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Radiometer Electronics^{AS}

Instruction Manual

**RE 104
Synthesized
Signal Generator
(Preliminary issue)**

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Synthesized
Signal Generator
(Preliminary issue)**

982-897 7904

PATENT PENDING

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AI - INTRODUCTION

All functions of the RE104 SYNTHESIZED SIGNAL GENERATOR are programmable and the instrument can be remotely controlled via optional interface units. Three different units are available:

1. BCD CONTROL INTERFACE
2. IEEE/IEC BUS INTERFACE
3. MEMORY UNIT

The RE104 is particularly dedicated to measurements on FM and AM broadcast receivers and tuners, and covers the frequency ranges 0.15 to 29.999 MHz and 86 to 129.999 MHz in 1 kHz increments. A crystal controlled oscillator ensures the accuracy and stability of the instrument.

The RE104 has very low AM and FM distortion when modulated from the internal or an external low distortion source. When the RE104 is stereo modulated from an external stereo generator, e.g. the RE501 Programmable Stereo Generator, an L/R separation of more than 60 dB is obtainable.

The RE104 incorporates a sweep generator for sweeping of the RF frequency. You may choose between three different presettable sweep widths and between a triangular or a saw tooth sweep signal. Also the repetition rate is presettable.

The RF output EMF can be varied from 0.45 μ V to 1 V in 1 dB steps by means of a built-in attenuator. A vernier makes it possible to vary the level continuously over a 12 dB range.

SECTION A _____ GENERAL INFORMATION

AII - EQUIPMENT AND ACCESSORIES

CODE NO.	TYPE	DESCRIPTION
390-757	RE104, 220 V	SYNTHESIZED SIGNAL GENERATOR
390-758	RE104, 115 V	SYNTHESIZED SIGNAL GENERATOR
615-783	220 V	line cord
615-403	115 V	line cord
450-016	220 V	spare fuse
450-019	115 V	spare fuse

Options available

901-013		BCD Interface Unit
901-049		IEC Bus Interface Unit
901-050		IEEE Bus Interface Unit
900-997		Memory Interface Unit
906-003	RE901	Keyboard

Accessories available

617-025	Cable for interconnecting the RE104 and the RE501, length 0.35 m, connecting BNC male to BNC male
617-763	Cable for interconnecting the RE104 and the RE501, length 0.70 m, connecting BNC male to BNC male
617-761	Multicable for interconnecting Memory Unit and Keyboard, length 2.5 m
617-762	Multicable for interconnecting RE104 and RE501 Memory Units, length 0.35 m
906-004	19" Rack mounting kit
770-662	Balancing Transformer for 75 ohm unbalanced to 300 ohm balanced. Impedance ratio: 1:4

SECTION A _____ GENERAL INFORMATION

AIII - SPECIFICATIONSFrequency characteristics

Frequency range:	0.15 - 29.999 MHz and 86 - 129.999 MHz
Frequency accuracy:	20×10^{-6}
Frequency resolution:	1 kHz
Frequency setting time (for frequency steps 1 MHz or less):	within 1 kHz in less than 50 ms
Short time stability:	better than $0.15 \times 10^{-6}/15$ min
Display:	6-digit LED

RF Output Level Characteristics

Source EMF:	0.45 μ V to 1 V _{RMS} variable in 1 dB steps
Accuracy:	
1 MHz to 29.999 MHz and 86 MHz to 129.999 MHz	± 1 dB, 0.7 mV to 1 V ± 1.5 dB, 0.45 μ V to 0.63 mV
0.15 to 1 MHz	± 1 dB additional error
Display:	3 digits - by means of an internal switch the level can be displayed in one of the following units: dBm - dBpw - dBfw - dB(μ V) across matched load or dB(μ V) EMF
Source impedance:	50 ohm
Output connector:	BNC

SECTION A _____ GENERAL INFORMATION

VSWR: <1.2

Leakage: <0.1 μ V EMF in a 2-turn loop 25 mm diameter at a distance of 25 mm from the generator

Switching time: 10 ms

Level vernier: external level variation 0 to -12 dB

Signal Purity

Harmonic distortion: <-35 dB relative to carrier

Spurious frequencies: <-80 dB relative to carrier

ssb noise 86 - 130 MHz: <-125 dB/ $\sqrt{\text{Hz}}$ 200 kHz from carrier

ssb noise 0.15 - 30 MHz: <-100 dB/ $\sqrt{\text{Hz}}$ 10 kHz from carrier

Modulation Characteristics

Modulation modes: FM, AM and sweep, simultaneously
30% AM ($f_{\text{mod}} = 1 \text{ kHz}$) and $\pm 75 \text{ kHz}$
FM (internal)

Modulation sources: 400 Hz and 1 kHz internal and 6 external modulation inputs selected from front panel or from programming interface unit

Modulation display: 00.0 to 99.5% AM or 00.0 to 99.5 kHz FM (peak value)

- calibrated when 400 Hz and 1 kHz int. modulation are selected
- calibrated when Ext. MOD. 4-6 is selected and ext. mod level is 1 Vp
- OFF when Ext. MOD. 1-4 is selected
- inputs on the rear are calibrated: 10 mVp for 1% AM or $\pm 1 \text{ kHz}$ FM
- UNCAL. annunciator switched on when ext. mod. level (Ext. 4-6) is $\pm 1\%$ besides the 1 Vp nominal value

S E C T I O N A _____ GENERAL INFORMATION

Frequency Modulation

Programming steps:	0.5 kHz
Max. deviation:	99.5 kHz
Deviation accuracy:	<u>+2%</u> of preset value
Input impedance:	10 kohm
Mod. freq. response:	5 Hz to 100 kHz within 1%
Distortion at <u>+99.5</u> kHz:	<0.02% at f mod = 1 kHz
L/R stereo separation:	60 dB 1 kHz to 5 kHz 50 dB 300 Hz to 10 kHz 40 dB 40 Hz to 15 kHz
S/N ratio relative to <u>+75</u> kHz deviation:	>-74 dB (15 kHz bandwidth)
Incidental FM on AM:	<+60 Hz peak at 30% AM, 1 kHz mod. frequency

Amplitude Modulation

Programming steps:	0.5%
Max. modulation depth:	90%
Modulation accuracy (output level vernier OFF):	<u>+5%</u> of preset value
Input impedance:	10 kohm
Mod. freq. response	40 Hz to 5 kHz for $f_c \geq 0.4$ MHz 40 Hz to 3 kHz for $f_c < 0.4$ MHz
Distortion at 30% AM:	<0.3% at 1 kHz (0.15 - 29.999 MHz)
Distortion at 80% AM:	<1% at 1 kHz (0.15 - 29.999 MHz)

S E C T I O N A _____ GENERAL INFORMATION

Residual AM (RMS value): 0.01% (5 kHz bandwidth)

Incidental AM on FM
(+100 kHz dev. 1 kHz mod.freq.): <0.2%

Frequency Sweep (internal)Sweep "NARROW":

Width: presetable between +5 kHz and +50 kHz
Rep. frequency: presetable between 5 Hz and 50 Hz

Sweep "MEDIUM":

Width: presetable between +50 kHz and +0.5 MHz
Rep. frequency: presetable between 5 Hz and 50 Hz

Sweep "WIDE":

Width: presetable between +0.5 MHz and +4 MHz
Rep. frequency: presetable between 25 Hz and 50 Hz

Sweep OUT

Sweep output signal: +5 V triangular or saw tooth
(selectable by internal switch)
Output impedance: <1 ohm (max. load 5 mA)
Sweep marker: bright spot/line on oscilloscope
corresponds to programmed centre
frequency

S E C T I O N A _____ GENERAL INFORMATION

POWER REQUIREMENTS

Line voltage: 115 V ac (95 - 130 V ac) or
220 V ac (190 - 260 V ac)

Line frequency: 47.5 - 63 Hz

Consumption: 60 VA

ENVIRONMENTAL REQUIREMENTS

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: 440 x 133 x 290 mm

Weight: 11.5 kg

S E C T I O N B _____ INSTALLATION AND OPERATION

BI - 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 Electronics representative or the factory. The packing material should be retained for inspection by the carrier in the case of complaint.

ELECTRICAL INSTALLATION

The RE104 SYNTHESIZED SIGNAL GENERATOR will operate on either 115 V ac or 220 V ac 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 above the fuse holder.

In accordance with international safety standards, the RE104 is supplied with a 3-wire line cord which, when connected to an appropriate ac power outlet, grounds the instrument cabinet. If the RE104 is to

SECTION B _____ INSTALLATION AND OPERATION

be connected to an ac power outlet without a ground connection, the ground jack \perp on the rear panel can be used to ground the instrument.

ENVIRONMENTAL REQUIREMENTS

The RE104 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 RE104 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 PANELS

FRONT PANEL

The front panel of the RE104 SYNTHESIZED SIGNAL GENERATOR is shown in Fig. B1.

- (1) FREQUENCY display
Displays the RF output frequency selected by (2) in the LOCAL mode or programmed in the REMOTE mode of operation.

- (2) FREQUENCY - INCREASE/DECREASE
The individual digits of the RF frequency can be stepped up or down by the appropriate buttons.

S E C T I O N B _____ INSTALLATION AND OPERATION

- (3) UNCAL. annunciator
Activated when a frequency outside the specified frequency range is selected.
- (4) UNLOCK annunciator
Switched on for approx. 30 sec. when the instrument is initially turned on. Indicates that one phase locked loop is unlocked.
- (5) MODULATION mode switch
 CW: Unmodulated carrier
 FM: Frequency Modulation. Modulation source selected by (7)
 AM: Amplitude Modulation. Modulation source selected by (7)
 FM + AM: 30% AM, $f_{\text{mod}} = 1 \text{ kHz}$
 +75 kHz FM deviation, $f_{\text{mod}} = 400 \text{ Hz}$
- SWEEP
Three different sweep modes can be selected. Sweep width and repetition rate are internally adjustable. Triangular or saw tooth sweep waveform is internally selected.
- (7) MOD. SOURCE
Up to eight different modulation frequencies can be selected when the instrument is either furnished by internal mod. sources or externally applied sources. In the basic version the RE104 is furnished with 400 Hz and 1 kHz.
- (8) REMOTE
Indicates when the instrument is in the REMOTE mode of operation, controlled from the programming connector. In the REMOTE mode of operation all front panel buttons (except the power switch) are disabled.
- (9) MOD. LEVEL - INCREASE/DECREASE
When either MOD. SOURCE 4-6, 400 Hz or 1 kHz is selected by (7) the modulation level can be set by means of (9).

S E C T I O N B _____ INSTALLATION AND OPERATION

- (10) MOD. LEVEL
Displays the modulation level set by (9).
- (11) UNCAL.
Indicates uncalibrated mod. level display, e.g. if the level from an external modulation source is beyond the specified value.
- (12) OUTPUT LEVEL - INCREASE/DECREASE
The output level can be stepped up or down in 1 or 10 dB steps by using the appropriate buttons.
- (13) OUTPUT LEVEL display
Indicates the RF output level chosen by (12).
- (14) OUTPUT LEVEL - VERNIER
Initiates an external vernier potentiometer. The reading of the vernier scale has to be added to/subtracted from the reading on (13).
- (15) UNCAL.
Indicates that the vernier is active, and is a reminder to correct the reading on (13).
- (16) dBxx
Indicates the units of the displayed output RF level.
- (17) OUTPUT
RF output connector. Impedance level 50 ohms.
- (18) POWER
Power ON/OFF switch.

SECTION B _____ INSTALLATION AND OPERATION

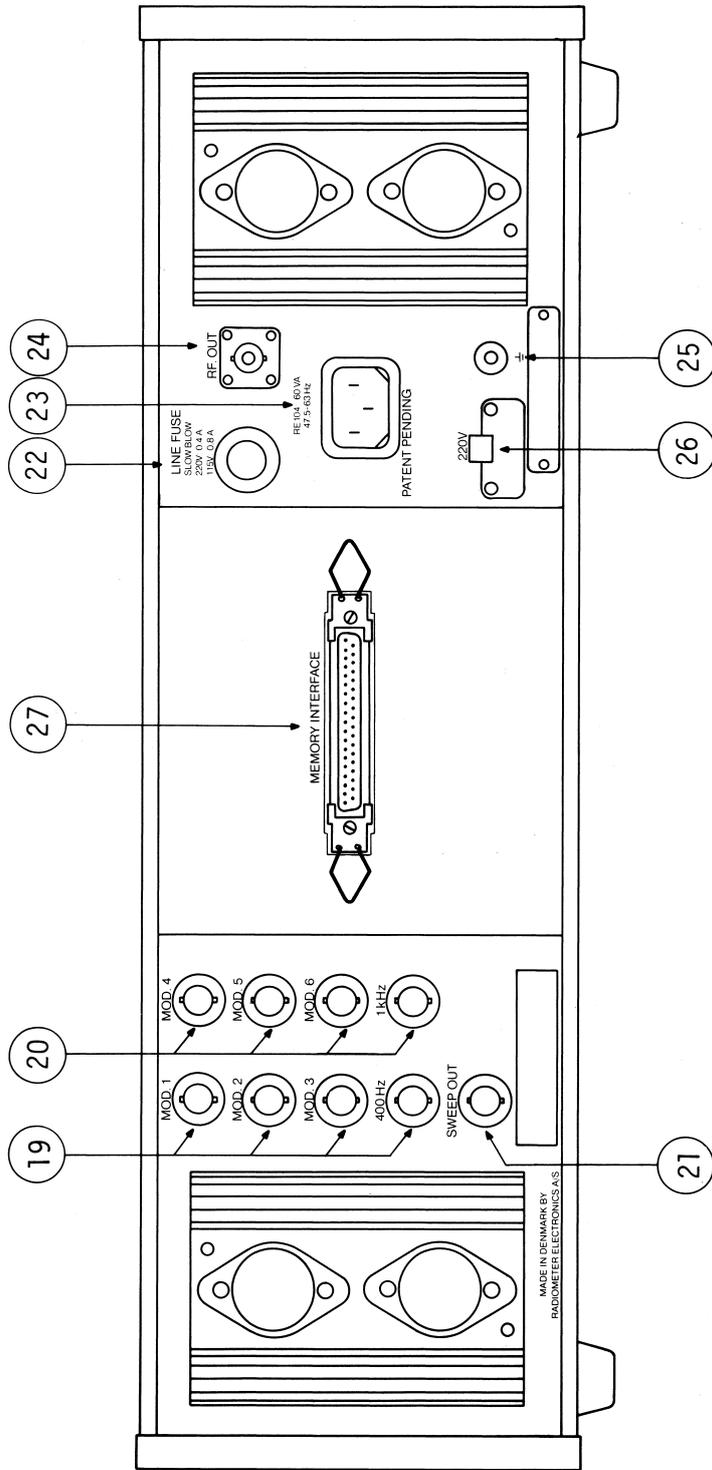


Fig. B2 - REAR PANEL

SECTION B _____ INSTALLATION AND OPERATION

REAR PANEL

The rear panel of the RE104 SYNTHESIZED SIGNAL GENERATOR is shown in Fig. B2.

- (19) MOD. 1-3
BNC connectors for external AM or FM modulation.
Input 10 mVp for ± 1 kHz deviation or 1% AM.
- (20) MOD. 4-6
Input 1 Vp for calibrated modulation display.
- (21) SWEEP OUT.
Sweep signal output.
Level ± 5 Vp, output impedance < 1 ohm (max. load 5 mA).
- (22) Line supply fuse
- (23) Line cord receptacle
- (24) Optional RF output connector
- (25) Ground socket
Used for grounding the instrument if it is not grounded via the power cord.
- (26) Line voltage selector
- (27) REMOTE control connector on interface unit.

SECTION B _____ INSTALLATION AND OPERATION

BIII - OPERATING INSTRUCTIONS

INTRODUCTION

The front panel is shown in Fig. B1. All functions (except the POWER switch) can be locally or remotely controlled. The displays and indicators are active in both local and remote modes of operation.

The RF frequency, modulation level and RF level can be stepped up or down by means of the pushbuttons. Modulation mode or modulation source can be chosen.

ON-OFF control of an external level vernier potentiometer is provided. By means of the vernier potentiometer the output level can be varied 0 to 12 dB below the level shown on the display.

FREQUENCY

By pressing an INCREASE or DECREASE button the appropriate frequency digit will be stepped up or down at a rate of approx. 3 steps per second. Carry and borrow will be transferred to succeeding digits.

The UNCAL. annunciator (3) indicates when the frequency display is set to a frequency outside the specified range, e.g. between 30,000 MHz and 79,999 MHz.

The UNLOCK annunciator (4) is activated when a significant part of the circuitry is not properly working. This occurs during the first 30 seconds after power turn-on of the instruments. When either the UNCAL. or UNLOCK annunciator is switched on, the RF output is invalid.

MODULATION

The CW, FM, AM, FM & AM simultaneously or the NARROW, MEDIUM or WIDE sweep can be selected.

In the AM & FM mode the AM percentage is fixed at 30% and the modulation frequency is 1 kHz. The FM deviation is +75 kHz and the modulation frequency 400 Hz. The NARROW, MEDIUM and WIDE sweep widths and repetition frequency can be set by internal potentiometers placed on the Modulation Unit PCB, see Fig. B3.

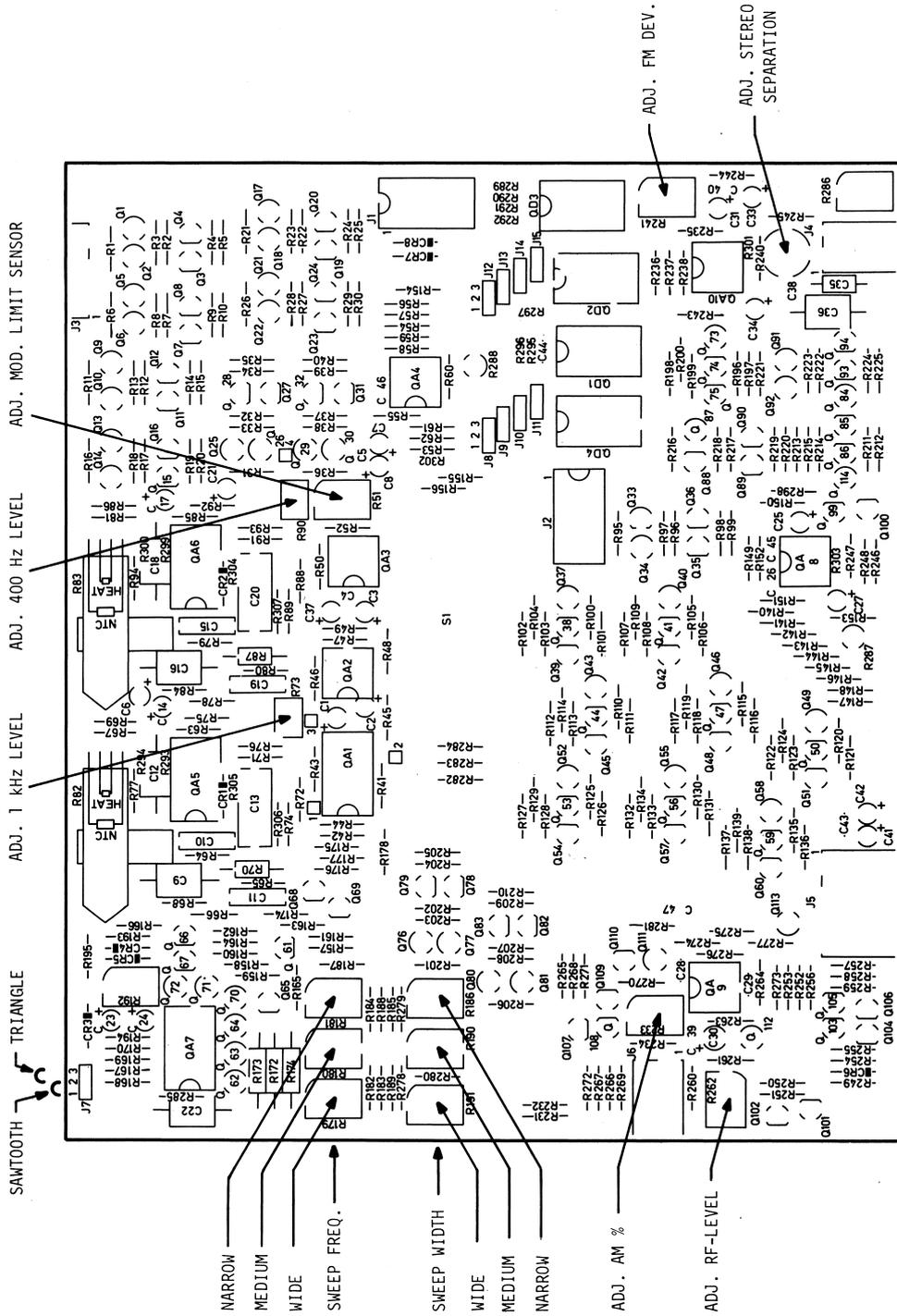


Fig. B3 - MODULATION AND SWEEP ADJUSTMENTS

SECTION B _____ INSTALLATION AND OPERATION

MOD. SOURCE

Selects one of a total of eight internal or external modulation sources. When using the internal modulation sources and Ext. 4 to Ext. 6 the modulation signal is always routed through the modulation attenuator and the modulation level is displayed. When using the external modulation inputs Ext. 1 to Ext. 3 the signal is routed directly to the modulation summing amplifiers. In this case, the MOD. LEVEL display is switched off.

SWEEP

Three sweep widths are provided, NARROW, MEDIUM and WIDE. The sweep widths and sweep frequency can be adjusted individually as shown in Fig. B3. Triangular or saw tooth sweep signal can be chosen by placing a jumper as shown in Fig. B3.

MOD. LEVEL

The modulation level is stepped up or down in steps of 0.5 (kHz deviation or %AM) in a similar way as the RF frequency.

OUTPUT LEVEL

The RF output level can be stepped up or down in 1 dB steps and can be displayed in different units. The operator can change the display unit by setting of a "DIL-switch" located behind the red perspex window on the front panel. The settings are shown in table B1. The appropriate unit annunciator window has to be inserted.

SECTION B _____ INSTALLATION AND OPERATION

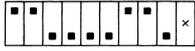
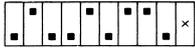
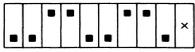
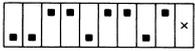
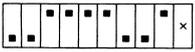
		Setting of DIL switch	Minimum reading	Maximum reading	
APPLIES FOR 50 OHM ATTENUATOR ONLY		1 2 3 4 5 6 7 8 9 0 	dBm (dB above 1 milliwatt)	-120	7
			dBpw (dB above 1 picowatt)	-30	97
			dBfw (db above 1 femtowatt)	0	127
			dBµV (dB above 1 µV EMF)	-7	120
			dBµV (dB above 1 µV across matched load)	-13	114

Table B1 - RF Level

EXTERNAL VERNIER

An external vernier potentiometer can be connected via the interface unit. It should have a value of 1 kohm.

The vernier is activated by pressing the button VERNIER, and the UNCAL. annunciator is activated to remind the operator that he must subtract the vernier setting from the display reading.

SECTION B _____ INSTALLATION AND OPERATION

PROGRAMMING

The functions of the RE104 can be externally controlled via an optional interface unit. When the RE104 is in the remote mode of operation, indicated by the REMOTE annunciator, all the front panel controls (except the power switch) are disabled. The REMOTE/LOCAL state is set by applying logical "0" or "1" to a terminal on the interface unit.

For further information, please refer to the instruction manual for the Interface Unit in use.

The function set-ups are transferred via (or from) the interface unit in serial form by a 4-bit data bus and a 4-bit address bus, and is stored in latches by applying a load pulse. The address and data codes are shown in Table B2.

BCD INTERFACE OPTION

Direct access to store data in the latches of the RE104 is obtained when using the BCD INTERFACE OPTION (901-013).

The address and data code shown in Table B1 must be used. When the address and data are set up a load pulse with a length of at least 2 μ sec. must be generated for clocking the data into the selected latch. The load pulse should be delayed at least 2 μ sec. in relation to the set-up of data and address.

A signal indicating that one or more of the UNCAL. annunciators are active, is available at the connector of the option.

For further information, see instruction manual for the BCD INTERFACE OPTION.

MEMORY INTERFACE OPTION AND KEYBOARD

When using the MEMORY INTERFACE OPTION (900-997), which contains a programmable memory, an entire function set-up can be stored and recalled.

SECTION B _____ INSTALLATION AND OPERATION

x = state is immaterial

FUNCTION		ADDRESS				DATA			
		D	C	B	A	D	C	B	A
RF FREQ.	100 MHz digit	0	0	0	1	BCD code 0 to 1			
RF FREQ.	10 MHz digit	0	0	1	0	BCD code 0 to 9			
RF FREQ.	1 MHz digit	0	0	1	1	BCD code 0 to 9			
RF FREQ.	100 kHz digit	0	1	0	0	BCD code 0 to 9			
RF FREQ.	10 kHz digit	0	1	0	1	BCD code 0 to 9			
RF FREQ.	1 kHz digit	0	1	1	0	BCD code 0 to 9			
MODULATION	CW	0	1	1	1	x	0	0	0
MODULATION	FM	0	1	1	1	x	0	0	1
MODULATION	AM	0	1	1	1	x	0	1	0
MODULATION	FM & AM	0	1	1	1	x	0	1	1
SWEEP	Narrow	0	1	1	1	x	1	0	1
SWEEP	Medium	0	1	1	1	x	1	1	0
SWEEP	Wide	0	1	1	1	x	1	1	1
MOD. SOURCE	Ext. 1	1	0	0	0	x	0	0	0
MOD. SOURCE	Ext. 2	1	0	0	0	x	0	0	1
MOD. SOURCE	Ext. 3	1	0	0	0	x	0	1	0
MOD. SOURCE	Ext. 4	1	0	0	0	x	0	1	1
MOD. SOURCE	Ext. 5	1	0	0	0	x	1	0	0
MOD. SOURCE	Ext. 6	1	0	0	0	x	1	0	1
MOD. SOURCE	Int. 400 Hz	1	0	0	0	x	1	1	0
MOD. SOURCE	Int. 1 kHz	1	0	0	0	x	1	1	1
MOD. LEVEL	x 10 (% or kHz)	1	0	0	1	BCD code 0 to 9			
MOD. LEVEL	x 1 (% or kHz)	1	0	1	0	BCD code 0 to 9			
MOD. LEVEL	+0.5 (% or kHz)	1	0	1	1	x	0	0	1
MOD. LEVEL	+0.0 (% or kHz)	1	0	1	1	x	0	0	0
RF LEVEL	100 dB digit	1	1	0	0	Set BCD code RF to wanted EMF RF in dB μ V <u>+7 dB</u>			
RF LEVEL	10 dB digit	1	1	0	1				
RF LEVEL	1 dB digit	1	1	1	0				
RF LEVEL VERNIER	OFF	1	1	1	1	x	x	x	0
RF LEVEL VERNIER	ON	1	1	1	1	x	x	x	1

Table B2 - BCD Data and Address Bus RE104

S E C T I O N B _____ INSTALLATION AND OPERATION

In the local mode the data set up by means of the front panel controls of the RE104 can be stored in the Memory Interface.

In the remote mode the data can be transferred from the Memory Interface to the latches in the RE104.

The data transmission from the RE104 to the Memory Interface and vice versa is controlled by the RE901 KEYBOARD. By means of the keyboard the test number is set up selecting the area of the programmable memory in which the data are to be stored.

Storing of up to 64 set-ups is possible.

The RE901 Keyboard contains an out-of-range indication which is switched on when one of the UNCAL. indicators of the RE104 is active.

The data transmission from the RE104 to the Memory Interface and vice versa can also be controlled by a computer.

For further information, see instruction manual for MEMORY INTERFACE OPTION and RE901 KEYBOARD.

IEC/IEEE BUS INTERFACE OPTION

The RE104 can be controlled by the IEC/IEEE bus when using the IEC/IEEE BUS INTERFACE OPTION (901-049 (IEC), 901-050 (IEEE)).

By means of a microprocessor the Interface Option converts the information on the IEC/IEEE bus to the 4-bit address and 4-bit data bus used in the RE104.

The language which should be used by the IEC/IEEE Bus controller for setting the controls on the RE104 is shown in Fig. B4.

For further information, see instruction manual for IEC/IEEE BUS INTERFACE OPTION for RE104.

CI - PRINCIPLE OF OPERATION

ORGANIZATION OF THE RE104 SYNTHESIZED SIGNAL GENERATOR

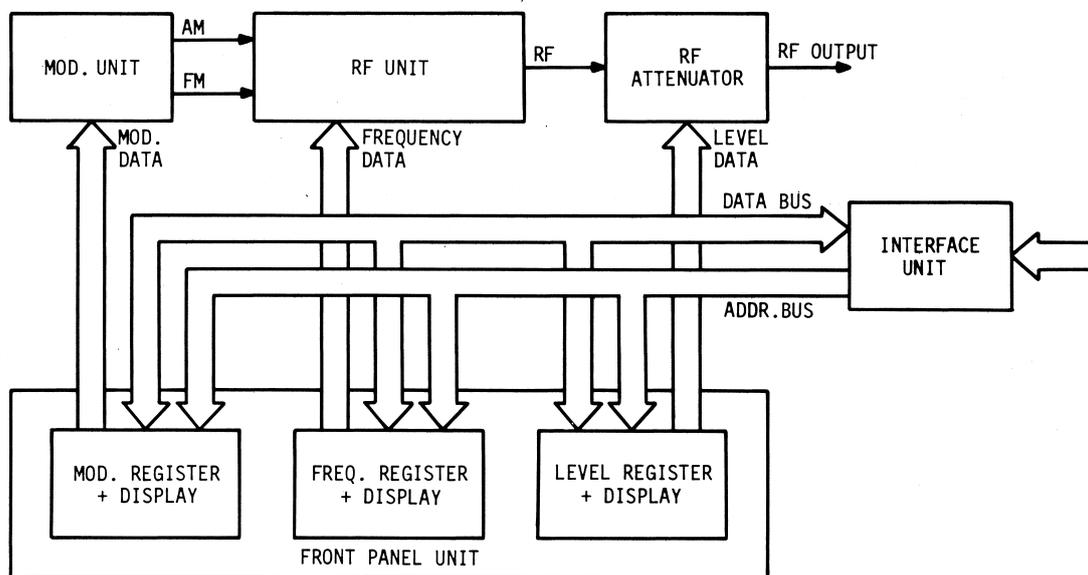


Fig. C1

As shown in Fig. C1 the RE104 comprises the following main units:

1. The Front Panel Unit, with data registers and displays for mo-

S E C T I O N C _____ TECHNICAL DESCRIPTION

dulation, RF frequency and RF level, and buttons for local control of the data in the registers. The front panel unit also contains a bidirectional data bus and a unidirectional address bus.

The data stored in the registers are always shown on the displays and fed to the RF synthesizer, modulation unit and attenuator.

2. The Interface Unit controls the data flow via the data bus by means of the address bus. In the LOCAL mode of operation data are available from the registers in the RE104 to the outside world.
In the REMOTE mode of operation external data can be loaded into the registers of the RE104.
For further information, please refer to the instruction manual for the relevant Interface Unit.
3. The RF Unit produces the RF frequency given by the BCD data coming from the Front Panel Unit, with or without modulation.
4. The Modulation Unit routes internally generated or external modulation signals to the AM or FM modulator contained in the RF Unit.
5. The RF attenuator controls the RF output EMF in 1 dB steps from $0.45 \mu\text{V}_{\text{RMS}}$ to 1 V_{RMS} .

The following text applies to the simplified block diagram, Fig. C2:

Front Panel Section

The registers for RF frequency, RF level and modulation level consist of presettable up/down decade counters.

For RF frequency six decade counter IC's are cascaded. By depressing an INCREASE or a DECREASE button, the corresponding IC counter will start counting up or down at a rate of approx. 3 counts per second. When the counter overflows or underflows, a carry or borrow pulse will be transferred to the succeeding counter IC.

Similar principles are used for the RF Level and the Mod. Level.

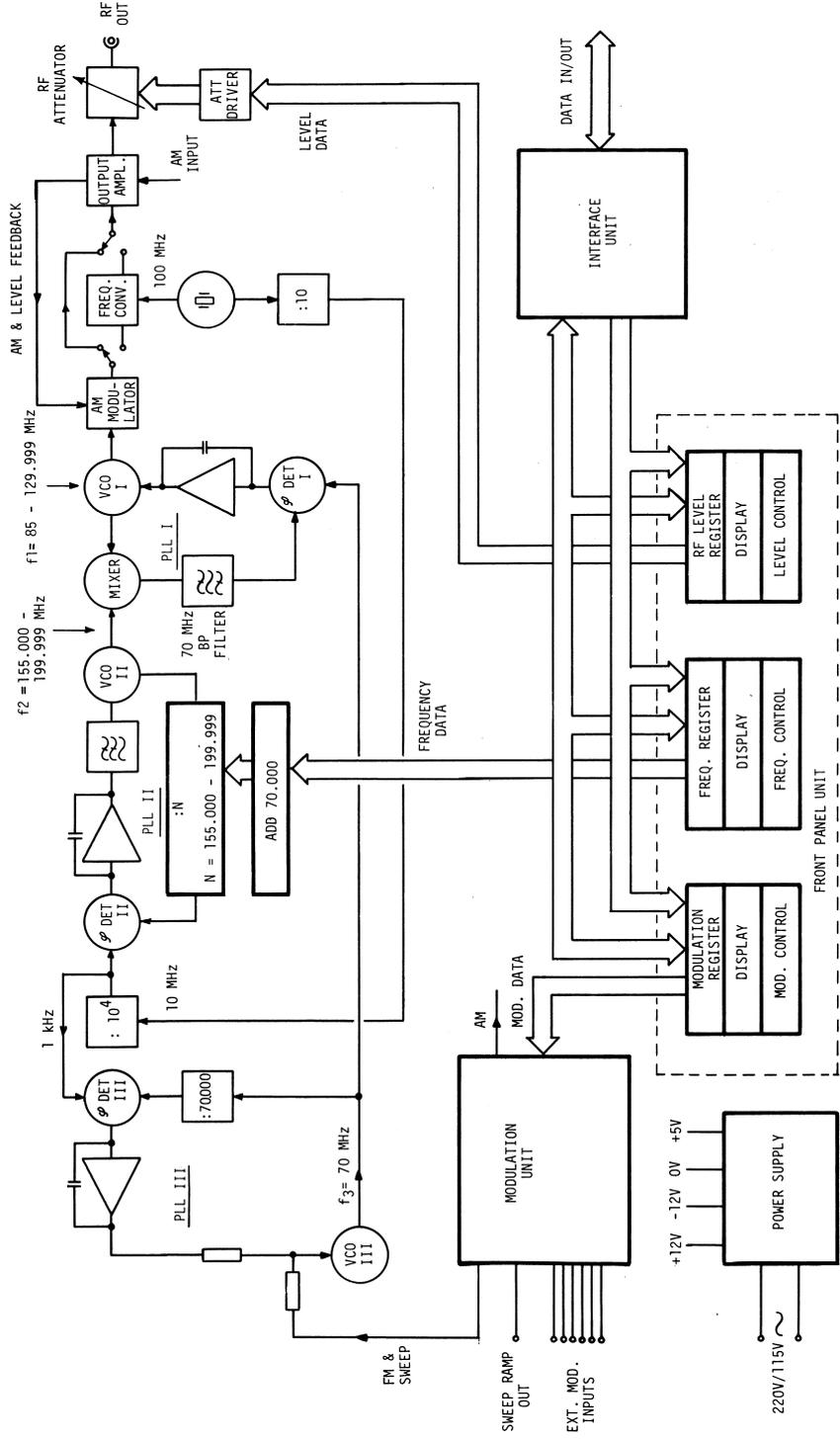


Fig. C2 - Simplified Block Diagram of the RE104 SYNTHESIZED SIGNAL GENERATOR

SECTION C _____ TECHNICAL DESCRIPTION

The counter outputs are routed to the displays and as parallel BCD data to the Mod. Unit, RF Unit and the attenuator driver. By means of 3-state buffers the BCD data can be fed to the optional Interface Unit. The data are transferred in serial form controlled from the Interface Unit via the address bus.

When data are routed from the interface unit to the decade counters (now working as storage registers) the same data and address bus are used and the data are loaded into the appropriate decade counter IC by applying a pulse to the parallel load terminal.

Modulation mode and modulation source are chosen by applying signal from the front panel button to an 8-input priority encoder.

RF Unit

Basically the RF Unit consists of three Phase Locked Loops (PLL):

1. The frequency programming loop (PLL II)
2. The frequency modulation loop (PLL III)
3. The output loop (PLL I)

The Frequency Programming Loop (PLL II)

consists of a Voltage Controlled Oscillator (VCO II), a programmable frequency divider (divide by N), a phase detector and a loop filter. The VCO covers the frequency range from 156 MHz to 199.999 MHz (f_2). After division by N in the programmable frequency divider, the signal ($f_2:N$) is compared to a reference signal of 1 kHz in the phase detector (ϕ_{det} II). When the loop is in lock, the frequency f_2 is given by:

$$f_2 = N \times f_{ref} = N \times 1 \text{ kHz.}$$

The division ratio N can be set to any integer in the range from 156000 to 199999, which means that the frequency f_2 can be set in 1 kHz increments from 156000 kHz to 199999 kHz. The loop filter removes 1 kHz feedthrough from the phase detector, and is optimized with respect to fast frequency shift time.

SECTION C _____ TECHNICAL DESCRIPTION

The Frequency Modulation Loop (PLL III)

The loop operates in a similar way as the frequency programming loop, but the frequency divider has a fixed division ratio of 1:70000, and the VCO III is therefore oscillating on a center frequency of 70,000 kHz, as the reference signal is the 1 kHz reference frequency.

The AF signal used for frequency modulation of the VCO III is applied to a summing network between the loop filter and VCO III. To avoid affecting the modulation by the feedback signal from the phase detector, the time constant of the loop filter is made large. This ensures very low loop gain in the specified modulation frequency range.

In this way a crystal stable oscillator, which can be frequency modulated, is established.

The Output Loop (PLL I)

The loop generates the output frequency for the FM band: 86 MHz to 129.999 MHz.

The output loop consists of VCO I which oscillates directly on the output frequency (in the range 86.000 to 129.999 MHz). The output from VCO I (f_1) is mixed with the output from VCO II (f_2). The difference frequency $f_2 - f_1$ is routed via a bandpass filter with a center frequency of 70 MHz to a phase detector (ϕ det I) using the output from VCO III (f_3) as a reference signal. When PLL I is locked the difference frequency $f_2 - f_1$ is equal to f_3 . The output frequency f_1 is then given by: $f_1 = f_2 - f_3 = f_2 - 70$ MHz.

The bandwidth of PLL I is approx. 1.5 MHz. Hereby frequency modulation superposed the f_3 signal is reproduced at the f_1 output with modulation frequency response up to approx. 1.5 MHz.

The AM Modulator and Output Amplifier

The output frequency from VCO I is applied to the amplitude modulation stage, the output of which is routed directly to the output amplifier when the programmed frequency is within the FM band.

S E C T I O N C _____ TECHNICAL DESCRIPTION

The output from the RF detector is compared to a dc voltage in a differential amplifier and the output is used for automatic level control in the AM stage. Amplitude modulation is produced by applying the modulation signal to the differential amplifier.

Frequency Converter

The frequency range 0.150 to 29.999 MHz is generated in the frequency converter. The frequency from VCO I is in this range limited to cover 100.15 to 129.999 MHz. By mixing this signal with a 100 MHz crystal controlled oscillator and filtering out the difference frequency, the frequency range from 0.150 to 29.999 MHz is generated. The frequency converter is inserted between the amplitude modulator and the output amplifier.

Reference Oscillator

The overall frequency accuracy and stability of the RE104 is determined by the 100 MHz crystal controlled oscillator, as the 1 kHz reference frequency for the phase locked loops is derived from the 100 MHz crystal oscillator by a 10^5 dividing circuit.

The Modulation Unit

Two internal modulation oscillators with frequencies of 400 Hz and 1 kHz are provided as standard. The oscillators have a highly stabilized output level which is applied to the modulation attenuator via the modulation source switch. Three external mod. input signals (Ext. 4 to Ext. 6) are applied to the modulation attenuator while three other external modulation inputs are directly applied to the FM or AM modulation summing amplifiers.

SECTION B _____ TECHNICAL DESCRIPTION

Sweep Generator

The sweep generator delivers a triangular or saw tooth wave, according to the choice of the operator, see Fig. B3, page B9. Three different sweeps are provided. The sweep width and the sweep repetition frequency can be set by internal potentiometers, see Fig. B3. The sweep signals contain a "plateau" at the zero crossing. This gives a marker spot on an oscilloscope, when its horizontal input is connected to the SWEEP OUT terminal on the rear panel of the RE104.

RF Attenuator

The RF attenuator covers the attenuation range by the Attenuator Driver circuit which converts the BCD inputs from the Front Panel section to a binary code with the level required to drive the attenuator.

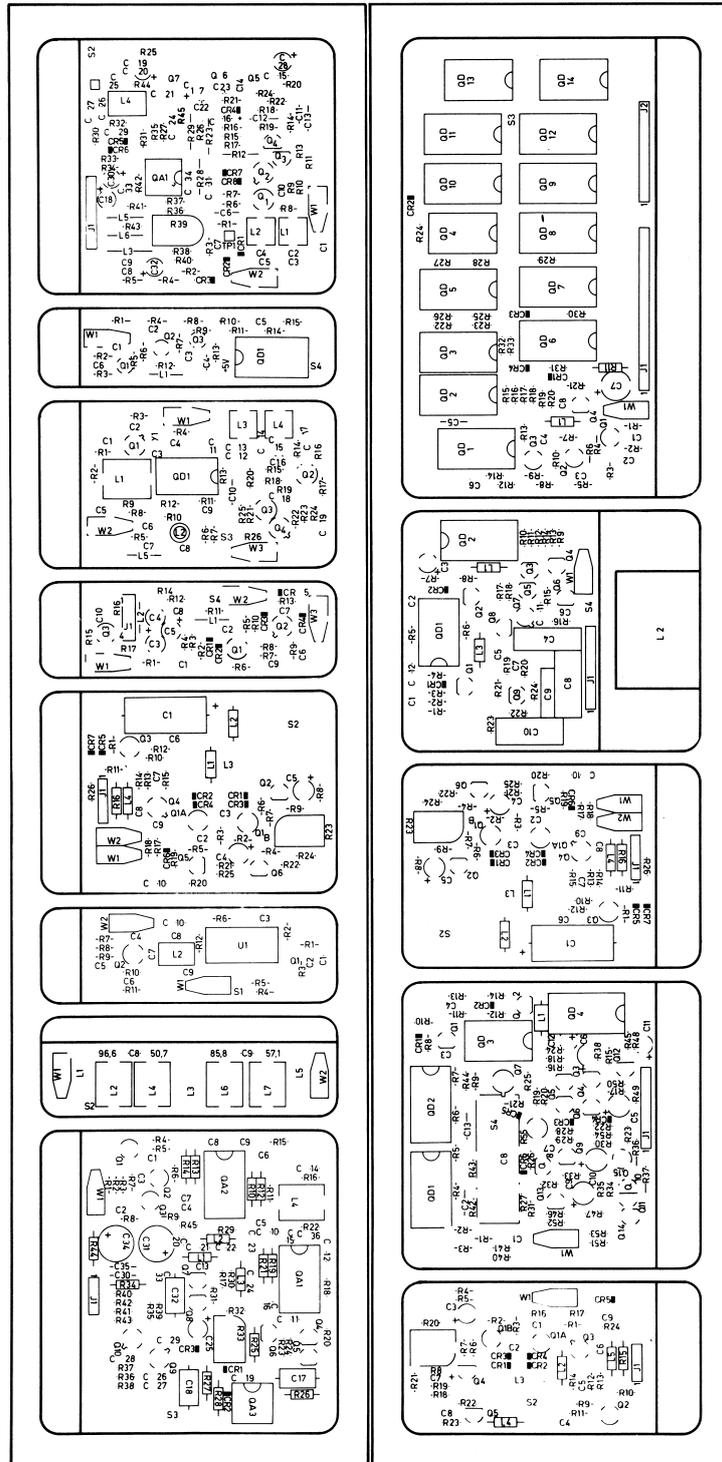


Fig. E1 - RF UNIT COMPONENT LOCATION

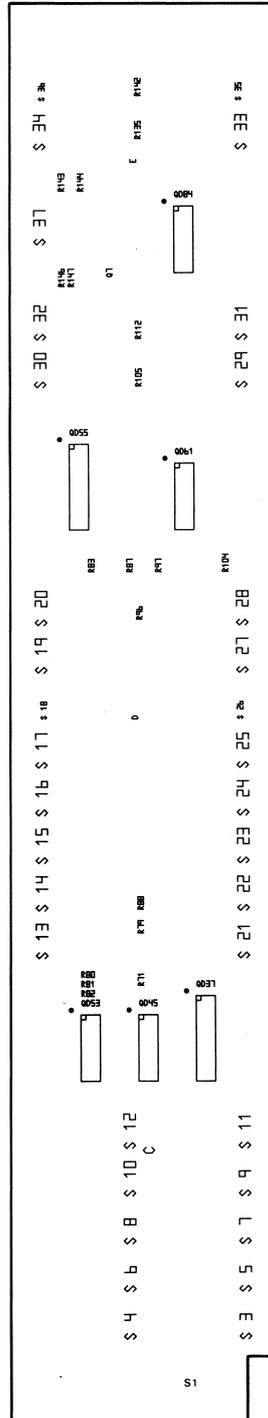


Fig. E2 - FRONT PANEL I - COMPONENT LOCATION

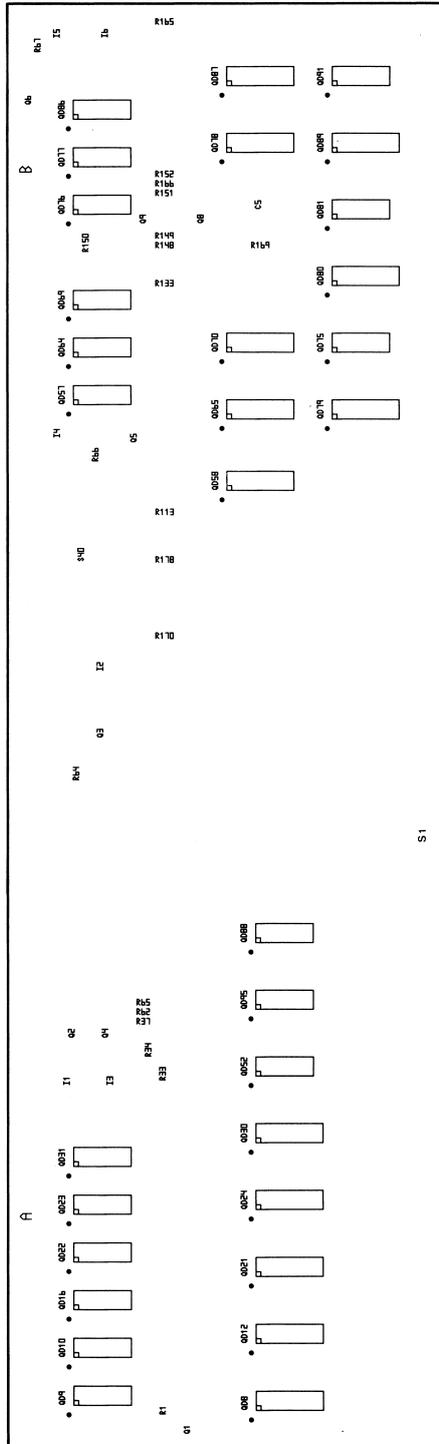


Fig. E3 - FRONT PANEL II - COMPONENT LOCATION

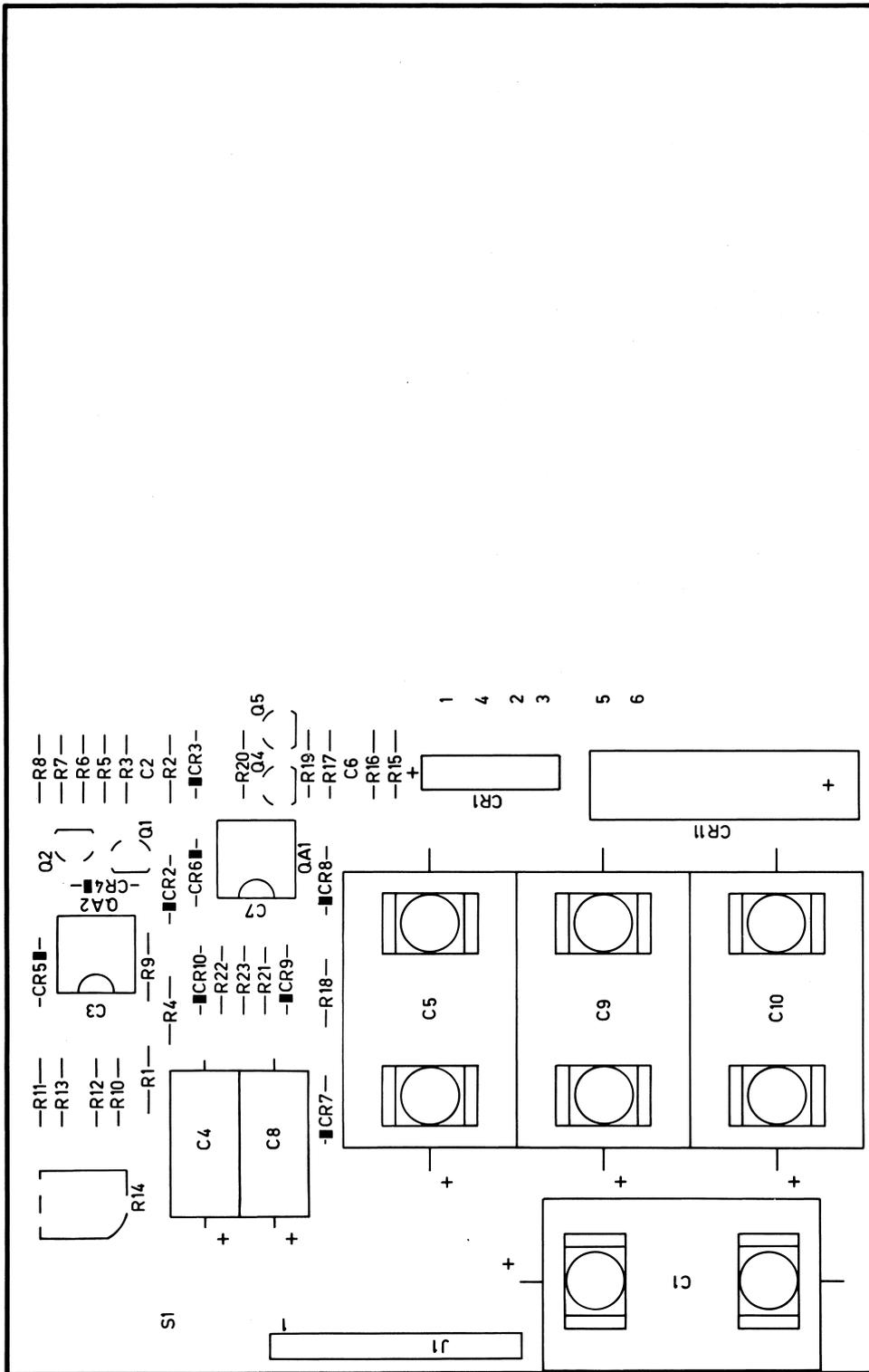


Fig. E6 - POWER SUPPLY - COMPONENT LOCATION

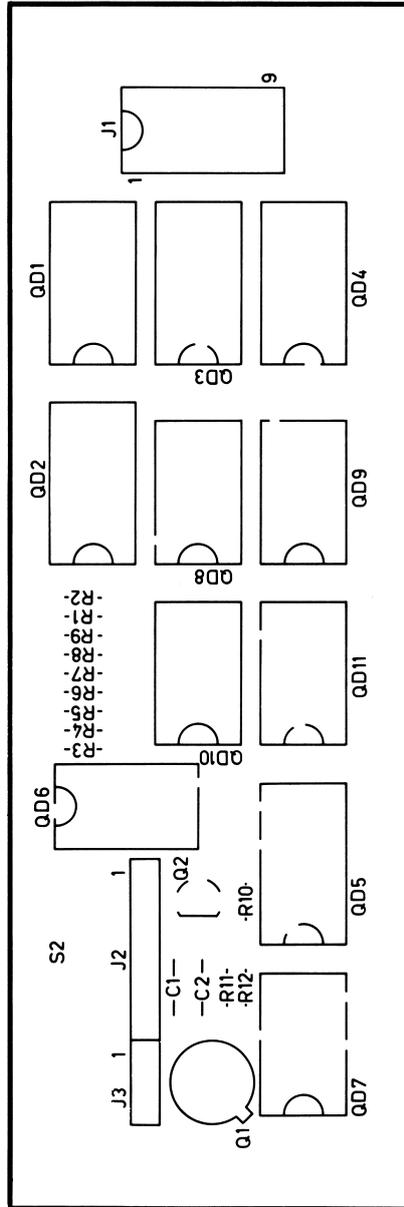
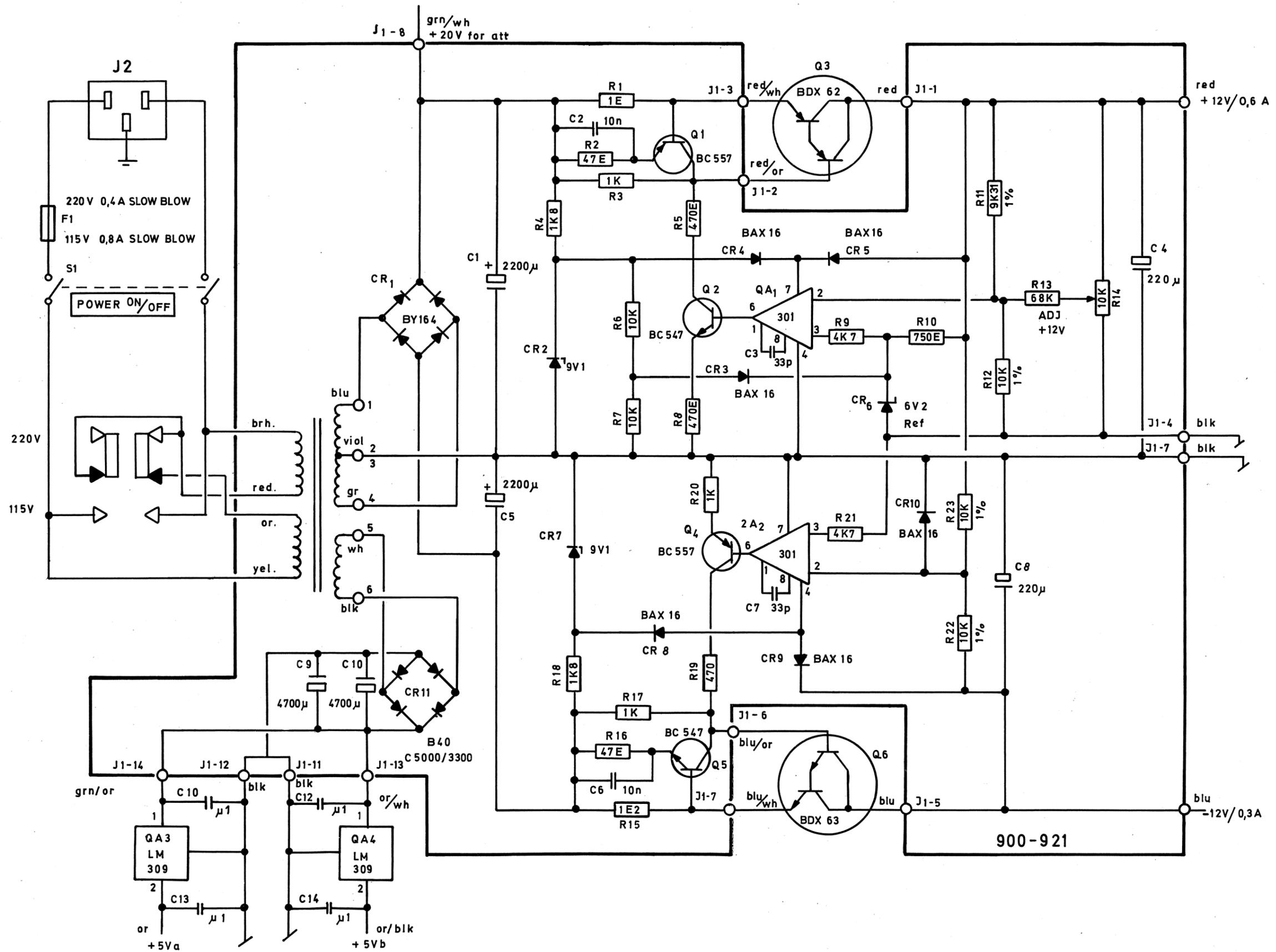
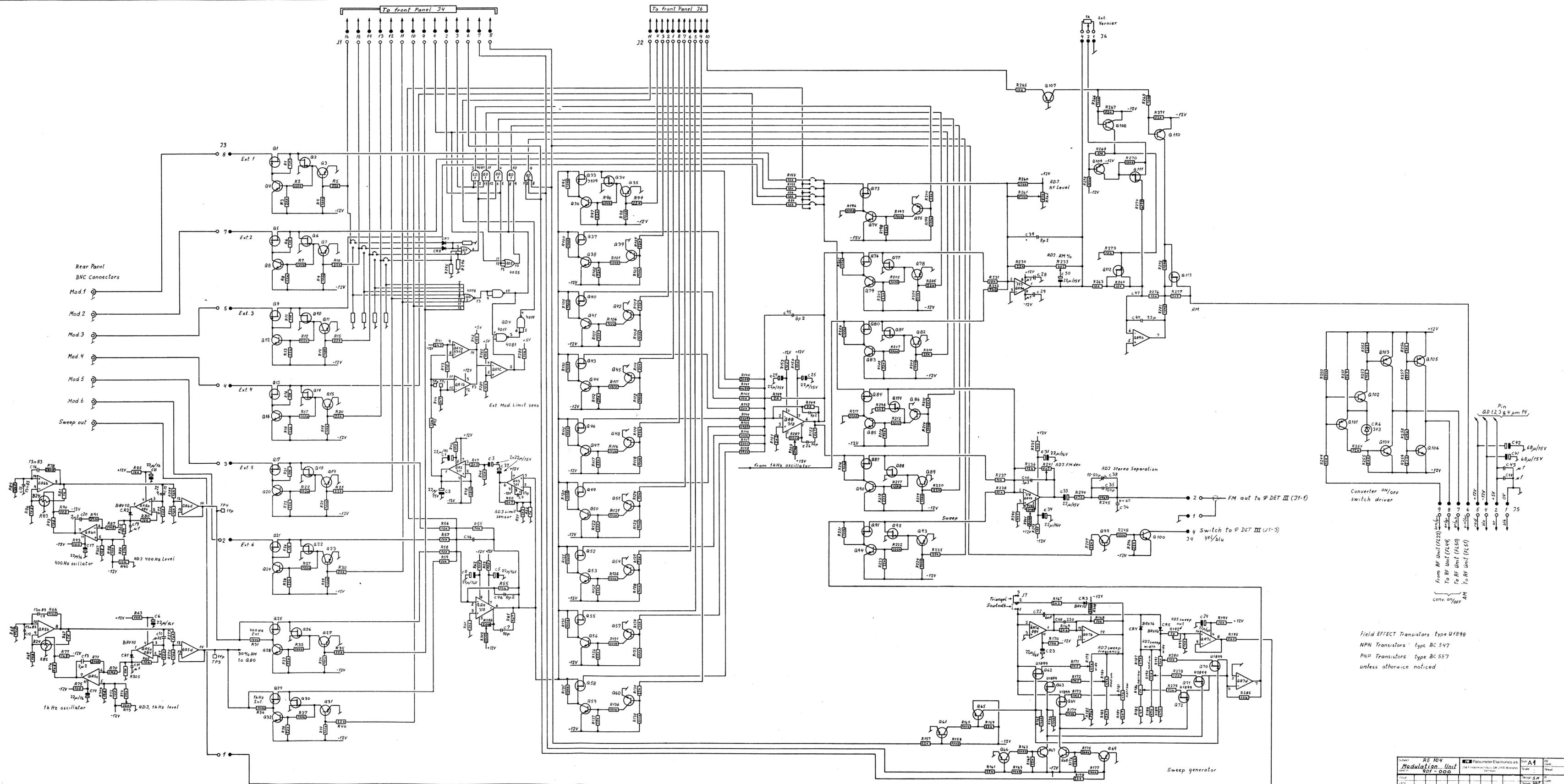


Fig. E7 - ATTENUATOR DRIVE - COMPONENT LOCATION



Subject Schematic diagram Power supply for used in RE 104		Radiometer Electronics a/s 254 Frederikssundsvej DK-2700 Brønshøj Denmark		Size A1	RE code
ISSUE		Scale :		Sheet	of
DATE		Design SM		R code	
DRAWN		Drawn UGP 790418		R code	
		App. SM		drw. 1968-A1	



Field EFFECT Transistors type U1899
 NPN Transistors type BC 547
 PNP Transistors type BC 557
 unless otherwise noticed

