RE 101
Signal Generator

982-791, 7904D

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Section A ____ General Information

A I. INTRODUCTION

The RE101 Signal Generator is primarily intended for measurements on high quality FM and AM broadcast receivers and tuners.

The RE101 generates RF signals for all measurements required for alignment and testing of receivers and tuners.

The RE101 covers the frequency ranges from 0.15 MHz to 30 MHz and from 86 MHz to 130 MHz.

The RE101 can be amplitude and frequency modulated from either internal or external sources with very low modulation distortion, and can be stereo modulated from an external stereo generator, for example the RADIOMETER ELECTRONICS SMG40 Stereo Generator. The combination of the RE101 and the SMG40 has an L/R separation which is better than 60dB.

The RE101 has an internal sweep generator for sweeping the RF frequency. This feature makes it well suited for IF measurements and adjustments. The RF output level is continuously and accurately adjustable within the range 0.1μV to 1V EMF. This in conjunction with low RF leakage permits accurate S/N ratio and sensitivity measurements to be made.

A II. EQUIPMENT and ACCESSORIES

Equipment and Accessories supplied:

CODE NO.	TYPE	DESCRIPTION
390-658	RE101, 220V	Signal Generator
390-659	RE101, 115V	Signal Generator
615-783	220V	Line cord
615-403	110V	Line cord
450-010	220V	Spare fuse
450-113	115V	Spare fuse

Accessories available:

CODE NO.	DESCRIPTION
617-022	Cable for interconnecting the RE101 to the SMG40, length 150 mm Connectors: BNC male to BNC male
800-114	Matching Pad, 75Ω to 60Ω voltage ratio: -6dB
800-115	Matching Pad, 75Ω to 50Ω voltage ratio: -8dB
770-662	Balancing Transformer, 75Ω unbalanced to 300Ω balanced Frequency range: 86 to 130 MHz
884-038	19" Rack mounting kit

A III. SPECIFICATIONS

FREQUENCY CHARACTERISTICS

Effective frequency range:		0.15	to	30 MHz
	and	86	"	130 MHz
Frequency bands:	1.	0.15	"	0.4 MHz
	2.	0.4	"	1.8 MHz
	3.	1.8	"	10 MHz
	4.	10	"	20 MHz
	5.	20	"	30 MHz
	6.	86	"	130 MHz
	7.	10	"	11.5 MHz

Band overlap:	Band 1-2	0.2 MHz
(nominal values)	Band 2-3	0.5 MHz
	Band 3-4	1 MHz
	Band 4-5	1 MHz

Counter resolution:	
86 - 130 MHz:	10 kHz ± 20 ppm ± 1 count
All other bands:	1 kHz ± 20 ppm ± 1 count
Accuracy:	± 20 ppm + 1 count
Stability:	
Frequency drift within 2 hours from initial power on:	Max. 25 kHz/hour typical <± 5 kHz/hour
Long term frequency drift (after 2 hours warm-up time	Max. 2.5 kHz/15 min. typical <± 0.5 kHz/15 min.
Temperature coefficient:	Max. 2.5 kHz/°C typical < 0.5 kHz/°C
Source e.m.f. influence on frequency:	< 100 Hz of the preset carrier frequency for a 10dB change in voltage in the high level end of the attenuator.
Carrier frequency shift caused by ±100 kHz FM:	<1 kHz
Restabilization time after frequency change:	Less than 1 sec. for frequency change within a band.

RF OUTPUT LEVEL CHARACTERISTICS

Source EMF:	0.1µV to 1V RMS
(modulated or unmodulated)	Continuously adjustable by means of a resistive attenuator calibrated from 0.1µV to 1V and from -20dB to +120dB above 1µV Output EMF is automatic stabilized.
Source impedance:	75Ω (50Ω optimal)
Output connector:	BNC

Accuracy of output EMF:	
1 MHz to 30 MHz and 86 MHz to 130 MHz	± 1dB 1µV to 1V ± 3dB 0.1µV to 1µV
0.15 MHz to 1 MHz	$\left\{\begin{matrix}+2\\-1\end{matrix}\right.$ dB 1µV to 1V ± 3 dB 0.1µV to 1µV
Short-term stability error:	< ±0.25dB /15 min.
Long-term stability error:	< ±0.5dB /3 hours
V.S.W.R. as a source:	< 1.2 for EMF ≤ 100 mV < 1.3 for EMF > 100 mV
V.S.W.R. as a load:	< 1.2 for EMF ≤ 100 mV < 1.3 for EMF > 100 mV
Leakage: (output level ≤ 1 mV)	< 1µV EMF in a 2 turn loop 25 mm diameter at a distance of 25 mm from the generator.
Modulation component of the output voltage 30% AM, f-mod. = 1 kHz:	more than 70 dB below carrier
SSB noise 86 - 130 MHz	more than 125 dB below carrier measured in a 1 Hz bandwidth 200 kHz offset from carrier.
SSB noise 0.15 to 30 MHz	more than 100 dB below carrier measured in a 1 Hz bandwidth 10 kHz offset from carrier.
Harmonic content: Non-harmonically related spurious RF:	more than 35 dB below carrier more than 80 dB below carrier

MODULATION CHARACTERISTICS

Modulation modes:	Internal AM, FM and sweep External AM and FM Simultaneously external AM and ±75 kHz FM (internal)

Internal modulation oscillator

Frequency:	400 Hz and 1 kHz ±2%
MOD.SYNC. output level:	Approx. 2.5 V_{RMS} from 680Ω
Distortion:	<0.03%
Frequency stability:	better than 1% during 1 hour
Modulation indication:	Peak reading meter: 0 to 100% AM or 0 to 100 kHz FM controlled from modulation mode switch.

Amplitude modulation

Internal AM (1 kHz or 400 Hz):	0 to 90% adjustable and 30% fixed
External AM:	0 to 90%
Modulation frequency response (3 dB bandwidth):	
30% AM:	40 Hz to 5 kHz (typically 40 Hz to 8 kHz for carrier frequency > 400 kHz 40 Hz to 3 kHz for carrier frequency < 400 kHz (band 1)
80% AM:	40 Hz to 3 kHz for carrier frequency > 400 kHz 40 Hz to 2 kHz for carrier frequency < 400 kHz
EXT.MOD. input:	10 mVp for 1% AM
Input impedance:	10 kΩ
AM distortion (for RF frequency 0.15 to 30 MHz and f-mod. = 1 kHz)	
at 30% AM:	<0.3%
at 80% AM:	<1%

AM distortion (for RF frequency 86 to 130 MHz and f-mod. = 1 kHz)	
at 30% AM:	<0.5%
at 80% AM:	<2 %
Modulation indicator:	0 to 100%
Accuracy:	±5% of preset value
Residual AM: (RMS value)	<0.01% measured in a 5 kHz bandwidth
Incidental AM: ($\triangle$ f : ± 100 kHz. $f_{mod.}$ = 1 kHz)	<0.2%
Amplitude modulation stability:	<0.1% /15 min.
" " "	<0.3% /3 hours
(80% AM, f.mod. = 1 kHz)	

Frequency Modulation

Internal FM: (1 kHz or 400 Hz)	0 to ±100 kHz adjustable and ± 75 kHz fixed
External FM:	0 to ± 100 kHz calibrated
	0 to ± 1 MHz uncalibrated
Modulation frequency response:	DC to ±100 kHz within 1% L/R separation 60 dB
EXT.MOD. input:	10 mVp for ± 1 kHz deviation
Input impedance:	10 kΩ
FM distortion at ±100 kHz deviation:	<0.05% 86 - 110 MHz and 10 - 11.5 MHz <0.03% 90 - 100 MHz
Typical FM distortion at ±75 kHz deviation: (1 kHz or 400 Hz)	0.02% at 98 MHz

Modulation indicator:	0 to ± 100 kHz
Accuracy: (Carrier frequency 86 - 110 MHz)	±10% of preset value
Signal to noise ratio: (Bandwidth 15 kHz, RMS value)	better than 76 dB relative to ± 75 kHz deviation
Incidental FM for 30% AM:	better than 62 dB rel. to ± 75 kHz dev.
" " for 80% AM: (f. mod. = 1 kHz or 400 Hz)	better than 48 dB rel. to ± 75 kHz dev.
Carrier frequency shift: (due to FM)	<1 kHz
Frequency deviation stability: (Δf = 100 kHz, $f_{mod.}$ = 1 kHz)	<0.1% /15 min. <0.3% /3 hours

FREQUENCY SWEEP

Internal (controlled from modulation mode switch)

a. Carrier frequency range:	0.15 to 30 MHz (band 1, 2, 3, 4 and 5)
Sweep width:	± 10 kHz
Sweep repetition frequency:	5 Hz (triangular)
Accuracy of sweep width:	± 15%
Linearity of sweep:	1%
Carrier frequency shift: (caused by ±10 kHz sweep)	< 2 kHz
b. Carrier frequency range:	86 to 130 MHz and 10 to 11.5 MHz (band 6 and 7)
Sweep width:	±0.5 MHz
Sweep repetition frequency:	50 Hz (triangular)
Accuracy of sweep width:	±15%
Linearity of sweep:	1%
Carrier frequency shift: (caused by ± 0.5 MHz sweep)	<10 kHz

SWEEP OUT

Output level:	±5 Vp
Output impedance:	<1Ω (max. load 5mA)
Sweep marker:	Bright spot appears on oscilloscope at the moment when the carrier frequency is equal to the displayed frequency.

POWER REQUIREMENTS

Line voltage:	115 Vac (95-130 Vac) or 220 Vac (190-260 Vac)
Line frequency:	47.5-63 Hz
Consumption:	18 VA

ENVIRONMENTAL REQUIREMENTS

Operating ambient temperature:	+5°C to +40°C
Storage temperature:	-40°C to +70°C
Relative humidity:	20 to 80%

DIMENSIONS AND WEIGHT

W x H x D:	300 x 100 x 250 mm
Weight :	6 kg

Section B ____ Installation and Operation

B1. PRELIMINARY INSTRUCTIONS

INITIAL INSPECTION

When unpacking the instrument, the accessories and the packing material should be visually inspected for physical damage. If the instrument is damaged, notify the carrier and your local Radiometer Electronic representative or the factory. The packing material should be retained for inspection by the carrier in the case of complaint.

ELECTRICAL INSTALLATION

The RE101 Signal Generator will operate on either 115Vac or 220Vac line supplies. The required line voltage is selected by a slide switch on the rear panel.

CAUTION: To prevent damage to the instrument check that the line voltage selector is set to the correct line voltage and that the line fuse has the correct value.

To change the line voltage, remove the locking-plate by unscrewing the two securing screws. Switch the slide switch to the required line voltage and replace the locking-plate. When changing the line voltage the line supply fuse must also be changed. The correct fuse values are printed beside the fuse holder.

In accordance with international safety standards, the RE101 is supplied with a 3-wire line cord which, when connected to an appropriate ac power outlet, grounds the instrument cabinet. If the RE101 is to be connected to an ac power outlet without a ground connection, the ground jack ⏚ on the rear panel can be used to ground the instrument.

ENVIRONMENTAL REQUIREMENTS

The RE101 will comply with the specifications given where the operating environment is within the following limitations:

Ambient temperature : between +5°C and +40°C

Relative humidity : between 20% and 80%

The RE101 should be stored in an environment with a temperature between -40°C and +70°C, and a relative humidity of less than 80%.

BII. DESCRIPTION OF FRONT AND REAR PANEL

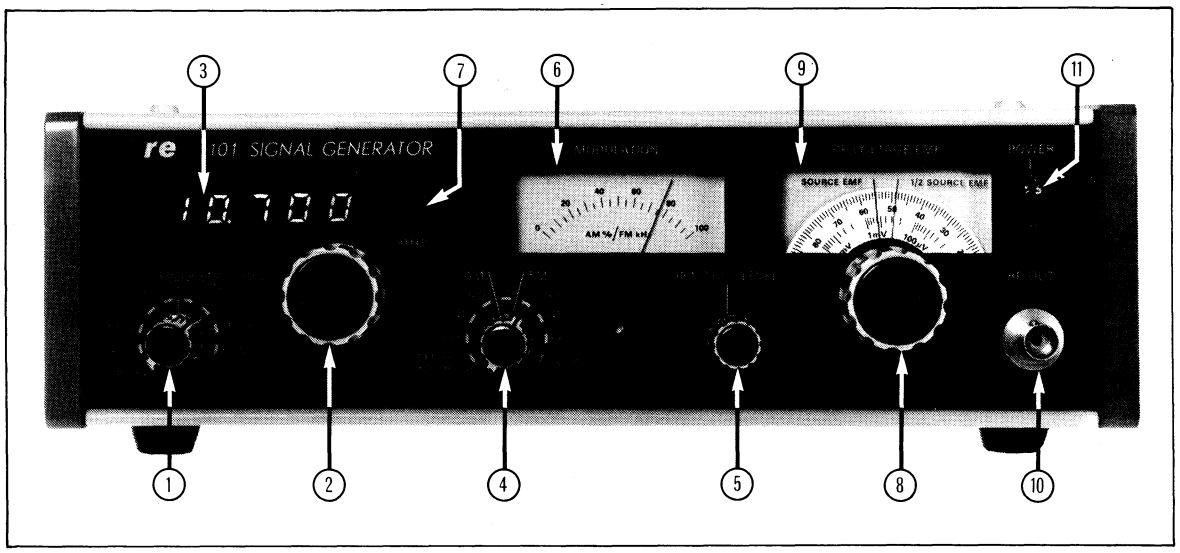


Fig. B1. Front Panel controls

(1) Frequency Range switch.

Ranges:		
	0.15	- 0.4
	0.4	- 1.8
	1.8	- 10
	10	- 20
	20	- 30
	86	- 130
	10	- 11.5
	RF OFF	RF signal OFF
	REMOTE	RF frequency controlled via terminals on rear panel

(2) Frequency setting.

(3) Frequency display (MHz). Displays the RF output frequency selected by (1) and (2).

(4) Modulation mode switch.

CW : unmodulated carrier

AM 30% : internal AM 30%

in this position the meter (6) indicates AM %

AM INT	: internal AM 0 to 90%, adjusted by (5)	in these positions
AM EXT:	: external AM 0 to 90%	the meter (6)
EXT AM and ±75 kHz FM:	external AM 0 to 90% and internal FM ±75 kHz	indicates AM %
FM ±75 kHz:	internal FM ±75 kHz	in these positions
FM INT	: internal FM 0 to ±100 kHz	the meter (6)
FM EXT	: external FM	indicates FM dev. kHz
SWEEP	: internal sweep. Sweep width (displayed (7)) and sweep frequency are controlled by (1).	

(5) INT.MOD.LEVEL. Sets the AM and FM modulation depth.

(6) MODULATION indicator. The meter indicates the AM in % or the FM dev. in kHz.

(7) SWEEP. Indicates the sweep width when (4) is in position SWEEP. The sweep width depends upon the Frequency Range setting (1) as follows:

±10 kHz within the range 0.15 MHz to 30 MHz;
±0.5 MHz within the ranges 10-11.5 MHz and 86-130 MHz.

(8) RF VOLTAGE EMF. Sets the RF output voltage at (10). Continuously adjustable from 0.1μV to 1V and from -20 dB to +120 dB above 1μV.

(9) RF VOLTAGE EMF. Scale indicating the source EMF set by (8), and 1/2 source EMF equivalent to the voltage across a matched load.

(10) RF OUT. RF output connector. The output level is adjusted by (8).

(11) POWER ON/OFF switch.

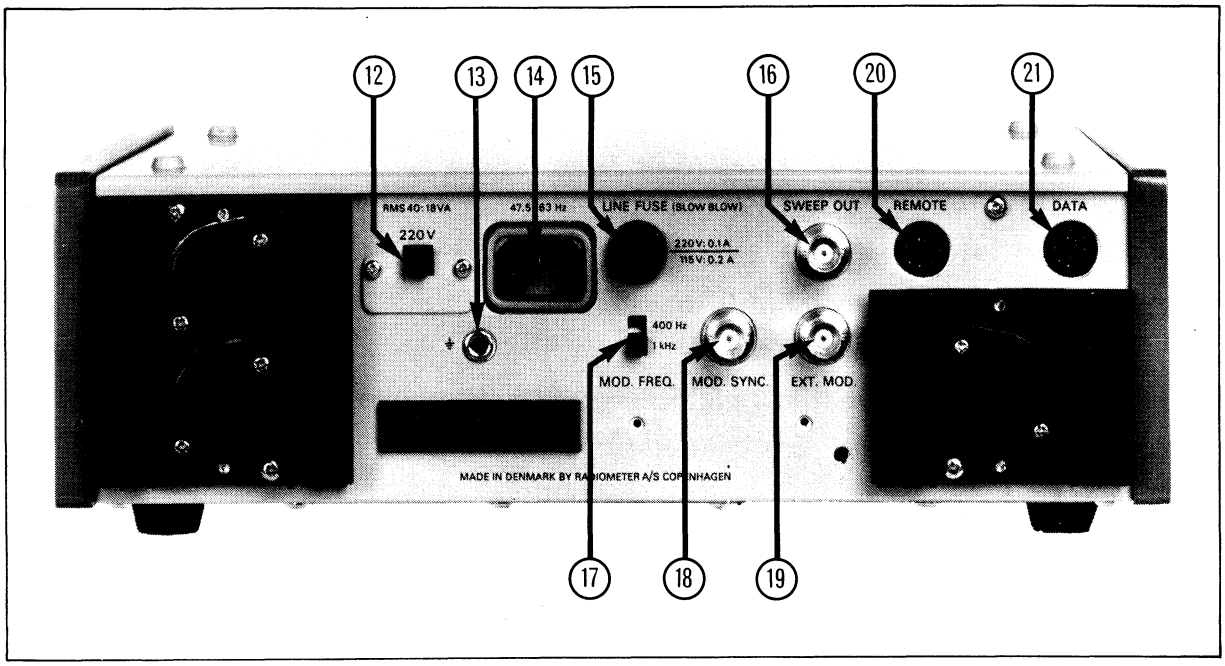


Fig. B2. Rear Panel

(12) Line voltage selector.

(13) Ground jack ⏚. This jack is used to ground the instrument if it is not grounded via the power cord.

(14) Line cord receptacle.

(15) Line supply fuse.

(16) SWEEP OUT. Sweep ramp output.
Level ±5 Vp, output impedance <1Ω (max. load 5 mA).

(17) MOD.FREQ. Selector for internal modulation frequency, 400 Hz or 1 kHz.

(18) MOD.SYNC. Synchronizing signal from the internal modulation oscillator.
Level approximately 2.5 V_{RMS}, Ri 680Ω.

(19) EXT.MOD. BNC-connector for external AM or FM modulation (FM is DC-coupled).
Input 10 mVp for ±1 kHz deviation. Input impedance 10 kΩ.

(20) REMOTE. Analog signal input for remote frequency control.

(21) DATA. Digital input/output for remote frequency control.

} For further information see B III Remote & Data connector specification

B III. OPERATING INSTRUCTIONS

INTRODUCTION

This section provides instructions for connecting the RE101 to a receiver, and special operating instructions concerning Frequency Sweep and Stereo Modulation of the RE101, and describes the REMOTE and DATA connector specifications.

For information concerning the general operating instructions, please refer to Section B II DESCRIPTION OF FRONT AND REAR PANEL.

OPERATING INSTRUCTIONS

Connecting the RE101 to a receiver

The RF level of the signal generator is calibrated in terms of EMF, i.e. the open circuit voltage on the RF OUT connector of the RE101 or 1/2 EMF, the equivalent of this voltage across a matched load. The source impedance of the signal generator is 75Ω.

When connecting the RE101 to the antenna connector of receivers with other impedances than 75Ω, a suitable impedance matching device is required.

A 75Ω unbalanced to 300Ω balanced transformer (770-662) for use within the frequency range 86 to 130 MHz is available from Radiometer Electronics.

When using this transformer the output EMF from the Signal Generator is stepped up by a factor two.

When testing AM receivers a suitable dummy antenna may be used.

Frequency sweep

A convenient method for testing and adjusting receivers is the use of a frequency sweep.

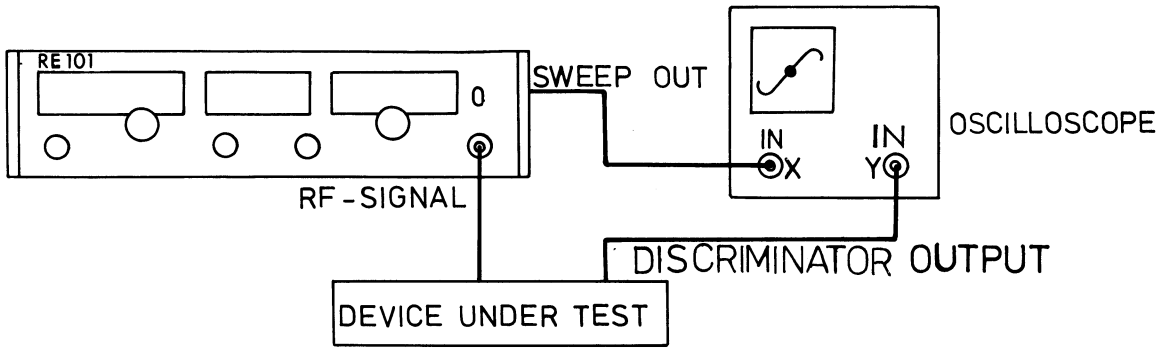


Fig. B3. shows a typical setup for frequency sweep.

The Sweep Out signal, which has a value of 10 V pp, is applied to the horizontal input connector of the osciloscope. The sensitivity of the oscilloscope should be set to 1 V per devision to obtain a full scale deflection on the horizontal axis (10 divisions). If one of the bands 86 to 130 MHz or 10 to 11.5 MHz (appropriate for testing FM-receivers) are chosen the sweep width is ±0.5 MHz, and the horizontal scale calibration is 100 kHz per division. If one of the bands 0.15 to 30 MHz (appropriate for testing AM-receivers) are chosen, the sweep width is ± 10 kHz and the horizontal scale calibration is 2 kHz per division.

A "bright spor" always appears at the position on the displayed curve, where the RF-frequency is equal to the value displayed on the build-in frequency counter. The "bright spot" may also be used for accurate alignment of the oscilloscope's horizontal position. Normally the spot will be placed at the centre of the screen, see Fig. B4.

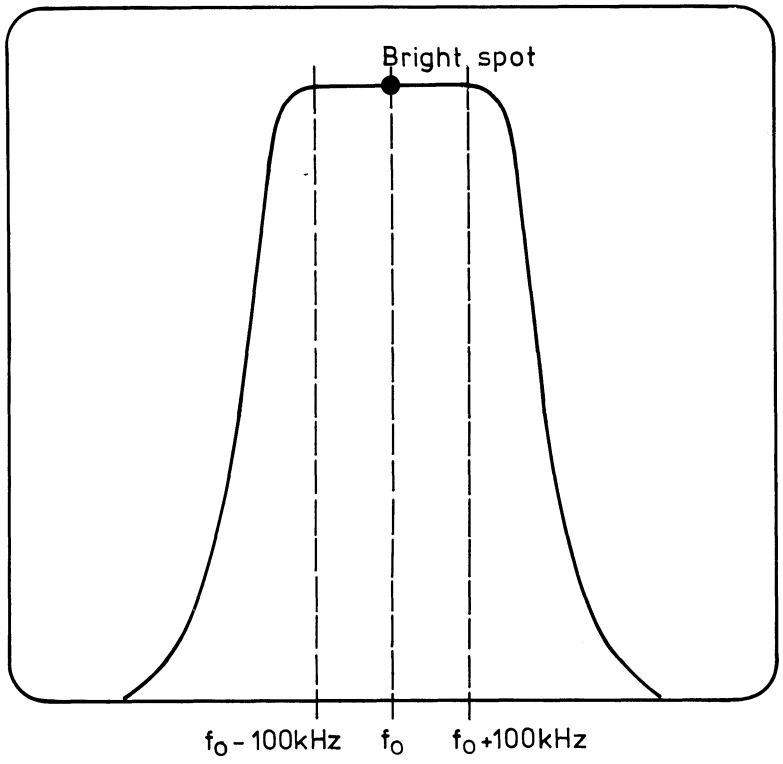


Fig. B4. IF-sweep.

The marker appears as a bright spot if the Output to the oscilloscope's vertical amplifier is taken after the envelope deflection. Otherwise it appears as a bright line. See Fig. B5 below

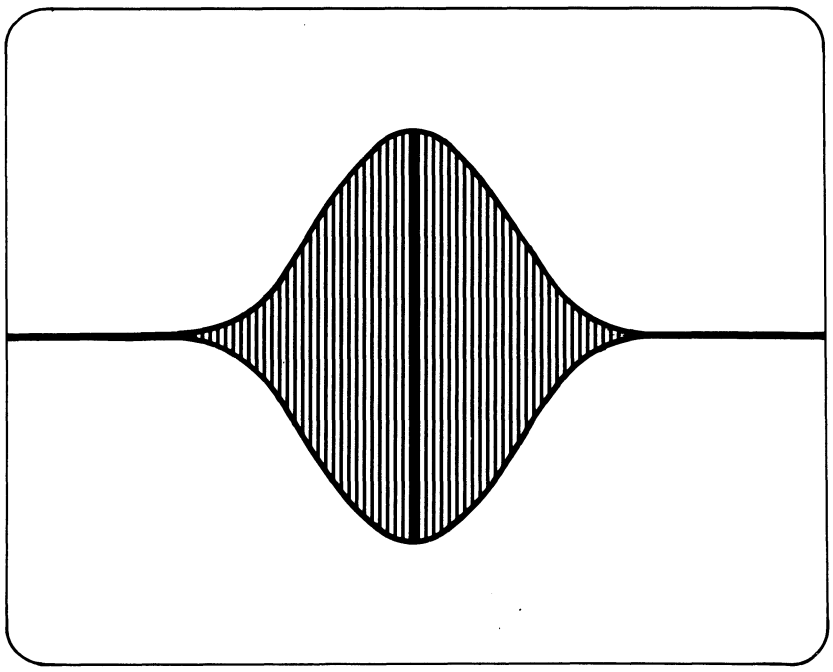


Fig. B5. Swept band-pass filter measured at the IF-frequency level.

Each of the two 3 dB frequencies can be found as shown in Fig. B6. The frequency is changed by the Frequency dial. The vertical axis on the oscilloscope is calibrated by reducing the RF-level by 3 dB. The distance between the two peaks on a discriminator S-curve may also be found in a similar way.

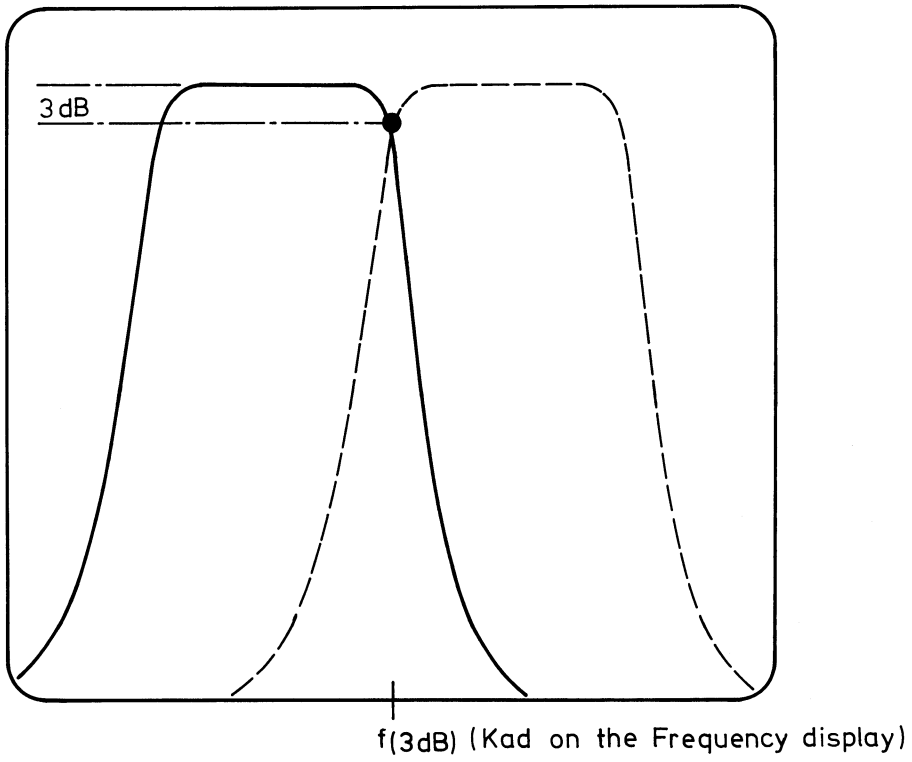


Fig. B6. Finding the IF 3 dB band width.

Stereo modulating the RE101

The COMPOSITE output from a stereo generator is applied to the EXT. MOD. input of the RE101. When the RADIOMETER ELECTRONICS SMG40 is used, the COMPOSITE signal should be taken from the COMPOSITE connector on the rear panel of the SMG40. The RE101/SMG40 combination is then automatically calibrated, that is, when the Meter on the SMG40 indicates 100% the frequency deviation on the RE101 will be ±75 kHz.

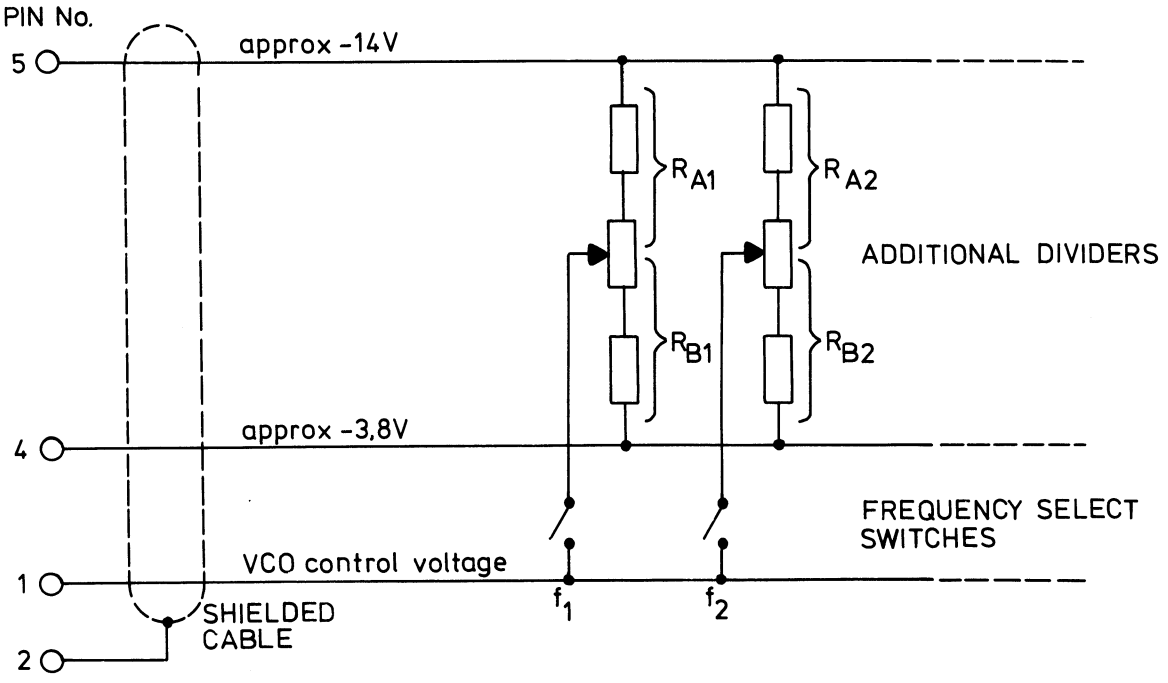
RE101 - REMOTE & DATA Connector Specifications

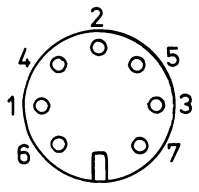
Introduction

The information given below describes the specifications applicable for the rear panel connectors designated REMOTE and DATA on the RE101 signal generator.

REMOTE - Connector

The best way to describe the function of this connector is by illustrating its use in setting up the carrier frequency by means of an external circuit.





7-pole DIN-connector as seen from the rear side of the instrument.

The following applies to the calculation of the resistors R_A and R_B. The total load ($R_{A1}+R_{B1}$) in parallel with ($R_{A2}+R_{B2}$) between terminals 4 and 5 must always be 1 kΩ (the potentiometer included).

For a given frequency the approx. varicap voltage can be found from the curve "Frequency vs. tuning voltage". Based on this voltage the value of the resistors R_A and R_B can be calculated.

DATA-Connector

The following digital and control signals are available on this connector:

PIN NO.

1. SWEEP WIDTH CONTROL:

   0 Volt corresponds to 0.5 MHz sweep width
   5 Volt corresponds to 10 kHz sweep width

2. GROUND

3. TRANSFER PULSE INVERTED

   The pulse indicates the time where the counter result is transfered to the latches related to the display.

4. COUNTER PULSE TRAIN INVERTED

   The repetition rate of this pulse train correspond to the VCO frequency (86-130 MHz) divided by 10.

5. RESET INVERTED

   The pulse indicates the time reset of the counter.

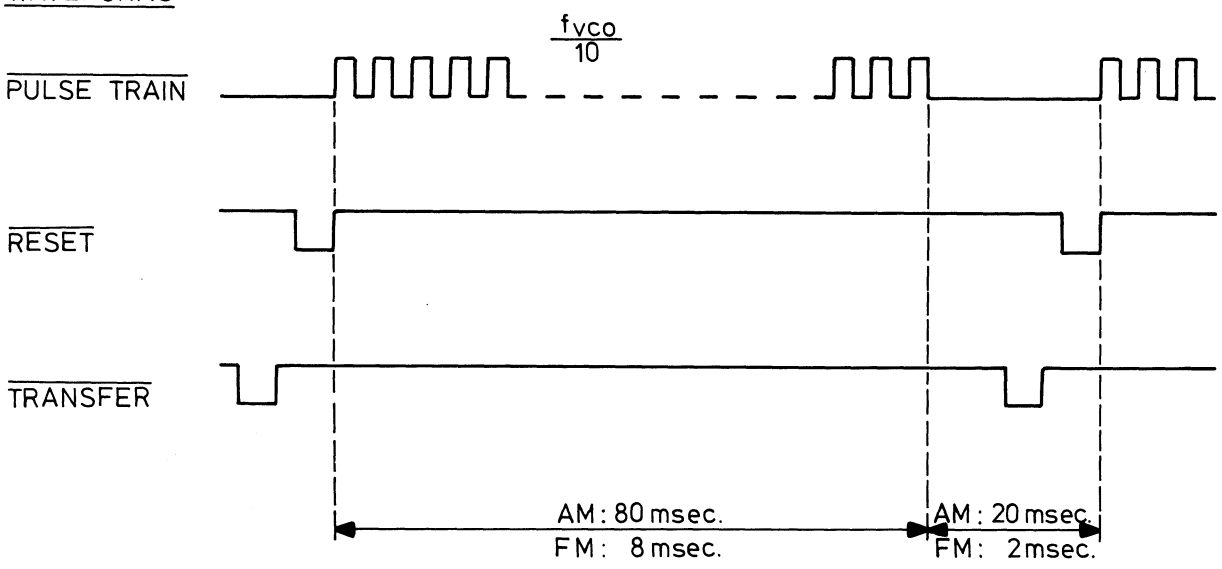
6. FREQUENCY RANGE

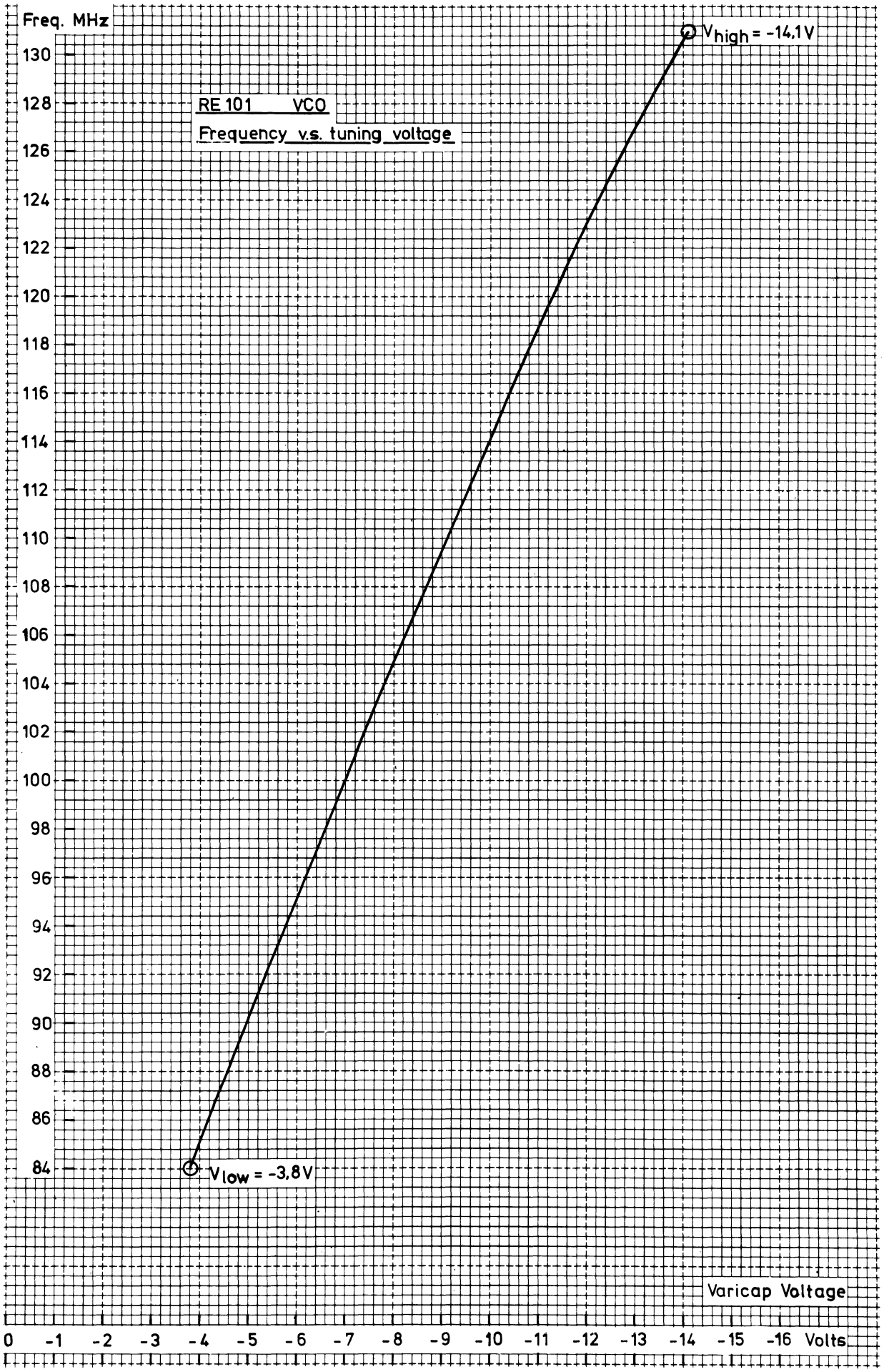
   0 Volt corresponds to the FM band (86-130 MHz)
   5 Volt corresponds to the AM bands (0.15-30 MHz)

7. To be grounded for RF-frequencies below 400 kHz, otherwise open.

The following outputs; REMOTE pins 4 and 5 DATA pins 3,4 and 5 are always active, whereas REMOTE pin 1 and DATA pins 1, 6 and 7 are only active when the FREQUENCY switch on the front panel is located in position REMOTE.

WAVEFORMS




Freq. MHz
130
128
126
124
122
120
118
116
114
112
110
108
106
104
102
100
98
96
94
92
90
88
86
84
RE 101 VCO
Frequency v.s. tuning voltage
V_{high} = -14,1V
V_{low} = -3,8V
Varicap Voltage
0 -1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11 -12 -13 -14 -15 -16 Volts

Section C_____Technical Description

C1. PRINCIPLE OF OPERATION

A simplified block diagram of the RE101 is shown in Fig. C1, page C3. The RF-generating circuits are contained in a shielded box shown as a dotted line in the block diagram.

A voltage controlled oscillator (VCO) generates a signal covering the frequency range 86 to 130 MHz. The frequency is selected by means of the frequency range switch and the tuning potentiometer located on the front panel. The VCO signal is fed to two circuits. To the Frequency Counter via a divide-by-ten Prescaler, and to the Amplitude Modulator stage. From the latter stage, the signal can pass one of two ways, depending upon the position of the Frequency Range switch. In the posiiton 86 to 130 MHz the signal passes directly to the Output Amplifier, and via the RF Attenuator to the RF OUT connector. In all other position of the Frequency Range switch (except REMOTE) the signal (frequency limited from 100.15 to 130 MHz) passes through a Frequency Converter where it is mixed with a crystal controlled 100 MHz signal, producing a signal covering the range 0.15 to 30 MHz after filtering. In order to obtain an adequate frequency stability, the frequency range 0.15 to 30 MHz has been divided into six overlapping bands selected by means of the frequency range switch.

The 5-digit Frequency Counter receives on input signal from the VCO through a prescaler. The reference frequency for the counter is obtained from the 100 MHz crystal controlled oscillator, located in the Frequency Converter, via a divide-by-ten prescaler. The counter resolution is 10 kHz within the range 86 to 130 MHz and 1 kHz within the ranges 0.15 to 30 MHz. The position of the decimal point is determined by the frequency range switch.

The Modulation Unit contains an audio frequency oscillator with two fixed frequencies, 400 Hz and 1 kHz, a peak detector, a modulation indicator and a modulation mode switch. Frequency modulation is obtained by adding the modulation signal to the frequency control voltage for the VCO. The amplitude modulation signal

is fed to the amplitude modulator via an AM and level feedback loop. Mixed AM and FM modulation is possible using the internal modulation oscillator as an FM source and an external oscillator as an AM source.

A generator for sweeping the carrier frequency is provided. This generator produces a symmetrical triangular signal which is added to the frequency control voltage for the VCO. The frequency and phase of the sweep signal is controlled from the Frequency Counter in order to achieve a flicker-free frequency display. The displayed frequency is always equal to the mean value of the carrier frequency. This sweep signal is fed to a connector for the horizontal deflection of an oscilloscope.

The RF attenuator is a resistive type with a constant output impedance and practically an infinite resolution continuously covering the range 0.1 μV to 1 V EMF. The RF output EMF is stabilized by the combined AM- and level-feedback loop.

The regulated power supply delivers voltages of: +12 V, -12 V, +5 V and an unregulated supply of -35 V.

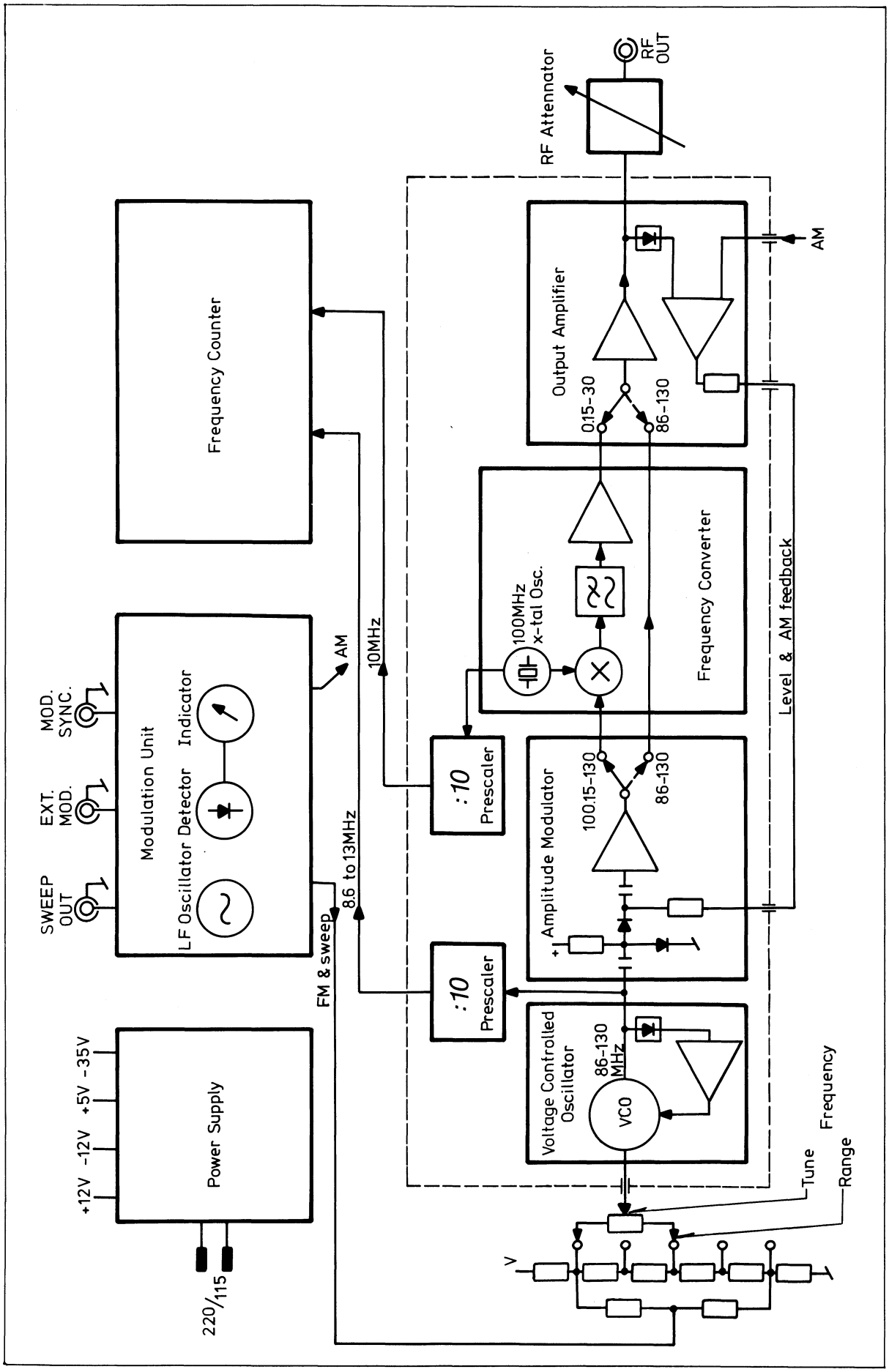


Fig. C1. Simplified blockdiagram of the RE 101

C II. MECHANICAL CONSTRUCTION

The mechanical construction of the RE101 Signal Generator is dominated by the shielded box containing the RF circuits and the precision attenuator. The shielded box for the RF circuits is milled from a solid block of aluminium, making the construction extremely stable and insensitive to microphony.

In order to give easy access to the various RF circuits for service, the lid of the shielded box forms part of the bottom of the RE101 cabinet, thus eliminating the need for disassembly of the cabinets. Furthermore, the PC-board containing the power supply is hinge-mounted for easy serviceability and to give access to all major parts within the compact cabinet construction.

C III. CIRCUIT DESCRIPTION

INTRODUCTION

This section contains a detailed circuit description of the RE101. The schematic diagram, drawing No. 1836-A1, is placed at the rear of Section E of this manual. For an overall view of the operation of the instrument, please refer to Fig. C1.

The circuit description is divided into the following sections:

VOLTAGE CONTROLLED OSCILLATOR (VCO)

The oscillator is a push-pull configuration ensuring a low harmonic distortion.

The active elements consist of two matched low noise FET-transistors (Q1A - B).

The oscillator tank circuit contains four matched variable capacitance diodes, CR1 to CR4, which give an almost linear frequency voltage variation ensuring low FM distortion and constant FM deviation across the bands. The diode CR5 compensates for temperature variations by providing a temperature dependent bias voltage to the diodes CR1 to CR4.

The RF signal is fed through a buffer amplifier, Q3 and Q4, to the following AM-Modulator stage. The buffer amplifier prevents frequency pulling of the oscillator circuit from the AM-Modulation stage. The output level of the buffer amplifier is rectified by CR6 and the dc signal is then applied to the local automatic level control (a.l.c.) loop, Q5 and Q6, to hold the RF harmonic distortion low. The time constants in the a.l.c. loop are carefully choosen to keep the noise low. The output level of the buffer amplifier is adjusted by R23.

FREQUENCY CONTROL UNIT

The frequency range 0.15 to 30 MHz is divided into five overlapping bands. A special band is provided for the FM IF frequency (10.7 MHz). The UHF band ranges form 86 MHz to 130 MHz.

Each band is selected by the frequency switch. Within each band the frequency is continuously tuned by means of a ten-turn conductive plastic potentiometer R43, which provides an infinite resolution.

The voltage for the frequency tuning is taken from a highly stabilized regulator to obtain a stable frequency with low FM noise. The regulated voltage is adjusted with R16 and R29 to cover the specified frequency ranges. To ensure against the pick up of noise and hum, the voltage regulator is placed close to the frequency control circuit and the VCO.

Frequency modulation and frequency sweep is introduced (via terminal 36, QA1) by superposing the modulation or sweep signal to the dc-signal which determines the carrier frequency. In order to keep the frequency deviation or sweep width constant

when tuning throughout the frequency ranges, the modulation or sweep signal is introduced in a way which compensates for the small non-linearity of the carrier frequency/voltage relationship.

The frequency range switch selects the sweep width (via terminal 4a) and the sweep frequency according to which frequency band is selected.

Within the frequency range 0.15 to 0.4 MHz, a compromise is made between a high AM modulation frequency and a low carrier frequency. Within this range the slew rate of the RF detector at the Output Amplifier is limited by grounding the circuit through FL16 and the frequency range switch. The maximum modulation frequency must be limited in accordance with the specifications, otherwise serious distortion will take place.

The frequency range switch controls (via terminal 5b) the ON/OFF position of the Frequency Converter by setting the correct dc levels to terminals FL7, FL12 and FL13 on the RF box. The Frequency Counter resolution is controlled via terminal 5b. In the REMOTE position, the input for the carrier frequency control is connected to the REMOTE connector on the rear panel. DC voltages derived from the regulator are also fed to the connector.

This permits the generators internal modulation facilities to be used also while external frequency programming is used.

FM-modulator and level and AM feedback loop

The AM modulator circuit is used for amplitude modulation and automatic level stabilisation.

The amplitude modulation is performed by controlling the dynamic resistance ratio of the two PIN-diodes, CR1 and CR2, by means of the bias current through the diodes. The automatic level stabilization is obtained by controlling the dynamic resistance of the PIN-diode CR3.

The RF amplifier Q1 and Q2 serves two purposes; it compensates the loss in the PIN-diodes, and it provides a low impedance for the amplitude modulation diodes, reducing the incidental FM.

The switching diodes CR4 and CR5 select whether the signal should pass through the Frequency Converter or directly to the Output Amplifier. The switching diodes are controlled from the frequency range switch.

The level and AM feedback loop is designed to achieve a good envelope distortion figure, and to maintain a constant modulation depth and constant RF level, with a varying carrier frequency.

The feedback is taken via a summing amplifier from the RF detector which is connected to the output terminal of the Output Amplifier. The summing amplifier (QA1) and the RF detector (CR5, CR6) are located on the Output Amplifier PC-board.

From the summing amplifier the feedback signal passes through a low pass filter composed of FL15, C1, L1 and FL6 to the AM-modulator stage. The slew rate of the RF selector is controlled by the bias current through the resistors R32, R33 and R34.

CR7 and CR8 compensate for temperature drift of CR5 and CR6, and thus ensure that the RF output level is independent of temperature variations.

Frequency Converter

The Frequency Converter PC-board contains four parts: The mixer QA1, the 100 MHz crystal controlled oscillator, a low pass filter, and an amplifier (Q2, Q3, Q4) which compensates for the losses in the mixer.

The input signal to the Frequency Converter, ranging from 100.15 MHz to 130 MHz, is balanced in the transformer L2 and is applied to the mixer, where it is mixed with the 100 MHz crystal controlled signal giving a difference frequency of 0.15 MHz to 30 MHz after fittering.

The 100 MHz local oscillator signal is balanced by means of the resistors R8 and R9. The mixer is of the transistor multiplier type, which gives excellent spurious rejection when driven by properly chosen input signal levels. The mixer is followed by a non-symmetrical low-pass filter having a cut off frequency of 30 MHz. Additional filtering is provided in a similar filter placed on the output amplifier PC-board. The amplifier has a grounded base transistor (Q2) in the input stage to assure a good termination of the low pass filter.

The ON/OFF position of the Frequency Converter is controlled by the PIN-diode switches (CR_4, CR_5 on the AM-modulator PC-board and CR_1, CR_2 and CR_3 located on the Output Amplifier PC-board). The switches are controlled from the Frequency Control circuit. In the ON position, the PIN-diodes act as linear low-ohmic resi-

stors and introduce no distortion as long as the frequency is high. All PIN-diodes, except one (CR_1 on the output amplifier PC-board), are always working at high frequencies. To prevent distortion from CR_1 at low frequencies, this diode is current driven from the output transistor Q4. The DC-current to Q4 is supplied partly via CR_1. The crystal controlled oscillator has an additional output which offers frequency division in a divide-by-ten prescaler, and is used as a reference frequency for the Frequency Counter.

Output Amplifier

The Output Amplifier PC-board includes the filter and switching diodes, CR_2 and CR_3, for the Frequency Converter. It also includes the output amplifier, the RF-detector, CR_5 and CR_6, and the summing amplifier (QA1) for RF-level stabilization and amplitude modulation.

The Output Amplifier which covers the frequency range 0.15 to 130 MHz consists of a pre-amplifier, Q_1 and Q_2, and a class B output stage Q_5, Q_6 and Q_7. The dc-potential of the output stage is stabilized by a dc-amplifier, Q_3 and Q_4. The output stage is capable of delivering an output power level which is sufficient to compensate for insertion loss in the RF attenuator and simultaneously to provide up to 2 V EMF in amplitude modulation peaks (100%) at the RF OUT connector. A low-pass filter following the output stage decreases any harmonic distortion present at high carrier frequencies. The RF output level is adjusted by the trimmer potentiometer R39.

RF Attenuator

The Attenuator is a resistive variable voltage divider having an output impedance which is mearly independent of the attenuator setting. Only at the upper 10 dB of output level is that a slight departure from the nominal valve of output impedance.

By means of the RF attenuator, the output level is continuously variable over a 140 dB range. Due to the automatic level stabilization, the source EMF is always calibrated and is independent of the carrier frequency setting.

Prescaler

There are two identical divide-by-ten prescalers. One for the VCO frequency 86 to 130 MHz and the other for the 100 MHz signal from the crystal controlled oscillator. Each consists of a buffer/preamplifier followed by an ECL frequency divider.

The prescalers deliver the input frequency (8.6 to 13 MHz) and the reference frequency (10 MHz) for the Frequency Counter.

Frequency Counter

Primarily the purpose of the frequency counter is to count and display the RF output frequency of the Signal Generator. In addition, it includes circuits for generation of synchronizing pulses for the sweep generator to synchronize the sweep to the counting period. This provides a non-blinking frequency display when sweeping the RF frequency.

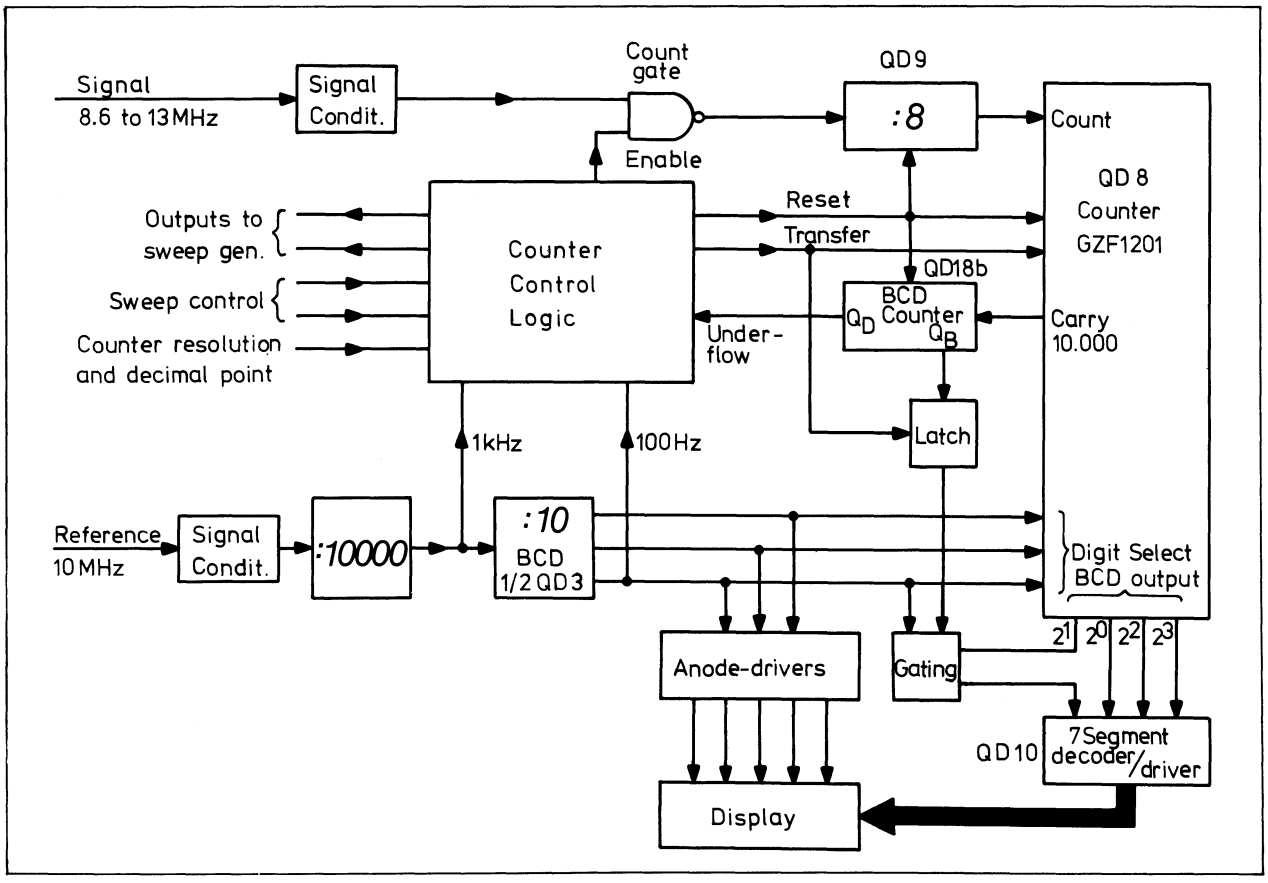


Fig. C2. Frequency Counter simplified blockdiagram

A simplified block diagram of the Frequency Counter is shown in Fig. C2. Details are shown in the schematic diagram (drawing 1836-A1).

The circuitry contains a decade counter, QD8, which has a total count capability of 19999. This capability is extended to 39999 by adding an extra BCD counter (QD18B), a latch (QD15A) and gating networks.

In addition to QD8 the counter includes latches which update when the TRANSFER input is high. It contains a multiplexer which successively passes the information in the latches to the BCD outputs. The multiplexer is controlled by the three digit select input lines, QD8/15, 16, 17, which simultaneously, via QD5,/12, 13, 14, controls the anode-drivers for the display. This means that the five digits in the display are strobed and only one digit displays at a given time. The digit select signals are derived from the reference frequency by means of QD3. Fig. C3a shows waveforms for the digit select and display strobing.

In operation the input signal, 8.6 to 13 MHz, is converted to TTL compatible logic and gated via the divide-by-eight counter QD9 to the counter input QD8/14. The counting is controlled as the Counter Control Logic in the following way:

1. The counter is reset to 00000 by a RESET pulse
2. Counting is initiated by enabling the Count Gate, QD14/1,2,3.
3. Counting is ended by disabling the Count Gate.
4. The counter state is transferred to the latches by the TRANSFER pulse.
5. The counter is reset to 00000 and is ready for a new count cycle.

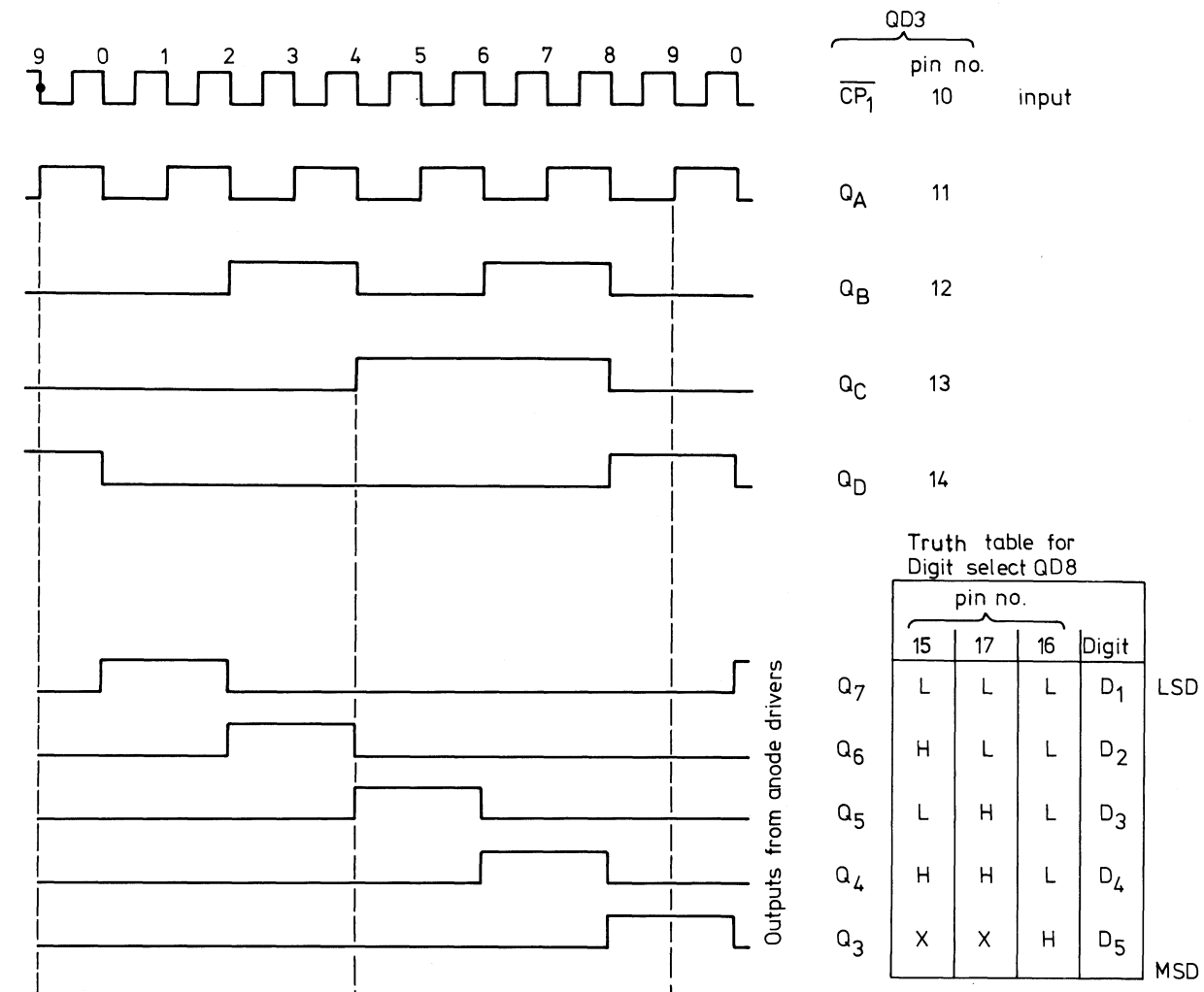
Waveforms for the counting cycle are shown in Fig. C4a. When the counter resolution is 1 kHz the complete counting cycle lasts 100 ms. When the counted resolution is 10 kHz the counting cycle lasts 10 ms.

The counter resolution is controlled from the Frequency Control Unit by applying a high or a low logic level to terminal 11/1 on the Frequency Counter PC-board, thereby feeding a 1 kHz at a 100 Hz signal, derived from the 10 MHz reference frequency QD3, unto the Counter Control Logic.

The 1 kHz resolution is used when the Frequency Converter is ON. Because the signal to the counter is taken ahead of the Frequency Converter, the frequency fed into the counter is 100 MHz above the frequency of the actual output signal. Normally there

is no problem, because the "one hundred" MHz digit does not exist when the frequency resolution is 1 kHz. If for some reason there is an error which makes the output frequency from the VCO, and hence the input, to the counter (before the divide-by-ten prescaler), lower than 100 MHz an "underflow pulse" resets the counter to 00.000. However, this situation will not occur as long as the signal generator is in correct working order.

Synchronizing signals for the frequency sweep generator are shown in Fig. C36 (for sweeping within the frequency range 10 to 11.5 MHz), and in Fig. C40 for sweeping all the other frequency ranges.



Truth table for Digit select QD8

pin no. 15	17	16	Digit	
L	L	L	D_1	LSD
H	L	L	D_2	
L	H	L	D_3	
H	H	L	D_4	
X	X	H	D_5	MSD

Fig. C3a Digit Select and Display Strobing

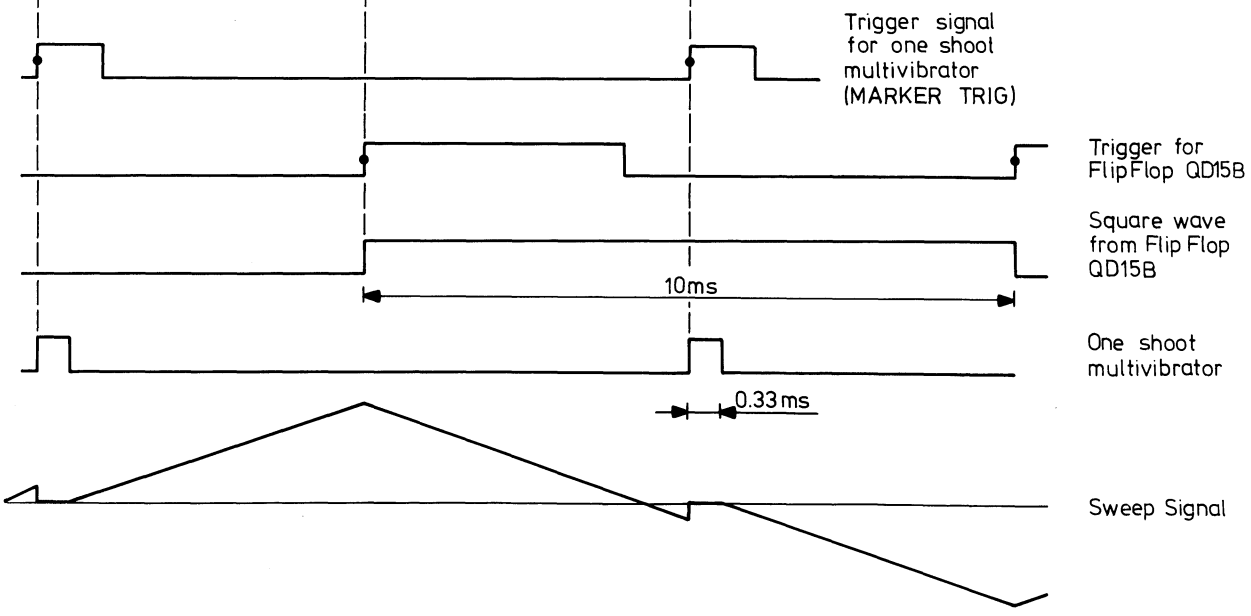


Fig. C3b Generating of Sweep Signal in Frequency Range 10 to 11.5 MHz

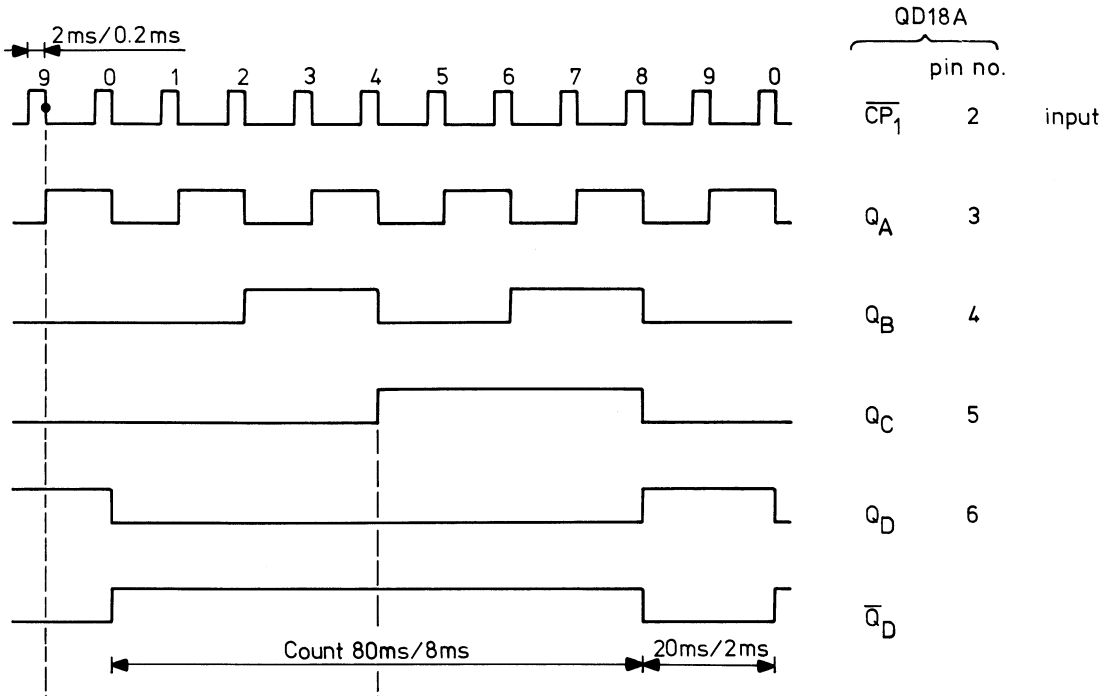


Fig. C4a Some Wave Forms in Counter Control Logic

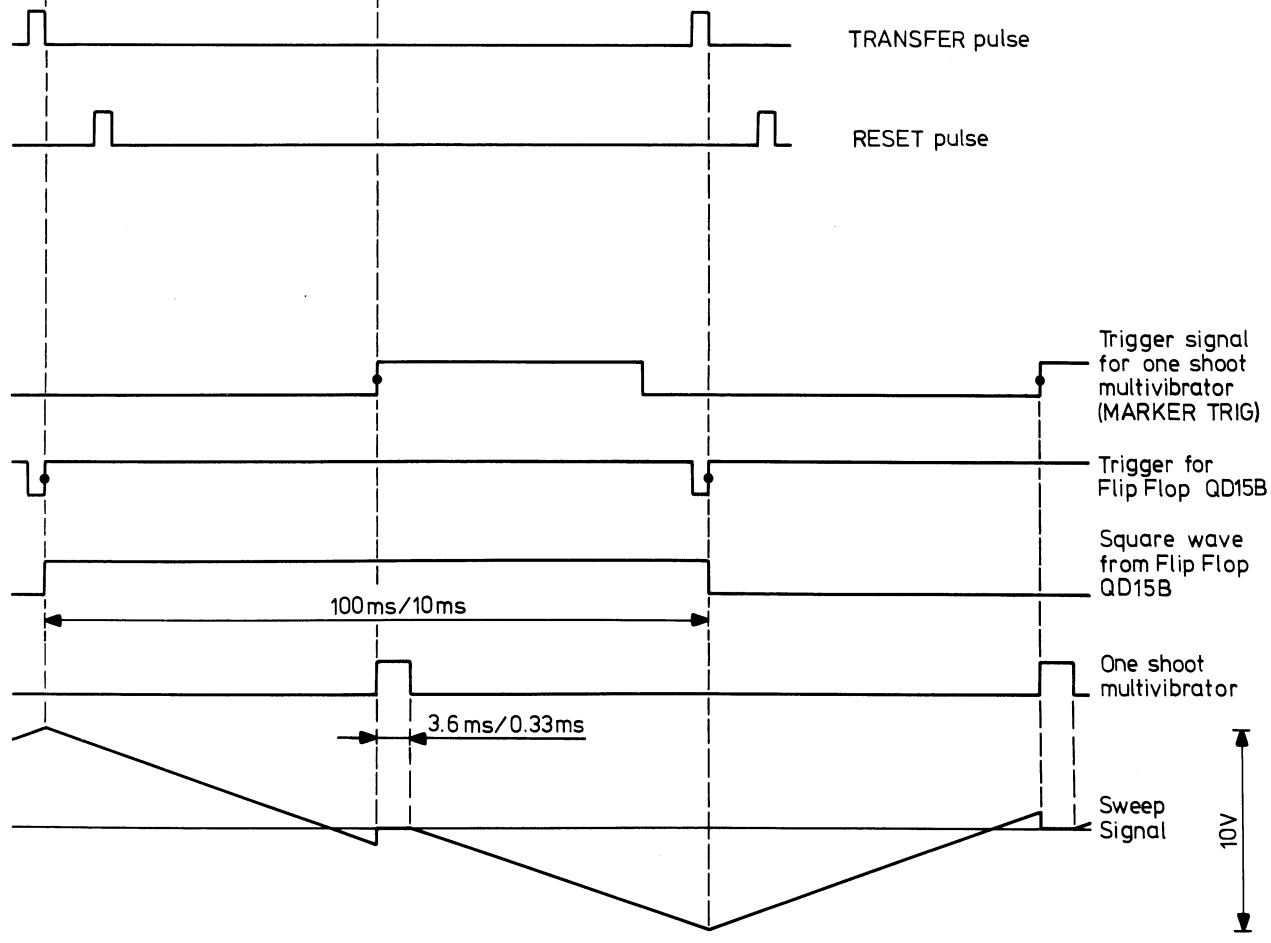


Fig. C4b Generating of Sweep Signal in all Frequency Ranges except 10 to 11.5 MHz

Modulation Unit

The Modulation Unit contains the LF-oscillator, the peak detector, the modulation meter and the Modulation Mode switch.

The LF-oscillator QA1, is a Wien Bridge Oscillator. The amplitude is stabilized by a thermistor to ensure a very low harmonic distortion. The oscillator frequency can be set to 400 Hz or 1 kHz by means of the MOD. FREQ. switch.

The amplifier QA3 is coupled as a peak detector. A dc voltage equal to the peak value of the input voltage to QA3 appears across C10. QA4 drives the modulation meter.

The Modulation Mode Selector directs the modulation signals to the AM-modulation loop via the amplifier QA2, or to the FM summing amplifier QA1, which is located on the Frequency Control Unit. At the same time, the selector connects the modulation signal, via QA3, to the modulation meter.

Sweeping is provided by applying the sweep signal to the FM-summing amplifier. The sweep width and the sweep repetition frequency depends upon the setting of the frequency range switch. Within the frequency ranges 0.15 to 30 MHz, the sweep width is ±10 kHz. Within the ranges 86 to 130 MHz and 10 to 11.5 MHz the sweep width is ±0.5 MHz, and the sweep repetition frequency is 5 Hz and 50 Hz respectively. In the Sweep Mode indicator on the front panel shows the sweep width.

Sweep Generator

The Sweep Generator is located on the Power PC-board, and is controlled by signals from the Frequency Counter in the following way:

A square wave (J1/7) from flip-flop QD15B, is amplified and then integrated by QA3 providing a triangular wave at the output. Each time the output voltage just passes zero, the FET switch Q12 is switched ON for a defined period. The output voltage is then reset and held at zero until Q12 is switched OFF, and the sweep then proceeds.

The ON/OFF position of Q12 is controlled by the one shot multivibrator QD1 which is controlled from the Frequency Counter via the MARKER TRIG input (J1/3). The ON period for Q12 is 3.6 ms within the ranges 0.15 MHz to 30 MHz and 0.33 ms within the range 86 to 130 MHz.

The sweep width is controlled via terminal J1/8. The complete cycle of the sweep signal is shown in Fig. C3b for a sweep within the frequency range 10 to 11.5 MHz, and in Fig. C4b for a sweep in all the other frequency ranges.

Within the ranges 0.15 MHz to 30 MHz, the time for a complete sweep cycle is 200 ms (5 Hz repetition frequency) and within the range 86 MHz to 130 MHz the time is 20 ms (50 Hz repetition frequency).

The sweep signal is present on the SWEEP OUT connector on the rear panel and is always $\pm 5\ V_p$ independent of the sweep width.

Power Supply

The Power Supply consists of a dual regulated supply for the +12 V and -12 V for the analog circuits, and a voltage doubler for an unregulated -35 V supply.

A separate regulated +5 V supply is provided for the logic circuitry.

Section D_____Maintenance

D I. INTRODUCTION

This section provides general maintenance information. Section D II describes the Performance Tests and Section D III the Adjustments. It is recommended to check, and, if necessary, recalibrate the instrument yearly.

The mechanical construction of the RE101 is such that maintenance in the form of lubrication of moving parts is not necessary.

To obtain access to the interior of the instrument, please refer to Section E II, Dismantling.

RECOMMENDED TEST EQUIPMENT

The equipment recommended for the performance tests, adjustments and trouble-shooting is listed in Table D 1. The specific instrument types given in column III are examples only, and any alternatives which have equivalent specifications may be used.

Table D 1, Recommended Test Equipment

Instrument	Key Specifications	Recommended Model
Digital Voltmeter	4 1/2 Digit AC/DC resolution 0.1 mV or less max. voltage at lest 100 V	Data Precision Model 1450
Power Meter	Impedance 75 Ω Frequency range 0.1 to 130 MHz	Hewlett Packard type 434A, with probe type 8483A
FM/AM modulation meter	Frequency range: at least 10 MHz to 130 MHz	Radiometer AFM2 Modulation Meter
Oscilloscope	Dual Mode DC to 20 MHz	Advance type OS1000
RF Spectrum Analyzer	Frequency range: 0.1 MHz to 350 MHz	Hewlett Packard type 8557A
LF Oscillator	Frequency range: 10 Hz to 100 kHz Distortion: $<$0.5%	Radiometer BKF10 Distortion Analyzer
Distortion Meter	Capable of measuring distortion down to 0.03%	
Test Loop	2 turns diameter: 25 mm	
Frequency Counter		Data Precision Model 5740

D II. PERFORMANCE TESTS

INTRODUCTION

The procedures in this section test the electrical performance of the RE101 - using the specifications in section A III as the performance standards. All tests can be performed without access to the interior of the instrument. The performance tests given in this section are suitable for incomming inspection, troubleshooting or preventative maintenance.

Equipment required for the performance tests is listed in table D 1.

Before any tests are performed the instrument should warm up for one hour.

FREQUENCY CONTROL AND VCO TEST

Check the carrier frequency bands using the built-in counter of the RE101. The bands should cover the nominal range as a minimum requirement.

Band 1	nominal	0.15	MHz	to	0.4	MHz
Band 2	nominal	0.4	MHz	to	1.8	MHz
Band 3	nominal	1.8	MHz	to	10	MHz
Band 4	nominal	10	MHz	to	20	MHz
Band 5	nominal	20	MHz	to	30	MHz
Band 6	nominal	86	MHz	to	130	MHz
Band 7	nominal	10	MHz	to	11.5	MHz

Check that the carrier frequency shift is < 1 kHz when the Modulation Mode switch is changed from position CW to position ±75 kHz.

RF OUTPUT LEVEL TEST

Recommended equipment:

Power Meter:	HP 434A
Probe:	HP 8483A

Set the RE101 controls as follows:

RF Frequency:	100 MHz
RF VOLTAGE EMF:	100 mV
Modulation Mode:	CW

Connect the Power Meter to the RF OUT connector on the RE101.

The output level should be - 14.8 dBm into 75 Ω (- 13.0 dBm into 50 Ω), corresponding to 50 mV.

Check the output level at the following frequencies:

100 MHz, 86 MHz, 130 MHz, 30 MHz, 10 MHz, 1 MHz and 0.2 MHz.

If the above RF Level checks prove satisfactory, further measurements at other levels (1 V EMF to 1 µV EMF) will normally be superfluous.

RF-LEAKAGE TEST

Recommended equipment:

Spectrum Analyzer: HP 8557A
Test Loop: Two turns, 25 mm diameter

Set the RE101 controls as follows:

FREQUENCY: 100 MHz
RF VOLTAGE EMF: $\leq$ 1 mV

Connect the Test Loop to the Spectrum Analyzer.

Permissible Leakage

$<$1 µV EMF at a distance of 25 mm from the Signal Generator cabinet.

At high attenuator settings the radiation is greater, but this is of no consequence in practical applications.

RF-HARMONICS TEST

Recommended equipment:

Spectrum Analyzer: HP 8557A

The harmonics of the RF frequency are measured by means of the spectrum analyzer connected to the RF OUT connector on the front panel of the RE101.

Permissible Level

Each of the harmonics should be at least 35 dB below the carrier level when the carrier frequency is within the specified frequency ranges.

NON-HARMONICS SPURIOUS FREQUENCY TEST

Non-harmonically related spurious frequencies can be generated in the Frequency Converter. They can also be divided from the 100 MHz reference frequency or from one of the prescalers.

Recommended equipment:

Spectrum Analyzer: HP 8557A

Connect the Spectrum Analyzer to the RF OUT connector on the RE101.

The non-harmonic spurious frequencies is measured by slowly tuning the RE101 through the frequency ranges.

Permissible Levels

The level of any non-harmonic spurious signals should be at least 80 dB below the carrier level.

MODULATION OSCILLATOR TEST

Recommended equipment:

Frequency Counter: Data Precision, Model 5741
Distortion Analyzer: Radiometer BKF10 Distortion Analyzer

Modulation Frequency:

Connect the counter to the MOD. SYNC. connector to the rear panel of RE101.

Set the MOD. FREQ. switch to position 1 kHz
Counter Reading: 1 kHz ±2%

Set the MOD. FREQ. switches to position 400 Hz
Counter Reading: 400 Hz ±2%

Distortion

Connect the INPUT connector of the BKF10 to the MOD. SYNC. connector of the RE101.

Read the distortion factor of the 400 Hz and the 1 kHz modulation frequency on the Distortion Meter.

Distortion factor: max. 0.03%

MODULATION MODE TEST

Recommended equipment:

Modulation Meter:	Radiometer, AFM2 Modulation Meter
Oscilloscope:	Advance, type OS1000
DVM:	Data Precision, Model 1450
LF Oscillator:	Radiometer, BKF10 Distortion Analyzer
Distortion Analyzer:	Radiometer, BKF10 Distortion Analyzer

The AM and FM modulation depths are detected and measured using the AFM2 Modulation Meter.

Connect the RF INPUT connector of the AFM2 to the RF OUT connector of the RE101.

Initial settings of the RE101.

The following measurements are performed at MOD. FREQ. 1 KHz and carrier frequency 10 MHz unless otherwise stated.

1. INT. 30% AM

Permissible error: max. 33%
min. 27%

2. INT. AM (0 to 90%)

Permissible error at 80% AM:
max. 84%
min. 76%

3. EXT. AM. Connect the LF Generator to the EXT. MOD. connector or the rear panel of RE101. Test the modulation frequency response at 30% AM and 80% AM (EXT. MOD. input level: 10 mVp provides 1% AM).

Permissible error:

30% AM: ±3 dB at mod./freq. 40 Hz to 5 kHz for carrier frequencies > 400 kHz

80% AM: ±3 dB at mod./freq. 40 Hz to 3 kHz for carrier frequencies > 400 kHz

4. AM distortion at 30% AM and 80% AM (internal). Connect the BKF10 Distortion Analyzer to the AF OUTPUT connector on the AFM2.

Permissible error:

at 30% AM: < 0.3% for carrier frequencies <30 MHz

at 80% AM: < 1% for carrier frequencies <30 MHz

5. EXT. AM sensitivity: 0.566 V_{RMS} should provide 80% AM

Permissible error:

Max. value: 84% AM

Min. value: 76% AM

6. Residual AM

AFM2 setting: FILTER at 50 Hz to 15 kHz (3 dB)
METER RANGE: 3%

RE101 setting: Modulation Mode at CW

connect a DVM to the AF OUTPUT connector on the AFM2.

Permissible error:

Residual AM: 0.01% RMS (~2 mV RMS on the DVM)

7. Incidental FM for 30% AM (at 1 kHz mod. freq.)

Permissible error: < ±60 Hz peak

8. Incidental FM for 80% AM (at 1 kHz mod. freq.)

Permissible error: < ±300 Hz peak

9. INT. ±75 kHz FM (measure at 11, 86, 100 and 110 MHz)

Permissible error: max. ±82 kHz
min. ±68 kHz

10. INT. FM. Adjustable from 0 to ±100 kHz

Set carrier frequency to 110 MHz

Permissible error:

Modulation indicator accuracy for ±80 kHz FM:
max. ±83 kHz
min. ±77 kHz

11. EXT. FM. Connect an LF generator to the EXT. MOD. connector. Set carrier frequency to 110 MHz, 0.566 V_{RMS} should provide ±80 kHz FM.

Permissible error:

As given in item 10.

12. FM distortion. This check is a little difficult to perform with the recommended test instruments. At the factory special instruments are used. The results of the distortion measurements are dependent upon the intrinsic distortion of the AFM2 as well as that of the RE101 under test. Connect the BKF10 Distortion Meter to the AF OUTPUT connector on the AFM2, deviation ±100 kHz, MOD. FREQ. 1 kHz.

Measure at the following carrier frequencies:

80, 100, 110 and 11 MHz.

Permissible error: 0.1%

13. EXT. AM and ±15 kHz FM. Check the function.

14. Residual FM. Connect a DVM to the AFM2 AF OUTPUT connector.

AFM2 setting: FILTER at 50 Hz to 15 kHz
METER RANGE: ±1 kHz

RE101 setting: Modulation Mode: CW

Permissible error:

Resistance FM: < 10 Hz (RMS value) ~2.2 mV RMS on the DVM

15. Incidental AM

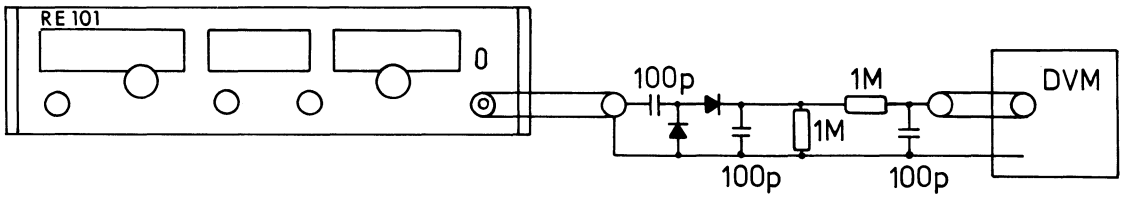


Fig. D1 Measurement of incidental AM

Proceed as follows:

a) Set the RF VOLTAGE EMF to max. (1 V)

b) Modulation level: INT. AM, 10%

c) Read the AF voltage = x mV
i.e., $\frac{x}{10}$ mV equals 1% AM

d) Set the Modulation Mode switch to position INT. FM and deviation deviation to ±100 kHz
MOD. FREQ. at 1 kHz

e) Read the AF voltage = y mV

f) Calculate the incidental AM% = $\frac{y}{x} \cdot 10\%$

Permissible error:

Incidental AM < 0.2%

16. SWEEP

Connect an oscilloscope to the SWEEP OUT connector on the rear panel of the RE101.

Set the RE101 controls as follows:

Modulation Mode switch at SWEEP
Carrier frequency to the 86 - 130 MHz band (±0.5 MHz SWEEP)

Read the SWEEP OUT level on the oscilloscope:

max. level 10.5 Vpp
min. level 9.5 Vpp

Repeat the measurement within the frequency range of 20 MHz to 30 MHz, (±10 kHz SWEEP).

Measure of the following carrier frequencies:

80, 100, 110 and 11 MHz.

Permissible error: 0.1%

DIII. ADJUSTMENTS

INTRODUCTION

Before any adjustments are performed the RE101 should warm up for one hour.

To gain access to the interior of the instrument, please refer to section EII. Dismantling.

POWER SUPPLY

Recommended equipment:

Digital Voltmeter: Data Precision, Model 1450.

Check out and Adjustment

The +12 V supply is adjusted by potentiometer R14, see Fig. D6 or Fig. D7. The -12 V supply automatically follows the +12 V supply. The +5 V is delivered from an IC voltage regulator and cannot be adjusted. The -35 V supply is unregulated and cannot be adjusted.

Voltage	Permissible errors	Location
+ 12 V	+11.99 V to +12.01 V	J2/2 (red lead)
- 12 V	-11.80 V to -12.20 V	J2/1 (blue lead)
+ 5 V	+ 4.75 V to + 5.25 V	J1/6 (orange lead)
- 35 V	-31 V to -40 V	J1/11 (green/white lead)

FREQUENCY CONTROL and VCO

Refer to Fig. D5 for the adjustment point locations.

Recommended equipment:

Digital Voltmeter: Data Precision, Model 1450

QA1 Zero Point

1. Connect a DVM to the EXT. MOD. connector.
2. Set the Modulation Mode switch to position EXT. FM.
3. The dc voltage on the EXT. MOD. connector should be 0 V ±2 mV.
   If not, adjust the zero point of QA1 with R17.

VCO Frequency

1. Connect the DVM to the Frequency Control input terminal FL2 on the RF box.
2. FREQUENCY RANGE: 86 to 130 MHz.
   Tune with the frequency dial until the DVM reads -7.000 V.
3. Adjust the VCO frequency to 100.00 MHz (indicated on display) by means of the tuning slug in the oscillator tank coil L3.

   Access to the tuning slug: Pass a screwdriver through the hole in the RF shielded box (see Fig. E1).

   NOTE: The cover of the RF box must always be in place, and all screws tightened, when any frequency adjustments are performed.

Adjustment of the 0.15 to 30 MHz frequency band

1. Set the RE101 controls as follows:

   Frequency Range: 20-30 MHz
   Frequency Dial: fully clockwise

2. Adjust f max to 31.00 MHz with R16.

3. Frequency Range: 0.15-0.4 MHz
   Frequency Dial: fully counter clockwise

4. Adjust f min. to 0.08 MHz with R29

5. As these two adjustments interact, items 2 and 4 should be repeated until both values are obtained.

When these adjustments are performed correctly the frequencies in all other ranges will normally be within the specified limits.

RF OUTPUT LEVEL

Recommended equipment:

Power Meter: HP 434A
Probe: HP 8483A

1. Set the RE101 controls as follows:

   RF Frequency: 100 MHz
   RF VOLTAGE EMF: 100 mV

2. Adjust the output level to -14.8 dBm into 75 Ω (-13.0 dBm into 50 Ω), corresponding to 50 mV, with R39. Access for the adjustment is through the hole in the RF box, see Fig. D6.

   NOTE: When the RF output level has been adjusted, it is always necessary to readjust the AM modulation depth as described in the following section.

MODULATION

Recommended equipment:

Modulation Meter:	Radiometer AFM2 Modulation Meter
Digital Voltmeter:	Data Precision, Model 1450
LF Oscillator:	Radiometer BKF10 Distortion Analyzer

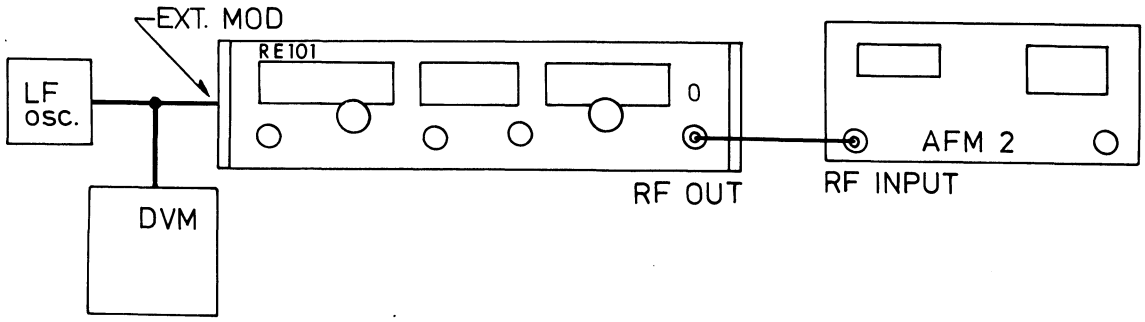


Fig. D2 Ext. Modulation adjustment

Connect the equipment as shown in Fig. D2.

1. EXT. FM:

   Set the RE101 controls as follows:

   RF Frequency: 110 MHz
   Modulation Mode switch: at EXT. FM

2. Set the LF oscillator frequency to 1 kHz and level 0.53 V_{RMS}

3. The Modulation Meter should now read ±75 kHz. If not, adjust to ±75 kHz deviation with R24, located on the Frequency Control PC-board, see Fig. D5.

4. Set the modulation mode switch to: ±75 kHz.

5. Adjust the reading of the MODULATION meter on the RE101 to ±75 kHz by R27 (see Fig. D5 or Fig. D6).

6. EXT. AM:

   Set the RE101 controls as follows:

   RF Frequency: 10 MHz
   Modulation Mode switch: EXT. AM

7. Set the LF oscillator frequency 1 kHz and level 0.53 V_{RMS}.

8. The Modulation Meter should now read 75% AM.
   If not, adjust to 75% AM modulation with R20, see Fig. D5 or Fig. D 6.

9. Check the RE101 MODULATION meter reading.
   If necessary, a compromise must be made between the AM and FM indications.

10. INT. FM

    Set the Modulation Mode switch to position ±75 kHz FM and adjust the internal modulation level with R9, see Fig. D5 or Fig. D6.

11. INT. AM

    Set Modulation Mode switch to position 30% AM. The Modulation Meter should now indicate 30% AM. If not a compromise must be made between the AM and the FM indications.

SWEEP

Recommended equipment:

Oscilloscope: Advance, type OS 1000

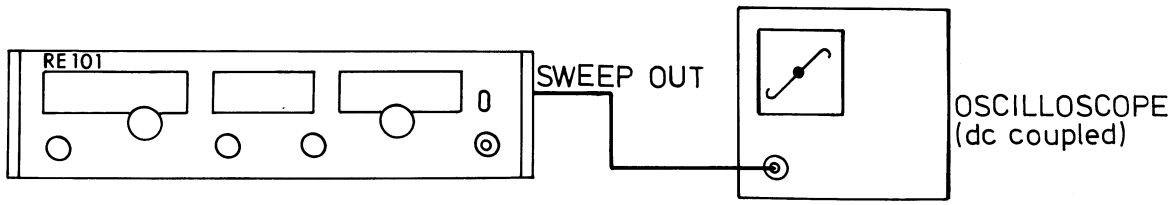


Fig. D3 Sweep Ramp level adjustment

1. Connect the oscilloscope to the SWEEP OUT connector on the rear panel of the RE101.

2. Set the RE101 controls as follows:

   Frequency range: 86 to 130 MHz (±0.5 MHz SWEEP)
   Modulation Mode switch to SWEEP.

3. Adjust the SWEEP OUT level to 10 V_{pp} with R40, see Fig. D6 or Fig. D7.

4. Switch to Frequency Range 20 to 30 MHz (±10 kHz SWEEP).

5. Adjust the SWEEP OUT level to 10 V_{pp} with R42, see Fig. D6 or Fig. D7.

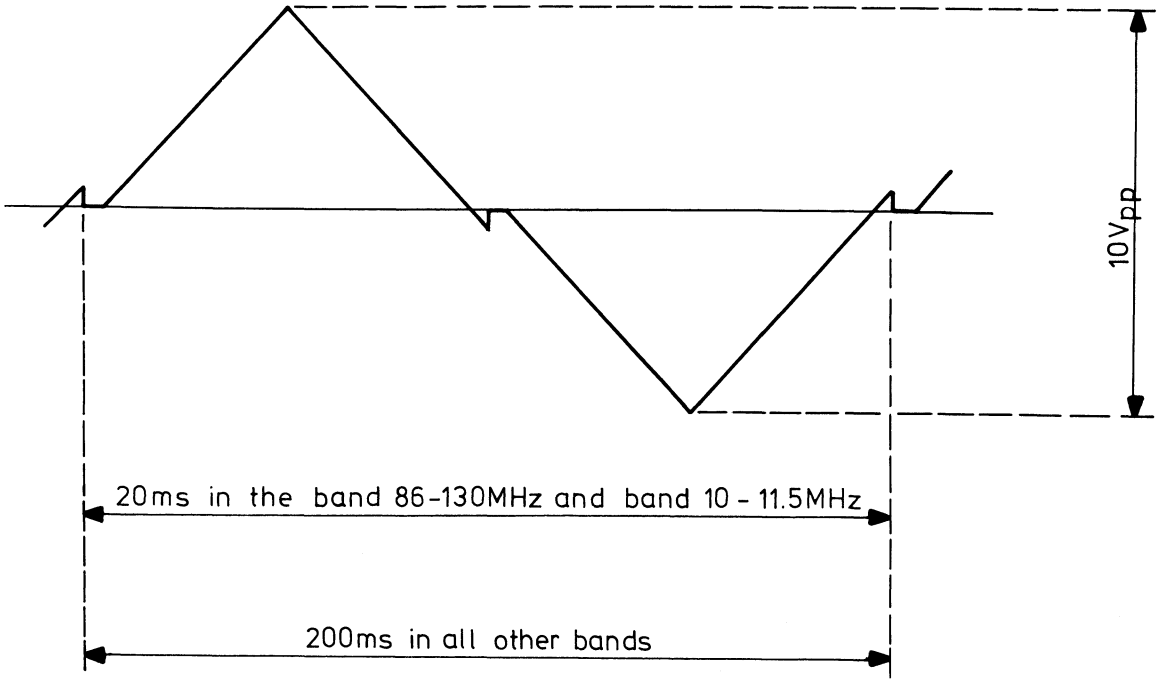


Fig. D4. Sweep ramp output

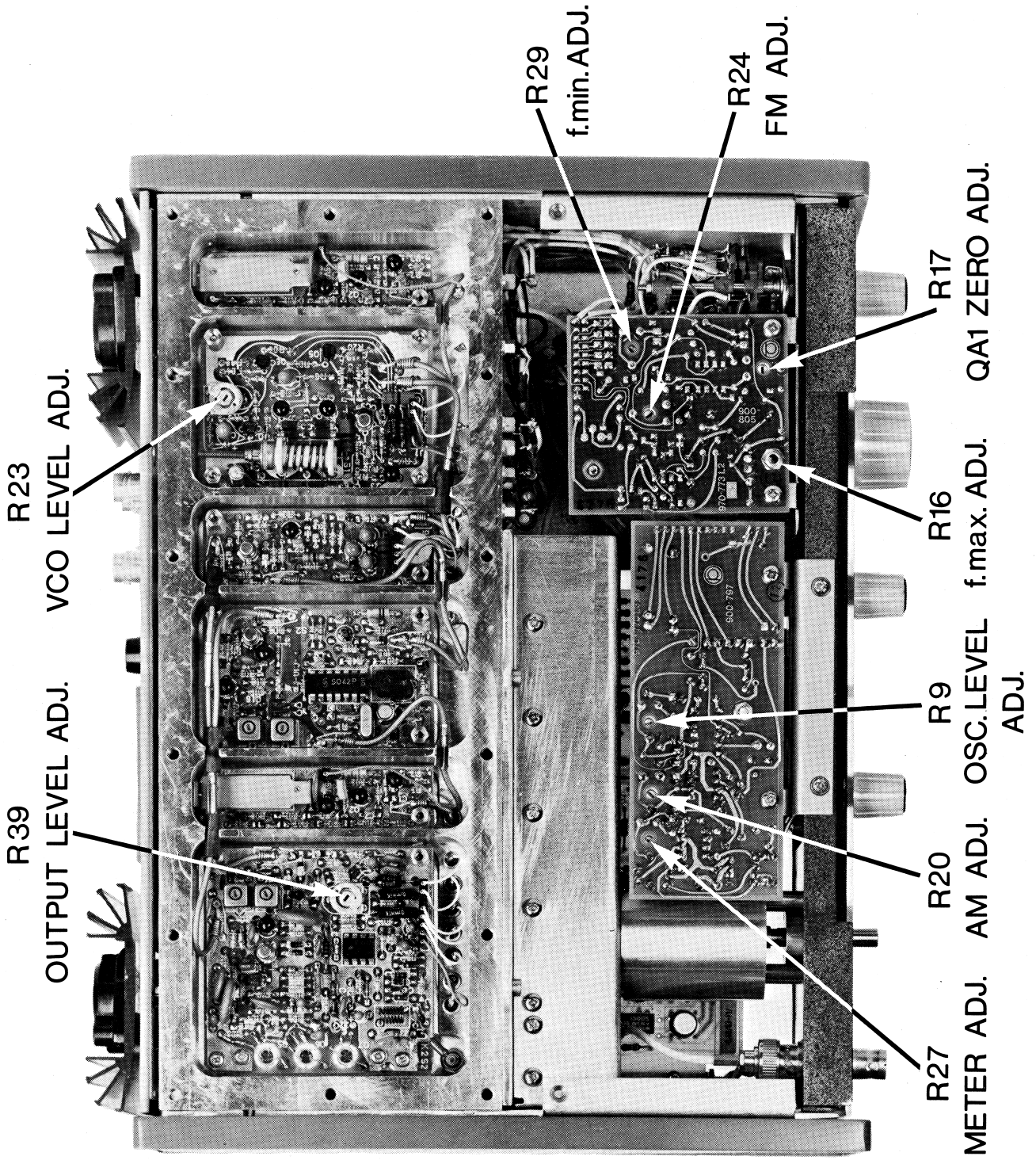


FIG. D5 Adjustment Point Locations

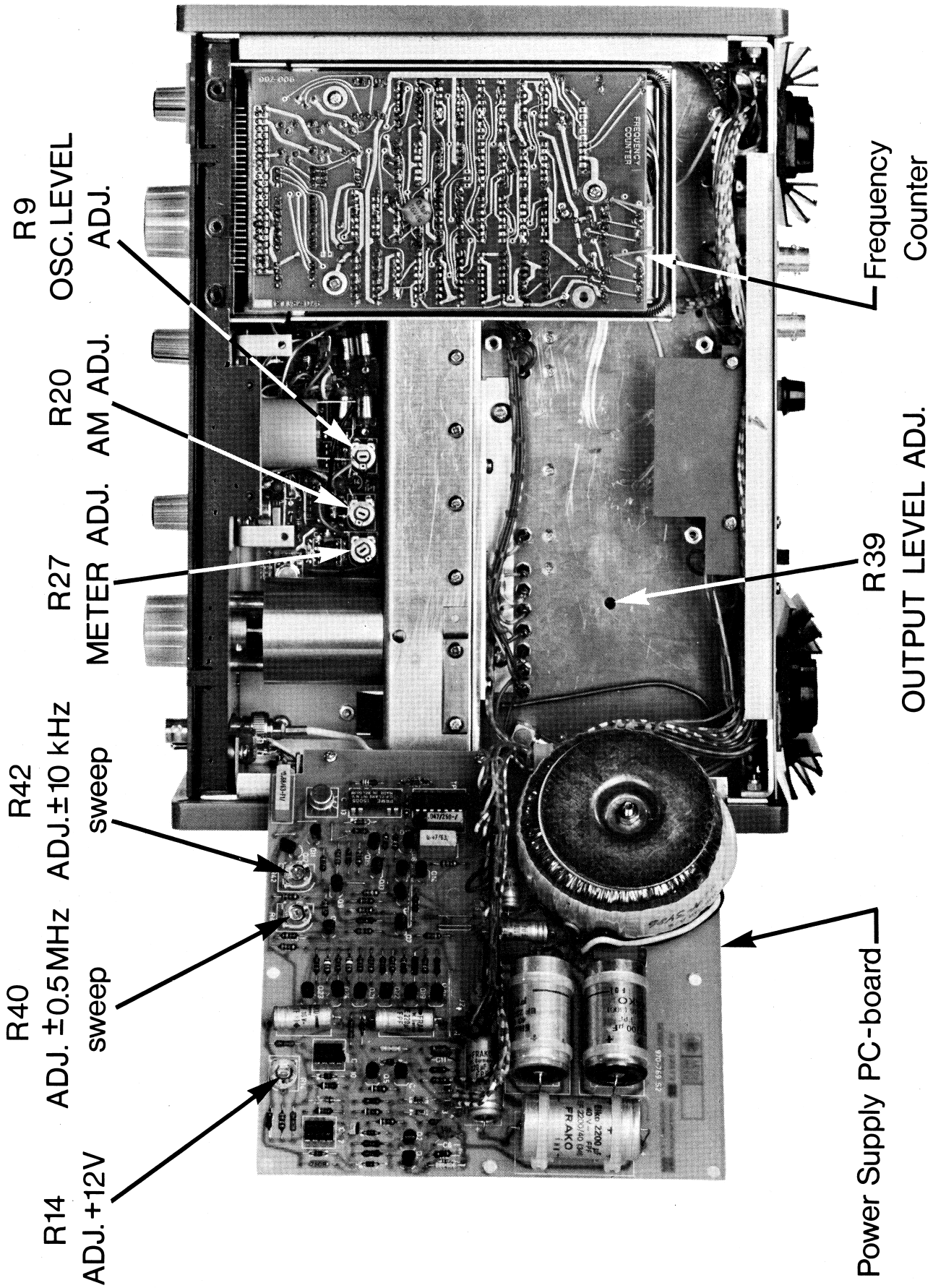


Fig. D6 Adjustment Point Locations

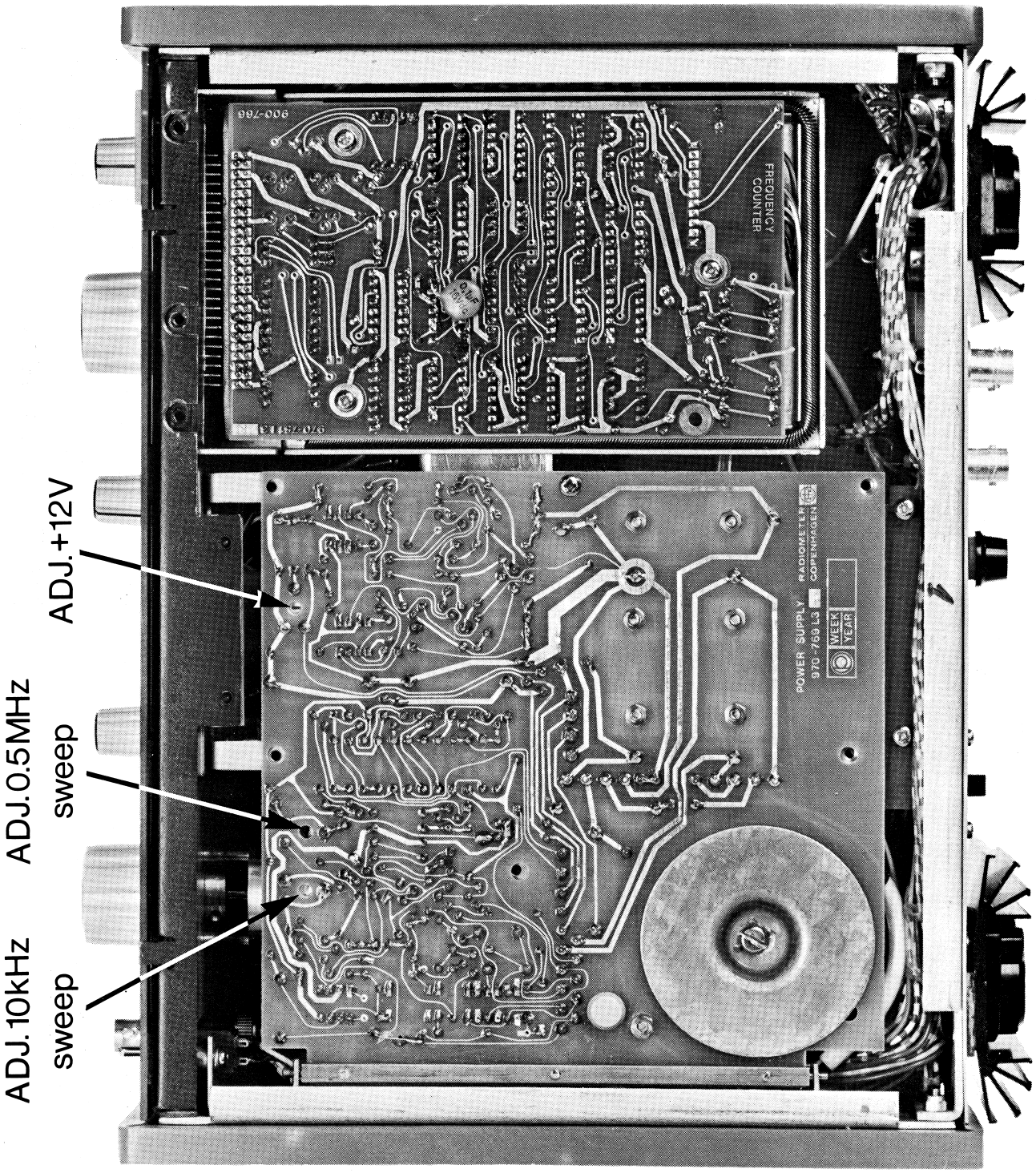


Fig.D7 Top view with Adjustment Point Locations

Section E_____Repair

E I. INTRODUCTION

This section provides information concerning the dismantling and the troubleshooting of the RE101.

Dismantling

This Section provides instructions for dismantling of the instrument and replacement of the modules.

Troubleshooting

Normally fault symptoms concern a particular module. When a faulty module has been found it is replaced, either with a new one, or troubleshooting is performed at the component level, using the schematic diagram (drawing 1836-A1) and the component placement diagrams (Figs. E4 to E7). It is recommended that any defective module is replaced with a Service Replacement supplied from the factory.

In the case of defects developing in the RF-attenuator, it is absolutely necessary that the attenuator or the whole instrument be sent to the Radiometer Service Department for repair.

Colour codes for interconnecting leads, dc potentials (typical values) and RF levels are troubleshooting aids included on the schematic diagram (drawing No. 1836-A1).

E II. DISMANTLING

TOP PLATE

Remove the top plate by unscrewing the two upper screws on the rear panel (see Fig. E1).

BOTTOM PLATE

Remove the two screws securing the plate.

POWER SUPPLY

Power supply can be tilted by removing six screws thus giving access to the interior of the instrument.

SIDE PANELS

Remove the four plugs and four screws on each panel.

FRONT PANEL (see Fig. E2)

1. Remove the top plate, bottom plate and the side panels.
2. Remove the four screws on the top of the Frequency Counter box.
3. Remove the Attenuator button.
4. Remove two countersunk screws on each side of the instrument which secure the front panel.
5. Remove the connector P4 and the pin connectors.
6. The front panel can now be removed.

RF-BOX COVER

Remove the fourteen screws, and lift the cover off.

LID FOR FREQUENCY COUNTER

Remove the four screws on the top of the cover, and remove the lid.

TILTING OF THE REAR PANEL

1. Remove the top plate.
2. Unscrew the two lower screws on the rear panel, see Fig. E1.

REMOVING THE RF ATTENUATOR

1. Remove the front panel as described above.
2. Remove the connector P3.
3. Remove the four screws securing the attenuator.
4. Remove the two screws which secure the output coaxial cable in place.

REMOVING PC-BOARDS

Most of the connections to the PC-boards are provided with pin or coaxial connectors. However, some connections are soldered, for example, to the Output Amplifier and to the Prescaler PC-boards.

Use the following procedure to remove a PC-board in the RF box:

1. Carefully disconnect the pin connectors and the coaxial connectors.
2. Remove the cable clamps.
3. Remove all screws which secure the PC-board to the RF box.
4. Unsolder the soldered connections.
5. Lift the PC-board out of the RF box.
6. To replace the PC-boards, do so in the reverse order. Carefully connect the pin connectors and ensure that they mate correctly. Take special care with the coaxial connectors, as they may be damaged if forced into place or incorrectly positioned.

The complete Modulation Unit and the Frequency Control Unit should be removed as complete unit from the front panel.

Reassembling is performed in the reverse order.

EIII. TROUBLESHOOTING

RECOMMENDED TEST EQUIPMENT

The equipment recommended in Table D 1 should also be used for testing and troubleshooting the RE101. Test equipment other than that listed may be used provided that it has the equivalent specifications.

POWER SUPPLY

A problem in the Power Supply often cause many symptoms which appear in other circuits, therefore always check the Power Supply voltages when a symptom does not clearly indicate a specific problem. The series regulator transistors for the +12 V, -12 V and +5V regulators are located on cooling fins on the rear panel.

FREQUENCY CONTROL UNIT

When troubleshooting the Frequency Control Unit it can be advantageous to loosen the complete front panel from the chassis to achieve better access to the circuits. Refer to Section E II DISMANTLING, FRONT PANEL.

DC levels corresponding to the position of the Frequency Range switch are given in Table E1.

Table E1. DC levels at the output terminals

Frequency Range	Approx. dc levels for VCO tuning		Logical level on terminals			
Position	Terminal 4b fmin.	fmax.	4a	5b	6b	7b
0.15 - 0.4 MHz	7.01 V	7.12 V	1	1	0	1
0.4 - 1.8 MHz	7.07 V	7.6 V	1	1	1	1
1.8 - 10 MHz	7.3 V	9.4 V	1	1	1	1
10 - 20 MHz	9 V	11.5 V	1	1	1	1
20 - 30 MHz	11.3 V	13.6 V	1	1	1	1
86 - 130 MHz	4.1 V	13.6 V	0	0	1	1
10 - 11.5 MHz	9 V	9.6 V	0	1	1	1
RF OFF	-		-	-	-	0
REMOTE	Depends upon signals on Remote Input lines					1

RF CIRCUITS

Troubleshooting in the RF box is made easier by measuring the RF levels, starting at the VCO output and then continuing through all the RF circuits. The signal levels are measured at the interconnection cables between the modules.

Typical signal levels are shown on the schematic drawing. At some points special attention must be paid to correct dc loading, see Table E2.

When a module seems to fail, measurements of the dc potentials will usually lead to the trouble.

Table E2

Module	Test Point	Level into 50 Ω	Freq. Range	Remarks
VCO	W1	-6 dBm	all	Level at W1 is adjusted with R23
	W2	-16 dBm		
AM-modulator	W2	≥ -12 dBm	10-20 MHz	FL6 grounded. The load should have dc continuity
	W3	≥ -12 dBm	86-130 MHz	
Converter	W3	≥ -10 dBm	10-20 MHz	330 Ω to + 12 V (across R25). The load should not allow dc passage. FL6 grounded.
Converter	W1	-16 dBm	all	Level adjusted to max. with L1.
Prescaler 8.6 to 13 MHz	J1	-3 dBm	all	J1 and J2 are located on top of the RF box.
Prescaler (10 MHz)	J2	-3 dBm	all	

Frequency Converter (see Table E2)

The crystal oscillator frequency should be adjusted to maximum level on W1 by adjusting L_1. Check that the frequency is within limits at the prescaler output J2. The frequency should be between 10.002 and 9.998 MHz. If necessary, a compromise must be made between the frequency accuracy and the maximum output level.

Adjustment of the filter (L_3 and L_4) is only necessary if any of the filter components have been replaced. Adjustment is made in the following manner:

1. Connect a Signal Generator via 1 kΩ resistor to the pin marked TP on the schematic diagram. The level should be approx. 0 dBm.
2. Solded a 330 Ω resistor in parallel with R_{25}.
3. Connect a Spectrum Analyzer (ac-coupled) to W3.
4. With the Signal Generator tuned to 41.3 MHz, L_3 should be adjusted to a minimum signal on the Spectrum Analyzer.
5. With the signal generator tuned to 60 MHz, L_4 should be adjusted to minimum output signal.
6. Remove both the 1 kΩ and the 330 Ω resistors,

Output Amplifier

The PIN-diode switch which determines whether the signal is fed through the Converter or not is tested in the following manner:

1. Apply an RF signal to the input connector W2. The frequency should be approx. 100 MHz and the level approx. - 12 dBm.
2. Set the Frequency Range switch to 86 - 130 MHz. With the RE101 attenuator set to max. output level, there should be approx. 1 V EMF at the RF OUT. connector (0.5 V into a load of 75 Ω).
3. Set the Frequency Range switch to one of the other ranges (converter ON). The output level should now decline by 50 to 60 dB.
4. Apply an RF signal to the input connector W1. The frequency should be between 0.1 and 30 MHz and the level approx. - 10 dBm.
5. Set the Frequency Range switch to 20 to 30 MHz. The level at the RF output terminal should now be approx. 1 V EMF.
6. Set the Frequency Range switch to the range 86 to 130 MHz and the output level should decrease by at least 50 dB.

If any of the components in the filter (L_1, L_2) are replaced, the filter should be re-adjusted. This is done in the following manner:

1. Apply an RF signal via a 1 kΩ to the input connector W1. The RF level should be about 0 dBm.
2. Connect a spectrum analyzer to the RF output terminal.
3. Set the input frequency to 41.3 MHz.
4. Adjust L_1 to minimum output by carefully tuning the core.
5. Set the input frequency to 60 MHz.
6. Adjust L_2 for minimum output by carefully tuning the core.

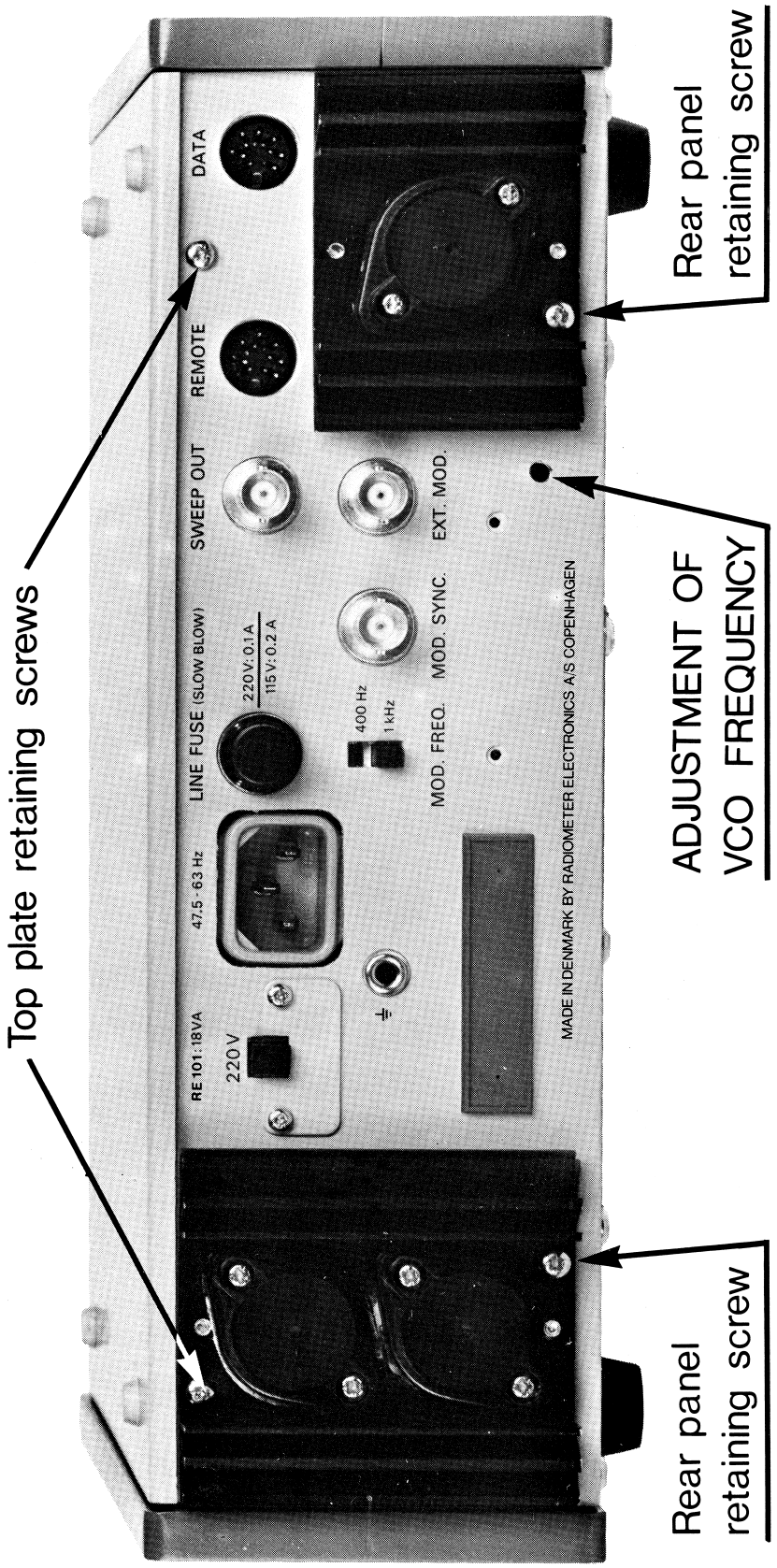


Fig.E1 Rear view.

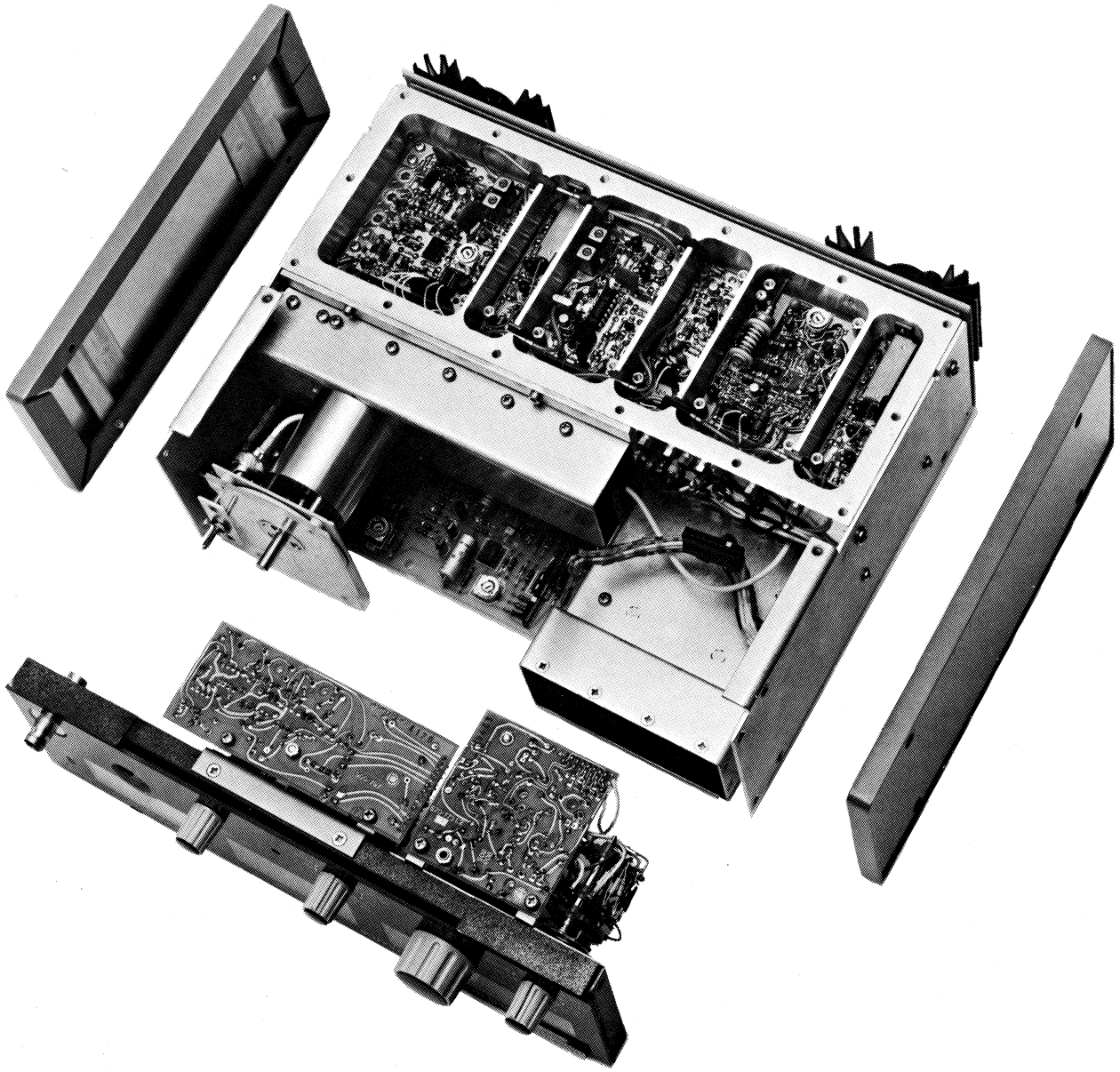


Fig. E 2 The RE 101 disassembled

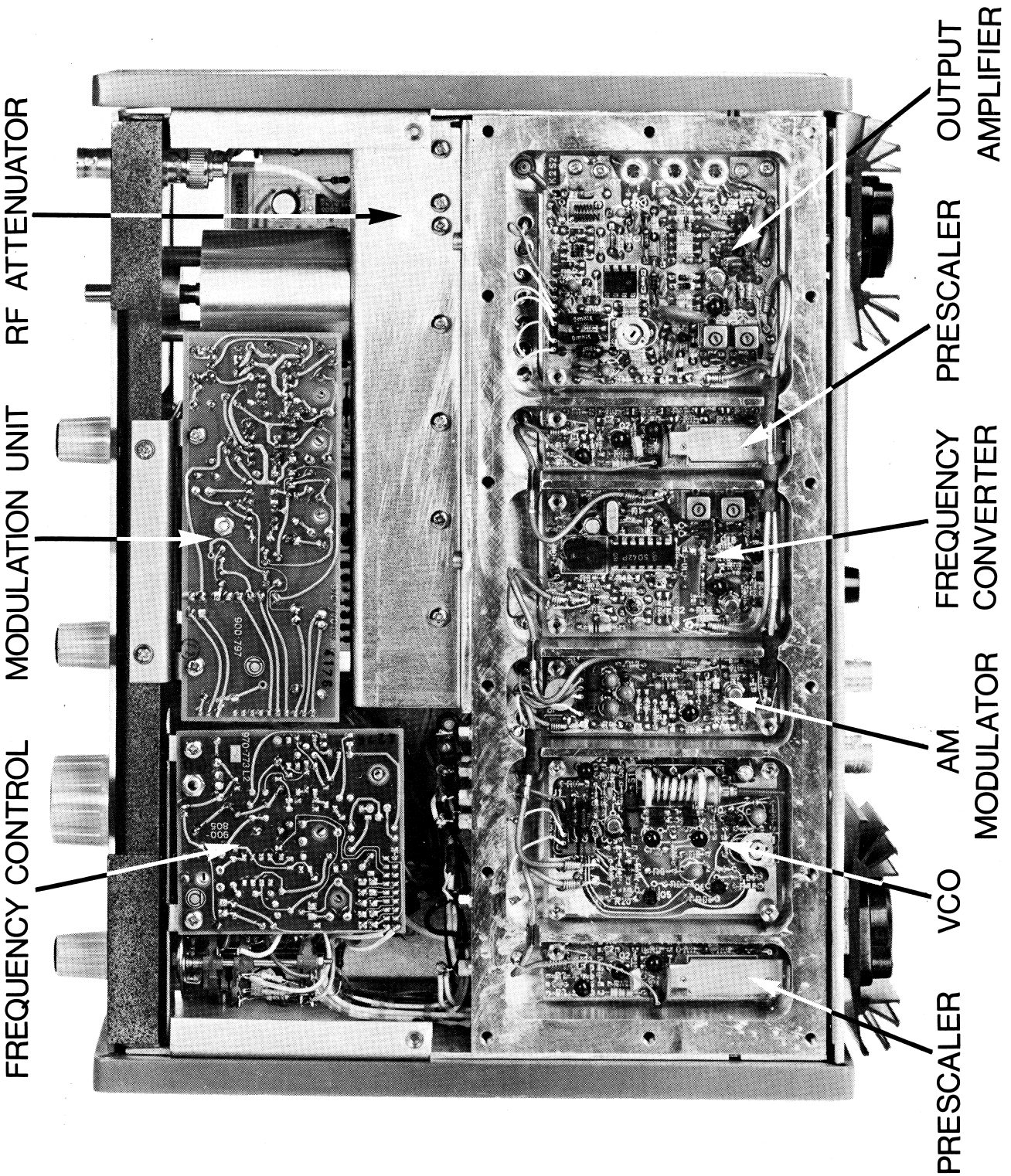


Fig. E3 Component and Assembly Locations.

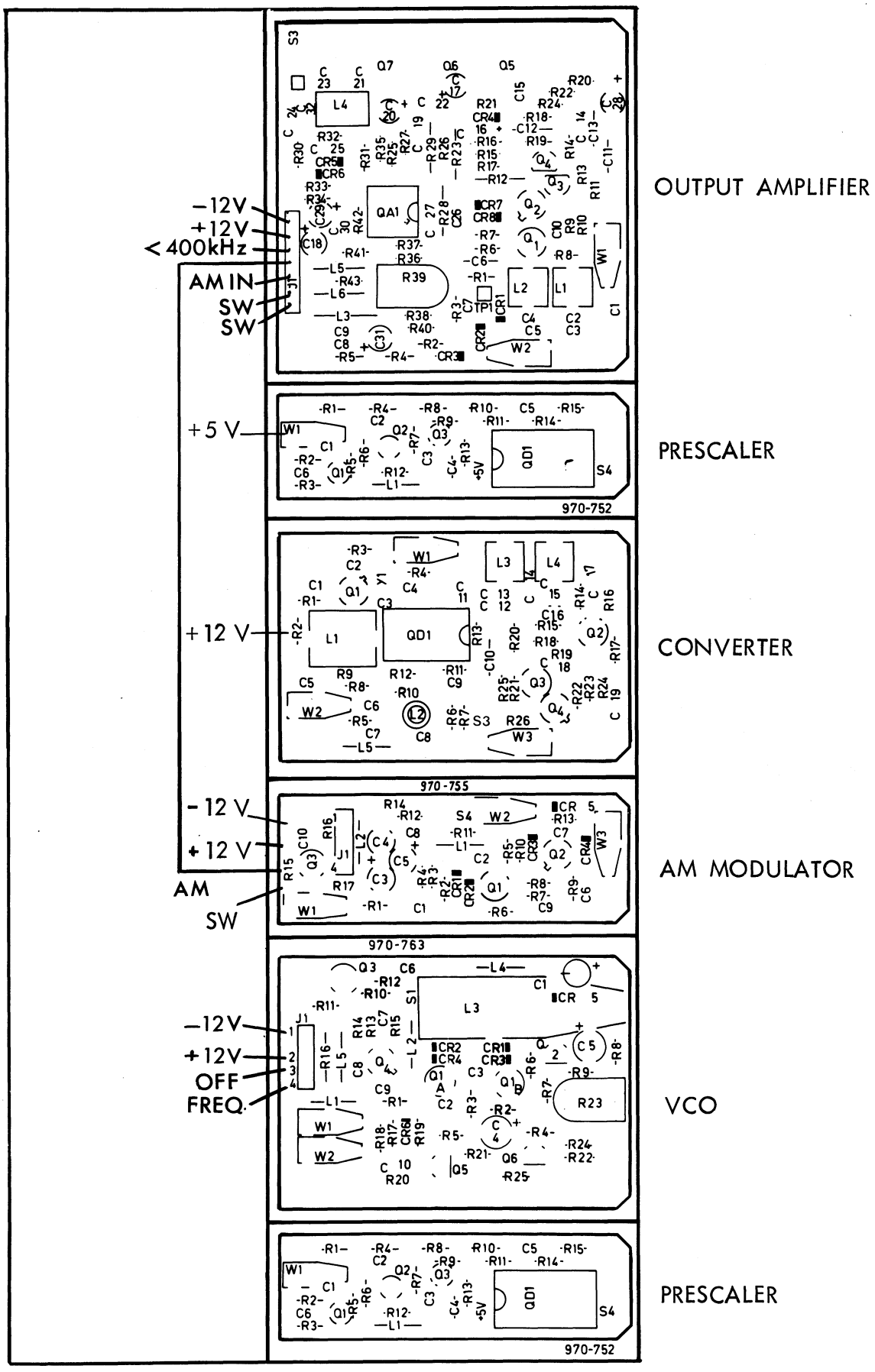


Fig. E4 Circuits Component Placement.

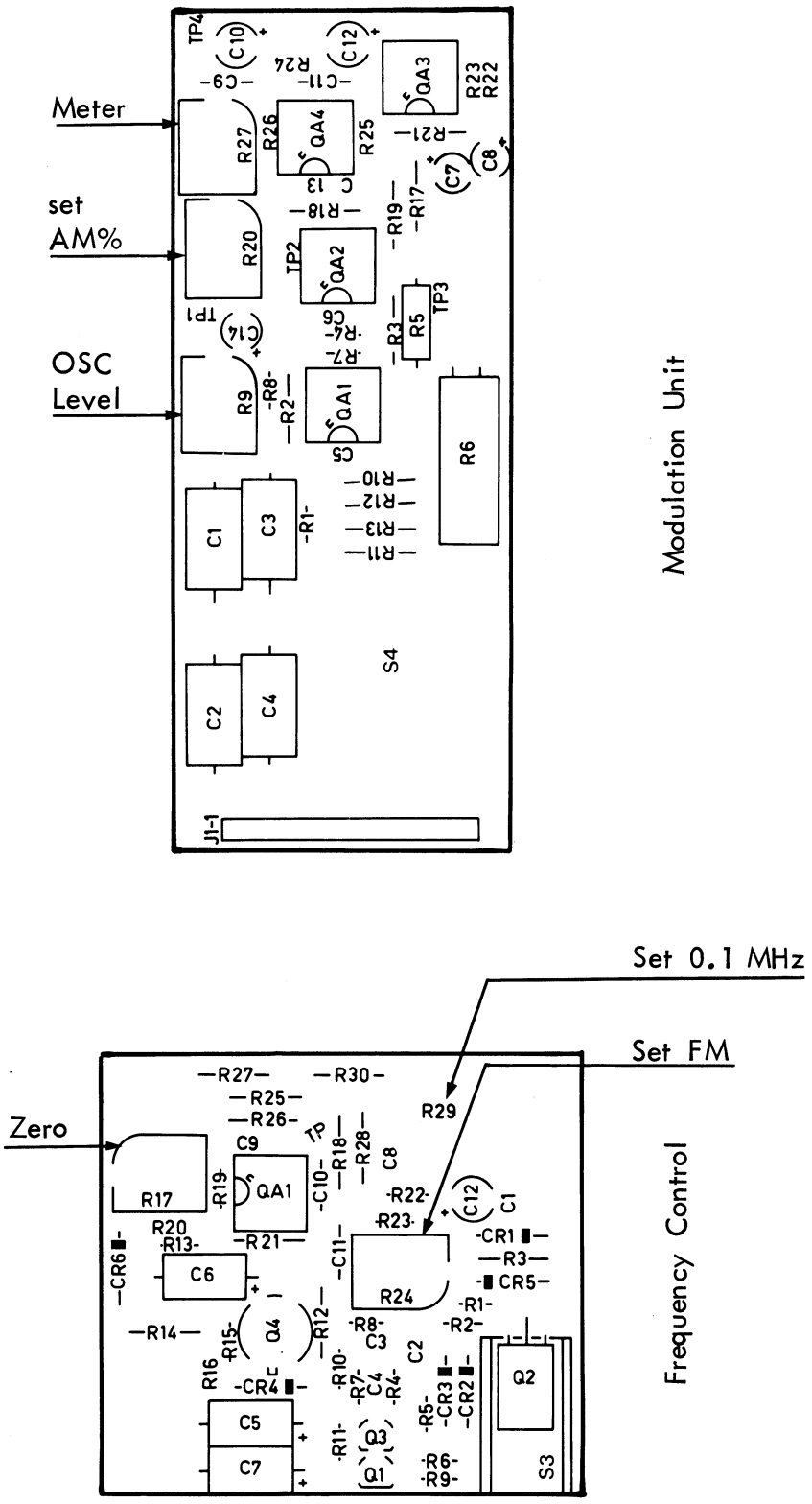


Fig. E5 AF Circuit Component Locations.

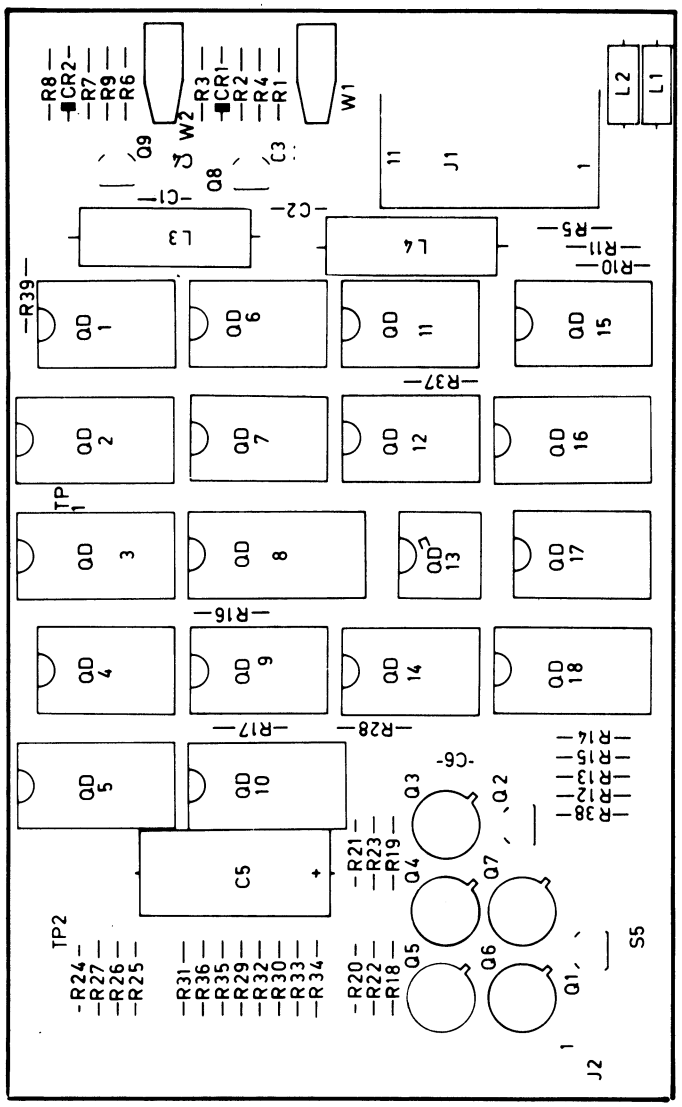


Fig. E6 Frequency Counter and Display Component Locations.

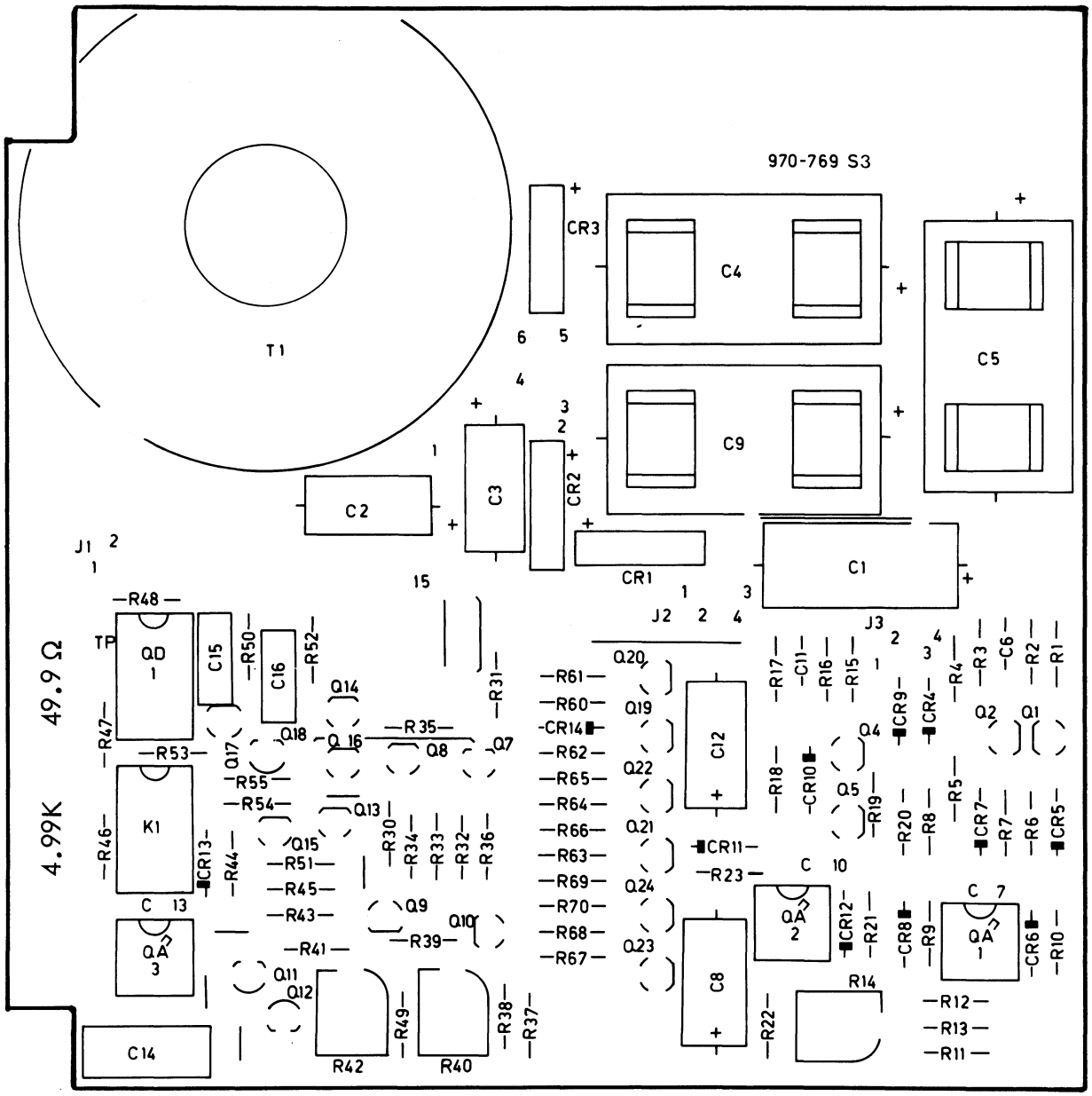


Fig. E7 Component Placement for Power Supply.

E IV. PARTS LIST

All electronic components and the most important mechanical parts are included in the parts list. Parts marked with an x are manufacture by Radiometer. Measurements of mechanical components are given in millimeters unless otherwise specified.

As we are continually improving our instruments, it is important, when ordering spare parts, that you include the following information:

The code number and description of the part.
The circuit reference from the schematic diagram.
The complete type designation of your instrument.
The serial number of your instrument.

MOUNTED UNITS

	Unit	Code No.
x	Frequency Counter	900-766
x	Prescaler	900-770
x	Converter	900-712
x	AM Modulator	900-777
x	Output Amplifier	900-786
x	VCO	900-787
x	Power Supply	900-795
x	Modulation Unit	900-797
x	Frequency Control	900-805
x	Attenuator	900-807

MAIN PARTS LIST

CAPACITORS

Designation					Code No.
C1	Ceramic,	82	pF	5%	211-282
C17, 18	Ceramic,	0.1	µF	-20 +30% 30 V	213-009

FILTERS

Designation	Description				Code No.
FL 1,3,4,5,7, 8,9,10,11,12, 13,16,17,18, 21,22,23,24, 26,27,28,29	Ceramic π - filter,	2 x 1.5	nF	250 V	216-001
FL2,6,14,15,25	Ceramic π - filter,	2 x 100	pF	250 V	216-004

FUSES

Designation	Description		Code No.
F1	100 mA slow blow	220 V	450-010
F1 ·	200 mA slow blow	115 V	450-113

CONNECTORS and PLUGS

Designation	Description		Code No.
J1	Coaxial connector	50 Ω	800-313
J2	Coaxial connector	50 Ω	800-312
J3	Coaxial connector	50 Ω	800-306
J4	Coaxial interconnection plug	75 Ω	800-112
J5,6	Multiconnector, 7-pole, female		805-475
J7,8,9	Coaxial connector BNC UG 657/u		800-108
J10	Telephone jack		803-240
J11	Line Cord Receptacle, 3-pole, U/CSA		802-212
P1,2	Coaxial plug	50 Ω	800-314

COILS

Designation	Description				Code No.
L1	HF mini choke	15	mH	20%	703-026
L2	HF mini choke	15	µH	20%	703-020
L3, L4	HF mini choke	17	µH		703-008

TRANSISTORS and IC's

Designation	Description	Code No.
Q3	BDX 62	360-181
Q6	BDX 62	360-182
QA4	Regulator LM 309K	364-029

SWITCHES

Designation	Description	Code No.
S1	Power switch, 2-pole, 3A/250 V ac	500-201
S2	Slide switch, line, CSA	500-111
S3	Slide switch	510-204

CABLES

Designation	Description	Code No.
W1	Coaxial RG 196/u (0.21 m)	600-014
W2	Coaxial RG 196/u (0.15 m)	600-014

MISCELLANEOUS

Description	Code No.
Bayonet head for fuse holder	460-006
Bayonet head for fuse holder	460-008
Base for fuse holder	460-007
House for multiplug, 11-pole	805-685
House for multiplug, 8-pole	805-686
House for multiplug, 2 x 10-pole	805-729

MISCELLANEOUS (cont'd.)

Designation		Code No.
House for multiplug, 5-pole		805-743
House for multiplug, 14-pole		805-746
Teflon stand off		823-905
EMI Gasket		837-804
Wire gauze	35.5 x 92	837-805

FREQUENCY COUNTER (900-766)

CAPACITORS

Designation	Description					Code No.
C1,2,6	Ceramic	0.1	µF	-20 +80%	12 V	213-017
C3,4	Ceramic	1	nF	-20 +80%	25 V	213-013
C5	Electrolytic	1000	µF		6 V	260-043

DIODES

Designation	Description	Code No.
CR1,2	Hot carrier diode, HP 5082-2811	350-032

LAMPS

Designation	Description	Code No.
I1,2	Lamp, 5 V, 60 mA	401-002

RACKS

Designation	Description	Code No.
J1	Terminal rack, 36-pole	805-716
J2	Terminal rack, 25-pole	805-486

COILS

Designation	Description			Code No.
L1,2	HF mini choke	47 µH	10%	703-008
L3,4	HF mini choke	22 µH	10%	

TRANSISTORS

Designation	Description	Code No.
Q1,2,8,9	BC 547B	360-159
Q3,4,5,6,7	ZN 2905A	360-073

INTERGRATED CIRCUITS

Designation	Description	Code No.
QD1	SN74LS90N	364-187
QD2,3,18	LOC MOS HEF4518P	364-226
QD4,6,7,12	LOC MOS HEF4011P	364-221
QD5	SN74LS42N	364-092
QD8	LOC MOS GZF1201P	364-225
QD9	SN74LS93N	364-220
QD10	SN7447AN	364-134
QD11	SN74LS04N	364-219
QD13	SN75452B	364-072
QD14	SN74LS00N	364-213
QD15	LOC MOS HEF4013P	364-222
QD16	LOC MOS HEF4049P	364-224
QD17	LOC MOS HEF4023P	364-223
QD20-24	LED Diaplay DL-707R	364-149

RESISTORS

Designation	Description				Code No.
R1,6	Carbon film, 47E	5%	0.2	W	106-247
R2,7	Carbon film, 15 K	5%	0.2	W	106-515
R3,8	Carbon film, 470E	5%	0.2	W	106-347

RESISTORS (cont'd.)

Designation	Description				Code No.
R4,9	Carbon film, 6K8	5%	0.2 W		106-468
R5,10,11	Carbon film, 1K	5%	0.2 W		106-410
R12,17	Carbon film, 3K9	5%	0.2 W		106-439
R13,38	Carbon film, 100E	5%	0.2 W		106-310
R14	Carbon film, 330E	5%	0.2 W		106-330
R15	Carbon film, 1K5	5%	0.2 W		106-415
R16,37,39	Carbon film, 10K	5%	0.2 W		106-510
R18,20,22, 24,27	Carbon film, 390E	5%	0.2 W		106-339
R19,21,23, 25,26	Carbon film, 2K2	5%	0.2 W		106-422
R28,29	Carbon film, 4K7	5%	0.2 W		106-447
R30,31,32,33, 34, 35, 36	Carbon film, 56E	5%	0.2 W		106-256

PRESCALER (900-770)

CAPACITORS

Designation	Description						Code No.
C1,2,5,6	Ceramic	1	nF	-20 +80%	25	V	213-013
C3	Ceramic	22	nF	-20 +100%	40	V	213-011
C4	Ceramic	0.1	µF	-20 +80%	12	V	213-017

COILS

Designation	Description			Code No.
L1	HF mini choke	22 µH	10%	703-011
L2	Ferrite tube, ø 1.2/3.7 x 3.5 mm			704-305

TRANSISTORS

Designation	Description	Code No.
Q1,2,3	BF 274	360-123

INTEGRATED CIRCUITS

Designation	Description	Code No.
QD1	ECL Prescaler 95H90	364-105

RESISTORS

Designation	Description	Code No.
R1	Carbon film, 1K8 5% 0.1 W	107-418
R2,5,10,15	Carbon film, 47E 5% 0.1 W	107-247
R3,8,9	Carbon film, 470E 5% 0.1 W	107-347
R4	Carbon film, 1K2 5% 0.1 W	107-412
R6	Carbon film, 680E 5% 0.1 W	107-368
R7,11	Carbon film, 560E 5% 0.1 W	107-356
R12	Carbon film, 180E 5% 0.1 W	107-318
R13	Carbon film, 150E 5% 0.1 W	107-315
R14	Carbon film, 1K 5% 0.1 W	107-410

CABLES

Designation	Description	Code No.
W1	Coaxial cable, 50 Ω with connector, male	616-064

CONVERTER (900-772)

CAPACITORS

Designation	Description	Code No.
C1,5,6,7,8,9	Ceramic 1 nF -20 +80% 25 V	213-013
C2	Ceramic 22 pF 2% 63 V NPO	213-206
C3	Ceramic 18 pF 2% 100 V NPO	213-222
C4,14	Ceramic 68 pF 2% 63 V NPO	213-215
C10	Ceramic 47 nF -20 +80% 30 V	213-016
C11	Ceramic 2.2 nF -20 +80% 25 V	213-012
C12	Ceramic 56 pF 2% 63 V NPO	213-210

CAPACITORS (cont'd.)

Designation	Description						Code No.
C13	Ceramic	27	pF	2%	63	V NPO	213-207
C15	Ceramic	12	pF	2%	100	V	213-227
C16	Ceramic	33	pF	2%	63	V	213-208
C17,19	Ceramic	22	nF	-20 +100%	100	V	213-011
C18	Ceramic	4.7	nF	-20 +80%	40	V	213-010

COILS

	Designation	Description	Code No.
<	L1	Oscillator coil	12267-A4
<	L2	Transformer	12268-A4
<	L3	Filter coil 542nH	12269-A4
<	L4	Filter coil 586nH	12269-A4
	L5	HF mini choke 47 µH 10%	703-008
	L6	Ferrite tube, ø 1.2/3.5 x 3.2	704-305

TRANSISTORS

Designation	Description	Code No.
Q1	BF 272	360-115
Q2,3	BF 274	360-123
Q4	BFY 90	360-071

INTEGRATED CIRCUITS

Designation	Description	Code No.
QA1	Mixer S O42P	364-152

RESISTORS

Designation	Description				Code No.
R1	Carbon film	5K6	5%	0.1 W	107-456
R2	Carbon film	10K	5%	0.1 W	107-510
R3	Carbon film	12K	5%	0.1 W	107-512
R4	Carbon film	47E	5%	0.1 W	107-247
R5, 14, 19, 24	Carbon film	100E	5%	0.1 W	107-310
R6, 7, 8, 9, 26	Carbon film	56E	5%	0.1 W	107-256
R10	Carbon film	270E	5%	0.1 W	107-327
R11, 12, 20	Carbon film	390E	5%	0.1 W	107-339
R13	Carbon film	2K2	5%	0.1 W	107-422
R15	Carbon film	1K5	5%	0.1 W	107-415
R16	Carbon film	3K3	5%	0.1 W	107-433
R17, 21	Carbon film	6K8	5%	0.1 W	107-468
R18, 22	Carbon film	1K	5%	0.1 W	107-410
R23	Carbon film	220E	5%	0.1 W	107-322
R25	Carbon film	1K8	5%	0.1 W	107-418

CABLES

Designation	Description	Code No.
W1, 3	Coaxial cable, 50 Ω with connector, female	616-065
W2	Coaxial cable, 50 Ω with connector, male	616-064

CRYSTAL

Designation	Description	Code No.
Y1	Quartz crystal, 100 MHz	910-112

AM MODULATOR (900-777)

CAPACITORS

Designation	Description				Code No.
C1, 2, 6, 7, 10	Ceramic	1 nF	-20 +100%	20 V	213-013
C3, 4	Tantalum	4.7 µF	20%	25 V	267-004
C5	Tantalum	22 µF	20%	15 V	267-019
C8	Ceramic	4.7 nF	-20 +100%	40 V	213-010
C9	Ceramic	1.5 pF	±0.25 pF	100 V	213-221

DIODES

Designation	Description	Code No.
CR1, 2, 3, 4, 5	PIN diode BA 379	350-038

COILS

Designation	Description			Code No.
L1	HF mini choke	100 µH	10%	703-009
L2	HF mini choke	15 µH	20%	703-020

TRANSISTORS

Designation	Description	Code No.
Q1, 3	BF 274	360-123
Q2	BFW 30	360-093

RESISTORS

Designation	Description				Code No.
R1	Carbon film	100E	5%	0.1 W	107-310
R2	Carbon film	11K	5%	0.1 W	107-522
R3	Carbon film	8K2	5%	0.1 W	107-482
R4	Carbon film	39K	5%	0.1 W	107-539
R5, 16	Carbon film	1K8	5%	0.1 W	107-418

RESISTORS (cont'd.)

Designation	Description				Code No.
R6	Carbon film	150E	5%	0.1 W	107-315
R7	Carbon film	470E	5%	0.1 W	107-347
R8	Carbon film	3K9	5%	0.1 W	107-439
R9, 14	Carbon film	560E	5%	0.1 W	107-356
R10	Carbon film	180E	5%	0.1 W	107-318
R11	Carbon film	5K6	5%	0.1 W	107-456
R12	Carbon film	10K	5%	0.1 W	107-510
R13	Carbon film	680E	5%	0.1 W	107-368
R15	Carbon film	47E	5%	0.1 W	107-247
R17	Carbon film	1K	5%	0.1 W	107-410

CABLES

Designation	Description	Code No.
W1	Coaxial cable, 50 Ω with connector, male	616-064
W2, 3	Coaxial cable, 50 Ω with connector, female	616-065

OUTPUT AMPLIFIER (900-786)

CAPACITORS

Designation	Description							Code No.
C1	Ceramic	56	pF	2%	63	V	NPO	213-210
C2	Ceramic	27	pF	2%	63	V	NPO	213-207
C3	Ceramic	68	pF	2%	63	V	NPO	213-215
C4, 27	Ceramic	12	pF	2%	100	V	NPO	213-227
C5	Ceramic	33	pF	2%	63	V	NPO	213-208
C6, 13	Ceramic	0.1	µF	-20 +80%	30	V		213-009
C7, 8, 9, 10, 15, 19, 26	Ceramic	4.7	nF	-20+100%	40	V		213-010
C11, 12	Ceramic	47	nF	-20 +80%	30	V		213-016
C14, 24	Ceramic	10	pF	2%	63	V		213-205

CAPACITORS (cont'd.)

Designation	Description						Code No.
C16, 17, 18, 20, 28, 29	Ceramic	2.2	µF	-20 +50%	25 V		267-007
C21	Ceramic	22	nF	-20 +100%	40 V		213-011
C22	Ceramic	2.7	nF	±0.02 pF	100 V	NPO	213-201
C23	Ceramic	4.7	pF	±0.25 pF	100 V	NPO	213-203
C25	Ceramic	22	pF	2%	63 V	NPO	213-206
C30	Ceramic	1	nF	-20+100%	25 V		213-013
C31	Tantalum	1	µF	-20 +50%	35 V		267-006
C32	Ceramic	1	pF	±0.25 pF	100 V	P100	213-220

DIODES

Designation	Description	Code No.
CR1, 2, 3	PIN diode BA 379	350-038
CR4	diode BAV 10	350-022
CR5, 6, 7, 8	Hot carrier diode HP 5082-2811	350-032

COILS

Designation	Description				Code No.
L1	Filter coil	542	nH		12351-A4
L2	Filter coil	586	nH		12351-A4
L3	HF mini choke	470	µH	10%	703-014
L4	Filter coil	133	nH		12270-A4
L5, 6	HF mini choke	100	µH	10%	703-009

TRANSISTORS

Designation	Description	Code No.
Q1	BF 274	360-123
Q2, 6	BFY 90	360-071
Q3, 4	BC 557B	360-160

TRANSISTORS (cont'd.)

Designation	Description	Code No.
Q5	BFW 30	360-093
Q7	BFR 99	360-189

INTEGRATED CIRCUITS

Designation	Description	Code No.
QA1	LM 301 AN	364-016

RESISTORS

Designation	Description					Code No.
R1	Carbon film	33E	5%	0.1 W		107-233
R2,4,27	Carbon film	390E	5%	0.1 W		107-339
R3	Carbon film	680E	5%	0.1 W		107-368
R5,30	Carbon film	220E	5%	0.1 W		107-322
R6,8	Carbon film	47E	5%	0.1 W		107-247
R7	Carbon film	1K8	5%	0.1 W		107-418
R9	Carbon film	330E	5%	0.1 W		107-333
R10,41	Carbon film	3K9	5%	0.1 W		107-439
R11,21	Carbon film	1K	5%	0.1 W		107-410
R12	Carbon film	220E	5%	0.2 W		106-322
R13,26	Carbon film	100F	5%	0.1 W		107-310
R11	Carbon film	2K7	5%	0.1 W		107-247
R15	Carbon film	22K	5%	0.1 W		107-522
R16	Carbon film	1M	10%	0.1 W		107-710
R17,20	Carbon film	2K2	5%	0.1 W		107-422
R18,40,43	Carbon film	5K6	5%	0.1 W		107-456
R19	Carbon film	68K	5%	0.1 W		107-568
R22	Carbon film	27E	5%	0.1 W		107-227
R23	Metal film	910E	1%	0.1 W	TK50	140-410
R24,25	Carbon film	1K5	5%	0.1 W		107-415
R28	Carbon film	180E	5%	0.2 W		106-318

RESISTORS (cont'd.)

Designation	Description				Code No.
R29	Carbon film	150E	5%	0.2 W	106-315
R31	Carbon film	10K	5%	0.1 W	107-510
R32,35	Carbon film	15M	10%	0.1 W	109-016
R33	Carbon film	8M2	10%	0.1 W	109-017
R34	Carbon film	56K	5%	0.1 W	107-556
R36	Carbon film	6K8	5%	0.1 W	107-468
R37	Carbon film	18K	5%	0.1 W	107-518
R38	Carbon film	27K	5%	0.1 W	107-527
R39	Potentiometer	10K	20%	0.5 W	182-008
R42	Carbon film	470K	5%	0.1 W	107-647
R44	Metal film	91E	1%	0.1 W	140-506

CABLES

Designation	Description	Code No.
W1,2	Coaxial cable, 50Ω, with connector, male	616-064

VCO (900-787)

CAPACITORS

Designation	Description						Code No.
C1	Electrolyte	22	µF		12 V		260-061
C2,3	Ceramic	3.3	pF	±25 pF	63 V	P100	213-202
C4	Tantalum	10	µF	-20 +50%	15 V		267-000
C5	Tantalum	100	µF	-20 +50%	3 V		267-011
C6,7,8,10	Ceramic	27	pF	2%		NPO	213-207

DIODES

Designation	Description	Code No.
CR1,2,3,4,5	Capacitance diode, quartet 4BB106	350-035
CR6	Hot carrier diode HP5082-2811	350-032

COILS

Designation	Description	Code No.
L1,2,4	HF mini choke 15 µH 20%	703-020
L3	Oscillator coil	12271-A4
L5	HF mini choke 100 µH 10%	703-009

TRANSISTORS

Designation	Description	Code No.
Q1A, Q1B	FET 2 x 1994E	360-152
Q2, 5	BC 547B	360-159
Q3	BF 274	360-123
Q4	BFW 30	360-093
Q6	BC 557B	360-160

RESISTORS

Designation	Description				Code No.
R1, 18	Carbon film	330E	5%	0.1 W	107-333
R2, 3	Carbon film	82K	5%	0.1 W	107-582
R4, 14	Carbon film	3K9	5%	0.1 W	107-439
R5	Carbon film	5K6	5%	0.1 W	107-456
R6	Carbon film	680E	5%	0.1 W	107-368
R7, 10	Carbon film	100E	5%	0.1 W	107-310
R8, 21	Carbon film	8K2	5%	0.1 W	107-482
R9	Carbon film	39K	5%	0.1 W	107-539
R11	Carbon film	1K8	5%	0.1 W	107-418
R12, 17	Carbon film	47E	5%	0.1 W	107-247
R13	Carbon film	220E	5%	0.1 W	107-322
R15	Carbon film	560E	5%	0.1 W	107-356
R16	Carbon film	180E	5%	0.2 W	106-318
R19	Carbon film	10K	5%	0.1 W	107-510
R20, 24, 25	Carbon film	1M	10%	0.1 W	107-710
R22	Carbon film	33E	5%	0.1 W	107-233
R23	Potentiometer	47K	20%	0.5 W	182-010

CABLES

Designation	Description	Code No.
W1, 2	Coaxial cable, 50 Ω, with connector, female	616-065

POWER SUPPLY (900-795)

CAPACITORS

Designation	Description						Code No.
C1	Electrolyte	220	µF		63 V		260-017
C2, 3	Electrolyte	100	µF		35 V		260-013
C4	Electrolyte	4700	µF		16 V		260-055
C5, 9	Electrolyte	2200	µF		35 V		260-053
C6, 11	Ceramic	10	nF	-20 +80%	30 V		213-020
C7, 10	Ceramic	33	pF	2%		NPO	213-208
C8, 12	Electrolyte	220	µF		16 V		260-037
C14	Polyester	0.68	µF	10%	63 V		241-030
C15	Polyester	47	nF	10%	250 V		241-049
C16	Polyester	0.47	µF	10%	63 V		241-038

DIODES

Designation	Description		Code No.
CR1, 2, 3	Rectifier	BY164	340-208
CR4, 9	Zener diode	C9V1-0.4	350-606
CR5, 6, 7, 10 11, 12, 13	Diode	BAX16	350-023
CR8	Reference zenerdiode	1N3497	350-637
CR14	Zenerdiode	C3V3-0.4	350-625

RELAYS

Designation	Description	Code No.
K1	Reed relay	570-053

TRANSISTORS

Designation	Description	Code No.
Q1,4,7,9,14, 16, 19, 21, 23	BC 557B	360-160
Q2,5,8,10,13, 15,17,20,22,24	BC 547B	360-159
Q11, 12, 18	J 109-18	360-188

INTEGRATED CIRCUITS

Designation	Description	Code No.
QA1, 2	LM 301AN	364-016
QA3	LF 356	364-023
QD1	SN 7412N	364-044

RESISTORS

Designation	Description					Code No.
R1	Carbon film	2E2	5%	0.33	W	106-122
R2, 17	Carbon film	47E	5%	0.2	W	106-247
R3, 16, 20	Carbon film	1K	5%	0.2	W	106-410
R4, 15	Carbon film	1K8	5%	0.2	W	106-418
R5, 8, 19	Carbon film	470E	5%	0.2	W	106-347
R6, 7, 32, 50, 61, 64	Carbon film	10K	5%	0.2	W	106-510
R9, 21	Carbon film	4K7	5%	0.2	W	106-147
R10	Metal film	750E	0.5%	1/8	W	140-765
R11	Metal film	9K31	1%	0.1	W	140-878
R12, 22, 23	Metal film	10K	1%	0.1	W	140-423
R13	Carbon film	68K	5%	0.2	W	106-568
R14, 40	Potentiometer	10K	20%	0.5	W	182-008
R18	Carbon film	3E3	5%	0.2	W	106-133
R30, 31	Carbon film	22K	5%	0.2	W	106-522
R33, 37, 48, 49, 51, 52	Carbon film	6K8	5%	0.2	W	106-468

RESISTORS (cont'd.)

Designation	Description						Code No.
R34, 41	Carbon film	47K	5%	0.2	W		106-547
R35	Carbon film	1K5	5%	0.2	W		106-415
R36	Carbon film	5K6	5%	0.2	W		106-456
R38, 39	Metal film	12K1	1%	0.1	W	TK100	140-515
R42	Potentiometer	22K	20%	0.2	W		182-007
R43, 65	Carbon film	12K	5%	0.2	W		106-512
R44	Carbon film	1M	5%	0.2	W		106-710
R45, 53, 54, 55	Carbon film	100K	5%	0.2	W		106-610
R46	Metal film	4K99	1%	0.1	W	TK100	140-422
R47	Metal film	49E9	1%	0.1	W	TK100	140-922
R60	Carbon film	220K	5%	0.2	W		106-622
R62	Carbon film	3K9	5%	0.2	W		106-439
R63, 66, 67, 70	Carbon film	2K2	5%	0.2	W		106-422
R68, 69	Carbon film	39K	5%	0.2	W		106-539

TRANSFORMER

Designation	Description		Code No.
T1	Transformer	(TBS659)	770-659

MODULATION UNIT (900-797)

CAPACITORS

Designation	Description						Code No.
C1, 2	Polystyrol	16	nF	1%	63 V		243-018
C3, 4	Polystyrol	10.55	nF	1%	63 V		243-104
C5	Ceramic	10	pF	2%	63 V	NPO	213-205
C6	Ceramic	5.6	pF	±0.25 pF	100 V	NPO	213-226
C7, 8, 10, 12	Tantalum	22	µF	20%	15 V		267-019
C9, 11	Ceramic	47	nF	-20+80%	30 V		213-016
C13	Ceramic	33	pF	2%	63 V	NPO	213-208
C14	Tantalum	47	µF	20%	35 V		267-004

INTEGRATED CIRCUITS

Designation	Description	Code No.
QA1, 2, 4	LM 301AN	364-016
QA3	LM 311H	364-024

RESISTORS

Designation	Description						Code No.
R1	Carbon film	680E	5%	0.1	W		107-368
R2, 3	Metal film	15K	1%	0.1	W	TK100	140-575
R4	Carbon film	470E	5%	0.1	W		107-347
R5	NTC	1K	20%	50	mW		160-001
R6	NTC	8K3	20%	3	mW		160-006
R7	Carbon film	1K	5%	0.1	W		107-410
R8	Carbon film	270E	5%	0.1	W		107-327
R9	Potentiometer	1K	20%	0.5	W		182-001
R10	Metal film	634E	1%	0.1	W	TK100	140-567
R11	Metal film	402E	1%	0.1	W	TK100	140-539
R12	Metal film	681E	1%	0.1	W	TK100	140-847
R13	Metal film	301E	1%	0.1	W	TK100	140-806
R14	Potentiometer	1K	20%	75	mW		182-102
R15	Carbon film	3K9	5%	0.2	W		106-439
R16	Metal film	4K99	1%	0.1	W	TK100	140-422
R17	Metal film	10K	1%	0.1	W	TK100	140-423
R18	Metal film	20K	1%	0.1	W	TK100	140-630
R19	Metal film	100K	1%	0.1	W	TK100	140-474
R20	Potentiometer	2K2	20%	0.5	W		182-012
R21	Metal film	2K21	1%	0.25	W	TK25	140-413
R22	Carbon film	2K2	5%	0.1	W		107-422
R23	Carbon film	680K	10%	0.1	W		107-668
R24	Carbon film	100E	5%	0.1	W		107-310
R25	Carbon film	10K	5%	0.1	W		107-510
R26	Carbon film	820E	5%	0.1	W		107-382
R27	Potentiometer	470E	20%	0.5	W		182-015

METER

Designation	Description	Code No.
M1	Modulation Meter, 1 mA, 70Ω	480-295

SWITCH

Designation	Description	Code No.
S1	Modulation Mode Switch	551-121

FREQUENCY CONTROL (900-805)

CAPACITORS

Designation	Description						Code No.
C1	Ceramic	22	nF	-20 +100%	40 V		213-011
C2, 3	Ceramic	100	pF	2%	63 V	NPO	213-211
C4	Ceramic	1	nF	-20 +100%	25 V		213-013
C5, 6	Polyester	2.2	µF	10%	63 V		241-031
C7	Electrolytic	10	µF		35 V		260-012
C8	Ceramic	3.3	pF	±25 pF	63 V	NPO	213-202
C9	Ceramic	10	pF	2%	63 V	NPO	213-205
C10, 11	Ceramic	47	nF	-20 +80%	30 V		213-016
C12	Tantalum	22	µF	20%	15 V		267-019

DIODES

Designation	Description			Code No.
CR1	Zener diode	C15-0.25		360-611
CR2, 5	Diode	BAX16		350-023
CR3	Zener diode	C7V5	0.4 W	350-621
CR4	Reference zener diode	1N3497		350-637
CR6	Zener diode	C4V7	0.4 W	350-642

TRANSISTORS

Designation	Description	Code No.
Q1, 3	BC 557B	360-160
Q2	BD 139	360-137
Q4	Dual transistor 2N2453A	360-171

INTEGRATED CIRCUITS

Designation	Description	Code No.
QA1	LM 318H	364-216

RESISTORS

Designation	Description					Code No.
R1	Carbon film	22K	5%	0.1 W		107-522
R2	Carbon film	1K	5%	0.1 W		107-410
R3, R5	Carbon film	33E	5%	0.2 W		106-233
R4, 10, 23	Carbon film	6K8	5%	0.1 W		107-468
R6, 22	Carbon film	10K	5%	0.1 W		107-510
R7	Carbon film	5K6	5%	0.1 W		107-456
R8	Carbon film	1K8	5%	0.1 W		107-418
R9	Carbon film	68K	5%	0.1 W		107-568
R11	Carbon film	82K	5%	0.1 W		107-582
R12	Metal film	30K9	1%	0.1 W	TK100	140-851
R13	Carbon film	27K	5%	0.1 W		107-527
R14	Metal film	10K	1%	1/2 W	TK50	140-739
R15	Metal film	40K2	1%	0.1 W	TK100	140-642
R16	Potentiometer	10K	10%	multiturns		182-403
R17	Potentiometer	10K	20%	0.5 W		182-008
R18	Metal film	10K	1%	0.1 W	TK100	140-423
R19	Carbon film	1K2	5%	0.1 W		107-412
R20	Carbon film	4K7	5%	0.1 W		107-447
R21	Metal film	4K99	1%	0.1 W		140-422

RESISTORS (cont'd.)

Designation	Description						Code No.
R24	Potentiometer	2K2	20%	0.5	W		182-012
R25	Metal film	6K8	1%	0.1	W	TK100	140-422
R26	Metal film	8K77	1%	0.1	W	TK100	140-623
R27	Metal film	255E	1%	0.1	W	TK100	140-805
R28	Carbon film	150E	1%	0.1	W		106-315
R29	Potentiometer	200E	10%	multiturns			182-404
R30	Carbon film	180E	5%	0.2	W		106-133
R32	Carbon film	353	5%	0.33	W		106-133
R33	Carbon film	6E2	5%	0.2	W		106-162
R34	Metal film	18E7	1%	0.1	W	TK100	140-925
R35	Metal film	91E	1%	0.1	W	TK100	140-506
R36	Carbon film	22E	5%	0.2	W		106-222
R37	Carbon film	27E	5%	0.2	W		106-227
R38	Metal film	13E7	1%	0.1	W	TK100	140-924
R39	Carbon film	82E	5%	0.2	W		106-282
R40	Metal film	75E	1%	0.1	W	TK100	140-926
R41	Metal film	169E	1%	0.1	W	TK100	140-803
R42	Metal film	115E	1%	0.1	W		140-507
R43	Potentiometer	1K	10%	2	W	10 turns	192-007

SWITCH

Designation	Description	Code No.
S1	Frequency Range Switch	551-122

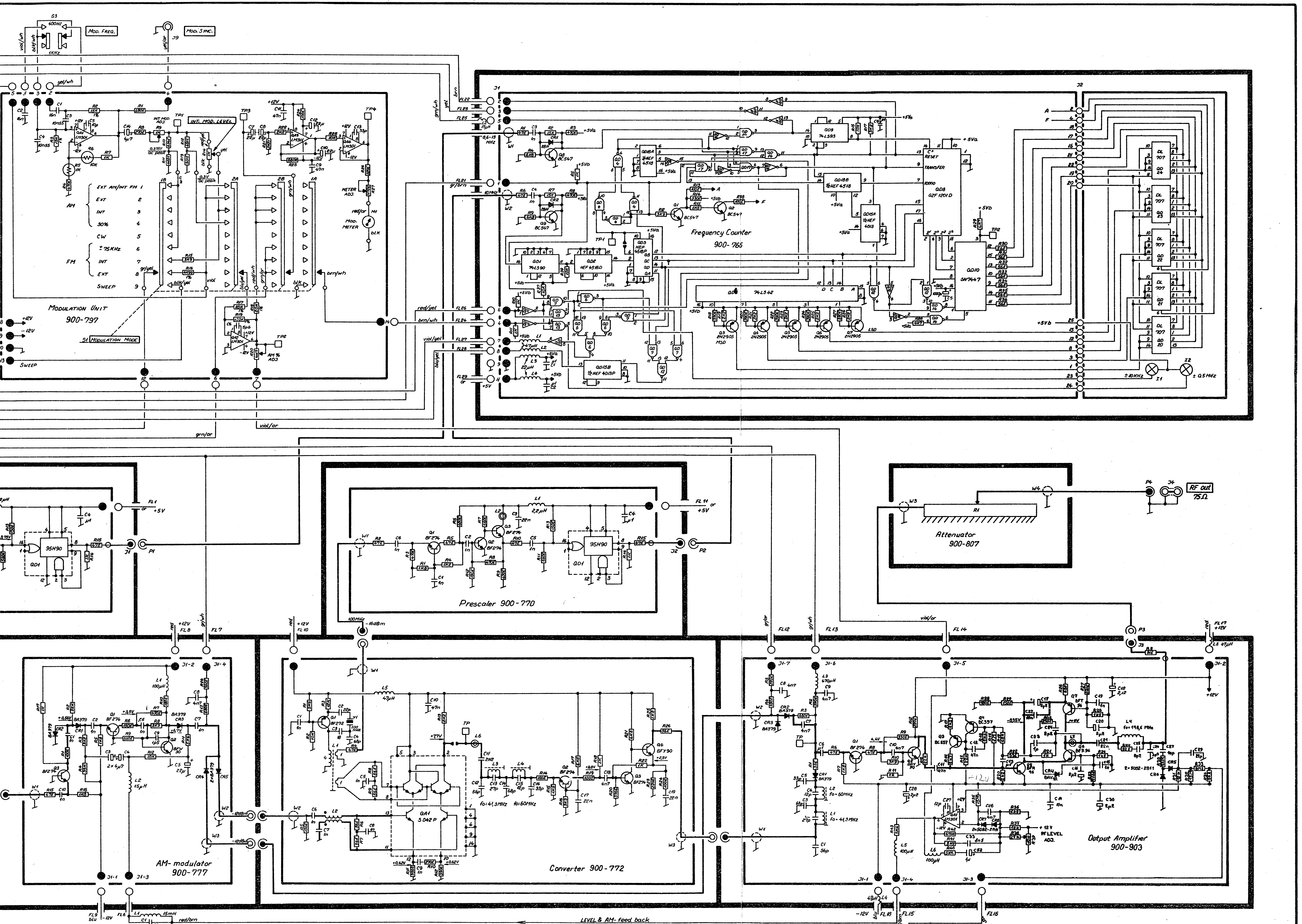
ATTENUATOR (900-807)

CONNECTORS

Designation	Description	Code No.
P3	Coaxial connector, 50 Ω	800-316
P4	Coaxial connector, 75 Ω	800-111

CABLES

Designation	Description	Code No.
W3	Coaxial cable, 93 Ω, ⌀ 2.2 mm, 0.15 m	600-017
W4	Coaxial cable, 75 Ω, teflon, 0.65 m	600-018



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	Rev. no.	1	2					Size A1. Scale : RE code — — Sheet of
	Drawn	13.10.77 HHV	JTP					Design
	Checked	13.10.77	21.9.76 SM					Drawn
	Dok.							App. R drw. 1836

REMOTE
DATA
SWEEP OUT
EXT. MOD.
MOD. FREQ.
400HZ
1KHZ
POWER ON/OFF
220V
115V
Modulation Unit
900-797
EXT AM/INT FM 1
AM
EXT 2
INT 3
30% 4
CW 5
FM
±75KHz 6
INT 7
EXT 8
SWEEP 9
MODULATION MODE
Power Supply
Circuit Board
900-795
SWEEP GENERATOR
CONVERTER ON/OFF
SWITCH DRIVER
ADJ. +12V
Remote V-Low
Remote V-Varicap
Remote V-high
Remote fo < 400KHz
Remote B
Remote A
Frequency Control 900-805
Freq. Tune
1. 0.15 - 0.40 MHz
2. 0.40 - 1.80 MHz
3. 1.80 - 10 MHz
4. 10 - 20 MHz
5. 20 - 30 MHz
6. 86 - 130 MHz
7. 10 - 11,5 MHz
8. RF OFF
9. REMOTE
Frequency Range
Prescaler 900-770
VCO 900-908
AM- modul
900-7