2	7	0	1	2	3	4	5	6	7	[7]	7	8	9	0								12
3	6	0	1	2	3	4	5	6	7	[6]	6	7	8	9	0							13
4	5	0	1	2	3	4	5	6	7	[5]	5	6	7	8	9	0						14
5	4	0	1	2	3	4	5	6	7	[4]	4	5	6	7	8	9	0					15
6	3	0	1	2	3	4	5	6	7	[3]	3	4	5	6	7	8	9	0				16
7	2	0	1	2	3	4	5	6	7	[2]	2	3	4	5	6	7	8	9	0			17
8	1	0	1	2	3	4	5	6	7	[1]	1	2	3	4	5	6	7	8	9	0		18
9	0	0	1	2	3	4	5	6	7	[0]	0	1	2	3	4	5	6	7	8	9	0	19

Most of the time the synchronous decade divider counts by ten, i.e. for every ten input pulses it generates an output pulse which is applied to the following asynchronous decade divider. But once during each division cycle of the complete 5-decade divider the synchronous decade divider counts some number from ten to nineteen, which is controlled by the decade switch, and then returns to counting by ten again.

When the condition of full is reached in the four cascaded asynchronous decade dividers, the flip-flop A2 is replaced by the flip-flop A1 so that the synchronous decade divider can be set to count in accordance with the position of the decade switch.

The condition of full is reached in the complete 5-decade divider. The flip-flop A2 is again inserted in the circuit instead of the flip-flop A1. The synchronous decade divider will now count in accordance with the position of the decade switch and then return to counting by ten again (see the table: "Counting Sequence for 5-Decade Variable-Ratio Frequency Divider").

A pulse is applied to the strobe line so that the 'divider state' is modified according to the position of the decade switch. The gate B5B generates a short output pulse which is applied to the phase discriminator in the 35.000-64.999 MHz loop circuit.

scaler. Most of the time the synchronous decade divider operates as a divide-by-ten divider, i.e. for every ten input pulses it generates an output pulse which is applied to the input of the following asynchronous decade divider D2 via the interface circuit. But once during each division cycle of the complete 5-decade divider the synchronous decade divider counts some number from ten to nineteen, which is controlled by the decade switch, and then returns to count by ten again. It should be noted that initially the flip-flops in the synchronous decade divider are all in state Q=0 and $\bar{Q}$=1, and the flip-flop A1 is disabled by the flip-flop B1A, B1B and the gate B2B. The 8th input pulse in the count-by-ten sequence causes the flip-flop A2 to change state to Q=1 whereby the flip-flops A3 and A4 are disabled, their $\bar{Q}$ outputs remaining in state 1. On the receipt of the 9th input pulse the outputs of the flip-flop A2 will not change state because one J input as well as one $\bar{K}$ input are in state 1. The 10th input pulse causes the flip-flop A2 to change state to Q=0 again whereby the flip-flops A3 and A4 are enabled, thus restarting the counting sequence for the synchronous decade divider. The negative-going edge of the output pulse thus generated by the Q output of the flip-flop A2 triggers the input flip-flop in the asynchronous decade divider D2.

Each of the four cascaded asynchronous decade dividers, D2, E2, F1 and H1, follows the 1-2-4-8 code. Most of the time the decade dividers D2, E2 and F1 operate as divide-by-ten dividers. For every ten input pulses the decade divider generates an output pulse which is applied to the input of the following decade divider. But once during each division cycle of the complete 5-decade divider the decade divider counts some number from ten to nineteen, which is controlled by the decade switch, and then returns to count by ten again. The decade divider H1 does never count by ten, once during each division cycle of the complete 5-decade divider it counts some number, three, four, five or six, which is controlled by its decade switch and the adder circuit. The counting sequence for the variable-ratio synchronous decade divider is shown in Fig. 2.2.2.6-1 while the counting sequence for the 5-decade variable-ratio divider is shown in Fig. 2.2.2.6-2. In order to illustrate how the 'divider state' is modified according to the positions of the decade switches, an example is given in Fig. 2.2.2.6-3 for a division ratio of 26. It should be noted that in the actual divider the division ratio will never be lower than 35000.

When the condition of full is reached in the divider circuit comprising the four cascaded asynchronous decade dividers, i.e. the condition where these dividers are all in 'divider state' 9 (the 9999 content) and the outputs A and D are simultaneously in state 1, the output of the decoder gate E1 goes low, thus causing the flip-flop D1A,D1B to change state whereby the output of the gate D1A goes low while the output of the gate D1B goes high. The output of the gate D1A is connected to the strobe inputs of the four decade dividers D2, E2, F1 and H1 so that when this output goes low the 'divider state' is modified according to the positions of the decade switches S3, S4, S5 and S6. After this the output of the gate E1 goes high again without affecting the state of the flip-flop D1A,D1B. The output of the gate D1B is connected to the input of the gate B1A via the interface circuit so that when this output goes high the flip-flop B1A,B1B changes state. The flip-flop A2 in the synchronous decade divider is then disabled by the gate B3B while the flip-flop A1 is enabled by the gate B2B to operate when seven more input pulses have been counted by the synchronous decade divider. Thus, on the receipt of the next input pulse, i.e. the 8th input pulse after the full condition is reached in the four cascaded asynchronous decade dividers, the flip-flop A2 remains in state Q=0, the flip-flops A3 to A5 change state to $\bar{Q}$=1 while the flip-flop A1 changes state to Q=1 and $\bar{Q}$=0.

The output $\bar{Q}$=0 of the flip-flop A1 enables the appropriate decoder gates, B2A to B5A, to set the synchronous decade divider in accordance with the decade switch position. It also causes the flip-flops D1A,D1B and B1A,B1B to change state and the output of the gate B5B to go low, thus generating a negative-going output pulse which is applied to the phase discriminator in the 35.000-64.999 MHz loop circuit. The change of state of the flip-flop D1A,D1B enables the four cascaded asynchronous decade dividers to count in accordance with the decade switch positions. The output Q=1 of the flip-flop A1 disables the flip-flops A3 to A5 so that on the

Table 2.2.2.6-2. Counting Sequence for 5-Decade Variable-Ratio Frequency Divider.

Decade Switch	S6	S5	S4	S3	S2
Division-Ratio Digit	a	b	c	d	e
'Divider State' Digit preset by decade switch	9-a	9-b	9-c	9-d	9-e
m+1	9-a	9-b	9-c	9-d	10-e
⋮	⋮	⋮	⋮	⋮	⋮
9 9 9 7 9	9	9	9	7	9
9 9 9 8 0	9	9	9	8	0
9 9 9 8 1	9	9	9	8	1
9 9 9 8 2	9	9	9	8	2
9 9 9 8 3	9	9	9	8	3
9 9 9 8 4	9	9	9	8	4
9 9 9 8 5	9	9	9	8	5
9 9 9 8 6	9	9	9	8	6
9 9 9 8 7	9	9	9	8	7
9 9 9 8 8	9	9	9	8	8
9 9 9 8 9	9	9	9	8	9
9 9 9 9 0	9-a	9-b	9-c	9-d	0
9 9 9 9 1	9-a	9-b	9-c	9-d	1
9 9 9 9 2	9-a	9-b	9-c	9-d	2
9 9 9 9 3	9-a	9-b	9-c	9-d	3
9 9 9 9 4	9-a	9-b	9-c	9-d	4
9 9 9 9 5	9-a	9-b	9-c	9-d	5
9 9 9 9 6	9-a	9-b	9-c	9-d	6
9 9 9 9 7	9-a	9-b	9-c	9-d	7
9 9 9 9 8	9-a	9-b	9-c	9-d	9-e
9 9 9 9 9	9-a	9-b	9-c	9-d	9-e
m+1	9-a	9-b	9-c	9-d	10-e

Number of Input Pulses Counted from Preset Number to Full Condition

'Divider State'

Division Cycle

Counting sequence repeated.

The 99999 content corresponding to full condition in the five-decade divider.

Division Ratio:
$N = a\times10^4 + b\times10^3 + c\times10^2 + d\times10 + e$

Preset Number:
$m = (9-a)\times10^4 + (9-b)\times10^3 + (9-c)\times10^2 + (9-d)\times10 + 9-e$

At the start of the counting sequence each decade divider counts some number from zero to nine, which is controlled by its decade switch (the preset 'divider state'), and then it counts by ten until the condition of full (i.e. the 9999 content) is reached in the four cascaded asynchronous decade dividers. The decade divider H1, however, only counts the number determined by the position of its decade switch.

The number of input pulses necessary to change the content m (the number preset on the divider) to the full condition (i.e. the 99999 content) in the complete 5-decade divider is equal to the division ratio, i.e.
$N = 99999 - m$

When the condition of full (i.e. the 9999 content) is reached in the four cascaded asynchronous decade dividers a pulse is applied to the strobe inputs of these dividers so that the 'divider state' is modified according to the setting of the decade switches S3, S4, S5 and S6.

A pulse is applied to the strobe line of the synchronous decade divider so that the 'divider state' is modified according to the setting of the decade switch S2, and a short output pulse is generated.

All decade dividers are set to count in accordance with the positions of the decade switches and on the receipt of the next input pulse the counting sequence is restarted.

Fig. 2.2.2.6-3. Counting Sequence for 5-Decade Variable-Ratio Frequency Divider

Decade Switch	S6	S5	S4	S3	S2
Division-Ratio Digit	0	0	0	2	6
'Divider State' Digit preset by decade switch	9	9	9	7	3
9 9 9 7 4	9	9	9	7	4
9 9 9 7 5	9	9	9	7	5
9 9 9 7 6	9	9	9	7	6
9 9 9 7 7	9	9	9	7	7
9 9 9 7 8	9	9	9	7	8
9 9 9 7 9	9	9	9	7	9
9 9 9 8 0	9	9	9	8	0
9 9 9 8 1	9	9	9	8	1
9 9 9 8 2	9	9	9	8	2
9 9 9 8 3	9	9	9	8	3
9 9 9 8 4	9	9	9	8	4
9 9 9 8 5	9	9	9	8	5
9 9 9 8 6	9	9	9	8	6
9 9 9 8 7	9	9	9	8	7
9 9 9 8 8	9	9	9	8	8
9 9 9 8 9	9	9	9	8	9
9 9 9 9 0	9	9	9	7	0
9 9 9 9 1	9	9	9	7	1
9 9 9 9 2	9	9	9	7	2
9 9 9 9 3	9	9	9	7	3
9 9 9 9 4	9	9	9	7	4
9 9 9 9 5	9	9	9	7	5
9 9 9 9 6	9	9	9	7	6
9 9 9 9 7	9	9	9	7	7
9 9 9 9 8	9	9	9	7	3
9 9 9 9 9	9	9	9	7	3
9 9 9 7 4	9	9	9	7	4

Number of Input Pulses Counted from Preset Number to Full Condition

'Divider State'

Division Cycle (26 States)

Counting sequence repeated.

Example: a=0, b=0, c=0, d=2, e=6

Division Ratio: $N = 0\times10^4+0\times10^3+0\times10^2+2\times10+6 = 20+6 = 26$

Preset Number: $m = (9-0)\times10^4+(9-0)\times10^3+(9-0)\times10^2+(9-2)\times10+9-6$

$= 9\times10^4+9\times10^3+9\times10^2+7\times10+3 = 99973$ $(= 99999 - N)$

receipt of the following input pulse, i.e. the 9th input pulse after the full condition is reached in the four cascaded asynchronous decade dividers, the flip-flop A1, the $\bar{K}$ inputs of which are permanently at state 0, changes state to Q=0 and $\bar{Q}$=1 whereby the output of the gate B5B goes high, the flip-flops D1A,D1B and B1A,B1B obtain their original states and the flip-flops A2 to A5 are enabled to count in accordance with the decade switch setting. It should be noted that the full condition has then been reached in the complete 5-decade divider, i.e. the 'divider state' corresponding to the 99999 content. On the receipt of the next input pulse the division cycle for the complete 5-decade divider is restarted.

At the start of the counting sequence for the 5-decade variable-ratio divider the synchronous decade divider will first count some number from zero to nine, which is controlled by its decade switch, and then return to count by ten until the condition of full (i.e. 9999 content) is reached in the four cascaded asynchronous decade dividers. Similarly, each of the decade dividers D2, E2 and F1 will first count some number from zero to nine, which is controlled by its decade switch, and then return to count by ten until the condition of full is reached in the four cascaded asynchronous decade dividers. The decade divider H1 will count some number, three, four, five or six, which is controlled by its decade switch and the adder circuit, once during a complete division cycle.

Once during each counting sequence the gate B5B produces an output pulse. As mentioned above, this output pulse is generated when the state of the $\bar{Q}$ output of the flip-flop A1 changes from 1 to 0 and then from 0 to 1 again. The total propagation delay time in this divider circuit is very short, because there are only seven stages in which delays can be introduced, i.e. the gates B6B and B6A, the flip-flops A6 and A1 and the gate B5B. This means that in the divider circuit used here the counter jitter is greatly reduced as compared with that which would occur in a corresponding ripple-through divider circuit containing approximately twenty stages.

The number of input pulses necessary to change the content m (the number preset on the divider) to the full condition in the complete 5-decade variable-ratio divider (i.e. the 99999 content) is equal to the division ratio N, i.e. N=99999-m. Thus, it is only necessary for the wiring of a decade switch to be arranged so that the nine's complement of each digit of the divisor is set in the corresponding decade. If, for example, the desired division ratio is N=76027, then the number to be preset on the divider is: m=99999-N=99999-76027=23972. The setting of the decade switches is also explained on the page containing the table for the counting sequence for the 5-decade variable-ratio frequency divider.

It will be seen that the operating frequency of the 35.000-64.999 MHz variable-ratio divider is 35000 kHz higher than the corresponding receiving frequency, which is read on the dials for the decade switches on the synthesizer front panel. Consequently, the division ratio of the 5-decade variable-ratio divider must be 35000 higher than the number read on the dials for the decade switches. In order to obtain this, 35000 is added to the number corresponding to the binary information on the decade switches (i.e. the preset number m). 5000 is added to the preset number by displacing the dial for the decade switch S5 five steps from the position corresponding to the preset number. 30000 is added to the preset number by means of the adder circuit consisting of the gates F2, F3, H2 and H3. When the decade switch S5 is set in one of the positions "0", "1", "2", "3" or "4", 30000 is added to the preset number, but when the said switch is set in one of the positions "5", "6", "7", "8" or "9", 40000 is added to the preset number ("one is carried").

2.2.2.7. Output Gate-Off Circuit. Reference Designation A8.

The subassembly containing this circuit is located in the frequency synthesizer drawer and connected to the mother board wiring by means of p.c. board-to-board connectors. If an automatic fault localization device is required for the synthesizer, the subassembly containing the output gate-off circuit is replaced by a subassembly containing the a.f.l. device (Ref. Designation A10), the output gate-off circuit being incorporated in this device.

The output gate-off circuit consists mainly of a one-shot multivibrator, employing two transistors Q1 and Q2, followed by a buffer-amplifier transistor, Q3, and an indicator-lamp control transistor, Q4. Normally, the transistor Q1 is cut off and the transistor Q2 saturated. If a pulse having a positive-going or a negative-going edge is applied to the input, the multivibrator will change state, i.e. the transistor Q1 will be saturated and the transistor Q2 cut off. The multivibrator will remain in this state until the capacitor C2 has been discharged through the resistor R5 and the base voltage on the transistor Q2 has reached a value of approximately +0.5V, then the multivibrator will change state again, i.e. the transistor Q2 will be saturated and the transistor Q1 cut off. The pulse thus produced by the multivibrator will have a duration of approximately three seconds.

The input circuit of the one-shot multivibrator is connected to the output of the first stage of the up-down counter in the 35.000-64.999 MHz phase-locked loop module (Ref. Designation A6) so that when the up-down counter changes state, i.e. when an out-of-lock condition exists, the one-shot multivibrator will produce a three-second output pulse. This pulse is amplified by the transistor Q3 and applied to the gated output amplifier, A6IC8, in the 35.000-64.999 MHz phase-locked loop plug-in module whereby the signal is blocked for approximately three seconds, thus allowing sufficient time for the loop to achieve lock-up. The output pulse from the buffer amplifier is also applied to the indicator-lamp control transistor Q4, which switches on the indicator lamp DS2 ("test") on the synthesizer front panel so that this lamp will light when the loop is not phase-locked.

2.2.2.8. Automatic Fault Localization Device. Reference Designation A10.

The automatic fault-localization (a.f.l.) device is supplied on special request. The subassembly containing this device is designed to be located in the frequency synthesizer drawer and connected to the mother board wiring by means of p.c. board-to-board connectors. If an a.f.l. device is supplied, it replaces the subassembly containing the output gate-off circuit (Ref. Designation A8), the output gate-off circuit being incorporated in the a.f.l. device subassembly. The complete a.f.l. circuit can be divided into fifteen individual circuits, i.e. fourteen signal-sensing circuits and a fault-localizing circuit.

In order to check the operation of the frequency synthesizer the fourteen signal-sensing circuits are connected to appropriate circuits contained in the plug-in modules. If the circuit being checked operates properly the signal-sensing circuit in question provides an output signal of logic level 1, but in case of faulty operation the signal-sensing circuit provides an output signal of logic level 0. The outputs of the signal-sensing circuits are connected to the inputs of the fault-localizing circuit through the test points designated "A", "B", "C", "D", "E", "F", "H", "K", "L", "M", "N", "P", "R" and "S" in the circuit diagram. Some of the signal-sensing circuits are contained in the plug-in modules. The signal sources to be checked are:-

Test Point:	Signal source:	Ref. Designation of the plug-in module:
"A"	500-Hz reference output from frequency standard	A3
"B"	500-Hz output from 33.4991-33.5000 MHz variable-ratio divider	A5 *
"C"	35.000-64.999 MHz output from phase-locked loop	A6
"D"	500-Hz output from 35.000-64.999 MHz variable-ratio divider	A7
"E"	30-MHz output from frequency standard	A3 *
"F"	Phase-control output from 35.000-64.999 MHz phase-locked loop	A6
"H"	Phase-control output from 33.4991-33.5000 MHz phase-locked loop	A4 *
"K"	1.5-MHz output from frequency standard	A3
"L"	33.5991-33.6000 MHz output from frequency tripler	A4
"M"	17.4955-17.5000 MHz output from phase-locked loop	A4
"N"	+17-volt regulated output from voltage-regulator circuits	A2
"P"	+12-volt regulated output from voltage-regulator circuits	A2
"R"	-5-volt regulated output from voltage-regulator circuits	A2
"S"	Unregulated outputs and -12-volt regulated output from rectifiers	A1

The fault-localizing circuit has seven outputs, one for each plug-in module. To each output is connected a transistor in the emitter circuit of which is inserted an indicator lamp. The output signals from the signal-sensing circuits are applied simultaneously to the fault-localizing circuit. If the frequency synthesizer operates properly the outputs from the signal-sensing circuits will all be at logic level 1, and none of the indicator lamps mentioned above will light. If the circuit in a plug-in module fails to operate properly the output from the signal-sensing circuit concerned will be at logic level 0, and the fault-localizing circuit will cause the indicator lamp for the plug-in module in question to light, thus indicating in which plug-in module the faulty circuit is localized. Similarly, if faults occur in two or more plug-in modules simultaneously, the indicator lamps for all the faulty modules will be lighted. The indicator lamps for the plug-in modules are located on top of the subassembly containing the a.f.l. device so that they are visible when the frequency synthesizer drawer is withdrawn. An extra indicator lamp, which is located on the front panel and designated "test", is lighted when a fault occurs in a plug-in module, but in order to find out where the fault is localized the frequency synthesizer drawer must be withdrawn so that the indicator lamps for the plug-in modules are visible.

The principle of operation for the a.f.l. device is shown in the simplified circuit diagram Fig. 2.2.2.8-1. The outputs from the circuits to be checked in a plug-in module are sensed by the signal-sensing circuits Nos. 1-4, while the inputs to the circuits are sensed by the signal-sensing circuits Nos. 5-7, these inputs being provided by circuits contained in other plug-in modules. The outputs from the signal-sensing circuits Nos. 1-4 are fed to the gate F, and if the circuits being checked in the plug-in module are operating properly all these outputs will be high (at logic level 1) so that the output of the gate F will be low (at logic level 0). The output from the gate F is fed to one input of the gate C while the outputs from the signal-sensing circuits Nos. 5-7 are fed to the other inputs of the gate C, and if the circuits are operating properly these outputs will be high. The output of the gate C will be high because the output of the gate F is low. If one of the circuits in the plug-in module to which the signal-sensing circuits Nos. 1-4 are connected fails to operate, the output of the signal-sensing circuit concerned goes low whereby the output of the gate F will go high, and provided that the outputs of the signal-sensing circuits Nos. 5-7 are all high the output of the gate C will go low, thus causing the indicator lamp in the emitter circuit of the output transistor to be lighted. If more than one circuit in the plug-in module fail to operate the indicator lamp will still be lighted. However, if one of the outputs from the signal-sensing circuits Nos. 5-7 is low the output of the gate C will remain high and the indicator lamp will not be lighted, but in this case the fault, which must have occurred in one of the plug-in modules

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* For transmitter frequency synthesizers only.

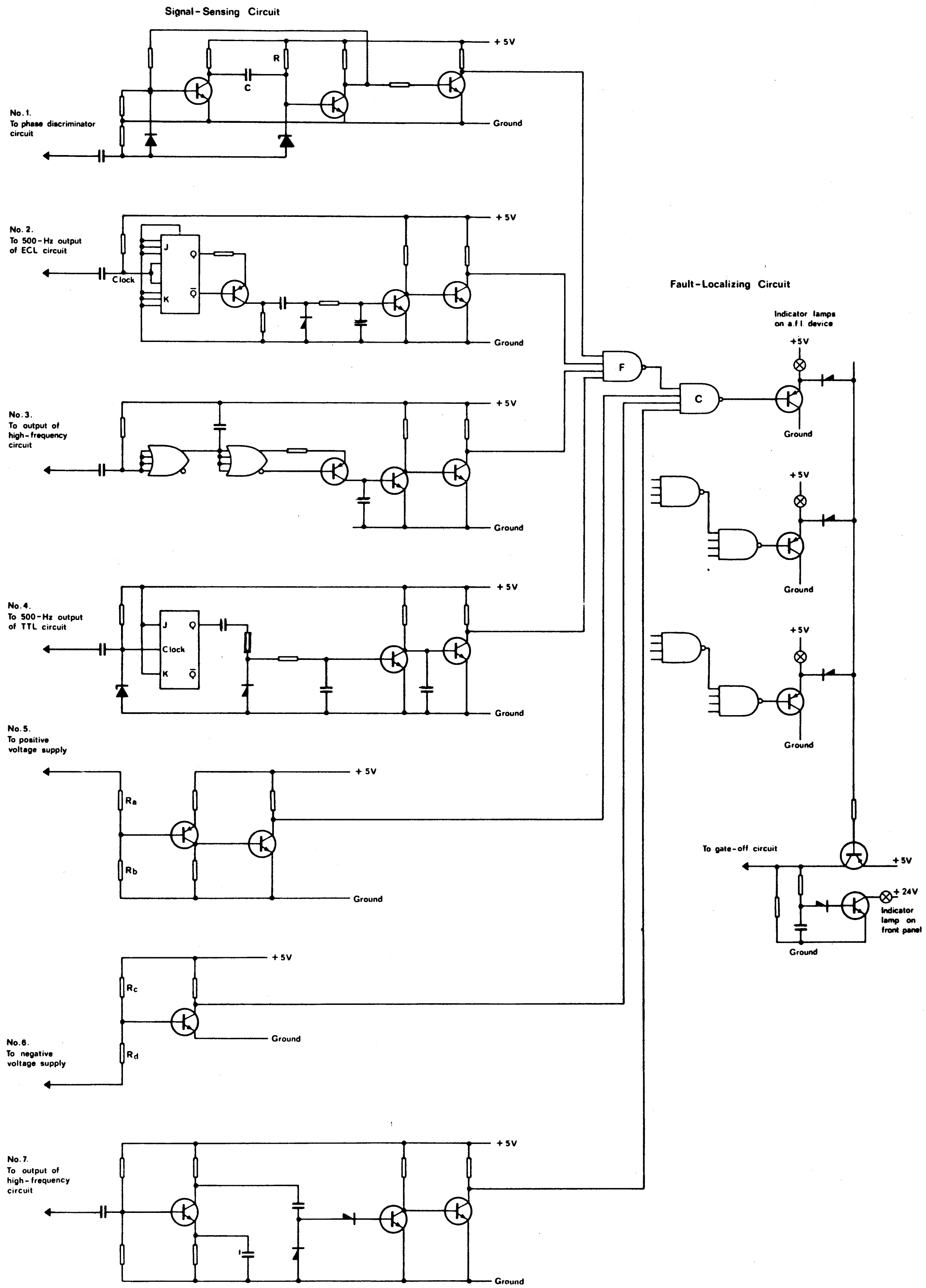


Fig. 2.2.2.8-1. Principle of Operation of Automatic Fault Localization Device.

employing the signal-sensing circuits Nos. 5-7, will be localized by means of the fault-localizing gates and indicator lamp for the plug-in module in question.

The signal-sensing circuit No. 1 is used for sensing the output signal from a phase discriminator. The circuit operates as a one-shot multivibrator. If a positive-going or a negative-going pulse edge appears at the input the one-shot multivibrator circuit will be triggered and its output will go low for approximately three seconds and then fall back to the stable state, the time being determined by the RC time constant of the circuit.

The signal-sensing circuit No. 2 is used for sensing a 500-Hz output signal from an ECL circuit. The signal-sensing circuit employs an ECL flip-flop which is triggered by the 500-Hz (repetition rate) signal. The output signal from the flip-flop is amplified and detected. The signal from the detector is fed to an output amplifier. The output of this amplifier is high as long as the 500-Hz input signal is present, but if the 500-Hz signal fails the output of the amplifier goes low.

The signal-sensing circuit No. 3 is used for sensing a high-frequency signal. The input circuit employs a pair of ECL gates connected as a linear amplifier and detector. The output signal from the detector is amplified by two transistors. The output of the circuit is high when the proper input signal is present, but if the input signal fails the output goes low.

The signal-sensing circuit No. 4 operates in a way similar to that of circuit No. 2. In this case the input signal is obtained from a TTL circuit, and a TTL flip-flop is employed in the input circuit.

The signal-sensing circuit No. 5 operates as a positive d.c. level detector. If the voltage obtained from the voltage divider Ra, Rb, which is inserted across the supply voltage, falls below a pre-determined value the output of the circuit goes low.

The signal-sensing circuit No. 6 operates as a negative d.c. level detector. The voltage divider Rc, Rd is inserted between the positive 5-volt supply lead and the negative voltage supply lead. If the voltage between the tap on the voltage divider and ground (chassis) is correct the output of the signal-sensing circuit is high, but if the negative supply voltage fails the output of the circuit goes low.

The signal-sensing circuit No. 7 is used for sensing a high-frequency signal. The input signal is amplified and detected. The signal from the detector is applied to an output amplifier. The output of the circuit is high when the proper input signal is present, but if the input signal fails the output goes low.

The operation of the frequency synthesizer is checked continuously by means of its a.f.l. device, while the push-button designated "test" on the front panel of the s.s.b. exciter must be pressed in order to check the operation of the exciter.

It should be noted that the indicator lamp on the front panel of the frequency synthesizer will light and indicate "faulty operation" immediately after the setting of the frequency synthesizer has been altered if the frequency is altered so much that the loop cannot remain phase-locked. The indicator lamp will then be lighted for approximately three seconds, during which time proper phase-lock should be established.

In the actual frequency synthesizer the indicator lamps and driver transistors are replaced by light-emitting diodes (LED).

2.2.2.9. Control-Line Filter Circuits. Reference Designation A11.

This plug-in module contains the radio-frequency filter circuits for the control lines intended for preselecting front-end tuned circuits in the associated receiver.

SECTION 3. - INSTRUCTION FOR INSTALLATION.

The frequency synthesizer panel-and-chassis assembly should be mounted in a standard 19-inch rack or cabinet together with the associated receiver. The mounting dimensions are shown in the outline dimensional drawing located in the diagram section at the rear of this manual. A cabinet complete with connectors, terminal board and radio-frequency filters for external wiring is available on special order. Normally, the frequency synthesizer is located above the receiver.

SECTION 4. - OPERATING INSTRUCTIONS.

A warming-up period of about 4 minutes is sufficient for the standard-frequency oscillator in the frequency synthesizer to reach normal stability, but if the standard-frequency oscillator is to be set up against a standard frequency at least 20 minutes should be allowed.

Set the frequency selector knobs (decade switches) on the synthesizer panel to the positions for the required frequency. Readjust the "clarifier" control on the receiver panel as described in the operating instructions for the receiver.

When the frequency synthesizer is set to one of the distress frequencies, 500 kHz or 2182 kHz, the red indicator lamp designated "distress" will light.

The indicator lamp designated "test" will light when the 35.000-64.999 MHz loop is not phase-locked. If the frequency synthesizer is equipped with an automatic fault localization device, this indicator lamp will also light in the case of faulty operation of the synthesizer, but in order to find out where the fault is localized the synthesizer drawer must be withdrawn so that the indicator lamps for the plug-in modules are visible. These indicator lamps are located on top of the subassembly containing the a.f.l. device and are designated "A1", "A2", "A3", "A4", "A5", "A6" and "A7" corresponding to the reference designations of the plug-in modules being checked.

It should be noted that the indicator lamp designated "test" will light and indicate "faulty operation" immediately after the setting of the frequency synthesizer has been altered if the frequency has been altered so much that the loop cannot remain phase-locked. The indicator lamp will then be lighted for approximately three seconds, during which time proper phase-lock should be established.

SECTION 5. - MAINTENANCE.

5.1. General.

It is recommended that the user should become familiar with the contents of SECTION 2. - DESCRIPTION before attempting the adjustment or replacement of component parts of the equipment.

5.2. Checking the Standard-Frequency Oscillator.

The method of checking the frequency of the standard-frequency oscillator by making comparisons with broadcast standard-frequency signals requires the use of a receiver covering the 5-, 10-, 15- or 20-MHz bands. The output from the "x500 kHz" socket, J10, on top of the frequency synthesizer should be loosely coupled to the antenna circuit of the receiver as shown below in Fig.7.2-1. The socket J10 is accessible when the synthesizer drawer is pulled out to its stop position. A list of radio stations transmitting standard frequencies is given in the ITU Publication "List of Radiodetermination and Special Service Stations".

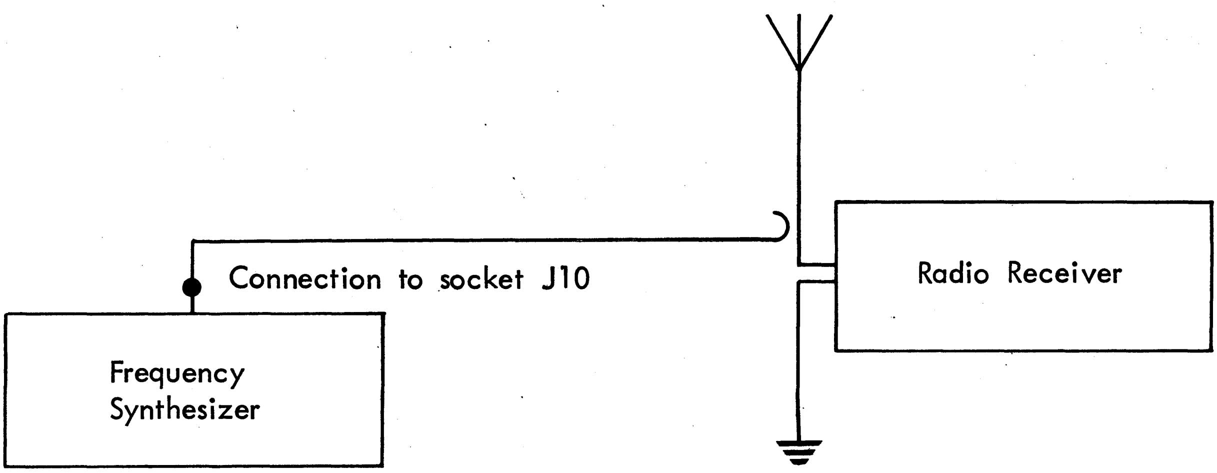


Fig.5.2-1. Diagram of Connections for Checking the Standard-Frequency Oscillator.

After allowing a warming-up period of at least 20 minutes for the frequency synthesizer and the receiver, proceed as follows:-

1) Select the standard-frequency broadcast station from which the reception of signals is best and tune it in with the receiver beat-frequency oscillator switched on and adjusted for a beat-note of approximately 1000 Hz.

2) Place the wire from the "x500 kHz" output, J10, on the frequency synthesizer near the antenna input terminal of the receiver in order to provide a suitable degree of coupling between the synthesizer and the receiver.

3) The audio-frequency output signal from the receiver should then be a beat-note of approximately 1000 Hz varying at a rate corresponding to the difference between the standard frequency of the radio station and the nearest harmonic of 500 kHz (the "x500 kHz" signal from the synthesizer). For best results the signal from the radio station and the signal from the synthesizer output should be about the same strength. Rearrange the coupling wire if necessary.

4) Wait for the transmission period during which the modulation is absent. Then adjust the frequency of the standard-frequency oscillator by means of the potentiometer R1 in the

voltage-control circuit of the oscillator until its harmonic is in zero beat with the frequency of the standard-frequency radio station. The potentiometer R1 is located on the mother board in the synthesizer panel-and-chassis assembly and is accessible for adjustment by a screwdriver through a hole in the top cover plate, designated "R1 STANDARD CALIBRATE". The exact setting is found by observing the slow rise and fall in intensity (not frequency) of the beat note as the harmonic comes close to zero beat, and adjusting to where the pulsation disappears or occurs at a very slow rate. It is advisable not to try to set the standard-frequency oscillator during the periods when the standard-frequency transmission is tone-modulated, since it is difficult to tell whether the harmonic is being adjusted to zero beat with the carrier or with one of the side bands.

SECTION 6. - ALIGNMENT.

6.1. General.

This frequency synthesizer equipment should maintain its correct factory adjustment over a reasonably long period of time. No one but an authorized and competent service man equipped with proper test facilities should be permitted to align the equipment. It is emphasized that realignment must not be attempted until all other causes for subnormal performance have been investigated. In order to gain access to the appropriate trimmer capacitors, iron-dust cores, potentiometers, etc. the plug-in module to be tested must be mounted on an extension plug-in board in the synthesizer panel-and-chassis assembly with the slide-out cover removed as illustrated below.

PC edge connector on extension plug-in board

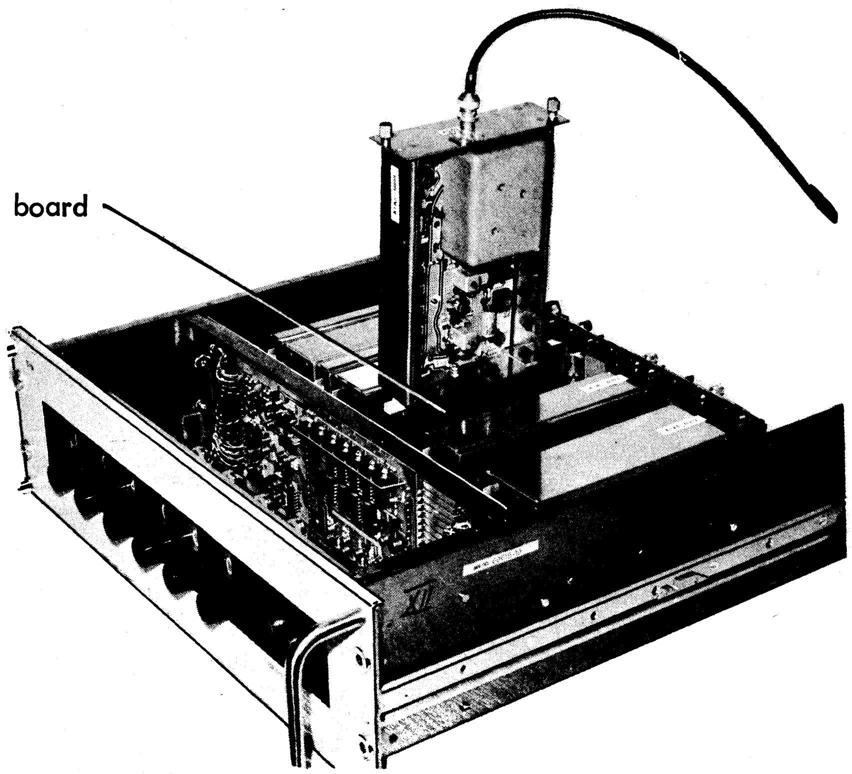


Fig. 6.1-1. Plug-in Module mounted on an Extension Plug-in Board.

While aligning a plug-in module, all the other plug-in modules of the frequency synthesizer must remain inserted in their proper positions in the panel-and-chassis assembly.

The test equipment must include a test oscilloscope for checking the amplitude and waveform of the signals and an electronic counter for measuring the frequency. These instruments must meet or exceed the following specifications:

Test Oscilloscope. Bandwidth, d.c. to 80 MHz; minimum deflection factor 5 mV/division; accuracy within 10%; test probe, -20 dB (high impedance). Tektronix Type 454 Oscilloscope recommended.

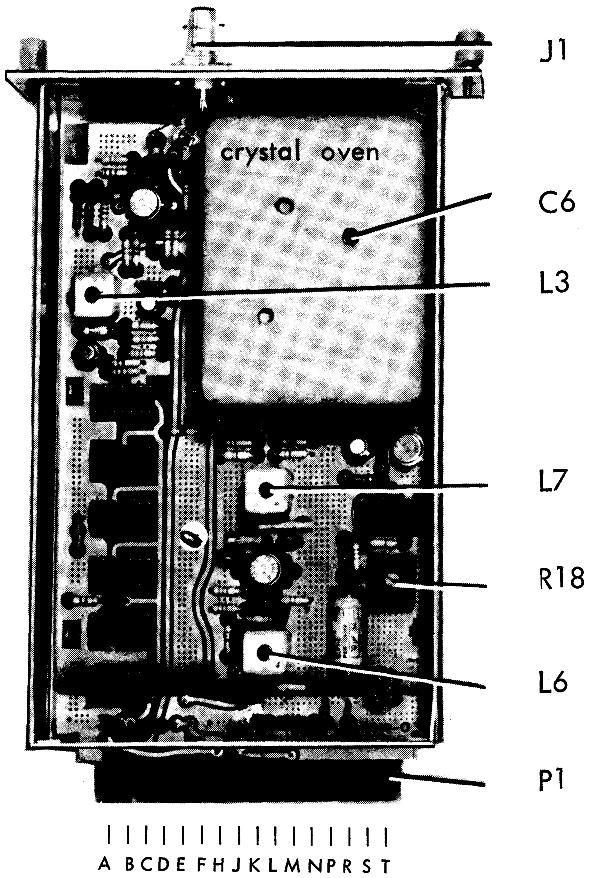
Electronic Counter. Max. frequency 80 MHz; accuracy $1x10^{-7}$; minimum sensitivity 25 mV r.m.s. A lower sensitivity may be sufficient if the test oscilloscope has an output socket for the vertical amplifier to which the electronic counter can be connected.

The alignment procedure for the plug-in modules having the reference designations A3 and A4 are outlined on the following pages. It should be noted that the "typical readings" are only given as a rough guide.

Plug-in Module for Frequency Standard.

Reference Designation, Transmitter Equipment: S1250A3A3
Receiver Equipment: M1250SYNA3

PC boards Nos. 18800 and 18809.



Alignment Procedure:

After allowing a warming up time of at least 20 minutes, proceed as follows:-

1. Connect a 50-Ω load to J1 and adjust L3 for max. output signal across this load.

   Output frequency: 1.5 MHz
   Typical output level: 600 to 700 mVpp

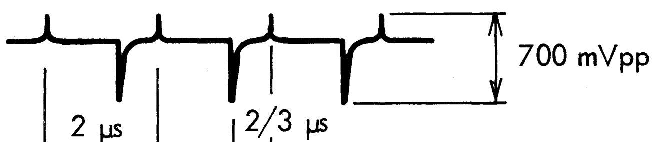
2. (For transmitter plug-in modules only). Adjust L7 and L6 for max. output signal from P1-D.

   Output frequency: 30 MHz
   Typical output level: 300 to 500 mVpp

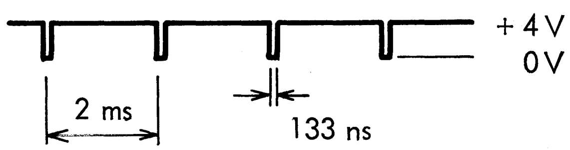
3. Adjust R18 for correct temperature, 75° C, on the surface of the oven chamber. The temperature should be measured by means of an electronic thermometer, the temperature-sensing probe being applied to the oven chamber surface through the hole for trimmer C6 in the heat-insulating cover.

4. Adjust the potentiometer R1 on the mother board in the synthesizer for a voltage of 3Vdc at P1-C. Adjust C6 for correct frequency of the output signal from J1, i.e. exactly 1500000.0 Hz.

Waveform of signal at P1-A:



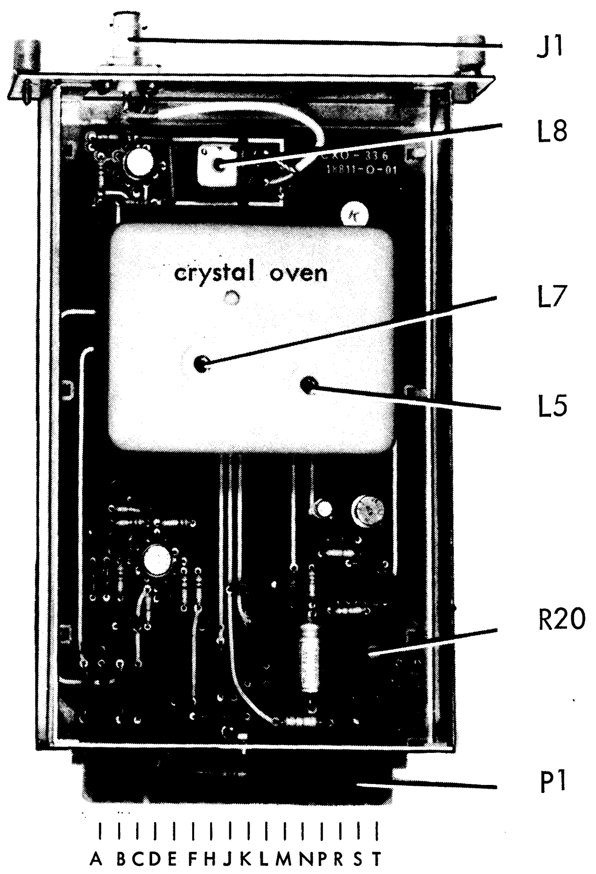
Waveform of signal at P1-H:



Plug-in Module for Voltage-Controlled Crystal Oscillator.

Reference Designation, Receiver Equipment: M1250SYNA4

PC boards Nos. 18811 and 18815.



Alignment Procedure:

After allowing a warming up time of at least 20 minutes, proceed as follows:-

1. Connect a 50-Ω load to J1 and adjust L7 and L8 for max. output signal across this load.

   Output frequency: 33.5 MHz
   Typical output level: 500 to 900 mVpp

2. Adjust R20 for correct temperature, 75° C, on the surface of the oven chamber. The temperature should be measured by means of an electronic thermometer, the temperature-sensing probe being applied to the oven chamber surface through a hole for a trimmer in the heat-insulating cover.

3. Adjust the potentiometers R2 and R3 on the mother board in the synthesizer for a voltage of 8Vdc on the arm of R3 and a voltage of 4.5Vdc on the arm of R2. Set the decade switch S1 on the front panel on "5", and set the clarifier control on the receiver in its midposition. Adjust L5 for a frequency of 33499500 Hz of the output signal from J1.

4. Set the decade switch S1 on "0" and readjust R3 for a frequency of 33500000 Hz of the output signal from J1.

5. Set the decade switch S1 on "9" and readjust R2 for a frequency of 33499100 Hz of the output signal from J1.

6. Repeat the two last steps until the correct frequencies are obtained.

SECTION 7. - PARTS LISTS.

INDEX

Parts Ordering Information

When ordering replacement parts it is important to include the following information:-

1. Name, type designation and serial number of principal equipment.

2. Circuit diagram number of the circuit in which the required part is used.

3. Assembly or subassembly reference designation (when applicable).

4. Basic reference designation of required part (item or symbol number), obtained from parts list.

5. Description and specification of required part, obtained from parts list.

To obtain parts not listed a complete description of the required parts must be included together with the name, type designation, circuit diagram number, etc. of the equipment.

PARTS LIST
Synthesizer

Diagram No. 4047

Symbol	Description	Specification	Type	Manufact.
CR1	Diode	Si	1 N 4007	Philips
CR2	Diode	Si	1 N 4007	Philips
CR3	Diode	Si	1 N 4007	Philips
CR4	Diode	Si	1 N 4007	Philips
DS1	Control lamp	18V 0.1A	E 10	
DS2	Control lamp	18V 0.1A	E 10	
J1	Connector, edge		6P57600 AA16-16	Continental
J2	Connector, edge		6P57610AH16	Continental
J3	Connector, edge		6P57610AH16	Continental
J4	Connector, edge		6P57610AH16	Continental
J5	Connector, edge		6P57610AH16	Continental
J6	Connector, edge		6P57610AH16	Continental
J7	Connector, edge		6P57600 AA16-16	Continental
J8	Connector, varicon		02-016- 113-6-200	Elco
J9	Connector, varicon		02-016- 113-6-200	Elco
J10	Test jack		PB3213-4	Schurter
J11	Connector, varicon		02-016- 113-6-200	Elco
J12	Connector, edge		6P57610AH16	Continental
P1	Test plug		PS3211-4	Schurter
R1	Potentiometer	5kΩ	79PR5k	Beckmann
R2	Potentiometer	2kΩ	79PR2k	Beckmann
R3	Potentiometer	2kΩ	79PR2k	Beckmann
R4	Resistor	2.7kΩ	CR 25	Philips
R5	Resistor	1.2kΩ	CR 25	Philips
R6	Resistor	1kΩ	CR 25	Philips
R7	Resistor	1kΩ	CR 25	Philips
R8	Resistor	1kΩ	CR 25	Philips
R9	Resistor	1kΩ	CR 25	Philips
R10	Resistor	1kΩ	CR 25	Philips
R11	Resistor	1kΩ	CR 25	Philips
R12	Resistor	1kΩ	CR 25	Philips
R13	Resistor	1kΩ	CR 25	Philips
R14	Resistor	1kΩ	CR 25	Philips
R15	Resistor	1kΩ	CR 25	Philips

PARTS LIST
Synthesizer

Diagram No. 4047

Symbol	Description	Specification	Type	Manufact.
R16	Resistor	1kΩ	CR 25	Philips
R17	Resistor	Factory-adjusted	CR 25	Philips
R18	Resistor	Factory-adjusted	CR 25	Philips
R19	Resistor	Factory-adjusted	CR 25	Philips
R20	Resistor	Factory-adjusted	CR 25	Philips
R21	Resistor	470Ω 5% 1/4W	CR 25	Philips
R22	Resistor	470Ω 5% 1/4W	CR 25	Philips
S1	Switch		19934	OAK
S2	Switch		19935	OAK
S3	Switch		19935	OAK
S4	Switch		19935	OAK
S5	Switch		19935	OAK
S6	Switch		19936	OAK
T1	Transformer, oven	220/24V 650 mA	T140-17439	Lübcke
W1 W1P1 W1P2	Coaxial cable assembly	length 140 mm	T.20690	Elektrom.

PARTS LIST
Synthesizer

Reference Designation A1

Diagram No. 4165

Symbol	Description	Specification	Type	Manufact.
C1	Not used			
C2	Capacitor	0.1µF 10% 400V	2222 344 51 104	Philips
C3	Not used			
C4	Capacitor	0.1µF 10% 400V	2222 344 51 104	Philips
C5	Not used			
C6	Capacitor	0.1µF 10% 400V	2222 344 51 104	Philips
C7	Not used			
C8	Capacitor	0.1µF 10% 400V	2222 344 51 104	Philips
C9	Not used			
C10	Capacitor	0.1µF 10% 100V	2222 344 21 104	Philips
C11	Not used			
C12	Capacitor	0.1µF 10% 100V	2222 344 21 104	Philips
C13	Not used			
C14	Capacitor	0.1µF 10% 100V	2222 344 21 104	Philips
C15	Not used			
C16	Capacitor	0.1µF 10% 100V	2222 344 21 104	Philips
C17	Not used			
C18	Capacitor	0.1µF 10% 100V	2222 344 21 104	Philips
C19	Capacitor, electrolytic	470µF 40V	PEG 124 KJ 347	Rifa
C20	Capacitor, tantalum	22µF 15V	0678 901 218	Bosch
C21	Capacitor, tantalum	47µF 35V	CS 13 AF 470 M	Philips
C22	Capacitor, tantalum	22µF 15V	0678 901 218	Bosch
C23	Capacitor, electrolytic	two 220µF 64V	PEG 124 MG 322	Rifa
C24	Capacitor, electrolytic	two 470µF 40V	PEG 124 KJ 347	Rifa
C25	Capacitor, electrolytic	two 1500µF 16V	PEG 124 GJ 415	Rifa
C26	Capacitor, electrolytic	1500µF 16V	PEG 124 GJ 415	Rifa
C27	Not used			
C28	Capacitor	0.1µF 10% 100V	2222 344 21 104	Philips
C29	Capacitor	0.1µF 10% 100V	2222 344 21 104	Philips
CR1	Rectifier, bridge		B 60 C 800 Si	AEG
CR2	Rectifier, bridge		B 60 C 800 Si	AEG
CR3	Rectifier, bridge		B 60 C 800 Si	AEG
CR4	Rectifier, bridge		B 60 C 800 Si	AEG
CR5	Diode		1 N 4007	Philips
CR6	Diode		1 N 4007	Philips
CR7	Diode, zener		ZP 12	ITT
J1	Connector	15-conductor	DA 15 P	McMurdo
L1	Not used			
L2	Not used			

Symbol	Description	Specification	Type	Manufact.
L3	Choke coil	3.3µH 0.9A	58/10/0050/10	Painton
L4	Choke coil	3.3µH 0.9A	58/10/0050/10	Painton
L5	Not used			
L6	Not used			
L7	Not used			
L8	Not used			
L9	Choke coil	3.3µH 0.9A	58/10/0050/10	Painton
L10	Choke coil	3.3µH 0.9A	58/10/0050/10	Painton
L11	Choke coil	3.3µH 0.9A	58/10/0050/10	Painton
L12	Choke coil	3.3µH 0.9A	58/10/0050/10	Painton
L13	Choke coil	3.3µH 0.9A	58/10/0050/10	Painton
P1	PC card-edge contacts			
Q1	Transistor		2 N 5087	Motorola
R1	Resistor	220Ω 5% 0.1W	CR 25	Philips
R2	Resistor	8.2kΩ 5% 0.1W	CR 25	Philips
T1	Transformer		T145-18135	Lübcke

PARTS LIST
Synthesizer   Reference Designation A2   Diagram No. 4166

Symbol	Description	Specification	Type	Manufact.
C1	Not used			
C2	Not used			
C3	Not used			
C4	Not used			
C5	Capacitor, tantalum	6.8µF 35V	0678 901 241	Bosch
C6	Capacitor, tantalum	15µF 20V	0678 901 221	Bosch
C7	Capacitor, tantalum	22µF 15V	0678 901 218	Bosch
C8	Capacitor, tantalum	22µF 15V	0678 901 218	Bosch
C9	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C10	Not used			
C11	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C12	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C13	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C14	Capacitor, tantalum	6.8µF 35V	0678 901 241	Bosch
C15	Capacitor, tantalum	22µF 15V	0678 901 218	Bosch
C16	Capacitor, tantalum	22µF 15V	0678 901 218	Bosch
C17	Capacitor, tantalum	22µF 15V	0678 901 218	Bosch
C18	Capacitor, tantalum	6.8µF 35V	0678 901 241	Bosch
C19	Capacitor, tantalum	6.8µF 35V	0678 901 241	Bosch
CR1	Diode, zener	Si	ZP 6.2	ITT
CR2	Diode, zener	Si	ZP 6.2	ITT
CR3	Diode, zener	Si	ZP 3.3	ITT
CR4	Diode, zener	Si	ZP 3.3	ITT
CR5	Not used			
CR6	Diode	Si	1 N 4007	Philips
CR7	Diode	Si	1 N 4007	Philips
IC 1	Voltage regulator		MC 1461 R	Motorola
IC 2	Transistor array		CA 3018	RCA
IC 3	Transistor array		CA 3018	RCA
P1	PC card-edge contacts			
Q1	Transistor	Si	BC 107 B	Philips
Q2	Transistor	Si	BC 107 B	Philips
Q3	Transistor	Si	BC 107 B	Philips
Q4	Transistor	Si	BC 107 B	Philips
Q5	Transistor	Si	BC 107 B	Philips
Q6	Transistor	Si	BC 107 B	Philips
Q7	Transistor	Si	BC 107 B	Philips
Q8	Transistor	Si	BC 107 B	Philips
Q9	Transistor	Si	BC 107 B	Philips
Q10	Not used			
Q11	Transistor	Si	BC 107 B	Philips
Q12	Transistor	Si	2 N 2102	RCA
Q13	Transistor	Si	2 N 3054	RCA
Q14	Transistor	Si	2 N 3054	RCA
Q15	Transistor	Si	2 N 3054	RCA

PARTS LIST
Synthesizer   Reference Designation A2   Diagram No. 4166

Symbol	Description	Specification	Type	Manufact.
R1	Resistor, wire-wound	4.7Ω 10% 3W	W 21	Welwyn
R2	Resistor, wire-wound	1Ω 10% 3W	W 21	Welwyn
R3	Resistor, wire-wound	0.15Ω 10% 3W	W 21	Welwyn
R4	Resistor, wire-wound	0.47Ω 10% 3W	W 21	Welwyn
R5	Resistor	3.3kΩ 5% 0.1W	CR 25	Philips
R6	Resistor	1kΩ 5% 0.1W	CR 25	Philips
R7	Resistor	180Ω 5% 0.1W	CR 25	Philips
R8	Resistor	180Ω 5% 0.1W	CR 25	Philips
R9	Resistor	6.8kΩ 5% 0.1W	CR 25	Philips
R10	Not used			
R11	Resistor	4.7kΩ 5% 0.1W	CR 25	Philips
R12	Resistor	2.2kΩ 5% 0.1W	CR 25	Philips
R13	Resistor	2.2kΩ 5% 0.1W	CR 25	Philips
R14	Resistor	6.8kΩ 5% 0.1W	CR 25	Philips
R15	Resistor	4.7kΩ 5% 0.1W	CR 25	Philips
R16	Resistor	2.2kΩ 5% 0.1W	CR 25	Philips
R17	Resistor	2.2kΩ 5% 0.1W	CR 25	Philips
R18	Resistor	3.3kΩ 5% 0.1W	CR 25	Philips
R19	Resistor	1kΩ 5% 0.1W	CR 25	Philips
R20	Not used			
R21	Resistor	560Ω 5% 0.1W	CR 25	Philips
R22	Resistor	560Ω 5% 0.1W	CR 25	Philips
R23	Not used			
R24	Not used			
R25	Resistor	Adjusted at	CR 25	Philips
R26	Resistor	the factory	CR 25	Philips
R27	Resistor	1kΩ 5% 0.1W	CR 25	Philips
R28	Resistor	1kΩ 5% 0.1W	CR 25	Philips
R29	Resistor	1.5kΩ 5% 0.1W	CR 25	Philips
R30	Not used			
R31	Resistor	1.5kΩ 5% 0.1W	CR 25	Philips
R32	Resistor	4.7 Ω 5% 1/4W	CR 37	Philips
R33	Resistor	27kΩ 5% 0.1W	CR 25	Philips
R34	Resistor	6.8kΩ 5% 0.1W	CR 25	Philips
R35	Resistor	Adjusted at the factory	CR 25	Philips
R36	Resistor	2.7kΩ 5% 0.1W	CR 25	Philips
R37	Resistor	2.7kΩ 5% 0.1W	CR 25	Philips
R38	Resistor	1.2kΩ 5% 0.1W	CR 25	Philips
R39	Resistor	1.2kΩ 5% 0.1W	CR 25	Philips
R40	Not used			
R41	Resistor	10Ω 5% 0.1W	CR 25	Philips
R42	Resistor	10Ω 5% 0.1W	CR 25	Philips
R43	Resistor	10Ω 5% 0.1W	CR 25	Philips
R44	Resistor	10Ω 5% 0.1W	CR 25	Philips

PARTS LIST
Synthesizer

Reference Designation A3 Diagram No. 4248

Symbol	Description	Specification	Type	Manufact.
C1	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C2	Capacitor	47pF 5% 250V	9/0112,3	Ferroperm
C3	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C4	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C5	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C6	Capacitor, trimmer	6x8 mm 18pF	2222 809 05003	Philips
C7	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C8	Capacitor	560pF 2% 350V	12CDS 0.464"	SRC
C9	Capacitor	22pF 5% 250V	9/0112,3	Ferroperm
C10	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C11	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C12	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C13	Not used			
C14	Capacitor	1nF 20% 40V	9/0129,8	Ferroperm
C15	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C16	Capacitor	1000pF 1%	12CDS-0464	SRC
C17	Capacitor	15µF 10V	0678 901 213	Bosch
C18	Capacitor	22pF 5% 250V	9/0112.3	Ferroperm
C19	Not used			
C20	Not used			
C21	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C22	Not used			
C23	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C24	Capacitor	10µF 64V	PEG 124MA210	Rifa
C25	Capacitor	4.7pF±0.5pF 250V	9/0112,3	Ferroperm
C26	Capacitor	68pF 5% 250V	9/0112,3	Ferroperm
C27	Capacitor	18pF 5% 250V	9/0112,3	Ferroperm
C28	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C29	Capacitor	68pF 5% 250V	9/0112,3	Ferroperm
C30	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C31	Capacitor	18pF 5% 250V	9/0112,3	Ferroperm
C32	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C33	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C34	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C35	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C36	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C37	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C38	Capacitor	1nF 20% 40V	9/0129,8	Ferroperm
CR1	Diode, zener		ZP 6.2	ITT
CR2	Diode, capacity		BB 104 blue	Siemens
CR3	Diode		AAZ 18	Philips
CR4	Diode		B 60 C 800 Si	AEG
CR5	Diode		1 N 4007	Philips

PARTS LIST
Synthesizer

Reference Designation A3 Diagram No. 4248

Symbol	Description	Specification	Type	Manufact.
CR6	Diode,		ZP 9,1	ITT
CR7	Diode		BYX 10	Philips
CR8	Diode		AAZ 18	Philips
CR9	Diode		AAZ 18	Philips
IC 1	Integrated circuit		CA 3018	RCA
IC 2	Decade divider		SN 7490N	Texas Instr.
IC 3	Dual J-K master-slave FF		SN 7473N	Texas Instr.
IC 4	Decade divider		SN 7490N	Texas Instr.
IC 5	Decade divider		SN 7490N	Texas Instr.
IC 6	Decade divider		SN 7490N	Texas Instr.
IC 7	8-input NAND gate		SN 7430N	Texas Instr.
IC 8	Oven control circuit		GEL 300	General El.
IC 9	Transistor array		CA 3018	RCA
IC 10	Transistor array		CA 3018	RCA
J1	BNC connector		UG 290A/U	Kings
L1	R.F. choke	2.2µH 0.395 A	IM 2	Dale
L2	R.F. choke	6.8µH 0.835 A	58/10/0010/10	Painton
L3	Signal shape coil	12µH	T.19333	Elektrom.
L4	R.F. choke	6.8µH 0.835 A	58/10/0010/10	Painton
L5	R.F. choke	6.8µH 0.835 A	58/10/0010/10	Painton
L6	Multiplier coil	500nH	T.19332	Elektrom.
L7	Multiplier coil	500nH	T.19332	Elektrom.
L8	Choke coil	15µH 500 mA	58/10/0012/10	Painton
P1	PC card-edge contacts			
Q1	Transistor	Si NPN	BFY 78	SGS
Q2	Transistor	Si NPN	BFY 78	SGS
Q3	Transistor	Si NPN	BC 107 B	Philips/ITT
Q4	Transistor	Si NPN	2 N 2102	RCA
R1	Resistor	100kΩ 5% 0.1W	CR 25	Philips
R2	Resistor	100kΩ 5% 0.1W	CR 25	Philips
R3	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R4	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R5	Resistor	2.7kΩ 5% 0.1W	CR 25	Philips
R6	Resistor	1.5kΩ 5% 0.1W	CR 25	Philips
R7	Resistor	680Ω 5% 0.1W	CR 25	Philips
R8	Resistor	1kΩ 5% 0.1W	CR 25	Philips
R9	Resistor	220Ω 5% 0.1W	CR 25	Philips
R10	Resistor	10Ω 5% 1/4W	CR 37	Philips
R11	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R12	Resistor	4.7kΩ 5% 0.1W	CR 25	Philips
R13	Resistor	1kΩ 5% 0.1W	CR 25	Philips
R14	Resistor	100kΩ 5% 0.1W	CR 25	Philips
R15	Resistor	2.2kΩ 5% 0.1W	CR 25	Philips
R16	Resistor	47Ω 5% 0.1W	CR 25	Philips
R17	Resistor	2.2kΩ 5% 0.1W	CR 25	Philips

PARTS LIST
Synthesizer

Reference Designation A3 — Diagram No. 4248

Symbol	Description	Specification	Type	Manufact.
R18	Resistor, potentiometer	2.5kΩ±20%	CT 1	Colvern
R19	Resistor	11 kΩ 5% 0.1W	CR 25	Philips
R20	Not used			
R21	Not used			
R22	Resistor, oven heater	70Ω	T.19108	Elektrom.
R23	Resistor	82kΩ 5% 0.1W	CR 25	Philips
R24	Resistor	220Ω 5% 0.1W	CR 25	Philips
R25	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R26	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R27	Resistor	10Ω 5% 0.1W	CR 25	Philips
R28	Resistor	4.7kΩ 5% 0.1W	CR 25	Philips
R29	Resistor	470Ω 5% 0.1W	CR 25	Philips
R30	Resistor	2.7kΩ 5% 0.1W	CR 25	Philips
R31	Resistor	220Ω 5% 0.1W	CR 25	Philips
R32	Resistor	10Ω 5% 0.1W	CR 25	Philips
R33	Resistor	4.7kΩ 5% 0.1W	CR 25	Philips
R34	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R35	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R36	Resistor	1kΩ 5% 0.1W	CR 25	Philips
R37	Resistor	1kΩ 5% 0.1W	CR 25	Philips
R38	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R39	Resistor	4.7kΩ 5% 0.1W	CR 25	Philips
R40	Resistor	330Ω 5% 1/4W	CR 37	Philips
R41	Resistor	10Ω 5%	CR 25	Philips
RT1	NTC resistor	100kΩ 5%	M 15	ITT
Y1	Quartz crystal	7.5 MHz	18941	Philips

PARTS LIST
Synthesizer

Reference Designation A4 — Diagram No. 4249

Symbol	Description	Specification	Type	Manufact.
C1	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C2	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C3	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C4	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C5	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C6	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C7	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C8	Capacitor	270pF 1% 350V	12CDS/0.464"	SRC
C9	Capacitor	27pF 5% 250V	9/0112,3 insul.	Ferroperm
C10	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C11	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C12	Capacitor	39pF 5% 250V	9/0116,3 insul.	Ferroperm
C13	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C14	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C15	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C16	Capacitor	39pF 5% 250V	9/0112,3 insul.	Ferroperm
C17	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C18	Capacitor	82pF 5% 250V	9/0112,3 insul.	Ferroperm
C19	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C20	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C21	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C22	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C23	Capacitor	10µF 64V	PEG 124 MA	Rifa
C24	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C25	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C26	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C27	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C28	Capacitor	1nF 20% 40V	9/0129,8	Ferroperm
C29	Capacitor, trimmer	6x8 mm 18pF	2222 809 05003	Philips
C39	Capacitor	1nF 20% 40V	9/0129,8	Ferroperm
CR1	Diode, variable capacitor		BB 104 blue	Siemens
CR2	Diode, zener		ZP 6.2	ITT
CR3	Diode, zener		ZP 6.2	ITT
CR4	Diode, zener		ZP 6.2	ITT
CR5	Diode, zener		B 60 C 800 Si	AEG
CR6	Diode, silicon		1 N 4007	Philips
CR7	Diode, zener		ZP 9.1	ITT
CR8	Diode, silicon		1 N 4007	Philips
CR9	Diode, germanium		AAZ 15	Philips
CR10	Diode, germanium		AAZ 15	Philips

Symbol	Description	Specification	Type	Manufact.
IC1	Integrated circuit		CA 3018	RCA
IC2	Integrated circuit		CA 3005	RCA
IC3	Not used			
IC4	Integrated circuit		CA 3018	RCA
IC5	Integrated circuit		LM 311 N	NSC
J1	BNC connector		UG 290 A/U	Kings
L1	R.F. choke	68μH 0.2A	58/10/0058/10	Painton
L2	R.F. choke	6.8μH 0.8A	58/10/0052/10	Painton
L3	R.F. choke	6.8μH 0.8A	58/10/0052/10	Painton
L4	R.F. choke	6.8μH 0.8A	58/10/0052/10	Painton
L5	Not used			
L6	R.F. choke	6.8μH 0.8A	58/10/0052/10	Painton
L7	R.F. amplifier coil	0.6μH	T.20050	Elektrom.
L8	R.F. amplifier coil	0.5μH	T.20051	Elektrom.
L9	R.F. choke	6.8μH 0.8A	58/10/0052/10	Painton
L10	R.F. choke	6.8μH 0.8A	58/10/0052/10	Painton
L11	R.F. choke	68μH 0.2A	58/10/0052/10	Painton
L12	R.F. choke	6.8μH 0.8A	58/10/0052/10	Painton
P1	PC card-edge contacts			
Q1	Transistor, silicon		BC 107 B	Philips
Q2	Transistor, silicon		2 N 2102	RCA
R1	Resistor	470Ω 5%	CR 37	Philips
R2	Resistor	27kΩ 5%	CR 25	Philips
R3	Resistor	100kΩ 5%	CR 25	Philips
R4	Resistor	10kΩ 5%	CR 25	Philips
R5	Resistor	10kΩ 5%	CR 25	Philips
R6	Resistor	2.2kΩ 5%	CR 25	Philips
R7	Resistor	1kΩ 5%	CR 25	Philips
R8	Resistor	220Ω 5%	CR 25	Philips
R9	Resistor	1.8kΩ 5%	CR 25	Philips
R10	Resistor	1kΩ 5%	CR 25	Philips
R11	Resistor	1kΩ 5%	CR 25	Philips
R12	Resistor	10kΩ 5%	CR 25	Philips
R13	Resistor	100Ω 5%	CR 25	Philips
R14	Resistor	4.7kΩ 5%	CR 25	Philips
R15	Resistor	4.7kΩ 5%	CR 25	Philips

Symbol	Description	Specification	Type	Manufact.
R16	Resistor	100Ω 5%	CR 25	Philips
R17	Resistor, oven heater	70Ω	T.19108	Elektrom.
R18	Resistor	2.2kΩ 5%	CR 25	Philips
R19	Resistor	11 kΩ 5%	CR 25	Philips
R20	Resistor, potentiometer	2.5kΩ 20%	CT 1	Colvern
R21	Resistor	82kΩ 5%	CR 25	Philips
R22	Resistor	4.7kΩ 5%	CR 25	Philips
R23	Resistor	10kΩ 5%	CR 25	Philips
R24	Resistor	10kΩ 5%	CR 25	Philips
R25	Resistor	1kΩ 5%	CR 25	Philips
R26	Resistor	1kΩ 5%	CR 25	Philips
R27	Resistor	10kΩ 5%	CR 25	Philips
R28	Resistor	4.7kΩ 5%	CR 25	Philips
R29	Resistor	1kΩ 5%	CR 25	Philips
R42	Resistor	10kΩ 5%	CR 25	Philips
R43	Resistor	10kΩ 5%	CR 25	Philips
RT1	Resistor, NTC	100kΩ	M 15	ITT
Y1	Quartz crystal	11199.9 kHz	T.19629	Agatronic

PARTS LIST
Synthesizer — Reference Designation A6 — Diagram No. 4169

Symbol	Description	Specification	Type	Manufact.
C1	Capacitor, tantalum	22µF 15V	0678 901 218	Bosch
C2	Capacitor	23.2nF 1%	IOPF	Fribourg
C3	Capacitor	23.2nF 1%	IOPF	Fribourg
C4	Capacitor	two 23.2nF 1% par.	IOPF	Fribourg
C5	Capacitor	100nF 10% 100V	MKC1862-410/06	ERO
C6	Capacitor	100nF 10% 100V	MKC1862-410/06	ERO
C7	Capacitor	100nF 10% 100V	MKC1862-410/06	ERO
C8	Capacitor	100nF 10% 100V	MKC1862-410/06	ERO
C9	Capacitor	100nF 10% 100V	MKC1862-410/06	ERO
C10	Capacitor, tantalum	15µF 20V	0678 901 221	Bosch
C11	Capacitor, tantalum	22µF 15V	0678 901 218	Bosch
C12	Capacitor, tantalum	22µF 15V	0678 901 218	Bosch
C13	Capacitor, tantalum	22µF 15V	0678 901 218	Bosch
C14	Capacitor, tantalum	6.8µF 35V	0678 901 241	Bosch
C15	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C16	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C17	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C18	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C19	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C20	Not used			
C21	Not used			
C22	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C23	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C24	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C25	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C26	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C27	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C28	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C29	Capacitor, tantalum	47µF 6.3V	0678 901 210	Bosch
C30	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C31	Capacitor, tantalum	6.8µF 35V	0678 901 241	Bosch
C32	Capacitor, tantalum	6.8µF 35V	0678 901 241	Bosch
C33	Capacitor, tantalum	6.8µF 35V	0678 901 241	Bosch
C34	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C35	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C36	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C37	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C38	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C39	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C40	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C41	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C42	Capacitor, tantalum	47µF 6.3V	0678 901 210	Bosch
C43	Capacitor, tantalum	47µF 6.3V	0678 901 210	Bosch
C44	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C45	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C46	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm

PARTS LIST
Synthesizer — Reference Designation A6 — Diagram No. 4169

Symbol	Description	Specification	Type	Manufact.
C47	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C48	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C49	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C50	Capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
CR1	Diode	Si	BAX 13	Philips
CR2	Diode, zener	Si	ZPD 6.2 blue	ITT
CR3	Diode	Si	BAX 13	Philips
CR4	Diode	Si	BAX 13	Philips
CR5	Diode	Si	BAX 13	Philips
CR6	Diode	Si	BAX 13	Philips
CR7	Diode	Si	BAX 13	Philips
CR8	Diode	Si	BAX 13	Philips
CR9	Diode, zener	Si	ZP 9.1	ITT
CR10	Not used			
CR11	Diode, switch	Si	BA 244	ITT
CR12	Diode, switch	Si	BA 244	ITT
CR13	Diode, switch	Si	BA 244	ITT
CR14	Diode, switch	Si	BA 244	ITT
CR15	Diode, capacitance	Si	BB 104	Siemens
CR16	Diode, capacitance	Si	BB 104	Siemens
CR17	Not used			
CR18	Diode, zener	Si	ZPD 6.2 blue	ITT
CR19	Diode	Si	BAX 13	Philips
IC 1	Quadrupœe 2-input NAND gate	TTL	SN 7400 N	Texas Instr.
IC 2	Dual J-K master-slave FF	TTL	SN 7473 N	Texas Instr.
IC 3	Quadruple 2-input NAND gate	TTL	SN 7400 N	Texas Instr.
IC 4	Binary Up/Down counter	TTL	DM 8563 N	Nat. Sem.
IC 5	Binary Up/Down counter	TTL	DM 8563 N	Nat. Sem.
IC 6	Quadruple 2-input NAND gate	TTL	SN 7400 N	Texas Instr.
IC 7	Voltage regulator		MC 1460 G	Motorola
IC 8	Differential amplifier		CA 3005	RCA
J1/J2	BNC connector		UG 290 A/U	Kings
L1	Choke coil	6.8µH	58/10/0010/10	Painton
L2	Choke coil	68µH	58/10/0016/10	Painton

Symbol	Description	Specification	Type	Manufact.
L3	Choke coil	6.8μH ± 10%	IM2	Dale
L4	Tank coil	0.620μH	87-5318/35	Stettner
L5	Choke coil	6.8μH	58/10/0010/10	Painton
L6	Choke coil	6.8μH ± 10%	IM2	Dale
L7	Choke coil	6.8μH ± 10%	IM2	Dale
L8	Choke coil	6.8μH ± 10%	IM2	Dale
L9	Choke coil	6.8μH ± 10%	IM2	Dale
L10	Not used			
L11	Choke coil	6.8μH	58/10/0010/10	Painton
L12	Choke coil	6.8μH	58/10/0010/10	Painton
P1	PC card-edge contacts			
Q1	Transistor	Si, NPN	2 N 5089	Motorola
Q2	Transistor	Si, NPN	2 N 5089	Motorola
Q3	Transistor	Si, NPN	2 N 5089	Motorola
Q4	Transistor	Si, NPN	2 N 5089	Motorola
Q5	Transistor	Si, NPN	2 N 5089	Motorola
Q6	Transistor	Si, PNP	2 N 5087	Motorola
Q7	Transistor	Si, PNP	2 N 5087	Motorola
Q8	Transistor	Si, PNP	2 N 5087	Motorola
Q9	Transistor	Si, PNP	2 N 5087	Motorola
Q10	Not used			
Q11	Transistor	Si, PNP	2 N 5087	Motorola
Q12	Transistor	Si, PNP	2 N 5087	Motorola
Q13	Transistor	Si, PNP	2 N 5087	Motorola
Q14	Transistor	Si, PNP	2 N 5087	Motorola
Q15	Transistor	Si, PNP	2 N 5087	Motorola
Q16	Transistor	Si, PNP	2 N 5087	Motorola
Q17	Transistor	Si, NPN	2 N 5089	Motorola
Q18	Transistor	Si, NPN	2 N 5089	Motorola
Q19	Transistor	Si, NPN	2 N 5089	Motorola
Q20	Not used			
Q21	Transistor	Si, NPN	2 N 5089	Motorola
Q22	Transistor	Si, NPN	2 N 5089	Motorola
Q23	Transistor	Si, NPN	2 N 5089	Motorola
Q24	Transistor, J-FET		BFW 11	Philips
Q25	Transistor	Si, NPN	BFY 78	SGS
Q26	Transistor	Si, PNP	2 N 5087	Motorola
Q27	Transistor	Si, NPN	BC 107 B	Philips
Q28	Transistor	Si, NPN	BC 107 B	Philips
Q29	Transistor	Si, NPN	BC 107 B	Philips
Q30	Not used			

Symbol	Description	Specification	Type	Manufact.
Q31	Transistor	Si, NPN	BC 107 B	Philips
Q32	Transistor	Si, NPN	BC 107 B	Philips
Q33	Transistor	Si, NPN	BC 107 B	Philips
Q34	Transistor	Si, NPN	BC 107 B	Philips
Q35	Transistor	Si, NPN	BC 107 B	Philips
Q36	Transistor	Si, NPN	BFY 78	SGS
Q37	Transistor	Si, NPN	BFY 78	SGS
Q38	Transistor	Si, NPN	BC 107 B	Philips
Q39	Transistor	Si, NPN	BC 107 B	Philips
Q40	Transistor	Si, NPN	BC 107 B	Philips
R1	Resistor, metal film	22kΩ 1% 1/4W	471	Vitrohm
R2	Resistor, metal film	1.2kΩ 1% 1/4W	471	Vitrohm
R3	Resistor, metal film	6.8kΩ 1% 1/4W	471	Vitrohm
R4	Resistor, metal film	560Ω 1% 1/4W	471	Vitrohm
R5	Resistor, metal film	6.8kΩ 1% 1/4W	471	Vitrohm
R6	Resistor, metal film	56kΩ 1% 1/4W	471	Vitrohm
R7	Resistor	13.7kΩ 1% 1/8W	C 5	Elektrosil
R8	Resistor	two 13.7kΩ 1%	C 5	Elektrosil
R9	Resistor	13.7kΩ 1% 1/8W	C 5	Elektrosil
R10	Not used			
R11	Resistor, metal film	22kΩ 1% 1/4W	471	Vitrohm
R12	Resistor, metal film	22kΩ 1% 1/4W	471	Vitrohm
R13	Resistor, metal film	22kΩ 1% 1/4W	471	Vitrohm
R14	Resistor, metal film	22kΩ 1% 1/4W	471	Vitrohm
R15	Resistor, metal film	22kΩ 1% 1/4W	471	Vitrohm
R16	Resistor, metal film	22kΩ 1% 1/4W	471	Vitrohm
R17	Resistor, metal film	2.7kΩ 1% 1/4W	471	Vitrohm
R18	Resistor, metal film	18kΩ 1% 1/4W	471	Vitrohm
R19	Resistor, metal film	5.6kΩ 1% 1/4W	471	Vitrohm
R20	Not used			
R21	Resistor, metal film	5.6kΩ 1% 1/4W	471	Vitrohm
R22	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R23	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R24	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R25	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R26	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R27	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R28	Resistor, metal film	10kΩ 1% 1/4W	471	Vitrohm
R29	Resistor, metal film	2.7kΩ 1% 1/4W	471	Vitrohm
R30	Not used			
R31	Resistor, metal film	33kΩ 1% 1/4W	471	Vitrohm
R32	Resistor, metal film	22kΩ 1% 1/4W	471	Vitrohm

PARTS LIST
Synthesizer — Reference Designation A6 — Diagram No. 4169

Symbol	Description	Specification	Type	Manufact.
R33	Resistor, metal film	10kΩ 1% 1/4W	471	Vitrohm
R34	Resistor, metal film	3.9kΩ 1% 1/4W	471	Vitrohm
R35	Resistor	453kΩ 1% 1/8W	C 5	Elektrosil
R36	Resistor	226kΩ 1% 1/8W	C 5	Elektrosil
R37	Resistor	113kΩ 1% 1/8W	C 5	Elektrosil
R38	Resistor	56kΩ 1% 1/8W	C 5	Elektrosil
R39	Resistor	28kΩ 1% 1/8W	C 5	Elektrosil
R40	Not used			
R41	Resistor	14kΩ 1% 1/8W	C 5	Elektrosil
R42	Resistor, metal film	2.7kΩ 1% 1/4W	471	Vitrohm
R43	Resistor, metal film	10kΩ 1% 1/4W	471	Vitrohm
R44	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R45	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R46	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R47	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R48	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R49	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R50	Resistor	200Ω 5% 0.1W	CR 25	Philips
R51	Resistor, metal film	1kΩ 1% 1/4W	471	Vitrohm
R52	Resistor, metal film	470Ω 1% 1/4W	471	Vitrohm
R53	Resistor, metal film	100kΩ 1% 1/4W	471	Vitrohm
R54	Resistor, metal film	39kΩ 1% 1/4W	471	Vitrohm
R55	Resistor, metal film	4.7kΩ 1% 1/4W	471	Vitrohm
R56	Resistor	220Ω 5% 0.1W	CR 25	Philips
R57	Resistor	5.6kΩ 5% 0.1W	CR 25	Philips
R58	Resistor	1.5kΩ 5% 0.1W	CR 25	Philips
R59	Resistor	120kΩ 5% 0.1W	CR 25	Philips
R60	Not used			
R61	Resistor	Factory-adjusted	CR 25	Philips
R62	Resistor, metal film	6.8kΩ 1% 1/4W	471	Vitrohm
R63	Resistor, metal film	15kΩ 1% 1/4W	471	Vitrohm
R64	Resistor	4.7Ω 5% 0.1W	CR 25	Philips
R65	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R66	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R67	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R68	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R69	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R70	Resistor	27Ω 5% 0.1W	CR 25	Philips
R71	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R72	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R73	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R74	Resistor	1kΩ 5% 0.1W	CR 25	Philips
R75	Resistor	100Ω 5% 0.1W	CR 25	Philips
R76	Resistor	1kΩ 5% 0.1W	CR 25	Philips
R77	Resistor	47Ω 5% 0.1W	CR 25	Philips
R78	Resistor	560Ω 5% 0.1W	CR 25	Philips

Symbol	Description	Specification	Type	Manufact.
R79	Resistor	47Ω 5% 0.1W	CR 25	Philips
R80	Not used			
R81	Resistor	100Ω 5% 0.1W	CR 25	Philips
R82	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R83	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R84	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R85	Resistor	47kΩ 5% 0.1W	CR 25	Philips
R86	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R87	Resistor	470Ω 5% 0.1W	CR 25	Philips
R88	Resistor	10kΩ 5% 0.1W	CR 25	Philips
R89	Resistor	4.7kΩ 5% 0.1W	CR 25	Philips
T1	Transformer, toroid		T.19286	Elektrom.
T2	Transformer, toroid		T.19286	Elektrom.

PARTS LIST
Synthesizer — Reference Designation A7 — Diagram No. 4170

Symbol	Description	Specification	Type	Manufact.
C1	Coupling capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C2	Not used			
C3	Filter capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C4	Filter capacitor	8.2nF 20% 40V	9/0138,8	Ferroperm
C5	Filter capacitor	22µF 15V	0678 901 218	Bosch
C6	Filter capacitor	22µF 15V	0678 901 218	Bosch
CR1	Diode, interfacing	Si	BAX 13	Philips
CR2	Not used			
CR3	Diode, interfacing	Si	BAX 13	Philips
CR4	Diode, interfacing	Si	BAX 13	Philips
CR5	Diode, interfacing	Si	BAX 13	Philips
CR6	Diode, interfacing	Si	BAX 13	Philips
CR7	Diode, interfacing	Si	BAX 13	Philips
CR8 to CR21	Diode, zener	Si	ZF 4.7	ITT
CR22	Diode	Si	BA 244	ITT
IC A1	J-K master-slave Flip-Flop	ECL Logic	MC1013P	Motorola
IC A2	J-K master-slave Flip-Flop	ECL Logic	MC1013P	Motorola
IC A3	J-K master-slave Flip-Flop	ECL Logic	MC1013P	Motorola
IC A4	J-K master-slave Flip-Flop	ECL Logic	MC1013P	Motorola
IC A5	J-K master-slave Flip-Flop	ECL Logic	MC1013P	Motorola
IC A6	J-K master-slave Flip-Flop	ECL Logic	MC1013P	Motorola
IC B1	Dual 4-input OR-NOR gate	ECL Logic	MC1004P	Motorola
IC B2	Dual 4-input OR-NOR gate	ECL Logic	MC1004P	Motorola
IC B3	Dual 4-input OR-NOR gate	ECL Logic	MC1004P	Motorola
IC B4	Dual 4-input OR-NOR gate	ECL Logic	MC1004P	Motorola
IC B5	Dual 4-input OR-NOR gate	ECL Logic	MC1004P	Motorola
IC B6	Dual 4-input OR-NOR gate	ECL Logic	MC1004P	Motorola
IC D1	Dual 4-input NAND gate	HLTTL	SN 74H20N	Texas Instr.
IC D2	Decade with preset capab.	TTL	N 8280A	Signetics
IC E1	8-input NAND gate	TTL	SN 74H30N	Texas Instr.
IC E2	Decade with preset capab.	TTL	N 8280A	Signetics
IC F1	Decade with preset capab.	TTL	N 8280A	Signetics
IC F2	Triple 3-input NAND gate	TTL	SN 7410N	Texas Instr.
IC F3	Quadruple 2-input NAND gate	TTL	SN 7400N	Texas Instr.
IC H1	Decade with preset capab.	TTL	N 8280A	Signetics
IC H2	Quadruple 2-input NAND gate	TTL	SN 7400N	Texas Instr.
IC H3	Quadruple 2-input NAND gate	TTL	SN 7400N	Texas Instr.
J1	BNC connector		UG 290A/U	Kings
L1	Filter coil	6.8µH	58/10/0010/10	Painton
L2	Filter coil	6.8µH	58/10/0010/10	Painton
P1	PC card-edge contacts			

PARTS LIST
Synthesizer — Reference Designation A7 — Diagram No. 4170

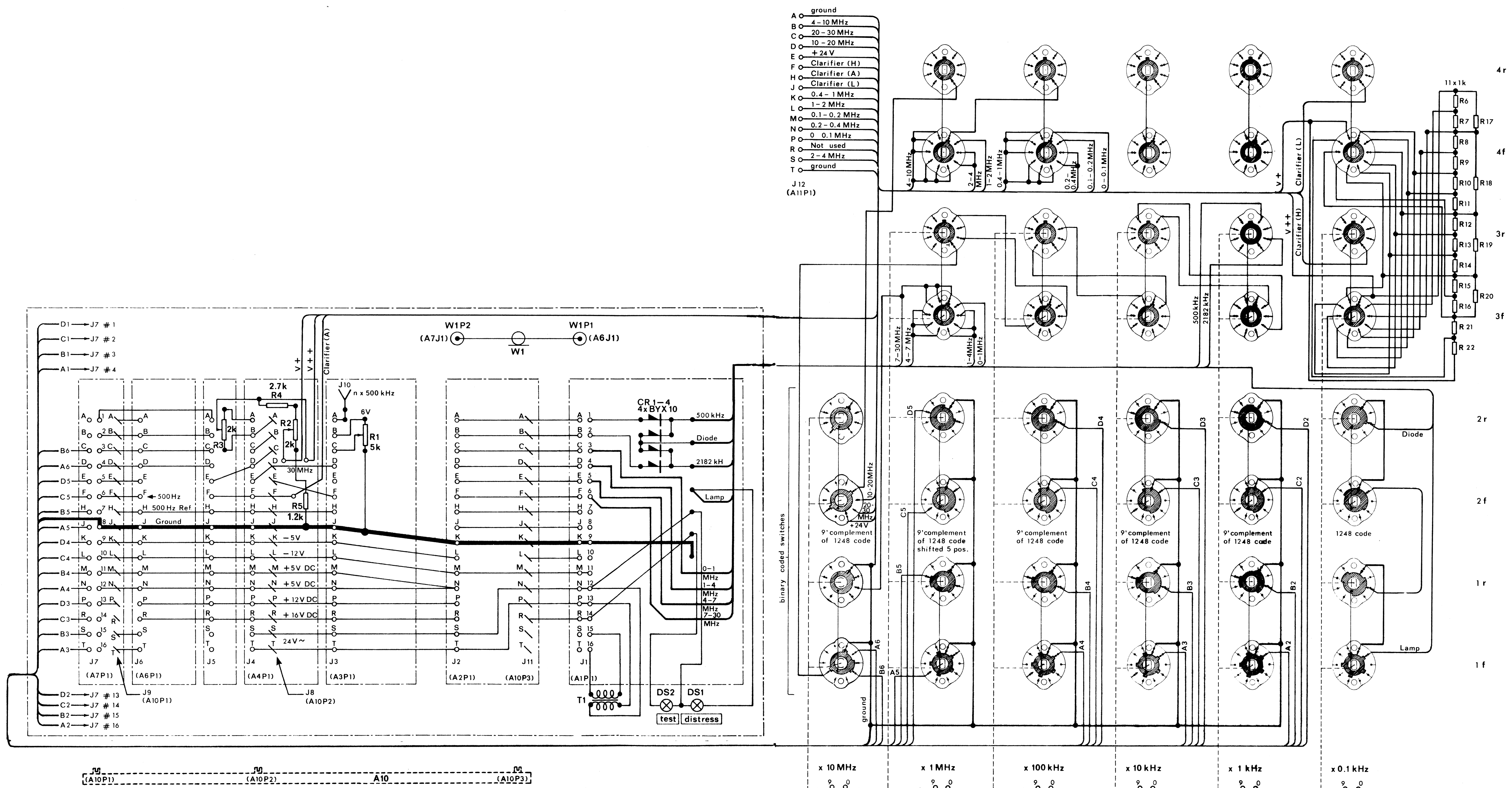
Symbol	Description	Specification	Type	Manufact.
Q1	Transistor, interfacing	Si	BFY78	SGS
Q2	Transistor, interfacing	Si	BFY78	SGS
R1	Resistor	1.5kΩ 5% 0.1W	CR 25	Philips
R2	Resistor	1.8kΩ 5% 0.1W	CR 25	Philips
R3	Resistor	470Ω 5% 0.1W	CR 25	Philips
R4	Resistor	1.8kΩ 5% 0.1W	CR 25	Philips
R5	Resistor	470Ω 5% 0.1W	CR 25	Philips
R6	Resistor	1kΩ 5% 0.1W	CR 25	Philips
R7	Resistor	470Ω 5% 0.1W	CR 25	Philips
R8 to R25	Resistor	4.7kΩ 5% 0.1W	CR 25	Philips
R26	Resistor	470Ω 5% 0.1W	CR 25	Philips
R27	Resistor	470Ω 5% 0.1W	CR 25	Philips

PARTS LIST
Synthesizer   Reference Designation A8   Diagram No. 4188

Symbol	Description	Specification	Type	Manufact.
C1	Capacitor	8.2nF 20% 40V	9/0138,9	Ferroperm
C2	Capacitor	47μF 6V	0678 901 210	Bosch
C3	Capacitor	47μF 6V	0678 901 210	Bosch
CR1	Diode		BAX 13	Philips
CR2	Diode		ZP 2,7	ITT
CR3	Diode		BAX 13	Philips
P1	Plug, varicon cont.		020061115200	Elco
Q1	Transistor		BC 107 B	Philips
Q2	Transistor		BC 107 B	Philips
Q3	Transistor		BC 107 B	Philips
Q4	Transistor		2 N 2102	RCA
R1	Resistor	4.7kΩ 5% 0.1W	CR 25	Philips
R2	Resistor	100kΩ 5% 0.1W	CR 25	Philips
R3	Resistor	100kΩ 5% 0.1W	CR 25	Philips
R4	Resistor	4.7kΩ 5% 0.1W	CR 25	Philips
R5	Resistor	100kΩ 5% 0.1W	CR 25	Philips
R6	Resistor	4.7kΩ 5% 0.1W	CR 25	Philips
R7	Resistor	10Ω 5% 0.1W	CR 25	Philips
R8	Resistor	820Ω 5% 0.1W	CR 25	Philips

PARTS LIST
Synthesizer   Reference Designation A11   Diagram No. 4171

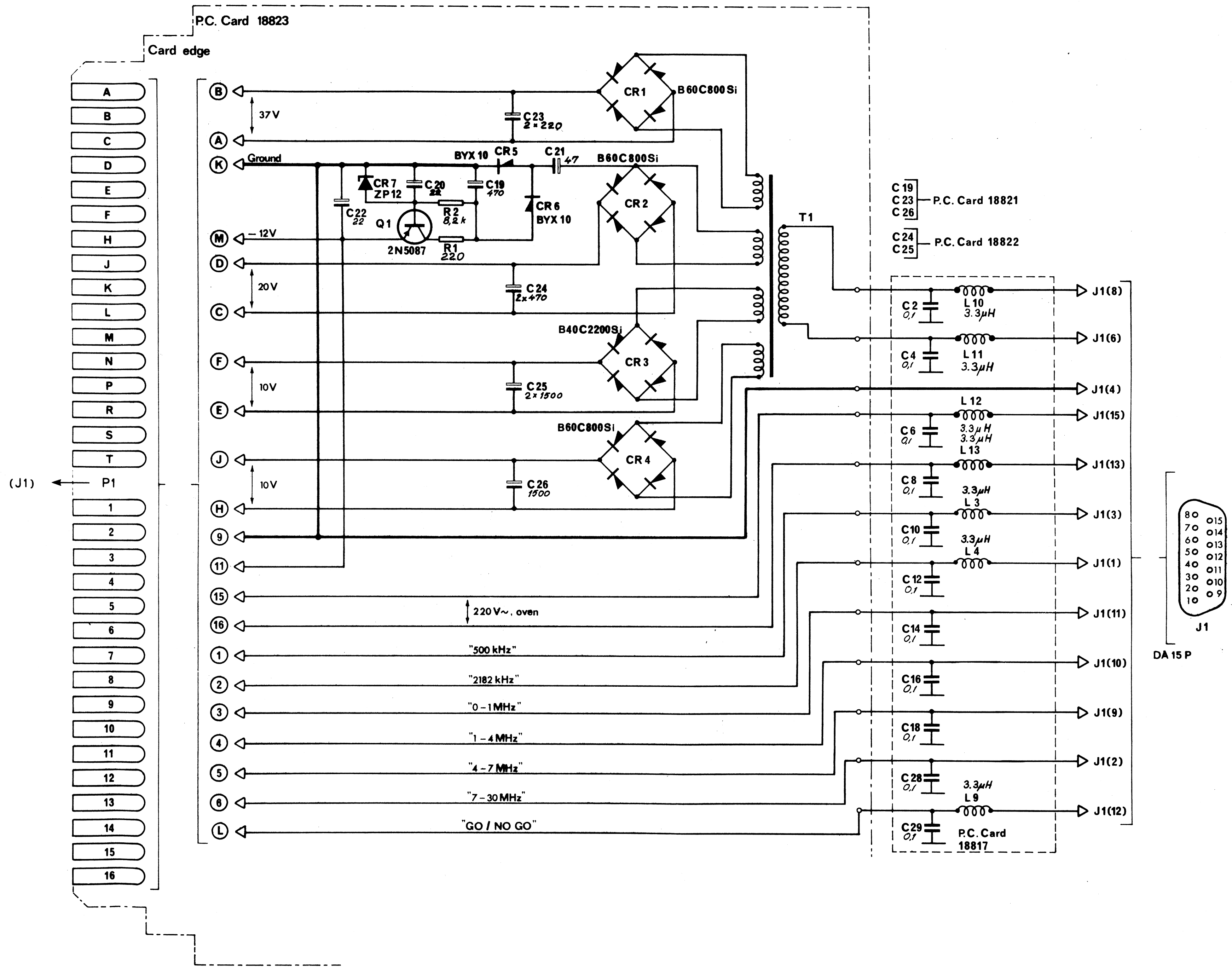
Symbol	Description	Specification	Type	Manufact
C1	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C2	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C3	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C4	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C5	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C6	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C7	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C8	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C9	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C10	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C11	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C12	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C13	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
C14	Capacitor	0.1μF 10% 100V	2222 344 21 104	Philips
J1	Connector, 15-way		DA 15 S	McMurdo
L1	R.F. choke	1mH 0.12A	1583-49	Prahn
L2	R.F. choke	1mH 0.12A	1583-49	Prahn
L3	R.F. choke	1mH 0.12A	1583-49	Prahn
L4	R.F. choke	1mH 0.12A	1583-49	Prahn
L5	R.F. choke	1mH 0.12A	1583-49	Prahn
L6	R.F. choke	1mH 0.12A	1583-49	Prahn
L7	R.F. choke	1mH 0.12A	1583-49	Prahn
L8	R.F. choke	1mH 0.12A	1583-49	Prahn
L9	R.F. choke	1mH 0.12A	1583-49	Prahn
L10	R.F. choke	1mH 0.12A	1583-49	Prahn
L11	R.F. choke	1mH 0.12A	1583-49	Prahn
L12	R.F. choke	1mH 0.12A	1583-49	Prahn
L13	R.F. choke	1mH 0.12A	1583-49	Prahn
L14	R.F. choke	1mH 0.12A	1583-49	Prahn
L15	R.F. choke	1mH 0.12A	1583-49	Prahn



Note 1:
Unless otherwise specified:-
All resistance values are in ohms.
All capacitance values are in microfarads.
All inductance values are in henries.

Note 2:
Partial Reference Designations are shown.
For Complete Designation prefix with Assembly and Subassembly Reference Designations.

Frequency Synthesizer Panel-and-Chassis Assembly



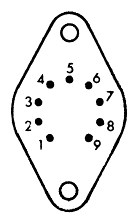
Note 1:
Unless otherwise specified:-
All resistance values are in ohms.
All capacitance values are in microfarads.
All inductance values are in henries.

Note 2:
Partial Reference Designations are shown.
For Complete Designation prefix with Assembly and Subassembly Reference Designations.

Rectifier Circuits

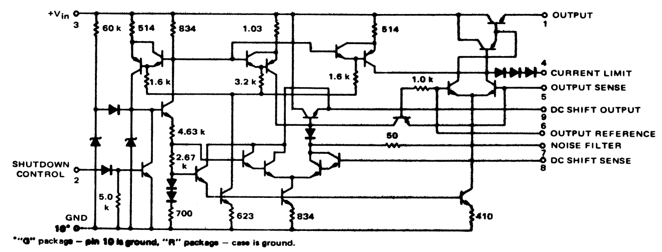
Ref. Designation A1

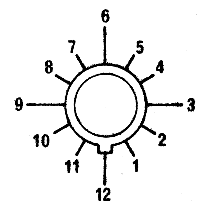
MC1461R



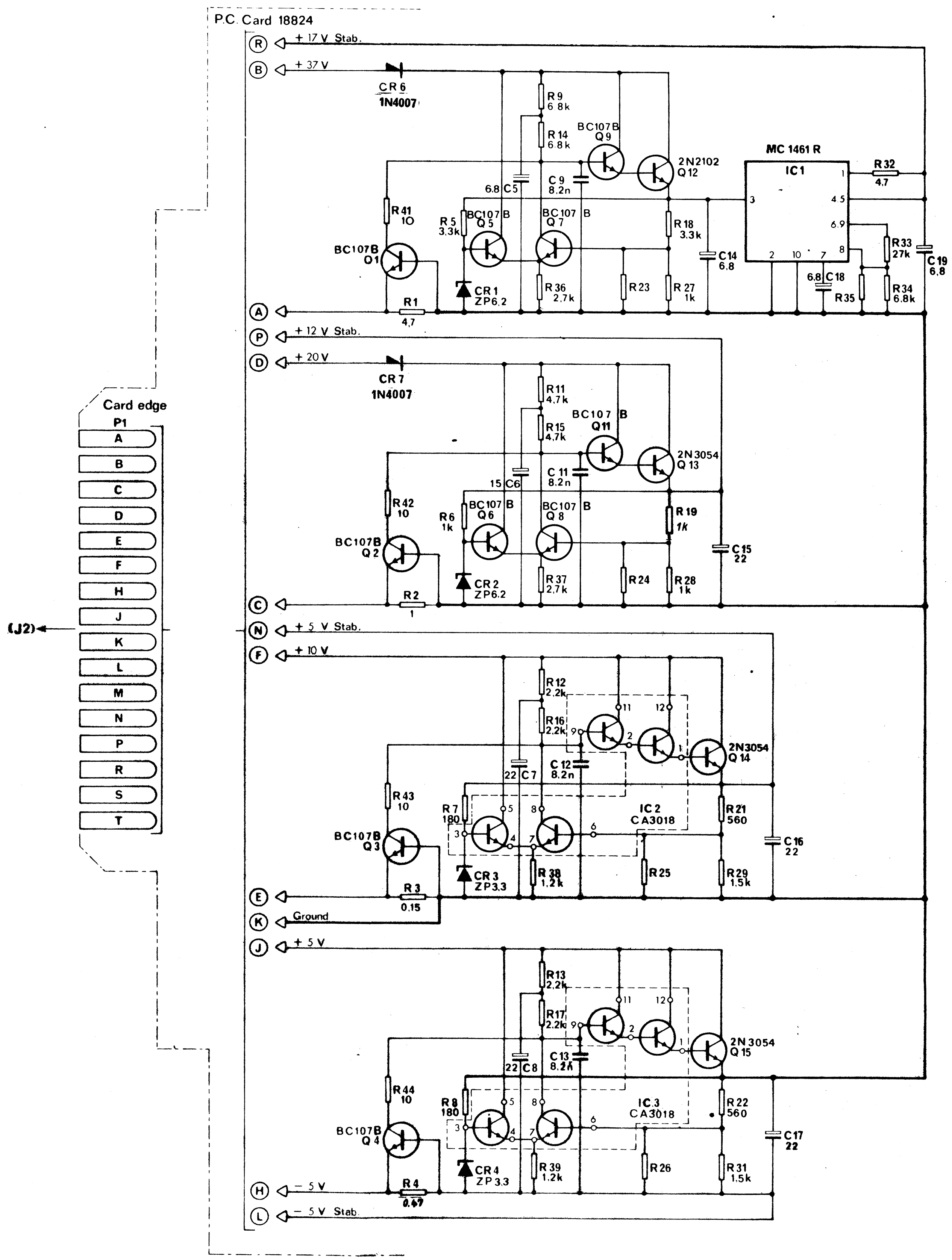
IC1

(Bottom View)





IC2 & IC3



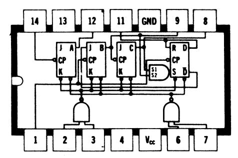
Note 1:
Unless otherwise specified:-
All resistance values are in ohms.
All capacitance values are in microfarads.
All inductance values are in henries.

Note 2:
Partial Reference Designations are shown.
For Complete Designation prefix with Assembly and Subassembly Reference Designations.

Voltage-Regulator Circuits

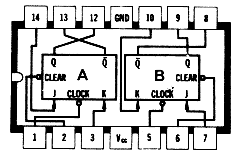
Ref. Designation A2

SN7490N



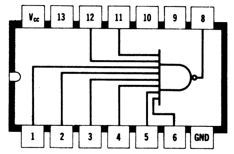
IC2, IC4, IC5 & IC6

SN7473N

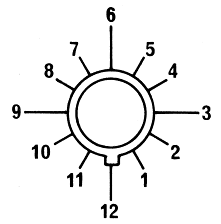


IC3

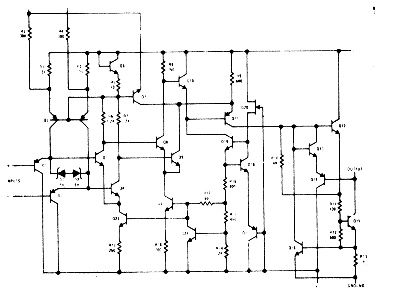
SN7430N



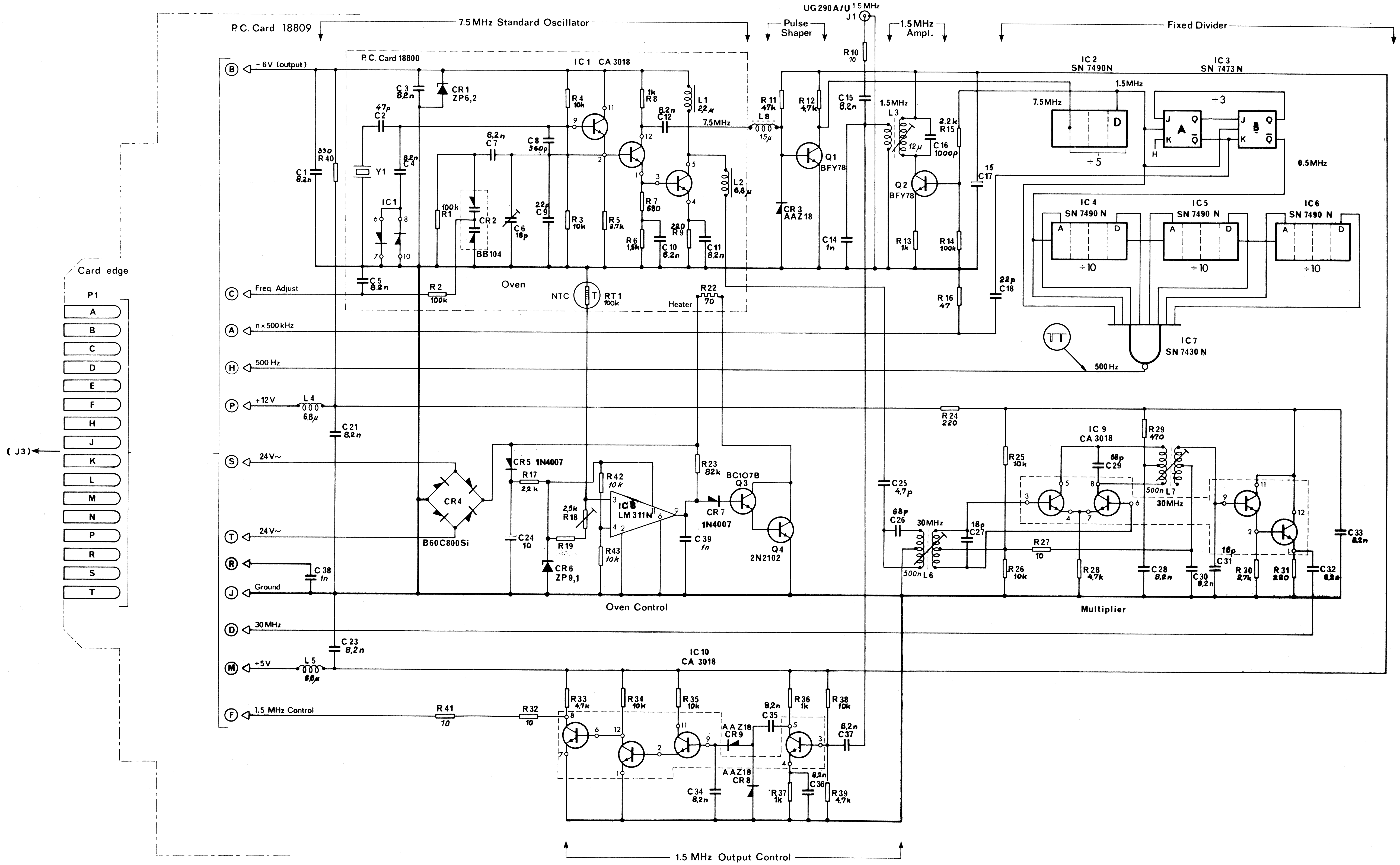
IC7



IC1, IC9 & IC10



IC8



H = +5V
L = 0V

Note 1:
Unless otherwise specified:-
All resistance values are in ohms.
All capacitance values are in microfarads.
All inductance values are in henries.

Note 2:
Partial Reference Designations are shown.
For Complete Designation prefix with Assembly and Subassembly Reference Designations.

Note 3:
Gates, flip-flops, etc. contained in an integrated-circuit package (IC) are identified by ref. designations shown on the individual logic-circuit symbols.

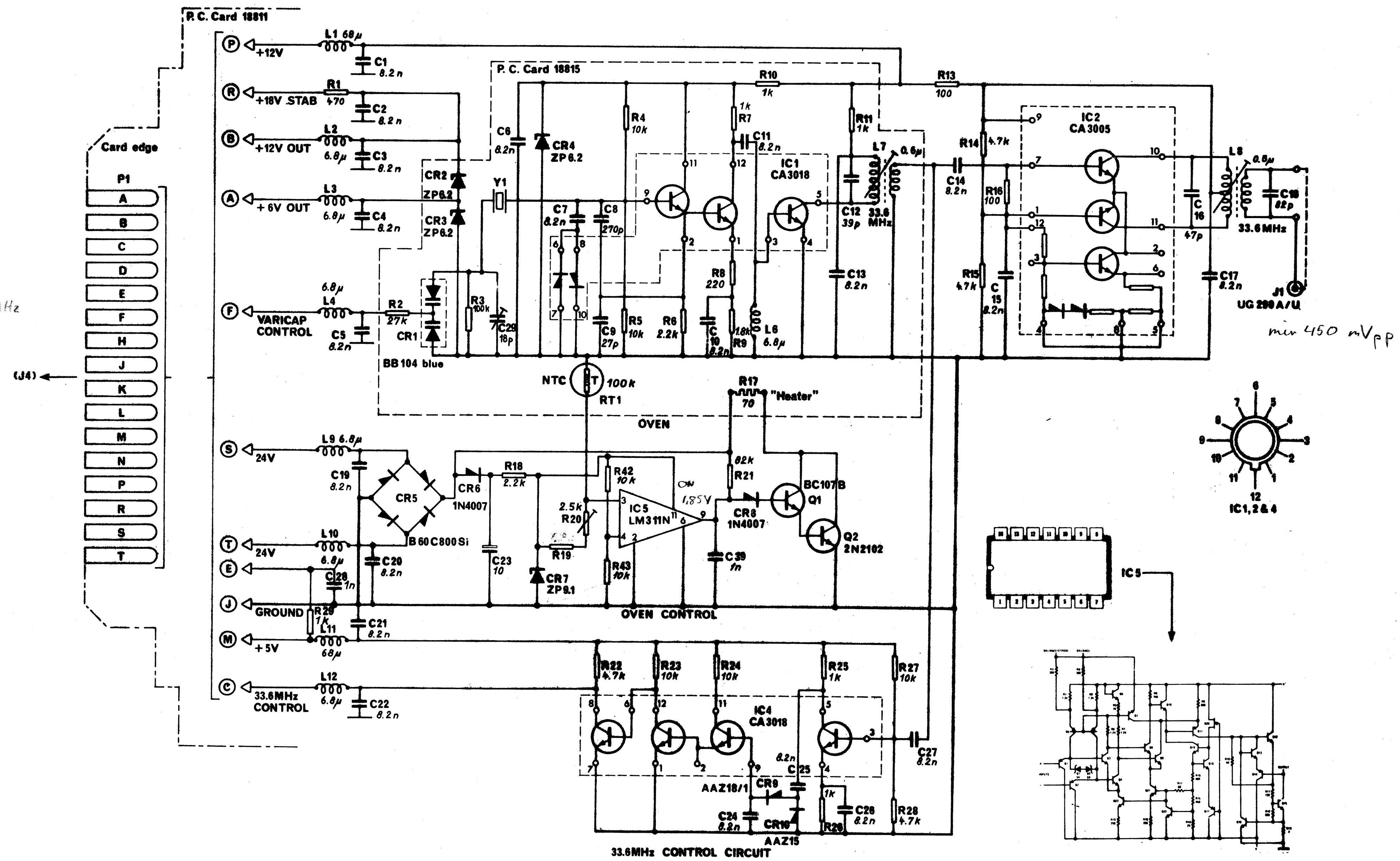
Frequency Standard

Ref. Designation A3

M 1250 SYN Diagr. No. 4248/1974-05

F = sidste ciffer
indstilles på R2 - R3 på
motherboard i stilling 0,1 og 0,9
R2 R3

33,600000 MHz → 36,599100 MHz



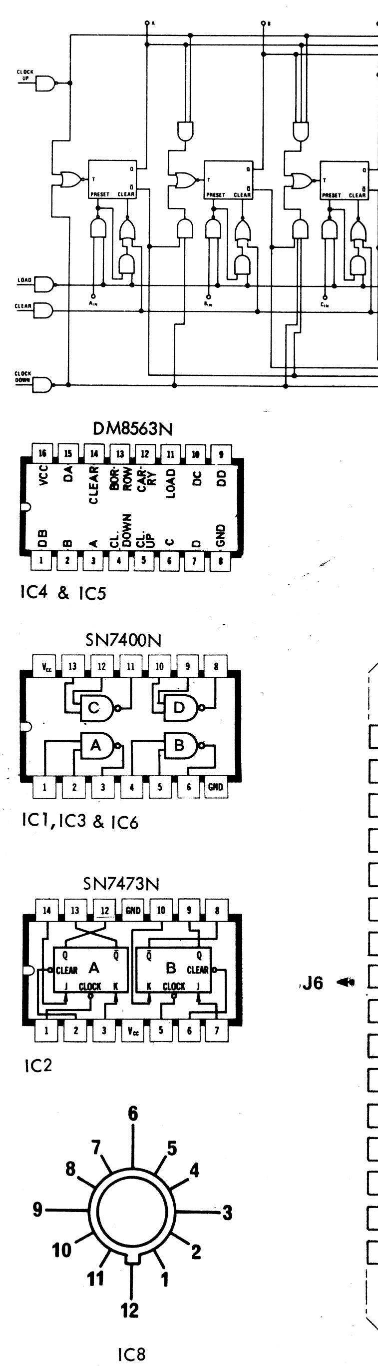
Note 1:
Unless otherwise specified:-
All resistance values are in ohms.
All capacitance values are in microfarads.
All inductance values are in henries.

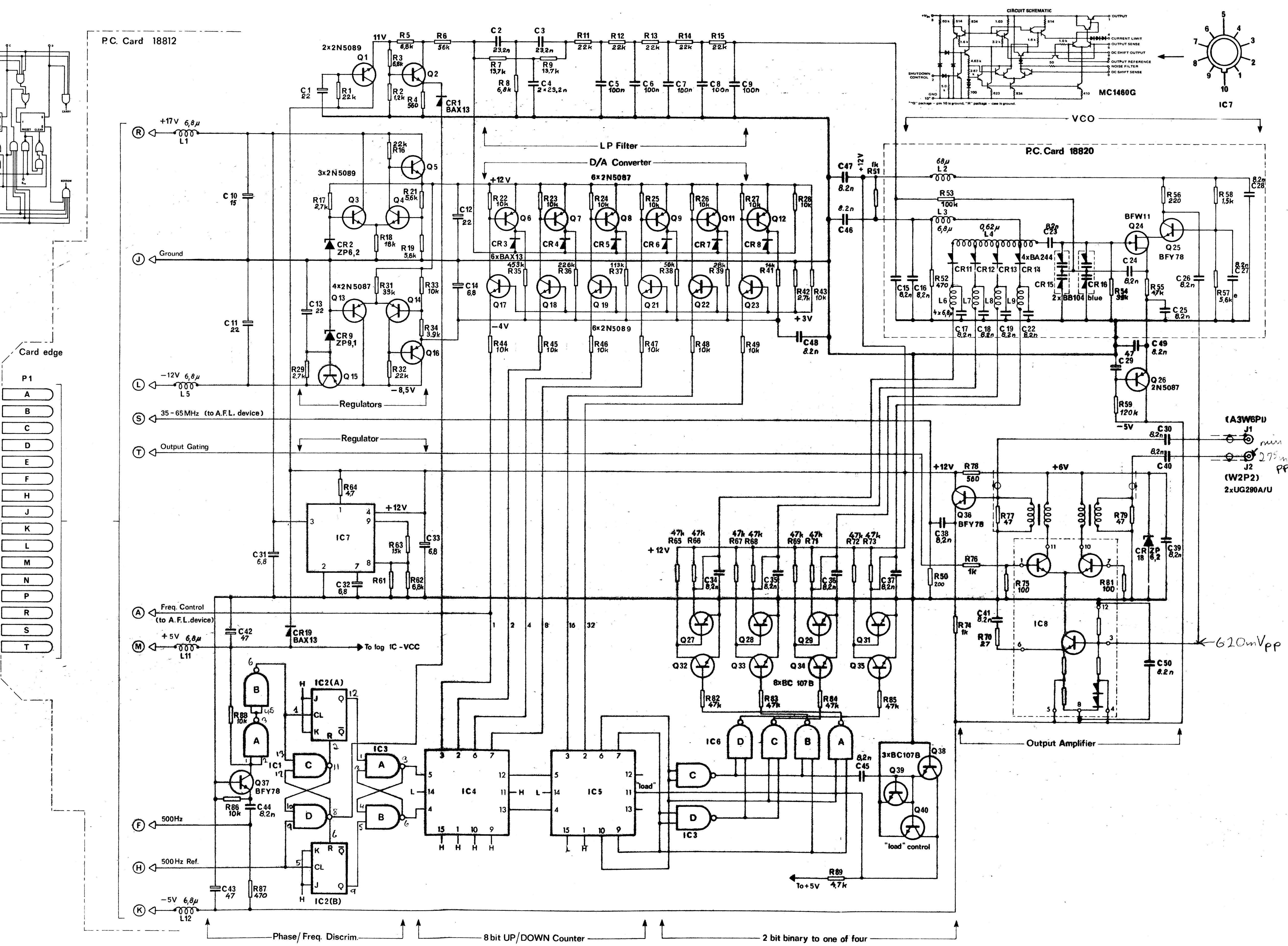
Note 2:
Partial Reference Designations are shown.
For Complete Designation prefix with Assembly and Subassembly Reference Designations,

M 1250 SYN Diagr. No. 4249/1974-05

Voltage-Controlled Crystal Oscillator

Ref. Designation A4





Note 1:
Unless otherwise specified:-
All resistance values are in ohms.
All capacitance values are in microfarads.
All inductance values are in henries

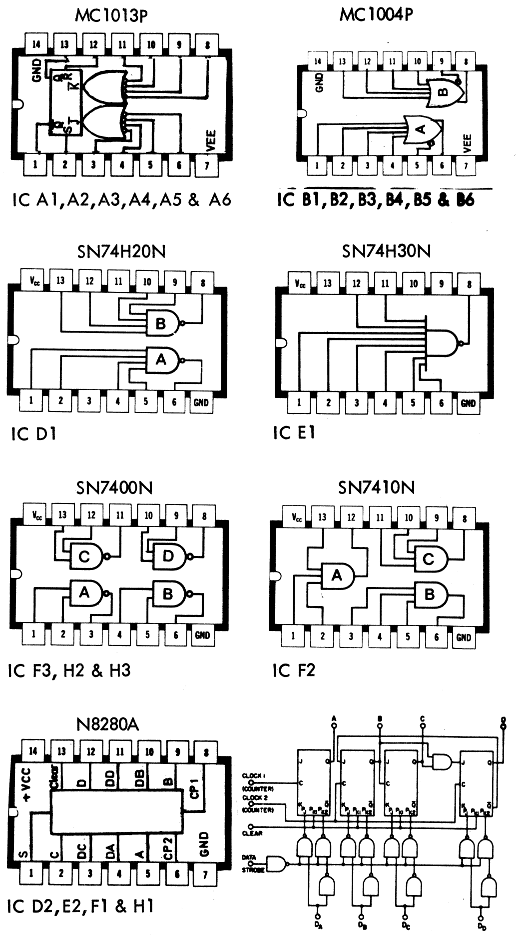
Note 2:
Partial Reference Designations are shown.
For Complete Designation prefix with Assembly and Subassembly Reference Designations.

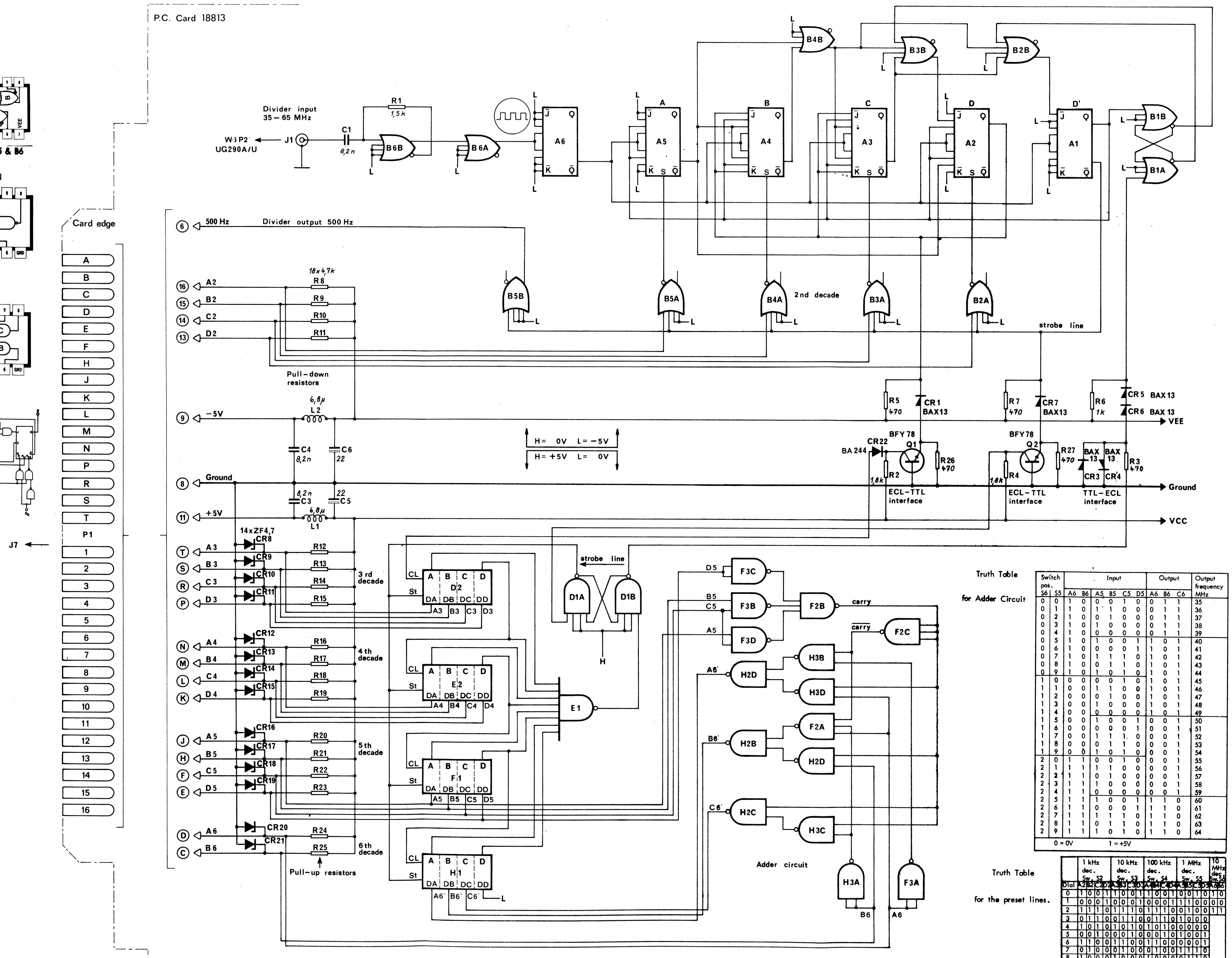
Note 3:
Gates, flip-flops, etc. contained in an integrated-circuit package (IC) are identified by ref. designations shown on the individual logic-circuit symbols.

H = +5V
L = 0V

35.000-64.999 MHz Phase-Locked Loop

Ref. Designation A6





Truth Table for Adder Circuit

Switch pos. S6	Switch pos. S5	Input A6	Input B6	Input A5	Input B5	Input C5	Input D5	Output A6	Output B6	Output C6	Output frequency MHz
0	0	1	0	0	0	1	0	0	1	1	35
0	1	1	0	1	1	0	0	0	1	1	36
0	2	1	0	0	1	0	0	0	1	1	37
0	3	1	0	1	0	0	0	0	1	1	38
0	4	1	0	0	0	0	0	0	1	1	39
0	5	1	0	1	0	0	1	1	0	1	40
0	6	1	0	0	0	0	1	1	0	1	41
0	7	1	0	1	1	1	0	1	0	1	42
0	8	1	0	0	1	1	0	1	0	1	43
0	9	1	0	1	0	1	0	1	0	1	44
1	0	0	0	0	0	1	0	1	0	1	45
1	1	0	0	1	1	0	0	1	0	1	46
1	2	0	0	0	1	0	0	1	0	1	47
1	3	0	0	1	0	0	0	1	0	1	48
1	4	0	0	0	0	0	0	1	0	1	49
1	5	0	0	1	0	0	1	0	0	1	50
1	6	0	0	0	0	0	1	0	0	1	51
1	7	0	0	1	1	1	0	0	0	1	52
1	8	0	0	0	1	1	0	0	0	1	53
1	9	0	0	1	0	1	0	0	0	1	54
2	0	1	1	0	0	1	0	0	0	1	55
2	1	1	1	1	1	0	0	0	0	1	56
2	2	1	1	0	1	0	0	0	0	1	57
2	3	1	1	1	0	0	0	0	0	1	58
2	4	1	1	0	0	0	0	0	0	1	59
2	5	1	1	1	0	0	1	1	1	0	60
2	6	1	1	0	0	0	1	1	1	0	61
2	7	1	1	1	1	1	0	1	1	0	62
2	8	1	1	0	1	1	0	1	1	0	63
2	9	1	1	1	0	1	0	1	1	0	64
0 = 0V				1 = +5V							

Truth Table for the preset lines.

Dial	1 kHz dec. Sw. S2 A2	B2	C2	D2	10 kHz dec. Sw. S3 A3	B3	C3	D3	100 kHz dec. Sw. S4 A4	B4	C4	D4	1 MHz dec. Sw. S5 A5	B5	C5	D5	10 MHz dec. Sw. S6 A6	B6
0	1	0	0	1	1	0	0	1	1	0	0	1	0	0	1	0	1	0
1	0	0	0	1	0	0	0	1	0	0	0	1	1	1	0	0	0	0
2	1	1	1	0	1	1	1	0	1	1	1	0	0	1	0	0	1	1
3	0	1	1	0	0	1	1	0	0	1	1	0	1	0	0	0		
4	1	0	1	0	1	0	1	0	1	0	1	0	0	0	0	0		
5	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	1		
6	1	1	0	0	1	1	0	0	1	1	0	0	0	0	0	1		
7	0	1	0	0	0	1	0	0	0	1	0	0	1	1	1	0		
8	1	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0		
9	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0		
	0 = 0V 1 = [illegible]5V				0 = 0V 1 = 5V													

Note 1:
Unless otherwise specified:-
All resistance values are in ohms.
All capacitance values are in microfarads.
All inductance values are in henries.

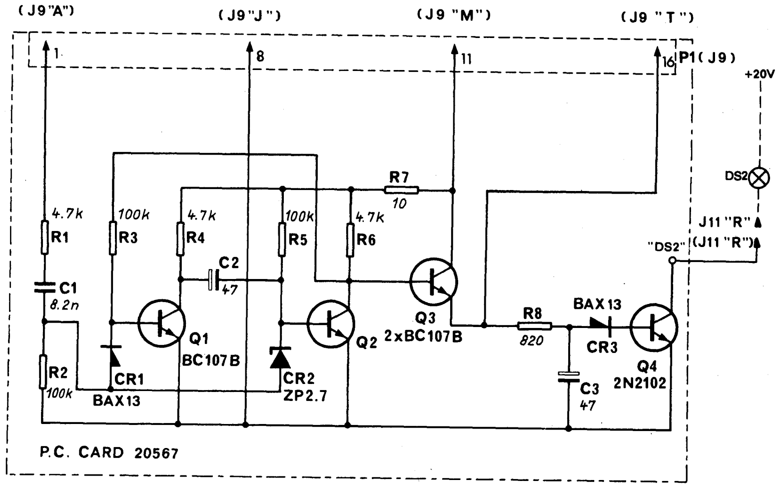
Note 2:
Partial Reference Designations are shown.
For Complete Designation prefix with Assembly and Subassembly Reference Designations.

Note 3:
Gates, flip-flops, etc. contained in an integrated-circuit package (IC) are identified by ref. designations shown on the individual logic-circuit symbols, e.g.
B3A is gate A contained in ICB3.
The first letter and the following number are also used as coordinates to specify the physical location of the IC on the p.c. card.

35.000-64.999 MHz Variable-Ratio Frequency Divider

Ref. Designation [illegible]A7

M 1250 SYN Diagr.No.4170/1974-05



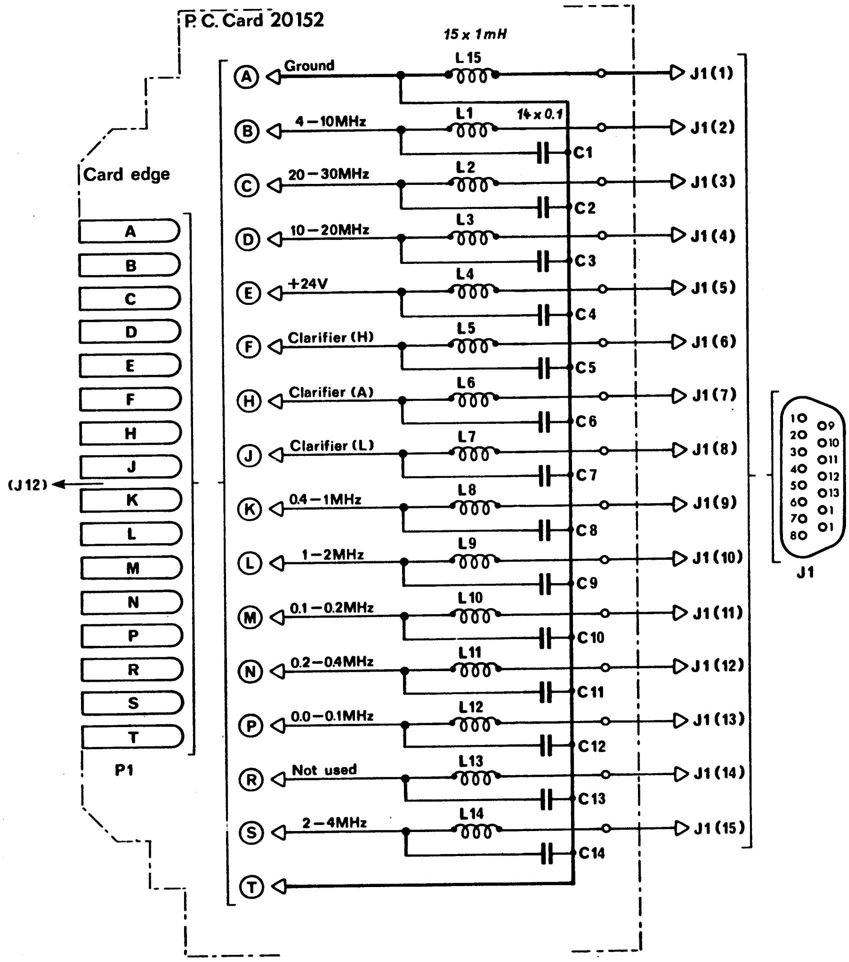
Note 1:
Unless otherwise specified:-
All resistance values are in ohms.
All capacitance values are in microfarads.
All inductance values are in henries.

Note 2:
Partial Reference Designations are shown.
For Complete Designation prefix with Assembly and Subassembly Reference Designations.

Output Gate-Off Circuit

M 1250 SYN Diagr.No.4188/1973-05

Ref. Designation A8

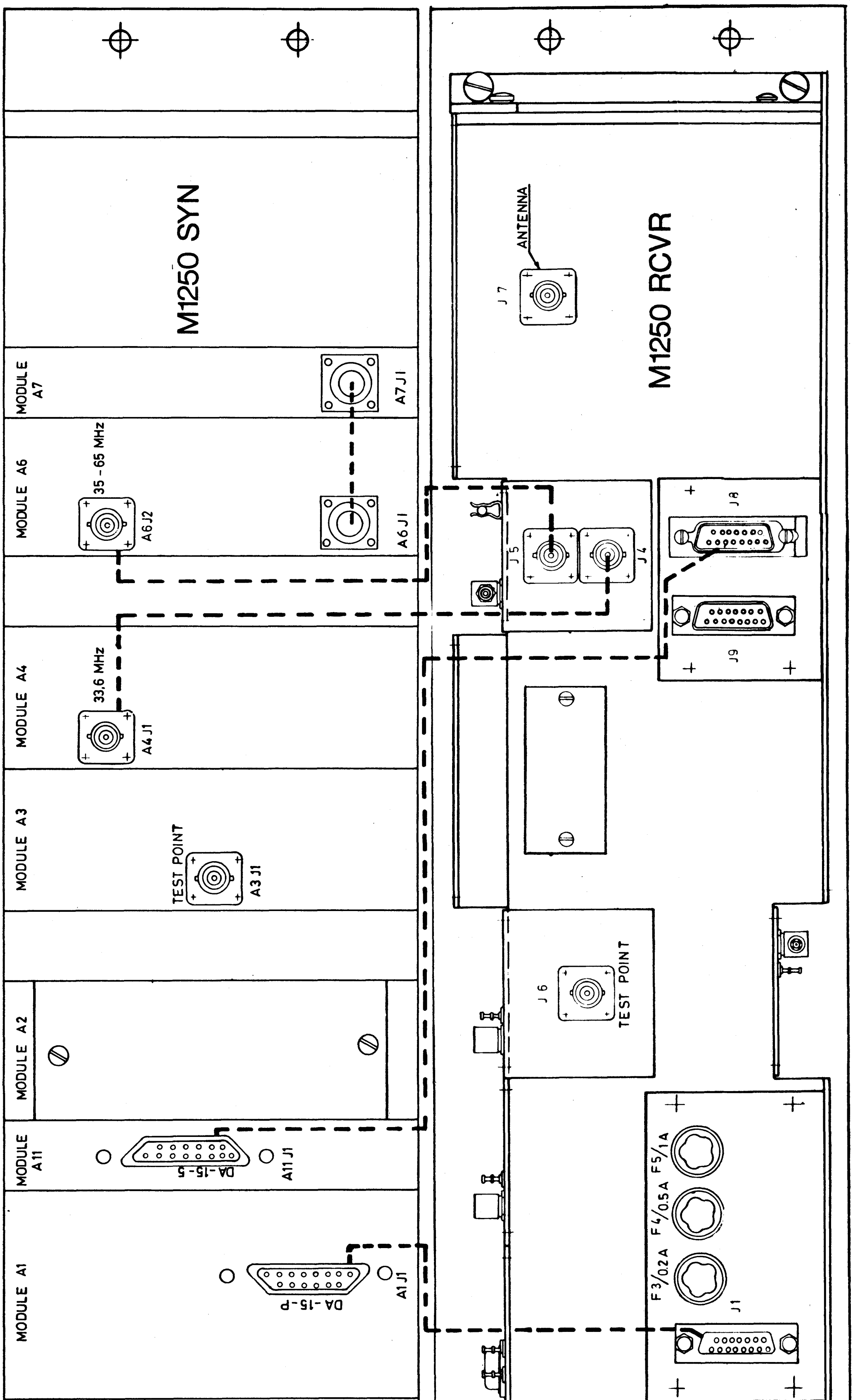


Note 1:
Unless otherwise specified:-
All resistance values are in ohms.
All capacitance values are in microfarads.
All inductance values are in henries.

Note 2:
Partial Reference Designations are shown.
For Complete Designation prefix with Assembly and Subassembly Reference Designations.

Control-Line Filter Circuits

Ref. Designation A11



Synthesizer Unit and Receiver Unit
Rear View

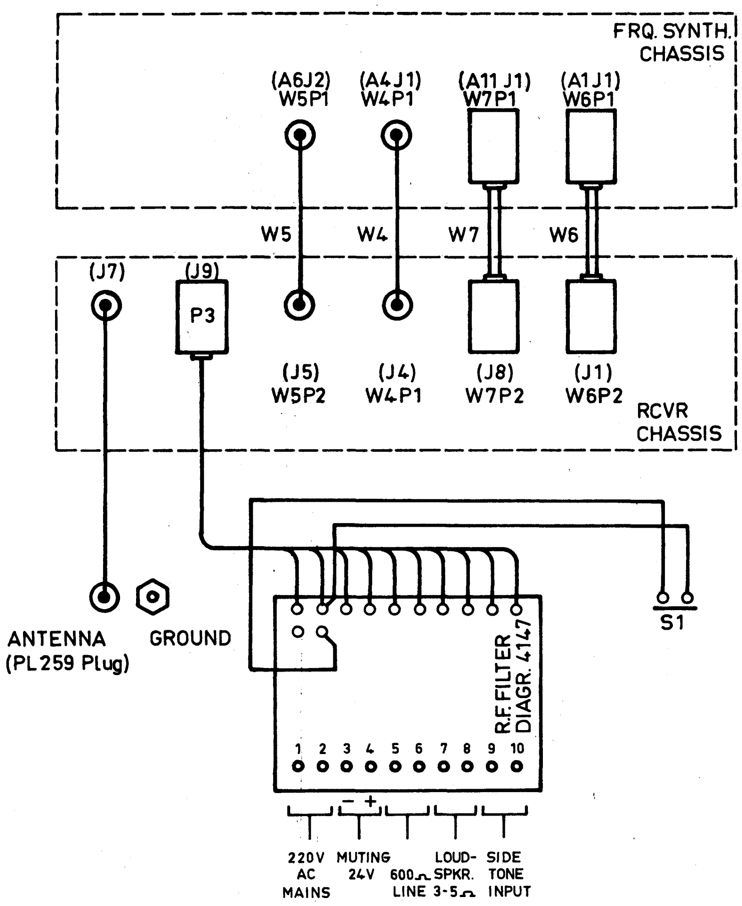
M 1250 RCVR Diagr. No. V-17157/3.71

PARTS LIST

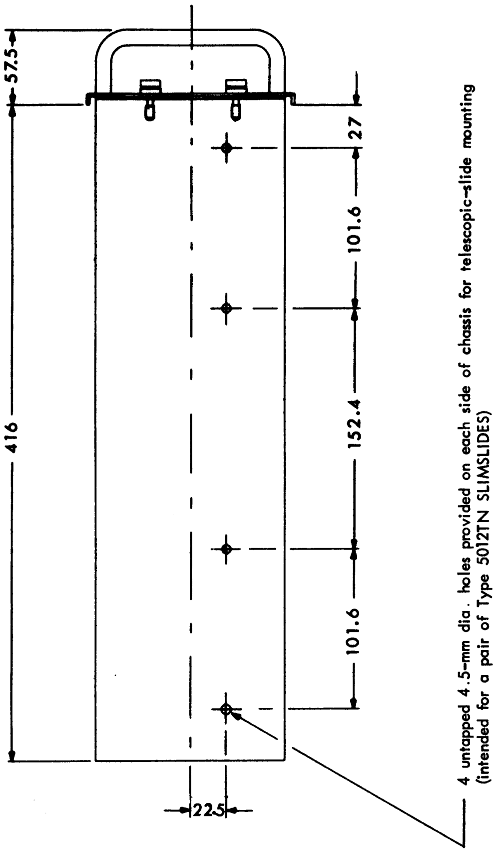
Cabinet Wiring

Diagram No. 4187

Symbol	Description	Specification	Type	Manufact.
S1	Switch, interlocking		DS 3	Burgess
W4	Coaxial cable		T.20226	Elektrom.
W5	Coaxial cable		T.20227	Elektrom.
W6	Multicable		T.20228	Elektrom.
W7	Multicable		T.20229	Elektrom.

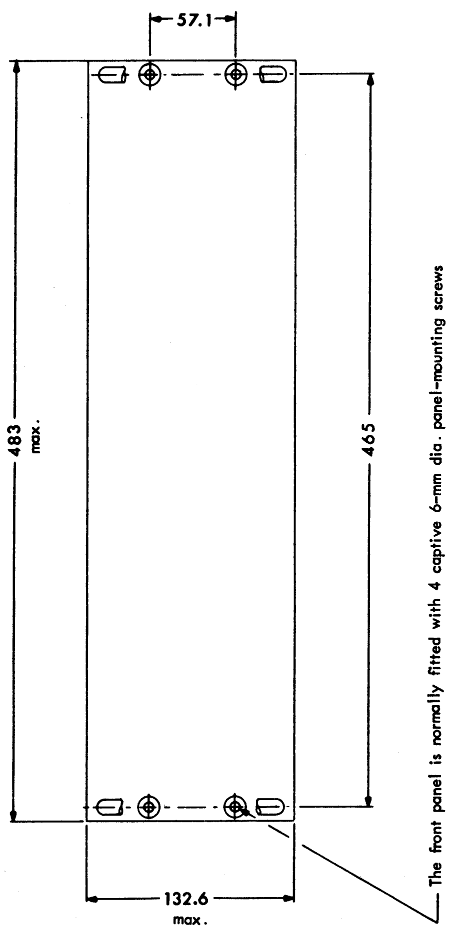


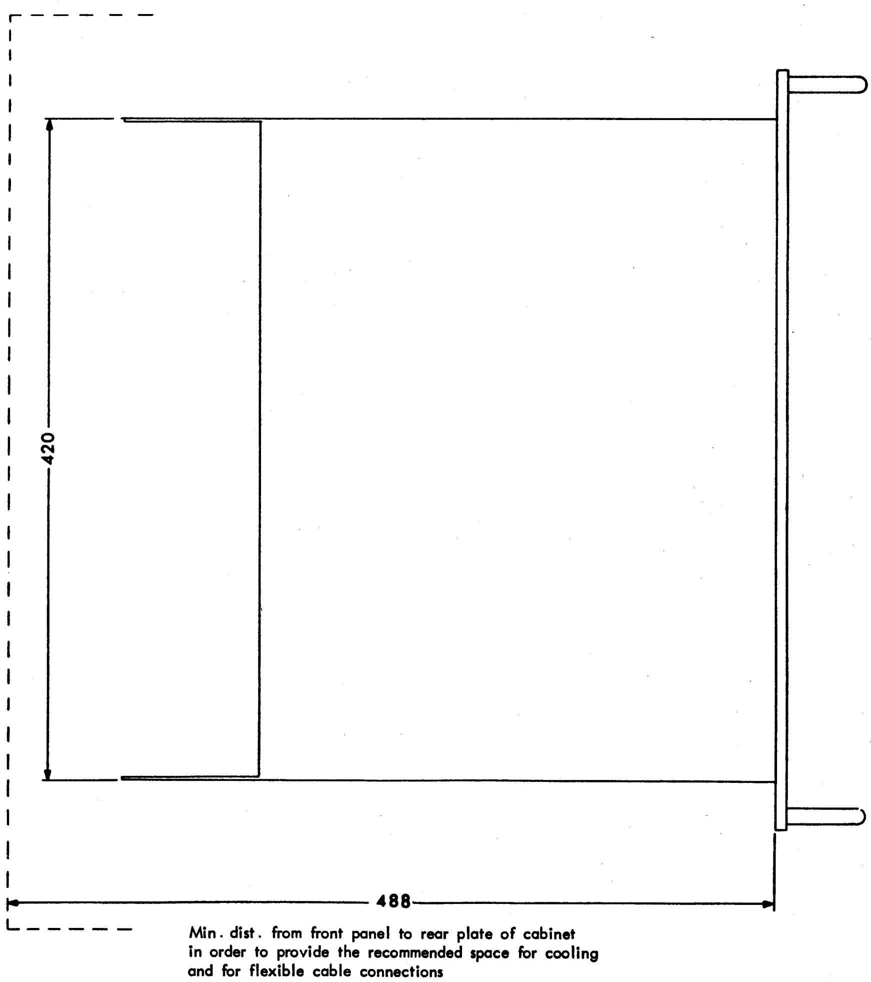
Cabinet Wiring



Notes:

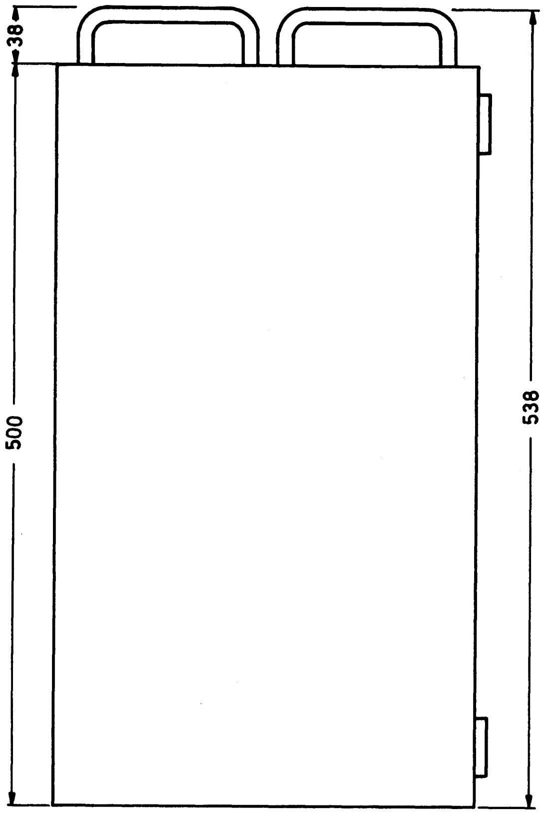
1. All dimensions are in mm
   Not to scale
2. Unless otherwise specified, all dimensions are nominal dimensions
   Nominal tolerance: ± 0.4 mm



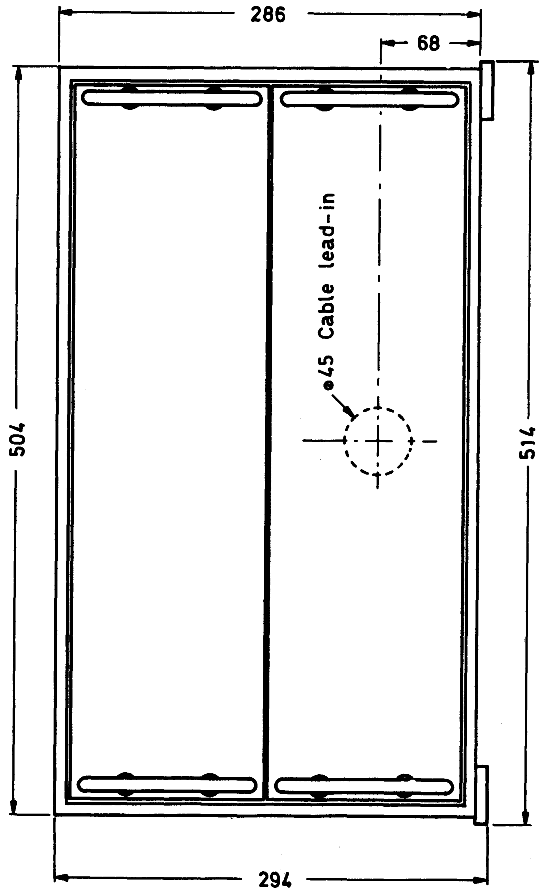


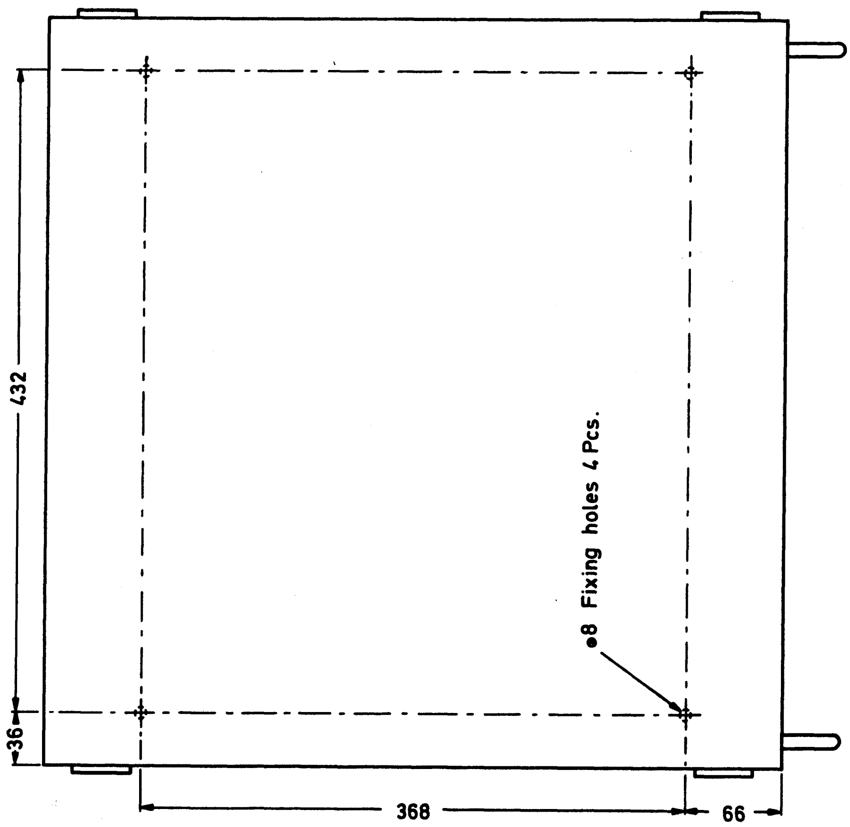
M1250SYN dwg No.20771/8-71

Frequency Synthesizer Panel-and-Chassis Assembly
Outline and Mounting Dimensions



All dimensions are in mm (NTS)





Main Receiver

Outline Dimensions and Method of Mounting

M 1250 DWG NO.20292/4.72