1 kW HF Transmitter Terminal

TTA 1860

Technical Manual

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RACAL

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Ref. WOH 3042

Printed in England

Issue 4

Feb. 91 — 25

LETHAL VOLTAGE WARNING

VOLTAGES WITHIN THIS EQUIPMENT ARE SUFFICIENTLY HIGH TO ENDANGER LIFE.

COVERS MUST NOT BE REMOVED EXCEPT BY PERSONS QUALIFIED AND AUTHORISED TO DO SO AND THESE PERSONS SHOULD ALWAYS TAKE EXTREME CARE ONCE THE COVERS HAVE BEEN REMOVED.

RESUSCITATION

TREATMENT OF THE NON-BREATHING CASUALTY

1 SHOUT FOR HELP. TURN OFF WATER, GAS OR SWITCH OFF ELECTRICITY IF POSSIBLE

Do this immediately. If not possible don't waste time searching for a tap or switch.

2 REMOVE FROM DANGER: WATER, GAS, ELECTRICITY, FUMES, ETC.

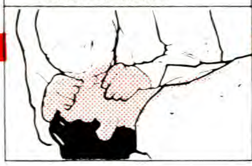
Safeguard yourself when removing casualty from hazard. If casualty still in contact with electricity, and the supply cannot be isolated, stand on dry non-conducting material (rubber mat, wood, linoleum). Use rubber gloves, dry clothing, length of dry rope or wood to pull or push casualty away from the hazard.

3 REMOVE OBVIOUS OBSTRUCTION TO BREATHING

If casualty is not breathing start ventilation at once.

LOOSEN NECKWEAR
TILT HEAD BACKWARDS
AND PUSH CHIN UPWARDS

PINCH THE NOSE
COMMENCE VENTILATION
FOUR GOOD INFLATIONS
MOUTH-TO-MOUTH



IF CHEST DOES NOT RISE
RE-CHECK AIRWAY, REMOVE
OBSTRUCTION AND RE-INFLATE

CHECK PULSE

POSITION OF PULSE

PULSE PRESENT

PULSE ABSENT

HEART HAS STOPPED BEATING
LAY ON BACK ON FIRM SURFACE
(eg FLOOR)
COMMENCE EXTERNAL CHEST
COMPRESSION AND CONTINUE
MOUTH-TO-MOUTH VENTILATION

ONE FIRST AIDER
15 Compressions at 80 per minute followed by 2 Inflations

TWO FIRST AIDERS
One conducts chest compressions, without pause at 60 per minute. The other administers mouth-to-mouth ventilation – after each 5th compression.

Check heart beat after first minute and then after every three minutes. Continue external chest compression and mouth-to-mouth ventilation until a normal pulse is felt and colour improves.

CONTINUE INFLATIONS
UNTIL RECOVERY OF
NORMAL BREATHING

CONTINUE INFLATIONS
UNTIL RECOVERY OF
NORMAL BREATHING

WHEN NORMAL BREATHING COMMENCES
PLACE CASUALTY IN RECOVERY POSITION

Keep casualty at rest. Remove on a stretcher. Watch closely, particularly for difficulty in breathing. Lightly cover with blankets or other materials.

SEND FOR DOCTOR AND AMBULANCE

DOCTOR	AMBULANCE	HOSPITAL	Nearest First Aid Post
TELEPHONE	TELEPHONE	TELEPHONE	

'POZIDRIV' SCREWDRIVERS

Metric thread cross-head screws fitted to Racal equipment are of the 'Pozidriv' type. Phillips type and 'Pozidriv' type screwdrivers are not interchangeable and the use of the wrong screwdriver will cause damage. POZIDRIV is a registered trade mark of G.K.N. Screws and Fastners Limited. The 'Pozidriv' screwdrivers are manufactured by Stanley Tools Limited.

1kW HF TRANSMITTER TERMINAL

TTA.1860

CONTENTS

NOTE: The Technical Manual for the MA.1720 Transmitter Drive Unit is supplied in a separate cover.

TTA.1860

GENERAL INFORMATION

CONTENTS

ILLUSTRATIONS	Fig. No.

	Appendices

TTA.1860

TECHNICAL SPECIFICATION

Frequency Range:	1.6MHz to 29.9999MHz in 100Hz steps.
RF Output Power:	CW: 1kW nominal (continuous key - down) ±1dB SSB: 1kW p.e.p. nominal ±1dB.
Intermodulation Products:	Better than -35dB from 1.6 to 10MHz and -25dB from 10MHz to 29.9999MHz relative to eitherone of two equal tones in a standard two-tone test:
Transmission Modes:	Basic version USB/LSB (A3J, A3A), compatible AM (A3H), ISB (A3B), CW (A1), MCW (A2H, A2J). Optional RTTY (F1).
Carrier Level:	-6dB, -16dB or -26dB relative to rated p.e.p. at full output in pilot carrier modes.
Carrier Suppression:	Better than -40dB relative to rated p.e.p. at full output in A3J mode.
A.F. Response:	Standard: Not greater than 4dB below peak response from 300Hz to 3000Hz. Optional: Not greater than 4dB below peak response from 300Hz to to 6000Hz.
Audio Input Impedances:	600 ohms ± 10%, balanced, floating.
Audio Input Levels:	-30 to +10dBm.
Weight:	344 kg (757 lb.).

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1. The Racal TTA.1860 is a 1kW Transmitter Terminal comprising the following units:

   (1) 1kW Linear Amplifier Type TA.1810.

   (2) Transmitter Drive Unit Type MA.1720

   (3) Feeder Matching Unit Type MA.1004

   (4) Line Switching Module Type MS.139

   The cabinet layout is given in Fig.1.

2. The Transmitter Terminal is all solid state and provides a nominal 1kW output in the frequency range 1.6MHz to 29.9999MHz. Frequency selection is provided by six thumbwheel switches on the front panel of the drive unit; facilities are also available to enable the drive unit to be operated on pre-set frequency channels by means of a pre-programmed selector such as the Racal MA.1038.

3. Control of the TTA.1860 may be extended to an external control panel (e.g. Racal MA.1040) or to a remote control position over telephone lines or radio links by means of the Racal CSA.1505 series or LA.7922/7923 Remote Control Systems and the MA.1040 Remote Control Panel.

4. The Transmitter Terminal offers choice of upper or lower sideband, with suppressed or reduced carrier, independent sideband compatible AM and radio telegraphy. Radio teleprinter (RTTY) is available as an optional built-in facility.

5. Where the output of the TTA.1860 is coupled to the antenna system via a suitable 50 ohm HF feeder, full output power and performance is achieved for a VSWR of up to 3:1.

BRIEF TECHNICAL DESCRIPTION

6. The following paragraphs briefly describe the various units of the Transmitter Terminal; for detailed information, reference should be made to the respective parts of this manual, or, in the case of the MA.1720, to the separate manual supplied for this unit.

MA.1720 Transmitter Drive Unit

7. This is a solid state drive unit with a frequency range of 1MHz to 29.9999MHz and an

output power which is variable from 50mW to 200mW (p.e.p.) peak envelope power. The MA.1720 provides 289, 999 frequency channels in 100Hz steps, the output frequency being derived from a highly stable crystal-controlled 5MHz source. Channel frequency is selected by six thumbwheel switches which display the selected frequency in digital form; 'locking-in' to the selected frequency is completed in approximately 10 milliseconds.

8. The unit offers choice of a upper or lower single sideband, with suppressed or reduced carrier, independent sideband and radio telegraphy. Radio teleprinter (RTTY) is available as an optional built-in facility. Details of the facilities which are selected by a front panel control switch are as follows.

SSB (Upper or Lower)	-26, -16dB or suppressed
ISB	-16 or -26dB carrier
Key	-6dB or suppressed carrier
A.M.	-6dB carrier (compatible A.M.)
C.W.	L.S.B. mode with 1kHz keyed tone
RTTY	Tone Shift Keying
RTTY Test	Selects Mark
VOX	Automatic Voice Switching
PTT	Press to Talk
Transmit	Continuous transmission

9. Vox (automatic voice switching) is available on Line 1 to enable two way conversation to be carried out without manual switching.

10. To increase the flexibility of any system in which the MA.1720 Drive Unit may be employed, provision is made for muting an associated receiver and for antenna switching between the associated transmitter and receiver. The receiver output may be monitored at the drive unit and the drive unit sidetone fed to the receiver.

Line Switching Module MS 139

11. The Line Switching Module MS.139 is located at the right hand side of the cabinet adjacent to the MA.1004 Feeder Matching Unit. It controls the switching of coaxial relays which select the appropriate coaxial cable length, for channel frequency selected, between the TA.1810 Linear Amplifier and the MA.1004 Feeder Matching Unit.

TA.1810 Linear Amplifier

12. The Linear Amplifier Type TA.1810 is an all solid state wideband amplifier which requires no tuning and is designed to give a nominal 1kW output in the frequency range 1.6MHz to 29.9999MHz.

13. The amplifier consists basically of eight interchangeable plug-in r.f. power modules, each capable of providing a nominal 125W output. The outputs from the r.f. power modules are combined in hybrid transformers to produce the 1kW output.

14. Front access is provided to all r.f. power modules, a number of which may be withdrawn while the equipment continues to operate without interruption of service.

15. Each module is fitted with an ON/OFF switch and two lamps which indicate the availability of a DC supply and an RF output. An RF monitor connector is also provided for each module.

16. Two front panel mounted meters and associated switches provide an indication of input power, forward and reflected output power and the voltage supplied to and current drawn by each r.f. power module.

17. To facilitate ease of servicing with minimum interruption to traffic, the TA.1810 may be divided into two 500W sections; this enables one section to be released for maintenance whilst the other section provides operation on half-power.

MA.1004 Feeder Matching Unit

18. The Feeder Matching Unit Type MA.1004 matches the 50 ohm linear amplifier output to a nominal 50 ohm feeder system. Full output power and performance from the linear amplifier is achieved for a VSWR of up to 3:1.

19. The MA.1004 contains a 'T' network in which the coil settings are controlled by two servo systems whilst the capacitor bank consists of 4 capacitors which are automatically switched in or out of circuit by means of solenoids.

20. The unit has a fast tuning capability, the average tuning time is 4.5 seconds; the maximum tuning cycle is 8 seconds. A manual tuning facility is also provided.

Cooling

21. Two internal air blowers provide cooling, one for each bank of four r.f. power modules in the TA.1810 Linear Amplifier, whilst an axial fan mounted on the rear panel provides cooling for the MA 1720 Drive Unit and the MA.1004 Feeder Matching Unit.

CHAPTER 2

OPERATING INSTRUCTIONS

INTRODUCTION

1. The operating instructions detailed in the following paragraphs assume that the units of the TTA.1860 have been installed and connected in accordance with the installation details in the appropriate handbook. It is also assumed that the transmitter terminal is connected to a suitable antenna or dummy load.

AUTOMATIC TUNING

Initial Tuning Procedure

2. Set the MANUAL/AUTO switch on the MA.1004 to AUTO.

3. Switch on the supply to the MA.1004. Note that the SUPPLY lamp does not illuminate.

4. Set the supply switch on each RF Module to ON.

5. Switch the left hand and right hand circuit breakers on the TA.1810 Power Supply Unit to ON.

6. Set the ON/OFF/REMOTE switch on the TA.1810 to REMOTE.

7. On the MA.1720 Transmitter Drive Unit:

   (1) Operate the SUPPLY push-button. Note that the SUPPLY ON lamp illuminates.

   (2) Set the CONTROL switch to LOCAL SYNTH.

   (3) Set the MUTE/TUNE/OPERATE switch to OPERATE - HIGH.

   (4) Set the MODE switch to mode of emission required.

   (5) Set the SIDEBAND switch to UPPER or LOWER as required.

   (6) Set the VOX/PPT/TX switch as required.

   (7) Select the required frequency on the thumbwheel switches; note that the IN LOCK lamp illuminates.

(8) Press the STANDBY push-button; note the STANDBY lamp illuminates.

8. On the TA.1810 Linear Amplifier, note that the green lamps on all eight RF Modules are illuminated.

9. On the MA.1004 note that the SUPPLY ON lamp is illuminated.

10. On the MA.1720 press the RESET push-button and note the RESET lamp extinguishes.

11. Note that the MA.1004 Feeder Matching Unit coarse tune sequence is followed by the fine tune sequence (indicated by the action of the servo motors). When the fine tune sequence is completed the READY lamp on the MA.1004 will illuminate.

12. After a short delay to allow for the MS139 line selection sequence the READY lamp on the MA.1720 will illuminate to indicate that the Transmitter Terminal is ready for use.

Changing Frequency

13. On the MA.1720 Transmitter Drive Unit

(1) Select the required operating frequency on the thumbwheel switches.

Note: The output of the MA.1720 is automatically muted whilst the operating frequency is being selected.

(2) Press the RESET push-button.

Note: The tuning signal is automatically selected when the RESET push-button is operated.

14. After a short delay to allow for the MS139 line selection sequence, the READY lamp on the MA.1720 will illuminate to indicate that the Transmitter Terminal is ready for use.

MANUAL TUNING

Initial Tuning Procedure

15. Set the AUTO/MANUAL switch on the MA.1004 to the required frequency range.

16. Switch on the supply to the MA.1004, note that the SUPPLY lamp does not illuminate.

17. Set the SUPPLY switch on each RF Power Module to ON.

18. Switch the left hand and right hand circuit breakers on the TA.1810 Power Supply to ON.

19. Set the ON/OFF/REMOTE switch on the TA.1810 to REMOTE.

20. On the MA.1720 Transmitter Drive Unit:

    (1) Operate the SUPPLY push button; note that the SUPPLY lamp illuminates.

    (2) Set the CONTROL switch to LOCAL SYNTH.

    (3) Set the MUTE/TUNE/OPERATE switch to OPERATE-HIGH or LOW as required.

    (4) Set the MODE switch to mode of emission required.

    (5) Set the SIDEBAND switch to UPPER or LOWER as required.

    (6) Set the VOX/PTT/TX switch as required.

    (7) Select the required frequency on the thumbwheel switches and note that the IN LOCK lamp illuminates.

    (8) Press the STANDBY push-button and note that the STANDBY LAMP illuminates.

21. On the TA.1810 Linear Amplifier, note that the green lamps on all eight RF Modules illuminate.

22. On the MA.1004 Feeder Matching Unit note that the SUPPLY ON lamp is illuminated.

23. Press the RESET push-button on the MA.1720 and tune the MA 1004 using the procedure detailed in the Manual Tuning Instructions in Chapter 2 of the MA.1004 manual (part 3 of this manual).

24. When manual tuning has been completed select the line appropriate to obtain maximum forward power, as indicated on the TA.1810 Linear Amplifier Forward Power Meter, and finally check tuning.

Changing Frequency

25. On the MA.1720 Transmitter Drive Unit:

    (1) Select the required operating frequency on the thumbwheel switches.

Note: The output of the MA.1720 is automatically muted whilst the operating frequency is being selected.

(2) Press the RESET push-button.

26. Set the AUTO/MANUAL switch on the MA.1004 to the required frequency range and tune the MA.1004 using the procedure described in Chapter 2 of the MA.1004 manual (part 3 of this manual).

27. When manual tuning has been completed select the line appropriate to obtain maximum forward power, as indicated on the TA.1810 Linear Amplifier Forward Power Meter, and finally check tuning.

CHAPTER 3

SETTING-UP PROCEDURE

INTRODUCTION

1. Before carrying out the following procedures, the individual units of the transmitter terminal must be installed and set up as detailed in the respective manuals.

2. The TTA.1860 cabinet has four 13 mm diameter holes in the base for securing the cabinet to the floor. If the cabinet is not bolted to the floor, only one power unit should be withdrawn at any one time to prevent the transmitter from toppling.

3. Ensure that an antenna system of the correct type, or a suitable dummy load, is connected to the transmitter terminal antenna socket.

4. The procedures detailed in paragraphs 5 to 9 must be carried out in the order given and should be repeated following the replacement of any unit.

PROCEDURE

Preliminary

5. (1) Set the ON/OFF/REMOTE switch on the TA.1810 to OFF.

(2) Set the left and right-hand circuit breakers on the TA.1810 power supply unit to OFF.

(3) Set the SUPPLY push-button on the MA.1720 to OFF.

(4) Connect the transmitter terminal antenna socket to a suitable ATU and antenna, or a dummy load.

MA.1720 Drive Unit

6. (1) Withdraw the MA.1720 from the cabinet and remove the top panel to gain access to the mixer and output board PM342, and the low level board PM341.

(2) Set the front panel METER swith to RF.

(3) Set the CONTROL switch to SYNTH.

(4) Set the MODE switch to RTTY TEST, or to CW and close the key (connected to the front panel jack, or interconnect 1TB16 pins 7 and 8 - fig. 3).

(5) Set the TUNE/MUTE/OPERATE switch to TUNE.

(6) Set the VOX/PTT/TX switch to TX.

(7) Set the frequency switches to display the required operating frequency.

(8) Ensure that the voltage selector on the rear panel is correctly set to suit the local source of supply.

(9) Set the MA.1720 SUPPLY push-button to ON and depress the RESET button.

(10) Adjust R204 on the low level board PM341 for a maximum indication on the front panel meter. Note the level indicated.

(11) Set the TUNE/MUTE/OPERATE switch to OPERATE HIGH and check that the output level indicated on the front panel meter is within plus or minus 0.5dB of the level noted at step (10).

(12) Adjust R70 on the mixer and output board PM342 for an indication of -5dB on the front panel meter.

(13) Set the SUPPLY push-button to OFF, replace the top cover on the MA.1720, and return the drive unit to the cabinet.

TA.1810 Linear Amplifier

7. (1) Remove the power supply panel to obtain access to the muting unit MS564.

(2) Remove the muting unit cover and check that the internal link in the muting unit is set for -6dB attenuation. (Connections within the muting unit are given in Chap. 2 of the TA.1810 manual.)

(3) Replace the muting unit cover.

(4) Remove the Pozidriv screw securing the angle bracket, mounted on the front edge of one bank of power supplies, and pull the bank of power supplies forward.

(5) Check that the mains voltage selector on each power supply is set to suit the local source of supply.

(6) Return the bank of power supplies to the cabinet and replace the Pozidriv securing screw.

(7) Repeat (4), (5) and (6) for the other bank of power supplies.

(8) Replace the power supply panel.

MA.1004 Feeder Matching Unit

8. (1) Withdraw the MA.1004 from the cabinet and remove the top cover.

(2) Check that the voltage tappings on the Power Supply Unit are correctly set to suit the local source of supply.

(3) Ensure that the 'Servos off' link LK1 on the Tune PCB PS559 of the MA.1004 is not made.

(4) Replace the top cover and return the Feeder Matching Unit to its position in the Cabinet.

NOTE: One of the screws securing the top cover of the MA.1004 is longer than the others and is located in the slotted hole in the centre of the cover.

VSWR Warning Facility

9. The VSWR warning board on the TA.1810 linear amplifier will give an indication (to an external position) when the reflected power of the amplifier exceeds a pre-determined level. If this facility is connected calibration should be carried out as follows:-

(1) Tune the system as detailed in Chapter 2.

(2) Switch OFF a number of RF Power Modules until the forward power corresponds with the required reflected power.

(3) Lower the TA.1810 meter panel and set the CAL/NORMAL switch inside the meter panel to CAL.

(4) Adjust the pre-set control 11AR12 inside the meter panel until the VSWR warning signal is just given at this level (i.e. lights an external lamp or operates an external buzzer).

(5) Return the CAL/NORMAL switch inside the meter panel to the NORMAL position and replace the TA.1810 meter panel.

EXTERNAL CONNECTIONS

10. A summary of external control signals which may be applied to the transmitter terminal from an external control panel is given in Table 1. Table 2 lists the outputs from the transmitter terminal which may be used to indicate transmission state to an external position. Refer to Appendix 2 for remote or extended control connection details.

TABLE 1 - INPUTS				
Connection	Function	Signal ON Condition	Signal OFF Condition	Action
TB9/1	Tune	Earth	Open Circuit	Reverts the MA1004 to the tune condition.
TB9/2	Servo Off	0V	+12V or Open Circuit	Switches off the servo motors in the MA1004
TB8/12	Reduced Power	+12V	0V	Resets the latching circuit in the TA 1810 Overload Unit to remove the Reduced Power Signal

TABLE 2 - OUTPUTS				
Connection	Function	Signal ON Condition	Signal OFF Condition	Action
TB8/3	Ready	0V	+12V	Indicates that the MA1004 has completed tuning.
TB8/11	Fault	0V	+12V	Indicates a fault in the MA1004 or a main contactor fault in the TA1810.
TB8/10	Reduced Power	+12V	0V	Indicates that the transmitter Terminal is operating on reduced power.
TB9/6	V.S.W.R. Warning	+12V	0V	Activates external warning circuit when Transmitter Terminal is operating into excessive V.S.W.R.
TB9/3 TB9/4	External Ready	Suitable for connection to a 24V 55mA bulb		Lights external lamp.

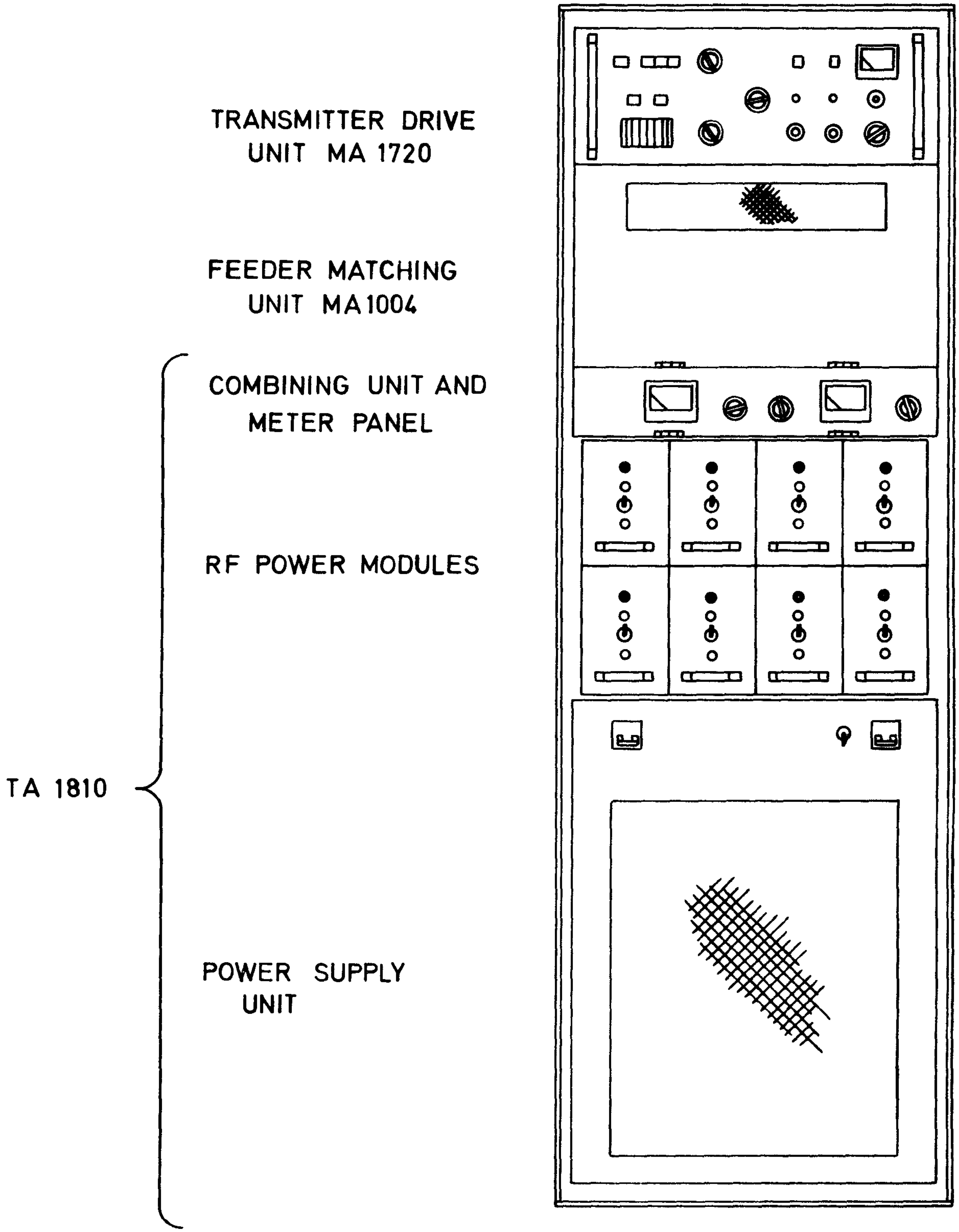
CHAPTER 4

COMPONENTS LIST

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
Connectors (see Fig. 2)						
PL29		37-Way Plug, free			916507	Cannon DC37P
		Shell			918105	Cannon DC51215-1
		Retainer			914246	Cannon DC51222-1
PL30		25-Way Plug, free			916489	Cannon DB25P
		Shell			914299	Cannon DB51213-1
		Retainer			914245	Cannon DB51221-1
PL32	50Ω	Coaxial Plug, free			900038	Transradio BN1/5
PL33		15-Way Plug, free			909729	Cannon DA15P
		Shell			912760	Cannon DA51211-1
		Retainer			914244	Cannon DA51220-1
SK33	50Ω	Coaxial Socket, free			912258	Transradio BN2/5B
SK34		15-Way socket, free			900905	Cannon DA15S
		Shell			912760	Cannon DA51211-1
		Retainer			914244	Cannon DA51220-1
		Sleeve Marked 1SK34			906387	Hellerman P75
SK35		3-Way socket, free			919694	Amphenol 62GB56T8-3.3S
		Clamp, right angle			919696	Amphenol 62GB-711-8-3.3S
		Sleeve marked 1SK35			922490	
SK36		15-Way socket, free			900905	Cannon DA15S
		Shell			912760	Cannon DA51211-1
		Retainer			914244	Cannon DA51220-1
		Sleeve marked 1SK36			923142	Hellerman P55
SK37		3-Way socket, free			919694	Amphenol 62GB56T8-3.3S
		Clamp right angle			919696	Amphenol 62GB-711-8-3.3S

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
<u>Miscellaneous</u>						
		Cable, coaxial Uniradio UR43			904628	
		Cable, coaxial Uniradio UR43M			923686	
		Cable, coaxial Uniradio UR67			904629	
		Cable, coaxial Uniradio UR107			914984	
		Cable, coaxial Uniradio UR110			919158	
		Cable, coaxial RF RG141A/U			917764	
		Cable 2-core screened 7/0076			908445	
		Cable 3-core screened 16/0.2mm			900716	
		Fanning Strip			921445	Klippon MF2/12

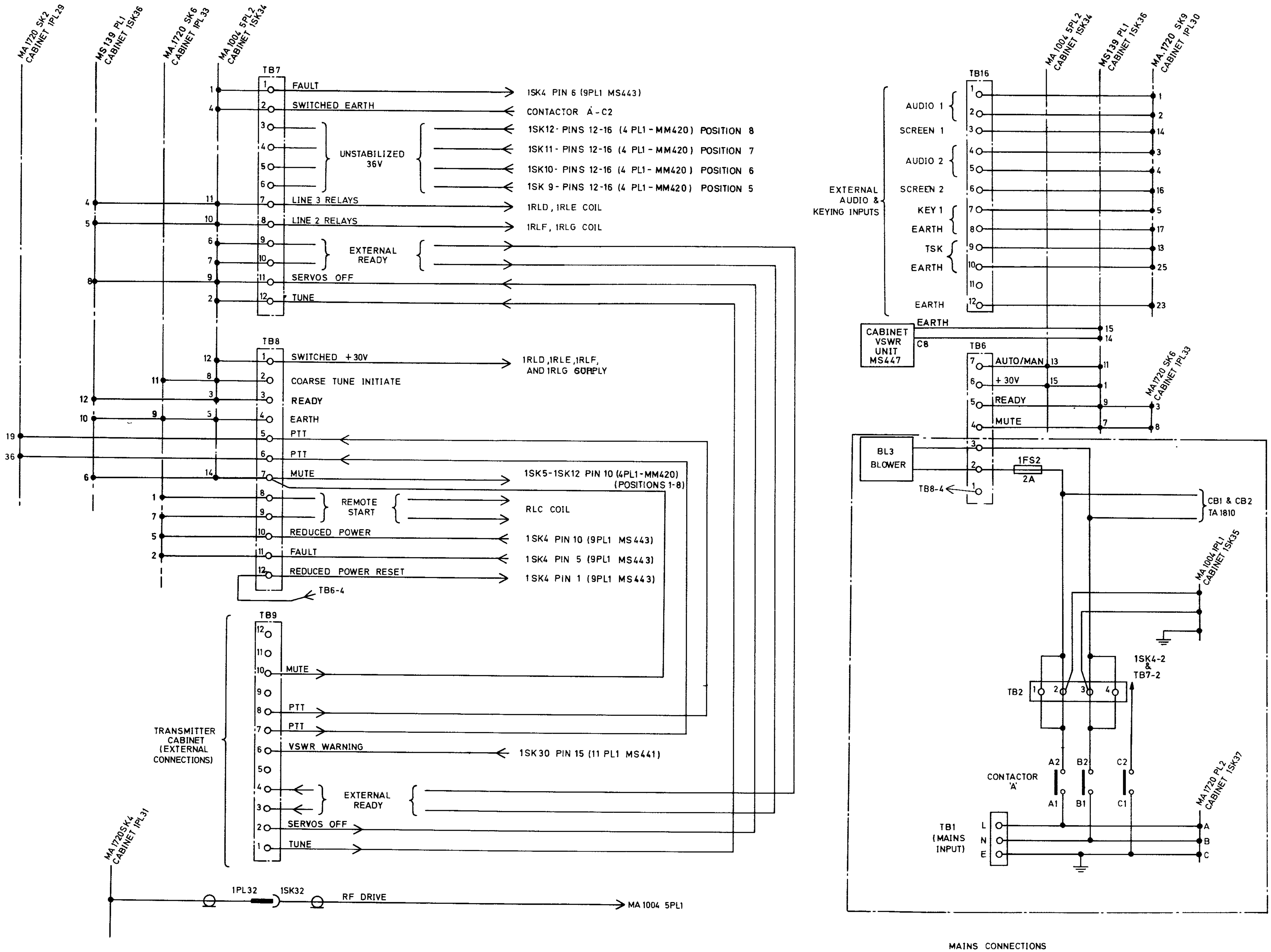
NOTE: The details of the remaining items shown on Fig. 2 will be found in the Components List of the TA.1810 under the heading of cabinet Assembly Chassis.



NOTE:-

THE LINE SWITCHING MODULE MS 139 IS MOUNTED INSIDE THE CABINET TO THE RIGHT OF THE FEEDER MATCHING UNIT.

WOH 3042 TTA.1860 Cabinet Layout Fig 1



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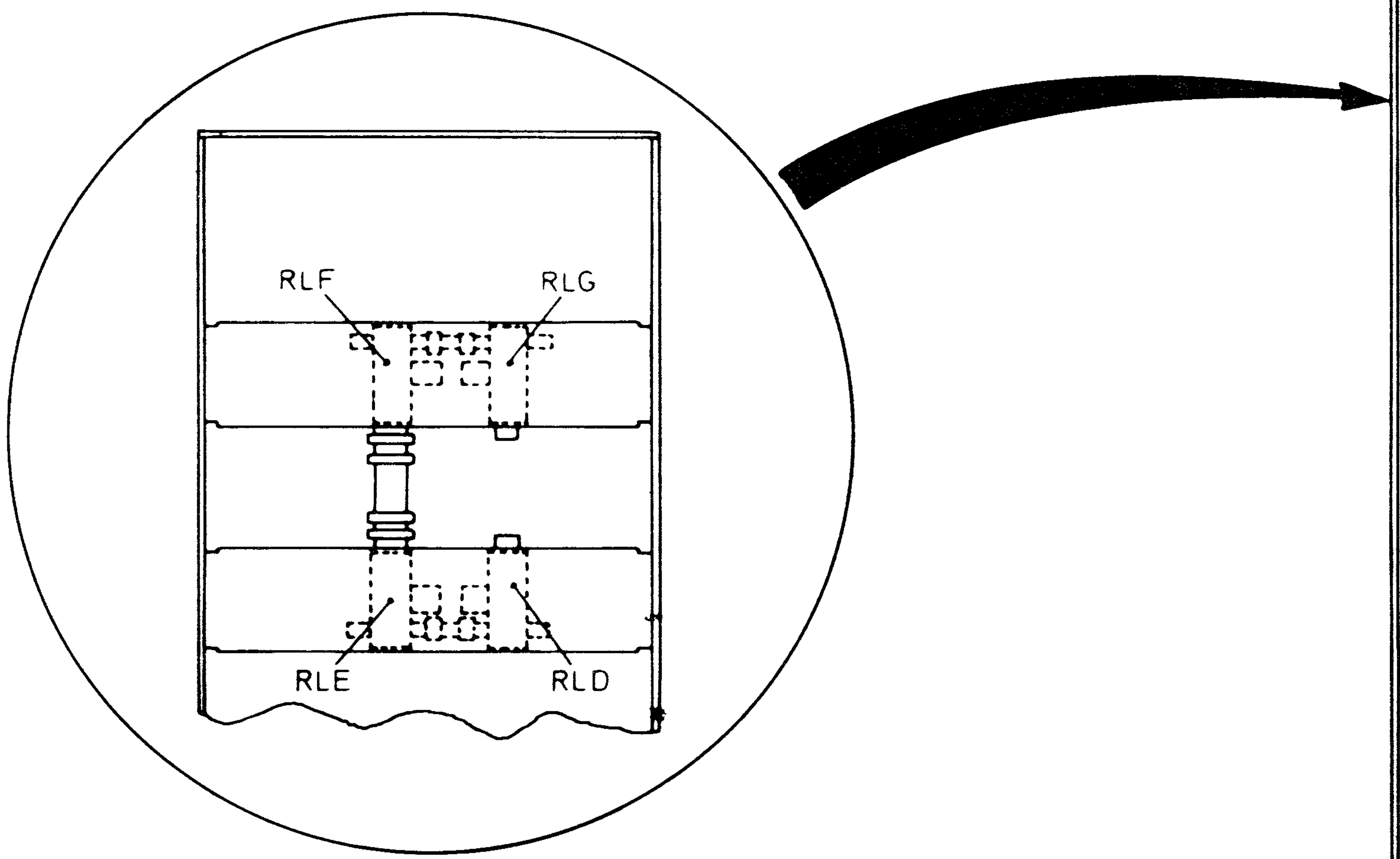
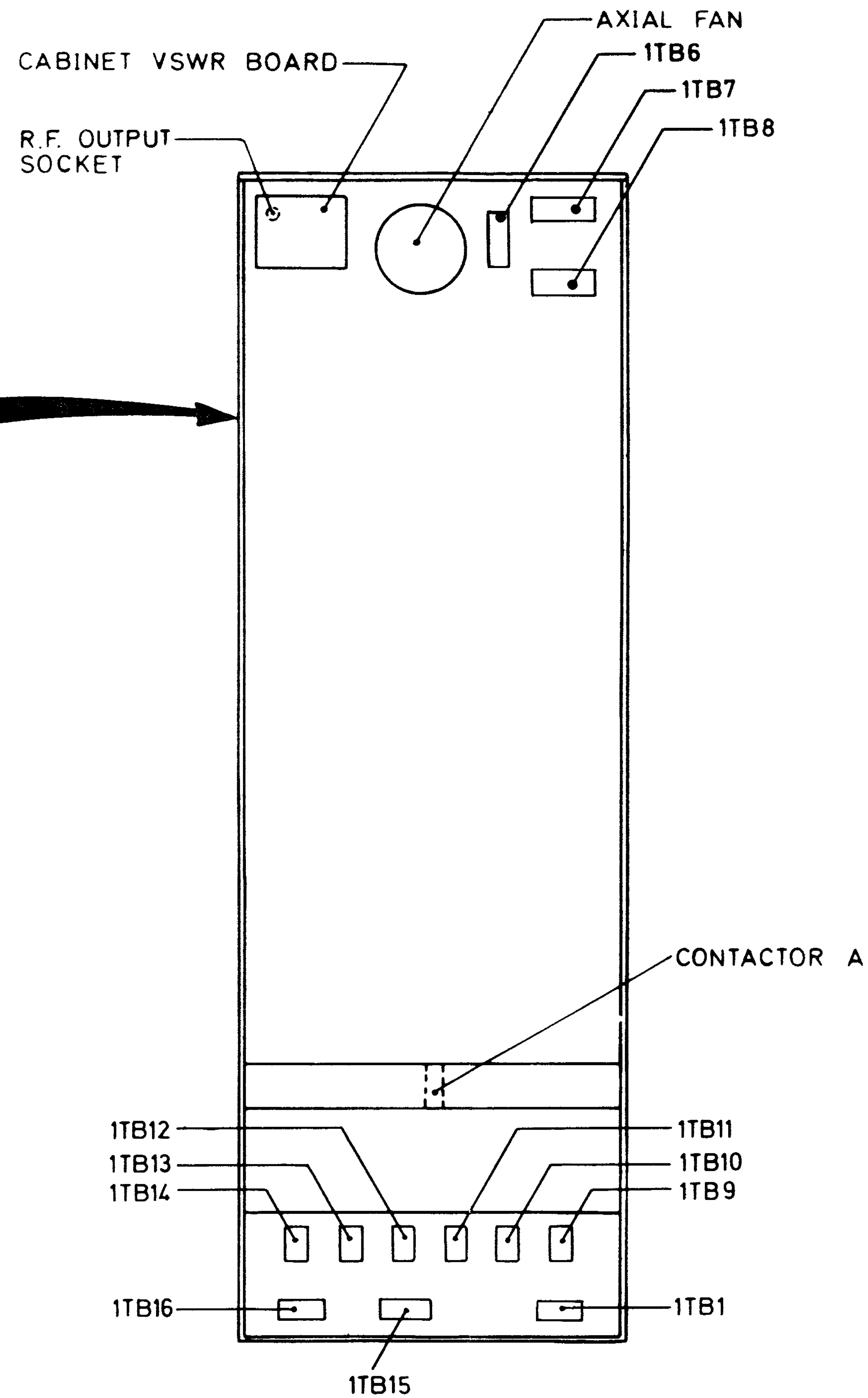
Cabinet Inter-Unit Wiring: TTA.1860

Fig. 2



COAXIAL RELAYS

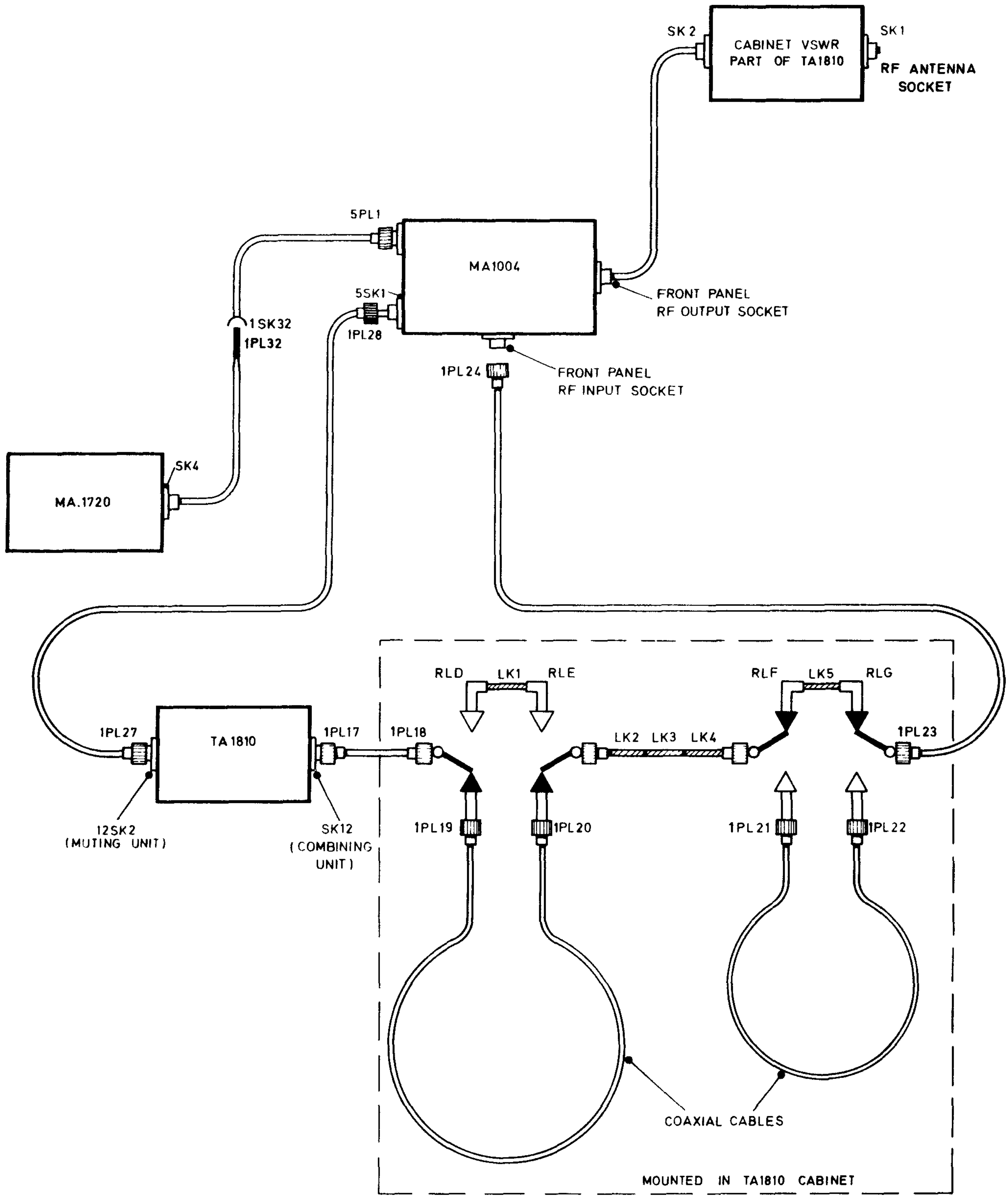
VIEW ON L.H. SIDE



FRONT VIEW

WOH3042

Fig. 3



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Coaxial Connections : TTA1860 Fig.4

APPENDIX NO. 1

ANTENNA TRANSMIT/RECEIVE SWITCHING (TTA.1860)

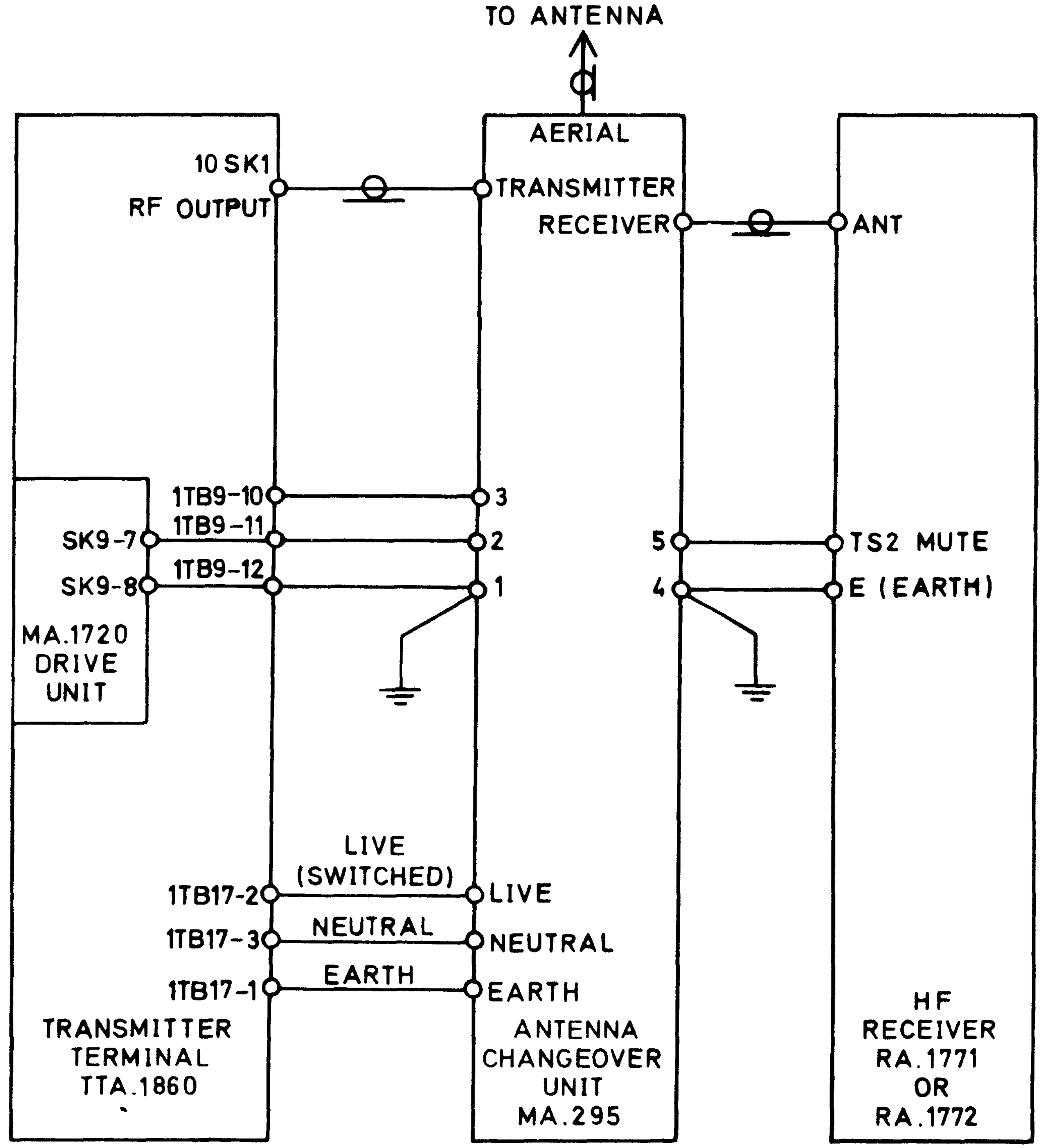
CONTENTS

INTRODUCTION

1. When a TTA.1860 Transmitter Terminal is used in simplex mode with an RA.1771 or RA.1772 Receiver, it is necessary to switch the common antenna between the transmitter and the receiver. This is achieved by an MA.295 Antenna Changeover Unit controlled by a muting circuit within the MA.1720 Drive Unit, which forms part of the transmitter.

2. When the Drive Unit is muted, the antenna is connected to the receiver, and a muting circuit within the receiver is de-muted, allowing the receiver to operate. When transmission is required, the drive unit is de-muted, the antenna is switched to the transmitter, and the receiver is muted.

3. This Appendix shows the connections between the MA.295 and the transmitter and receiver. Separate handbooks are available for the receiver and the MA.295.



Interconnecting Diagram:
Antenna Transmit/Receive Switching
TTA.1860

WOH3042

App. 1 Fig. 1

APPENDIX NO. 2

CONNECTIONS FOR REMOTE OR EXTENDED CONTROL

CONTENTS

INTRODUCTION

1. When a Transmitter Terminal is operated by a remote or extended control system, control inputs are made to terminal blocks at the base of the cabinet. The terminal blocks are wired to connectors at the rear of the MA.1720 Drive Unit. This Appendix lists the wiring connections between the terminal blocks and the MA.1720.

WIRING TABLE

CABLE RUN		FUNCTION
FROM	TO	
1SK38-1	1TB10-1	x 10kHz
-2	-2	x 10kHz
-3	-3	x 10kHz
-4	-4	x 10kHz
-5	-5	x 1kHz
-6	-6	x 1kHz
-7	-7	x 1kHz
-8	-8	x 1kHz

NOTE: Socket 1SK38 mates with MA.1720 PL3
Plug 1PL29 mates with MA.1720 SK2

CABLE RUN		FUNCTION
FROM	TO	
1SK38-9	1TB10-9	)
-10	-10	) x 100Hz
-11	-11	)
-12	-12	)
-13	1TB11-1	)
-14	-2	) x 10MHz
-15	-3	)
-16	-4	)
-17	-5	)
-18	-6	) x 1MHz
-19	-7	)
-20	-8	)
-21	-9	)
-22	-10	) x 100kHz
-23	-11	)
-24	-12	)
1PL29-1	1TB12-1	Spare
-2	-2	Spare
-3	-3	I.S.B. Control
-4	-4	Spare
-5	-5	High Power Control
-6	-6	-16dB Control
-7	-7	Key Supp. Control
-8	-8	Vox Control
-9	-9	Extended Tx. lamp
-10	-10	Extended Reset
-11	-11	Extended Tune
-12	-12	Extended Reduced Power
-13	1TB13-1	Extended 'In lock'
-14	-2	Remote 'On'
-15	-3	Extended mode control
-16	-4	-7V
-17	-5	+5V
-18	-6	+20V
-19	-7	Local PTT

NOTE: Socket 1SK38 mates with MA.1720 PL3
Plug 1PL29 mates with MA.1720 SK2

WIRING TABLE (Contd)

CABLE RUN		FUNCTION
FROM	TO	
1PL29-20	1TB13-8	RTTY Test
-21	-9	RTTY
-22	-10	LSB Control
-23	-11	Low Power Control
-24	-12	-26dB Control
-25	1TB14-1	-6dB Control
-26	-2	Key -6dB Control
-27	-3	Spare
-28	-4	Extended 'EHT ON'
-29	-5	Extended 'STANDBY ON'
-30	-6	Extended 'Reset' lamp
-31	-7	Extended 'Ready' lamp
-32	-8	Extended 'Mute'
-33	-9	Extended 'ON'
-34	-10	Extended PTT
-35	-11	0V
-36	-12	+12V
-37	1TB15-1	Remote PTT

NOTE: Socket 1SK38 mates with MA.1720 PL3
Plug 1PL29 mates with MA.1720 SK2

1 1kW LINEAR AMPLIFIER

TYPE TA.1810

REF: WOH 3037
ISSUE: P
April 87 — 25

BERYLLIUM OXIDE - SAFETY PRECAUTIONS

INTRODUCTION

The following safety precautions are necessary when handling components which contain Beryllium Oxide. Most RF transistors contain this material although the Beryllium Oxide is not visible externally. Certain heatsink washers are also manufactured from this material.

PRACTICAL PRECAUTIONS

Beryllium Oxide is dangerous only in dust form when it might be inhaled or enter a cut or irritation area. Reasonable care should be taken not to generate dust by abrasion of the bare material.

Power Transistors

There is normally no hazard with power transistors as the Beryllium Oxide is encapsulated within the devices. They are safe to handle for replacement purposes but care should be exercised in removing defective items to ensure that they do not become physically damaged.

They MUST NOT:

(a) be carried loosely in a pocket, bag or container with other components where they may rub together or break and disintegrate into dust,

(b) be heated excessively (normal soldering is quite safe),

(c) be broken open for inspection or in any way abraded by tools.

Heatsink Washers

Heatsink washers manufactured from Beryllium Oxide should be handled with gloves, cloth or tweezers when being removed from equipment. They are usually white or blue in colour although sometimes difficult to distinguish from other types. Examples of washers used are 917796, 917216 and 700716.

They MUST NOT:

(a) be stored loosely,

(b) be filed, drilled or in any way tooled,

(c) be heated other than when clamped in heatsink application.

DISPOSAL

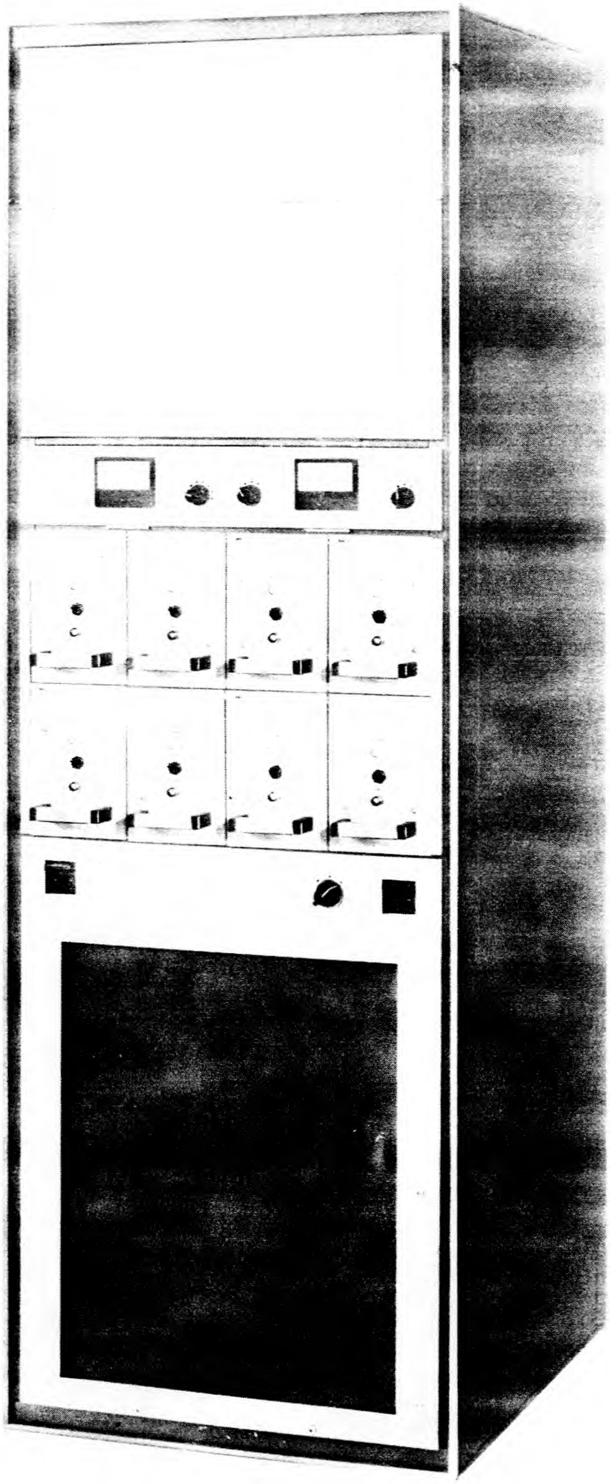
Defective and broken components must not be disposed of in containers used for general refuse. Defective components should be individually wrapped, clearly identified as "DEFECTIVE BERYLLIA COMPONENTS" and returned to the Equipment Manufacturer for subsequent disposal.

Broken components should be individually wrapped and identified as "BROKEN BERYLLIA COMPONENTS". They must not be sent through the post and should be returned by hand.

MEDICAL PRECAUTIONS

If Beryllia is believed to be on, or to have entered the skin through cuts or abrasions, the area should be thoroughly washed and treated by normal first-aid methods followed by subsequent medical inspection.

Suspected inhalation should be treated as soon as possible by a Doctor - preferably at a hospital.



1kW Linear Amplifier Type TA.1810

1kW LINEAR AMPLIFIER

TA1810

CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Continued)

TECHNICAL SPECIFICATION

Frequency Range	1.6 to 30.0 MHz
Power Output	1KW $\pm$ 1dB p.e.p. and C.W.
Output Impedance	50 ohm (will operate at full power into 3:1 V.S.W.R. when operating with MA1004 Feeder Matching Unit).
Intermodulation Products	35dB below 1 tone 1.6 to 10MHz in a standard two tone test. 25dB below 1 tone 10.0 to 30mHz. in a standard two tone test.
Harmonic Radiation	Better than -43dB below p.e.p. when operating with MA1004 or MA1034 filter units.
Wideband Noise	125dB below p.e.p. in 3KHz bandwidth - with Drive Unit muted.
Input Level	25mW - 200mW nominal $\pm$ 1.5dB over the frequency range.
Input Impedance	50 ohm
Supply	210-250V single phase 47-60Hz. Consumption 5.5KVA.

ALTERNATIVES

Certain recommended alternative components are listed below. These alternative components may be used when the appropriate item given in the following components list is no longer available.

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer
		Page 8.33 LOW LEVEL BOARD (PS351)				
5ATR15		2N3553			928074	RCA
5ATR16		2N3553			928074	RCA
5ATR20		2N3553			928074	RCA
5ATR22		2N3553			928074	RCA

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1. The TA.1810 is an all solid-state wideband linear amplifier which operates over the frequency range 1.6MHz to 30MHz. The output power (1kW total) is obtained by combining the 125W outputs of eight identical plug-in modules in a passive combining network.

2. The amplifier, complete with power supplies etc, is mounted in a floor standing cabinet, the top section of which contains space for fitting associated drive equipments and filter/feeder matching units (para.5). The amplifier operates from a 210/250V single phase AC supply, and internal regulation (up to ±6%) is provided, as are all necessary cooling and air filtering facilities.

3. Installation is extremely simple (see Chap.3). For fixed station operation it is not essential to fix the cabinet directly to the floor, since it can be free standing if required, (see CAUTION on page 3-1). Alternatively the cabinet can be bolted permanently to the floor. Electrical connections i.e. audio, keying and AC supply are made to terminals in the bottom rear of the cabinet, the RF output connector is situated at the top rear.

ASSOCIATED EQUIPMENTS

4. The TA.1810 amplifier is designed to operate primarily with the Racal MA.1720 (Synthesized) or MA.7917 (Channelized) Transmitter Drive Units. It can, however, be used in conjunction with any HF exciter with a nominal 100mW output over the required frequency range.

5. Connection to an external antenna should be made via one of two alternative units, dependent upon the type of antenna to be used, viz

   (i) For operation into a wideband antenna, cut dipole, or any other antenna which will normally present a V.S.W.R. better than 3:1 at the operating frequency, the Racal Feeder Matching Unit Type MA.1004 is recommended. This is a fast-acting automatically-tuned unit which ensures maximum power transfer into the antenna at all frequencies, and at the same time provides a high degree of attenuation to harmonic frequencies.

   (ii) When operating into a whip or long wire antenna with an associated aerial tuning unit, the Racal Filter Switching Unit (Type MA.1034) is required. This unit is a simpler device than the MA.1004, and provides harmonic attenuation; impedance matching is provided by the external A.T.U.

6. The TA.1810 cabinet assembly is designed to include, as required, any combination

of exciter (MA.1720 or MA.7917) and output filtering/matching unit (MA.1034 or MA.1004) thereby providing an overall self-contained, fully automatic, solid state H.F. transmitter.

COMPOSITION OF THE TA.1810 AMPLIFIER   Fig.1-1

7. This section lists the units, modules and printed-circuit (p.c.) boards which form the TA.1810 linear amplifier. Detailed technical descriptions are given in Chap.5.

Prefix Codes

8. Prefix codes are given to each unit or module and to each board in a unit or module as listed below. As an example, the complete reference for resistor R1 of a board A in sub-unit No. 5 is 5AR1. Prefix codes are shown encircled on illustrations.

PREFIX CODES

Prefix Code	Unit, Module or P.C. Board	Type No.	Quantity Used	Circuit Diagram Fig. No.
1	Cabinet Assembly	TA.1810	1	30
	Containing			
None	Power Supply Module	MS.64	1 each Four identical Modules.	25
None	Power Supply Module	MS.64		
None	Power Supply Module	MS.64		
None	Power Supply Module	MS.64		
None	R.F. Power Module	MM.420	8	21
	Consisting of			
4	Stabilizer Module	M S.440	8 (total)	27
	Containing			
4A	P.C. Board	PS.313	8 (total)	27
5	R.F. Amplifier Module	MM.320	8 (total)	21
	Containing			
5A	Low Level Board	PS.351/PS.314	8 (total)	13
5B	High Level Board	PS.315	8 (total)	15
5C	Protection Board	PS.251	8 (total)	19
5D	VSWR Board	PS.316	8 (total)	17
6	Combining Unit	MS.441	1	23
	Containing			
6A	P.C. Board A	PS.252	1	
6B	P.C. Board B	PS.252	1	
7	Splitter Unit	MS.444	1	1
	Containing			
7	P.C. Board	PS.318	1	

IMPORTANT
SEE PAGE 1-3 FOR VARIANTS OF RF POWER MODULES

PREFIX CODES (Continued)

Prefix Code	Unit, Module or P.C. Board	Type No.	Quantity Used	Circuit Diagram Fig. No.
8	Distribution Amplifier	MS.442	2	3
	Containing			
8	P.C. Board	PS.319	2 (total)	
9	Overload Unit	MS.443	1	5
	Containing			
9	P.C. Board	PS.322	1	
10	Cabinet VSWR Unit	MS.447	1	7
	Containing			
10	P.C. Board	PS.317	1	
11	Meter Panel Assembly	MS.445	1	9
	Containing			
11A	VSWR Warning P.C. Board	PS.446	1	11
12	Muting Unit	MS.564	1	33
	Containing			
12A	P.C. Board	PS.565	1	

MM.420 RF POWER MODULE VARIANTS

9. Four versions of the RF Power Module are available, designated MM.420, MM.420/1, MM.420/2 and MM.420/3 as given in Table 1.

TABLE 1

R.F. Power Module	MM.420	MM.420/1 *	MM.420/2	MM.420/3 *
Consisting of				
Stabilizer Module	MS.440	MS.440	MS.440	MS.440
Containing				
P.C. Board	PS.313	PS.313	PS.313	PS.313
R.F. Amplifier Module	MM.320	MM.320/1	MM.320/2	MM.320/3
Containing				
Low Level Board	PS.351A/ PS.314A	PS.351B/ PS.314B	PS.351A/ PS.314A	PS.351B/ PS.314B
High Level Board	PS.315	PS.315	PS.315	PS.315
Protection Board	PS.251	PS.251	PS.251	PS.251
VSWR Board	PS.316	PS.316	PS.316	PS.316

* Note MM420/1 and MM420/3 are special versions and are NOT fitted in the standard TA.1810. See Para. 10

EXPLANATION OF VARIANTS

10. (1) The MM.420 has normal a.g.c. characteristics (given by the 'A' version of the low level board) and uses power transistors Racal Part Number 923126 (TR.1 to TR.4, TR.7 to TR.10) and 4.7Ω resistors (R.18 and R.36) in the high level board.

(2) "The MM420/1 is a special version with long time constant a.g.c. characteristics ('B' version of the low level board) and uses power transistors Racal Part Number 923126 (TR1 to TR4 and TR7 to TR10) and 4.7Ω resistors (R18 and R36) in the high level board. It is otherwise identical to the MM420/3.

(3) The MM.420/2 has normal a.g.c. characteristics and uses power transistors Racal Part Number 926524 (TR.1 to TR.4, TR.7 to TR.10) and 2.2Ω resistors (R.18 and R.36) in the high level board.

(4) "The MM420/3 is a special version with long time constant a.g.c. characteristics ('B' version of the low level board) and uses power transistors Racal Part Number 926524 (TR1 to TR4 and TR7 to TR10) and 2.2Ω resistors (R18 and R36) on the high level board. It is otherwise identical to the MM420/1

(5) "The Standard TA1810 may be fitted with MM420 or MM420/2 RF Power Modules and these are directly interchangeable (See para.12). The MM420/1 and MM420/3 are used for a specialised application and are NOT fitted in the standard TA.1810. The MM420/1 and MM420/3 are directly interchangeable (See para. 12).

REPLACEMENT OF POWER TRANSISTORS

11. It is essential that the correct type of power transistor (and associated resistor) is replaced in a module in accordance with para.10 and Components List, pages 8-18 and 8-20. Power transistor types must not be mixed in a module.

MIXING OF MODULES

12. "When issued from the factory the standard TA.1810 is fitted with one version of the RF Power Module throughout, either MM420 or MM420/2.
RF modules MM420 and MM420/2 are directly interchangable and can be mixed without limitation in a standard transmitter. Modules MM420/1 and MM420/3 are also directly interchangeable and can be mixed in the special long time constant version.

IDENTIFICATION OF MODULES

13. Modules are identified on plates fitted at the rear of the module, which can be seen when a module is removed from the cabinet.

THE R.F. CIRCUITS — Fig. 1.2

14. A block schematic showing the RF path and the RF levels within the RF circuits is given as Fig. 1.2. These circuits are now described in more detail. The nominal RF levels appearing at each stage are also shown. The RF input from the associated transmitter drive unit is fed, via the Muting Unit, into the splitter unit which provides a separate output to each distribution amplifier. The distribution amplifiers each provide four buffered outputs at 50 ohm with a nominal gain of 3dB from the input to each output. The four outputs from each amplifier are fed, via 50 ohm coaxial lines, to the inputs of the MM.420 RF power modules. The 125W output from each RF module is fed, via 50 ohm coaxial lines, to inputs on the combining unit MS.441.

15. The module outputs are combined two at a time in hybrid stages. The first four hybrid stages provide four 250W outputs which are combined in two further hybrid stages to produce the two 500W outputs. The two 500W outputs are available separately at 50 ohm impedance, at a patch panel. During normal operation both outputs are connected to the final hybrid transformer to produce a combined output of 1kW.

16. The gain characteristics of each module are maintained at similar values, via automatic level control circuits. In addition electrical path lengths, including coaxial cable lengths, are similar for each circuit. These provisions ensure that the phase and amplitude characteristics of each path are similar, thus allowing the combining unit to function at optimum efficiency.

17. The complete amplifier is wideband, therefore no tuning or moving parts are involved.

18. The output from the combining unit is normally fed v'a an MA.1004 or MA.1034 unit (see para.5) which, in turn, feeds the V.S.W.R. unti Type MS.447. The V.S.W.R. unit monitors the forward and reflected output power from the amplifier and provides visual indication on the meter and an external warning voltage should a pre-determined reflected output power level be exceeded.

19. The automatic level control circuits (para.11) also provide protection by automatically reducing power if a mismatch impedance occurs at the module outputs.

20. The overload unit Type MS.443 (shown on Fig. 1.4) automatically monitors the operational state of the amplifier and provides an external signal if unbalanced RF inputs are fed to the combining unit, or if any MS64 power supply unit fails (See Chapter 5 for a detailed description).

POWER SUPPLY DISTRIBUTION — Figs.1.3 and 1.4

21. Each 500W amplifier is provided with its own power supply which can be independently switched. Each power supply consists of two identical DC power supply units Type MS64 whose outputs are paralleled to provide DC supplies to each bank of four RF modules. Associated with each RF module is a Stabilizer Module M S.440 which

forms part of the Type MM420 Amplifier. Each MS 440 module provides a stabilized DC output to each RF module under varying AC conditions and includes a fast current trip circuit to protect the RF circuits if an overload occurs. The DC voltage and the current taken by each module can be monitored at the amplifier meter panel.

OPERATIONAL FEATURES

Active Standby Philosophy

22. The 1kW amplifier TA.1810 consists basically of two 500W amplifiers, each comprising four 125W RF modules. Each 500W amplifier is mechanically and electrically independent of the other: At the final hybrid stage of the combining unit the two 500W outputs are combined to give 1kW. The final hybrid stage can be by-passed by external patching, allowing one amplifier to continue to function and provide 500W output, regardless of condition, of the second 500W amplifier.

23. The operational flexibility of the two 500W amplifiers is increased by using eight independent RF modules each providing 125W output. As the outputs of the modules are combined, (not parallelled) they are isolated from each other electrically. Therefore an operational module is not affected by a defective module even if the defect is a short-circuit, open circuit or any other fault condition. In addition, a defective module can be unplugged and replaced while the remainder of the modules continue to operate. The only effect on transmission due to a defective module will be a small reduction in output power (of the order of 1.5dB).

24. This extremely important feature together with the ability to transmit temporarily with only one 500W amplifier in use (para.17) ensures an overall equipment reliability very much greater than that obtained using conventional transmitters, giving a 'lost transmission time' due to faults that is extremely small.

25. It should be noted that when a failure of one 500W amplifier occurs the radiated power is reduced from 1KW to 250W until the output connector is transferred (patched) to the still functioning 500W outlet. Until patching is carried out 250W is dissipated internally in the combiner (which is continuously rated) allowing only 250W to appear at the output. Patching for 500W output can be carried out at a suitable break in transmission; approximately 30 seconds is required for this operation.

Operating Indicators on Modules

26. Each module can be switched off separately at its own front panel. The operating state of each module is indicated by two front-panel lamps. The illumination of the green lamp shows the presence of the D.C. supply; the white lamp illuminates when the module is providing an RF output. A faulty or weak module is indicated by a lower level of illumination when compared with the remainder of the indicator lamps.

Metering and Monitoring

27. The Metering panel (MS445) allows metering of the 30V and 20V DC supply

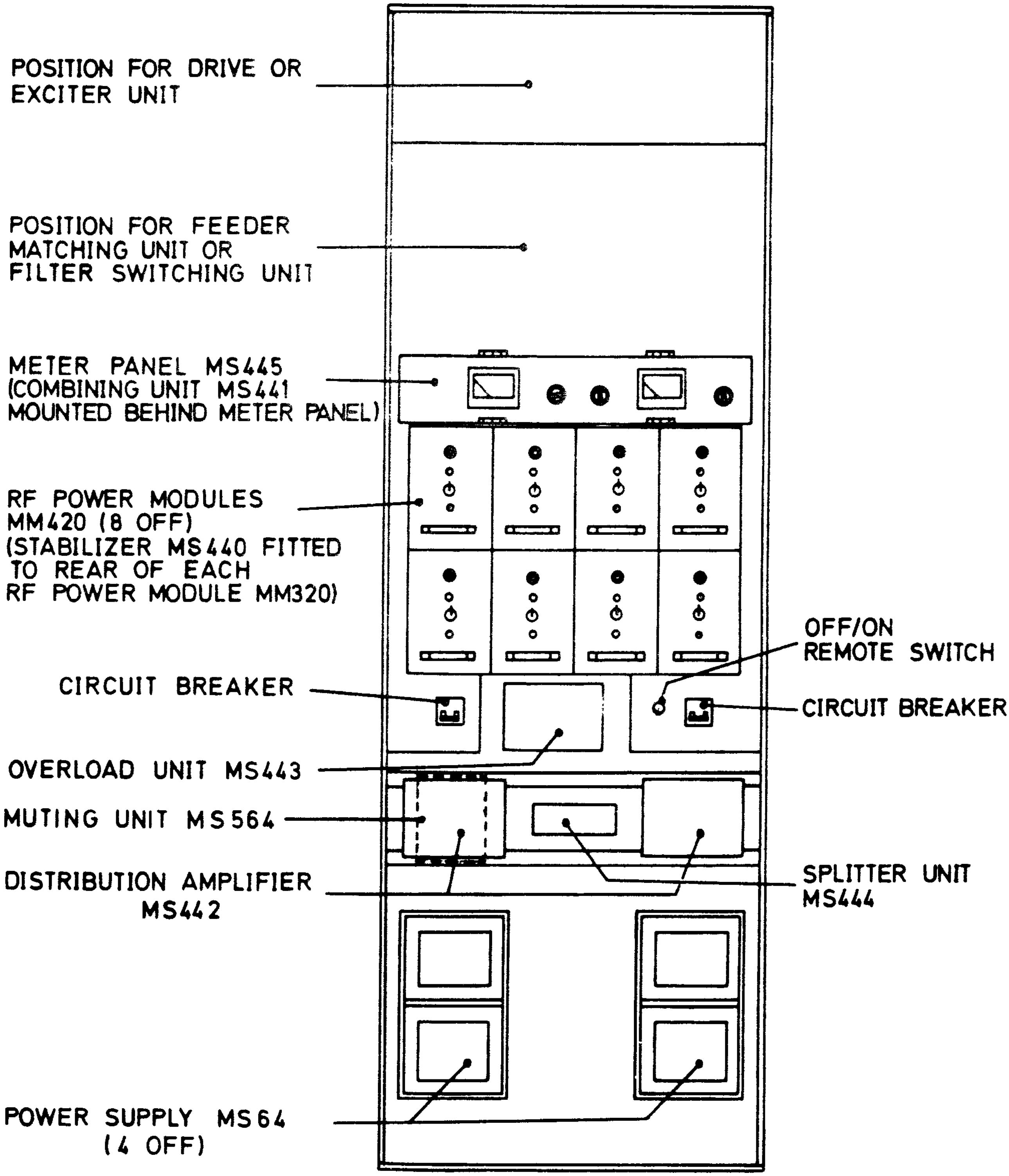
voltages, and the 30V supply current to each module. In addition the input RF power level and the forward and reflected output power levels are indicated. Front panel monitoring is provided for all module outputs, each 500W output and the 1KW output, via 50 ohm BNC connectors.

COOLING

28. Forced air cooling is built into the amplifier cabinet. Two similar blowers are fitted at the bottom of the cabinet for cooling the RF modules, a third is located at the top rear of the cabinet and provides general cooling for the units fitted at the top of the cabinet. The total air flow from each blower fitted to the base of the cabinet is approximately 220cfm at 1.3W.G.

29. When the standard version of the cabinet is used air is taken in from the front via the filter panel which covers the power supply units at the bottom of the cabinet, and is exhausted at the rear of the cabinet. When a ducted system (to special order) is required the air filter is fitted at the rear of the cabinet and inlet and outlet ducting are bolted to the rear cabinet skin.

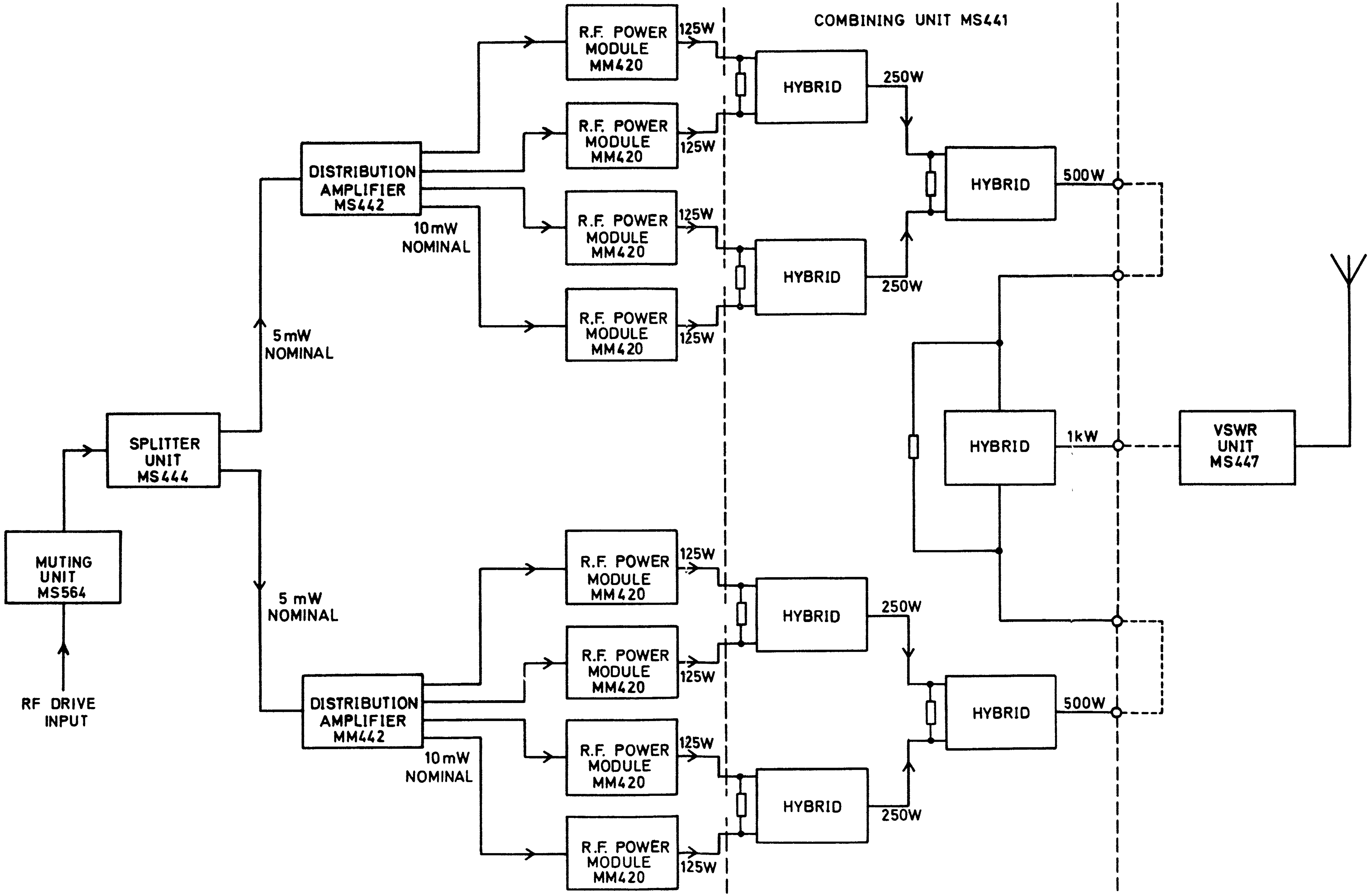
30. The air flow system is not interlocked with the electrical system since all RF modules are individually protected against overheating. The RF modules will operate for a considerable period of time (dependent on ambient temperature) with both blowers inoperative. This means that the equipment can be operated satisfactorily for several minutes with a module removed and a consequent loss of air through the gap created.



WOH3037

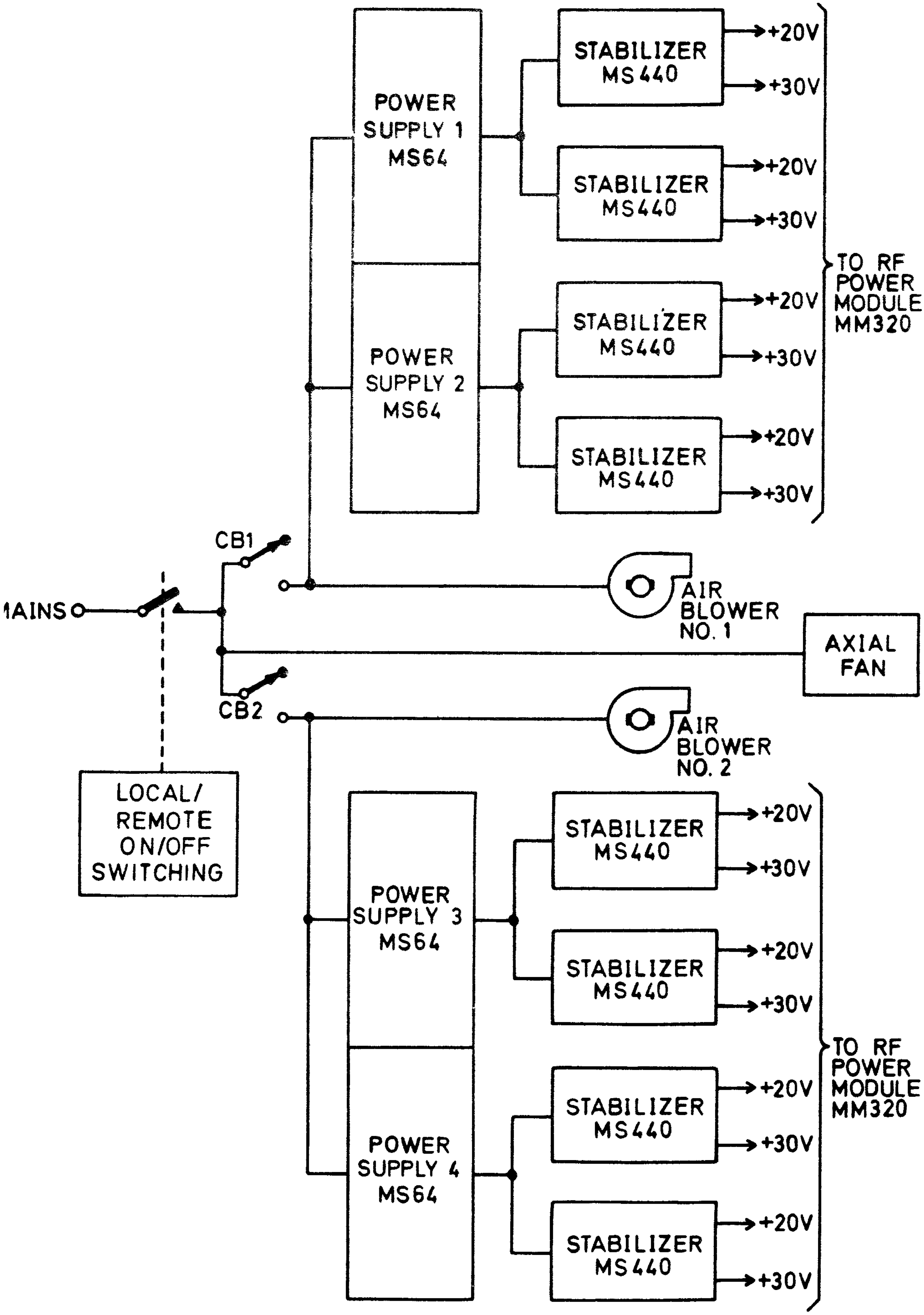
TA.1810 : Location of Sub-Units

Fig. 1·1



Block Diagram: Linear Amplifier Type TA.1810

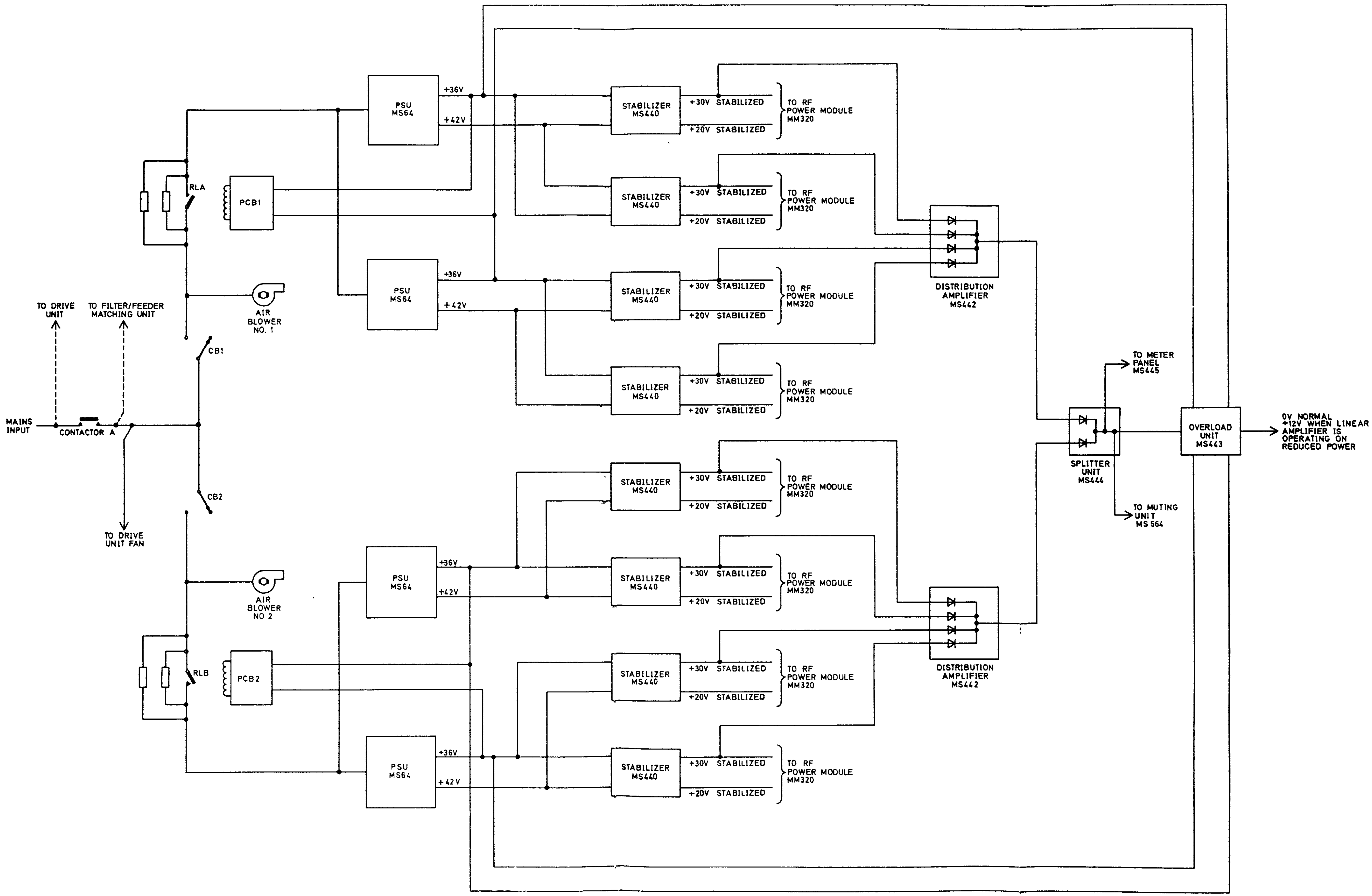
Fig. 1·2



TA.1810 Simplified Block Schematic: Power Supply Distribution

WOH3037

Fig. 1·3



WOH3037

TA.1810 Block Schematic: Power Supply Distribution

Fig. 1·4

CHAPTER 2

SETTING-UP AND OPERATING INSTRUCTIONS

INTRODUCTION

1. It is assumed that the installation procedure described in Chapter 3 has been carried out, i.e. all units are mounted within the cabinet assembly, and all external wiring connections made in accordance with the appropriate terminal technical manual. Initially, the Setting-Up Procedure given in paras.3 to 5 should be carried out in conjunction with the Operating Procedure.

OPERATING PROCEDURE

2. Switching on is achieved as follows:-

(i) Set the amplifier control switch to ON for 'local' operation, or to REMOTE.

NOTE: When REMOTE is selected the amplifier is switched on from an external source by a 12V line. Switching is normally carried out from the MA.1720 Drive Unit when this unit is fitted.

(ii) Check that the blower at the top of the cabinet operates when ON is selected.

(iii) Set the two front panel circuit breakers on the TA.1810 to ON. This immediately energizes the blowers and switches on all the supplies to the overall amplifier. In this condition the individual RF modules are not muted. To mute them externally it is necessary to apply an external earth connection to TB9 pin 10.

(iv) Switch ON all the RF modules via their respective front panel switches, and note that all green lights are illuminated.

(v) Check that the 20V and 30V supplies are present at all modules as indicated on the appropriate meter. Monitor the individual module currents on the switched meter and ensure they indicate approximately equal values, when an RF output is being supplied.

3. Ensure that the Splitter Unit attenuators are set to 0dB (i.e. SK1 linked to pin 13; pin 10 linked to pin 9).

4. Terminate the RF output connector on the TA.1810 with a 1kW 50 ohm resistive load.

5. Feed in a CW drive signal, in the frequency range 1.6 to 30 MHz, to PL28. Adjust the drive level, in conjunction with the Muting Unit attenuators, for an input power of 25 mW as monitored on the Meter Panel. Refer to the table below for the Muting Unit attenuator settings:

Pins linked on Muting Unit	Attenuation
8 and 10 14 and 13	0dB
8 and 11 15 and 13	3dB
8 and 9 12 and 13	6dB
8 and 11 15 and 9 12 and 13	9dB

6. Ensure that the clear lamps on the eight RF modules are glowing at approximately equal brightness.

7. Monitor module currents at the front panel meter and ensure that they all indicate approximately 12A and that in no case is 15 amps exceeded. Currents will be lower at the LF end of the band, and highest at midband, but at any one frequency setting, individual module currents should be similar.

8. Switch-off, disconnect dummy load and connect antenna.

9. For system operation refer to the appropriate system handbook.

500W RF Output

10. If it is required to operate the TA.1810 as two separate 500W amplifiers, i.e. for maintenance purposes, the following procedure should be adopted.

(1) Switch off the linear amplifier.

(2) Remove the front panel of the Power Supply.

(3) Disconnect the plug mating with 8SK5 on the Distribution Amplifier not required for traffic.

(4) Connect the plug, disconnected in (3), to the Dummy Load 1SK29 which is located on the hinged mounting plate.

(5) Switch off the circuit breaker on the amplifier section not required for traffic.

(6) Lower the meter panel to its fullest extent by removing the retaining arm and allowing the meter panel to rest gently on its hinges.

(7) Disconnect the output lead from the 1kW output.

(8) Disconnect the output lead from the required 500W output and use the Combiner Patch Lead Assembly BA 604047 supplied with Accessory Kit CA.607, to connect the required 500W output to the output lead disconnected in (7).

Note: This is important to maintain the pre-programmed line selection when the linear amplifier is used in pre-programmed systems e.g. with the MA.7917 Exciter or the MA.1034A Filter Switching Unit.

(9) Switch on the amplifier and operate normally.

(10) The other half of the amplifier may be operated for test purposes by connecting a dummy load to the 500W RF output socket and a Signal Generator to the appropriate Distribution Amplifier input socket.

CHAPTER 3

INSTALLATION

GENERAL

1. The equipment is shipped with the RF modules and the power supply units packed separately. Unpacking and fitting instructions are given in paras. 8, 9 and 10.

FLOOR MOUNTING

2. The cabinet is provided with floor standing fitments and need not be permanently fixed to the floor. If a permanent fixing is intended, the feet provided should be removed and the base screwed to the floor.

CAUTION: When the cabinet is not fixed to the floor only one power unit should be withdrawn at any one time to avoid the danger of the cabinet toppling.

MAIN EARTH

3. An earth strap should be connected between the earth point in the base of the cabinet and the main station earthing system.

POWER AND SIGNAL CONNECTIONS

Mains Supply

4. A single phase supply at 6kVA maximum is required. Line, neutral and earth connections are made in the rear of the cabinet at the bottom (TB1 Pins 1, 2 and 3 respectively). Each MS64 Power supply has an individual mains selector plug. This should be set to the voltage appropriate to the incoming mains supply.

Antenna Connection

5. This is made to the RF output connector (Type C) at the top rear of the cabinet. UR 102 (50 ohm) cable is recommended.

Audio and Keying Inputs

6. These connections to the associated drive unit (if fitted) should be made to TB16 at the bottom of the cabinet in accordance with the following table, using the fanning strips provided.

NOTE: For further information refer to the associated terminal technical manual.

TABLE OF AUDIO/KEYING CONNECTIONS

TB16 pin	
1) 2)	Audio 1
3	Screen
4) 5)	Audio 2
6	Screen
7) 8)	Key
9)	Earth
10) 11)	TSK
12	Earth

Miscellaneous External Connections

7. Interconnections required between the TA.1810 and units such as the MA.1720 Drive Unit and the MA.1004 Feeder Matching Unit will be found in the associated terminal technical manual.

FITTING THE RF MODULES

8. The eight RF modules are packed in pairs. Carefully unpack them and slide one into each of the eight compartments in the cabinet. Signal and power connectors on the rear of the RF modules will mate with fixed connectors at the rear of the cabinet as the modules are slid into position. Secure each module with the two quick-release fasteners attached to the front panels.

FITTING THE POWER SUPPLY UNITS

9. The four power supply units are packed in pairs into specially strengthened cases. After removing the lids, study carefully the unpacking instructions attached to the underside of the lids.

NOTE: Failure to observe these instructions may result in the units being damaged.

10. To fit the power supply units into the cabinet proceed as follows:-

(1) Remove the power supplies panel from the front of the cabinet by releasing the eight quick-release screws.

(2) Remove the Pozidrive screw (marked 'A' in Fig. 3.1) which secures each power supply unit mounting panel to the front edge of the cabinet, and withdraw one of the panels to its full extent.

NOTE: All connections to the connectors on the inside of the lower rear panel (e.g. the audio and keying inputs) should be made at this stage because the rear panel is not accessible from the front of the cabinet once the power supply units have been fitted. However, access may be gained from the rear by removing the four fixing screws and hinging down the lowest rear skin.

(3) Remove the lower three Pozidrive mounting screws from one of the power supply units and unscrew the upper three Pozidrive screws approximately $\frac{1}{4}$ inch.

(4) Position the power supply unit on the lower half of the mounting panel by passing the three Pozidrive screws through the three keyhole slots (marked 'A' in Fig. 3.2) in the mounting panel and sliding the power supply unit back into the smaller section of the keyholes.

(5) Insert the lower three Pozidrive mounting screws at positions 'B' in Fig. 3.2 and fully tighten all six screws.

(6) To fit the upper power supply unit, repeat operation (3) and lower the power supply unit into the three slots (marked 'C' in Fig. 3.2) at the top of the mounting panel. Insert the lower three Pozidrive screws at positions 'D' in Fig. 3.2 and fully tighten all six screws.

(7) Lay the connecting cable harness along the chassis stiffener (marked 'E' in Fig. 3.2) and connect it to the power supply units as follows:-

Cable with red or orange sleeve:	+ve 36V terminal
Cable with black sleeve:	-ve 36V terminal
Orange leads:	+ve 42V terminal
Green leads:	E terminal
Blue leads:	N terminal
Brown leads:	L terminal

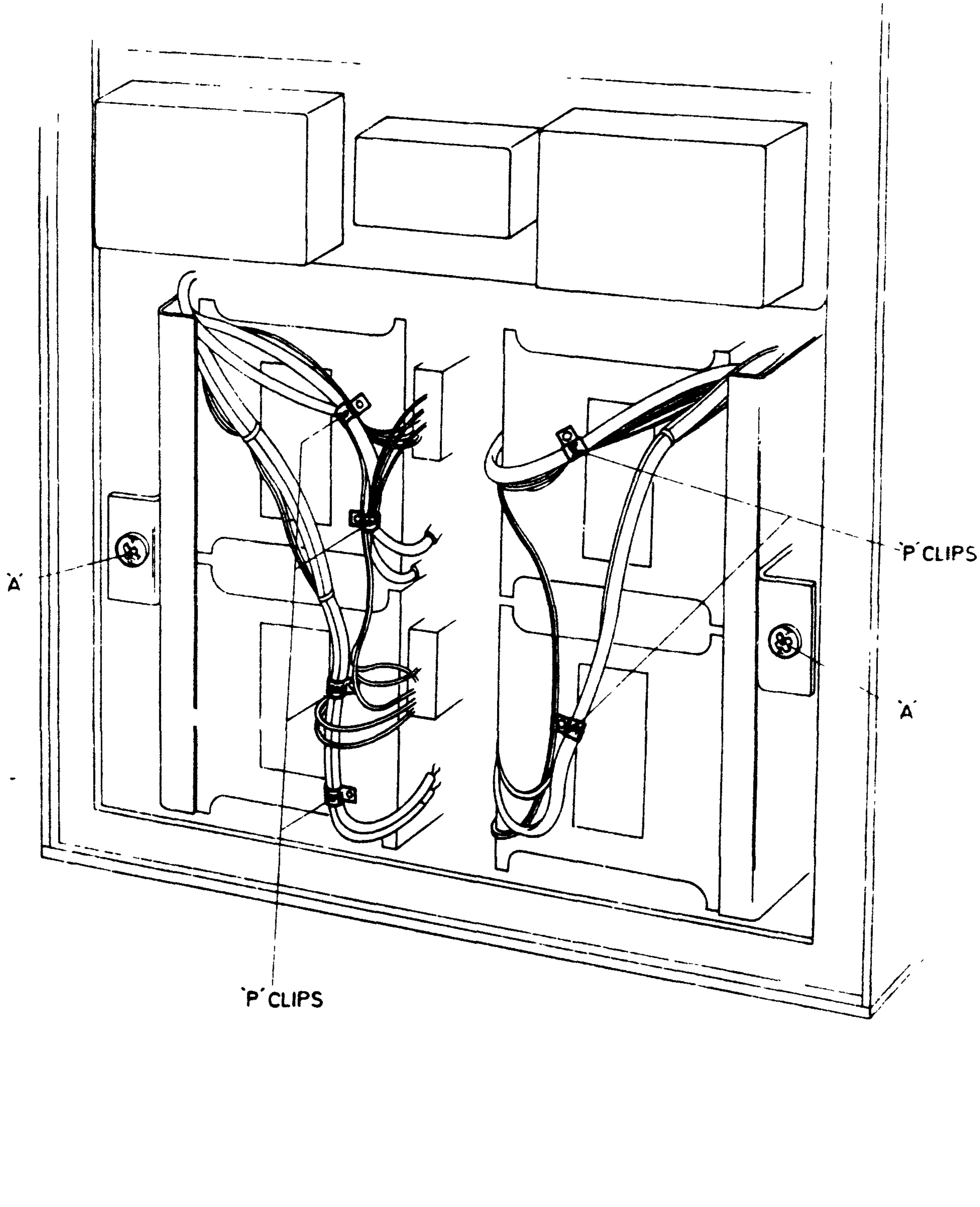
(8) Clamp the cables to the front of the power supply units using the 'P' clips provided.

NOTE: The right hand units utilize one 'P' clip per unit and the left hand units utilize two 'P' clips per unit (see Fig. 3.1).

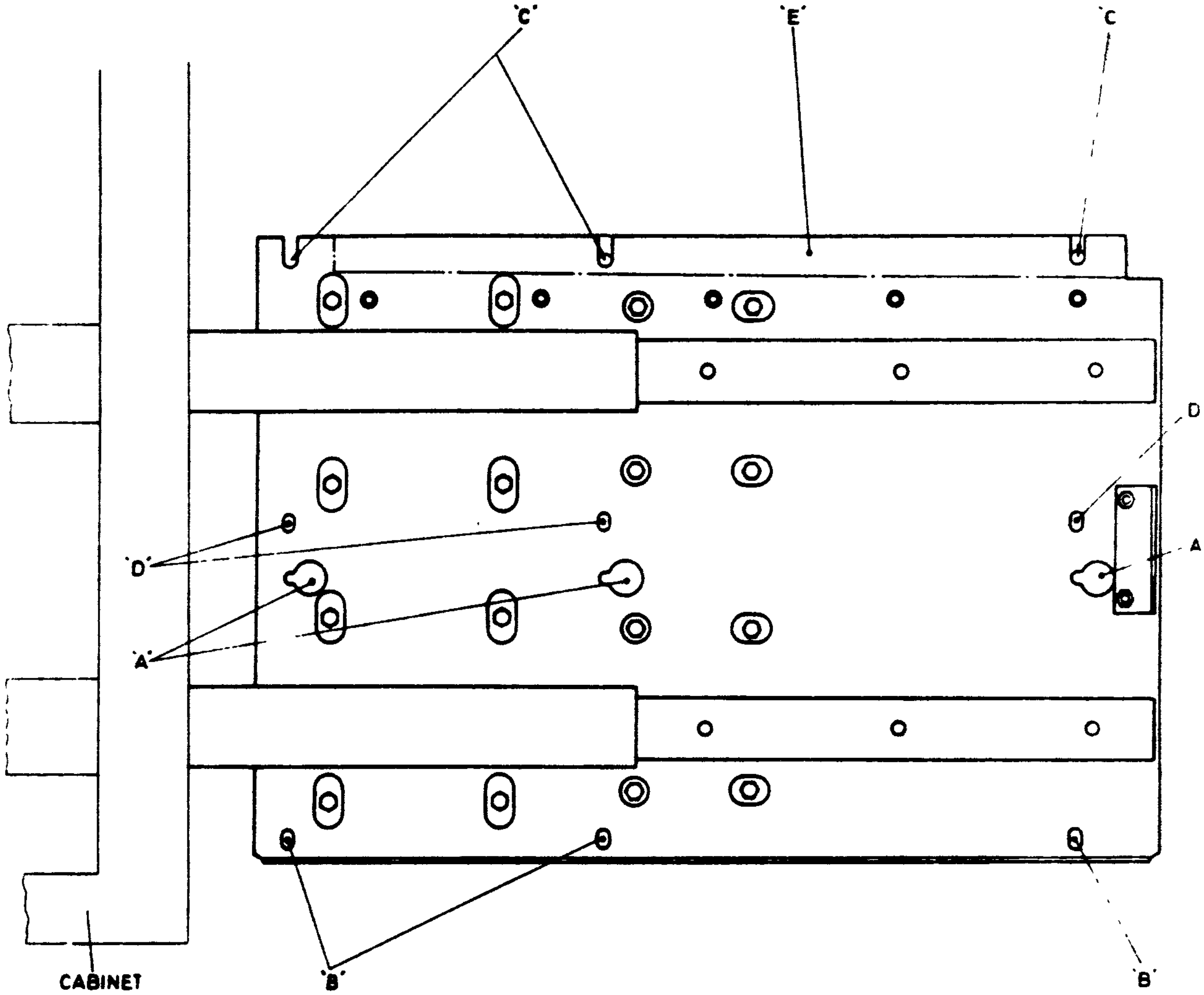
(9) Slide the assembled unit into the cabinet and secure it with the Pozidrive screw ('A' in Fig. 3.1).

(10) Withdraw the other power supply mounting panel to its full extent and repeat operations (3) to (9) inclusive.

(11) Re-fit the power supplies panel to the cabinet.



WOH3037 Power Supply Units – Final Assembly Fig. 3·1



WOH 3037

Power Supply Unit Mounting Panel. **Fig.3·2**

CHAPTER 4

BRIEF TECHNICAL DESCRIPTION

INTRODUCTION

1. The following paragraphs briefly describe the function of the units and sub-units which constitute the TA.1810 Linear Amplifier; detailed technical description are given in Chapter 5.

CABINET ASSEMBLY

2. As detailed in Chapter 1, the sub-assemblies contained in the TA.1810 cabinet are the Splitter Unit, Distribution Amplifiers, Overload Unit, Cabinet V.S.W.R. Unit, Muting Unit and Meter Panel.

Muting Unit MS564

3. The Muting Unit provides muting of the r.f. drive signal to the Splitter Unit. On de-mute, it ensures that the r.f. drive level is restored at a controlled rate.

Splitter Unit MS444

4. The Splitter Unit is a passive network providing two separate outputs of equal amplitude and phase to the Distribution Amplifiers. The RF input level is sampled at the Splitter Unit, and the output is fed to a metering circuit on the Meter Panel.

Distribution Amplifier MS442

5. Each Distribution Amplifier provides four separate and isolated RF outputs to a bank of four RF Power Modules. Each unit contains four buffer amplifiers each with an approximate gain of 3dB.

Overload Unit MS443

6. The Overload Unit provides a reduced power warning signal in the event of failure of a power supply or an RF Power Module. The unit also provides a 'fault' signal if there is either a total supply failure whilst the main contactor is still made or a 'fault'signal is received from an associated unit, such as the MA.1004 Feeder Matching Unit.

Cabinet V.S.W.R. Unit MS447

7. The Cabinet V.S.W.R. Unit monitors the forward and reflected powers on the RF output feeder and provides d.c. outputs to the metering circuit on the Meter Panel MS445.

Meter Panel MS445

8. The Meter Panel contains two meters and associated switches to provide an indication of the voltages applied to, and the current drawn from the 30V supply by, each RF Power Module. The RF input power and the Forward and Reflected RF output power of each

module is also indicated. The Meter Panel also contains V.S.W.R. Warning Board which comprises a trip circuit operated by the V.S.W.R. Unit reflected power line. The trip circuit can be used to operate a fault line to a suitable internal circuit.

RF POWER MODULE MM 420

9. The RF Power Module Type MM 420 is an all solid-state wideband linear amplifier capable of delivering at least 125 Watts over the frequency range of 1.6MHz to 30MHz.

10. The complete module consists of a basic RF Amplifier Type MM320 and a power stabiliser unit Type MS.440. The two units consisting of printed circuit boards mounted on finned castings are bolted together in line to form a complete plug-in unit. When required they can be readily separated, for example, when replacing a faulty stabiliser unit.

11. Eight complete modules (MM 420) are used in the TA.1810 Linear Amplifier and each module plugs directly into the TA.1810 cabinet. Particulars of variants of modules are given on page 1-3.

RF Amplifier Type MM.320

12. The RF Amplifier Type MM.320 consists of a Low Level Board and High Level Board which make up the basic RF amplifier together with two associated printed circuit boards, namely a VSWR Board and a Protection Board. A block diagram of the amplifier assembly is shown in Fig.4-1 at the rear of this chapter whilst the interconnection and physical location of the sub-units are shown in Figs.21 and 22 respectively.

Low Level Boards (PS314 and PS351)

13. The Low Level Board (either PS314 or PS351) amplifies the input R.F. signal of 10mW nominal from the Distribution Amplifier to approximately 2W. In addition it provides a variable gain stage which is used as the automatic level control circuit to maintain the output R.F. level of the High Level Board constant and to reduce the output to a safe level when a load mismatch occurs.

14. The R.F. input to the Low Level Board is fed first to the Automatic Level Control (a.l.c.) stage consisting basically of two transistors operating in class A push-pull. On the PS314 the gain of the stage is varied by causing two other transistors (one in parallel with each of the class A transistors) to partially conduct, thereby shunting part of the RF drive. On the PS351 the gain of the stage is varied by causing two diodes (one associated with each class A transistor) to shunt part of the RF drive.

15. Following the a.l.c. stage are two class A amplifier stages. The first stage comprises two transistors operating in grounded base mode and connected in push-pull. The second stage is similar to the first but employs four transistors connected in a parallel/push-pull configuration and transformer coupled to the output.

High Level Board

16. This board contains two stages of R.F. amplification. The drive stage consists of two power transistors operating in class B push-pull with grounded base. This stage is transformer coupled to the final P.A. stage which comprises 8 power transistors which are connected in a parallel push-pull arrangement and operated in common emitter mode. Negative feedback is applied to the P.A. stage to ensure a flat response over the frequency range.

17. All components associated with the RF output amplifier, with the exception of the transistors and diodes, are mounted on the High Level Board. The transistors themselves are stud-mounted on the main casting to ensure maximum heat dissipation. Replacement of a transistor can be effected without removing the High Level Board (refer to Chapter 6).

18. The High Level Board includes diodes monitoring the RF collector voltage swing of the power transistors. If this becomes too large, the diodes conduct and operate the a.l.c. stage reducing the drive level (refer to para. 14) to avoid saturation.

V.S.W.R. Board

19. The Voltage Standing Wave Ratio Board monitors the forward and reflected output power of the High Level Board before it is fed to the R.F. output connector of the MM.420.

20. The forward power detector is fed back to the a.l.c. stage on the Low Level Board to control the output level under normally matched conditions (i.e. 50 ohm). The actual forward output level is set by a potentiometer.

21. Under mismatched conditions, the resultant output from the reflected power detector is also fed back to the a.l.c. stage to reduce the output level appropriate to the degree of mismatch. The level at which the reflected power takes over from normal a.l.c. control is adjustable via a second potentiometer.

WARNING:

THE POTENTIOMETERS OF THE RF POWER MODULE MM 420 SHOULD ONLY BE ADJUSTED WHEN SETTING UP THE MODULE AS PART OF THE ADJUSTMENT PROCEDURE (CHAPTER 7, PARA.14). THEY SHOULD NOT BE ADJUSTED WHEN THE MODULE IS INSTALLED IN THE TA.1810, SINCE THE PROTECTION AFFORDED TO THE OUTPUT TRANSISTORS MAY BE REDUCED WITH THE CONSEQUENT RISK OF TRANSISTOR FAILURE.

Protection Board

22. The Protection Board is designed to provide protection for the R.F. amplifier against d.c. fault conditions. Depending on the actual fault, it operates in one of two ways:

(1) Firstly if a short circuit should occur on the Stabiliser Unit (MS 440) this would apply approximately 40V to the Amplifier H.T. rail, overstressing the R.F. transistors. To prevent this a power thyristor is included which in the event of such a fault, conducts and operates a fuse thereby open circuiting the positive supply.

(2) Secondly if the collector currents of the R.F. output transistors exceed a prescribed maximum (approximately 7 Amps for each group of four transistors) a fast acting d.c. overload signal is applied to the a.l.c. stage on Low Level Board, to ensure this current level is not exceeded.

NOTE: If reducing the R.F. drive does not control the transistor currents then a d.c. overload trip in the stabiliser unit will operate.

COMBINING UNIT MS.441

23. The Combining Unit is a completely passive unit containing only a series of hybrid combining transformers, impedance transformers and ballast load resistors.

24. The function of the unit is to accept the output of each R.F. Power Module and to combine their output powers into a common output line whilst providing RF isolation between any one module and the others.

25. As shown on the block schematic of the Unit (Fig.4.2) the eight RF inputs from the RF Power Modules are fed into hybrid transformers in pairs and the first four hybrid stages produce four 250 W outputs. These 250W outputs are again combined in pairs to produce two 500W outputs which are combined in a final hybrid to produce the 1kW output. The final hybrid may be by-passed if it is required to operate on 500W output. (Chap.1 para 17 refers).

AUTOMATIC LEVEL CONTROL (a.l.c.)

26. Four separate detectors control the output level of the module via the a.l.c. circuit, these are:

(1) Forward Power Control - Normal operation into 50 ohms.

(2) Reflected Power Control - Operates to reduce the output of the module when working into a mismatch i.e. when the Reflected Power Level would be liable to damage the output stage.

(3) 'Swingometer' - This operates by monitoring the collector voltage swing of the output stages and under certain impedances will reduce the output level to prevent the output transistors running into saturation.

(4) Current a.l.c. - Operates quickly to reduce the output of the module in the event of fast transients by sensing the current in each half of the output stage.

PROTECTION

27. In addition to a.l.c. protection each module is protected against overheating by a thermostat whilst a voltage detecting circuit in conjunction with a fuse in the supply line provides protection against short circuits in the stabilizer. A.C. supply overload protection is provided for each pair of MS64 power supplies by circuit breakers on the front panel.

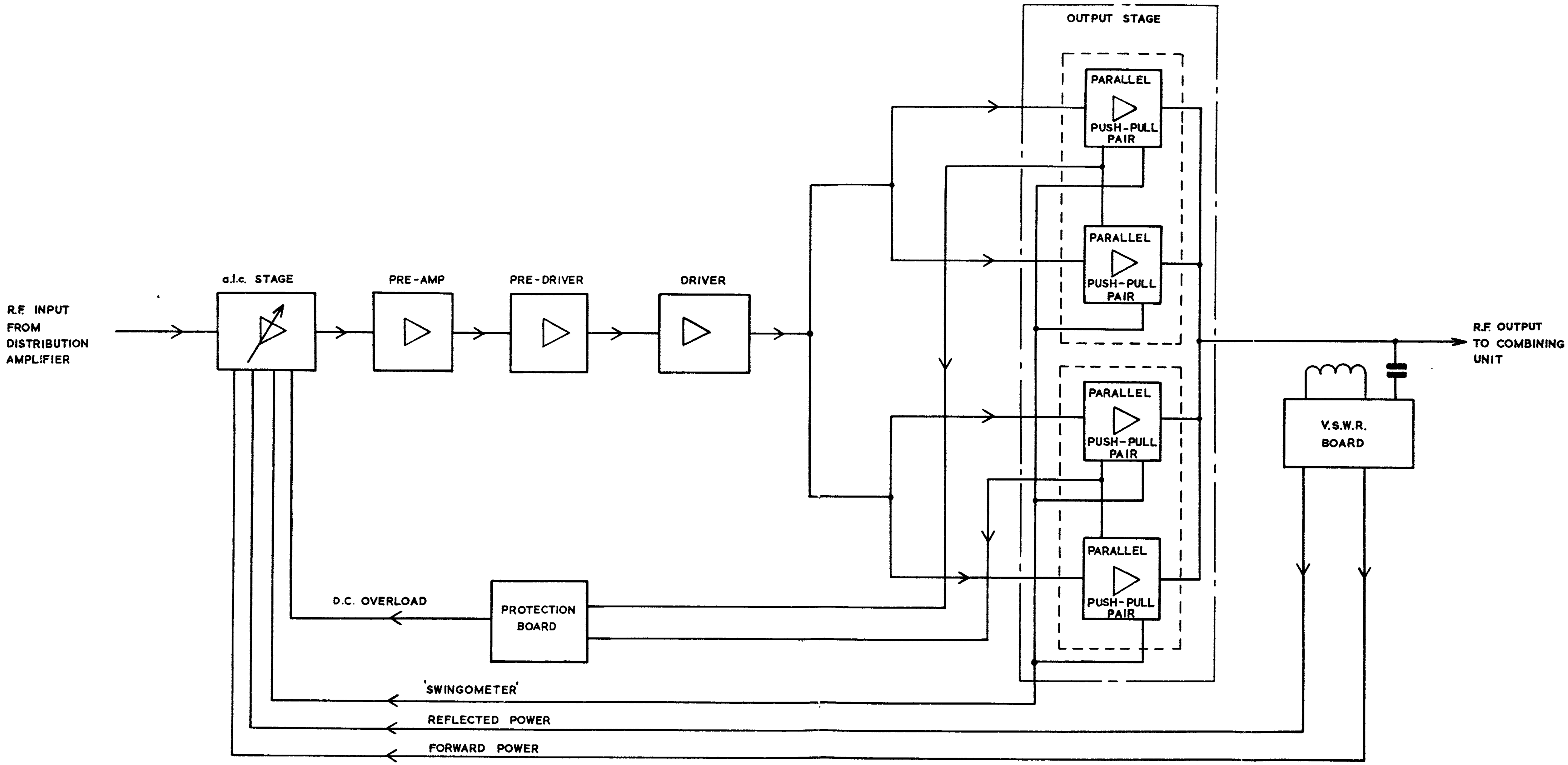
POWER SUPPLIES

Power Supply Unit Type MS64

28. The main d.c. power supply for the TA.1810 is provided by four standard d.c. power supplies Type MS64 each providing smooth unregulated d.c. outputs to the individual stabilizers. The power supplies operate from single phase a.c. mains input.

Stabiliser Type MS.440

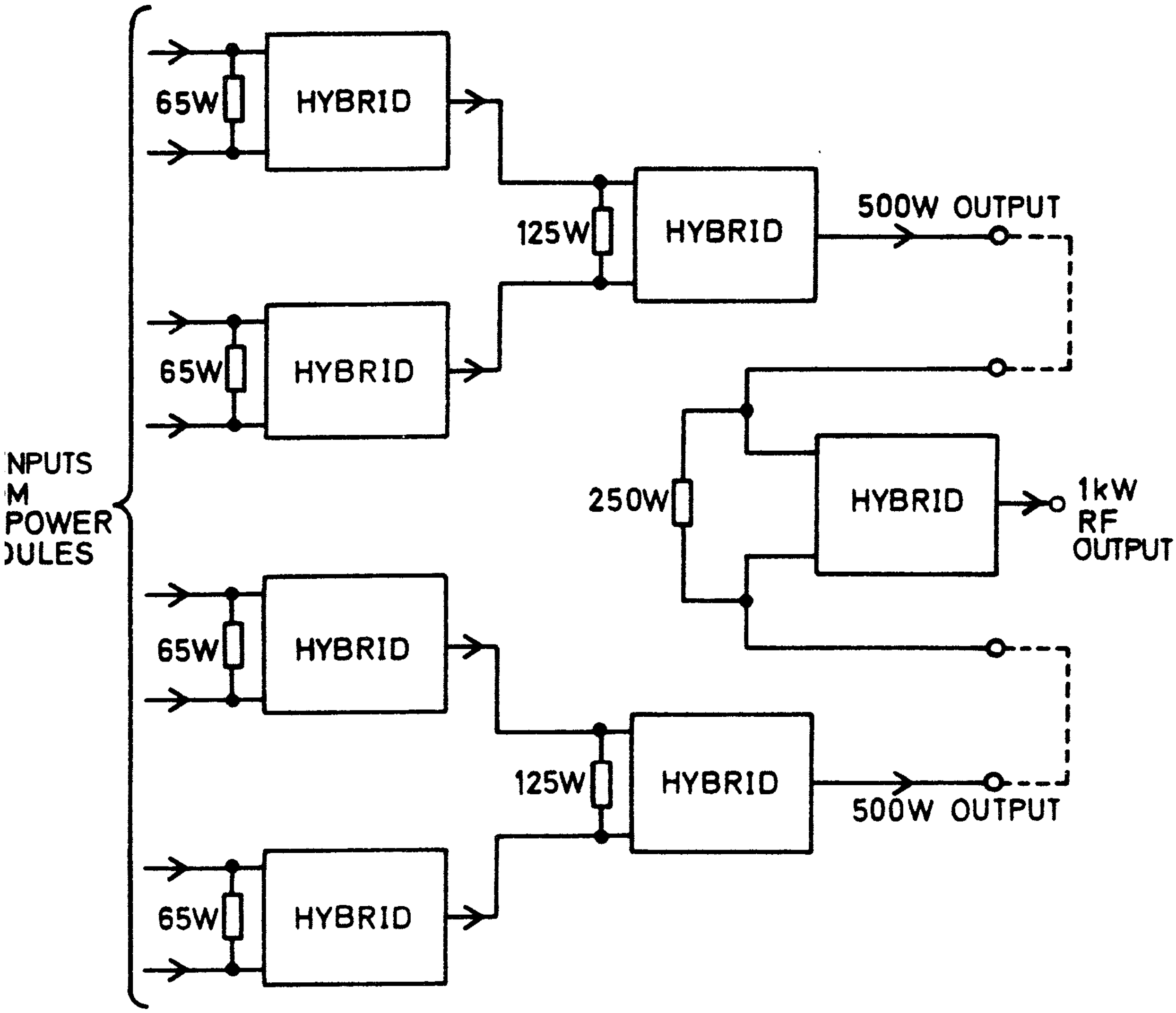
29. The stabiliser Type MS.440 provides stabilised +30V d.c. and +20V d.c. supplies to each RF Amplifier Type MM320. In addition each stabiliser provides inputs to the +30V current metering facility on the Meter Panel.



WOH 3037

Block Diagram: R.F. Amplifier MM320

Fig. 4·1



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Block Diagram: Combining Unit Fig. 4·2

CHAPTER 5

DETAILED TECHNICAL DESCRIPTION

INTRODUCTION

1. The circuit descriptions detailed in the following paragraphs should be read in conjunction with the appropriate circuit diagram.

CABINET ASSEMBLY

2. As outlined in Chapter 1, the TA.1810 cabinet assembly comprises the Muting Unit, the Splitter Unit, Distribution Amplifiers, Overload Unit, Cabinet V.S.W.R. Unit and Meter Panel in addition to items such as switching contactors, circuit breakers, blowers, coaxial line switching relays and miscellaneous interconnecting cableforms. The overall interconnection diagram is shown in Fig. 31.

Control

3. Switching on of the overall cabinet assembly can be accomplished from the local position (i.e. power supply front panel) or from a remote position. This requires the internal 12V starting relay to be energized from the remote point. Selection of OFF, ON (local control) or REMOTE is made from the front of the cabinet assembly. Each 500W power supply and associated blower can be switched off independently by operation of the relevant circuit breaker.

Muting Unit MS564 Fig.33

4. The r.f. drive signal is fed to SK2 and routed, via an attenuator network, to the primary of transformer T2. Transistors TR1 and TR2 form a push-pull, class A amplifier operating in grounded base mode and providing approximately unity gain. The r.f. output from the secondary of T1 is fed to SK1. Base bias for TR1 and TR2 is derived from the emitter of TR3 and is approximately +9.3V, i.e. zener diode D3 voltage (+10V) minus TR3 base/emitter junction voltage (0.7V).

5. During normal operation (de-muted) the mute control line, PL1-3, is held at +12V: when muted it is grounded. Noise immunity is provided by diode D7. With the unit de-muted, the voltage at the junction D1/D2 is approximately +7.2V, i.e. zener D3 (+10V) minus the junction voltages of D5, TR5, TR7 and TR4 (0.7V each). As the emitter voltage of both TR1 and TR2 is approximately +8.6V, D1 and D2 are cut-off and TR1 and TR2 are conducting, thus allowing the r.f. drive signal at T2 be coupled to T1.

6. When muting occurs, D8 is grounded and the base potential of TR6 falls to approximately +1.4V thus switching off TR6. This causes TR5 to be switched on allowing C8 to be charged-up via R14 and TR5. The base voltage of TR5 will now rise to approximately +12.1V (i.e. zener D3 (+10V) plus the junction voltages of D4, D9 and D6 (0.7V each), and the voltage at the junction D1/D2 will rise to +10V, i.e. 12.1V minus the base/emitter junction voltages of TR5, TR7 and TR4. As D1 and D2 are now forward biased, they conduct thereby raising the voltage at the emitter of TR1 and TR2 to approximately +9.3V. Transistors TR1 and TR2 are therefore cut-off thus blocking the r.f. drive.

7. On de-muting, the mute control line at PL1-3 reverts to +12V switching on TR6 which, in turn, switches off TR5. Capacitor C8 will now discharge through R16 reducing the voltage at the emitter of TR5. (Transistors TR7 and TR4 form a Darlington pair which prevents significant loading across C8, thus ensuring the major discharge path for C8 is R16). The fall in voltage at the base of TR5 will be held to approximately +9.3V by the action of D5. During the discharge time of C8 (approximately 5 to 7 milliseconds) the potential at D1/D2 junction falls to approximately +7.2V, i.e. +9.3V minus the base/emitter junctions of TR5, TR7 and TR4. As the potential at D1/D2 falls, TR1 and TR2 start to conduct, thus ensuring that the r.f. drive to SK1 is restored at a controlled rate.

8. The attenuation level afforded by the muting action is approximately 40dB at the H.F. end of the frequency range, and greater towards the L.F. end.

Splitter Unit MS.444 Fig. 1

9. The R.F. input from the Muting Unit is fed in at SK1. It is then routed, via an attenuator network, to passive splitter R9 and R10 which provides two equal outputs at PL2 and PL3.

10. The output of the attenuator stage, at the junction of R9 and R10 is detected and a d.c. output fed from an emitter follower (TR1) to provide meter indication of the RF level. Calibration of this is effected by R12.

11. The two +30V inputs at PL1, pins 1 and 3, are derived from the two Distribution Amplifiers (MS.442) and combined by D2 and D3 at the collector of TR1. The Splitter Unit will thus continue to function with only one of the Distribution Amplifiers active. The +30V line at TR1 collector is routed to the Meter Panel (MS.445) the Overload Unit (MS.443) and the Muting Unit (MS.564) via PL1, pins 2, 9 and 10 respectively.

Distribution Amplifier MS.442 — Fig.3

12. Each Distribution Amplifier provides a nominal 3dB of gain from the input to each output. The input from the Splitter Unit is fed into SK5 which is connected to 4 separate auto transformers T2, T4, T6 and T7. Capacitor C10 ensures that the input impedance is correct. The centre tap of each transformer is fed via a resistor into the emitter of a grounded base transistor biased by a DC voltage derived from a resistive network R1 and R2 across the 30V supply rail.

13. The collectors of each transistor are transformer - coupled and isolated RF outputs appear at SK1, SK2, SK3 and SK4. The diodes and zener diodes across each output transformer ensure that the positive collector voltage swing never exceeds the safe transistor rating.

14. The four +30V inputs at PL1, pins 1, 2, 3, and 4, from the four MS.440 Stabilizers are combined by D9, D10, D11 and D12. This ensures that the Distribution Amplifier will continue to function with only one MS.440 Stabilizer remaining active. The +30V line at the junction of D9 to D12 is routed to the Splitter Unit (MS.444) via PL1, pin 5.

Overload Unit MS.443 — Fig. 5

15. The function of this unit is to provide a 'reduced power' warning signal in the event of failure of a power supply or an RF module. It also provides a 'fault' signal if there is either a total supply failure whilst the main contactor is still made or a 'fault' signal is received from an associated unit, such as the MA. 1004 Feeder Matching Unit.

16. The D.C. outputs of all four MS 64 units are monitored and fed to PL1, pins 8, 9, 11 and 12 of the Overload Unit. Each input is fed via noise immunity circuits (e.g. C1, D1, R3, R7). These circuits ensure that transient noise spikes will not cause the circuit to give a false indication, and that they will only respond to genuine input signals. The input transistors are connected in series so that when any are switched off due to having no input, TR5 will be switched on.

17. If an RF imbalance signal, whose value exceeds the bias on the base of TR8, is present at PL1, pin 4, TR6 will switch on, TR9 will switch off, TR7 will switch on, TR10 will switch off and C9 will charge via R25. Transistors TR11 and TR12 form a latching circuit which, in the normal state, has TR12 switched on and TR11 off. However, as C9 charges up, after an RF imbalance signal is received, TR11 is turned on, and after a delay, the circuit switches over to the latched state with TR11 conducting and TR12 switched off. In this condition TR13 is switched off and +12V (via R35) appears at the output PL1 pin 10 to operate an external circuit. In the normal operating condition the output at PL1 pin 10 is 0V.

18. This latched condition is maintained even if the fault signals are removed. It is set by an unlatching signal applied to PL1 Pin 1 from the external 'Coarse-tune initiate/Reset' or the 'Ready/Not Ready' line. This is normally derived from the MA 1720 drive unit. Noise immunity is provided by D8, D9, R36 and C11.

V.S.W.R. Unit type MS 447 — Fig.7

19. This unit monitors the forward and reflected powers on the RF output feeder and provides the respective d.c. outputs to the Meter Panel MS 445. The design is that of a conventional reflectometer and is identical in principle to the RF Module V.S.W.R. unit described in paras. 36 to 43. It is balanced by adjusting C3 for an indicated null on reflected power when the feeder is terminated in 50 ohm.

Meter panel type MS 445 — Fig.9

20. This unit contains two meters, ME1,(which is switched and meters the +30V, +20V supplies to,and the +30V supply current drawn by,each of the eight RF modules) and ME2, which is also switched, to monitor the input power (fed from the Splitter Unit), and the forward and reflected powers fed from the V.S.W.R. Unit.

21. Also included is a V.S.W.R. Warning P.C.B. (Fig.11) which contains a trip circuit operating from the V.S.W.R. Unit reflected power line. The trip circuit comprises a long-tailed pair, TR2 and TR3, driven from TR1. TR4 provides the output to energize relay RLH (Fig.31) and hence mute the transmitter output. Provision is also made to operate a 'fault' line to a suitable external circuit. The VSWR trip level is normally set to operate at a reflected power not exceeding 700 watts. Lower Power settings may be used by adjusting 11R12 to suit a particular installation.

22. Switch S1 on the V.S.W.R. Warning Board is set to NORMAL during traffic condition. The CAL position is used during setting-up procedure.

RF AMPLIFIER TYPE MM 320

Interconnection of Sub-Units — Fig.21

23. The overall interconnectionsof the sub-units making up the RF Amplifier Assembly are shown on Fig.21.

Inputs

24. The power supply inputs are +20V and +30V DC on TS1 Pins 3 and 2 respectively. These are connected directly to the associated Stabiliser Unit Type MS.440. The only other connection is the external muting line on TS1 Pin 4. This applies a 0V signal to the Low Level Board which operates the relevant switching transistors thereby cutting off the RF output. The RF input from the Distribution Amplifier is at PL1.

Outputs

25. The RF Output appears at PL2. It is fed from two outputs on the High Level Board, which are connected together prior to T1. The latter is a monitoring transformer, feeding LP2 and an external RF monitor socket. T2 is the reflectometer toroid for the V.S.W.R. unit and C3 is the associated capacitive probe.

Protection Components Fig.21

26. If the stabilizer trip does not operate, the SCR1 is triggered under this fault condition from the Protection Board, which short circuits the +30V supply line thus blowing fuse FS1. Pulse transformer T3 triggers SCR1 if there is a significant out-of-balance current between each half of the power amplifier stage. This occurs if one p.a. transistor has failed (normally short circuit) thereby preventing operation of the module until the faulty p.a. transistor has been replaced. Hence overloading of the remaining p.a. transistors is prevented.

27. Capacitors C1 and C2 with inductor L1 are r.f. decoupling components. THE1 is the thermostat on the assembly heat sink which open circuits the +20V supply rail if the safe working temperature (85°C approx.) is exceeded.

Low Level Board Fig.13 and Fig.13a

28. The Low Level Board fitted in the TA.1810 may be either Type PS351 (Fig.13) or Type PS314 (Fig. 13a).

(1) PS351: The RF input is connected to pins 4 and 5 of the printed circuit board. Transformer T4 provides a balanced push-pull signal to the a.l.c. stage which consists of TR18, TR19, D15, D16 and associated components. Transistors TR18 and TR19 act as an RF amplifying stage operating in class A grounded-base mode. Diodes D15 and D16 provide control of the stage by shunting part of the drive current, thus reducing the output of TR18 and TR19 in accordance with the signal input from TR7 (see para. 33).

NOTE: Two versions of the PS351 board are available; assembly DC604137/A which has a normal a.l.c. discharge time and assembly DC604137/B which has a long discharge time. The difference between the two versions are given in fig.13.

(2) PS314: The RF input is connected to pins 4 and 5 on the printed circuit board. Transformer T4 provides a balanced push-pull signal to the Automatic Level Control (a.l.c.) stage comprising TR14, TR18, TR19 and TR23. Transistors TR18 and TR19 are an R.F. amplifying stage and operate in class A, grounded base mode. The function of TR14 and TR23 is to shunt part of the drive current, thus reducing the gain of TR18 and TR19 in accordance with the signal input from TR7 (see para. 33).

NOTE: Two versions of the PS314 board are available; assembly DC603363/A which has a normal a.l.c. discharge time, and assembly DC603363/B which has a long discharge time. The differences between the two assemblies are detailed in Fig.13a.

29. The RF output from the a.l.c. stage is transformer coupled by T3 to the amplifier stage comprising TR17 and TR21 which also operates in class A push-pull grounded base mode.

30. Transformer T2 couples the signal to the emitters of the final stage of the Low Level Board comprising TR15 and TR16 in parallel, operating push-pull class A, with TR20 and TR22 in parallel.

31. Transformer T1 combines the outputs from TR15, TR16, TR20 and TR22 and feeds the signal at a level of between 1W and 2W to pins 2 and 3 of the board.

Automatic Level Control (a.l.c.) Detectors (On Low Level Board)

32. The forward d.c. voltage derived from the V.S.W.R. Board is fed to pin 11. R1 is the 'set forward power' control which determines the threshold level at which the a.l.c. holds the output power under normal conditions. This voltage is amplified by TR1 and is gated via D1 into the a.l.c. switching circuits.

33. The d.c. voltage derived from the reflected power monitor on the V.S.W.R. Board is amplified by TR3 and is combined with a fixed fraction of the forward power (via TR2) at the parallel collectors. The output signal, whose level is adjusted by R6, controls the level at which the a.l.c. will respond to a reflected power signal caused by a load mismatch. This output is gated to the a.l.c. switching circuits via D2. These circuits provide current gain via TR6, TR7 and TR24 (where fitted) and a reference level determined by R29, D20 in conjunction with TR9, TR11 and TR25 (where fitted) and associated components.

34. The attack time is approximately 200-500 microseconds and the discharge time is determined by C3 discharging through R18. When TR24 and TR25 are fitted and when R18 = 1Mohm this approximates to 1 second. Normally however, the discharge time (without TR24 or TR25 and with R18 = 100K) is approximately 50 milliseconds.

Muting Circuit (On Low Level Board)

35. The external muting signal is applied to Pin 12 (0V muted, +12V normal). With +12V applied, TR10 and TR12 are switched on, thereby supplying +20V to the TR17/TR18 amplifier stage. TR13 is also conducting, supplying a positive bias voltage to the final amplifying stage. Under muted conditions transistors TR8, TR10, TR12 and TR13 are cut off thereby applying muting to both the penultimate and final stages.

36. When muting occurs on the standard ('A') version of the amplifier, the gain of the a.l.c. stage is increased to maximum by the action of D13 and R52 which reduce the voltage on C3. On the 'B' version of the amplifier this effect of increased gain of the a.l.c. stage is reduced by D14 and R54 which reduce the voltage on C12. However, since the action of D13 and R52 is still present the module will operate at maximum gain, after a short delay, on de-muting.

37. TR8 and associated diodes, resistors etc, form an input noise immunity circuit. Diodes D11 and D12 provide temperature compensation for TR13 to maintain a stable bias voltage.

High Level Board (PS 315) Fig.15

R.F. Signal Path

38. The RF input signal (from the Low Level Board) is connected to pin 4 which feeds four transformers T6, T7, T9 and T10, whose primary windings are connected in parallel. The secondary winding of T6 and T7 each feed a group of three paralleled resistors and all 6 feed the emitter of TR5. T9 and T10 are similarly connected to drive the emitter of TR6 but are wired in antiphase to T6 and T7. The resultant effect is therefore to drive TR5 and TR6 in push-pull. TR5 and TR6 form the driver stage and operate in grounded

base Class B mode. T8 is the driver output push-pull transformer, and it drives T1/T2 and T4/T5 in push-pull, and also T11/T12 and T14/T15 in push-pull. Transformers T4, T5, T11 and T12 are therefore all connected in parallel. Similarly T1, T2, T14 and T15 are also connected in parallel, both groups operating in push-pull.

39. All eight transformers are 2:1 step-down auto-transformers driving the base of each of the eight P.A. transistors. The eight transistors are connected as four parallel pairs, operating in push-pull, each stage being a grounded emitter class B amplifier. TR1 and TR2 are in parallel giving an output via T3 in push-pull with TR3 and TR4 which are in parallel. Similarly TR7 and TR8 are in parallel giving an output via T13 in push-pull with TR9 and TR10 which are also connected in parallel.

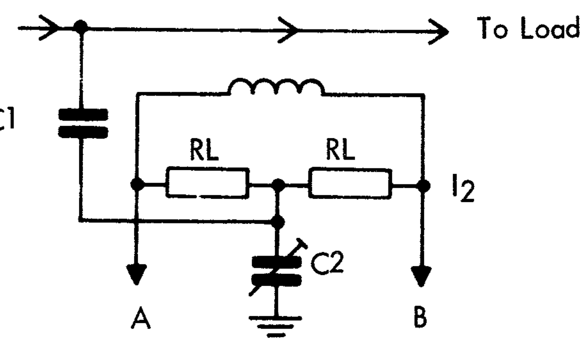
40. RF feedback is applied from the collectors of each pair of output transistors via a 470 ohm resistor to the collectors of the appropriate driver transistors.

V.S.W.R. Board PS316 Fig.17

41. Two RF inputs are fed in this V.S.W.R. Board. The first is derived from the reflectometer toroid T2 and is pro-portional to the RF output line current, and the second is fed from C3 (Fig.21) which is proportional to the RF output line voltage.

Principle of Operation

42. A simplified circuit of the V.S.W.R. Board is shown below to illustrate the principle of operation.



43. The secondary induced voltage in the feeder toroid causes a current to flow I_2 which is equal to $\frac{j\Omega M I_1}{2RL + j\Omega L_2}$ where I_1 is the primary current, M is the toroid mutual inductance, 2RL is the total secondary load resistance and L_2 is secondary inductance of the toroid, Ω is the angular frequency in radians.

44. If $2RL \ll j\Omega L_2$ at the lowest frequency then $I_2 = \frac{MI}{L_2}$ which is independent of frequency. The output voltage developed across each secondary resistor is then $I_2 RL$ and they are 180° out of phase.

45. The RF voltage divided down by C1 and C2 is applied between the resistor junction point and earth, and adjusted by C2 so that, with the matched line condition, the voltage across C2 is equal in amplitude to the voltage across each resistor. This voltage Vc is also not frequency conscious since $Vc = \frac{V_1 C_1}{C_1+C_2}$ and is in phase with the voltage across one RL and out of phase with the other. The result is that under matched conditions at terminal A the voltage ($Vc + I_2RL$) appears (the forward power output) and at terminal B the voltage ($Vc-I_2RL$) = 0 appears (reflected power output).

46. Under mismatched conditions such that a short circuit appears on the feeder, then Vc is zero and the forward and reflected outputs are equal. Similarly with an open circuit on the line, the voltages appearing across the two resistors from the toroid are zero, and again the forward and reflected outputs are equal.

47. It can be shown that intermediate mismatched impedances produce some output from the reflected port, but that the forward output remains constant, for a given linear amplifier output power.

48. R1 and R2 form the resistor loads and C3 and C5, in parallel, produce the required capacitive voltage. The outputs are coupled via C2 and C7, then rectified by voltage doubler circuits (D1, D2, C1 and D5, D6, C8). C9 and R5 boost the low frequency power response of the module, by effectively reducing the d.c. level at the forward output at the low frequency end (i.e. below approximately 5MHz). This means that more power is required from the RF amplifier module to reach the same a.l.c. threshold voltage.

Protection Board PS 251 — Fig.19

49. The Protection Board has two main functions.

(1) It monitors the module positive supply voltage and if this exceeds a safe operating level, a pulse is generated to fire a thyristor (mounted on the RF Power Module chassis) which in turn trips the stabilizer or if this has failed blows an associated fuse FS1.

(2) It also monitors the DC current taken by each group of four output transistors and operates the a.l.c. line if this exceeds a predetermined level.

50. The +30V supply is monitored on Pin 1 and connected via a chain of zener diodes, and a potentiometer R1 to the base of TR1. R1 provides an adjustable reference voltage for the operation of the long-tailed pair comprising TR1 and TR2. The output from TR1 is amplified by TR3 the operating voltage of which is determined by R10 and R13. When transistor TR3 conducts, a voltage is generated which operates the thyristor gate, SCR1, via pin 8.

51. The d.c. current overload inputs are fed to pins 3 and 4, as either or both these levels increase, transistors TR4 and TR5 will start to conduct and cause TR6 and TR1, connected as emitter followers, to conduct and provide a d.c. output to the a.l.c. circuit via pin 5 of the p.c.b. Diode D7 maintains C3 in a charged state so that TR6 will switch on quickly. The Zener diode D5 limits the maximum voltage to approximately 12.5 volts to prevent possible damage to the transistors in the a.l.c. stage on the Low Level Board.

COMBINING UNIT MS 441 Fig.23

52. The Combining Unit is a completely passive unit which combines the 125W outputs from the RF Power Modules to produce the 1kW output.

Power Combining

53. The operation of the Combining Unit is best described by considering just one combining operation. Thereafter all subsequent combining sequences are essentially the same, apart from variations of actual impedance and power level. The principle however applies at each stage.

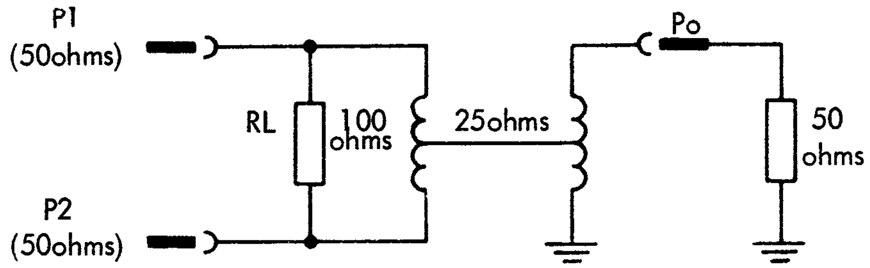


Fig (a)

54. Fig(a) shows a simple combining circuit with a 50 ohm input and 50 ohm output impedance. The features of this network are as follows:-

If P_1 and P_2 are equal and in phase then $Po = P_1 + P_2$ and there is zero power dissipated in RL.

If $P_1 = 0$ then $Po = \frac{P_2}{2}$

i.e. -6dB reduction on original Po with both inputs present. In this case $\frac{P_2}{2}$ is also dissipated in RL. If P_1 and P_2 are 180° out of phase, zero power appears at the output and $P_1 + P_2$ is dissipated in RL.

55. Although for maximum power output P_1 and P_2 should ideally be matched exactly in amplitude and phase fairly large differences can be tolerated within the extremes quoted above before a significant reduction in output power occurs. For example a 10% difference in amplitude results in a power output reduction of approximately 0.2% while a phase difference of 10° only results in a power output reduction of 0.75% of the total input Power $P_1 + P_2$.

Isolation

56. The second basic property of the combining network is that it provides isolation between the two inputs. This means that any impedance change at either input does not affect the input impedance presented to the other generator.

57. How this isolation is achieved is illustrated by considering the equivalent circuit of the two extremes i.e. open circuit and short circuit as well as the normal 50 ohm condition.

58. Fig (b) shows the 50 ohm input case. Since there is no voltage, i.e. output and input volts are the same and no power dissipation i.e. power output equals the power at A + the power at B, the output impedance must equal half the impedance at A or B. Therefore the impedance at the hybrid transformer output is 25 ohm for the two inputs to be 50 ohm.

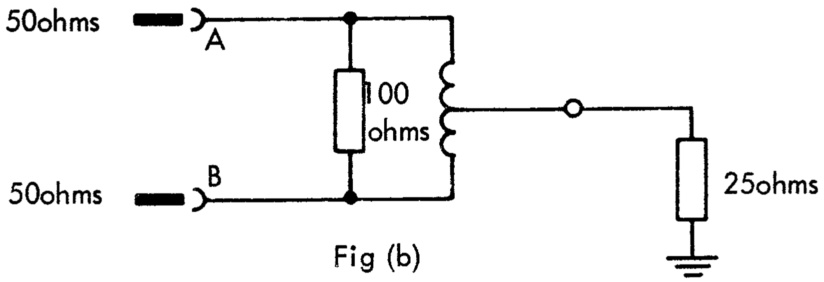


Fig (b)

59. Fig (c) shows the equivalent circuit for a short circuit at input B. The 50 ohm impedance at the hybrid output is transformed up to 100 ohm at input A, in parallel with RL giving a resultant input impedance of 50 ohm (i.e. as normal).

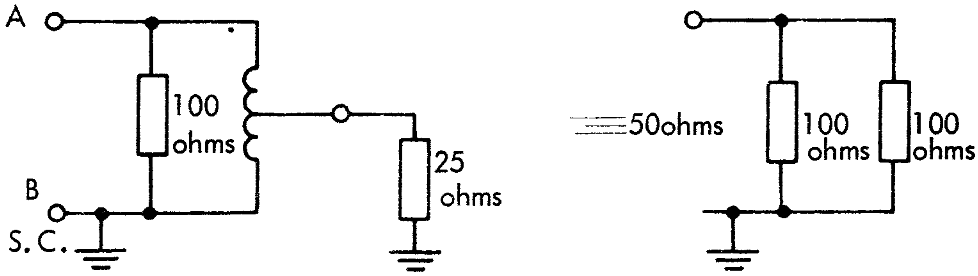


Fig. (c)

60. Fig (d) shows the equivalent circuit for an open circuit at input B. The 100 ohm impedance of RL is transformed to 25 ohm in series with the existing 25 ohm load impedance giving a resultant impedance of 50 ohm at input A (i.e. as normal). It can be shown that input A will always be 50 ohm for miscellaneous impedances appearing at input B.

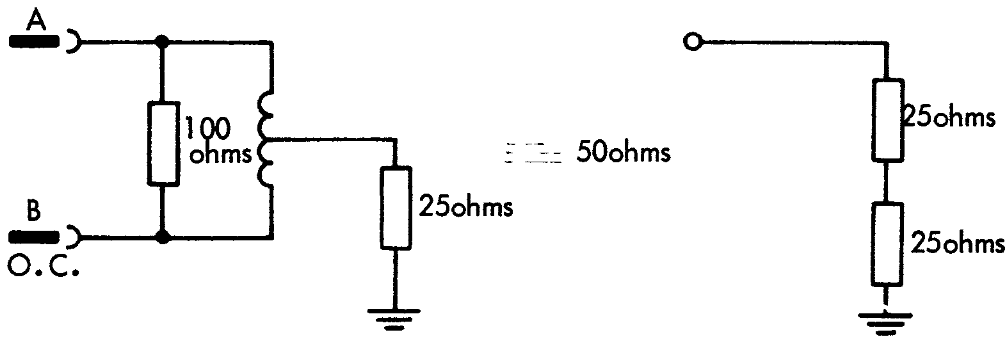


Fig. (d)

Design Features

61. In order to meet the theoretical performance outlined in the proceeding paragraphs it is necessary to provide balancing coils in series with each ballast resistor to ensure optimum isolation and input impedance matching over the full frequency range. This offsets the effects of transformer leakage inductance and circuit stray capacities which would otherwise cause an inferior performance.

WARNING

THE SETTING OF THESE ADJUSTABLE INDUCTORS IS CRITICAL AND THEY ARE ACCURATELY SET UP BEFORE DESPATCH FROM THE FACTORY. ANY FURTHER ADJUSTMENT SHOULD NOT BE NECESSARY BUT IF IT IS, THE PROCEDURE GIVEN IN CHAPTER 7, PARA.14 MUST BE FOLLOWED.

Power Dissipation

62. As described previously if power from one or more modules is lost then an unbalanced situation is created in the combining unit which results in power dissipation within the combining unit, as well as a reduction of output power. Fig. 5.1 shows the approximate output power against numbers of inoperative modules - the white sections show the power dissipated internally and the shaded columns indicate the actual output power.

Note: The conditions given in Fig.5.1 are 'worst case'. With four modules operational the linear amplifier can be 'patched' to give 500W output (refer to Chap.1 para.17).

63. The combining unit is rated to withstand the maximum dissipated power (i.e. 250W) continuously. A warning signal is however signalled out showing that power is being lost in the combining unit. This is sensed by a current transformer in each ballast resistor line. This RF unbalanced signal is rectified and fed to the Overload Unit MS443 where it is available to operate an external circuit which will indicate that the TA.1810 is operating on reduced power. It is only a warning indication and does not trip off the

amplifier, since there is no risk of damage whilst continuing to operate in this condition.

64. The eight RF inputs from the RF modules are fed into hybrid transformers in pairs. Inputs 1 and 2 are fed to opposite ends of AT3 and AT5 in parallel. Inputs 3 and 4 are connected to opposite ends of AT4 and AT6 in parallel - similarly for inputs 5, 6, 7 and 8.

65. Also connected in parallel with AT3 and AT5 are ballast resistor R3 in series with a current monitoring transformer AT1 and an inductor L1. L1 operates in conjunction with C1 and is adjusted for maximum isolation and optimum input impedance matching. The output of AT1 is detected and fed to PL1 Pins 8/9 and then to the Overload Unit, to provide an RF unbalance signal. The remaining input hybrids are identical to inputs 1 and 2.

66. The outputs from AT3/AT5 and AT4/AT6 on Board A are then fed to the next hybrid transformer stage T1. R5 and R6 are connected in parallel across the primary of T1 forming the ballast load in series with L3, which together with C5 and C7 optimises the isolation.

67. The output from Board B feeding T2 is identical to that from Board A.

68. The output from T1 appears at an impedance of 12.5 ohm and this is 'stepped up' to 50 ohm by T3. This is then fed to SK9 via T5 current monitoring transformer. SK9 is then normally connected to PL2 which feeds one side of the 1KW hybrid transformer T7 and the other side is fed from the other 500W output appearing at SK10. R3, R4, R5 and R6 form the ballast load for T7, and have a total rating of 250W. The output of T7 is at 25 ohm impedance, and is transformed to 50 ohm by T8. C9 is included to improve the isolation of the two 500W inputs. T9 is a current transformer for output monitoring.

AUTOMATIC LEVEL CONTROL AND PROTECTION

69. The overall Automatic Level Control (a.l.c.) protection aspect of the TA.1810 Linear Amplifier is an important and basic feature of the design, both for normal operation and for protection under abnormal conditions.

70. Protection of the transistorized RF Power Modules is vital for the overall reliability of the equipment and in many instances the protection circuits operate via the a.l.c. stages of the module so that the two are closely interdependent.

71. The details of the actual a.l.c. stage have been described in paras. 27 to 29. It is this stage which is controlled under various overload conditions as well as for normal operation.

72. The following inputs are connected to the a.l.c. and on exceeding the pre-set threshold level, will determine the operating gain and hence the output level of the RF Power Module.

(1)	Forward Power -	normal operation into 50 ohm.
(2)	Reflected Power -	operates to a.l.c. if mismatch at the output of the module is less than approximately 2:1 V.S.W.R.
(3)	Transistor Collector	
	RF Voltage (Swingometer) -	Operates the a.l.c. if the voltages exceeds a pre-determined level (normally approximately 25V peak).
(4)	DC current -	Operates the a.l.c. if the mean d.c. current, when driven, exceeds 15 Amp approx.

73. The levels at which the forward and reflected power take over control of the a.l.c. are adjustable but should only be set up in accordance with the instructions laid down in Chapter 7. In the case of the collector RF voltage and DC current detectors these are pre-determined by the design values of components and cannot be varied. The attack and decay times of the respective inputs are listed in para.34 with the exception of d.c. current which is approximately 10 μ seconds.

74. In addition to the previously mentioned a.l.c. protection circuits, additional protection is included as follows:-

(1) A thermostat to detect overheating of each module.

(2) A 'latching' current trip circuit for each Stabiliser Unit.

(3) A high rupturing capacity fuse for each module for protection against a stabiliser short circuit.

(4) A magnetic circuit-breaker for AC supply input overload protection to each power unit.

(5) Two fuses for low mains current consumption.

75. Together these overload circuits provide an extremely high degree of overall protection.

POWER SUPPLIES

Power Supplies Unit Type MS64 — Fig.25 and 25a

76. The Power Supply Units fitted in the TA.1810 may be either Type MS64/1 (Fig.25) or Type MS64/2 (Fig.25a). The two versions are mechanically and electrically interchangeable but there are differences in the transformers, inductors and components used. The modules have therefore been identified as follows:-

Type No.	Racal Drawing No.	Description
MS64/1	DD.603718	Power Supply Module (Gresham)
MS64/2	DD.605310	Power Supply Module (Gardners)

77. Each Power Supply Unit is a self contained d.c. power supply providing smoothed unregulated d.c. outputs from a single phase a.c. supply. Two outputs are provided:-

(1) +36V at 30 amps
(2) +42V at 100 milliamps.

Each incorporates a bridge rectifier, from two separate transformer windings. The +36V rail has a choke input filter, while the +42V supply employs a capacitor input filter. Under no load conditions, however, the +36V supply behaves like a capacitor input filter and the no load voltage rises to approximately 60V. The associated units are adequately ratedto withstand this.

78. A plug-in mains selector is provided on each MS 64, to provide simple adjustment on installation.

Stabilizer Unit Type MM 440 — Fig.27

79. The stabilizer Unit Type MS 440 provides a stabilized +30V and +20V supply to the RF Amplifier Type MM 320. It is fed from the main power supply unit Type MS64 which provides a smoothed nominal 36V, at full load, to each stabilizer.

Note: In the following circuit description the component prefix codes detailed in Chapter 1 are used.

80. In addition the Stabilizer unit provides current metering facilities for the +30V supply to each RF Amplifier Assembly. A fast acting current overload trip circuit is also included. The latter is reset by removing the d.c. input. All power dissipating components e.g. power transistors and resistors are mounted directly on the finned casting. The low level circuitry is included on a printed circuit board, PS 313.

Output Ratings

81. The maximum current ratings of the two supply lines are:-

(1) +30V at 15 amps

(2) +20V at 2 amps

82. The normal 36V DC input to the Stabilizer Unit from the MS 64 power units, is connected to Pins 12,13, 14, 15 and 16 in parallel (positive) and pins 4, 5, 6, 7 and 8 in parallel (OV) Pin 3 is a separate earth.

83. A second d.c. input at 42V is required to feed 4TR2 and 4TR5. This is also fed from the MS 64 power units. The maximum current consumption, however is only 50mA. The +30V and +20V stabilised outputs appear on TS1 Pins 2 and 3 respectively.

84. The stabiliser itself comprises three separate circuits as follows:-

(1) +30V Stabiliser

(2) +20V Stabiliser and

(3) DC Overload/Trip Circuit.

+30V Stabilizer

85. The main d.c. input is fed to TR1 and TR4 connected in parallel. These are the main series stabilizing transistors. They are controlled by a feedback system comprising 4TR5, 4TR2 and 4TR3. Transistor 4TR5 is the comparator stage while 4TR2 and 4TR3 provide current amplification for the feedback loop. The emitter of 4TR5 is held at 5.6V by 4AD3 while the base voltage is derived from the stabilized +30V rail via an adjustable resistor 4A R10. This control determines the setting of the +30V output level.

86. As the voltage tends to rise, due to a reduction of load current, TR5 base voltage will also rise, causing 4TR5 to conduct more, which in turn causes 4TR2, 4TR3 and TR1 and 4TR4 to conduct less. This gives a greater voltage drop across 4TR1 and 4TR4, thereby reducing the output voltage and opposing the initial change of output level. The circuit is therefore self compensating, and with the high loop gain involved relatively large input voltage variations have no effect on the output voltage.

+20V Stabilizer

87. This follows the +30V stabiliser and has 4ATR7 as the main series stabiliser, with 4ATR6 as an amplifier and 4ATR4 as the reference detector stage. The output level is set by R16. In principle it functions exactly as the +30V stabilizer.

D.C. Trip Circuit

88. As the d.c. load current increases the voltage drop across 4R1 increases. This increases the voltage appearing across the base of 4ATR1 - which is adjustable via 4AR3. Under normal conditions this voltage is inusfficient to cause 4ATR1 to conduct so that 4ATR2 is also non-conducting. The collector voltage of 4ATR2 is high and therefore isolated from the main +30V stabilising feedback loop i.e. base of 4TR2, by 4AD2.

89. A similar trip circuit for the +20V supply is provided by 4ATR3, the trip voltage being developed across R9 and applied to Board Pins 9 and 10. Transistor 4ATR3 is coupled to 4ATR1 via diode 4AD1.

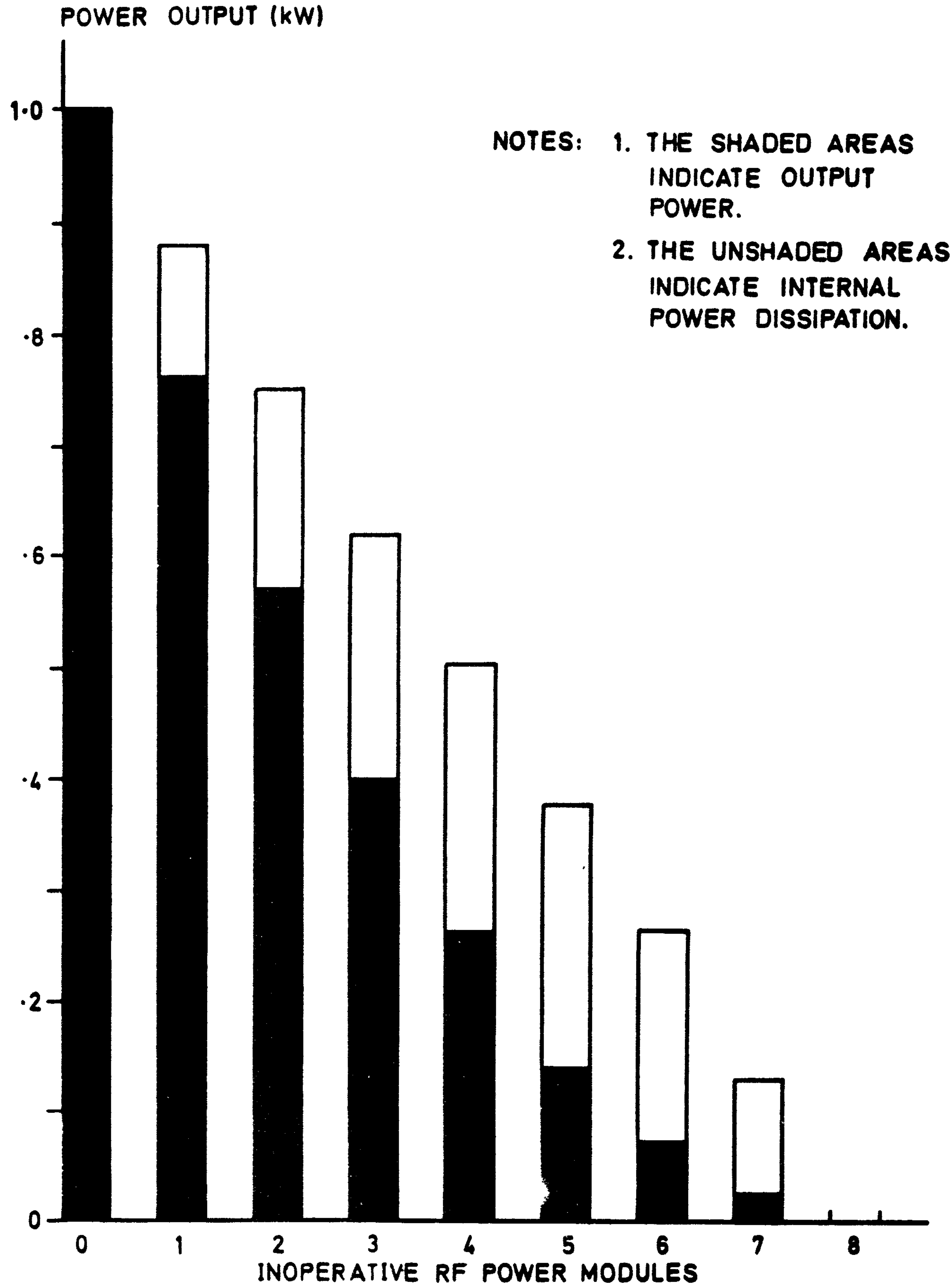
90. The voltage level at which 4ATR3 starts to conduct is determined by the Vbe of 4ATR3 i.e. 0.6V. Under normal operating conditions this voltage is less than 0.6V and again 4A TR2 is non-conducting.

91. In the event of either 4ATR1 or 4ATR3 switching on however, caused by an overload current in either the main input or the +20V stabilizer input, then 4ATR2 will switch on, causing the main +30V stabilizer transistors to be switched off. Positive feedback between 4ATR2 and 4ATR1 then causes them to 'latch' on, so that the main stabilizing transistors are held non-conducting until the unit is reset by interupting the d.c. supply in, by unplugging and re-inserting the RF Power Module or by operation of the appropriate circuit breaker on the front panel of the Power Supply Unit.

92. The four MS64 Power Supply Units are protected against switch-on surges by two surge protection circuits - PCB1 which controls PSU1 and PSU2, and PCB2 which controls PSU3 and PSU4. As the two circuits are identical only one will be described.

93. When contactor A is closed the mains supply is fed, via CB2 and surge limiting resistors R3 and R4, to the mains input connections on PSU3 and PSU4. The 36V output of PSU3 is applied across pins 1 and 8 of PCB2, and the 36V output of PSU4 is applied across pins 2 and 8 of PCB2. As the output voltage rises, the voltage at the base of TR2 and hence the emitter of TR2 also rises. When this voltage reaches 15V, zener diode D3 starts to conduct via R2 and R3 thereby priming TR1. Current will now flow through TR2, RLB and TR1 thus energising the relay and closing the relay contact. The surge limiting resistors R3 and R4 are thus switched out of circuit immediately the switch-on surge has been suppressed.

94. Zener diode D2 protects RLB from excessive voltage under no-load conditions when the Power Supply voltage rises above 39V.



WOH3037

Ratio: Approximate Output/ Inoperative Modules

Fig. 5·1

CHAPTER 6

ROUTINE MAINTENANCE, DISMANTLING AND REASSEMBLY

ROUTINE MAINTENANCE

1. Routine maintenance requirements on the TA.1810 amplifier are minimal, as only the following items need be checked at regular intervals.

Air Filter

2. This should be washed at appropriate intervals in water with a detergent.
NOTE; Ensure filter is completely dried before replacing in cabinet.

Contactor Contacts

3. It is recommended that the contacts on the main switching contactor be examined every six months, and replaced if significant deterioration is observed.
NOTE: The bearings of the two blowers fitted above the power units are 'sealed for life' and therefore require no lubrication. Refer to para.28 for the blower fitted to the top rear of the cabinet.

DISMANTLING AND REASSEMBLY

4. Modular construction is used throughout and access to all sub-units and cabinet connectors is via the front of the cabinet.

Power Supply Unit type MS 64

5. The Power Supply Units Type MS64 are mounted in two banks (each comprising two MS 64 Units) at the bottom left and right of the TA 1810 cabinet.

CAUTION: When the cabinet is not fixed to the floor only one bank of power supplies should be withdrawn at any one time to avoid the danger of the cabinet toppling.

Removal

6. (1) Undo the 4 quick release screws on either side of the Power Supply Unit front panel and remove the front panel.

(2) Switch off the circuit breaker appropriate to the power supply unit to be removed.

(3) Remove the Pozidriv screw securing the angle bracket, mounted on the front edge of the appropriate bank of power supplies, to the front edge of the cabinet; pull the pair of power supplies forward to their fullest extent.

(4) Remove the mains shroud to the appropriate power supply.

CAUTION: If one half of the TA.1810 Linear Amplifier is operating, use a meter to check that mains is not present.

(5) Disconnect the mains cable and remove the three Pozidriv screws securing the bottom of the power supply to the mounting panel.

(6) Slacken off but do not remove the 3 Pozidriv screws securing the top of the power supply to the mounting panel.

(7) Remove the power supply from the mounting panel.

Replacement

7. Replacement of a power supply is effected by reversing the procedure described in para. 6(1) to 6(7).

Splitter Unit, Distribution Amplifiers, Overload Unit and Muting Unit

8. The Splitter Unit, Distribution Amplifiers, Overload Unit and Muting Unit are mounted on a hinged plate which is located above the power supplies. The cover to each unit is secured by four slotted screws whilst the units are secured to the hinged panel by Pozidriv screws.

9. To gain access to the Muting Unit, which is mounted behind the left hand Distribution Amplifier, proceed as follows:-

(1) Isolate the cabinet from the mains supply.

(2) Remove the screws securing the left hand side of the hinged mounting plate.

(3) Disconnect the coaxial output sockets (8SK1 to 8SK4) from the left hand Distribution Amplifier and hinge the mounting plate forward.

Circuit Breakers

10. The circuit breaker assemblies are mounted on either side of the overload unit but fixed to the cabinet upright. Access to these assemblies, which contain the Relay Control PCBs, starting relays and surge resistors, is via screwed metal covers. These are provided with warning plates since mains voltages exist on the circuit breaker terminals underneath the cover plates. When replacing a circuit breaker ensure that the cable grommet is properly positioned and that the cables are not trapped.

Main Switching Contactor

11. The main switching contactor (Con A) is located on the back of the hinged mounting plate located above the power supplies.

Removal

12. (1) Isolate the cabinet from the mains supply.

(2) Remove the screws securing the left hand side of the hinged mounting plate.

(3) Disconnect the coaxial output sockets (8SK1 to 8SK4) from the left hand Distribution Amplifier and hinge the mounting plate forward.

(4) Remove the contactor cover and the side plates on which the cover is mounted.

(5) Remove the connections to the contactor noting their positions for replacement.

(6) Remove the Contactor by removing the four red screws and the contactor fixings to the hinged mounting plate.

Replacement

13. To replace the main contactor reverse the procedures detailed in 12(1) to 12(6).

Air Blowers

14. Two air blowers are located immediately above the power supplies, the lower bank of RF Power Modules must be removed to give access to the fixings on the blower plate.

Removal

15. (1) Isolate the cabinet from the mains supply.

(2) Remove the power supplies panel.

(3) Hinge forward the mounting plate as described in para. 12(2) and 12(3).

(4) Remove the lower four RF Power Modules.

(5) Slide the power supplies forward to their fullest extent.

CAUTION: When the cabinet is not fixed to the floor only one bank of power supplies should be withdrawn at any one time to avoid the danger of toppling the cabinet.

(6) Disconnect the cabinet terminals on the blower.

(7) Use a 3/8" box spanner through the access holes, provided by removing the lower 4RF Power Modules, to undo the 4 blower plate captive fixings.

(8) Lower the blower and remove it from the cabinet.

Replacement

16. (1) Replacement of an air blower is effected by reversing the procedures described in 15(1) to 15(8).

(2) Before attempting to tighten the 4 blower plate captive fixings, locate the blower in position and ensure that fan outlet is correctly located within the air duct.

Meter Panel

17. The Meter Panel is located above the RF Power Modules and houses two meters and the V.S.W.R. Warning PCB.

Removal

18. (1) Remove cabinet connector mating with the Meter Panel Plug (11PL1).

(2) Remove the 4 screws securing the hinges and remove the Meter Panel from the cabinet.

(3) To obtain access to the meters and the V.S.W.R. Warning PCB remove the 5 fixing screws (3 front and 2 rear) and remove the cover.

NOTE: Access to the V.S.W.R. Warning PCB may be gained without removing the meter panel.

Replacement

19. To replace the Meter Panel reverse the procedures detailed in 18 (1) to 18 (3).

Combining Unit

20. The unit or units located above the Combining Unit must be removed to give reasonable access to the rear fixings.

Removal

21. (1) Fully lower the Meter Panel by releasing the catch on the left hand side of the cabinet.

(2) Disconnect the four RF connectors on the right hand side of the unit.

(3) Disconnect the four RF connectors and the 9-way Cannon D connector on the left hand side of the unit.

(4) Disconnect the RF connector from the front of the unit.

(5) Remove the fixing screws from the rear edge of the unit.

(6) Slacken off the captive fixings on the lower flanges (2 left hand side and 2 right hand side).

(7) Lift one side of the unit and ease it out from the cabinet through the gap immediately above, taking care not to foul cables.

Replacement

22. Replacement of the Combining Unit is effected by reversing the procedures detailed in 21 (1) to 21 (7).

RF Power Modules

23. The RF Power Modules are removed by undoing the 2 quick release screws and sliding the module forward from the cabinet. When replacing a module ensure that it is properly located in the guide channel.

RF Power Module MM 420

24. To separate the Stabilizer Module from the RF Power Module proceed as follows:

(1) Slacken the 4 fixing screws on tag strip TS1 and remove the fanning strip.

(2) Remove the fixing nuts and washers on both RF connectors (5PL1 and 5PL2) on the rear panel noting carefully the order in which the washers are removed.

(3) Remove both Pozidriv screws connecting the top plate of the MM 440 Module to MM 320 Module.

(4) Slacken off the two nuts and bolts connecting the mating edges of the heat sink.

(5) Remove the Stabilizer Module by pulling it in the direction of the heat sink.

High Level Board and Protection Board

25. To obtain access to the High Level Board proceed as follows:

(1) Place the complete module assembly on a bench with the front panel of the module to the right and the heat sink on the bench.

(2) Remove the fixing nut on plug 5PL2 on the rear panel noting carefully the order in which the washers are removed.

(3) Remove both Pozidriv screws fixing the Low Level plate to the pillar nuts.

(4) Remove 2 nuts and bolts connecting the Low Level plate to the front panel.

(5) The Low Level plate may now be hinged away to give access to the High Level Board.

CAUTION: If it is required to operate the module in this condition care must be taken to ensure that the Low Level plate does not short the live points.

WARNING

THE P.A. TRANSISTORS AND THEIR ASSOCIATED INSULATING WASHERS CONTAIN BERYLLIUM OXIDE, THE DUST OF WHICH IS TOXIC. BEFORE HANDLING THESE DEVICES REFER TO THE SAFETY PRECAUTIONS AT THE FRONT OF THE HANDBOOK.

Method of Changing a P.A. Transistor

Note: Refer to page 1-3 concerning P.A. transistor types.

26. (1) Remove the fixings on the Low Level Board sub-assembly (including its mounting plate) so that it can be hinged up and over to gain access to the High Level Board (refer to para.25). Unsolder the pins of the relevant transistor, and then place the module in its normal upright position with access to both sides of the transistor.

(2) Undo the nuts on the stud end with a box spanner. To do this and prevent rotation of the transistor it will be necessary to hold a broad screw driver blade against one side of the hexagonal shaped transistor body through the appropriate hole on the High Level Board.

(3) When refitting a new transistor use new insulating washers (Racal Part No. 920916) if necessary and cover both sides of the washer with 'Thermaflow' thermal paste Type A30/J (Jermyn Industries) before assembly. Reverse the procedure detailed in (1) and (2) for reassembly.

Note: It is important that 'Thermaflow' or other high conductivity paste is used in preference to silicone grease to ensure adequate thermal conductivity.

Access to Stabilizer Heat Sink.

27. Remove the Stabilizer (refer to para. 24) or hinge back the Low Level plate (refer to para. 25).
Undo 2 screws fixing the top plate to the rear plate on the stabilizer.
Hinge back the top plate to obtain access to the components mounted on the stabilizer heat sink.

'Woods' Air Blowers

28. After a considerable period of use, or after some 12 months storage under tropical conditions without use, it will be found that the oil has migrated from the grease in the bearings of these fans. As a result the fan will start to over-heat, and will ultimately seize up and fail.

29. To obviate this failure the fans should be overhauled and the bearings replaced at routine intervals. This could be immediately before putting into service if storage as above has occurred, or after 1 to 5 years operation dependent upon environment and duty cycle.

30. A spare set of bearings, packed for tropical storage, can be obtained from Racal (Part No. BA44126). The bearings are Ransome Hoffman Pollard type 106P V2 and the grease is SHELL ALVANIA RA. Bearing replacement should be carried out as follows:

1. Disconnect the mains supply to the unit and render the unit safe.
2. Disconnect the mains leads to the fan and remove the fan from the unit. The air filter should be removed and cleaned at the same time (para. 2).
3. Using a 4 B.A. open-jaw spanner, slacken off the hexagon headed screw retaining the impeller. Remove the impeller and clean off any dust. Remove any dust from the fan housing.
4. Using a 6 B.A. box spanner, remove the two nuts securing the two through-bolts. Withdraw the through-bolts.
5. Remove the rear bearing housing.
6. Remove the rotor with its two bearings. If the rotor and bearings show signs of gross over-heating (due to a stalled fan left on for a considerable time) the fan should be scrapped. A certain amount of discolouring will not, however, be harmful.
7. Remove the bearings using a bearing puller, taking care to avoid damaging the shaft. Scrap the bearings.
8. If the shaft is scored or damaged, restore polish with very fine emery. The new bearings should be a neat fit, not requiring excess force to fit them, but the shaft must not slip in the inner race.
9. Fit the replacement bearings, non shielded faces outwards avoiding pressure on the outer race. If SHELL ALVANIA RA grease is available it may be added to the two bearing housing after cleaning. This will increase the life of the fan by acting as a reservoir. Excess grease will cause pressure in the bearing, which will result in over-heating and failure.
10. Check the field windings for overheating, continuity and insulation to frame. Clean off any dust.

11. Refit the rotor with bearings and bearing housings. Secure with two through-bolts.

12. Re-fit the impeller, ensuring that the screw seats in the dimple in the shaft.

13. Before re-fitting the fan, connect to the mains supply and check for correct operation.

14. Return the fan to the unit and reconnect all leads.

CHAPTER 7

FAULT LOCATION & ALIGNMENT PROCEDURE

INTRODUCTION

1. A list of test equipment required for fault location and alignment procedure is given below.

TEST EQUIPMENT

(1) DC Power Supply +36V at 15 amps)
(2) DC Power Supply +40V at 100 milliamps) required when not using internal supplies refer to para.15.

(3) RF Power Meter
(Example: Bird Thruline Model 43 with 250W head)

(4) 50 ohm, 250W Dummy Load.
(Example: Bird Model 8141).

(5) Valve Voltmeter
(Example: Marconi TF1041C).

(6) Variable resistor load 3 ohm 135W rating.

(7) Variable resistor load 10 ohm 35W rating.

(8) RF Drive Source, 10mW minimum output, 2MHz - 30MHz.
(Example: Racal MA 1720).

(9) Accessory Kit CA607 containing:-

- (i) 1 set of Module RF and DC Connectors
- (ii) Combiner Patch Lead Assembly
- (iii) Extension Lead Assembly

(10) Multimeter (Example: AVO 8)

FAULT LOCATION PROCEDURE

2. Any fault on the TA.1810 can be very quickly located to a particular sub-unit using the front panel facilities provided.

3. Each RF module has a green lamp indicating that the DC supply is present, and a clear lamp which is illuminated when the module is radiating RF. A meter is included to show the current and voltage levels, and RF monitoring points are included at each stage to provide check facilities, using an oscilloscope or spectrum analyser. The RF input and RF output powers (both forward and reflected) are also indicated on a meter.

4. If a malfunction occurs, the following should be checked:-

(i) All module green lights are illuminated.

(ii) All module clear lights are illuminated when the amplifier is driven.

(iii) Individual module currents and voltages

(iv) RF input power.

(v) RF output power (forward and reflected)

The sequence of checks outlined in Tables 1 and 2 will, in conjunction with the previous checks, locate the fault quickly to the Power Supplies, Stabilizer Unit, RF Modules, Combining Unit, Distribution Amplifiers or Splitter Unit.

TABLE 1

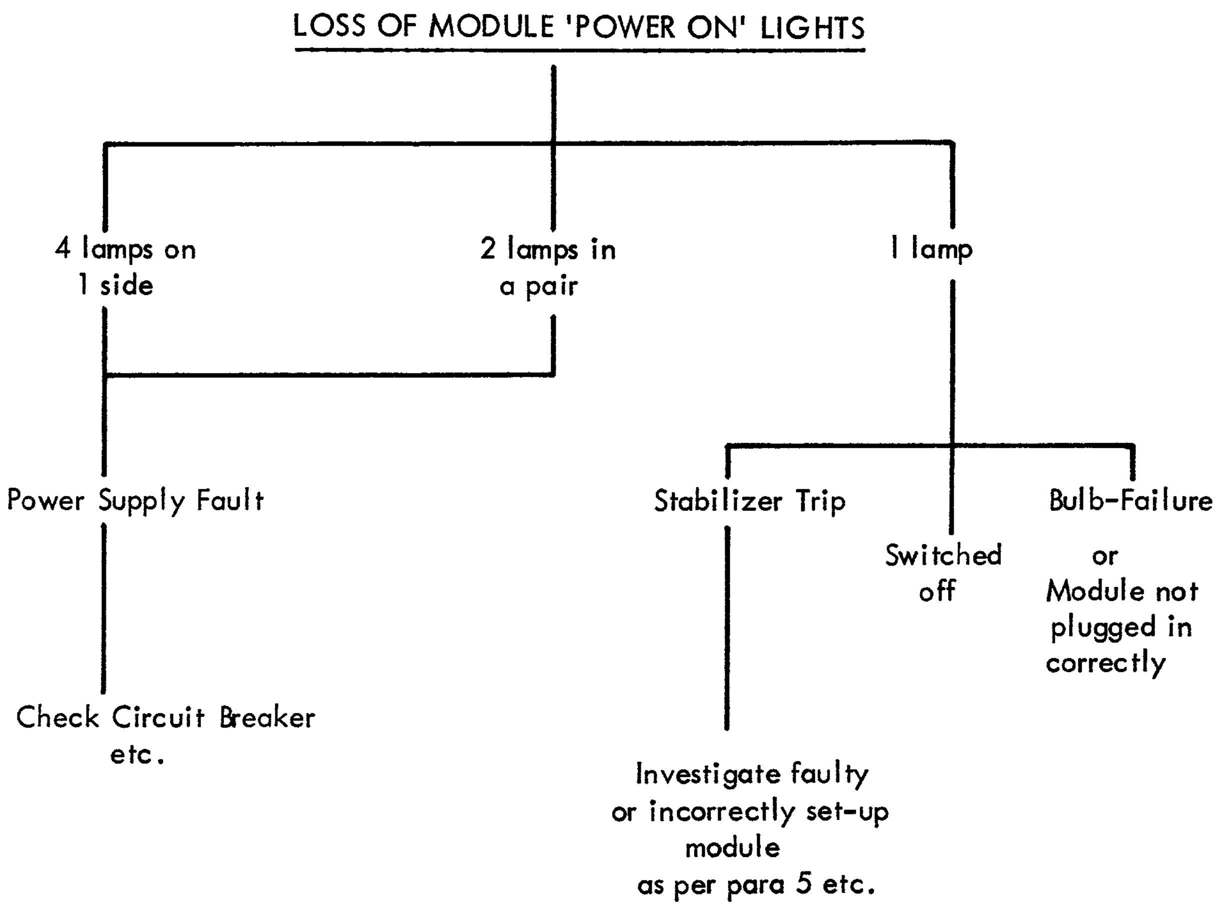
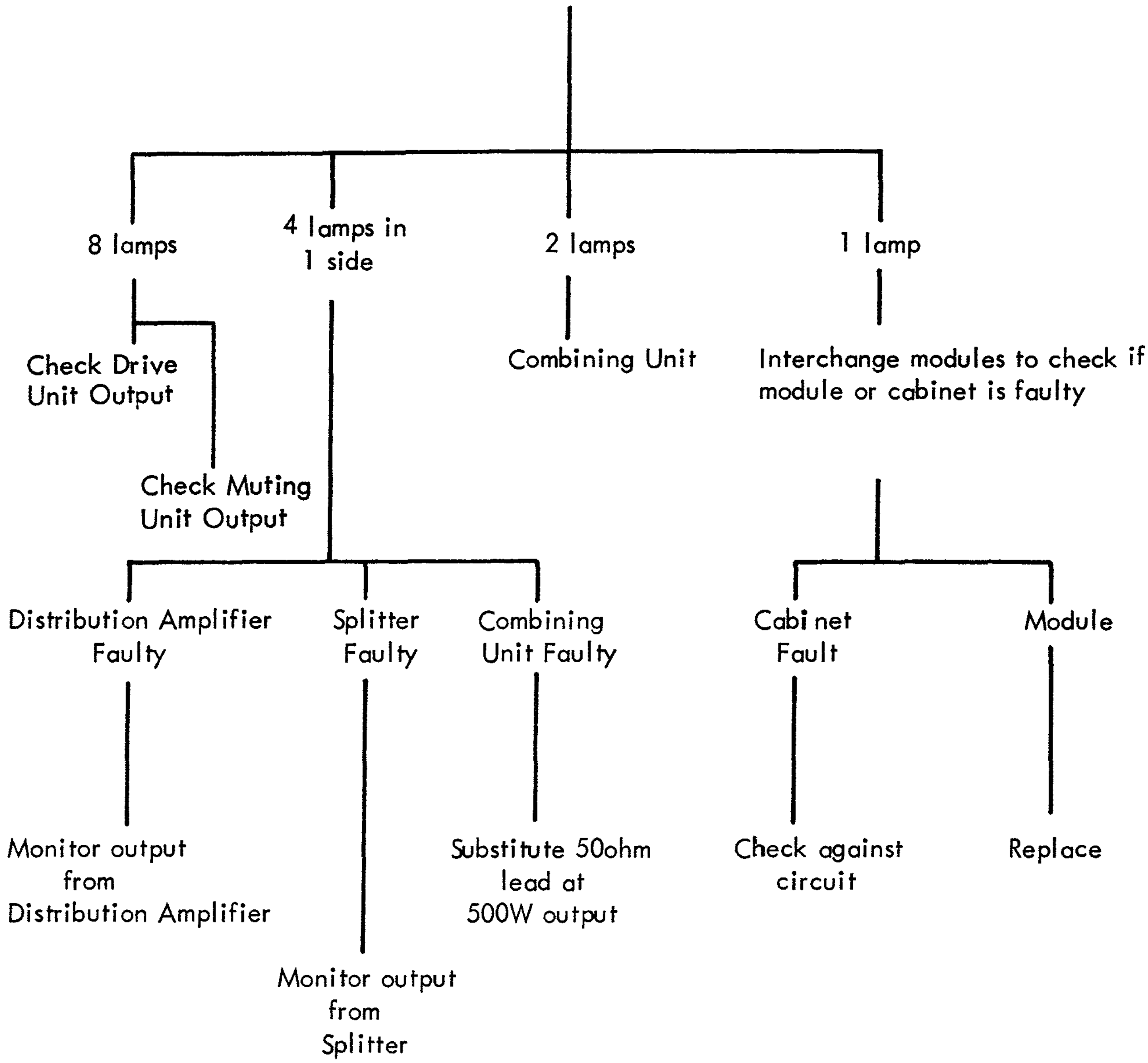


TABLE 2

LOSS OF MODULE RF OUTPUT LIGHT



Sub-Unit Fault Location

5. Fault location on sub-units is a fairly simple process; in most cases it is merely a matter of checking against the circuit diagram. The exception is the RF Amplifier Module Type MM.420, and procedures for detailed circuit checking are described below.

Fault Location - RF Module MM420

6. When a faulty module has been identified it is recommended that it be replaced and subsequent fault location carried out away from the transmitter. (Refer to Chapter 7, para.15.)

RF Module Checks - Without RF Drive

7. Remove the module from the cabinet and set the SUPPLY switch on the module to the ON position. Using a multimeter, measure the resistance of the +30V supply input between pin 2 of TS1 and chassis. If the resistance is less than 10 ohm an abnormal condition is indicated, and the module circuits should be investigated. If the impedance is satisfactory, the setting of the Stabilizer trip level (para.17) should be checked followed by checks of the module with RF drive applied (paras.8 to 13).

RF Module Checks - With RF Drive

8. Check that the +30V supply current (to the High Level Board) is approximately 8A to 12A dependent on the drive frequency. Even if the current measured appears to be correct is is advisable to check all RF power transistors by measuring each emitter voltage (from each transistor stud to earth).

NOTE: Ensure transistor stud is not earthed or the transistor may be destroyed. The eight output transistors should be equal within 0.1V. Typical voltages are approximately 0.6V but are slightly dependent on the drive level and frequency applied.

9. If zero voltage or a significantly low voltage exists, the appropriate transistor should be changed using the procedure described in Chap.6 Para. 25.

10. If a discrepancy of more than 0.1V exists, then checks on RF drive levels to the transistor must be made, following logically the RF signal path as given in the circuit diagram. Typical causes could be bias voltage errors or circuit dry joints.

11. Measurements of RF gain on both the Low Level Board and overall module are sometimes necessary to locate a low gain stage. When checked at 10MHz below the A.L.C. operating level the input signal for a 100W output should be between 250mW and 400mV injected at the module input socket.

12. With the Low Level Board terminated in a 50 ohm 2W non-inductive resistor, and isolated from the High Level Board, its output should be 2W for an input signal

of not more than 10mW, injected at the module input socket.

13. When the low gain stage is located, detailed DC measurements on individual components will enable easy identification of the fault.

ALIGNMENT PROCEDURES

Adjustments to RF Module MM.420

14. Following repair work and/or component replacement, it is necessary to carry out the complete adjustment procedure (paras 16 to 22) on the RF Module, to ensure that all operating and protection levels are correct. Unless the procedure is correctly carried out the RF module may not be performing to its specification and may suffer further malfunction if not adequately protected due to incorrect settings. In addition it may periodically be necessary to carry out a routine check of the module performance. In such cases, the following procedure should be carried out.

15. For the purpose of setting-up and re-aligning, the module may be operated completely separately from the main amplifier using items (1), (2), (4) and the Module D.C. Connectors (part of Accessory Kit CA607 - item (9)) of the test equipment listed in para.1. Alternatively the MM420 can be operated out of the transmitter cabinet by using the Extension Lead Assembly (part of Accessory Kit CA607) to connect to the TA.1810 supplies. If the second procedure is used, the TA 1810 should be operated as two separate 500W units and the three modules associated with the one under test should be switched off.

Note: Since the module is operated outside the cabinet it will not be forced air cooled, therefore it is recommended that it is not operated for more than 20 mins at full power. If, however, this time is greatly exceeded the module thermostat will operate to avoid overheating.

Setting-up the Stabilizer Output Volts

16. Check the nominal 30V supply at tags 2 and 1 of TS1. Adjust 4AR10 on the Stabilizer Unit to set this voltage to 30.5 volts. Check the nominal 20V supply at tags 3 and 1 of TS1. Adjust 4AR16 on the Stabilizer unit to set this voltage to 20 volts.

Setting-up the Stabilizer Trip Level

17. Switch off the module and disconnect it from the supply. Set 4AR3 on the Stabilizer fully anti-clockwise and connect an external load resistor (item (6) of the test equipment) between tag 1 and tag 2 of TS1 without disconnecting the Stabilizer from the module. Reconnect the module to the supply and switch on the supply, adjust the load resistor for a reading of 18.5-19 amp, indicated on an ammeter connected in series with the +36V supply, or for a reading of 16 to 16.5A on the front panel meter of the TA.1810 (switched to the appropriate module). Slowly adjust 4AR3 clockwise until the stabilizer trip circuit operates. Remove the external load resistor.

18. The trip circuit for the +20V supply is pre-set on manufacture. To check the

action of the trip circuit, switch off the module and disconnect it from the supply. Connect an external load resistor (item (7) of the test equipment) in series with an ammeter (set to read 5A FSD (between tags 1 and 3 of TS1. Reconnect the module to the supply and switch on the supply. Increase the load current by adjusting the external load resistor and note that the trip circuit operates between 3 and 4 amps.

Note: The current must not be adjusted to exceed 4 amps.

Setting-up Module Over Voltage - Low Level Trip

Note: Before applying RF to the module, the supply voltage must be set to 30.5V by adjustment of 4AR10.

19. Monitor the nominal 30V supply between Tags 2 and 1 on TS1, and adjust 4AR10 to increase the output voltage. Check that the over voltage trip operates between 32.5 and 33.5 volts. This adjustment should be carried out with the module undriven. In no circumstances should the output voltage be increased above 34 volts. If the trip does not operate at the specified levels, slowly adjust 5CR1 on the protection board until it does so.

Setting-up the V.S.W.R. Detectors

20. Before setting-up the Reflected and Forward Power Levels the V.S.W.R. detectors on each individual RF Module should be balanced. Connect the RF output socket of the module to a true 50 ohm resistive load.

Apply an RF signal at 10MHz to the module, switch on the module and increase the level of drive signal until the module is delivering 100W into the load. Connect a multimeter (set to read d.c. volts) between pin 10 on the Low Level PCB and earth. Adjust 5DC3 on the V.S.W.R. PCB (through the access hole in the cover) for a minimum reading on the multimeter, this should be between 400mV and 650mV.

Note: The cover of the V.S.W.R. PCB must always be in position when the module is operating.

Setting-Up Reflected Power Level

21. Set 5AR6 on the Low Level Board (PS314) fully clockwise. Disconnect the RF output socket 5PL2 and apply an RF input signal of 10MHz at a level of 2mW. Check that the DC current does not exceed 3 amps, if measured on the front panel meter, or 5 amps if measured on an ammeter connected in series with the 36V supply. If these values are exceeded a fault condition exists and must be corrected before proceeding further.

22. Apply a short circuit at the RF output connector, increase the RF drive level to approximately 10mW and adjust 5AR6 to obtain a reading of 6.5 amp on the front

panel meter or 8.5 amp on an ammeter connected in series with the 36V supply. Remove the short circuit and re-connect the RF output load.

Note: It is important that the short circuit is applied at the RF output connector 5PL2 and not at an earlier point in the output circuit.

Setting-up the Forward Power Level

23. Set the drive signal to 18MHz at a level of 10mW. Set the module output power to 135 watts (into a 50 ohm dummy load) by adjusting 5AR1 on the module Low Level Board. Check that as the frequency is raised from 1.6 to 30MHz (at 10mW input) the output does not exceed 150W or drop below 120W.

Setting-up and Adjustment of V.S.W.R. Unit MS447

24. This unit should be set-up with the TA.1810 operating into a true 50 ohm resistive load at full power. With the reflected power meter selected, observe the indicator. If this exceeds 25 watts, then the V.S.W.R. unit is unbalanced. Adjust C3 for a null at an operating frequency of 10MHz. If the null cannot be reduced to 25W or below switch off and remove the unit. Carry out detailed d.c. measurements against the circuit diagram to check diodes, resistors etc.

Setting-up the Meter Panel

25. After setting-up the V.S.W.R. Unit MS447 (and with the RF output still connected to a 50 ohm resistive load) the transmitter output power should be measured on a power meter. With switch 11SA (located in the meter panel) set to NORMAL, the meter panel potentiometer 11 AR1 should be adjusted to give the same power indication on the upper scale of the front panel meter (with meter switch set to FORWARD POWER) as that measured in the RF power meter. Switch off a number of modules until the forward power indication on the meter drops to below 250 watts. Set switch 11SA to CALIBRATE and the meter panel switch to REFLECTED POWER, adjust 11AR2 on the meter panel to obtain the same reading on the lower scale of the meter as the forward power reading on the upper scale.

26. The VSWR trip level can now be set up by adjusting 11R12 until the trip operates a: a reflected power not exceeding 700 watts. Lower power settings may be used if a more sensitive trip is required to suit a particular installation. Set switch 11SA back to NORMAL.

Setting-up and Adjustments on Combining Unit MS.441

27. As described in Chapter 5, all adjustments to the Combining Unit are carefully set up in the factory prior to dispatch; re-alignment is not normally necessary. Only in the very rare occurrence of a transformerbeing replaced should this unit need to be re-aligned. The procedure requires the use of specialized equipment such as the Rhode and and Schwarz Polyscop. Using such equipment, adjustment of the relevant coils should be made to achieve a compromise between matched input impedance and isolation over the frequency range.

CHAPTER 8

COMPONENTS LIST

CONTENTS

CHAPTER 8

COMPONENTS LIST

Cct Ref	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		CABINET ASSEMBLY CHASSIS				
Resistors (ohm)						
1R1	12	Wirewound	12W	5	913817	Welwyn
1R2	12	Wirewound	12W	5	913817	Welwyn
1R3	12	Wirewound	12W	5	913817	Welwyn
1R4	12	Wirewound	12W	5	913817	Welwyn
1R5	51	Metal Oxide		5	907490	Electrosil TR5
1R6	2.2m	Voltage Dependent		5	926942	Mullard 2322-594-53912
1R7	4.7k			10	937596	
1R8	4.7k			10	937596	
1AR1	2.2m	Metal Glaze	¼W	5	939308	Mullard VR25
1AR2	10m	Metal Glaze		±5	941944	Mullard VR 25
1AR3	3.9k	Metal Oxide		2	915074	Electrosil TR4
1AR4	1.5k	Metal Oxide		2	911166	
1AR5	1k	Metal Oxide		2	913489	Electrosil TR4
1AR6	22k	Metal Oxide		2	913493	Electrosil TR4
Capacitors (μF)						
1C1	4		440V	±10	Supplied with 1BL1 & 1BL2	
1C2	4		440V	±10		
1C3	33	Electrolytic	100V	-10 +50	939484	ITT/ERIE JF10A 330T 100 AA
1C4	33	Electrolytic	100V	-10 +50	939484	ITT/ERIE JF10A 330T 100 AA
1C5	33	Electrolytic	100V	-10 +50	939484	ITT/ERIE JF10A 330T 100 AA
1C6	33	Electrolytic	100V	-10 +50	939484	ITT/ERIE JF10A 330T 100 AA
1C7	0.1	Polyester	160V	20	930563	Ashcroft A2B1015A
1C8	0.1	Polyester	160V	20	930563	Ashcroft A2B1015A
1AC1	15			20	910060	ITT TAAB/15/M20
1AC2	0.1		160V	5	943302	Ashcroft B2A 101 05(

Cct Ref.	Value	Description	Rat.	Tol %	Racal Part Number	Manufacturer
Diodes						
1D1 to 1D3		1N4002			911460	Texas
1D4 to 1D6		1N4149			914898	STC
1AD1		1N4006			925856	Texas
1AD2		1N4006			925856	Texas
1AD3		1N4006			925856	Texas
1AD4		1N4006			925856	Texas
1AD5		BZX79C12			928372	Mullard
1AD6		1N4006			925856	Texas
1AD7		1N4149			914898	STC
1AD8		BXX79C8V2			923962	Mullard
Transistors						
1TR1		BFY51			908753	Mullard
1TR2		BFY51			908753	Mullard
1ATR1		2N6028			938037	Motorola

*Not fitted to Assembly DC 603140/Z

Cct. Ref	Value	Description	Rat.	Tol %	Racal Part Number	Manufacturer
Switches						
1SA		Rotary S.P.C/O			921590	Tok Switches Ltd
Relays						
1RLA		Solid State D2440-1			937595	
1RLB		Solid State D2440-1			937595	
1RLC		Sealed 1-pole H.D. (12V, 170ohm)			916469	ITT 4190 EC
1RLD		Remote Co-axial (26V d.c.)			921770	Dowkey Series 60
1RLE		Remote Co-axial (26V d.c.)			921770	Dowkey Series 60
1RLF		Remote Co-axial (26V d.c.)			921770	Dowkey Series 60
1RLG		Remote Co-axial (26V d.c.)			921770	Dowkey Series 60
1RLH		2-Pole (24V d.c.)			923398	ITT TYPE 240 AEO
Circuit Breakers						
1CB1		2-Pole, 15A, 50-60Hz			921435	Highland Electronics
1CB2		2-Pole, 15A, 50-60Hz			921435	Highland Electronics
Blower Assemblies						
1BL1		Centrifugal			CA603744	Racal
1BL2		Centrifugal			CA603744	Racal
1BL3		6" dia. Axial			CD47527	Racal
Contactors						
1CONA		240V, 50Hz, 30A			925278	Arrow Type 129A4U/003TF, 220/250V.
Connectors						
*1PL1		Coaxial 50ohm			923981	Radiall R141082
*1PL2		Coaxial 50ohm			923981	Radiall R141082
*1PL3		Coaxial 50ohm			923981	Radiall R141082
*1PL4		Coaxial 50ohm			923981	Radiall R141082
*1PL5		Coaxial 50ohm			923981	Radiall R141082
*1PL6		Coaxial 50ohm			923981	Radiall R141082
*1PL7		Coaxial 50ohm			923981	Radiall R141082
*1PL8		Coaxial 50ohm			923981	Radiall R141082
*1PL9		Coaxial 50ohm			923981	Radiall R141082
*1PL10		Coaxial 50ohm			923981	Radiall R141082
*1PL11		Coaxial 50ohm			923981	Radiall R141082
*1PL12		Coaxial 50ohm			923981	Radiall R141082
*1PL13		Coaxial 50ohm			923981	Radiall R141082
*1PL14		Coaxial 50ohm			923981	Radiall R141082
*1PL15		Coaxial 50ohm			923981	Radiall R141082
*Add		Adaptor-Elbow			924736	Radiall R141770

Cct. Ref	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
Connectors (contd)						
*1PL16		Coaxial 50ohm			923981	Radiall R141082
1PL17		Coaxial 50ohm			922179	Transradio C7/5
1PL18		Coaxial 50ohm			922179	Transradio C7/5
1PL19		Coaxial 50ohm			901716	Transradio C1/5
1PL20		Coaxial 50ohm			901716	Transradio C1/5
1PL21		Coaxial 50ohm			901716	Transradio C1/5
1PL22		Coaxial 50ohm			901716	Transradio C1/5
1PL23		Coaxial 50ohm			922179	Transradio C7/5
1PL24		Coaxial 50ohm			922179	Transradio C7/5
1PL25		Coaxial 50ohm			922179	Transradio C7/5
1PL26		Coaxial 50ohm			922179	Transradio C7/5
*1PL27		Coaxial 50ohm			923981	Radiall R141082
1PL28		Coaxial 50ohm			923981	Radiall R141082
1SK1		15-Way 'D'			900905	Cannon DA15S
1SK2		15-Way 'D'			900905	Cannon DA15S
1SK3		15-Way 'D'			900905	Cannon DA15S
1SK4		25-Way 'D'			915970	Cannon DB25S
1SK5		16-Way			920178	Amphenol 26-190-16
1SK6		16-Way			920178	Amphenol 26-190-16
1SK7		16-Way			920178	Amphenol 26-190-16
1SK8		16-Way			920178	Amphenol 26-190-16
1SK9		16-Way			920178	Amphenol 26-190-16
1SK10		16-Way			920178	Amphenol 26-190-16
1SK11		16-Way			920178	Amphenol 26-190-16
1SK12		16-Way			920178	Amphenol 26-190-16
1SK13		Coaxial 50ohms			912050	Radiall R15000
1SK14		Coaxial 50ohms			912050	Radiall R15000
1SK15		Coaxial 50ohms			912050	Radiall R15000
1SK16		Coaxial 50ohms			912050	Radiall R15000
1SK17		Coaxial 50ohms			912050	Radiall R15000
1SK18		Coaxial 50ohms			912050	Radiall R15000
1SK19		Coaxial 50ohms			912050	Radiall R15000
1SK20		Coaxial 50ohms			912050	Radiall R15000
1SK21		Coaxial 50ohms			912050	Radiall R15000
1SK22		Coaxial 50ohms			912050	Radiall R15000
1SK23		Coaxial 50ohms			912050	Radiall R15000
1SK24		Coaxial 50ohms			912050	Radiall R15000
1SK25		Coaxial 50ohms			912050	Radiall R15000
*Add		Adaptor-Elbow			924736	Radiall R141770

Cct. Ref	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
<u>Connectors (Contd)</u>						
1SK26		Coaxial 50ohms			912050	Radiall R15000
1SK27		Coaxial 50ohms			912050	Radiall R15000
1SK28		Coaxial 50ohms			912050	Radiall R15000
1SK29		Coaxial 50ohms			908387	Transradio BN5/5A
1SK30		50-Way 'D'			900574	Cannon DD50S
1SK31		9-Way 'D'			918090	Cannon DE9S
1SK32		Coaxial 50ohms			912258	Transradio BN2/5B
1SK33		Coaxial 50ohms			918394	Transradio BN2/5A
1LK1		Adaptor Plug Coaxial 50ohms			922215	Transradio C8/5
1LK2		Adaptor Plug Coaxial 50ohms			922215	Transradio C8/5
1LK3		Adaptor Socket Coaxial 50ohms			901735	Transradio C3/5A
1LK4		Adaptor Plug Coaxial 50ohms			922215	Transradio C8/5
1LK5		Adaptor Plug Coaxial 50ohms			922215	Transradio C8/5
<u>Fuses</u>						
1FS1		Fuselink 2A			900143	Belling-Lee L1055
1FS2		Fuselink 2A			900143	Belling-Lee L1055
1FS3		Fuselink 250mA			901219	Belling-Lee L1055/250
<u>Terminals</u>						
1TB1		4-Way,60A			901468	Grelco, AD4/H
1TB2		4-Way,60A			901468	Grelco,AD4/H
1TB3		NOT USED				
1TB4		4-Way,36A			917678	Klippon,KS4D
1TB5		4-Way,36A			917678	Klippon,KS4D
1TB6		7-Way, 25A			923714	Klippon, MK3/7
1TB7		12-Way,25A,110V			921428	Klippon,MK2L/12
1TB8		12-Way,25A,110V			921428	Klippon,MK2L/12
1TB9		12-Way,25A,110V			921768	Klippon,MK2/12
1TB10		NOT USED				
1TB11		NOT USED				
1TB12		NOT USED				
1TB13		NOT USED				
1TB14		NOT USED				
1TB15		12 Way, 25A, 110V			921428	Klippon, MK2L/12
1TB16		12-Way,25A,110V			921768	Klippon,MK2/12
<u>Bearings</u>						
		Bearing set for Woods Blower, circuit ref. 1BL3			BA44126	Ransome Hoffman Pollard 106P V2
<u>THYRISTORS</u>						
1ASCR1		BTX18 - 100			917837	Mullard

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer

SPLITTER UNIT

Resistors (ohm)

7R1	390	Metal Oxide		5	908472	Electrosil TR4
7R2	150	Metal Oxide		5	910389	Electrosil TR4
7R3	1.2k	Metal Oxide		5	911179	Electrosil TR4
7R4	39	Metal Oxide		5	917062	Electrosil TR4
7R5	18	Metal Oxide		5	916545	Electrosil TR4
7R6	150	Metal Oxide		5	910389	Electrosil TR4
7R7	1.2k	Metal Oxide		5	911179	Electrosil TR4
7R8	390	Metal Oxide		5	916331	Electrosil TR4
7R9	51	Metal Oxide		5	917056	Electrosil TR4
7R10	51	Metal Oxide		5	917056	Electrosil TR4
7R11	1.5k	Metal Oxide		5	911166	Electrosil TR4
7R12	2.2k	Pre-set Linear			920518	Plessey, MPWT
7R13	82	Metal Oxide		5	917057	Electrosil TR4

Capacitors (uF)

7C1	.01	Fixed	25V	+50 -25	911845	Erie, 831/T/25V
7C2	10	Electrolytic	25V	-10 +50	941763	Mullard, 030-36109

Transistors

7TR1		BC107			911929	Mullard

Diodes

7D1		1N4149			914898	S.T.C.
7D2		1N4002			911460	Texas
7D3		1N4002			911460	Texas

Connectors

7PL1		15-Way			909729	Cannon, DA15P
*7PL2		Coaxial 50ohms			923981	Radiall R141082
*7PL3		Coaxial 50ohms			923981	Radiall R141082
7SK1		Coaxial 50ohms			908387	Transradio BN5/5A
*Add		Adaptor-Elbow			924736	Radiall R141770

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer

DISTRIBUTION AMPLIFIER

Resistors (ohm)

8R1	470	Wirewound	2½W	5	913612	Welwyn W21
8R2	33	Metal Oxide		5	908690	Electrosil TR4
8R3	10	Metal Oxide		5	920736	Electrosil TR4
8R4	12	Metal Oxide		5	917782	Electrosil TR4
8R5	10	Metal Oxide		5	912868	Electrosil TR4
8R6	12	Metal Oxide		5	917782	Electrosil TR4
8R7	10	Metal Oxide		5	912868	Electrosil TR4
8R8	12	Metal Oxide		5	917782	Electrosil TR4
8R9	10	Metal Oxide		5	920736	Electrosil TR4
8R10	12	Metal Oxide		5	917782	Electrosil TR4
8R11	Not used					

Capacitors (uF)

8C1	0.1	Fixed	100V	20	914173	STC, PMC2R
8C2	0.1	Fixed	100V	20	914173	STC, PMC2R
8C3	0.1	Fixed	100V	20	914173	STC, PMC2R
8C4	0.1	Fixed	100V	20	914173	STC, PMC2R
8C5	0.1	Fixed	100V	20	914173	STC, PMC2R
8C6	0.1	Fixed	100V	20	914173	STC, PMC2R
8C7	0.1	Fixed	100V	20	914173	STC, PMC2R
8C8	0.1	Fixed	100V	20	914173	STC, PMC2R
8C9	0.1	Fixed	100V	20	914173	STC, PMC2R
8C10	47p	Fixed	500V	10	917418	Erie 831/N1500
8C11	0.1	Fixed	100V	20	914173	STC, PMC2R
8C12	0.1	Fixed	100V	20	914173	STC, PMC2R
8C13	0.1	Fixed	100V	20	914173	STC, PMC2R

Transistors

8TR1		2N3553			916730	
8TR2		2N3553			916730	
8TR3		2N3553			916730	
8TR4		2N3553			916730	

Diodes

8D1		1N4149			914898	S.T.C.
8D2		BZX79C9V1			921751	Mullard
8D3		1N4149			914898	S.T.C.
8D4		BZX79C9V1			921751	Mullard
8D5		1N4149			914898	S.T.C.

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
Diodes (contd)						
8D6		BZX79C9V1			921751	Mullard
8D7		1N4149			914898	S.T.C.
8D8		BZX79C9V1			921751	Mullard
8D9		1N4002			911460	Texas
8D10		1N4002			911460	Texas
8D11		1N4002			911460	Texas
8D12		1N4002			911460	Texas
8D13		ZENER			943731	
Transformers						
8T1					CT603431	Racal
8T2					CT603432	Racal
8T3					CT603431	Racal
8T4					CT603432	Racal
8T5					CT603431	Racal
8T6					CT603432	Racal
8T7					CT603432	Racal
8T8					CT603431	Racal
Connectors						
8PL 1		15-Way			909729	Cannon DA15P
8SK1		Coaxial 50ohms			908387	Transradio, BN5/5A
8SK2		Coaxial 50ohms			908387	Transradio, BN5/5A
8SK3		Coaxial 50ohms			908387	Transradio, BN5/5A
8SK4		Coaxial 50ohms			908387	Transradio, BN5/5A
8SK5		Coaxial 50ohms			908387	Transradio, BN5/5A
Miscellaneous						
8FB1		Ferrite Bead			907488	Mullard FX1242
8FB2		Ferrite Bead			907488	Mullard FX1242
8FB3		Ferrite Bead			907488	Mullard FX1242
8FB4		Ferrite Bead			907488	Mullard FX1242

OVERLOAD UNIT

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
Resistors (ohm)						
R1	560	Wirewound	$2\frac{1}{2}$W	5	913614	Welwyn W21
R2	560	Wirewound	$2\frac{1}{2}$W	5	913614	Welwyn W21
R3	4.7k	Metal Oxide		5	906022	Electrosil TR5
R4	4.7k	Metal Oxide		5	906022	Electrosil TR5
R5	4.7k	Metal Oxide		5	906022	Electrosil TR5

Cct. Ref	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
Resistors (ohm) (contd)						
R6	4.7k	Metal Oxide		5	906022	Electrosil TR5
R7	470	Metal Oxide		5	920758	Electrosil TR4
R8	470	Metal Oxide		±2	920758	
R9	470	Metal Oxide		±2	920758	
R10	470	Metal Oxide		±2	920758	
R11	4.7k	Metal Oxide		5	906022	Electrosil TR5
R12	1k	Metal Oxide		±2	913489	
R13	1k	Metal Oxide		±2	913489	
R14	1k	Metal Oxide		±2	913489	
R15	10k	Metal Oxide		±2	914042	
R16	*	Metal Oxide				Electrosil TR4
R17	270	Metal Oxide		5	910391	Electrosil TR4
R18	1k	Metal Oxide		±2	913489	
R19	8.2k	Metal Oxide		±2	914042	
R20	1.5k	Metal Oxide		5	911179	Electrosil TR4
R21	10k	Metal Oxide		±2	914042	
R22	10k	Metal Oxide		±2	914042	
R23	1k	Metal Oxide		±2	913489	
R24	1k	Metal Oxide		±2	913489	
R25	10k	Metal Oxide		±2	914042	
R26	10k	Metal Oxide		±2	914042	
R27	47k	Metal Oxide		5	913496	Electrosil TR4
R28	2.2k	Metal Oxide		5	906020	Electrosil TR5
R29	4.7k	Metal Oxide		5	913490	Electrosil TR4
R30	4.7k	Metal Oxide		5	913490	Electrosil TR4
R31	4.7k	Metal Oxide		5	913490	Electrosil TR4
R32	10k	Metal Oxide		±2	914042	
R33	10k	Metal Oxide		±2	914042	
R34	10k	Metal Oxide		±2	914042	
R35	4.7k	Metal Oxide		5	906022	Electrosil TR5
R36	4.7k	Metal Oxide		5	913490	Electrosil TR4
Capacitors (uF)						
C1	0.1	Fixed	100V	20	914173	ITT,PMC2R
C2	0.1	Fixed	100V	20	914173	ITT,PMC2R
C3	0.1	Fixed	100V	20	914173	ITT,PMC2R
C4	0.1	Fixed	100V	20	914173	ITT,PMC2R
C5	0.1	Fixed	100V	20	914173	ITT,PMC2R

* S.C.T. R16 may be 2.7k, 3.3k, 3.9k, 4.7k or 5.6k

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
Capacitors (uF)(contd)						
C6	0.1	Fixed	100V	20	914173	ITT, PMC2R
C7	0.1	Fixed	100V	20	914173	ITT, PMC2R
C8	0.1	Fixed	100V	20	914173	ITT, PMC2R
C9	22	Electrolytic	40V	-10 +50	928089	Mullard 108/17229
C10	.01	Fixed	100V	20	914171	ITT, PMC2R
C11	0.1	Fixed	100V	20	914173	ITT, PMC2R
C12	0.1	Fixed	100V	20	914173	ITT, PMC2R
C13	0.1	Fixed	100V	20	914173	ITT, PMC2R
Diodes						
D1		BZX79 - C18			930318	Mullard
D2		BZX79 - C18			930318	Mullard
D3		BZX79 - C18			930318	Mullard
D4		BZX79 -C18			930318	Mullard
D5		1N4149				S.T.C.
D6		BZX79-C6V8			921750	Mullard
D7		BZX79-C6V8			921750	Mullard
D8		BZX79C5V6			921749	Mullard
D9		1N4149			914898	S.T.C.
D10		BZX79-C12			928372	Mullard
D11		1N4149			914898	S.T.C.
Transistors						
TR1		BC107			911929	Mullard
TR2		BC107			911929	Mullard
TR3		BC107			911929	Mullard
TR4		BC107			911929	Mullard
TR5		BC107			911929	Mullard
TR6		BC107			911929	Mullard
TR7		BC107			911929	Mullard
TR8		BC107			911929	Mullard
TR9		BC107			911929	Mullard
TR10		BC107			911929	Mullard
TR11		BC107			911929	Mullard
TR12		BC107			911929	Mullard
TR13		BC107			911929	Mullard
Connectors						
PL1		25-Way			916489	Cannon DB25P

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		V.S.W.R. UNIT				
Resistors (ohm)						
R1	22	Metal Oxide		5	922070	Electrosil TR8
R2	22	Metal Oxide		5	922070	Electrosil TR8
R3	22	Metal Oxide		5	922070	Electrosil TR8
R4	22	Metal Oxide		5	922070	Electrosil TR8
Capacitors (uF)						
C1	2pF	Ceramic Disc	4KV	±20%	920558	Unilator Type 10
C2	0.1	Fixed	100V	20	914173	ITT, PMC2R
C3	4-60pF	Dielectric Trimmer	200V		916940	Mullard, 809-07011
C4	120pF	Fixed			902236	Lemco, MS199/M
C5	0.1	Fixed	100V	20	914173	ITT, PMC2R
C6	0.1	Fixed	100V	20	914173	ITT, PMC2R
C7	0.1	Fixed	100V	20	914173	ITT, PMC2R
C8	1000pF	Feed-through		20	907011	Erie 361K2600
C9	1000pF	Feed-through		20	907011	Erie 361K2600
Diodes						
D1		1N4149			914898	Mullard
D2		1N4149			914898	Mullard
D3		1N4149			914898	Mullard
D4		1N4149			914898	Mullard
Inductors						
L1		Coil Assembly			BT603391	Racal
Connectors						
SK1					917555	Transradio C4/5CH
SK2					917555	Transradio C4/5CH
		METER PANEL				
Switches						
SA					BSW603464	Racal
SB					BSW603463	Racal
SC					BSW603463	Racal
Meters						
ME1					AD603409	Racal
ME2					AD603410	Racal

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
Connectors						
PL1		50-way			900577	Cannon DD50P
Resistors						
R1	220k	Metal Oxide		2	935387	Electrosil TR4
R2	220k	Metal Oxide		2	935387	Electrosil TR4
R3	10k	Metal Oxide		2	914042	Electrosil TR4
R4	180k	Metal Oxide		2	920644	Electrosil TR4
R5	180k	Metal Oxide		2	920644	Electrosil TR4
R6	10k	Metal Oxide		2	914042	Electrosil TR4

V.S.W.R. Warning P.C.B.

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
Resistors						
R1	22k	Pre-set Linear			919816	Plessey MPWT Dealer
R2	22k	Pre-set Linear			919816	Plessey MPWT Dealer
R3	2.2k	Metal Oxide		±2	916546	
R4	1k	Metal Oxide		±2	913489	
R5	22k	Metal Oxide		5	913493	Electrosil TR4
R6	27k	Metal Oxide		5	913494	Electrosil TR4
R7	27k	Metal Oxide		5	913494	Electrosil TR4
R8	4.7k	Metal Oxide		5	913490	Electrosil TR4
R9	470	Metal Oxide		±2	920758	
R10	4.7k	Metal Oxide		5	913490	Electrosil TR4
R11	10k	Metal Oxide		±2	914042	
R12	4.7k	Pre-set Linear		20	921023	Plessey MPWT Dealer
R13	22k	Metal Oxide		5	913493	Electrosil TR4
R14	10k	Metal Oxide		±2	914042	
R15	1k	Metal Oxide		±2	913489	
Capacitors (uF)						
C1	0.1	Fixed	100V	20	914173	STC,PMC2R
C2	0.1	Fixed	100V	20	914173	STC,PMC2R
C3	0.1	Fixed	100V	20	914173	STC,PMC2R
Transistors						
TR1		BC107			911929	Mullard
TR2		BC107			911929	Mullard
TR3		BC107			911929	Mullard
TR4		BCY71			911928	Mullard
Inductors						
L1	10uH				921609	Painton 406/8/27484/013
Switches						
S1		2-Position,c/o			915644	EMI T15014 '001

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part Number	Manufacturer

RF POWER MODULE - MM 420

CHASSIS

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part Number	Manufacturer
		Resistors (ohms)				
5R1	0.1	Fixed		5	920183	CGS HSA5
5R2	0.1	Fixed		5	920183	CGS HSA5
5R3	1k	Metal Oxide		5	906031	Electrosil TR5
5R4	470	Metal Oxide		2	920758	Electrosil TR4
		Capacitors				
5C1	0.1	Polyester	160V	20	930563	Ashcroft A2B1015A
5C2	47	Tantalum	35V	20	917478	STC, TAAD/47/M35
5C3	6.8p	Disc Ceramic	500V	0.5p	919457	Erie 831/NPO
5C5	0.1	Polyester	160V	20	930563	Ashcroft A2B1015A
5C6	0.1	Polyester	160V	20	930563	Ashcroft A2B1015A
5C7	0.1	Polyester	160V	20	930563	Ashcroft A2B1015A
		Diodes				
5D1		1N4002			911460	Texas
5D2		1N4002			911460	Texas
5D3		1N4002			911460	Texas
5D4		Zener-BZX79C12			928372	Mullard
		Transformers				
5T1		RF Mon. Toroid			BA604038	Racal
5T2		VSWR Toroid			BT603391	Racal
5T3					CT604968	Racal
		Inductors				
5L1		Ferrite Core			912598	Neosid, F14
5L2	100 μH	Choke		10	941856	Sigma Products (02/10/3002/10)
		Connectors				
5PL1		Coaxial			912192	Radiall R15510
5PL2		Coaxial			912192	Radiall R15510
5SK3		Coaxial			905449	Transradio, BN5/5B
		Miscellaneous				
5SCR1		Thyristor,			943826	Mullard BTY91-400R
5THE1		Thermostat			AD602957	Racal
5RLA		Relay, 26.5V			921683	Clare Elliott, G24
5PL1		Lamp, 28V, 0.04A			918756	Guest, 727T
5PL2		Lamp, 28V, 0.04A			918756	Guest, 727T
5FS1		Fuse, 17A (L350 16)			920921	Int. Rectifiers
5SA		Switch, DPDT			917716	NSF

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer

LOW LEVEL BOARD (PS314) (See page 8-30 for PS351)

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (ohms)				
5AR1	100k	Pre-Set Linear			920057	Plessey, MPWT (Dealer)
5AR2	4.7k	Metal Oxide		5	913490	Electrosil TR4
5AR3	4.7k	Metal Oxide		5	913490	Electrosil TR4
5AR4	100k	Metal Oxide		5	915190	Electrosil TR4
5AR5	47k	Metal Oxide		5	913496	Electrosil TR4
5AR6	10k	Variable			919815	Plessey MPWT (Dealer)
5AR7	2.2k	Metal Oxide		±2	916546	
5AR8	2.2k	Metal Oxide		±2	916546	
5AR9	2.2k	Metal Oxide		±2	916546	
5AR10	10k	Metal Oxide		±2	914042	
5AR11	100	Metal Oxide		5	910388	Electrosil TR4
5AR12	10k	Metal Oxide		±2	914042	
5AR13	2.2k	Metal Oxide		±2	916546	
5AR14	47k	Metal Oxide		5	913496	Electrosil TR4
5AR15	2.2k	Metal Oxide		±2	916546	
5AR16	27k	Metal Oxide		5	913494	Electrosil TR4
5AR17	18k	Metal Oxide		5	900994	Electrosil TR4
* 5AR18	100k	Metal Oxide		5	907866	Electrosil TR5
5AR19	47	Metal Oxide		5	911930	Electrosil TR4
5AR20	1k	Metal Oxide		±2	913489	
5AR21	47k	Metal Oxide		5	913496	Electrosil TR4
5AR22	470	Metal Oxide		5	906019	Electrosil TR5
5AR23	1k	Metal Oxide		±2	913489	
5AR24	4.7k	Metal Oxide		5	913490	Electrosil TR4
5AR25	220	Metal Oxide		5	910390	Electrosil TR4
5AR26	47	Metal Oxide		5	917063	Electrosil TR4
5AR27	1k	Metal Oxide		±2	913489	
* 5AR28	100k	Metal Oxide		5	913489	Electrosil TR5
5AR29	2.2k	Metal Oxide		±2	916546	
** 5AR30	2.2k	Metal Oxide		±2	916546	
5AR31	820	Metal Oxide		5	906024	Electrosil TR5
5AR32	56	Metal Oxide		5	908289	Electrosil TR4
5AR33	1k	Metal Oxide		±2	913489	
5AR34	330	Wirewound	2½W	5	913608	Welwyn W21
5AR35	27	Metal Oxide		5	920745	Electrosil TR4

* On Assembly DC 603363/B these resistors are 1 Megohm ±5% Electrosil TR5 (Racal Part No. 914036)

** Fitted to Assembly DC 603363/B only.

TA.1810

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (ohms) contd				
5AR36	47	Metal Oxide		5	920743	Electrosil TR5
5AR37	10	Metal Oxide		5	920736	Electrosil TR4
5AR38	22	Metal Oxide		5	920743	Electrosil TR4
5AR39	100	Metal Oxide		5	913962	Electrosil TR6
5AR40	10	Metal Oxide		5	920736	Electrosil TR4
5AR41	10	Metal Oxide		5	920736	Electrosil TR4
5AR42	10	Metal Oxide		5	920736	Electrosil TR4
5AR43	10	Metal Oxide		5	920736	Electrosil TR4
5AR44	100	Metal Oxide		5	913962	Electrosil TR6
5AR45	10	Metal Oxide		5	920736	Electrosil TR4
5AR46	22	Metal Oxide		5	920743	Electrosil TR4
5AR47	47	Metal Oxide		5	907495	Electrosil TR5
**5AR48	27	Metal Oxide		5	906341	Electrosil TR5
**5AR49	270	Metal Oxide		5	908143	Electrosil TR5
**5AR50	27	Metal Oxide		5	906341	Electrosil TR5
**5AR51	270	Metal Oxide		5	908143	Electrosil TR5
5AR52	4.7k	Metal Oxide		5	913490	Electrosil TR4
5AR53	33k	Metal Oxide		5	913495	Electrosil TR4
**5AR54	1k	Metal Oxide		±2	913489	
		Capacitors (uF)				
5AC1	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC2	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC3	100	Electrolytic	20V	20	913970	ITT, TAA
5AC4	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC5	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC6	1000pF	Fixed		20	915243	Erie 831K2600
5AC7	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC8	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC9	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC10	100	Electrolytic	20V	20	913970	ITT, TAA
5AC11	0.1	Fixed	100V	20	914173	ITT, PMC2R
*5AC12	100	Electrolytic	20V	20	913970	ITT, TAA
5AC13	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC14	0.01	Fixed	25V	+50 -25	911845	Erie 831/T
5AC15	0.1	Fixed	100V	20	914173	ITT, PMC2R

** Fitted to Assembly DC 603363 B only

* On Assembly DC 603363 B this capacitor is 1uF ± 20% Polyester, ITT, PMT2R (Racal Part No. 919311)

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		<u>Capacitors (uF) contd</u>				
5AC16	0.01	Fixed	25V	$^{+50}_{-25}$	911845	Erie 831/T
5AC17	0.1	Fixed	100V	20	914173	ITT PMC2R
5AC18	0.1	Fixed	100V	20	914173	ITT PMC2R
5AC19	0.1	Fixed	100V	20	914173	ITT PMC2R
5AC20	0.1	Fixed	100V	20	914173	ITT PMC2R
5AC21	0.01	Fixed	25V	$^{+50}_{-25}$	911845	Erie 831/T
5AC22	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC23	0.01	Fixed	25V	$^{+50}_{-25}$	911845	Erie 831/T
5AC24	0.01	Fixed	25V	$^{+50}_{-25}$	911845	Erie 831/T
5AC25	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC26	0.01	Fixed	25V	$^{+50}_{-25}$	911845	Erie 831/T
5AC27	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC28	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC29	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC30	0.01	Fixed	25V	$^{+50}_{-25}$	911845	Erie, 831/T
5AC31	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC32	0.01	Fixed	25V	$^{+50}_{-25}$	911845	Erie, 831/T
5AC33	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC34	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC35	0.01	Fixed	25V	$^{+50}_{-25}$	911845	Erie, 831/T
5AC36	0.01	Fixed	25V	$^{+50}_{-25}$	911845	Erie, 831/T
5AC37	470pF	Fixed	500V	10	923987	Erie, K120061/AD
5AC38	470pF	Fixed	500V	10	923987	Erie, K120061/AD
5AC39	470pF	Fixed	500V	10	923987	Erie, K120061/AD
5AC40	470pF	Fixed	500V	10	923987	Erie, K120061/AD
5AC41	0.1	Fixed	100V	20	914173	ITT, PMC2R
*5AC42	0.1	Fixed	100V	20	914173	ITT, PMC2R
*5AC43	0.01	Fixed	25V	$^{+50}_{-25}$	911845	Erie, 831/T
*5AC44	0.01	Fixed	25V	$^{+50}_{-25}$	911845	Erie, 831/T
5AC45	4.5-20pF	Variable			910061	Steatite 7S

* On Assembly DC603363/B this component is 0.01uF $^{+50}_{-25}$% Erie 831/T (Racal Part No. 911845)

** Fitted to Assembly DC603363/B only

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Capacitors (uF) contd				
5AC46	33pF	Disc Ceramic		5	919459	Erie,831/N750
5AC47	0.01	Fixed	25V	+50 -25	911845	Erie,831/T
5AC48	0.01	Fixed	25V	+50 -25	911845	Erie,831/T
		Transistors				
5ATR1		BC107			911929	Mullard
5ATR2		BC107			911929	Mullard
5ATR3		BC107			911929	Mullard
5ATR4		BCY71			911928	Mullard
5ATR5		BC107			911929	Mullard
5ATR6		BFY51			908753	Mullard
5ATR7		BFY51			908753	Mullard
5ATR8		BC107			911929	Mullard
5ATR9		BFY51			908753	Mullard
5ATR10		BCY71			911928	Mullard
5ATR11		BFY51			908753	Mullard
5ATR12		BFX29			915267	Mullard
5ATR13		BFY51			908753	Mullard
5ATR14		2N3866			917219	Mullard
5ATR15		2N3553			916730	Mullard
5ATR16		2N3553			916730	Mullard
5ATR17		2N3553			916730	Mullard
5ATR18		2N3866			917219	Mullard
5ATR19		2N3866			917219	Mullard
5ATR20		2N3553			916730	Mullard
5ATR21		2N3553			916730	Mullard
5ATR22		2N3553			916730	Mullard
5ATR23		2N3866			917219	Mullard
**5ATR24		BC107			911929	Mullard
**5ATR25		BC107			911929	Mullard
		Diodes				
5AD1		1N4149			914898	STC
5AD2		1N4149			914898	STC
5AD3		BZX79C5V1			924821	Mullard
5AD4		BZX79C5V1			924821	Mullard
5AD5		1N4149			914898	STC

** Fitted to Assembly DC 603363/B only.

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Diodes (contd)				
5AD6		1N4149			914898	STC
5AD7		1N4149			914898	STC
5AD8		1N4149			914898	STC
5AD9		1N4149			914898	STC
≠ 5AD10		1N4149			914898	STC
5AD11		1N4149			914898	STC
5AD12		1N4149			914898	STC
5AD13		1N4149			914898	STC
**5AD14		1N4149			914898	STC
5AD15	to 5AD19	NOT USED				
≠ 5AD20		BZX79C10			920320	Mullard
		Transformers				
5AT1		Output			CT603360	Racal
5AT2		Interstage 6:1			CT603358	Racal
5AT3		Interstage 6:1			CT603358	Racal
5AT4		Input			CT603357	Racal
		Miscellaneous				
5AFB1		Ferrite Bead			907488	Mullard FX1242
5AFB2		Ferrite Bead			907488	Mullard FX1242
5AFB3		Ferrite Bead			907488	Mullard FX1242
5AFB4		Ferrite Bead			907488	Mullard FX1242
5AFB5		Ferrite Bead			907488	Mullard FX1242
5AFB6		Ferrite Bead			907488	Mullard FX1242
**LK1		23 SWG Tinned Copper			900094	

≠ Fitted to Assembly DC 603363/A only
** Fitted to Assembly DC 603363/B only

HIGH LEVEL BOARD

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (ohms)				
5BR1	180	Wirewound	$2\frac{1}{2}$W	5	913602	Welwyn W21
5BR2	47	Wirewound	9W	5	913738	Welwyn W23
5BR3		NOT USED				
5BR4	10	Wirewound	$2\frac{1}{2}$W	5	913571	Welwyn W21
5BR5	470	Metal Oxide		5	906019	Electrosil TR5

Cct. Ref.	Value	Description	Rat	Tol. %	Racal Part Number	Manufacturer
		Resistors (ohms) contd				
5BR6	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR7	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR8	100	Metal Oxide		5	907491	Electrosil TR5
5BR9	100	Metal Oxide		5	907491	Electrosil TR5
5BR10	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR11	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR12	470	Metal Oxide		5	906019	Electrosil TR5
5BR13	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR14	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR15	100	Wirewound	9W	5	913746	Welwyn W23
5BR16	100	Metal Oxide		5	907491	Electrosil TR5
5BR17	100	Metal Oxide		5	907491	Electrosil TR5
*5BR18		Wirewound				
5BR19	27	Wirewound	2½W	5	913582	Welwyn W21
5BR20	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR21	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR22	12	Metal Oxide		5	920738	Electrosil TR4
5BR23	12	Metal Oxide		5	920738	Electrosil TR4
5BR24	12	Metal Oxide		5	920738	Electrosil TR4
5BR25	12	Metal Oxide		5	920738	Electrosil TR4
5BR26	12	Metal Oxide		5	920738	Electrosil TR4
5BR27	12	Metal Oxide		5	920738	Electrosil TR4
5BR28	12	Metal Oxide		5	920738	Electrosil TR4
5BR29	12	Metal Oxide		5	920738	Electrosil TR4
5BR30	12	Metal Oxide		5	920738	Electrosil TR4
5BR31	12	Metal Oxide		5	920738	Electrosil TR4
5BR32	12	Metal Oxide		5	920738	Electrosil TR4
5BR33	12	Metal Oxide		5	920738	Electrosil TR4
5BR34	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR35	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
*5BR36		Wirewound				
5BR37	27	Wirewound	2½W	5	913582	Welwyn W21
5BR38	100	Metal Oxide		5	907491	Electrosil TR5
5BR39	100	Metal Oxide		5	907491	Electrosil TR5
5BR40	100	Wirewound	9W	5	913746	Welwyn W23
5BR41	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR42	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR43	470	Metal Oxide		5	906019	Electrosil TR5
5BR44	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR45	1	Metalux	¼	2	921418	EGEN (BEYSCHLAG) MBE 0414

* 5BR18 and 5BR36 value depends on type of MM.420 module fitted (see page 1-3),
4.7Ω Racal Part Number 917145 for MM.420 and MM.420/1,
1.0Ω Racal Part Number 941978 for MM.420/2 and MM.420/3.

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (ohms) contd				
5BR46	100	Metal Oxide		5	907491	Electrosil TR5
5BR47	100	Metal Oxide		5	907491	Electrosil TR5
5BR48	1	Metalux	$\frac{1}{4}$	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR49	1	Metalux	$\frac{1}{4}$	2	921418	EGEN (BEYSCHLAG) MBE 0414
5BR50	470	Metal Oxide		5	906019	Electrosil TR5
5BR51	47	Wirewound	9W	5	913738	Welwyn W23
5BR52		NOT USED				
5BR53	10	Wirewound	$2\frac{1}{2}$W	5	913571	Welwyn W21
5BR54	180	Wirewound	$2\frac{1}{2}$W	5	913602	Welwyn W21
		Capacitors				
5BC1	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC2	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC3	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC4	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC5	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC6	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC7	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC8	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC9	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC10	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC11	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC12	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC13	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC14	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC15	1000pF	Ceramicon	500V	20	917419	Erie 831/K350081
5BC16	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC17	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC18	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC19	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC20	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC21	1000pF	Ceramicon	500V	20	917419	Erie 831/K350081
5BC22	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC23	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC24	0.1	Fixed	100V	20	924152	ITT,PMC2R
5BC25	0.1	Fixed	100V	20	924152	ITT,PMC2R

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Capacitors contd.				
5BC26	0.1	Fixed	100V	20	924152	ITT, PMC2R
5BC27	0.1	Fixed	100V	20	924152	ITT, PMC2R
5BC28	0.1	Fixed	100V	20	924152	ITT, PMC2R
5BC29	0.1	Fixed	100V	20	924152	ITT, PMC2R
5BC30	0.1	Fixed	100V	20	924152	ITT, PMC2R
5BC31	0.1	Fixed	100V	20	924152	ITT, PMC2R
5BC32	0.1	Fixed	100V	20	924152	ITT, PMC2R
5BC33	0.1	Fixed	100V	20	924152	ITT, PMC2R
5BC34	0.1	Fixed	100V	20	924152	ITT, PMC2R
		Transistors				
5BTR1		Special Racal Type			923126 for MM.420 and MM.420/1	
5BTR2		Special Racal Type			926524 for MM.420/2 and MM.420/3	
5BTR3		Special Racal Type			See page 1-3 for explanation of variants	
5BTR4		Special Racal Type				
5BTR5		Special Racal Type			926524	Mullard 587 BLY
5BTR6		Special Racal Type			926524	Mullard 588 BLY
5BTR7		Special Racal Type			923126 for MM.420 and MM.420/1	
5BTR8		Special Racal Type			926524 for MM.420/2 and MM.420/3	
5BTR9		Special Racal Type			See page 1-3 for explanation of variants	
5BTR10		Special Racal Type				
		Diodes				
5BD1		1N4997			920571	Motorola
5BD2		1N4997			920571	Motorola
5BD3		1N4149			914898	STC
5BD4		BAV 10			918130	Mullard
5BD5		BAV 10			918130	Mullard
5BD6		1N4149			914898	STC
5BD7		1N4149			914898	STC
5BD8		BAV 10			918130	Mullard
5BD9		BAV 10			918130	Mullard
5BD10		1N4149			914898	STC
5BD11		1N4997			920571	Motorola
5BD12		1N4997			920571	Motorola
		Transformer				
5BT1					CT603362	Racal
5BT2					CT603362	Racal
5BT3					DT603385	Racal
5BT4					CT603362	Racal
5BT5					CT603362	Racal

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Transformers contd				
5BT6					CT603387	Racal
5BT7					CT603387	Racal
5BT8					DT603386	Racal
5BT9					CT603387	Racal
5BT10					CT603387	Racal
5BT11					CT603362	Racal
5BT12					CT603362	Racal
5BT13					DT603385	Racal
5BT14					CT603362	Racal
5BT15					CT603362	Racal
		Miscellaneous				
5BFB1		Ferrite Bead			907488	Mullard, FX1242
5BFB2		Ferrite Bead			907488	Mullard, FX1242
5BFB3		Ferrite Bead			907488	Mullard, FX1242
5BFB4		Ferrite Bead			907488	Mullard, FX1242

V.S.W.R. BOARD

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (ohms)				
R1	22	Fixed		2	911627	Electrosil TR5
R2	22	Fixed		2	911627	Electrosil TR5
R3	10k	Metal Oxide		±2	914042	
R4	22k	Metal Oxide		5	913493	Electrosil TR4
R5	2.7k	Metal Oxide		5	916548	Electrosil TR4
R6	15k	Metal Oxide		5	920645	Electrosil TR4
		Capacitors (uF)				
C1	0.01	Fixed	25V	+50 -20	926386	Erie 861/T
C2	0.01	Fixed	25V	+50 -20	926386	Erie 861/T
C3	4-60pF	Dielectric Trimmer	200V	+50 -25	916940	Mullard 809-0701
C4	0.01	Fixed	25V	+50 -20	926386	Erie 861/T
C5	270pF	Silver Mica	125V	2	920435	Lemco M5119MR
C6	0.1	Fixed	100V	20	924152	ITT, PMC2R
C7	0.01	Fixed	25V	+50 -20	926386	Erie 861/T
C8	0.01	Fixed	25V	+50 -20	926386	Erie 861/T
C9	47pF	Fixed	500V	10	917418	Erie 831/T

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Diodes				
D1		1N4149			914898	STC
D2		1N4149			914898	STC
D3		1N4149			914898	STC
D4		1N4149			914898	STC
D5		1N4149			914898	STC
D6		1N4149			914898	STC

PROTECTION BOARD

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (ohms)				
5CR1	1k	Pre-set Linear			919805	Plessey MPWT (Dealer)
5CR2	1k	Metal Oxide		±2	913489	
5CR3	2.2k	Metal Oxide		±2	916546	
5CR4	4.7k	Metal Oxide		5	913490	Electrosil TR4
5CR5	1k	Metal Oxide		±2	913489	
5CR6	2.2k	Metal Oxide		±2	916546	
5CR7	68k	Metal Oxide		5	916478	Electrosil TR4
5CR8	27k	Metal Oxide		5	913494	Electrosil TR4
5CR9	1k	Metal Oxide		±2	913489	
5CR10	68	Metal Oxide		5	916476	Electrosil TR4
5CR11	220	Metal Oxide		5	910390	Electrosil TR4
5CR12	220	Metal Oxide		5	910390	Electrosil TR4
5CR13	1k	Metal Oxide		5	917265	Electrosil TR4
5CR14	390	Metal Oxide		5	916331	Electrosil TR4
5CR15	NOT USED					
5CR16	680	Metal Oxide		5	910113	Electrosil TR4
5CR17	10k	Metal Oxide		±2	914042	
5CR18	330	Metal Oxide		5	915690	Electrosil TR4
5CR19	6.8k	Metal Oxide		5	910112	Electrosil TR4
5CR20	390	Metal Oxide		5	916331	Electrosil TR4
5CR21	NOT USED					
5CR22	27	Metal Oxide		2	911628	Electrosil TR5
5CR23	330	Metal Oxide		5	915690	Electrosil TR4
5CR24	27	Metal Oxide		2	911628	Electrosil TR5
5CR25	120k	Metal Oxide		5	915373	Electrosil TR4
5CR26	2.2k	Metal Oxide		±2	916546	

Cct. Ref.	Value	Description	Rat.	Tol %	Racal Part Number	Manufacturer
		<u>Capacitors (uF)</u>				
5CC1	3300pF	Fixed	500V	25	917437	Erie,831/K7004
5CC2	0.1	Fixed	100V	20	924152	ITT,PMC2R
5CC3	1	Fixed	160V	20	928281	Ashcroft A2B1025A
5CC4	0.1	Fixed	100V	20	924152	ITT,PMC2R
5CC5	1000pF	Ceramicon	500V	20	917419	Erie 831/K350081
5CC6	1000pF	Ceramicon	500V	20	917419	Erie 831/K350081
5CC7	0.1	Fixed	100V	20	924152	ITT,PMC2R
5CC8	NOT USED					
		<u>Transistors</u>				
5CTR1		BC107			911929	Mullard
5CTR2		BC107			911929	Mullard
5CTR3		BCY71			911928	Mullard
5CTR4		BCY71			911928	Mullard
5CTR5		BCY71			911928	Mullard
5CTR6		BFY51			908753	Mullard
5CTR7		BFY51			908753	Mullard
		<u>Diodes</u>				
5CD1		BZX79C5V6			921749	Mullard
5CD2		BZX79C5V6			921749	Mullard
5CD3		BZX79C5V6			921749	Mullard
5CD4		BZX79C5V6			921749	Mullard
5CD5		BZX79C15			941641	Mullard
5CD6		1N4149			914898	STC
5CD7		1N4149			914898	STC
5CD8		1N4002			911460	Texas

STABILIZER MODULE

Cct. Ref.	Value	Description	Rat.	Tol %	Racal Part Number	Manufacturer
		<u>Resistors (ohms)</u>				
4R1	0.05	Wirewound		10	920181	CGS,HSA50
4R2	100	Metal Oxide		5	910388	Electrosil,TR4
4R3	100	Metal Oxide		5	910388	Electrosil,TR4
4R4	680	Metal Oxide		5	910113	Electrosil,TR4
4R5	0.1	Wirewound		10	920407	CGS,HSA25
4R6	0.1	Wirewound		10	920407	CGS,HSA25
4R7	0.05	Wirewound		5	921606	CGS HSA5
4R8	0.05	Wirewound		5	921606	CGS HSA5
4R9	0.2	Wirewound		5	920418	CGS HSA5

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer
		<u>Resistors (ohms) cont'd</u>				
4R10	2.7	Wirewound		5	920184	CGS, HSA50
4R11	680	Metal Oxide		5	910113	Electrosil, TR4
4R12	100	Metal Oxide		5	910388	Electrosil, TR4
4R13	56	Metal Oxide		5	908142	Electrosil, TR5
		<u>Capacitors (UF)</u>				
4C1	NOT USED					
4C2	0.1	Fixed	250V	20	927110	ITT, PMC2R
4C3	68	Electrolytic	63V		919121	Mullard, 108-18689
4C4	0.1	Fixed	250V	20	927110	ITT, PMC2R
4C5	.01	Fixed	40V	+50	926360	Erie 831/T/40V
4C6	0.01	Fixed	40V	-25	926360	Erie 831/T/40V
		<u>Diodes</u>				
4D1		IN4002			911460	Texas
		<u>Transistors</u>				
4TR1		3055H			906371	RCA
4TR2		BSW66A			936039	Mullard
4TR3		3055H			906371	RCA
4TR4		3055H			906371	RCA
4TR5		BFY51			908753	Mullard
4TR6		BFY51			908753	Mullard
4TR7		3055H			906371	RCA
				<u>STABILIZER P.C.B.</u>		
		<u>Resistors (ohms)</u>				
4AR1	10k	Metal Oxide		5	914042	Electrosil TR4
4AR2	1k	Metal Oxide		±2	913489	
4AR3	100	Variable			920531	Plessey MPWT (Dealer)
4AR4	150	Metal Oxide		5	910389	Electrosil TR4
4AR5	1k	Metal Oxide		±2	913489	
4AR6	10k	Metal Oxide		±2	914042	
4AR7	Not used					
4AR8	1k	Wirewound	2½W	5	913626	Welwyn W21
4AR9	2.2k	Metal Oxide		±2	916546	
4AR10	470	Variable			920058	Plessey MPWT (Dealer)
4AR11	470	Metal Oxide		±2	920758	
4AR12	1.2k	Metal Oxide		2	906550	Electrosil TR5
4AR13	1k	Metal Oxide		±2	913[illegible]89	
4AR14	680	Metal Oxide		5	910113	Electrosil TR4
4AR15	560	Metal Oxide		5	917061	Electrosil TR4

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (contd)				
4AR16	100	Variable			920531	Plessey, MPWT (Dealer)
4AR17	220	Metal Oxide		5	910390	Electrosil TR4
4AR18	3.3k	Metal Oxide		5	910111	Electrosil TR4
		Capacitors (uF)				
4AC1	0.1	Fixed	100V	20	914173	ITT, PMT2R
4AC2	0.1	Fixed	100V	20	914173	ITT, PMT2R
4AC3	Not used					
4AC4	0.01	Fixed	400V	20	918967	STC
4AC5	0.1	Fixed	100V	20	914173	ITT, PMT2R
4AC6	0.1	Fixed	100V	20	914173	ITT, PMT2R
4AC7	0.01	Fixed	400V	20	918967	STC
4AC8	0.1	Fixed	100V	20	914173	ITT, PMT2R
		Diodes				
4AD1		1N4002			911460	Texas
4AD2		1N4002			911460	Texas
4AD3		BZX79C5V6			921749	Mullard
4AD4		BZX79C5V6			921749	Mullard
		Transistors				
4ATR1		BSS68			927901	Mullard
4ATR2		BSW66			917389	Mullard
4ATR3		BCY71			911928	Mullard
4ATR4		BFY51			908753	Mullard
		Thermistors				
TH1		UA3208			943056	Mullard
		COMBINING UNIT				
		Resistors (ohms)				
6R1	10	Metal Oxide		5	908471	Electrosil TR5
6AR1	180	Metal Oxide		5	915465	Electrosil TR4
6BR1	180	Metal Oxide		5	915465	Electrosil TR4
6R2	10	Metal Oxide		5	908471	Electrosil TR5
6AR2	180	Metal Oxide		5	915465	Electrosil TR4

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Resistors (ohms) Contd				
6BR2	180	Metal Oxide		5	915465	Electrosil TR4
6R3	100	High Power		5	919969	Electrosil H37
6AR3	100	High Power		5	919969	Electrosil H37
6BR3	100	High Power		5	919969	Electrosil H37
6R4	100	High Power		5	919969	Electrosil H37
6AR4	100	High Power		5	919969	Electrosil H37
6BR4	100	High Power		5	919969	Electrosil H37
6R5	100	High Power		5	919969	Electrosil H37
6AR5	100	High Power		5	919969	Electrosil H37
6BR5	100	High Power		5	919969	Electrosil H37
6R6	100	High Power		5	919969	Electrosil H37
6AR6	100	High Power		5	919969	Electrosil H37
6BR6	100	High Power		5	919969	Electrosil H37
6R7	100	High Power		5	919969	Electrosil H37
		Capacitors (uF)				
6C1	68pF	Fixed		10	920176	LCC, CAI
6AC1	0.1	Fixed	100V	20	915502	ITT, PMF
6BC1	0.1	Fixed	100V	20	915502	ITT, PMF
6C2	68pF	Fixed		10	920176	LCC, CAI
6AC2	0.1	Fixed	100V	20	915502	ITT, PMF
6BC2	0.1	Fixed	100V	20	915502	ITT, PMF
6C3	68pF	Fixed		10	920176	LCC, CAI
6C4	68pF	Fixed		10	920176	LCC, CAI
6C5	100pF	Fixed		10	920190	LCC, CAI
6C6	100pF	Fixed		10	920190	LCC, CAI
6C7	100pF	Fixed		10	920190	LCC, CAI
6C8	100pF	Fixed		10	920190	LCC, CAI
6C9	100pF	Fixed		10	920177	LCC, AAV020
6C10	0.1	Fixed	100V	20	914173	ITT, PMC2R
		Diodes				
6AD1		1N4149			914898	STC
6BD1		1N4149			914898	STC
6AD2		1N4149			914898	STC
6BD2		1N4149			914898	STC
		Inductors				
6L1					BT603749	Racal
6L2					BT603749	Racal
6L3					BT603749	Racal
6L4					BT603749	Racal
6AL1					CT603079	Racal
6BL1					CT603079	Racal

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Inductors contd				
6AL2					CT603079	Racal
6BL2					CT603079	Racal
6AL3					CT603080	Racal
6BL3					CT603080	Racal
6L5	10uH	Choke			922364	Cambion
		Transformers				
6T1					CT603082	Racal
6AT1					BT603141	Racal
6BT1					BT603141	Racal
6T2					CT603082	Racal
6AT2					BT603141	Racal
6BT2					BT603141	Racal
6T3					CT603082	Racal
6AT3					DT602946	Racal
6BT3					DT602946	Racal
6T4					CT603082	Racal
6AT4					DT602946	Racal
6BT4					DT602946	Racal
6T5					BT603066	Racal
6AT5					DT602946	Racal
6BT5					DT602946	Racal
6T6					BT603066	Racal
6AT6					DT602946	Racal
6BT6					DT602946	Racal
6T7					BT602989	Racal
6T8					BT602974	Racal
6T9					BT603066	Racal
		Connectors				
6SK1		BNC,50ohms			900061	Transradio,BN12/5
6SK2		BNC,50ohms			900061	Transradio,BN12/5
6SK3		BNC,50ohms			900061	Transradio,BN12/5
6SK4		BNC,50ohms			900061	Transradio,BN12/5
6SK5		BNC,50ohms			900061	Transradio,BN12/5
6SK6		BNC,50ohms			900061	Transradio,BN12/5
6SK7		BNC,50ohms			900061	Transradio,BN12/5
6SK8		BNC,50ohms			900061	Transradio,BN12/5
6SK9		Type C, 50ohms			917555	Transradio,C4/5CH
6SK10		Type C, 50ohms			917555	Transradio,C4/5CH

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		Connectors contd				
6SK11		BNC,50ohms			900061	Transradio BN12/5
6SK12		Type C,50ohms			917555	Transradio C4/5CH
6SK13		BNC, 50ohms			900061	Transradio BN12/5
6SK14		BNC, 50ohms			900061	Transradio BN12/5
6PL1		9-Way Plug			915643	Cannon DE9P
6PL2		Right Angle Plug (50ohms)			908713	Amphenol AMP82
6PL3		Right Angle Plug (50ohms)			908713	Amphenol AMP82
6TS1		Terminal Strip			905221	Wingrove & Rogers TS8-04

POWER SUPPLY MS64/1

The following list is compiled from Gresham Transformers Ltd drawing number A43360A

Capacitors (μF)				Gresham Drawing No
C1	Not Used			
C2	10,000	Electrolytic		
C3	10,000	Electrolytic	100V	A43360E-01
C4	10,000	Electrolytic	100V	A43360E-01
C5	10,000	Electrolytic	100V	A43360E-01

Diodes

D1-D4	1R-25G10(4off)	A43360E-07
D5-D8	1R-BS1	

Miscellaneous

T1	Mains Transformer	43365
L1	Choke, 5mH	43366
VS1	Mains Selector Unit	UE 60666L5-2

POWER SUPPLY MS64/2

The following list is compiled from Gardner Transformers Ltd., drawing No.GR75000

Capacitors (μF)				Gardners Number
C1	Not Used			Item
C2	1000	Electrolytic	63V	943307
C3	12000	Electrolytic	80V	GR75000-5
C4	12000	Electrolytic	80V	GR75000-5
C5	12000	Electrolytic	80V	GR75000-5

Diodes

D1-D4		IR-70 HF 40 (4 off)	GR75000-4
D5-D8		IR-BS2	GR75000-3

Miscellaneous

T1		Mains Transformer	GR116004
L1		Choke, 5mH	GR116005
Fuse	2.5A (20mm)		Belling Lee Item 11A
		Fuseholder L2006	Belling Lee Item 11

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer
		LOW LEVEL BOARD (PS351)				
Resistors (ohms)						
5AR1	100k	Pre-set linear			920057	Plessey, MPWT Dealer
5AR2	4.7k	Metal Oxide		5	913490	Electrosil TR4
5AR3	3.3k	Metal Oxide		5	910111	Electrosil TR4
5AR4	100k	Metal Oxide		5	915190	Electrosil TR4
5AR5	47k	Metal Oxide		5	913496	Electrosil TR4
5AR6	10k	Variable		5	919815	Plessey MPWT Dealer
5AR7	2.2k	Metal Oxide		±2	916546	
5AR8	2.2k	Metal Oxide		±2	916546	
5AR9	2.2k	Metal Oxide		±2	916546	
5AR10	10k	Metal Oxide		±2	914042	
5AR11	100	Metal Oxide		5	910388	Electrosil TR4
5AR12	10k	Metal Oxide		±2	914042	
5AR13	2.2k	Metal Oxide		±2	916546	
5AR14	47k	Metal Oxide		5	913496	Electrosil TR4
5AR15	1k	Metal Oxide		2	907731	Electrosil TR5
5AR16	27k	Metal Oxide		5	913494	Electrosil TR4
5AR17	18k	Metal Oxide		5	909994	Electrosil TR4
5AR18*	100k	Metal Oxide		5	907866	Electrosil TR5
5AR18**	1M	Metal Oxide		5	914036	Electrosil TR4
5AR19	47	Wirewound		5	913588	Welwyn W21
5AR20	1k	Metal Oxide		±2	913489	
5AR21	47k	Metal Oxide		5	913496	Electrosil TR4
5AR22	470	Metal Oxide		5	906019	Electrosil TR5
5AR23	1k	Metal Oxide		±2	913489	
5AR24	4.7k	Metal Oxide		5	913490	Electrosil TR4
5AR25	220	Metal Oxide		5	910390	Electrosil TR4
5AR26	47	Metal Oxide		5	917063	Electrosil TR4
5AR27	1k	Metal Oxide		±2	913489	
5AR28	1k	Metal Oxide		±2	913489	
5AR29	2.2k	Metal Oxide		±2	916546	
5AR30	470	Metal Oxide		5	906019	Electrosil TR5
5AR31	820	Metal Oxide		5	906024	Electrosil TR5
*** 5AR32	47	Metal Oxide		2	917063	Electrosil TR4
5AR33	1k	Metal Oxide		±2	913489	
5AR34	330	Wirewound	2½W	5	913608	Welwyn W21
5AR35	27	Metal Oxide		5	920745	Electrosil TR4
5AR36		Not used				
5AR37	10	Metal Oxide		5	920736	Electrosil TR4
5AR38	22	Metal Oxide		5	920743	Electrosil TR4

* Used on Version DC604137/A Board only.

** Used on Version DC604137 B Board only.

*** Adjust on Test- value will be typically between 33 and 68Ω

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer

LOW LEVEL BOARD (Continued)

Resistors (ohms) (contd.)

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer
5AR39	100	Metal Oxide		5	913962	Electrosil TR6
5AR40	10	Metal Oxide		5	920736	Electrosil TR4
5AR41	10	Metal Oxide		5	920736	Electrosil TR4
5AR42	10	Metal Oxide		5	920736	Electrosil TR4
5AR43	10	Metal Oxide		5	920736	Electrosil TR4
5AR44	100	Metal Oxide		5	913962	Electrosil TR6
5AR45	10	Metal Oxide		5	920736	Electrosil TR4
5AR46	22	Metal Oxide		5	920743	Electrosil TR4
5AR47	Not Used					
5AR48*	10	Metal Oxide		5	908471	Electrosil TR5
5AR48**	27	Metal Oxide		5	906341	Electrosil TR5
5AR49**	270	Metal Oxide		5	908143	Electrosil TR5
5AR50*	10	Metal Oxide		5	908471	Electrosil TR5
5AR50**	27	Metal Oxide		5	906341	Electrosil TR5
5AR51**	270	Metal Oxide		5	908143	Electrosil TR5
5AR52	4.7k	Metal Oxide		5	91349[illegible]	Electrosil TR4
5AR53	33k	Metal Oxide		5	913495	Electrosil TR4
5AR54**	1k	Metal Oxide		±2	913489	
5AR55	3.3k	Metal Oxide		5	910111	Electrosil TR4
5AR56	150	Metal Oxide		2	910389	

Capacitors (uF)

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer
5AC1	0.1	Fixed	100V	20	924152	ITT, PMC2R
5AC2	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC3	100	Electrolytic	20V	20	913970	ITT, TAA
5AC4	0.1	Fixed	100V	20	924152	ITT, PMC2R
5AC5	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC6	1000pF	Fixed		20	917419	Erie 831 /K350081
5AC7	0.1	Fixed	100V	20	924152	ITT, PMC2R
5AC8	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC9	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC10	100	Electrolytic	20V	20	913970	ITT, TAA
5AC11	0.1	Fixed	100V	20	924152	ITT, PMC2R
5AC12*	10	Electrolytic		20	905399	ITT, TAA B/10/M20
5AC13	Not Used					
5AC14	0.01	Fixed	25V	+50 -25	926386	Erie 861, T
5AC15	0.1	Fixed	100V	20	924152	ITT, PMC2R
5AC16	0.01	Fixed	25V	-50 -25	926386	Erie 861 T

* Used on Version DC604137/A Board only.
** Used on Version DC604137/B Board only.

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer

LOW LEVEL BOARD (Continued)

Capacitors (uF)

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer
5AC17	0.1	Fixed	100V	20	924152	ITT, PMC2R
5AC18	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC19	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC20	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC21	0.01	Fixed	25V	+50 -25	926386	Erie 861/T
5AC22	0.1	Fixed	100V	20	924152	ITT, PMC2R
5AC23	0.01	Fixed	25V	+50 -25	926386	Erie 861/T
5AC24	0.01	Fixed	25V	+50 -25	926386	Erie 861/T
5AC25	0.1	Fixed	100V	20	924152	ITT, PMC2R
5AC26	0.01	Fixed	25V	+50 -25	926386	Erie 861/T
5AC27	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC28	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC29	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC30	0.01	Fixed	25V	+50 -25	926386	Erie 861/T
5AC31	0.1	Fixed	100V	20	924152	ITT, PMC2R
5AC32	0.01	Fixed	25V	+50 -25	926386	Erie 861/T
5AC33	0.1	Fixed	100V	20	924152	ITT, PMC2R
5AC34	Not Used					
5AC35	Not Used					
5AC36	Not Used					
5AC37	470pF	Fixed		10	914325	Erie H1-K AD
5AC38	470pF	Fixed		10	914325	Erie H1-K AD
5AC39	470pF	Fixed		10	914325	Erie H1-K AD
5AC40	470pF	Fixed		10	914325	Erie H1-K AD
5AC41	0.1	Fixed	100V	20	924152	ITT, PMC2R
5AC42	0.1	Fixed	100V	20	914173	ITT, PMC2R
5AC43**	0.01	Fixed	25V	+50 -25	926386	Erie 861/T
5AC44**	0.01	Fixed	25V	+50 -25	926386	Erie 861/T
5AC45	4.5-20pF	Variable			910061	Steatite 7S
5AC46	33pF	Disc Ceramic		5	919459	Erie 831/N750

** Used on Version DC604137/B Board only.

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer

LOW LEVEL BOARD (Continued)

Transistors

5ATR1		BC107			911929	Mullard
5ATR2		BC107			911929	Mullard
5ATR3		BC107			911929	Mullard
5ATR4		BCY71			911928	Mullard
5ATR5		BC107			911929	Mullard
5ATR6		BFY51			908753	Mullard
5ATR7		BFY51			908753	Mullard
5ATR8		BC107			911929	Mullard
5ATR9		BFY51			908753	Mullard
5ATR10		BCY71			911928	Mullard
5ATR11		BFY51			908753	Mullard
5ATR12		BFX29			915267	Mullard
5ATR13		BFY51			908753	Mullard
5ATR14	Not Used					
5ATR15		2N3553			928074	Mullard
5ATR16		2N3553			928074	Mullard
5ATR17		2N3553			916730	Mullard
5ATR18		2N3866			917219	Mullard
5ATR19		2N3866			917219	Mullard
5ATR20		2N3553			928074	Mullard
5ATR21		2N3553			916730	Mullard
5ATR22		2N3553			928074	Mullard
5ATR23	Not Used					
5ATR24**		BC107			911929	Mullard
5ATR25**		BC107			911929	Mullard

Diodes

5AD1		1N4149			914898	STC
5AD2		1N4149			914898	STC
5AD3		BZX79C5V1			924821	Mullard
5AD4		BZY88C3V6			917626	Mullard
5AD5		1N4149			914898	STC
5AD6		1N4149			914898	STC
5AD7		1N4149			914898	STC
5AD8		1N4149			914898	STC
5AD9		1N4149			914898	STC
5AD10*		1N4149			914898	STC

* Used on Version DC604137/A Board only.
** Used on Version DC604137/B Board only.

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer

LOW LEVEL BOARD (Continued)

Diodes (contd.)

5AD11		1N4149			914898	STC
5AD12		1N4149			914898	STC
5AD13		1N4149			914898	STC
5AD14**		1N4149			914898	STC
5AD15		1N4002			940826	Texas
5AD16		1N4002			940826	Texas
5AD17*		1N4149			914898	STC
5AD18*		1N4149			914898	STC
5AD19	Not Used					
5AD20		BZX79C10			920320	Mullard

Transformers

5AT1		Output			CT603360	Racal
5AT2		Interstage			CT603358	Racal
5AT3		Interstage			CT603358	Racal
5AT4		Input			CT603357	Racal

Miscellaneous

5AFB1		Ferrite Bead			907488	Mullard FX1242
5AFB2		Ferrite Bead			907488	Mullard FX1242
5AFB3		Ferrite Bead			907488	Mullard FX1242
5AFB4		Ferrite Bead			907488	Mullard FX1242
5AFB5		Ferrite Bead			907488	Mullard FX1242
5AFB6		Ferrite Bead			907488	Mullard FX1242

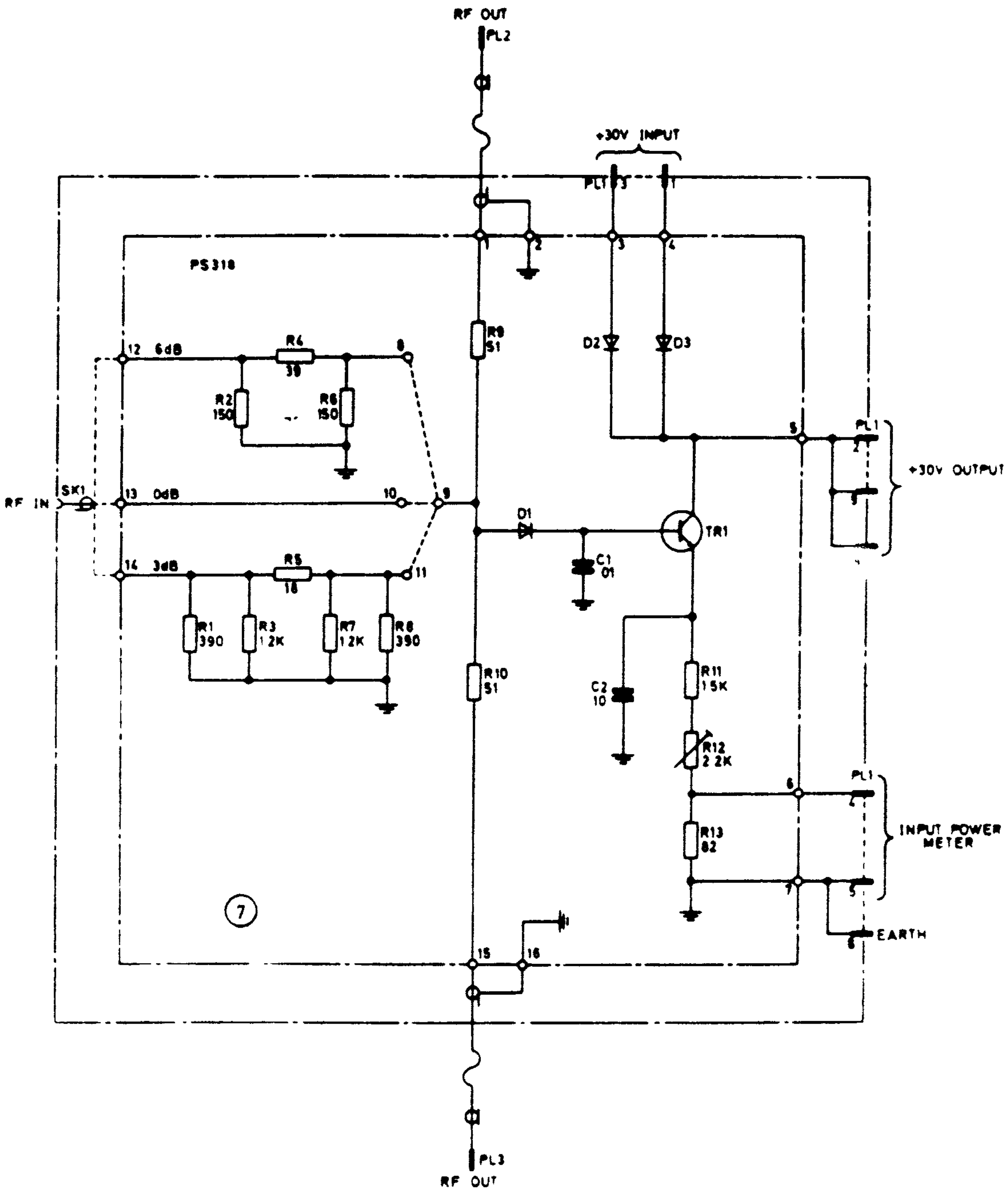
* Used on Version DC604137/A Board only.
** Used on Version DC604137/B Board only

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		MUTING UNIT				
Resistors (ohm)			W			
12ARI	100	Fixed		5	913962	Electrosil TR6
12AR2	100	Fixed		5	913962	Electrosil TR6
12AR3	47	Wirewound	6	5	913694	Welwyn W22
12AR4	390	Metal Oxide		5	916331	Electrosil TR4
12AR5	150	Metal Oxide		5	910389	Electrosil TR4
12AR6	1.2k	Metal Oxide		5	911179	Electrosil TR4
12AR7	1k	Metal Oxide		±2	913489	
12AR8	39	Metal Oxide		5	917062	Electrosil TR4
12AR9	18	Metal Oxide		5	916545	Electrosil TR4
12AR10	1.2k	Metal Oxide		5	911179	Electrosil TR4
12AR11	2.2k	Metal Oxide		± 2	916546	
12AR12	150	Metal Oxide		5	910389	Electrosil TR4
12AR13	390	Metal Oxide		5	916331	Electrosil TR4
12AR14	33	Wirewound	2½	5	913584	Welwyn W21
12AR15	1k	Metal Oxide		±2	913489	
12AR16	*	Metal Oxide				
12AR17	47k	Metal Oxide		5	913496	Electrosil TR4
12AR18	Not Used					
12AR19	4.7k	Metal Oxide		5	913490	Electrosil TR4
12AR20	220	Metal Oxide		5	910390	Electrosil TR4
12AR21	470	Metal Oxide		5	906019	Electrosil TR5
12AR22	47k	Metal Oxide		5	913496	Electrosil TR4
12AR23	18k	Metal Oxide		5	900394	Electrosil TR4
12AR24	27k	Metal Oxide		5	913494	Electrosil TR4
Capacitors (μF)						
12AC1	0.01	Fixed	25V	+50 -25	911845	Erie 831/T
12AC2	0.1	Fixed	100V	20	914173	ITT, PMC2R
12AC3	0.1	Fixed	100V	20	914173	ITT, PMC2R
12AC4	0.1	Fixed	100V	20	914173	ITT, PMC2R
12AC5	0.01	Fixed	25V	+50 -25	911845	Erie, 831 T

* Refer to Test Selection Table on Figure 33

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
12AC6	0.1	Fixed	100V	20	914173	ITT, PMC2R
12AC7	22	Electrolytic	63V	+50 -10	943075	Mullard
12AC8	10	Tantalum	20	20	905399	TAAB10M20
12AC9	0.1	Fixed	100V	20	914173	ITT, PMC2R
12AC10	0.1	Fixed	100V	20	914173	ITT, PMC2R
12AC11	0.1	Fixed	100V	20	914173	ITT, PMC2R
12AC12	33p	Fixed	500V	5	919459	Erie, 831/N750
Diodes						
12AD1		1N4002			923564	Fairchild
12AD2		1N4002			923564	Fairchild
12AD3		BZX79C10			920320	Mullard
12AD4		1N4149			914898	STC
12AD5		1N4149			914898	STC
12AD6		1N4149			914898	STC
12AD7		1N4149			914898	STC
12AD8		1N4149			914898	STC
12AD9		1N4149			914898	STC
12AD10		1N4149			914898	STC
Transistors						
12ATR1		2N3553			916730	Mullard
12ATR2		2N3553			916730	Mullard
12ATR3		BFY51			908753	Mullard
12ATR4		BFY51			908753	Mullard
12ATR5		BFY51			908753	Mullard
12ATR6		BC107			911929	Mullard
12ATR7		BC107			911929	Mullard
Transformers						
12AT1		Output Transformer			CT604693	Racal
12AT2		Input Transformer			CT604693	Racal

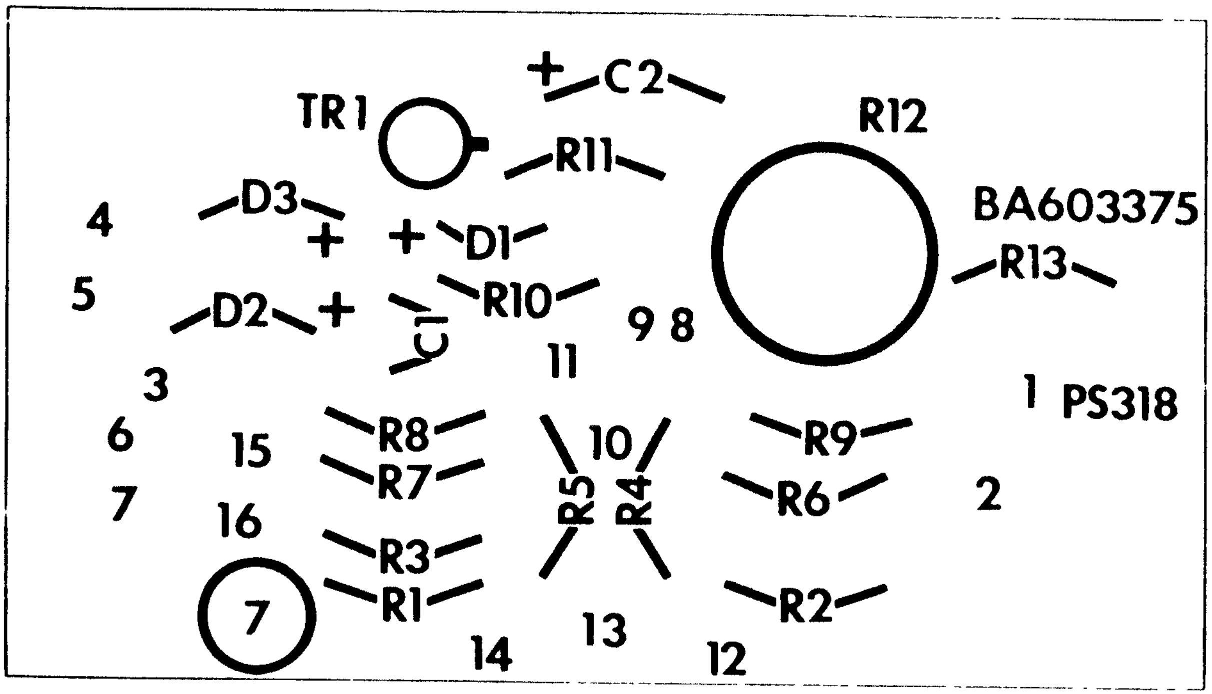
Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
Ferrite Beads						
12AFB1		FX1242			907488	Mullard
12AFB2		FX1242			907488	Mullard
12AFB3		FX1242			907488	Mullard
12AFB4		FX1242			907488	Mullard
Connectors						
12SK1		Coaxial 50 ohms			908387	Transradio BN5/5A
12SK2		Coaxial 50 ohms			908387	Transradio BN5/5A
12PL1		9-way plug			915643	Cannon DE9P



WOH3037 | CC603327
E | 1

Circuit: Splitter Unit

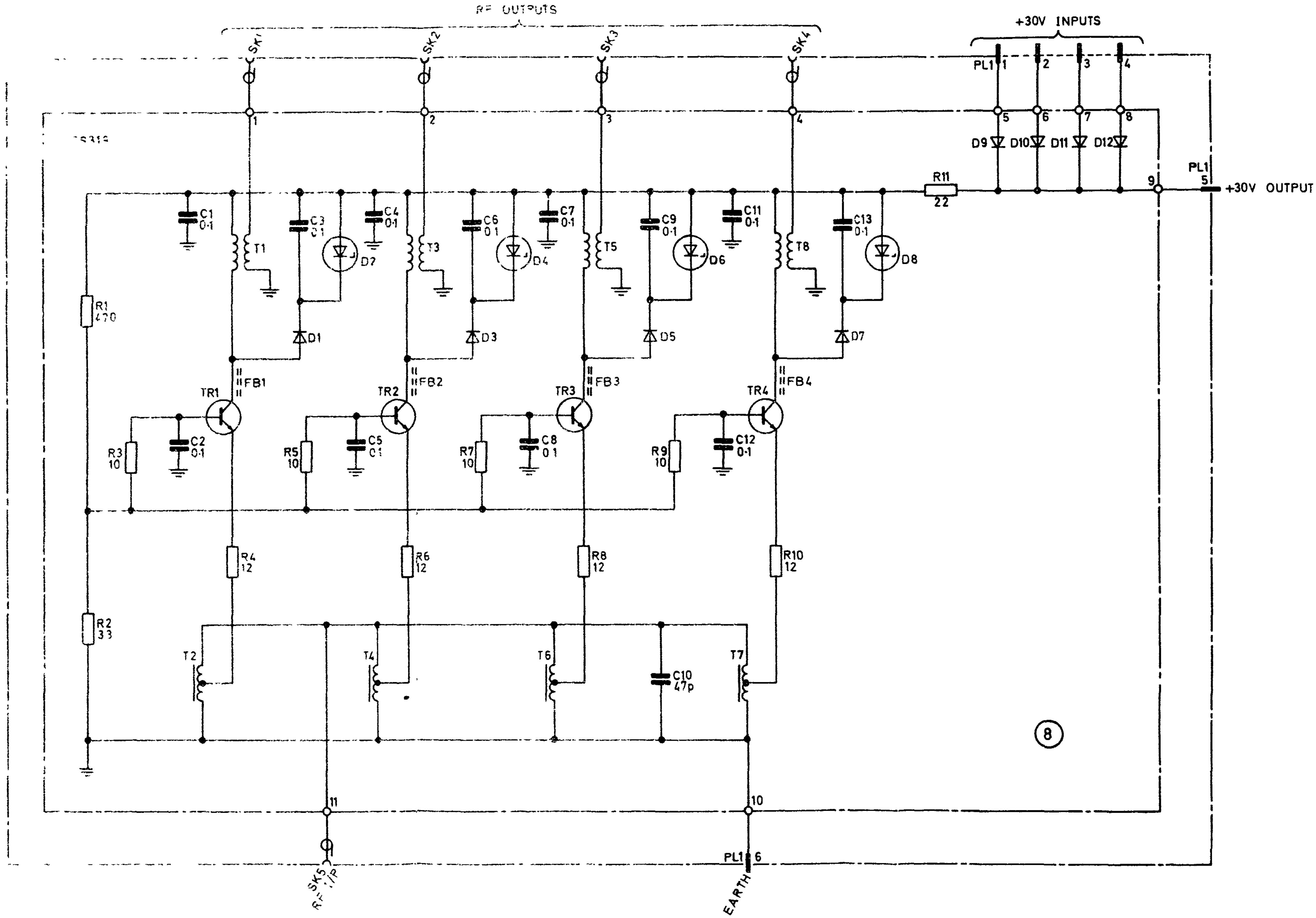
Fig. 1



Component Layout: Splitter Unit

Fig 2

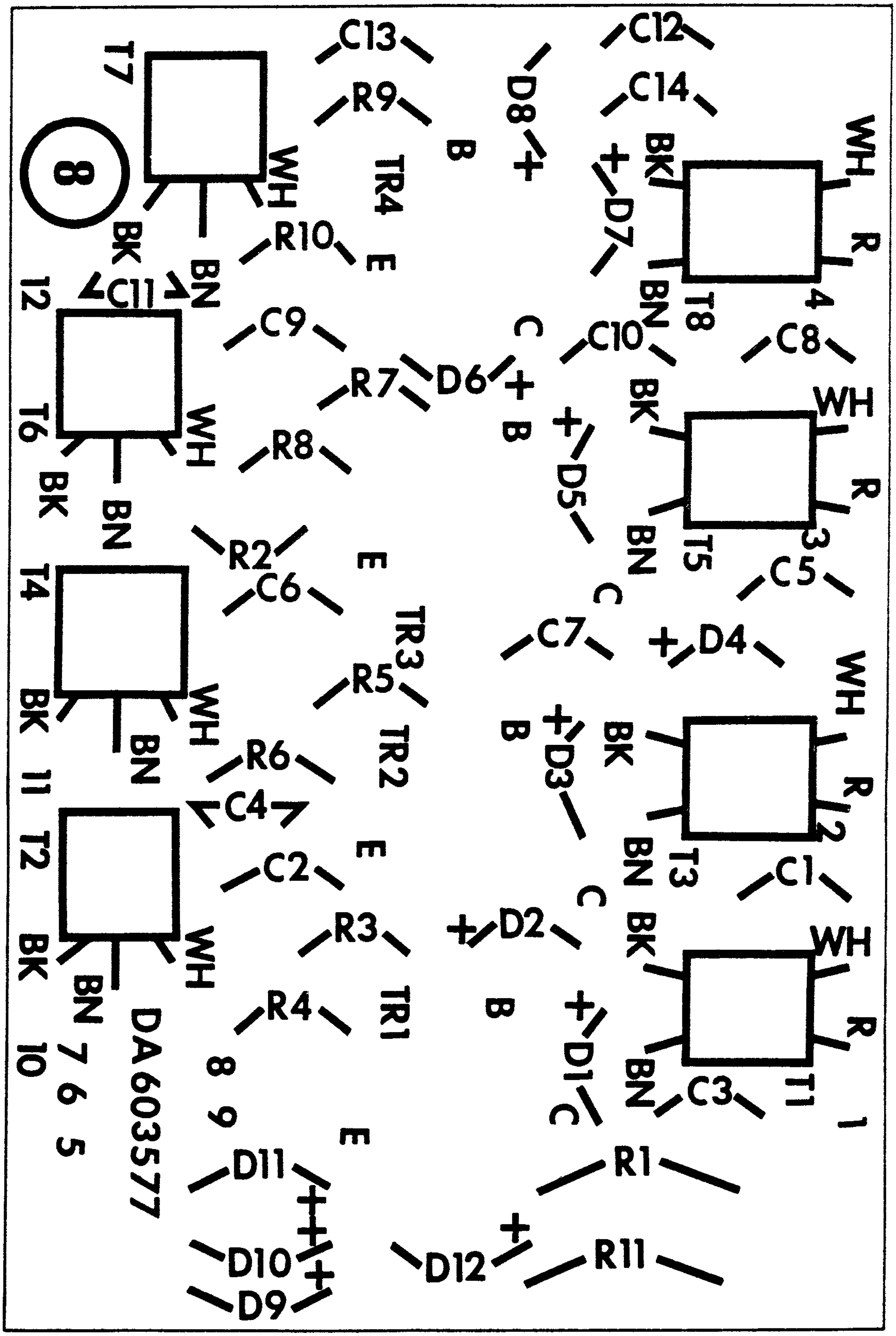
WOH 3037 BA603375



WOH3037

Circuit: Distribution Amplifier

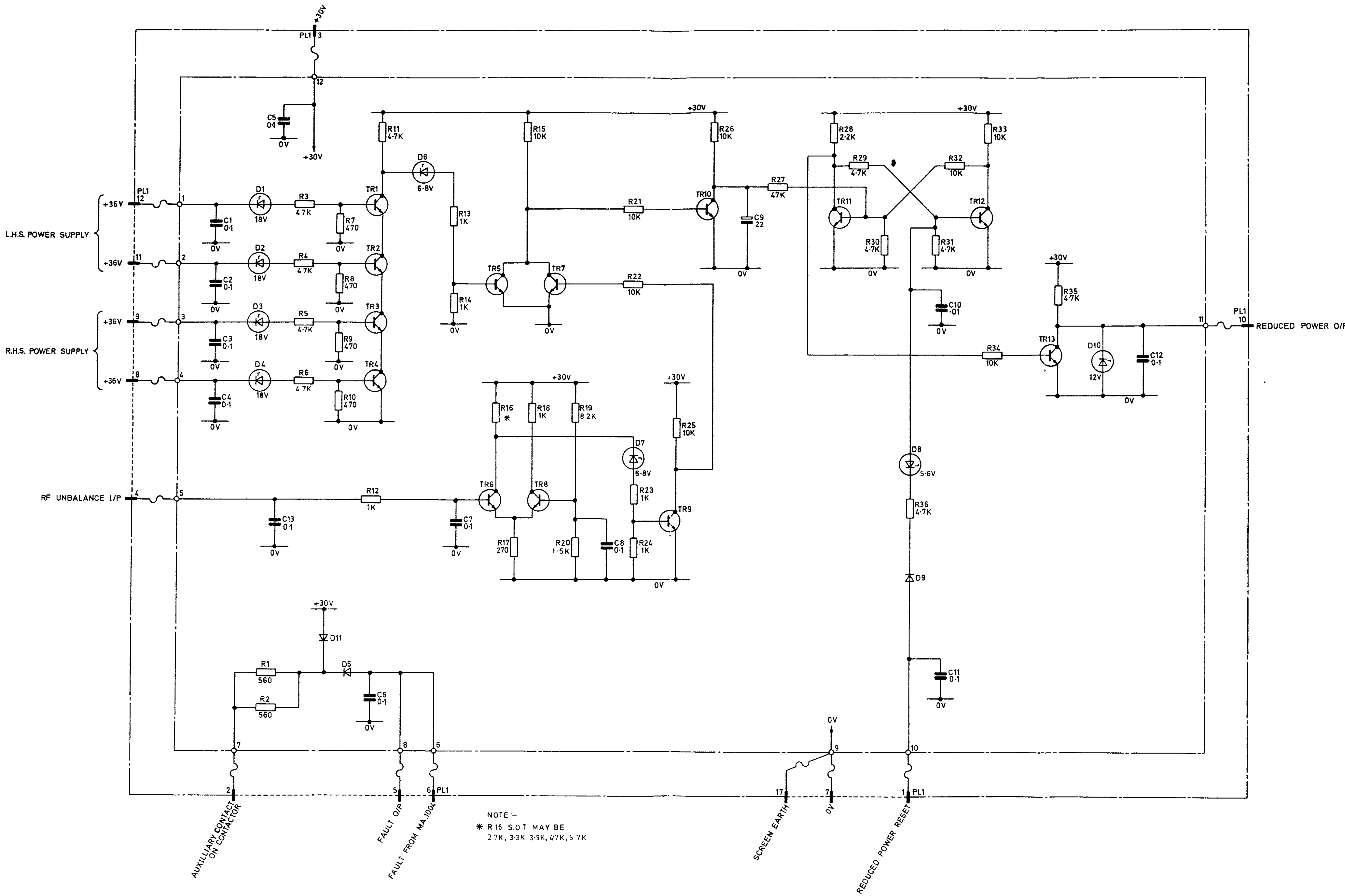
Fig. 3



WOH 3037 | BA 603577

Component Layout: Distribution Amplifier

Fig. 4



WOH3037	DC603342
D 2	

Circuit: Overload Unit

Fig. 5

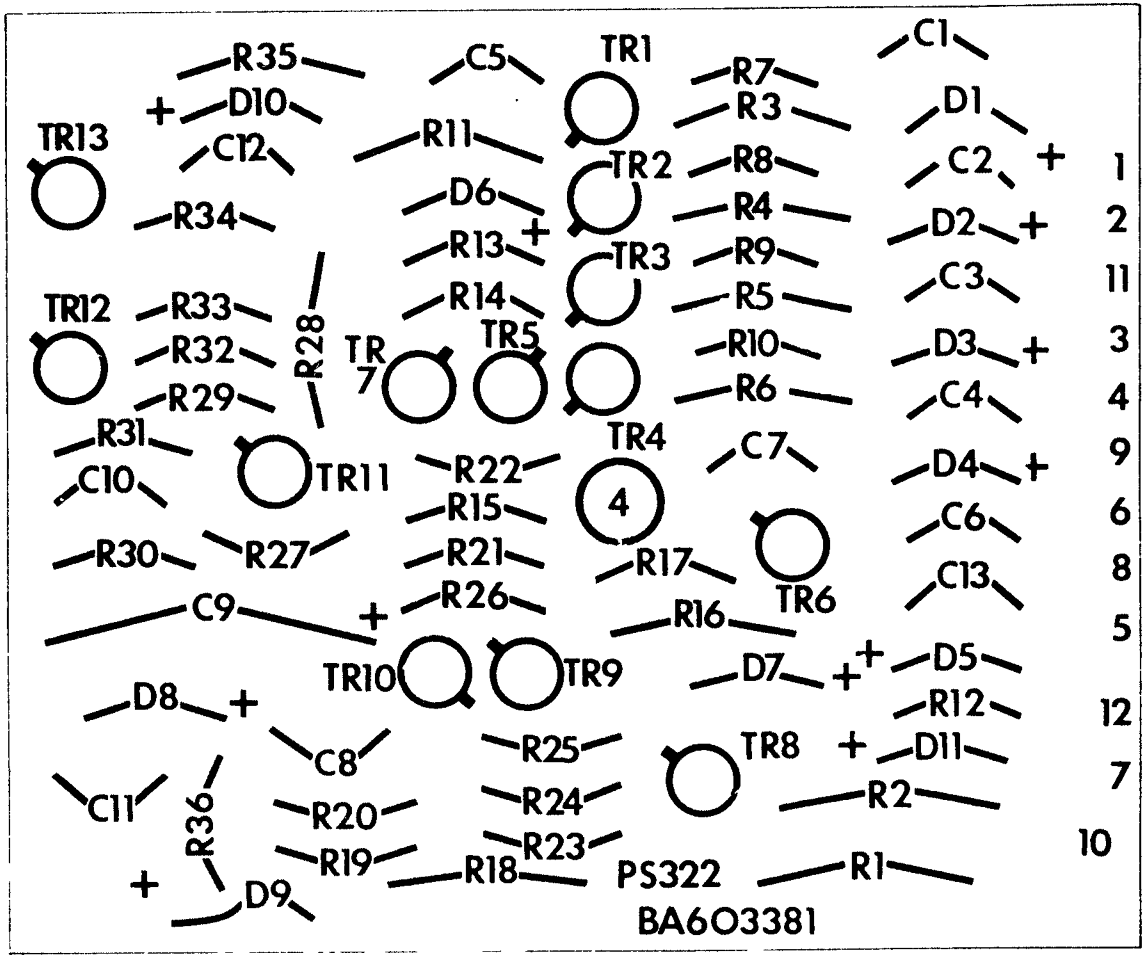
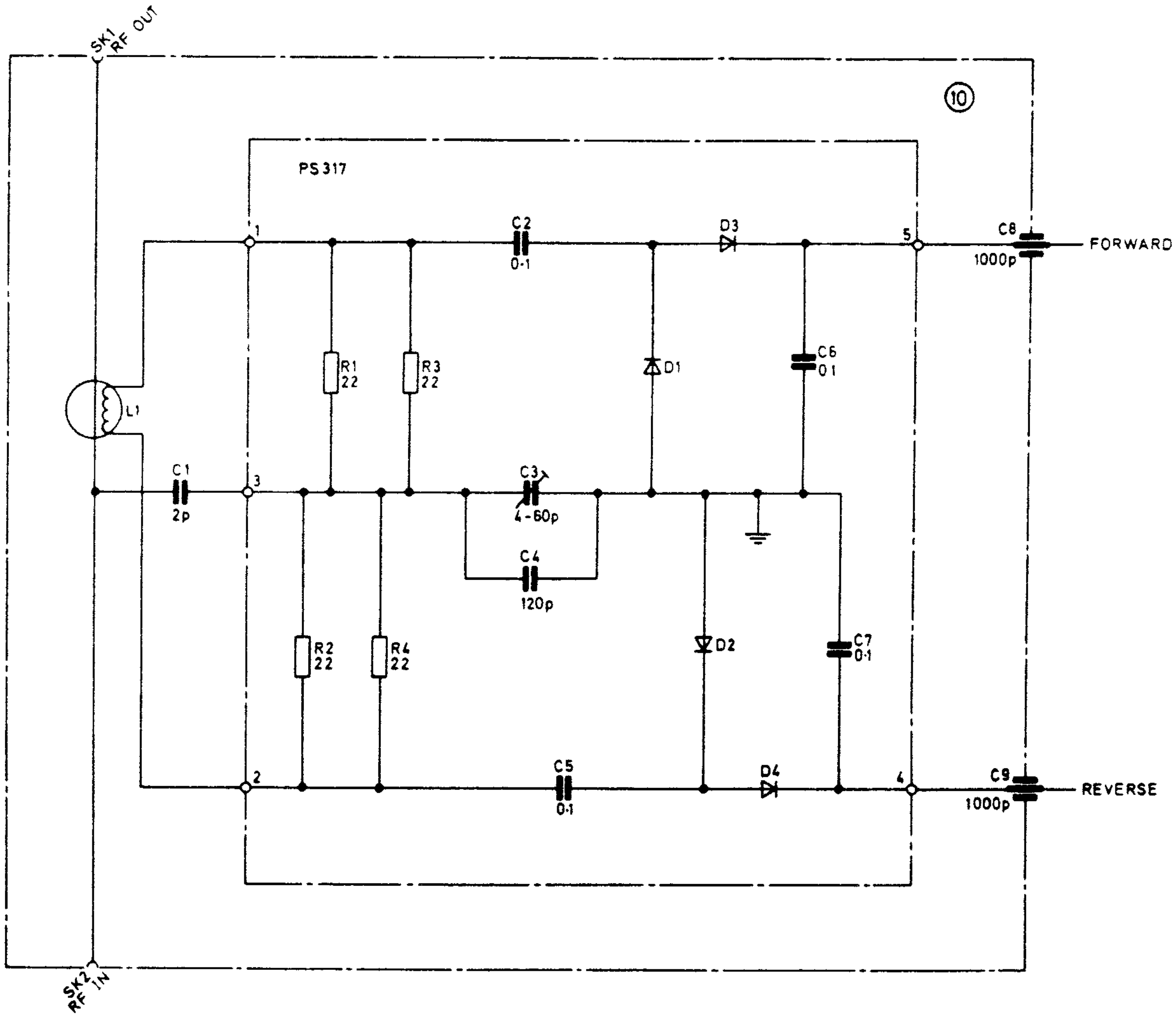


Fig. 6

Component Layout : Overload Unit

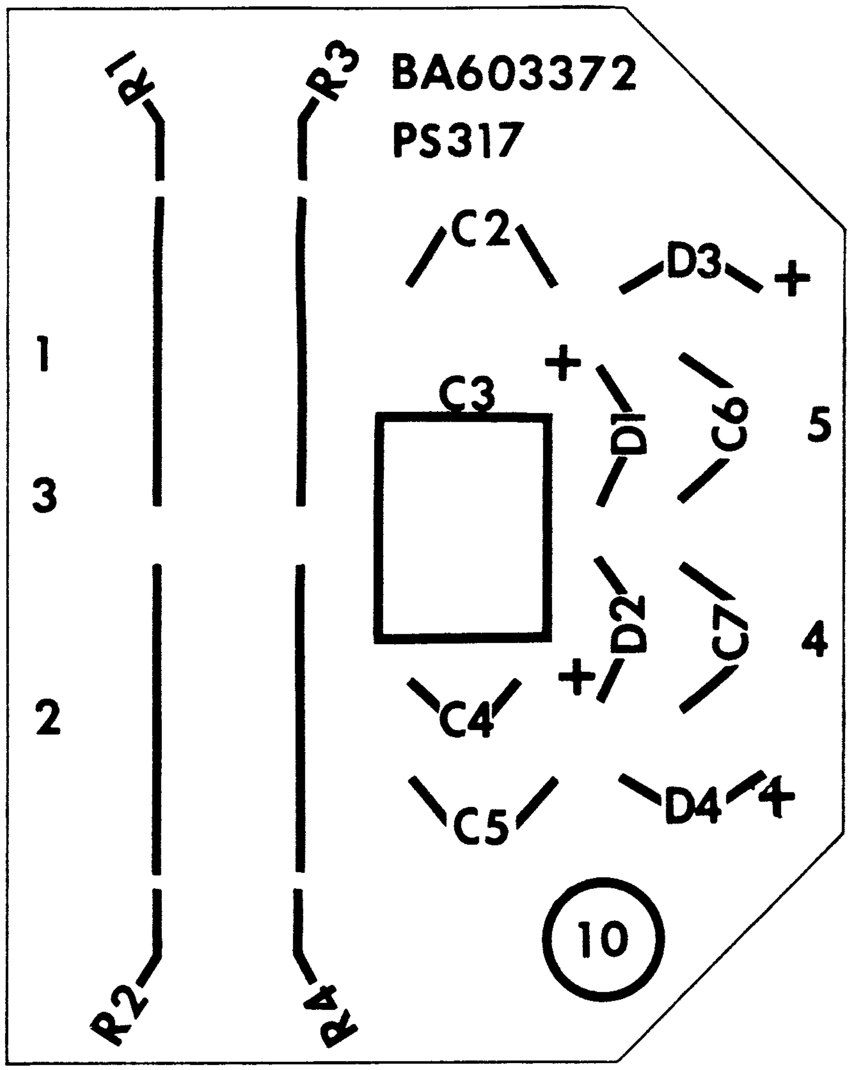
WOH3037[BA603381]



WOH3037	CC603384
B 2	

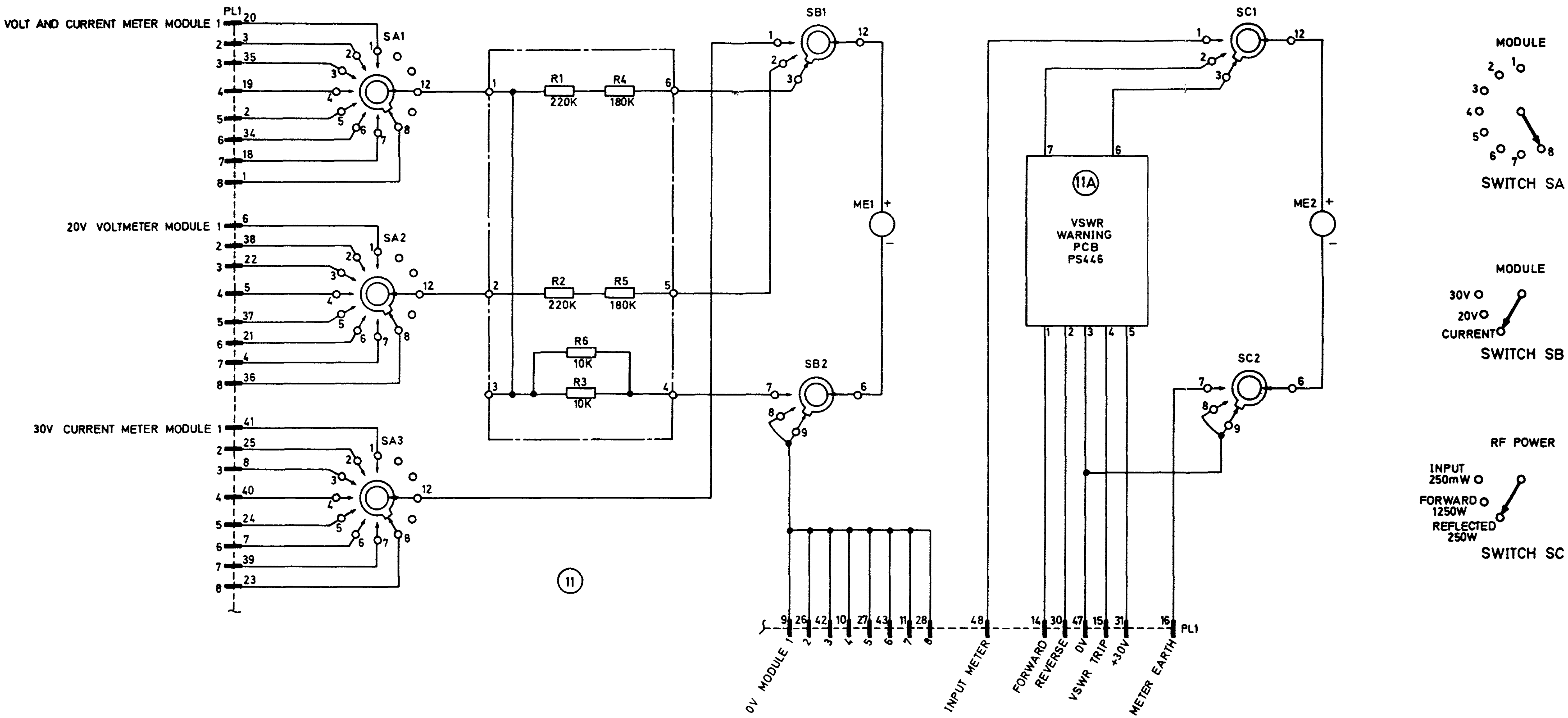
Circuit: Cabinet V.S.W.R. Unit

Fig. 7



W0H 3037	BA 603372

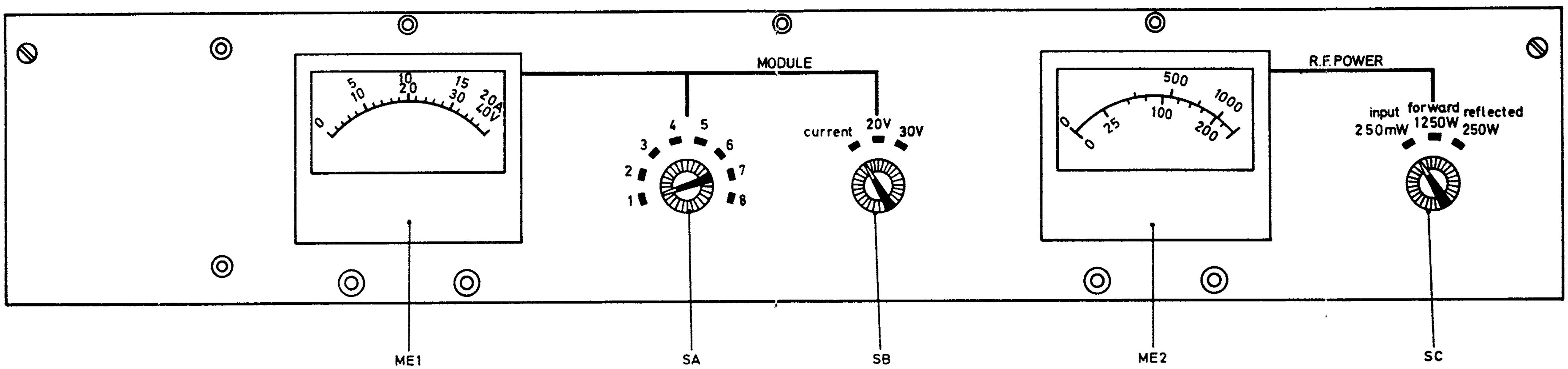
Component Layout : Cabinet V.S.W.R. Unit Fig. 8



37 CC603450

Circuit: Meter Panel

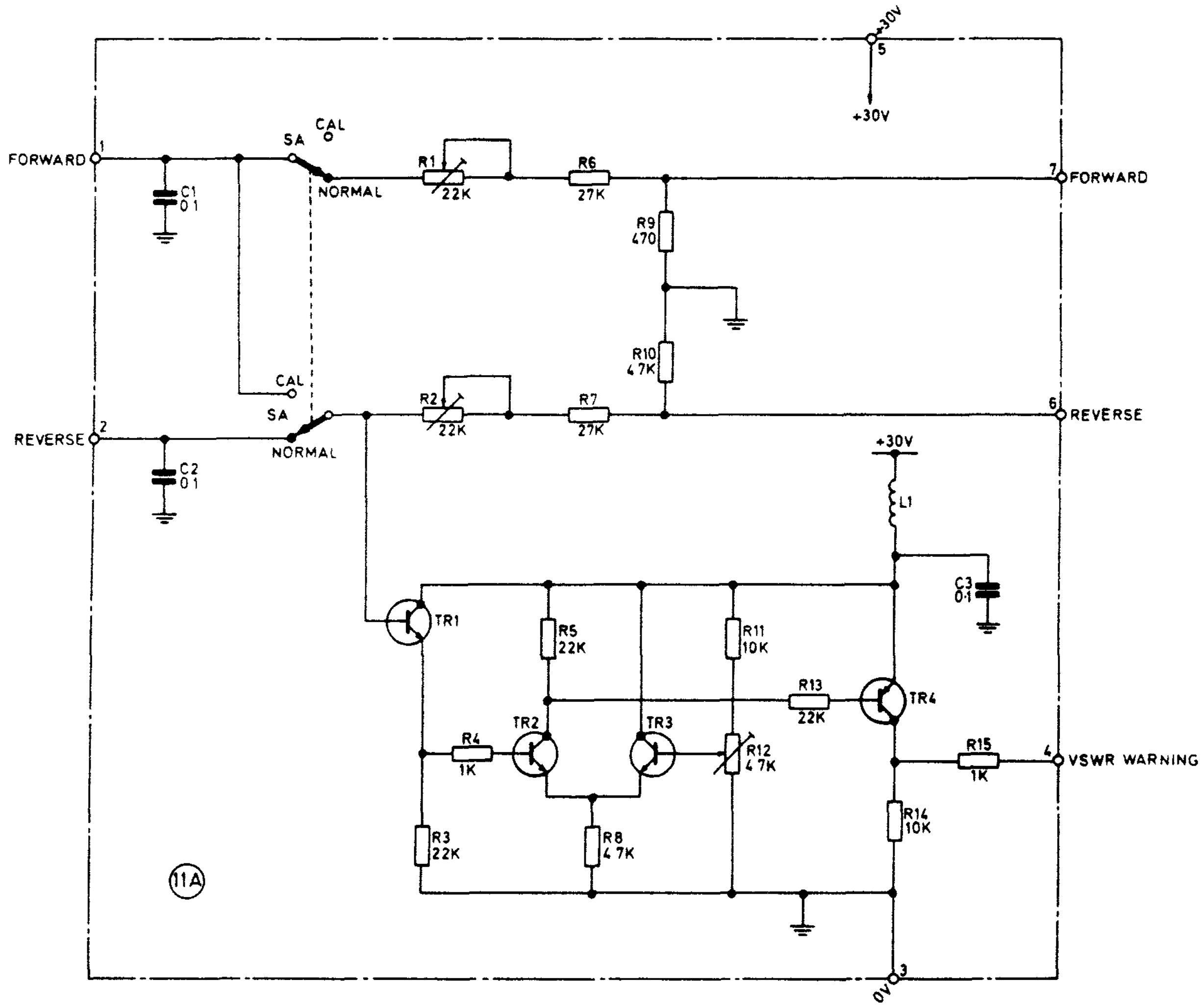
Fig. 9



WOH3037

Fig. 10

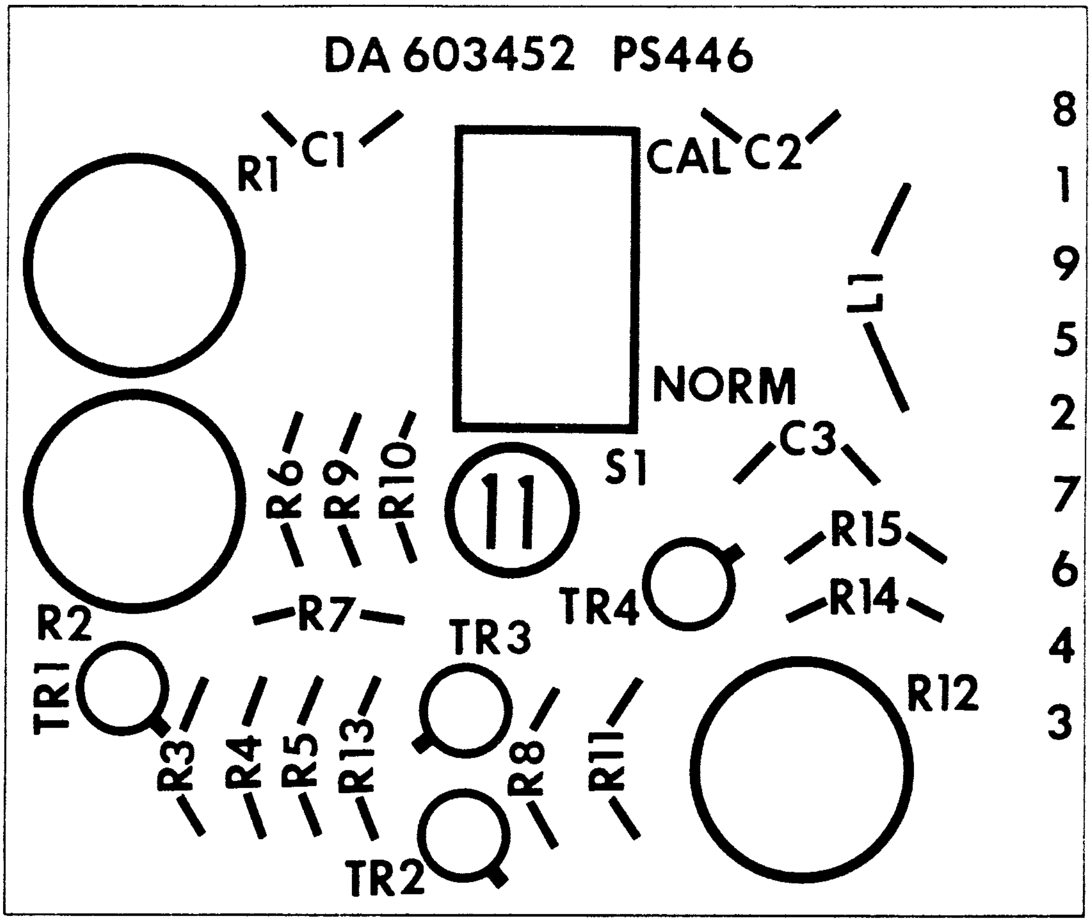
Component Layout : Meter Panel



WOH3037	BC603451
A	

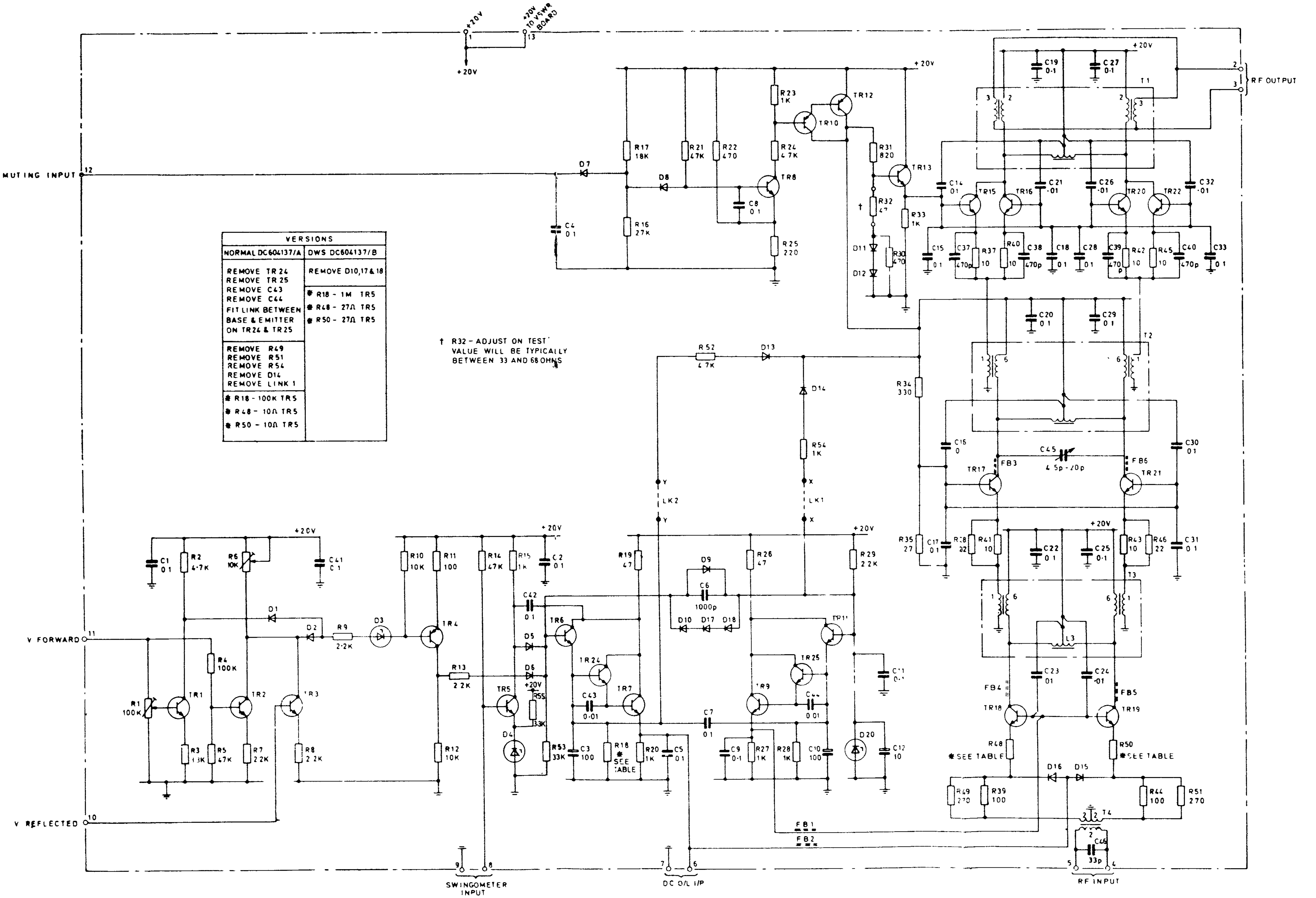
Circuit: V.S.W.R. Warning P.C.B

Fig. 11



WOH 3037 | BA 603452

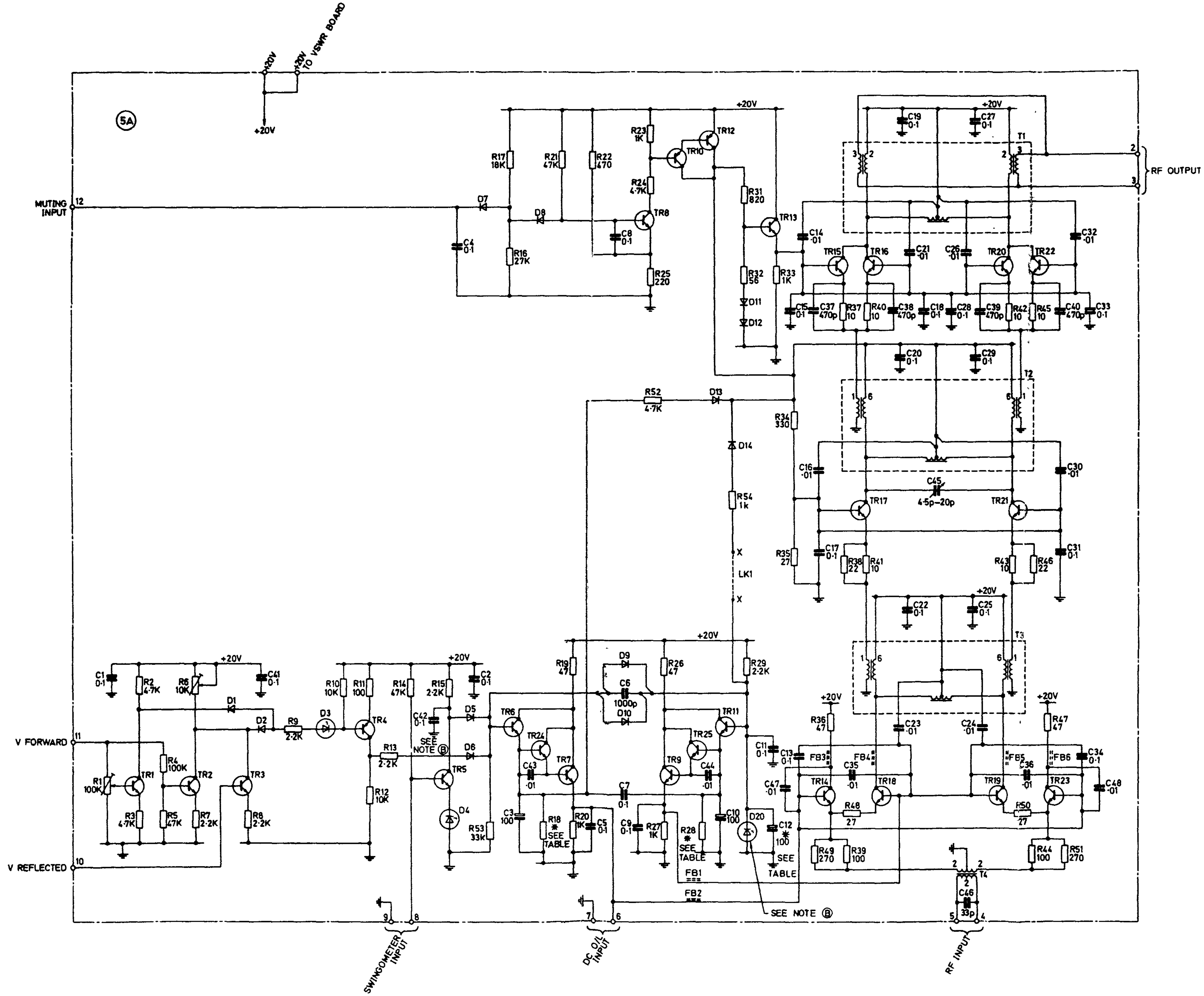
Component Layout : VSWR Warning P.C.B. Fig 12



WOH 3037	DC604137
C 2 4 5	

Circuit: Low Level P.C.B. PS351

Fig.13



VERSIONS

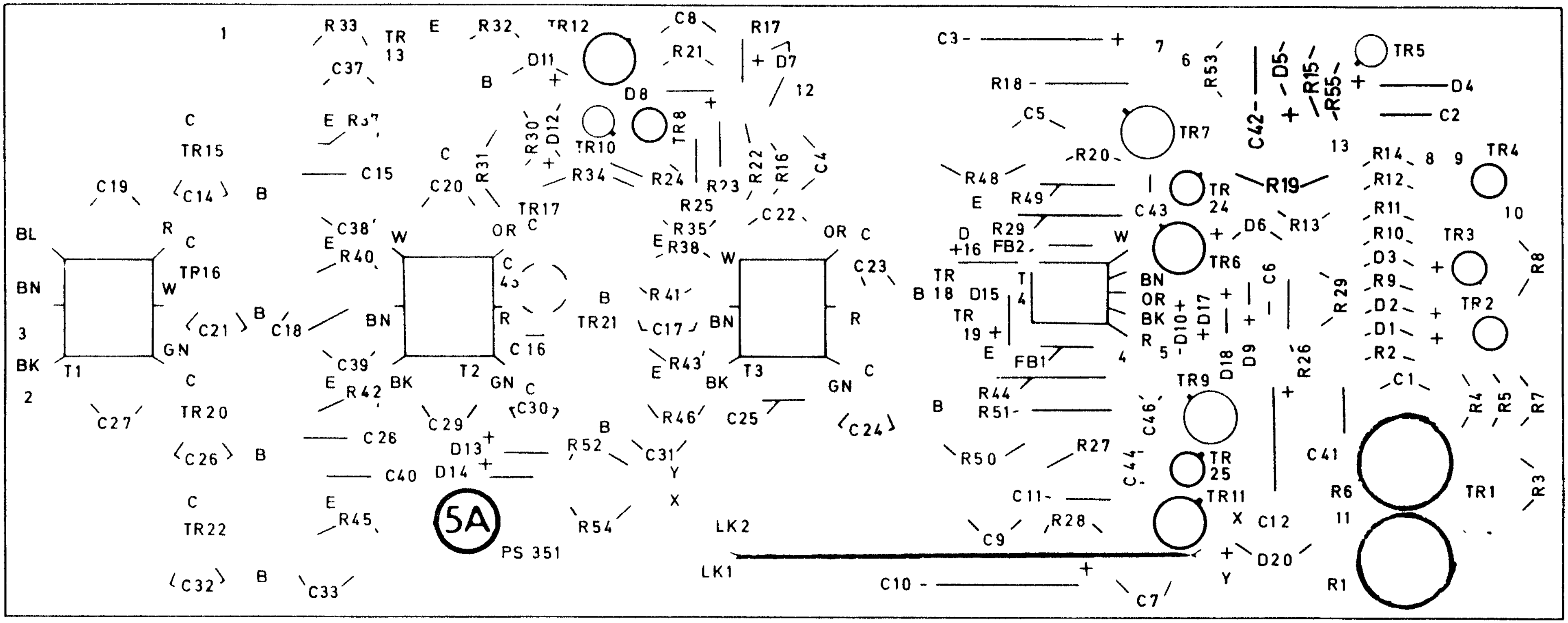
DC603363/A ALC DISCHARGE TIME NORMAL
REMOVE TR24 REMOVE TR25 REMOVE C43 REMOVE C44 REMOVE R54 REMOVE D14 FIT LINK BETWEEN BASE & EMITTER ON TR24 & TR25
REMOVE R49 REMOVE R51
REMOVE R48 AND REPLACE WITH WIRE LINK
REMOVE R50 AND REPLACE WITH WIRE LINK
* R18–100K * R28–100K REMOVE LK1

DC603363/B ALC DISCHARGE TIME LONG
REMOVE D10
*R18 – 1M *R28 – 1K *C12 – 1 Ⓑ D20 TO BE REPLACED BY R30 C42 TO BE 0·1µF

WOH3037	DC603363/V
E F G	

Circuit: Low Level Board PS314

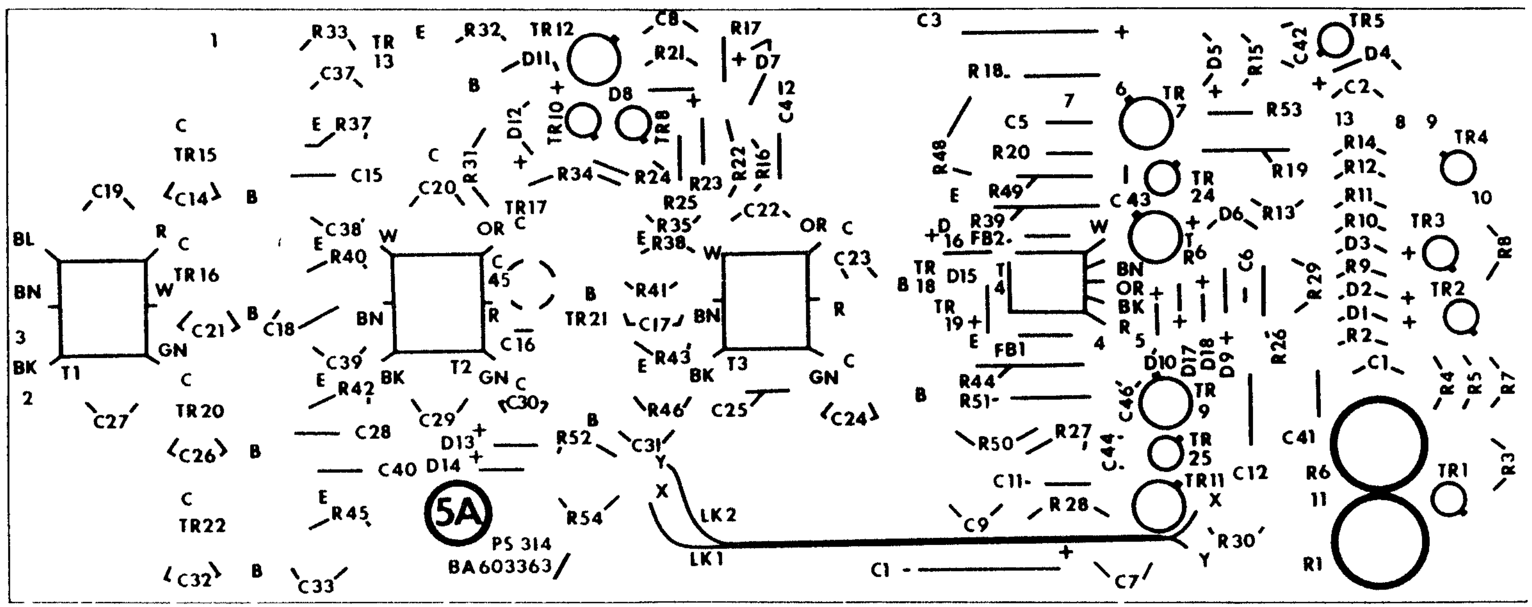
Fig.13a



Component Layout:
Low Level P.C.B.(PS351)

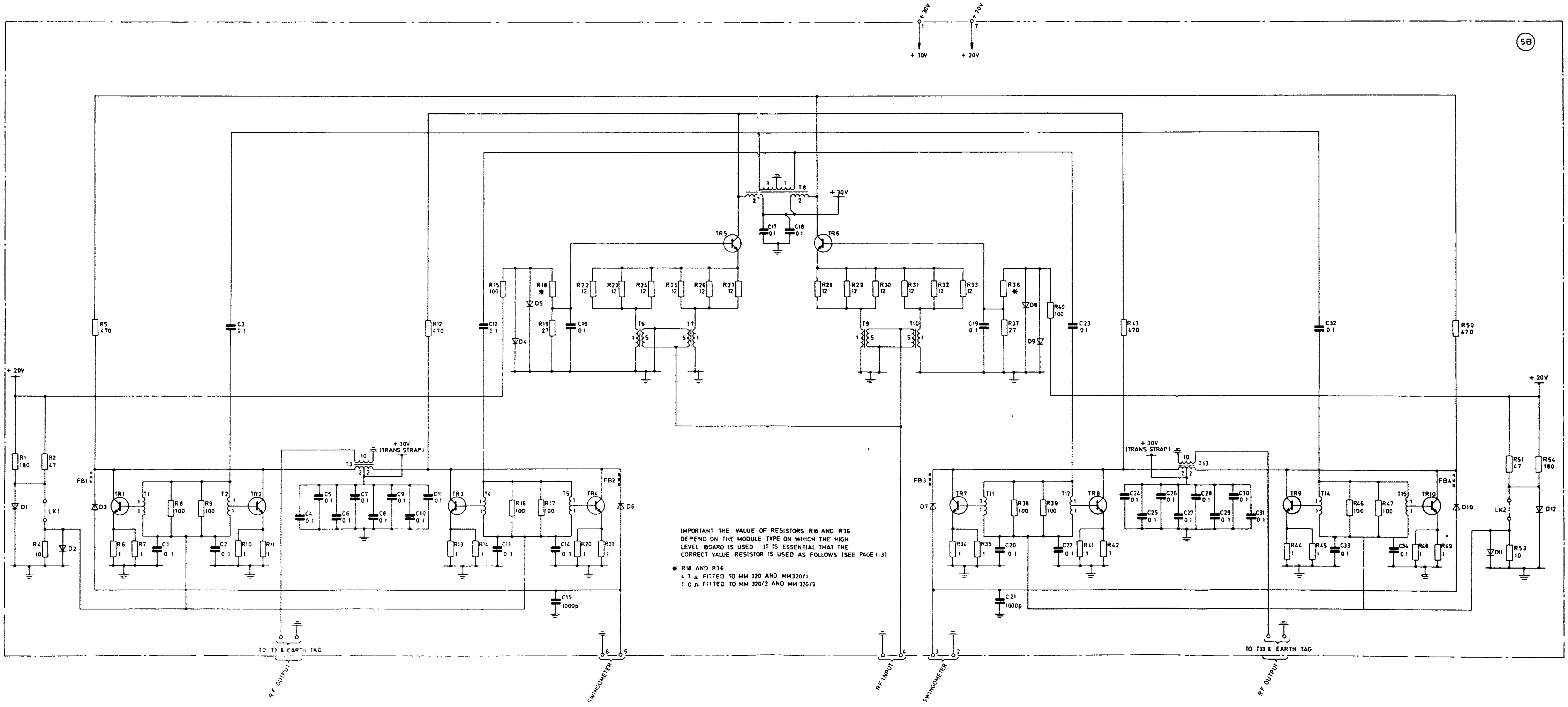
Fig.14

WOH3037 | DD604172
2 | 3 | 4



Component Layout : Low Level P.C.B.(PS314)

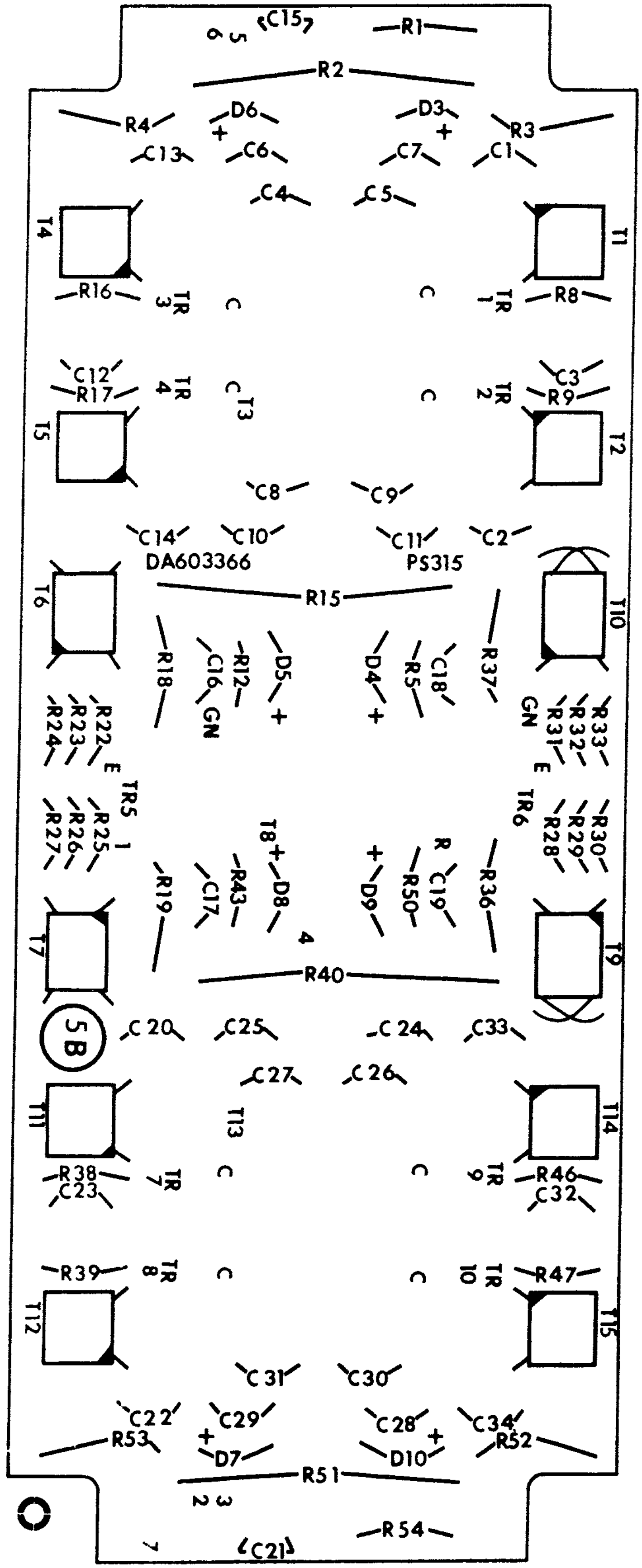
Fig. 14a



WOH 3037	EC 603366
D 2 3 4	

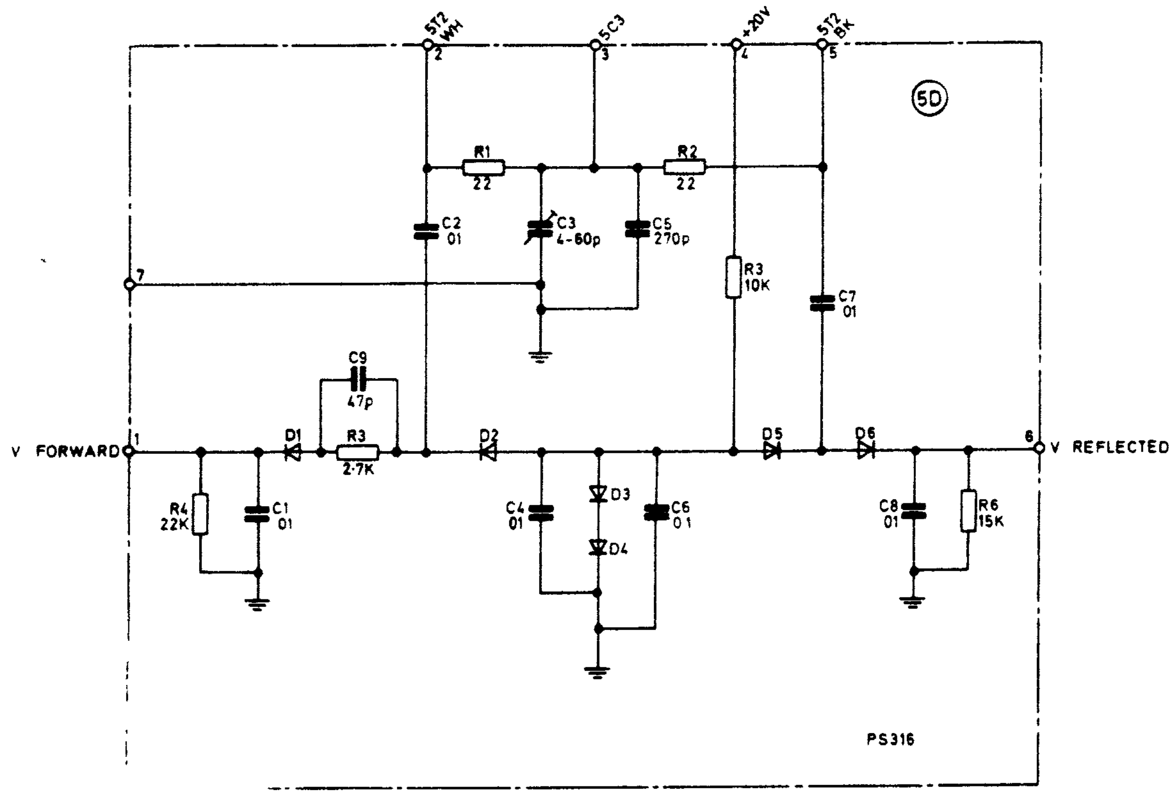
Circuit: High Level Board PS 315

Fig. 15



WOH 3037 | DA 603366

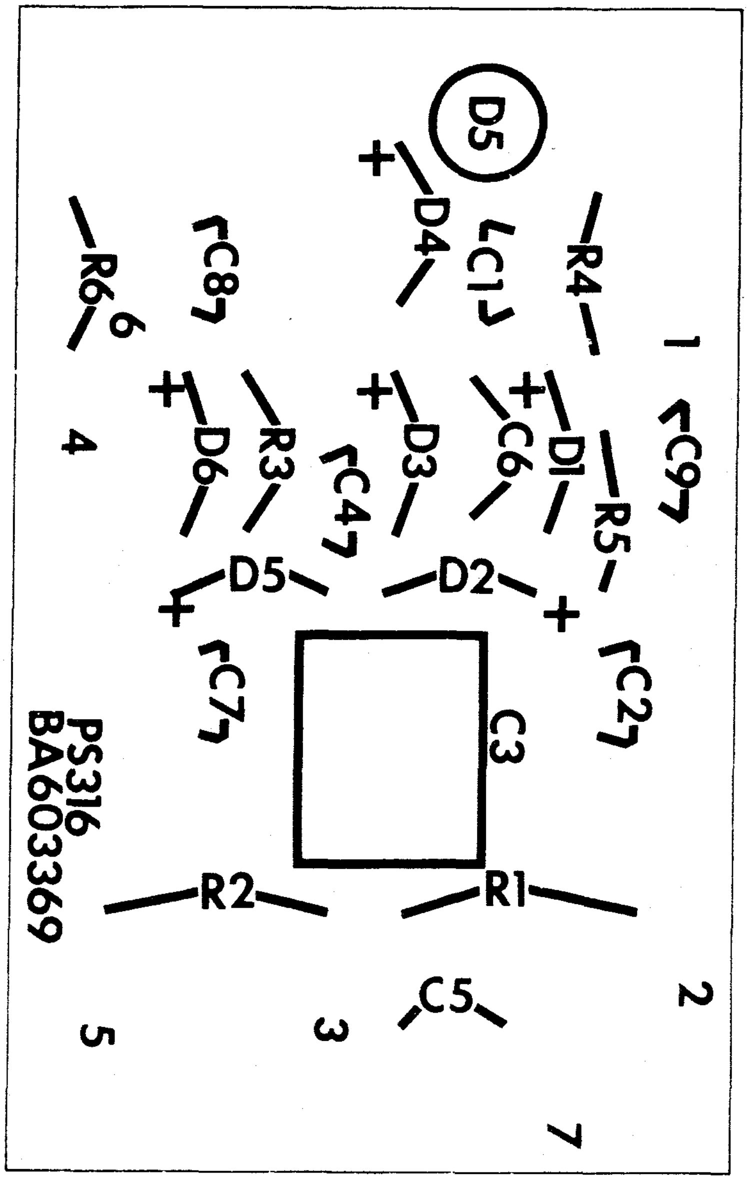
Component Layout : High Level P.C.B. Fig 16



WOH3037	BC603369
D	

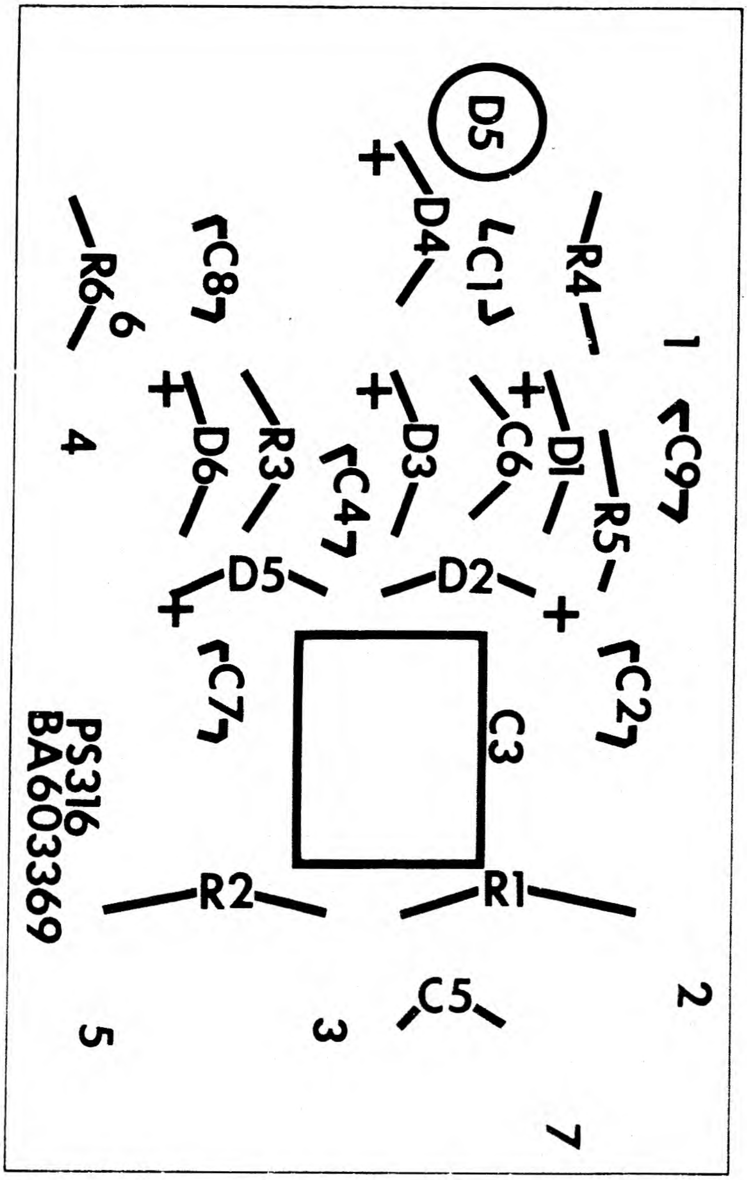
Circuit: V.S.W.R. P.C.B

Fig. 17



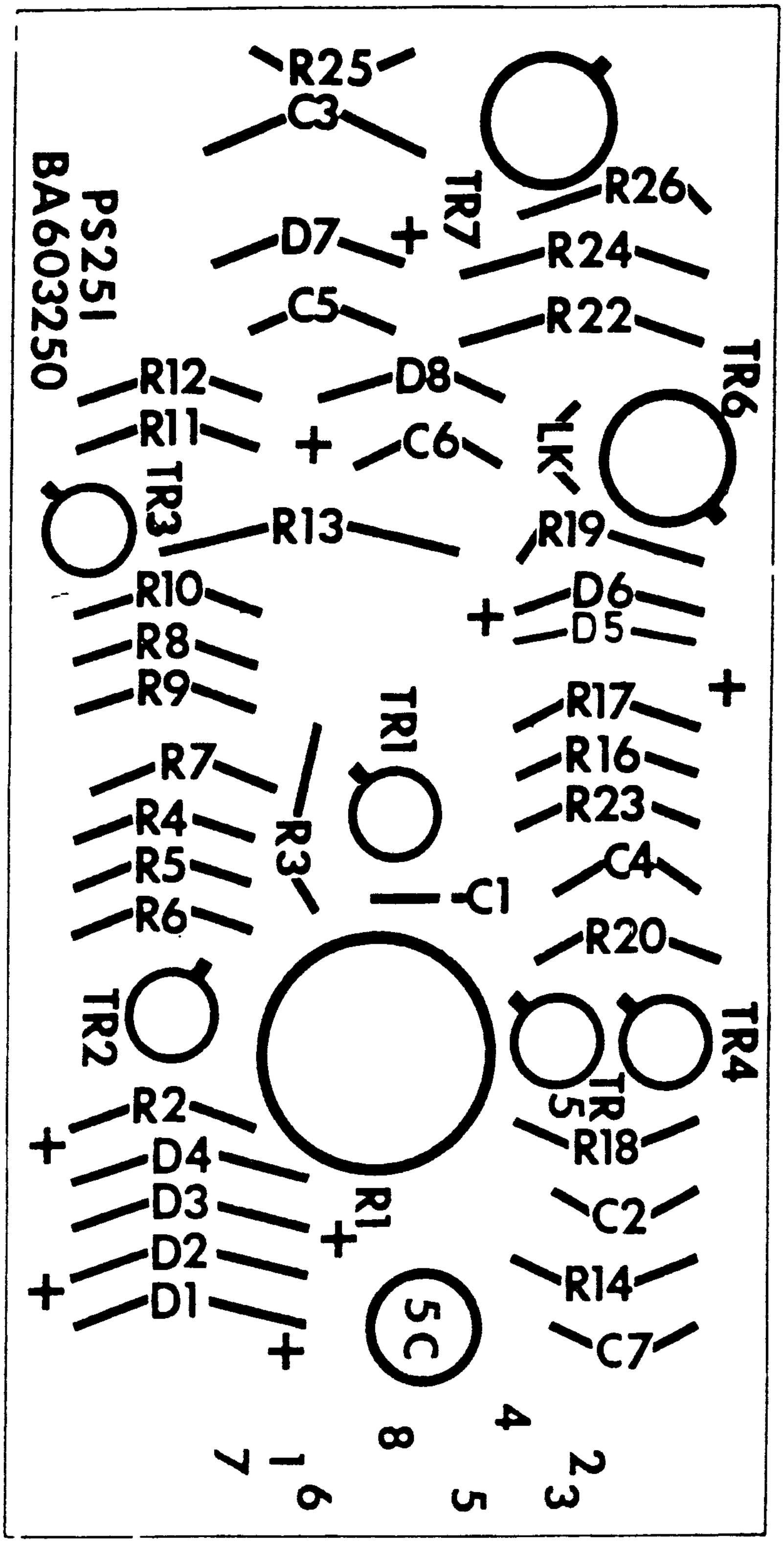
WOH 3037 | BA 603369

Component Layout V.S.W.R. P.C.B. Fig.18



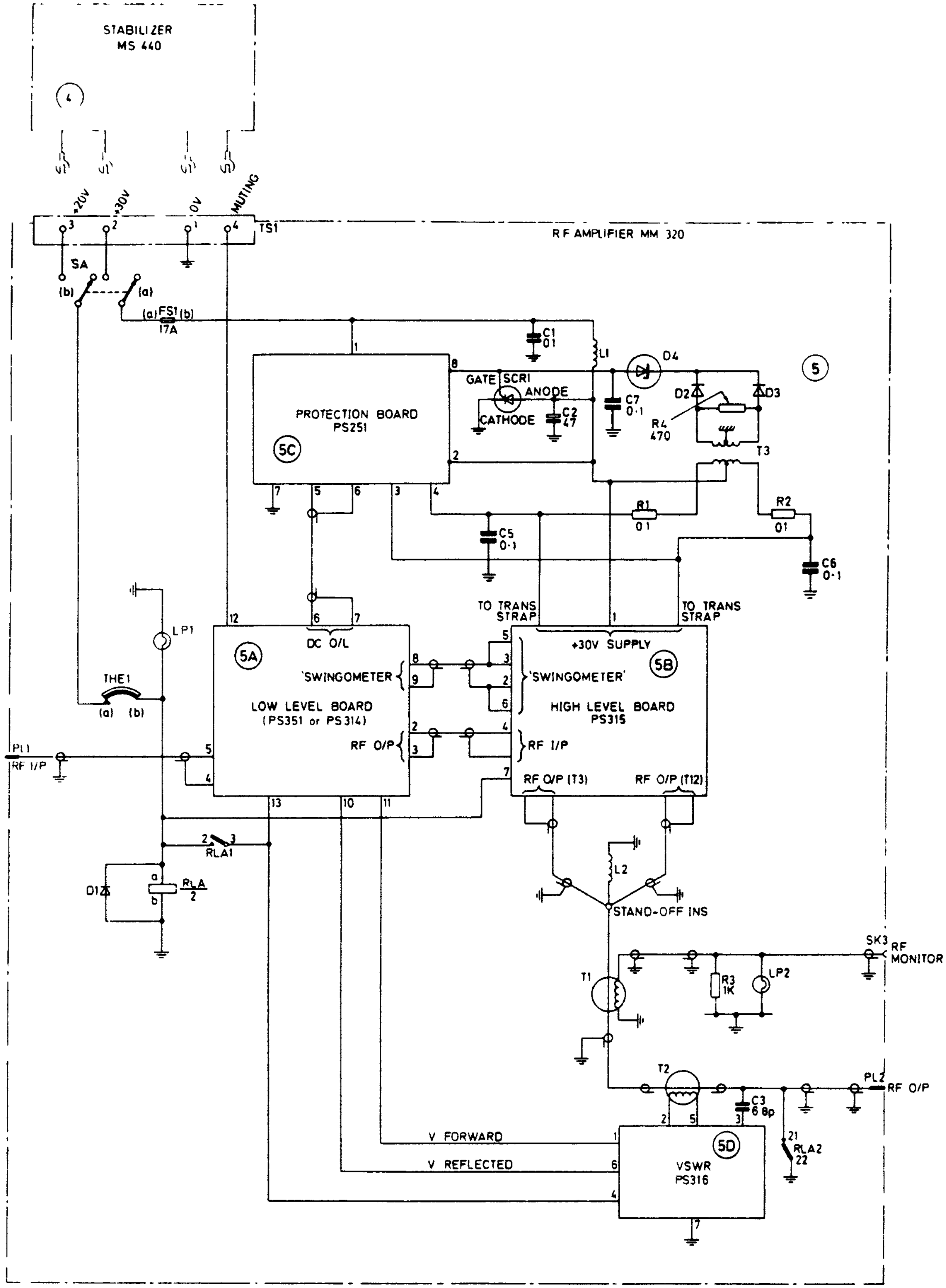
WOH 3037	BA 603369

Component Layout V.S.W.R. P.C.B. Fig.18



WOH 3037 BA 603250

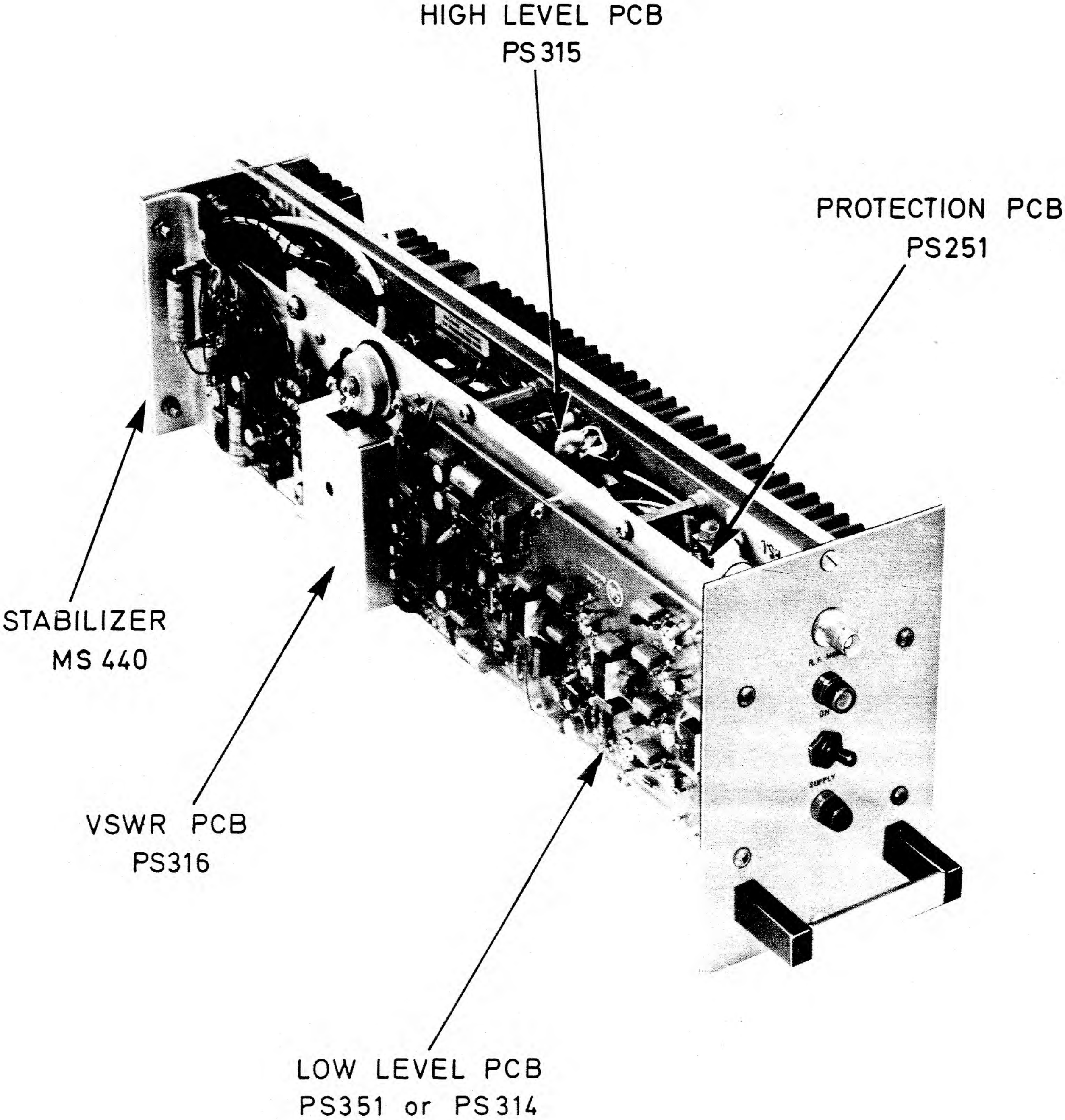
Component Layout : Protection P.C.B. Fig 20



Circuit: Interconnections R.F. Module

Fig. 21

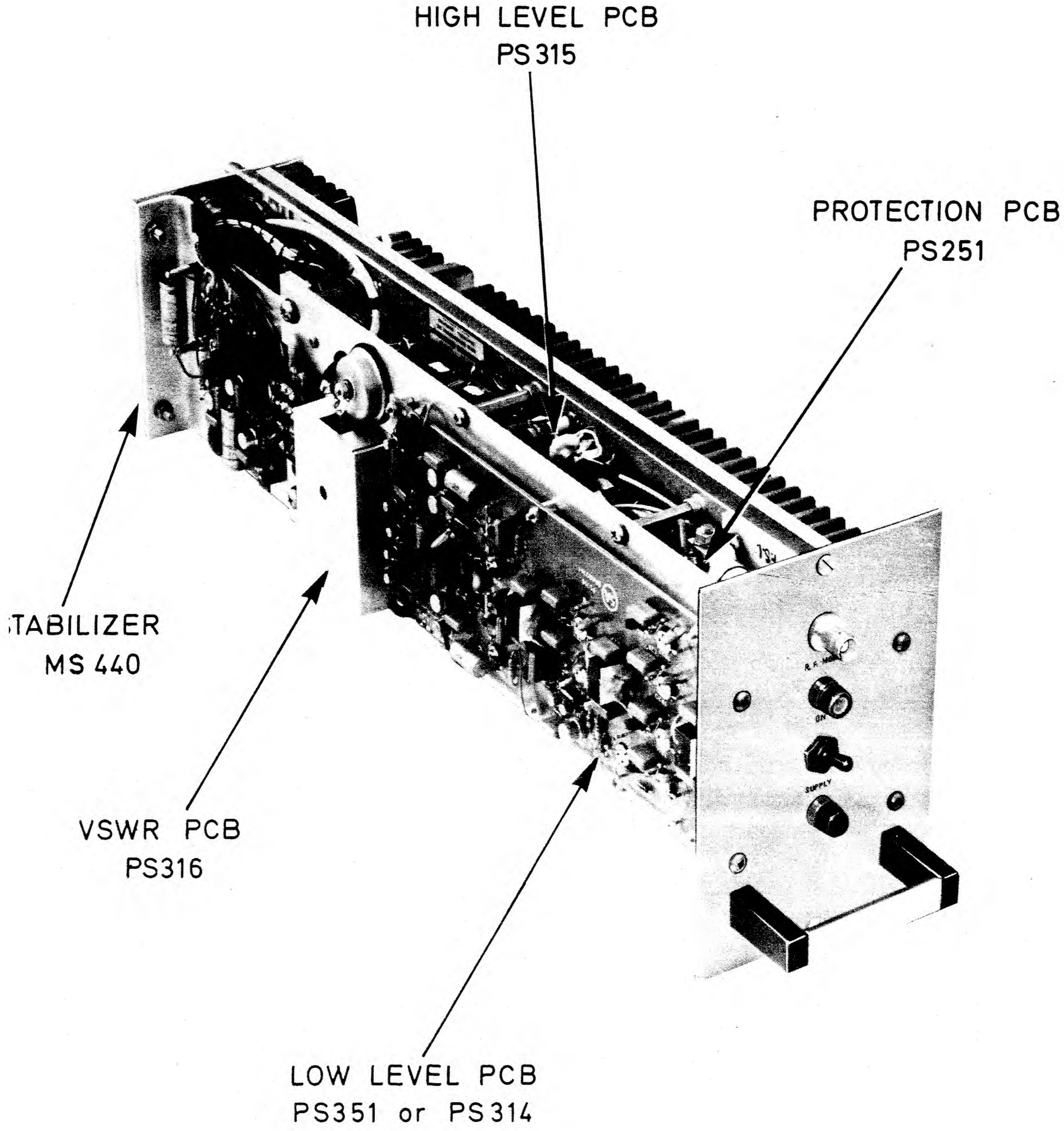
WOH3037 | DC602850
t | 3 | 4 | 5 | 6 | 7 | 8 | 9 |



RF Power Module MM420
Sub-Unit Location

WOH 3037

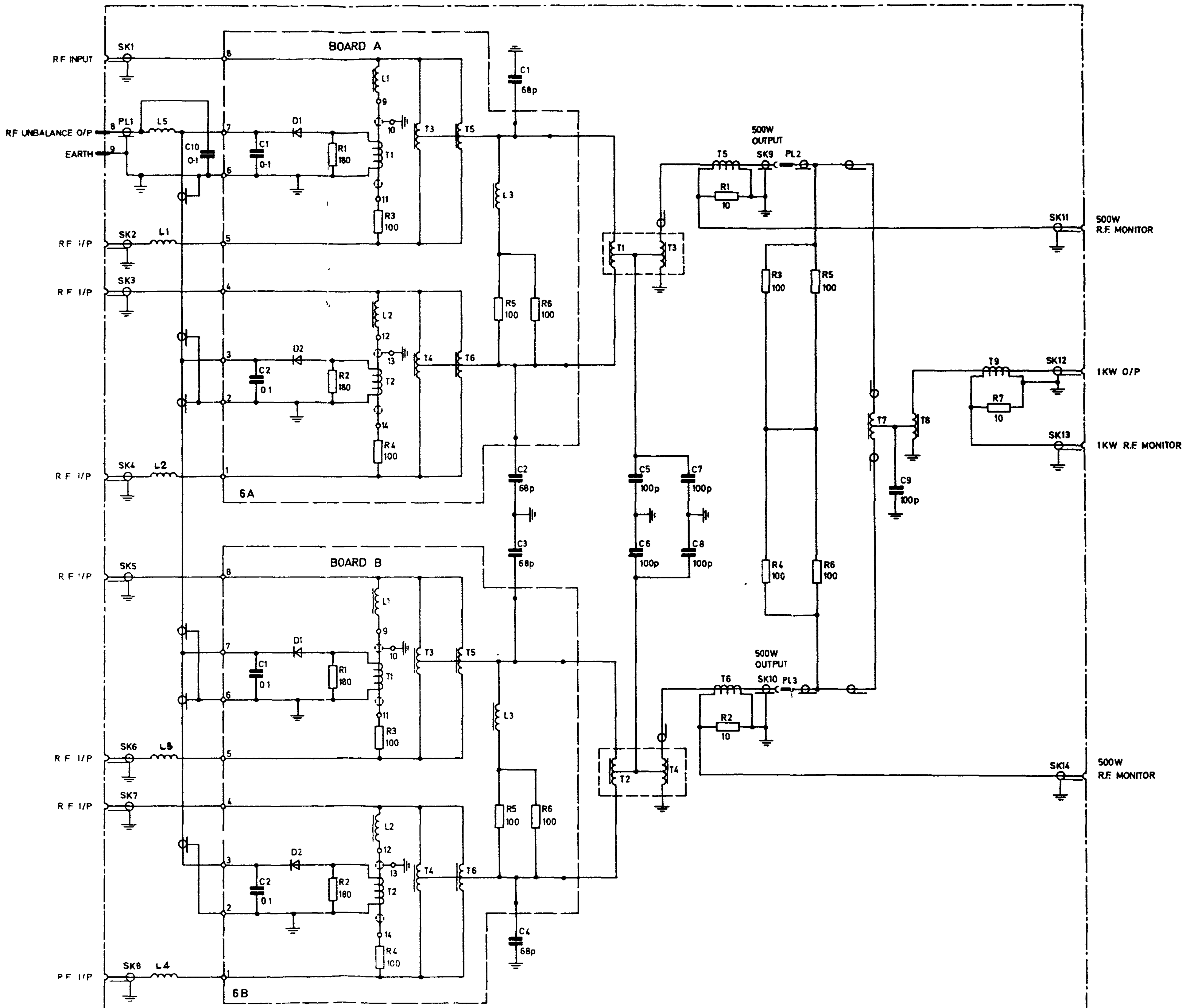
Fig. 22



RF Power Module MM420
Sub-Unit Location

WOH3037

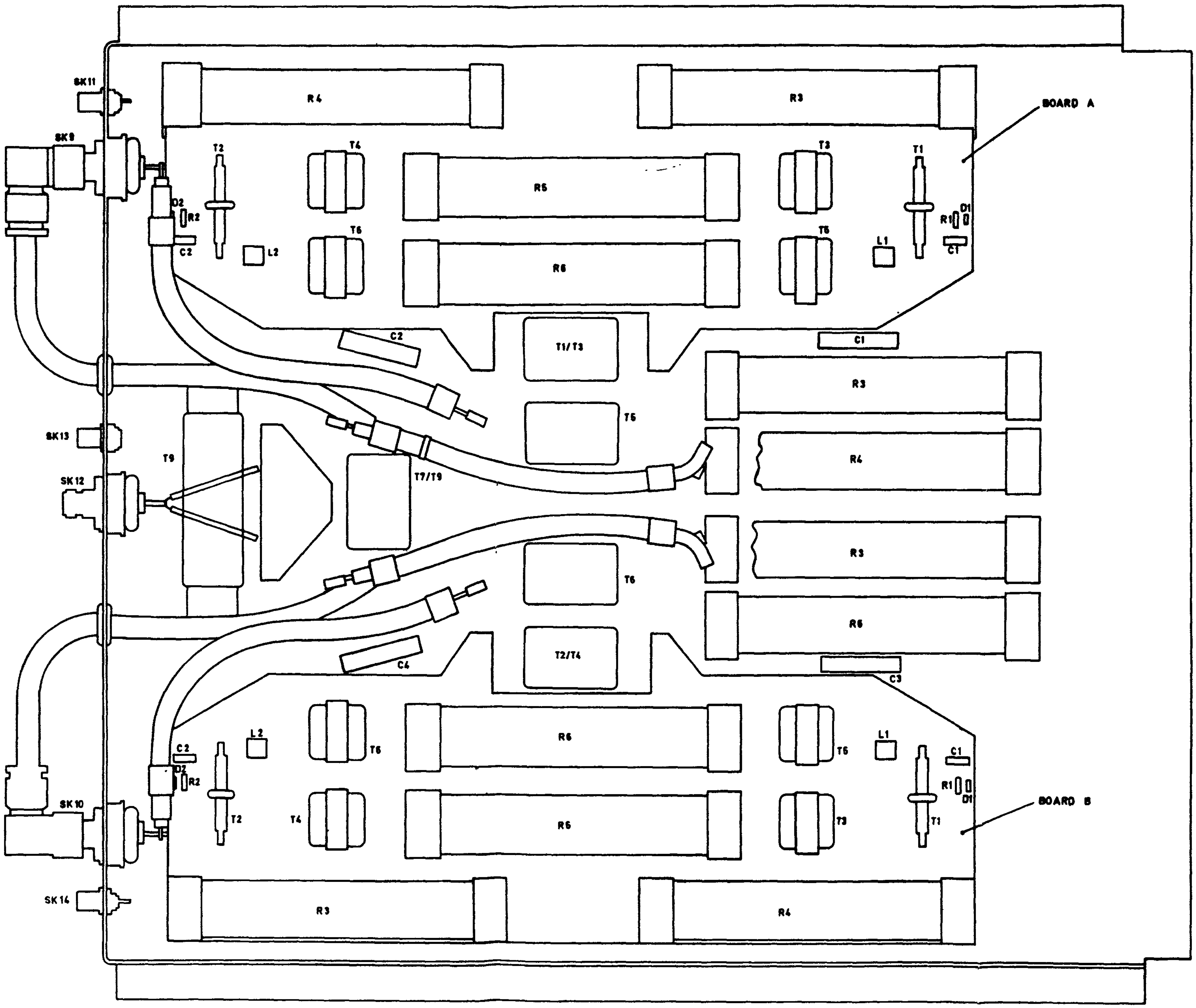
Fig. 22



WOH 3037	DC602975
D	1

Circuit: Combining Unit

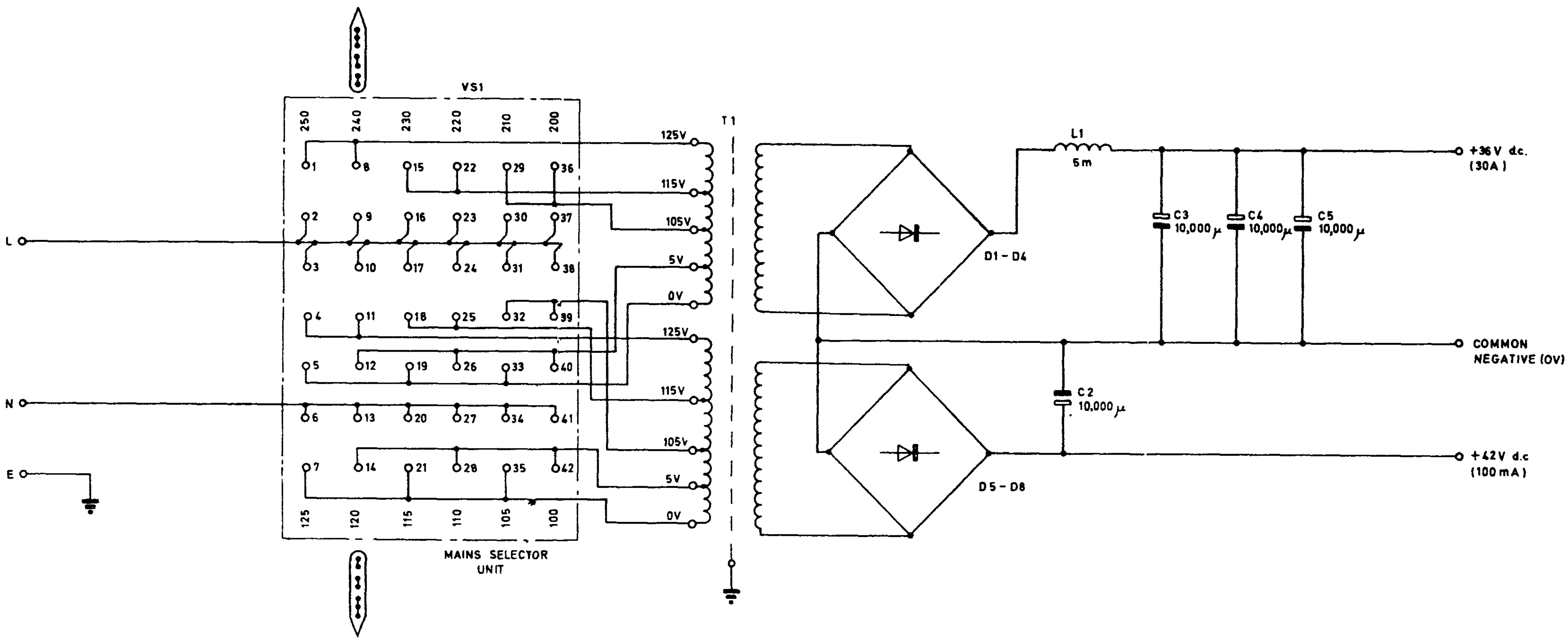
Fig. 23



WOH3037

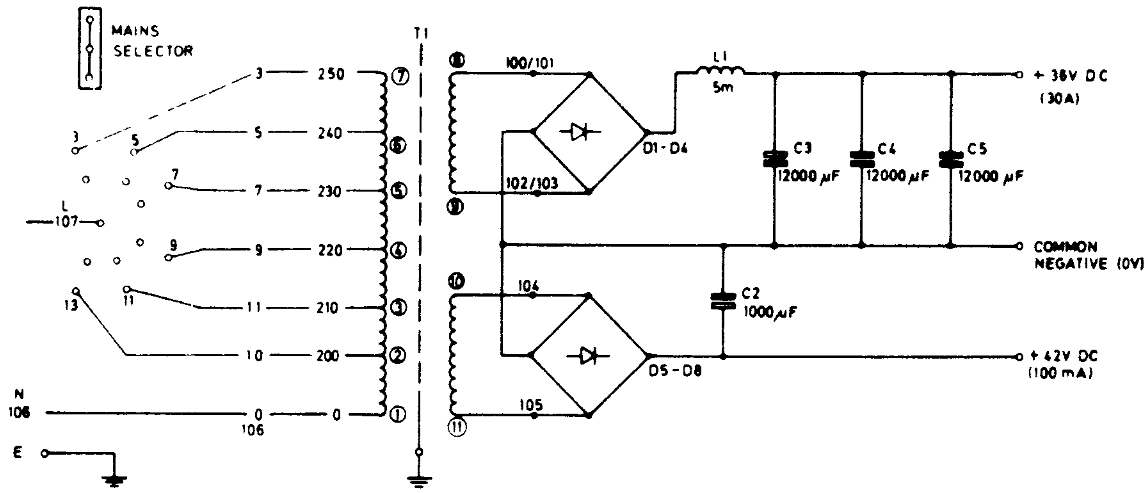
Component Layout: Combining Unit MS441

Fig. 24



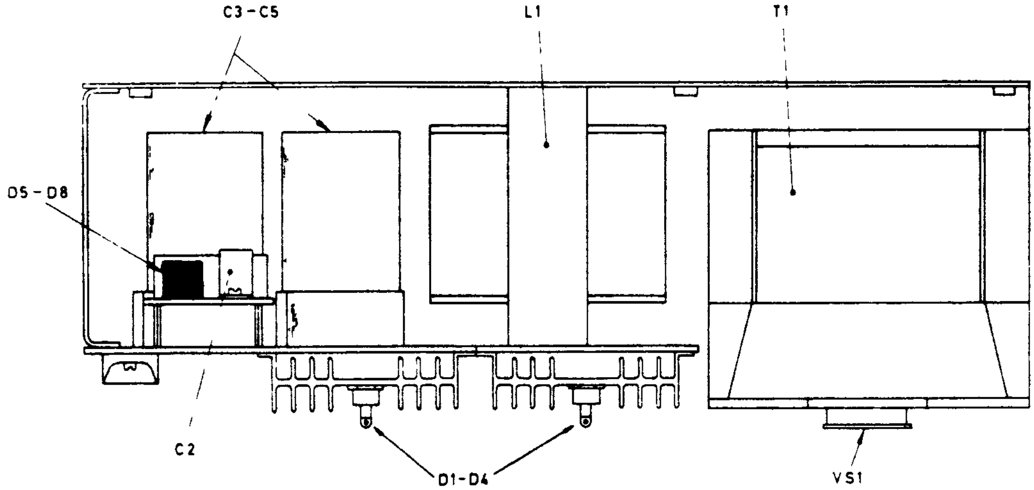
Circuit: Power Supply Unit MS64

Fig. 25

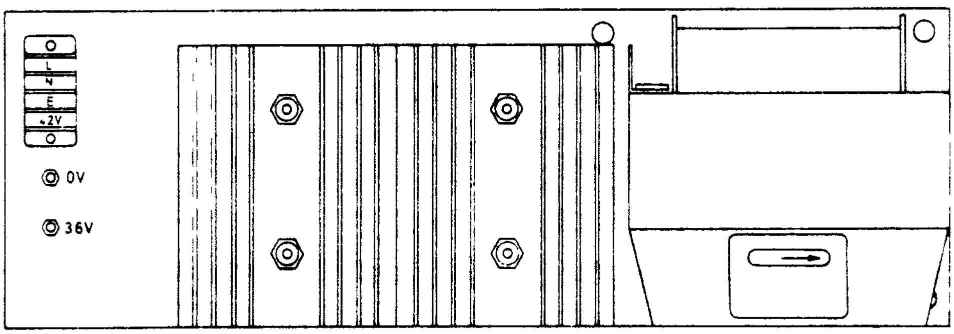


[WOH 1037]

Circuit: Power Supply Unit MS64/2 Fig. 25a



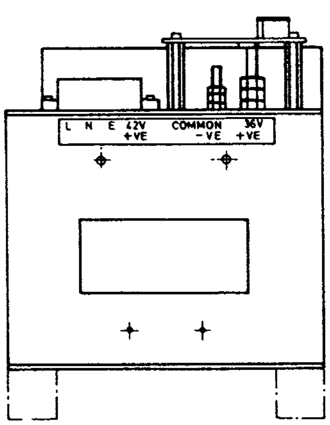
TOP VIEW

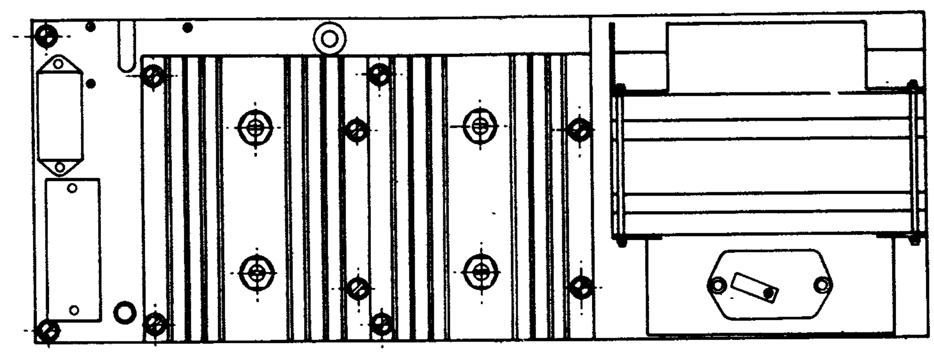


FRONT VIEW

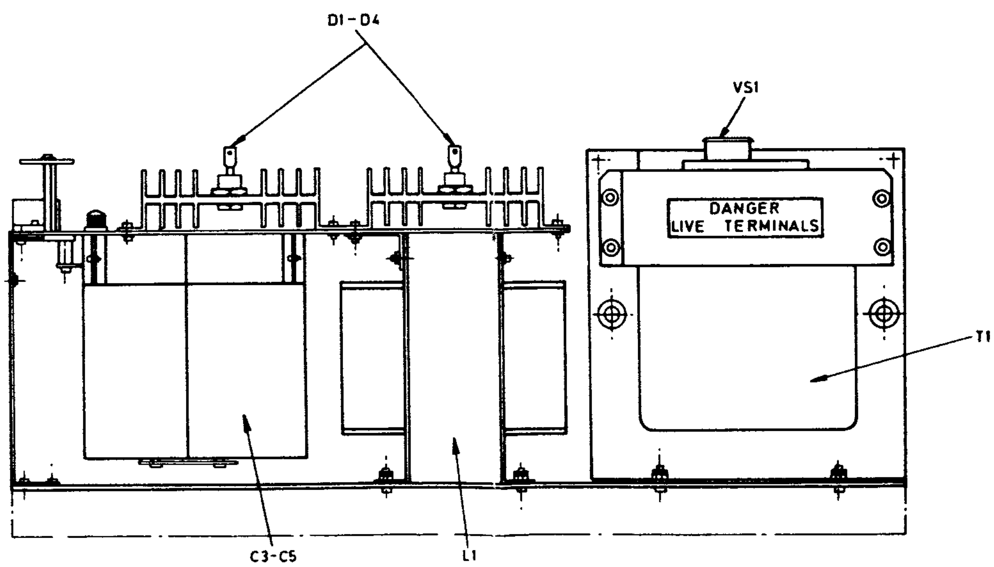
WOH 3037

Component Layout: Power Supply Unit MS64 Fig.26





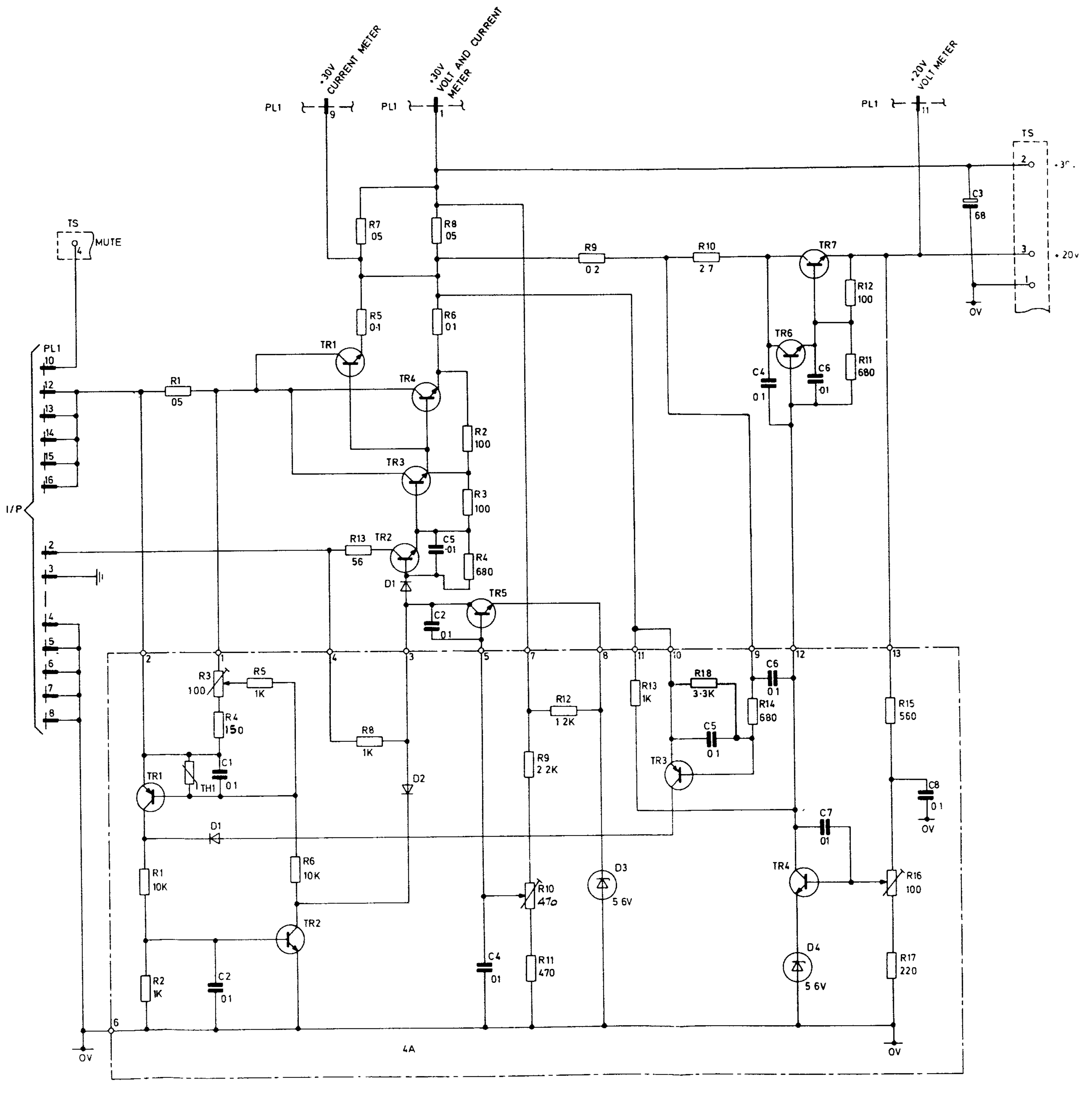
FRONT VIEW



TOP VIEW

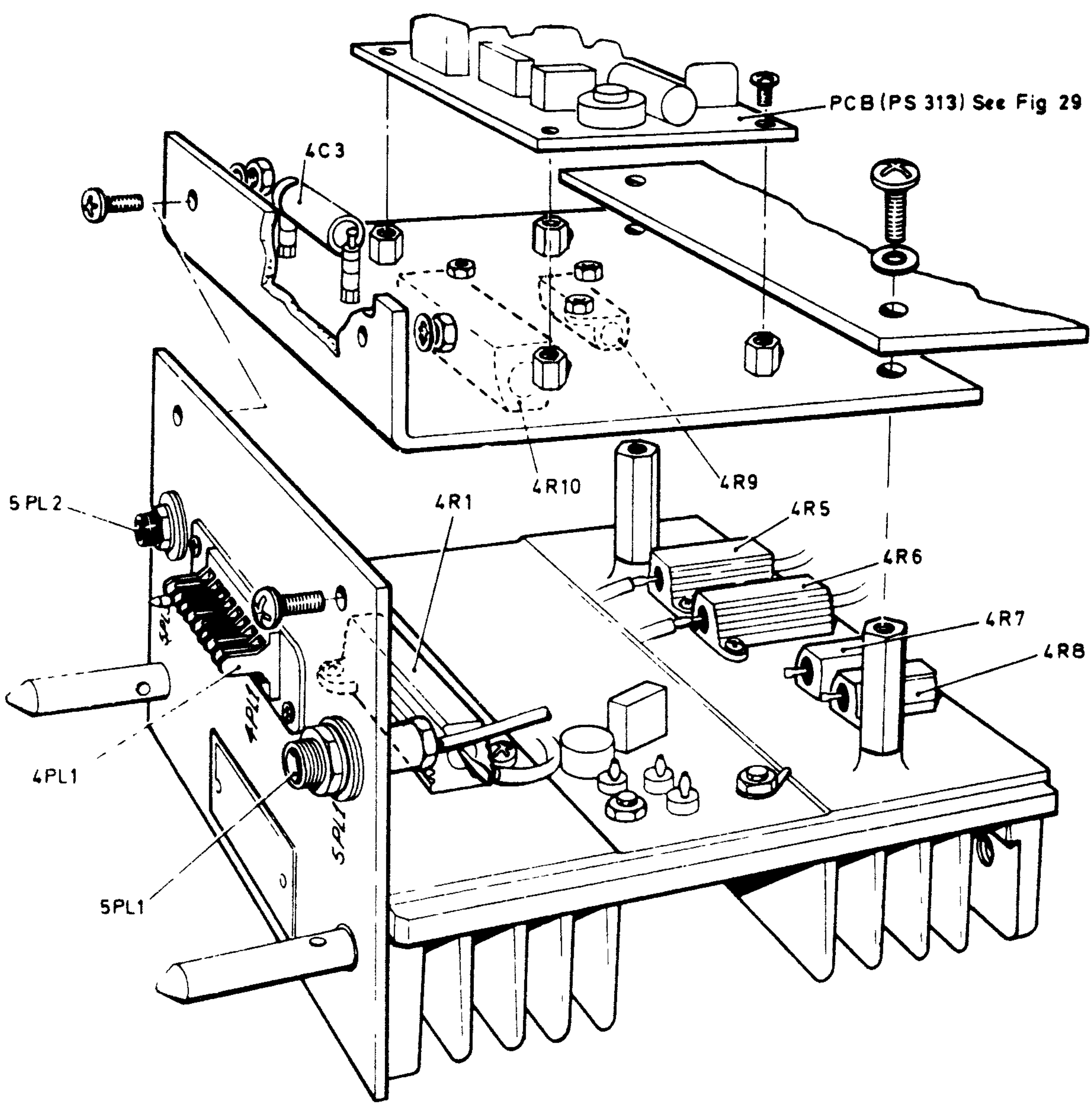
**Component Layout:
Power Supply Unit MS64/2**

Fig.26a



Circuit : Stabilizer MS 440

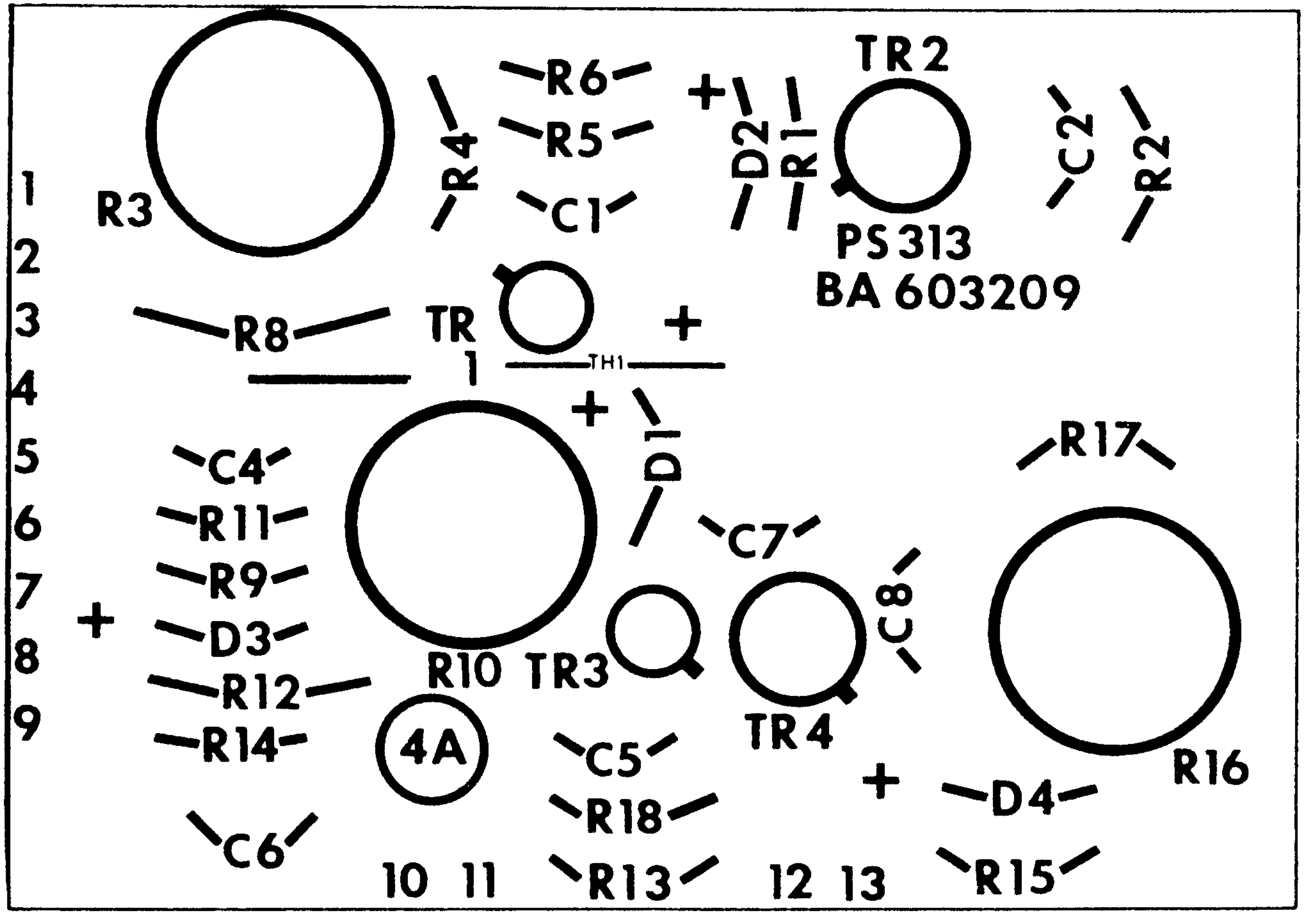
Fig 27



Component Layout
Stabilizer Module MS440

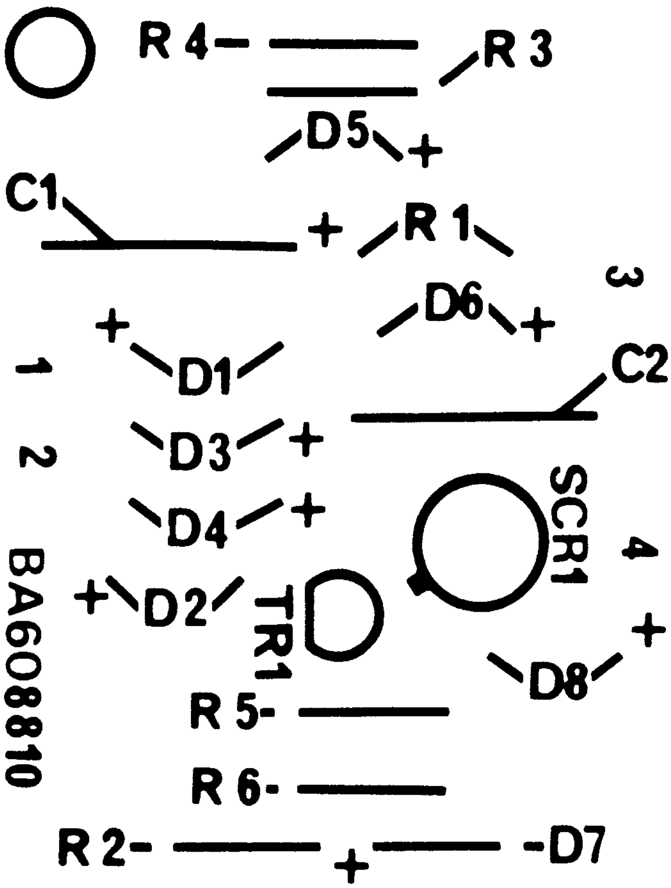
WCH3037

Fig. 28



Component Layout : Stabilizer PCB

Fig. 29

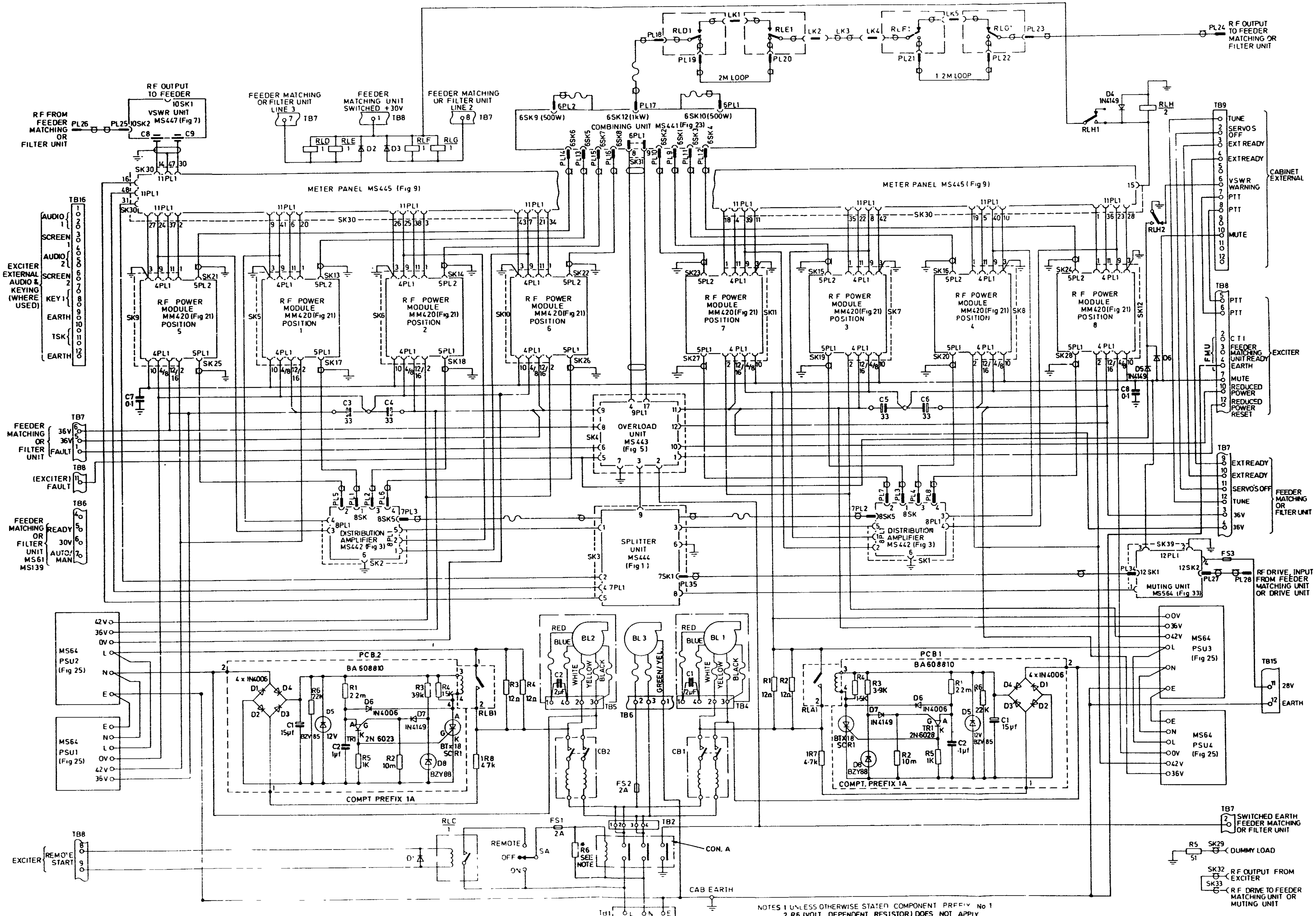


NOTE: CIRCUIT IS SHOWN ON OVERALL
INTER CONNECTING DIAGRAM FIG.31

WOH 3037	BD 608808

Component Layout: Relay PCB

Fig.30

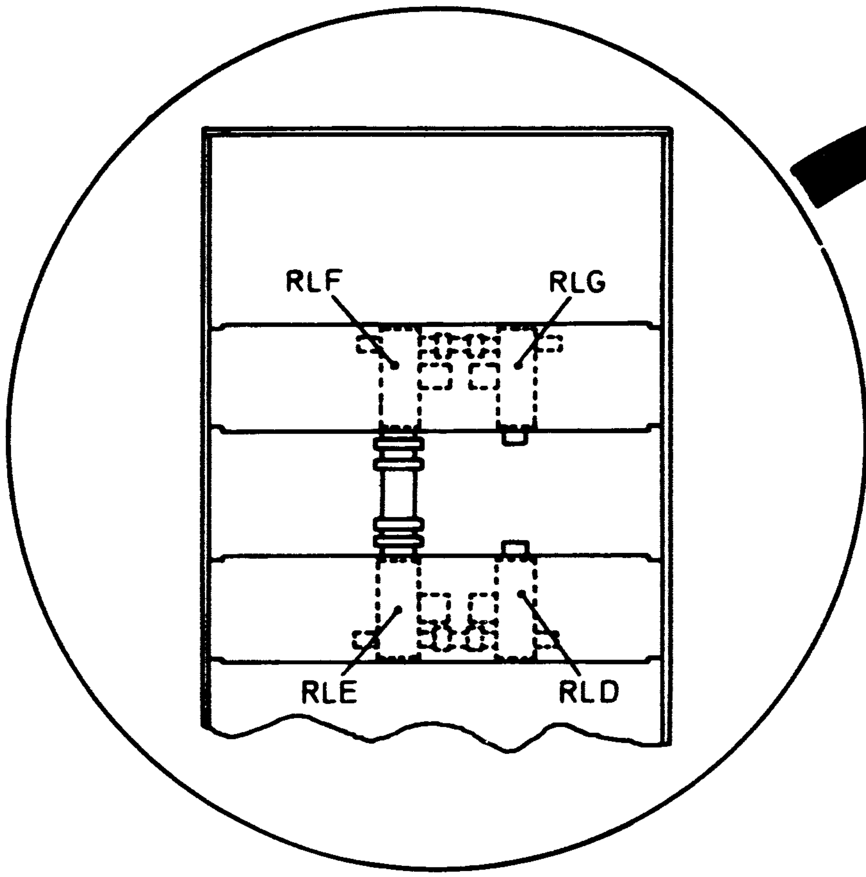


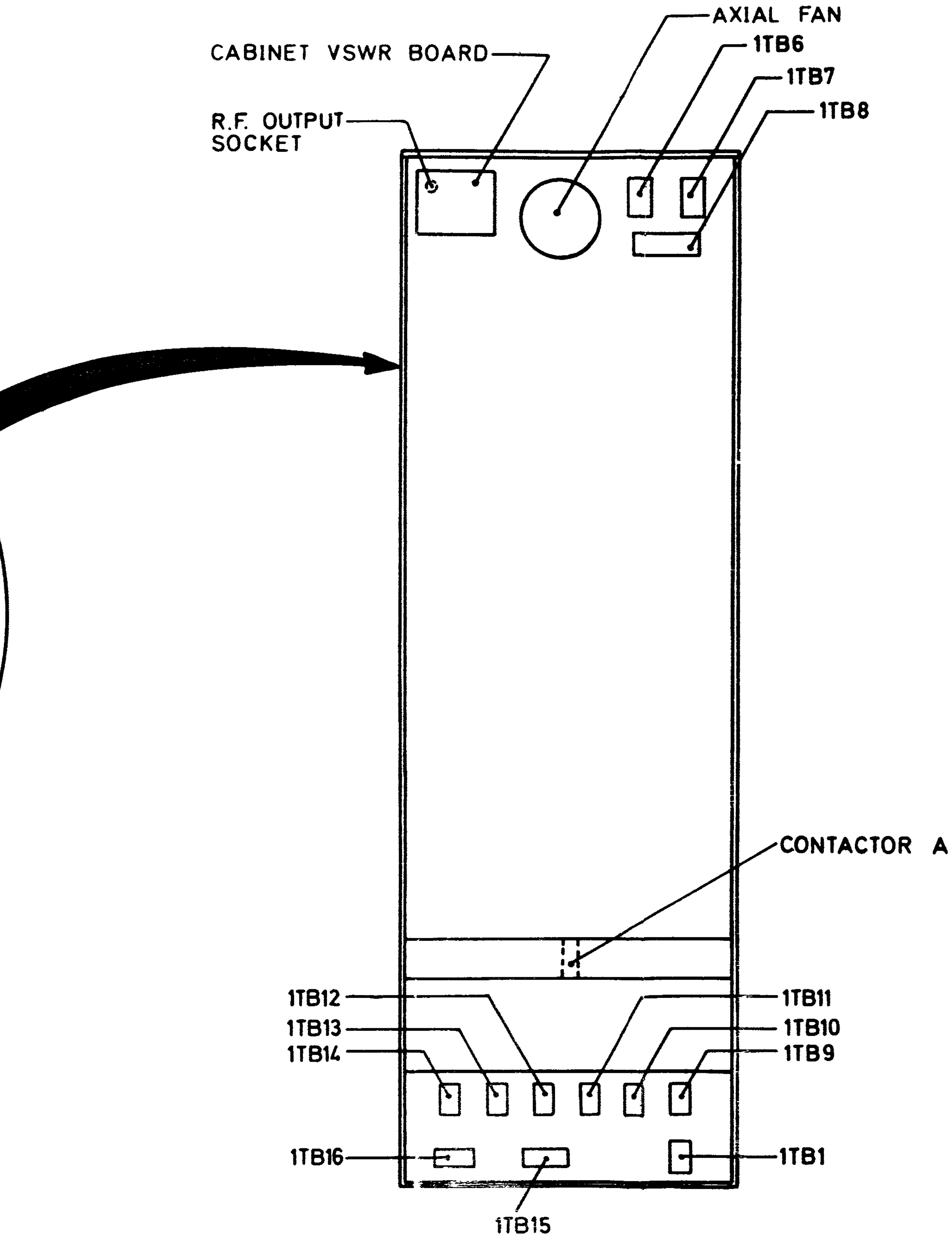
NOTES 1 UNLESS OTHERWISE STATED COMPONENT PREFIX No 1
2 R6 (VOLT. DEPENDENT RESISTOR) DOES NOT APPLY TO DC603140/Z

W0H3037 DC603140/A & /Z
2 4 5 7 8 12

Overall Interconnecting Diagram : TA1810

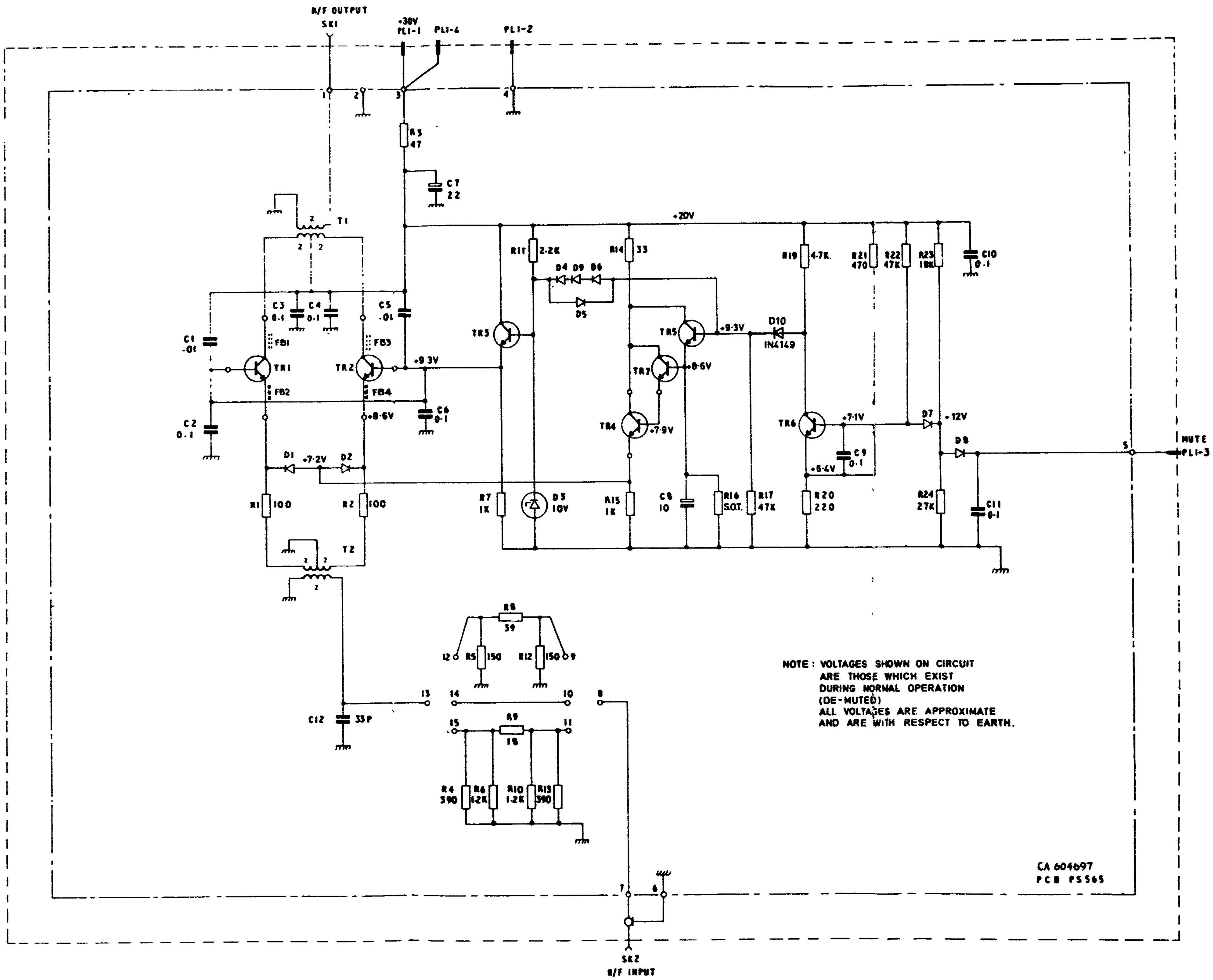
Fig.31





TA.1810 Location of Cabinet Connectors

Fig.32



TEST SELECTION TABLE

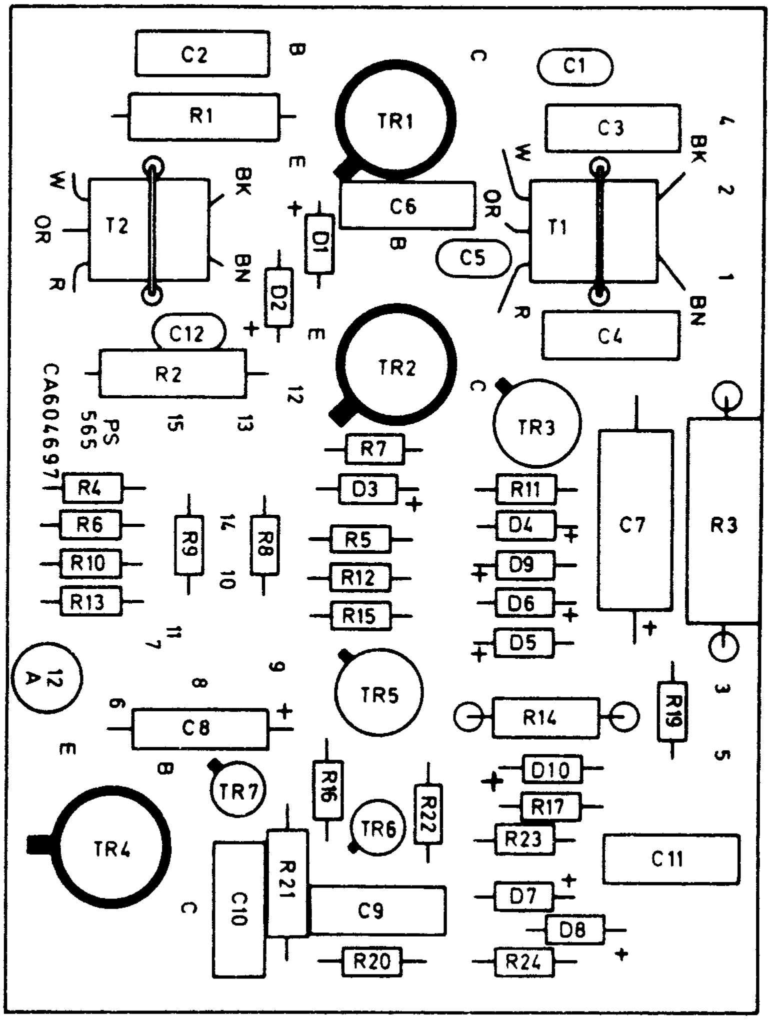
RESISTORS FIXED OXIDE FILM ±2%
0·25 WATT TO BS CECC 40 101-019 STYLE FX

DRG. No.	VALUE Ω	PT. No
AD82334/1	2K7	916548
—— " ——/2	3K3	910111
—— " ——/3	3K9	915074
—— " ——/4	4K7	913490
—— " ——/5	5K6	918128

WGH 3037 | DC604702
1 | 2 | 3 | 4

Circuit : Muting Unit

Fig. 33



WOH 3037
CA604697 | 1 | 2 | 3

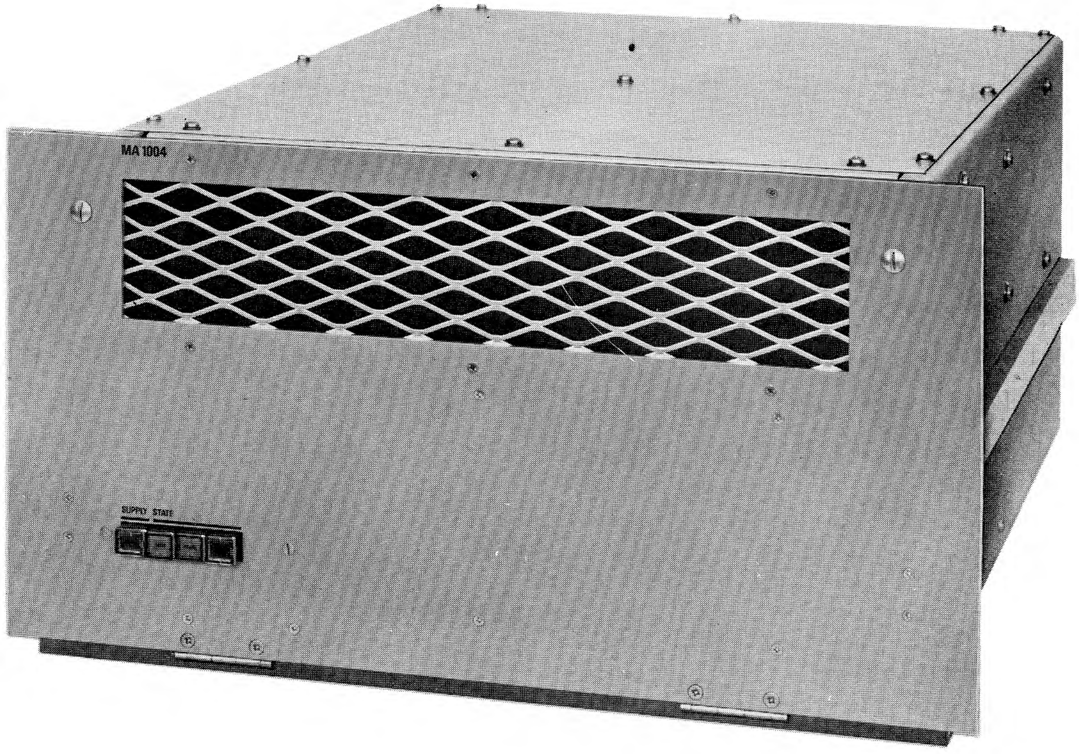
Component Layout: Muting Unit

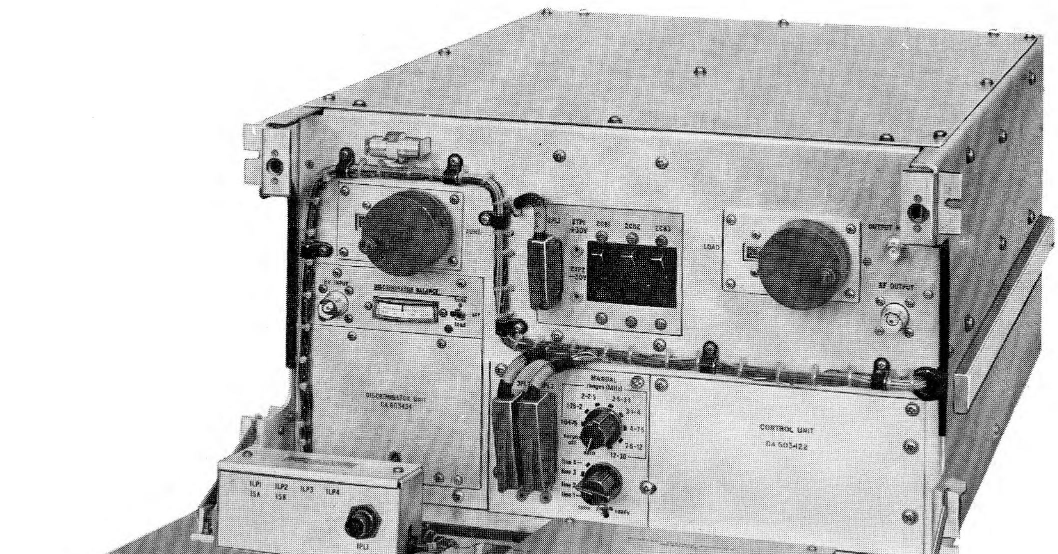
Fig. 34

MA 1004

FEEDER MATCHING UNIT

REF: WOH 3043
ISSUE: 14.2.91 - 25





VIEW WITH FRONT PANEL LOWERED

WOH3043

Feeder Matching Unit (FMU) MA.1004

FEEDER MATCHING UNIT MA.1004

CONTENTS

Table No.	TABLES	Page No.

ILLUSTRATIONS

TECHNICAL SPECIFICATION

Frequency Range	1.6 - 30MHz
Input Power	50W - 1.25kW
Load Impedance	50 ohm nominal - maximum VSWR 3:1
Input Impedance	50 ohm nominal
Harmonic Output	50mW maximum (when used with Racal range of solid state transmitters).
Tuning Time	8 Seconds Maximum 3 Seconds Typical
Low level input	25 - 200mW
Low level input impedance	50 ohm nominal
Power Consumption	350 VA maximum
Mains Input (Voltage Range	210V - 250V
(	+6% -10%
(Frequency Range	47 - 60Hz
Type of Tuning	Automatic with manual override
Weight	30kg (66lb)
Dimension	266mm (10,5/8in.) x 600mm (24in.) x 482mm (19¼in.)
Temperature Range (Storage	-40°C to +70°C
(Operating	-10°C to +55°C
Relative Humidity (Operating)	95% at 40°C

CHAPTER 1

GENERAL DESCRIPTION

INTRODUCTION

1. The MA.1004 Feeder Matching Unit (FMU) matches the 50ohm output of the Racal 1KW and 500W wideband solid-state linear amplifiers to antennas having impedances of up to 3:1 VSWR relative to 50ohm.

2. A power output of 1kw CW can be accepted, in the range 1.6 to 30MHz. Tuning of the FMU is carried out automatically; the maximum time required for a frequency change is eight seconds, average time is three to four seconds. Manual tuning facilities are provided for emergency or maintenance purposes.

3. The matching network consists of two variable inductors and a switched bank of ceramic capacitors arranged in 'T' configuration. The matching network also forms a low-pass filter which attenuates harmonics of the wanted frequency.

4. The FMU is a self-contained unit complete with power supply. It is, however, normally operated only within the associated transmitter cabinet.

5. The FMU is servo-tuned in two sequences, an initial coarse-tune sequence followed by a fine-tune sequence. A low level (25mW into 50ohm) drive is required for coarse-tuning, followed by a high power (50W minimum) input. The low-level drive is the normal output from the drive unit to the linear amplifier, the high-power signal is the output from the Linear Amplifier to the antenna.

PHYSICAL DESCRIPTION — Figs 29 & 30

6. The FMU is normally mounted on angle supports within the main transmitter cabinet. The unit can be withdrawn from the front of the cabinet but cannot be operated in the withdrawn position. The dimensions and weight are given in the Technical Specification.

7. The unit is constructed of sheet metal and embodies a main chassis upon which is mounted the sub-assemblies. A prefix coding system is used to provide unique identification of units, boards and components as listed below.

Sub-Assembly	Prefix Ref.
Main assembly (chassis)	1
Power Supply MS448	2
Including	
Power Supply PC Board PS57	2A

Sub-Assembly	Prefix Ref
Control Unit (MS450)	3
Including	
Motherboard PW178	3A
Range PC Board PS60	3B
Tune PC Board PS59	3C
Tune Servo Pre-amplifier PC Board PS108	PS108 (Tune)
Load Servo Pre-amplifier PC Board PS108	PS108 (Load)
Fine-Tune Discriminator (MS449)	4
Including	
Discriminator PC Board PS56	4A
Constant Voltage Amplifier (CVA) (MS452)	5
Including	
CVA PC Board PS58	5A
Coil, Motor and Gearbox Assembly (MS451) (Two)	6 (Coils are identified
Including	as IL1 and IL2)
Coarse-Tune Discriminator (PS106) (Two)	6A
Microswitch Bank Assembly	7
Tune Servo Power Amplifier (including PC Board PS201) (MS265)	9
Load Servo Power Amplifier (including PC Board PS201) (MS265)	9

BRIEF TECHNICAL DESCRIPTION

8. The RF network is a 'T' section filter comprising two continuously variable inductors and a bank of fixed ceramic capacitors, combinations of which are selected in eight ranges appropriate to the operating frequency. The wipers of the variable inductors are each positioned by an integral motor and gearbox which is driven by associated power and pre-amplifiers forming two independent Servo systems. The appropriate ceramic capacitors are connected by spring contacts, each operated by a solenoid and selected by the control unit. A section of each variable inductor is shorted out on the two highest frequency ranges by a similar mechanism.

AUTOMATIC TUNING

9. The sequence of Automatic Tuning is as follows:-

(a) Coarse Tuning

The low level RF drive to the Linear Amplifier from the Drive Unit is removed and rerouted, via a constant voltage amplifier (CVA),to the two coarse-tune discriminators. The outputs of the coarse tune discriminators are switched to the two servo amplifiers. The capacitor bank is then reset to neutral (i.e. no capacitors selected). The servo motors drive the wipers of the coils to the correct position to obtain zero output from the discriminators, i.e. the coarse-tuned condition.

(b) Coarse Tune/Fine Tune Change over

When the servo motors have completed coarse tuning and a detector has sensed that the servo amplifier outputs have fallen to a sufficiently low level (i.e. servo motors stopped), the control circuit allows the unit to change over to fine tune. At this time, using information from the motor-driven microswitch bank, the correct combination of ceramic capacitors appropriate to the coil position (and hence frequency range) is selected. The RF drive is then removed from the coarse tune discriminators and reconnected to the linear amplifier, and the servo amplifier inputs are switched to the fine tune discriminator output.

(c) Fine Tuning

The fine tune discriminators sample the amplitude and phase of the input signal to the 'T' network and provide zero outputs when the nominal 50 ohm resistive condition is obtained. The phase discriminator drives the 'tuning' coil wiper and the amplitude discriminator drives the 'loading' coil wiper. The servos are allowed to fine tune for a short period (about $1\frac{1}{2}$ seconds) and then a large time constant (integrator) is switched into each servo pre-amplifier feedback loop to prevent hunting. This has the effect of severely reducing the a.c. loop gain, but maintaining a high d.c. loop gain and hence high accuracy.

(d) Ready Condition

After a period of about three seconds from the coarse-tune fine-tune change over the control circuits provide a 'ready' signal output. The servos can then be inhibited, via a link in the 'Tune' P.C. Board, or can be left energized, dependent upon the transmitter system requirements.

MANUAL TUNING

10. During manual tuning, the servo system is inhibited and the selection of frequency range is made at a rotary switch situated on the control unit. This unit also contains two other switches associated with manual tuning (i) the line switch, used to select any one of four coaxial line lengths between the linear amplifier RF output and the FMU input (the lines are situated in the cabinet and in automatic operation are selected by external means) and (ii) the manual TUNE/READY switch, which is used to override the 'unready' output signal.

11. Both the manual range switch and the manual line switch operate via the range p.c. board to generate the necessary timing sequence so that arcing due to RF cannot occur at the capacitor or inductor contacts as they open and close. The variable inductors are positioned manually using the front panel control knobs in conjunction with the coarse tuning graph and the fine tune distriminator output meter.

CHAPTER 2

INSTALLATION AND OPERATION

INTRODUCTION

1. The Installation section of this chapter gives the procedures and connections necessary during initial installation (or re-installation after major maintenance) of the unit. The operating procedures are described in para. 8 and subsequent.

WARNING. DURING OPERATION HIGH-LEVEL RF VOLTAGES ARE PRESENT AT THE RF INPUT AND RF OUTPUT CONNECTORS AND SUPPLY VOLTAGES ARE PRESENT AT CERTAIN MULTI-WAY CONNECTORS; THESE CONNECTORS ARE ACCESSIBLE WHEN THE HINGED FRONT PANEL IS LOWERED. ENSURE THAT POWER IS REMOVED BEFORE ANY CONNECTOR IS DISTURBED.

INSTALLATION

2. The MA.1004 normally forms part of a 1KW or 500W Transmitter Terminal and is mounted in the transmitter cabinet. The following instructions assume that the MA.1004 is to be installed in the transmitter cabinet.

Initial Procedure

3. After unpacking the unit, carry out a careful visual check for any damage that may have been incurred during transit or storage. Lower the hinged front panel and remove the top cover of the unit and check that the interior is free of packing material etc. Raise the hinged front panel.

Supply Voltage Tappings

4. Remove the top cover of the unit and check that voltage tappings are set to suit the local supply voltage (see fig.5). Adjust tappings if necessary, and replace the cover over the FMU, ensuring that the longer screw is fitted in the central position.

AC Volts	Line Brown to winding 'c'	Neutral Blue to winding 'd'	Link Resistor R1 winding 'c'	 winding 'd'
210	0	105	105	0
220	5	115	115	5
230	0	115	115	0
240	5	125	125	5
250	0	125	125	0

Installation into Transmitter Cabinet

5. (1) Ensure that all power is removed from the cabinet.

(2) Remove blanking panel (if fitted) from the cabinet, and lower the hinged meter panel.

(3) Arrange the cabinet connecting cables so that they are positioned as close to the cabinet sides as possible, with connectors protruding from the front of the cabinet.

(4) Lift the FMU (two people are required) and slide it into the cabinet, ensuring that cables and connectors are not trapped or damaged. Do not slide the unit fully into place, but leave it protruding 60 to 80 mm (2 to 3 in).

(5) Lower the hinged front panel of the FMU.

(6) Support the cables and slide the FMU fully into the cabinet.

(7) Secure the FMU with the front panel screws. If necessary release the hinged front panel support arms and lower the panel to its fullest extent to gain access to screws. Replace the support arms in their normal position after securing the FMU.

Connection of the FMU in Transmitter Cabinet

6. (1) Connect the cabinet cables to the FMU as given in the table below, ensuring that the cables do not obstruct the movement of the hinged panel or the manual tuning controls when the panel is raised.

Cabinet Connector	Connects to	FMU Connector	Remarks
1SK35		1PL1	Mains supply. Arrange the cable to lie along the hinged panel between the hinge and the constant voltage amplifier (CVA) to its mating connection.
1PL28		5SK1	Low-level RF output
1SK32		5PL1	Low-level RF input
1SK34		5PL2	Control/Interface connections. Push in the connector, move the slide lock retainer to allow connector to mate fully then move the slide to 'locked' position.
1PL24		RF Input	High-power RF input
1PL26 (see note)		RF Output	High-power RF output

Note: The RF output cable of the cabinet is of extra length to allow the FMU to be by-passed if required (see para. 14). Additional cable should be stowed by pushing carefully into the side skin of the cabinet.

CONNECTOR FUNCTIONS

7. NOTE: If the FMU does not form part of a Racal Transmitter it is important to ensure compatability of equipment.

Plug and Pin No.	Function	Input of Output	Circuit Logic
1PL1	Supply	Input	210 to 250V +6%-10% 47 to 65Hz
Pin (a)	Line		
Pin (b)	Neutral		
Pin (c)	Earth		
5PL1 (50 ohm Coaxial)	Low level RF from Exciter	Input	25-200mW 1.6-30MHz
5SK1 (50 ohm Coaxial)	Low level RF to Linear Amplifier	Output	As input from exciter (5PL1)
5PL2	Control/Interface connections		
Pin 1	Fault	Output	OV = fault +12V = normal
Pin 2	Tune	Input	OV = Tune open circuit = normal
Pin 3	Ready	Output	OV = Ready +12V = Not ready
Pin 4	Earth from Contactor	Input	OV = Normal Open circuit = otherwise
Pin 5	Earth		
Pin 6) Pin 7)	External Ready Lamp	Output	30V from 120 ohm source resistance for 24V, 55mA lamp
Pin 8	Coarse Tune Initiate	Input	Open circuit or +12V = C.T. Initiate OV = Normal
Pin 9	Servos Off	Input	OV = Servos Off Open circuit or +12V = normal
Pin 10	Line 2	Output	OV to energise cabinet line 2 selection relay. Open circuit = relay not energised.

5PL2 (contd)

Plug and Pin No.	Function	Input of Output	Circuit Logic
Pin 11	Line 3	Output	OV to energise cabinet line 3 selection relay, Open circuit = relay not energised
Pin 12	+30V switched	Output	+30V supply to line selection relays in 'fine-tune' condition. Open circuit otherwise.
Pin 13	Manual	Output	+30V for 'manual' output to line switching unit (when fitted). Open circuit in 'auto'.
Pin 14	+30V Unstabilized	Output	+30V nom = 30V unstabilized supply available. Open circuit = 30V supply not available.
Pin 15	+30V stabilized	Output	+30V = stabilized supply to line switching unit available (when fitted). Open circuit in other conditions.
4SK1 (50 ohm coaxial)	High-Power RF from linear amplifier	Input	1.25KW maximum 1.6 to 30MHz
1SK1 (50ohm coaxial)	High-Power RF from FMU	Output	as input from Linear Amplifier Amplifier (4SK1)

OPERATING PROCEDURE

8. When the FMU has been correctly installed as part of a Racal Transmitter Terminal it is normally only necessary to carry out the extremely simple Automatic Tuning procedure given in para. 12., after carrying out the Initial Procedure (para. 10). It is however, advisable to carry out the manual tuning Procedure given in para. 11 following initial installation or major maintenance to ensure that the FMU is set-up correctly. The FMU cannot be operated as an independent unit.

CONTROLS AND INDICATORS — Fig. 4

9. The following controls and indicators are fitted to the FMU.

Front Panel

Note: Only the Front panel controls and indicators are used during Automatic Tuning.

(1) SUPPLY ON Push-button switch and indicator lamp

(2) TUNE Push-button switch and indicator lamp. The switch is not normally used when the FMU forms part of a Racal Transmitter Terminal. The indicator lamp illuminates during a tuning sequence.

(3) READY indicator lamp. Illuminates when the FMU is ready to accept traffic.

(4) SERVO LIMIT indicator lamp. Illuminates when an inductor is driven to an extreme position (see para. 13).

Sub Front Panel (Accessible when Front Panel is lowered)

(5) TUNE control and counter. Allows manual operation of the TUNE inductor.

(6) LOAD control and counter. Allows manual operation of the LOAD inductor.

(7) Circuit Breakers CB1, CB2 and CB3. These protect the FMU power supplies.

(8) DISCRIMINATOR BALANCE meter and three position switch. Used during manual tuning (para. 11).

(9) MANUAL switch. The AUTO position is normally used (para. 12). The SERVOS OFF position inhibits the servo motors. The remainder of the positions are used during manual tuning (para. 11).

(10) LINE switch. This switch is used during manual tuning (para. 11)

(11) TUNE/READY switch. Used after manual tuning to signal 'ready' to drive unit.

INITIAL PROCEDURE

10. The following procedure should be carried out prior to Automatic or Manual operation.

(1) Ensure that the SUPPLY switch on the front panel is OFF.

(2) Check that the Installation Procedure (paras. 2 to 7) has been correctly carried out.

(3) Lower the front panel and check that the circuit breakers CB1, CB2 and CB3 are ON. Raise front panel.

(4) Check that the FMU output is connected to a suitable antenna or dummy load.

(5) Mute the output from the drive unit and switch on the system cabinet.

(6) Depress the SUPPLY ON push-button and check that the associated green indicator lamp illuminates.

MANUAL TUNING PROCEDURE

11. (1) Carry out the Initial Procedure (para.10)

(2) Set the TUNE/READY switch to TUNE.

(3) Select the required frequency range at the MANUAL switch. When a frequency is at the end of two bands either band can be selected (e.g. when 2.0000MHz frequency is required either the 1.75 - 2 or the 2 - 2.5 range can be used).

(4) Set the LINE switch to LINE 1.

(5) Switch on the drive unit and set to give an output of between 25mW and 200mW at the selected frequency (see appropriate System Handbook).

(6) Referring to the tuning graph (fig.1) rotate the manual TUNE control until the appropriate counter setting for the required frequency is indicated.

(7) Refer to graph and set the LOAD control to the appropriate counter-setting.

(8) Adjust the manual TUNE and LOAD controls alternately until the DISCRIMINATOR BALANCE meter needle is centralised, setting the meter switch to TUNE or LOAD as required.

(9) Switch the meter circuit of the linear Amplifier to monitor the FORWARD POWER output (as given in the appropriate handbook) and note the reading.

(10) Set the switch on the FMU to LINE 2.

(11) Repeat operation (8)

(12) Note the FORWARD POWER output of the linear amplifier

(13) Repeat operations (8) and (9) with LINE 3 selected.

(14) Repeat operations (7) and (9) with LINE 4 selected.

(15) Select the LINE position that gives the greatest power output and finally re-adjust the TUNE and LOAD controls.

(16) Set the TUNE/READY switch to READY and the DISCRIMINATOR BALANCE switch to OFF. The FMU is now correctly tuned.

AUTOMATIC TUNING PROCEDURE

12. (1) Check that the Initial Procedure (para.10) has been carried out.

(2) When the FMU forms part of a Racal Transmitter System, the tuning initiation procedure is normally carried out automatically. The TUNE lamp will be illuminated whilst the servos are tuning, followed by the illumination of the READY lamp after a short delay.

(3) Switch on the drive unit and adjust it to give an output of between 25mW and 200mW at the selected frequency (see appropriate System Handbook).

(4) If tuning is not automatically initiated the TUNE push-button should be depressed to initiate a tuning cycle. Alternatively, a TUNE input can be provided at 5PL2-2.

NOTE 1 A tuning sequence will be initiated each time the TUNE button is depressed. No RF output is available from the transmitter when the TUNE button is depressed.

NOTE 2 The selection of a line suitable for the operating frequency (operations 10 to 15 of the manual Tuning Procedure, Para.11), is carried out automatically during the automatic Tuning Procedure.

(5) The operation of the automatic system can be checked, if required, by ensuring that the counters adjacent to the TUNE and LOAD controls indicate approximately in accordance with the tuning graph (fig.1) at the end of coarse tuning.

Fault Indication

13. A front panel SERVO LIMIT indicator is illuminated if either inductor is driven to its extreme of travel. If this occurs initiate another tuning procedure. If fault is still present check the input frequency and the output load impedance. If fault persists refer to Chapter 5.

BY-PASSING THE FEEDER MATCHING UNIT

14. The following procedures allow associated transmitters to operate in the event of a failure of the MA.1004. Under these conditions, the harmonic performance will be degraded and, if there is other than unity v.s.w.r. on the antenna feeder, the power output may be reduced.

(1) Switch off the power supply to the cabinet.

(2) Lower the hinged front panel of the MA.1004.

(3) Disconnect the high-power r.f. cables from the RF INPUT and RF OUTPUT sockets.

(4) Disconnect the low-power r.f. cables from 5PL1 and 5SK1 (rear of front panel).

(5) Release the slide locks and disengage the multiway connectors.

(6) Dress the cables to clear the sides of the MA.1004.

(7) Release the side arms and lower the front panel to its fullest extent. Remove the four screws securing the MA.1004 to the cabinet.

(8) Close the front panel and lift the MA.1004 clear (two persons are required) taking care to support the rear of the unit as it leaves its runners.

(9) Where the associated transmitter is either TTA.1860 or TTA.1870 series, proceed as follows:-

(a) Disengage the multiway connector (1SK36) from the MS.139 Line Switching Unit.

(b) Connect the MS.139 dummy plug (part of accessory kit CA.608) to 1SK36.

(10) Interconnect the high-power r.f. cables using the adaptor provided (located above the TUNE control on the MA.1004).

(11) Interconnect the low-power r.f. cables disconnected at step (4).

(12) Check that all unused cables are stowed correctly.

15. Transmission may now be resumed. The operating procedures are similar to those given in the relevant transmitter handbooks; the differences will be self-evident.

16. The instructions for refitting the MA.1004 into the cabinet are given in Chapter 2 para. 5.

CHAPTER 3

PRINCIPLES OF OPERATION

1. The following paragraphs describe the operation of the FMU during a tuning sequence to suit a change of frequency. Reference should be made to the functional diagram fig.3.

AUTOMATIC TUNING

Initiation of a Tuning Sequence

2. A tuning sequence is initiated by a +12V or open circuit input at 5PL2-8 or, alternatively, by a OV input at 5PL2-2. The front panel TUNE button may also be used in local applications. All three tune signals are commoned and fed to the Tune Board 3C pin 23, then, via 3CTR5 and 3CTR6 to the bistable 3CTR12, 3CTR13, which is reset. This removes the OV Fine Tune signal from 3C pin 16 and de-energises 3CRLA (para.4). At the same time 3CTR14, 3CTR15 and their associated delays are reset, de-energising 3CRLC, removing the Ready output (pin 28) and illuminating the TUNE indication lamp via 3CTR17 and pin 29.

3. The removal of the OV 'Fine-Tune' signal from 3C pin 16 (which is connected to 3B pin 30), results in an open circuit at 3B pin 29 (via 3BTR1 to 3BTR5). The relay 5RLA is, therefore, de-energized (para. 5). The open circuit at 3B pin 29 also removes the +30V output from 3B pin 27 (via 3BTR1, 3BTR6 to 3BTR13), de-energizing the solenoids IRLA to IRLF and relay 3RLA.

4. Relay 3RLA switches the servo pre-amplifier inputs to the outputs of the coarse-tune discriminators. Relays 3CRLA and 3CRLC set the gain of the servo pre-amplifiers to the coarse-tune state.

5. Relay 5RLA removes the low-level RF drive from the linear amplifier input and re-routes it, via the constant voltage amplifier (5TR1, 5TR3, 5TR4, 5TR6, 5TR8, 5TR10), to the coarse-tune discriminator inputs.

Coarse Tuning

6. The drive signal (low-level RF input) is fed to the coarse-tune discriminators which provide d.c. outputs. The outputs are amplified by the servo pre- and power amplifiers and cause the motors to drive the coil wipers to new coarse-tune positions.

7. The outputs from the servo pre-amplifiers are also applied (via 3CTR1 to 3CTR4) to gate 3CTR7, and inhibit its output until both pre-amplifier outputs have fallen below a reference level, i.e. until both servos have stopped.

Coarse Tune/Fine Tune Changeover

8. When all three input conditions of gate 3CTR7 (i.e., the two servo pre-amplifier outputs (para.7) and the 'correct RF' condition (para.16)), are satisfied, bistable 3CTR10, 3CTR12, 3CTR13 changes state (i.e. latches) and can only be reset by a coarse-tune initiate signal as described in paragraph 2.

9. The change of state results in

(1) a OV Fine Tune output at 3C pin 16.

(2) RLA being energised, reducing the gain of servo pre-amplifiers.

(3) Delays 3CR27, 3CC10, 3CTR14 and 3CR28, 3CC11, 3CTR15 commence.

10. The OV Fine Tune signal at 3C Pin 16 and 3B Pin 30 causes the output at 3B pin 27 to rise to 30V via 3BTR6 to 3BTR12 and, after a short delay, 3B Pin 29 to be grounded via 3BTR2 to 3BTR5, thus energising 5RLA (paragraph 12).

11. When the output at 3B Pin 27 rises to +30V, a trigger pulse is generated at 3B pin 26 by 3BTR13, and is routed via switch 3SA1 and the microswitch bank (Unit 7) to the appropriate range input on the Range PCB. The pulse is then encoded by diodes and used to select the appropriate combination of capacitors and coil connections in the main RF network by means of solenoids IRLA to IRLF. At the same time, relay 3RLA is energised, connecting the output of the fine-tune discriminators to the servo pre-amplifiers (paragraph 10).

12. When relay 5RLA changes over, (paragraph 10) the low-level RF drive is removed from the CVA (and coarse-tune discriminators) and re-applied to the linear amplifier input, thus providing a high-power input at 4SK1.

Fine Tuning

13. The outputs of the fine-tune discriminator (Unit 4) cause the servos to drive the coil wipers to the fine-tune position, giving a nominal 50 ohm resistive condition at 4SK1.

14. When delay 3CR27, 3CC10, 3CTR14 elapses, relay 3CRLC is energised, switching a large time constant into the servo pre-amplifiers. This drastically reduces the AC loop gain to prevent hunting, but maintains a high DC gain, giving high accuracy.

Ready Condition

15. When delay 3CR28, 3CC11, 3CTR15 has elapsed, the READY lamp is illuminated via TR16, and the TUNE lamp extinguished, via TR17. At this stage the servos are normally inhibited via the servo pre-amplifier supply gate (3CTR20 to 3CTR23) and link 3LK1. If required, however, the servos may be left energised by the removal of link 3LK1.

'CORRECT RF' DETECTED

16. If the low-level RF input is removed during any stage of the tuning procedure, (or during the 'ready' condition when servos are active), the servos are inhibited after a short delay via the RF detector 5TR15, 5TR16, 5TR17 and 3TR18 to 3TR23. This ensures that the servos cannot 'drift' away from the correctly tuned position in the absence of a compensating output from either the coarse or fine-tune discriminators. If this condition occurs in coarse tune, the coarse tune/fine tune changeover is inhibited via 3CTR7 until the RF is re-applied and coarse tuning is correctly completed. (paragraph 8).

SERVO PROTECTION

17. Current Limit Detector circuits are fitted to prevent the servo motors drawing excessive starting currents. The power amplifier output current is sensed by 9R1 which provides a control voltage via 9D1 to 9D6, to the pre-amplifiers, thus reducing the gain of the system and limiting the output current.

SERVOS OFF

18. At any stage of tuning, or afterwards, the servos may be switched off by two methods. The first is by operation of the manual range switch to the SERVOS OFF position. The second is by application of an external servos off (OV) signal to 5PL2-9. In either case, +30V is applied to 3C Pin 30 which opens the servo pre-amplifier supply gate 3CTR20 to 3CTR23.

FAULT SIGNALLING

19. Both Positive and Negative stabilised supplies are monitored, and, in the event of either supply failing, 5TR11-14 produce a fault output (OV) on 5PL2-1 provided that an external earth is applied on 5PL2-4. This earth is routed via the cabinet contactor, so that a fault output is not produced when the cabinet is switched off. If either servo runs to its limit position it operates a microswitch, which is used to disconnect the motor drive, and to illuminate the front panel SERVO LIMIT indicator. The servo limit condition also produces a fault output on 5PL2-1.

MANUAL TUNING

20. During manual operation the servo systems are completely inhibited and the selection of frequency range and line must be made by the operator (See Chapter 2.).

21. When switch 3SA is set to any of the manual range positions, +30V is applied to 3C Pin 25, via 3SA3 and 3SC1, causing 3CTR8 to 'pull down' the input to TR5, thus providing a 'tune' signal. The Fine Tune output on 3C Pin 16 is therefore removed but, after delay 3CR22, 3CC8 has expired is reapplied through 3CTR8, 3CTR9. The trigger pulse from 3B Pin 26 (para. 11) is now routed through 3SA1 to the appropriate range input on the range P.C.B. and through 3SA2, 3SC2 to the appropriate line input(a) on the range p.c.b.

22. The range P.C.B. operates normally to select appropriate capacitor combinations and coil connections; in addition it selects line lengths, at the transmitter, as the normal selection method is overridden by the manual signal.

23. If either 3SA or 3SC is moved to another position, the +30V signal on 3C Pin 25 is briefly interrupted as the switch passes between positions, therefore the OV fine tune output from 3C Pin 16 is momentarily lost. This causes the solenoids IRLA to IRLF to be unlatched. When the +30V reappears a trigger pulse is generated to reselect the combination appropriate to the new switch position. There is no necessity to remove the drive because the normal protective time sequencing operates during manual conditions.

24. Selection of a manual range applies a tune signal to 3C Pin 23, therefore the 'Ready' output must be provided manually. This is achieved by operation of switch 3SB which grounds 3CTR15 output via 3CTR8 (in 'manual' only), removes the TUNE output, and provides a READY output.

CHAPTER 4

DETAILED CIRCUIT DESCRIPTION

INTRODUCTION

1. The overall function of the unit is given in chapter 3. This chapter gives a detailed description of the circuits, the majority of which are mounted on printed circuit boards.

2. Each board carries a prefix code, as given in chapter 1, para. 7. The prefix codes are, generally, omitted from component references in this chapter unless the omission can cause ambiguity.

OVERALL CIRCUIT (prefix code 1) Fig.31

3. The overall circuit connections are mainly self-evident, or have been discussed in chapter 3. Capacitors 1C6 and 1C7 form a potential divider which provides a sample of the RF output at 1SK2 (via 1R1) for monitoring purposes.

POWER SUPPLY MS 448 (Prefix Codes 2 and 2A) Fig.7

4. Components of the PC Board PS57 within the power supply are prefix coded 2A, other components are coded 2. All input and output connections to the unit are made via a fifteen-way connector fitted to the front of the unit.

5. The unit provides the following outputs.

+30V (nominal) unstabilized DC 1.5A

-30V (nominal) unstabilized DC 1.5A

+30V stabilized DC 1.5A

-30V stabilized DC 0.2A

6. The circuit utilises a single-phase transformer with two secondary windings each feeding a bridge rectifier and reservoir capacitor. The supply input is via a circuit breaker CB1. The rectified outputs are protected by damped circuit breakers in each supply rail. If a circuit breaker trips both the stabilized and unstabilized outputs of the appropriate polarity are interrupted (See Note following para. 10). The stabilized outputs are also individually protected by electronic trip circuits (para. 8).

7. The positive stabilizer circuit operates as follows. Zener diode 2AD3 and resistor 2AR20 provide a stable reference voltage which is applied to the emitter of 2ATR6. A sample of the output voltage is fed via the potential divider chain 2AR22, 2AR23 and 2AR24 to the base of 2ATR6 which it is compared with the reference voltage. If the output voltage tends to be high the conduction of 2ATR6 is increased, reducing the

voltage at 2ATR5 base. Transistors 2ATR5 and 2TR1 are emitter-followers which provide current gain, therefore the reduced voltage at 2ATR5 provides a reduced output voltage. The output level, which may be set by adjusting 2AR23, is therefore maintained at a sensibly constant level.

8. The positive current trip circuit operates as follows. The output current is fed via 2AR10 and a proportion of the voltage developed across 2AR 10 (determined by the potential divider 2AR8, 2AR12) is applied across the base and emitter of 2ATR1. When this voltage reaches the trip level, 2ATR1 conducts, driving 2ATR3 into conduction. A rapid change of state then occurs because, as 2ATR3 conducts 2ATR1 is also driven more fully, causing both transistors to 'latch' in the fully conducting condition.

9. The voltage at the collector of 2ATR3 drops to about 0.5V causing the voltage at 2ATR6 collector to drop to about +1.2V (via D1). The output voltage is, therefore, effectively reduced to zero and can only be reset by switching off the mains supply, allowing time for capacitor 2C1 to discharge (about 10 seconds), then switching on again.

10. The negative stabilizer and trip circuit operates in a similar manner to that described for the positive circuit.

NOTE: On some units the +30V stabilized supply is not routed via circuit breaker 2CB2.

CONTROL UNIT MS450 (Prefix code 3) Fig.10

11. The control unit is an aluminium box containing the logic circuits, capacitor switching and timing circuits and servo pre amplifiers. These functions are performed by four plug-in P.C. boards, which mate with a mother board inside the unit. Also contained in the unit are switches for manual control, a power transistor to provide a switched supply to the cabinet line-switching relays during fine-tuning and a relay used to switch the servo pre-amplifier inputs to either the coarse-tune or fine-tune discriminators. The control unit prefix code is 3, the individual printed circuit boards within the unit carry the following codes.

Code 3A	Motherboard PW178
Code 3B	Ranged Printed Circuit Board PS60
Code 3C	Tune Printed Circuit Board PS59
Code PS108 (Tune)	Tune Pre-Amplifier PS108
Code PS108 (Load)	Load pre-Amplifier PS108

12. The motherboard provides interconnections between the boards plugged into it, and includes RF filtering components for the Servo Pre-Amplifier inputs. The main function of the Range PC Board is to select the appropriate capacitors from the capacitor bank to suit the selected frequency. The Tune PC Board performs most of the logic and timing functions associated with the tuning sequence. The two Servo Pre-Amplifiers provide the high DC voltage gains necessary to raise the outputs from the discriminators to a level

sufficient to drive the servo power amplifiers and motors. Transistor TR1 provides a supply for relay 3RLA and the line switching relays in the Cabinet, and is controlled from pin 27 of the Range PCB (para. 23).

RANGE PC BOARD PS60 (Prefix Code 3B) — Fig. 12

13. The Range PC Board encodes the range (frequency band) information from the microswitch bank or manual range switch and switches into the high-power circuit the correct combination of capacitors. It also switches the inductor solenoids and provides the necessary delays to prevent the capacitor and inductor solenoid contacts making and breaking whilst RF drive is applied to the linear amplifier. During manual operation the circuits also switch the coaxial relays in the Transmitter cabinet to provide one of four coaxial line lengths between the linear amplifier output and the FMU input. The operation of these relays is also sequenced to prevent arcing at the contacts.

14. A stabilized +30V supply is applied to pin 31 of the Board, the earth connection is at pin 32.

Delay Circuits

15. At the completion of coarse tuning the input at pin 30 (normally at +30V) changes to approximately +2V, cutting-off TR1. After a delay, caused by C2 discharging to approdimately 6V, TR6 is cut-off, causing TR7 and TR8 to conduct and C4 to be rapidly charged via R13. The Darlington pair TR9 and TR11 are then driven into conduction, causing TR10 and TR12 to conduct and provide a +30V supply to the solenoids (via pin 27).

16. At the same time as TR6 turns off, TR2 and TR3 are also cut-off, allowing C3 to charge via R9 and R10. When the voltage across C3 rises to approximately 24V transistor TR4 is cut off and TR5 is driven into conduction, providing an output to relay 5RLA (CVA) which removes the low level RF drive from the coarse-tune discriminator and routes it to the linear amplifier.

17. When changing from fine to coarse tune, pin 30 is open circuited and TR1 conducts, rapidly charging C2 through R4. TR2 and TR3 conduct, rapidly discharging C3, via R8; TR4 conducts and TR5 is cut-off. The relay 5RLA is thus de-energised and the RF input removed from the linear amplifier. At the same time as TR2 to TR5 conduct, TR6 also conducts, cutting-off TR7 and TR8 and causing C4 to discharge through R14, R15 until, at approximately 6V, TR9, TR11, TR10, TR12 cut-off, de-energising the solenoids.

18. In manual operation, the input to pin 30 is only briefly interrupted between manual ranges, therefore, TR1 acts as a pulse stretcher to ensure that the delays have sufficient time to operate.

Thyristor Circuits

19. The thyristors CSR1 to CSR7 energize solenoids 1RLA to 1RLF to select the correct capacitor/inductor combination for the frequency range in use (see Table 4.1)

TABLE 4.1

SELECTED CAPACITORS AND SHORTED TURNS

RANGE	RANGE P.C.B. INPUT PULSE	RANGE P.C.B. OUTPUTS (LOW)	SOLENOIDS ENERGIZED	CAPACITORS IN CIRCUIT	TOTAL CAPACITANCE	1L1 and 1L2 TURNS
1.6 to 1.75MHz	Pin 25	Pins 1 & 22	IRLA, IRLB	IC1, IC2	900pF + strays	Not shorted
1.75 to 2MHz	Pin 18	Pins 1,2,6	IRLA, IRLD, IRLC	IC1, IC5, IC3, IC4	774pF + strays	Not shorted
2 to 2.5MHz	Pin 16	Pins 1 & 2	IRLA, IRLD	IC1, IC5	592pF + strays	Not shorted
2.5 to 3.1MHz	Pin 23	Pin 1	IRLA	IC1	510pF + strays	Not shorted
3.1 to 4MHz	Pin 24	Pin 22	IRLB	IC2	390pF + strays	Not shorted
4 to 7.5MHz	Pin 20	Pin 6	IRLC	IC3, IC4	182pF + strays	Not shorted
7.5 to 12MHz	Pin 8	Pins 2 & 3	IRLD, IRLE, IRLF	IC5	82pF + strays	Shorted
12 to 30MHz	Pin 5	Pin 3	IRLE, IRLF	NONE	Strays only	Shorted

20. The selected thyristors are triggered by a single pulse, which is generated at the same time as the solenoid supply is energized (para.23), and are reset by removing the supply. The +5V triggering pulse is generated by TR13 and returned, either via the microswitch bank (automatic operation) or via the Range Switch SA1 (manual operation), to the appropriate range input of the board (pin 25, 18, 16, 23, 24, 20, 8 or 5). The pulse is then steered to the appropriate thyristor(s) via diodes D8 to D11, D15 to D18 or D20, and applied to the gates of the thyristor(s) CSR1 to CSR7.

21. Thyristors CSR1 to CSR5 control solenoids IRLA to IRLF which, in turn, switch capacitors IC1 to IC5 and the selected turns of IL1 and IL2. Thyristors CSR6 and CSR7 are used, in manual conditions only, to energize the line selector relays of the transmitter cabinet.

22. The solenoid IRLA to IRLF, and relay 3RLA (which switches the servo pre-amplifier inputs between coarse-tune and fine-tune discriminators) are energized by a slave transistor 3TR1 fed from pin 27.

Trigger Pulse Circuit

23. Transistor TR13 generates a single trigger pulse each time the voltage at pin 27 rises from 0 to 30V. When pin 27 is at OV, C5 is discharged to approximately 11V via D23 and D6. When TR12 conducts (para.16) and pin 27 rises to +30V, capacitor C5 charges via D22, R19 and T13 base-emitter junction, thus driving TR13 into conduction. The collector voltage rises to approximately +30V and this is limited by R20, D7 to give a +5V pulse at pin 26. When C5 is almost fully charged the voltage across R18 falls to below 0.6V, cutting-off TR13 and causing the completion of the output pulse at pin 26.

TUNE P.C. BOARD PS59 (Prefix Code 3C) — Fig.14

24. The Tune PC Board PS59 contains circuits which

(1) Control the Coarse-Tune, Fine-Tune, Ready Sequence.

(2) Detect when the servo motors are running.

(3) Switch the gain of the servo pre-amplifiers during tuning.

(4) Signal the state of the FMU.

25. The operation of the circuit is described, assuming a start from the 'in-coarse-tune' state and progressing through 'fine tune' to 'Ready', and reverting to the 'in-coarse-tune' state due to a 'tune' signal.

Servo Condition Detector

26. The outputs of the two servo pre-amplifiers (para.45) are fed via pins 13 and 7 of the Tune PC Board, to transistors TR1 and TR2, which are non-inverting for positive inputs and inverting for negative inputs. The transistors provide approximately unity gain.

The outputs at TR1 and TR2 collectors are, therefore, equal to the magnitude of the corresponding pre-amplifier outputs, and are combined in the 'or' gate D1, D2. The greater of the two outputs is compared, by the long-tailed pair TR3, TR4, with a reference voltage of approximately 12V, developed by R10 and R11.

27. When either output is greater than approximately +12V (which is greater than the pre-amplifier output required to drive a motor against 'striction') the servo 'running' condition is detected, and the collector of TR4 rises to approximately 27V. During 'servo stopped' conditions TR4 collector is at approximately 18V.

AND Gate D3, D6

28. The output of TR4 (servo(s) running) and the RF detector (see para.65) are combined in diodes D3, D6 which form an AND gate. The gate therefore gives a 0 volt output when

(1) The servo motors are NOT running

AND (2) RF drive is present at the detector.

29. Resistor R14 and Capacitor C5 give a delay on the output of the gate so that, should RF drive be removed during coarse tuning, and then re-applied, the servo pre-amp, outputs will have time to recover and prevent TR7 from being spuriously turned on. (See next para.).

Gate TR6, TR7

30. The output of AND gate D3, D6 is applied to TR7 and the output of pulse stretcher TR5 (Para.39) is applied to TR6. TR6 and TR7 form gates which give approximately +20V on TR7 collector when

(1) Both servos are stopped.

AND (2) RF drive is present at the detector

AND (3) There is no (TUNE) output from TR5.

These are the three conditions for coarse tune/fine-tune changeover.

Bistable TR10, TR12 and TR13

31. When these three conditions are satisfied the outputs of gates TR6 and TR7 cause the bistable TR10, TR12 and TR13 to changeover and latch. This is achieved by the 20V at TR7 collector which drives TR10 and TR12 into conduction and cuts-off TR13.

Relay and Time Delay Circuits

32. The conduction of TR10 and TR12 reduces the output at pin 16 to +2V (normally at approximately +6.5V) via D13, and energizes relay RLA via D16. Relay RLA contacts switch the gain of the pre-amplifiers (para.45). The cutting-off of TR13 causes the two delay circuits R27, C10 and R28, C11 to commence timing.

33. After approximately 1.5 seconds, i.e. when C10 has charged to approximately 9V, TR14 turns on and operates RLC, provided that the +30V servo supply is available (para.35). The contacts of relay RLC are also used to switch the gain of the servo pre-amplifiers (para.45).

34. After a further delay of approximately 1.5 seconds capacitor C11 has charged to about 9V, driving TR15 and TR16 into conduction and producing a 'ready' (+30V) signal at Pin 28. TR17 is therefore cut off, removing the tune signal from pin 29.

Servo Supply Switching Circuit

35. The servos are switched off by removing the ±30V supplies to the servo pre-amplifiers. This can be achieved by four methods.

(1) An external 'Servos Off' signal, routed via the CVA (unit 5)

(2) An internal 'Servos Off' signal from switch 3SA (Manual range switch).

(3) Link LK1 on the Tune PC Board is normally connected to switch off the servos when the 'ready' state is achieved.

(4) Absence of the 'correct RF' signal (OV) at pin 20.

36. The first three signals are connected together and operate instantaneously. When any of these are present, approximately +30V is applied at Pin 30 and this cuts off TR20, thus overriding TR19. TR20 to TR23 are therefore cut off removing the ±30V supplies to the servo pre-amplifiers. The last signal operates via a delay so that, during keying, the servos will not be switched at the keying rate. During longer periods of no-drive, however, the servos are inhibited to prevent long term d.c. drift from driving the servos in the absence of a compensating discriminator output.

37. The incorrect RF signal (+30V) at pin 20 cuts off TR18 and, when C14 has discharged via R37, R38 to about 36V, TR19 is cut off. This cuts off TR20 to 23 as given previously and removes the servo supplies.

Coarse Tune Initiate Circuit

38. A tuning sequence is initiated by a OV input to Pin 23 which performs the following functions

(1) It resets the two delays R27, C10 and R28, C11 via R29, D21 and D24, thus de-energising RLC and removing the READY signal (See para.34).

(2) It resets the bistable TR10, TR12, TR13, via TR5 and TR6 by removing the supply to TR13 collector and removing the input to TR10 base.

39. TR5 is a pulse stretcher which turns off for about 200ms when a short (minimum 2m sec) OV Tune input is applied at Pin 23. This ensures that the bistable has sufficient time to reset.

40. The reset bistable allows Pin 16 to rise to about +6.5V (limited on the range PCB) and de-energises relay RLA.

41. The control circuits are now reverted to the coarse-tune state and the unit is ready to retune to a new frequency.

'Manual' Circuit

42. When manual operation is selected a +30V input is applied to pin 25 via switches SA3 and SC1 (see fig.10). This input drives TR8 into conduction, causing a 'tune' input to TR5. This causes a momentary open circuit output at pin 16. Capacitor C8 charges via the coil of relay RLA, R21 and R22; when the voltage at C8 reaches approximately 2.5V transistor TR9 is driven into conduction and the open circuit at pin 16 is changed to a OV output, via D12, TR9, D11, TR8 and D9, thus giving a 'fine-tune' output to the Range P.C. Board.

43. During switch SA3 or SC1 selection the input at pin 25 is momentarily interrupted. Transistor TR9 is maintained in the conducting condition however, as C3 has insufficient time to charge via R47, preventing TR5 from conducting. After Manual tuning the switch SB must be set at the READY position to drive TR16 into conduction and indicate the 'ready' condition.

THE SERVO SYSTEMS

44. The FMU contains two identical servo systems; one drives the input (tune) variable inductor, the other drives the output (load) variable inductor. Each system consists of

(a) Servo pre-amplifier

(b) Servo Power Amplifier

(c) Servo Gearbox including coarse-tune discriminator.

The inputs to the servo systems are derived from discriminators. The coarse-tune discriminators are part of the Gearbox units (Unit 9) and the fine-tune discriminators are unit 4.

SERVO PRE-AMPLIFIERS PS108 (Prefix Code PS108) Fig.15

45. The two Servo Pre-Amplifier Circuits are identical, both being used to amplify the DC signals from the Discriminators. The first stage is an operational amplifier IC1 whose gain is controlled by external relays 3ARLA and 3ARLC mounted on the Tune PCB. The operational amplifier uses supply rails of +12V and -6V which are obtained by Zener stabilisation from the ±30V supplies to the remainder of the PCB. The offset in the input to the operational amplifier is countered by the potentiometer R4 which is adjusted to

give zero output in the balanced state. The output from the operational amplifier is fed to a longtailed pair, TR1 and TR2, and then to a second long-tailed pair TR3 and TR4. These pairs provide voltage amplification whilst minimizing any temperature drift.

46. The output from the second longtailed pair is fed to the output transistors, TR5 and TR6, which provide a relatively low output impedance to the Servo Power Amplifier. The gain of the second stage of the amplifier is controlled by the feedback path from the output of TR5 and TR6 to the output of the operational amplifier through R16. The d.c. balance of the output stage is adjusted by setting R19 to give equal voltages at TP1 and TP2.

47. The gain of the Servo Pre-Amplifier is controlled by external relays. In 'coarse-tune' the feedback is via R10 (1Mohm) and pin 11 is connected to pin 14 to discharge C2 if necessary. This condition gives the maximum loop gain.

48. During fine-tuning pin 11 is externally connected to pin 9, placing R2 in parallel with R10. The gain given in this condition is sufficient to bring the system to almost the correct position but there may be a tendency to hunt about the final position. When the 'ready' condition is obtained, pin 9 is connected to pin 14, switching C2 in parallel with R10 and providing a high d.c. gain and a slow a.c. response to give stability. The amplifier gain is approximately 1500 during coarse-tuning (pins 11 and 14 connected) and approximately 225 during fine-tuning (pins 9 and 11 connected).

49. The motor current feedback (current limit) signal is used to restrict stall current levels in conjunction with the Servo Power Amplifier Board. When the output current from the Servo Power Amplifier Board reaches the current limit, a voltage is fed back to pin 4 on the Servo Pre-Amplifier Board.

50. When this signal is present dominant negative feedback is applied to the long-tailed pairs on the Servo Pre-Amplifier Board via R17. This reduces the voltage gain of the pre-amplifier circuit and limits the current to a safe level during the normal tuning period. If however the high current persists for about 10 seconds, the appropriate circuit breaker in the power supply trips, thereby protecting the servo motor(s).

SERVO POWER AMPLIFIERS MS265 (Prefix Codes 9 and 9A Fig.28

51. Components on the PS201 P.C. Board are Prefix coded 9A, other components are coded 9. The servo power amplifier provides the current gain necessary to drive the servo motor, with a voltage gain slightly less than unity. Transistors TR1 and TR2 form a complex NPN high gain, high current transistor, and TR3, TR4 form a complex PNP high gain, high current transistor. The two complex transistors are arranged as a push-pull complementary pair. The diodes D1 to D6 provide the current limit delay, so that the voltage developed across R1 must exceed ±3V approximately before an output to the servo pre-amplifier is given at pin 7.

COIL, MOTOR AND GEARBOX ASSEMBLY MS451 (Prefix Codes 6 & 6A) Fig.24

52. Components on the Coarse-Tune Discriminator PC Board are prefix-coded 6A, coils are coded 1L1 and 1L2, other components are coded 6.

Motor and limit Switches (Prefix Code 6)

53. The motor M1 is used to drive a variable inductor (1L1 'tune' or 1L2 'load') through reduction gears. Limit switches SA1 and SB1 are used to electrically disconnect the motor before mechanical end stops are reached. When the motor is driving towards the LF position a positive voltage is applied at the input pin 8. If the microswitch SB1 is operated the return path through the motor is opened and diode D2 places a short circuit across the motor to give rapid braking. When the motor is required to retune the inductor to a higher frequency, a negative voltage is applied at pin 8, D2 is reverse biassed but D4 conducts, driving the motor away from the end stop. A similar action occurs when the HF limit switch SA1 is operated.

54. Microswitch contacts SA2 and SB2 are used to signal a 'Servo limit' condition.

Coarse-Tune Discriminator (Prefix Code 6A) • Fig.25

55. The Coarse-Tune Discriminator PS106 provides a d.c. input to the servo system during coarse-tuning. The RF signal from the CVA is fed via terminal 6TB1-1 to pin 1 of the P.C. board, and to Transformer T1. The signal is then fed to a bridge circuit comprising R1, R2, R3 and the variable capacitor 6C1. The outputs are detected from the junction of R3 and 6C2 and the wiper of R7.

56. 6C2 is ganged to the output of the gearbox and its position is adjusted during 'coarse-tuning' such that its impedance gives equal voltage amplitudes at the two detection points. R7 allows the bridge circuit to be balanced at a frequency of 1.6MHz. The preset variable capacitor 6AC1 allows the bridge, after adjustment at 1.6MHz, to be balanced at 30MHz. The output from pin 3 is fed to the Servo Pre-Amplifier.

FINE-TUNE DISCRIMINATOR MS449 (Prefix Code 4) Fig.19

57. The phase discriminator compares the phase of the input RF voltage and current and provides an output which causes the 'tune' inductor IL1 to be adjusted to give the resistive condition at the FMU input. The amplitude discriminator compares the amplitude of the input RF voltage and current and provides an output which causes the 'load' inductor to be adjusted to give an input impedance of nominally 50 ohm.

Phase Discriminator

58. The phase discriminator accepts an input from 4L1, a current transformer on the RF input line which produces two equal voltages proportional to, and in phase with, the line current. The voltages are developed across 4AR2 and 4AR5. Components 4R1, 4R2 and 4AC4 form an RC potential divider across the input which develops a voltage across

4AC4 proportional to, and lagging by 90°, the line voltage. This voltage across 4AC4 is vectorially added to the two equal voltages across 4AR2 and 4AR5.

59. If the phase relationship is correct the two resultants are equal in magnitude (see fig.16) and, after rectification in 4AD1, 4AD2, they cancel in 4AR4 to produce zero outputs at pins 5 and 6.

60. If the phase relationship is incorrect the two resultants become unequal in magnitude so that, after rectification, the cancellation is not complete and a d.c. output is produced. This output is fed to the servo pre-amplifier and causes the servo system to reduce the phase error.

61. Variable resistor 4AR4 is used to compensate for any unbalance in the discriminator and 4AR16 to correct the discriminator characteristic at the low frequency end of the range.

Amplitude Discriminator

62. The amplitude discriminator is fed via 4L2, a current transformer on the input line which develops a voltage across 4AR11 proportional to line current. Components 4C1 and 4AC7 provide a capacitive potential divider which develops a voltage across 4AC7 proportional to line voltage. These outputs are rectified in peak to peak detectors, and, if the impedance is correct, the outputs are equal in magnitude and cancel in 4AR10 to produce zero output at pins 2 and 3.

63. Resistor 4AR15 is included to correct the discriminator characteristic at the LF end of the range; resistors 4AR8 and 4AR12 reduce the effect of harmonics on the discriminator output.

64. Meter 4M1 and its associated switch 4SA is used to monitor the discriminator outputs, and is normally only used during manual tuning.

CONSTANT VOLTAGE AMPLIFIER MS452 (Prefix Codes 5 and 5A) Fig.22

65. Components on the PS58 P.C. board of the Constant Voltage Amplifier (CVA) are prefix-coded 5A, other components are coded 5.

66. The CVA contains the input and output circuits which interface the FMU with the transmitter, the low-power RF switching relay, the RF detector and the constant-voltage amplifier. Apart from the high-power RF connections and the supply input, all external connections to the FMU are made via the CVA. The required logic states of external control connections are +12V (nominal) or open circuit for one state and OV for the second state. The connections are listed in Chapter 2.

Ready Circuit

67. The +30V 'Ready' or OV 'Not Ready' signal from the Tune P.C. Board is applied to PL3-14, and is interfaced by TR2 to provide a OV=Ready or +12V = Not Ready

signal at PL2-3. An output is taken via R37 and PL3-10 to the front panel READY indicator lamp, and, via R40 and PL2-7, to an external READY indicator lamp. Pin PL3-17 is connected to earth via the servo motor limit switches so that the earth is removed if a 'servo limit' fault occurs (para.73). PL2-6 is the return for the external READY indicator lamp.

Coarse Tune Initiate Circuit

68. Coarse tuning is initiated externally by a +12V or open circuit input at PL2-14 (normal condition of the input is OV). This signal is interfaced by TR5 to provide a OV Initiate signal at PL3-8. An external signal (OV for Initiate) may be applied to pin PL2-2 if required.

Servos Off Circuit

69. The servos can be switched off by a OV input at PL2-9, which is interfaced by TR9 to provide a +30V output at PL3-16. The normal input state is +12V or open circuit.

Fault Indicator Circuit

70. Failure of the +30V or -30V stabilized supplies provides a fault output indication (OV = fault, +12V = normal) at PL2-1. The fault output is also provided when a servo limit fault occurs (para.73). An earth input, normally derived from the transmitter cabinet contactor via PL2-4, is required before the fault circuit can operate.

71. When both the +30V and -30V supplies are available TR14 is cut-off due to the reverse bias on D21. In this condition TR13 is conducting and TR12 and TR11 are cut-off, providing a +12V output at pin PL2-1, via D19 and R32. The output is limited at this voltage by the Zener Diode D17.

72. If the -30V supply fails TR14 is driven into conduction reversing the state of TR13, TR12, and TR11 and reducing the output to approximately +1.5V at PL2-1. If the +30V supply fails, there will be no voltage on D19+ and therefore on PL21, the fault output, unless this point is connected to an external source. In this event D19 is reverse-biassed via R32. TR12 is therefore 'turned on' via R33 and this turns on TR11, reducing the voltage at PL2-1 to about +1.5V.

Servo Limit Circuit

73. A servo limit fault (either 'tune' or 'load') applies an earth at PL3-9, which provides an external fault output (OV) at 5PL2-1 (via D16). The SERVO LIMIT indicator lamp is illuminated via R34, PL3-12 and PL3-13.

CVA and Relay RLA

74. When relay RLA/2 is energized by an earth at PL3-21 the low-power RF input at PL1 is routed directly to the output SK1. When the relay is de-energized the input is fed to the CVA via T2, and socket SK1 is earthed.

75. The RF from T2 is applied to the emitters of TR6, TR7, TR8 and TR10 via resistors R18, R19, R26 and R30. The collectors of TR7 and TR8 provide the output of the CVA, which is fed to the coarse-tune discriminators via T1, PL3-4 and PL3-5.

76. The output of T1 is also fed, via C4, to the detector stage D5, D6 and the detected output is compared, by the long-tailed pair TR1 and TR3, with a reference level set by potentiometer R2. The output of the comparator, at TR3 collector, is amplified by TR4 and fed to TR6 and TR10, which act as variable shunts across TR7 and TR8. The output of the circuit is, therefore, maintained at a constant level as pre-set by R2.

RF Detector

77. The RF input at PL1 is detected by the peak-to-peak detector D18, D20, whose output is used to drive TR15 into conduction, which in turn, drives TR16 into conduction. Transistor TR17 is then cut-off, disconnecting PL3-15 from the +30V supply and giving an open circuit, 'RF Detected' output at PL3-15. In the absence of RF TR17 turns on giving +30V at PL3-15.

MICROSWITCH BANK (Prefix Code 7) Fig.27

78. The microswitch bank consist of seven microswitches which areoperated by cams on a shaft driven by the 'tune' motor and gearbox unit. Switch positioning at the completion of coarse tuning is, therefore, related to input frequency. The positions of the cams are adjusted so that the microswitches operate in succession at the frequency range changeover points. The microswitch contacts are wired so that the highest frequency range selected inhibits all the lower range outputs. The output of the switchbank is fed to the Range PC Board in the Control Unit where it is used to select the combination of capacitors and shorted inductor turns appropriate to the operating frequency.

CHAPTER 5

FAULT LOCATION

INTRODUCTION

1. The only fault indicator fitted to the FMU is the SERVO LIMIT indicator lamp. The procedure to clear a servo limit fault is given in Chapter 2.

INITIAL FAULT LOCATION

2. The following procedure should be carried out prior to detailed fault location.

(1) Connectors

Check that all connectors are securely mated.

(2) Mains Supply

Check that the circuit breaker 2CB1 is set to ON and that the supply lamp on the front panel is illuminated.

(3) Unstabilized Supplies

Check that circuit breakers 2CB2 and 2CB3 are set to ON.

(4) Stabilised Supplies

Check that +30V appears at 2TP1, and that -30V appears at 2TP2 (both test points on the power supply unit.

(5) Check that the correct operating procedure is being used (Chapter 2).

FAULT LOCATION PROCEDURE (MANUAL OPERATION)

3. Fault location during manual operation is relatively simple since much of the circuitry is inoperative. The range P.C.B. works in the same way as for automatic operation, except that in 'manual', it also controls the coaxial line switching relays, whereas in 'automatic' these are controlled by an external unit. Normal fault finding procedures should be applied making reference to individual circuits.

FAULT LOCATION PROCEDURE (AUTOMATIC OPERATION)

4. The detailed fault location procedure is tabulated under four headings, viz.

(1) Servo Motors will not rotate (Table 5.1)

(2) Servos will not Coarse-Tune correctly (Table 5.2)

(3) Servo Motors will not rotate in 'fine-tune' condition (Table 5.3)

(4) Servos will not Fine-Tune correctly (Table 5.4)

The automatic operating procedure (Chapter 2) should be used during the following procedure.

FAULT LOCATION AT RANGE, TUNE and PRE-AMPLIFIER BOARDS

5. Extender boards are available to allow access to be gained to the Range, Tune and Pre-Amplifier boards in the Control Unit. Extender Board CA 604130 is used with the Tune and Range boards; extender board CA 604163 is used with the Pre-Amplifier boards.

TABLE 5.1

SERVO MOTORS WILL NOT ROTATE

- Is the Initial Procedure (para. 2) satisfactory?
  - No → Check Power Supply Unit
  - Yes → Is MANUAL range switch set to auto?
    - No → Set to Auto
    - Yes → Is MA.1004 receiving a 'Servos Off' signal at 5PL2-9?
      - Yes → Remove the signal
      - No → Is RF drive of 25mW in the range 1.6MHz to 30MHz present at 5PL1?
        - No → Apply correct drive input
        - Yes → Is the TUNE lamp illuminated?
          - No → Depress the TUNE button
          - Yes → Is there an output at 3 TP1 and/or 3 TP2
            - Yes → Is there an output from the servo power amplifier(s)
              - Yes → Check gearbox(es) and motor(s)
              - No → Check Servo Power Amplifier(s)
            - No → Are the servo pre-amp supplies present?
              - No → Check Tune PCB
              - Yes → Is an error voltage being developed by the coarse-tune discriminators?
                - Yes → Check Servo pre-amplifiers
                - No → Is RF reaching the coarse-tune discriminators?
                  - Yes → Check Coarse-tune discriminator(s)
                  - No → Check C.V.A.

TABLE 5.2

SERVOS WILL NOT COARSE-TUNE CORRECTLY

Check that the low-power drive input is between 1.6MHz to 30MHz (at 25mW to 200mW). If drive is correct check the coarse-tune tracking (see Chapter 6)

TABLE 5.3

SERVO MOTORS WILL NOT ROTATE IN 'FINE' TUNE CONDITION

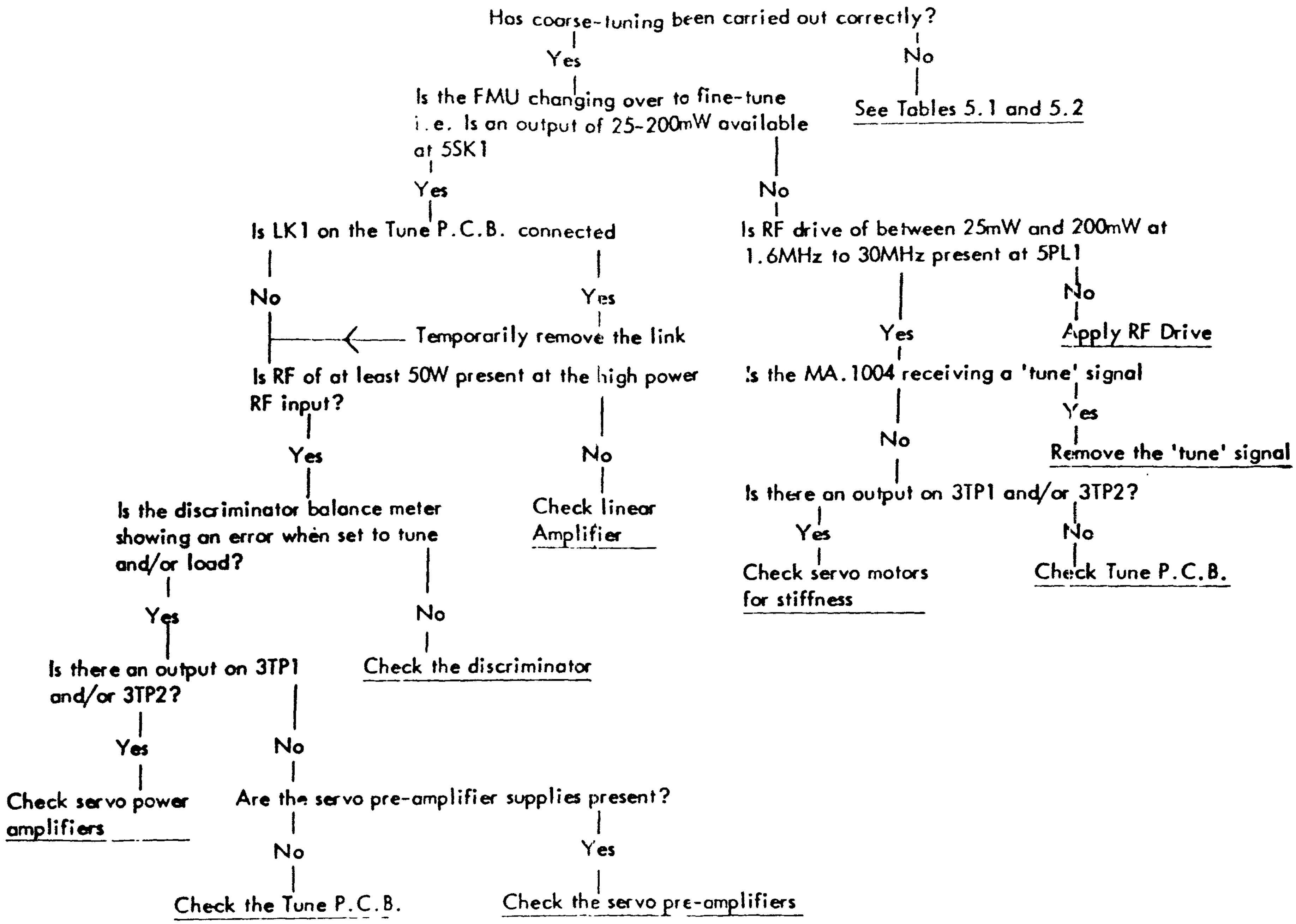


TABLE 5.4

SERVOS WILL NOT FINE-TUNE CORRECTLY

- Is the drive frequency between 1.6MHz and 30MHz?
  - Yes
    - Is the unit coarse-tuning correctly?
      - No
        - See Table 5.2
      - Yes
        - Is the High-Power RF output terminated in a suitable load i.e., up to 3:1 VSWR at 50 ohm?
          - Yes
            - Is the combination of capacitors selected appropriate to the frequency of operation?
              - Yes
                - Are the amplitude and phase discriminators set up correctly?
                  - Yes
                    - Inspect the components of the high-power network for damage
                  - No
                    - Reset the discriminators (See Chapter 6)
              - No
                - Is the microswitch bank correctly set up?
                  - Yes
                    - Check the Range P.C.B.
                  - No
                    - Reset microswitch bank (See Chapter 6)
          - No
            - Terminate the RF output
  - No
    - Correct drive frequency

CHAPTER 6

MAINTENANCE

NTRODUCTION

. This Chapter covers the routine maintenance procedures for the FMU, and the mechanical and electrical alignment procedures. The relevant alignment procedures hould be used when assemblies are replaced after overhaul, or if the fault location rocedure indicates mal-aligned component. An accessory kit is available to assist in naintaining the MA 1004.

OUTINE MAINTENANCE

. The following procedures should be carried out at approximately 12 month intervals (more often under severe conditions of use).

lechanical

. Coil and Gearbox

(a) Examine the spur gears and lubricate if necessary with a high temperature lithium based grease such as 'Esso Beacon 325'.

(b) Examine the small insulating wear strips located at two corners of the rotor (either side of the coil helix) and replace if necessary using Evostik 528 adhesive.

(c) Check the backlash between the rotor assembly and shaft:-

Rotate the manual tuning handle to bring one corner of the rotor assembly to the top and then hold the handle firmly in this position. With a suitable tool e.g. small screwdriver, try to push the corner of the rotor around the helix in both directions. Note the two limits of FREE movement.

The distance between these positions should not exceed 1/8" at the circumference of the coil. If this figure exceeds 1/8", the backlash adjustments should be performed as follows:-

Rotate the manual tuning handle so that the rotor contacts point to the bottom of the unit. Using a small screwdriver inserted between the coil turns tighten both of the screws visible in the body of the rotor by 1/8 turn ONLY.

Recheck the backlash as above and continue adjustment as necessary ensuring that both screws are turned through the same angle each time.

Do not overtighten the adjustment screws.

4. Air Filter

The air intake filter mounted on the hinged panel should be removed at regular intervals and cleaned by washing in warm soapy water. Ensure that the filter is completely dry before replacement.

Electrical

5. Check the positive and negative stabilized supplies at regular intervals (test points 2TP1 and 2TP2 on the power supply unit). The method of adjustment is described under 'Realignment' (para. 12).

MECHANICAL RE-ALIGNMENT

6. Whenever a coil and gearbox is removed, it is necessary to realign the counter and drive assembly (para. 9) and to reset the coarse tune tracking (para. 15). In addition, when the 'tune' coil (1L1) and gearbox is removed, it is necessary to realign the microswitch bank coupling and operating cams.

7. The mechanical re-alignment procedure is carried out with all power removed from the FMU.

Coil and Gearbox

8. The following procedure is applicable to each inductor and gearbox, and is carried out with the assembly on the bench.

(1) Slacken the grub screw securing the gearbox microswitch striker arm and ensure that the arm is free to move on its shaft.

(2) Rotate the coil shaft manually until the rotor reaches the mechanical stop at the gearbox end of the shaft, ensuring that the air-spaced variable capacitor does not reach the limit of its travel.

(3) Check that the tips of vanes of the air spaced variable capacitor are approximately 3 mm. from complete engagement. If positioning is incorrect remove the terminal block from the gearbox assembly to gain access to the solid coupling between the capacitor and gearbox. Slacken the two grub screws securing the capacitor shaft and rotate the capacitor to achieve the above condition. Tighten the two grub screws to lock the capacitor.

(4) Rotate the coil until the rotor is equal-distance from the two mechanical end stops, (total mechanical travel is approximately 36 turns) then move the microswitch striker arm until it lies midway between the two microswitches. Tighten the grub screw to lock the striker arm in position.

(5) Rotate the coil shaft until the rotor reaches a quarter turn from the mechanical stop at the opposite end of the coil from the gearbox. Adjust the striker screw for microswitch SA so that the switch just operates and lock the screw.

(6) Rotate the coil shaft until the rotor reaches a quarter turn from the mechanical stop at the gearbox end of the coil. Adjust the striker screw for microswitch SB so that the switch just operates and lock the screw.

(7) The coil and gearbox assembly is now mechanically aligned and ready for fitting into the unit.

Counter and Drive Assembly

9. The counter and drive assembly should be aligned in conjunction with its associated coil and gearbox, as follows.

(1) Wind the appropriate drive handle anticlockwise until the rotor reaches the mechanical end-stop.

(2) Rotate the handle clockwise until the rotor contacts are adjacent to the fixed shorting link on the coil assembly. If the counter indicates 100 it is correctly aligned.

(3) If the reading is not 100, proceed as follows:-

(4) Remove the four screws fixing the counter and drive assembly to the sub front panel and withdraw the counter and drive, taking care to support the drive coupling block.

(5) Remove the block.

(6) Wind the handle until the counter reads 100 and check that the rectangular metal drive block then lies with its main axis at 90° to the axis of the driven block.

(7) If the drive block position is incorrect slacken the grub screw securing the large bevel gear and rotate the gear relative to the shaft to achieve this condition. Note: Take care not to overmesh the gear. Tighten the grub screw to lock the gear.

(8) Replace the drive coupling block and the counter and drive assembly and then recheck that the counter reads 100.

Microswitch Bank Coupling

10. Realignment of the coupling between the coil and gearbox and the microswitch bank should only be necessary when either unit has been removed and the relationship between the gearbox shaft and the coupling has been disturbed.

(1) Before refitting the coil and gearbox, slacken the grub screws in the coupling and slide the coupling to the bottom of the microswitch bank shaft.

(2) When the coil and gearbox has been refitted, remove the rear and side access covers and slide the coupling up the shaft until it is fitted to an equal distance on both shafts.

(3) Rotate the coupling until it lies in such a position that when the coil rotor is moved from end to end, all four grub screws will be accessible through the rear cover. Tighten the two grub screws on to the coil and gearbox shaft.

(4) Remove the side access cover and rotate the microswitch bank shaft so that all the cam securing grub screws will be accessible when the coil rotor is rotated throughout its complete range. Tighten the remainder of the grub screws in the coupling.

(5) Replace the rear access cover.

NOTE: Whenever the microswitch bank coupling is disturbed, the electrical realignment procedure (para. 16) must be carried out.

ELECTRICAL REALIGNMENT

Test Equipment Required

11. The following test equipment is required to carry out the electrical realignment.

(1) Electronic Multimeter 50mV to 10V d.c., 3V a.c., 1-30MHz. The Marconi 1041C is suitable (an oscilloscope can be used).

(2) Multimeter. The Avo Model 8 is suitable.

(3) RF Signal Generator. 1.6 to 30MHz at 25mW to 200mW output, the Rhode and Schwartz SMLR is suitable.

(4) Metered Dummy load 50 ohm 1kW. The Bird Termaline 694 type is suitable.

(5) Special Type G potentiometer adjusting tool, manufactured by Plessey.
(6) Accessory Kit CA608 (for details see para 18.)

Power Supplies

12. Realignment of the power supplies consist of adjusting the voltage of the positive and negative stabilized 30V outputs. The supplies can be monitored at 2TP1 and 2TP2 on the subpanel and are adjusted by 2AR23 and 2AR26 respectively. Access may be gained to these components by removing the top cover of the FMU.

CAUTION: REMOVAL OF THE TOP COVER EXPOSES MAINS AND RF VOLTAGES

Coarse-Tune Discriminator Input Level Adjustment

13. The input to the coarse-tune discriminators is adjusted as follows, with the FMU on a bench.

(1) Connect the FMU to a mains power supply, and select AUTO at the range switch.

(2) Remove the cover from the CVA and connect an electronic multimeter to pins 22 and 24 (earth) of the PC board in the CVA.

(3) Connect a signal generator to 5PL1, and set its output to 100mW r.m.s. at 10MHz.

(4) Switch on the FMU and check that the output indicated on the electronic multimeter is 1.8V r.m.s. If the reading is incorrect adjust 5AR2 to suit.

(5) Switch off, remove test gear and replace covers unless further tests are to be carried out.

<u>Servo Pre-Amplifiers Adjustment</u>

14. The balance of the servo Pre-Amplifiers is adjusted as follows, with the FMU on a bench.

(1) Connect the FMU to a mains supply and select Auto on the MANUAL Range Switch. Do not apply an RF input.

(2) Remove the control unit cover and unplug the Tune PCB. Make a link between 3CTR19 collector and emitter. Replace the Tune PCB and unplug the Tune servo pre-amplifier pcb. Replace the servo pre-amplifier using the test extension board.

(3) Switch on the FMU.

(4) Connect an electronic voltmeter set to +10V d.c. range to the R10, R14, R15 junction (negative lead to earth) and check that a zero voltage is indicated. If incorrect, adjust R4 to suit, increasing meter sensitivity as necessary.

(5) Set meter to 10V dc and measure the voltage at TP1 and TP2.

(6) Adjust R19, to give equal voltage at TP1 and TP2 increasing the meter sensitivity as necessary.

(7) Switch off, remove test gear and link fitted at 14.2. Replace covers unless further tests are to be carried out.

<u>Coarse-Tune Tracking</u>

15. The coarse-tune tracking is adjusted as follows.

(1) Check the coarse tune discriminator input level if there is any doubt about its accuracy (refer to para. 13).

(2) With the FMU on the bench, set the range switch to AUTO, and connect 1PL1 to a power supply.

(3) Connect an RF signal generator to 5PL1 and adjust it to deliver between 25 and 200mW at 1.6MHz.

(4) If the readings are other than 125, use the special type G potentiometer adjusting tool, and adjust the appropriate potentiometer 6AR7 via the access hole in the left side of the unit for 'tune' and the right side for 'load' to give counter indications of 126 in both cases.

(5) Adjust the signal generator frequency to 30MHz. The two servo systems should run until the counters read 200. If the readings are other than 200 adjust the appropriate trimmer capacitor(s) 6AC1 via the same side access holes to bring both indicators to 200.

(6) Repeat operations (4) and (5).

<u>Microswitch Cam Alignment</u>

16. Before adjusting the microswitch cams, the coarse tune tracking should be checked (para. 15).

(1) Carry out operations 15(2) and (3), but adjust the signal generator frequency to 1.75MHz. Allow the servo system to coarse tune.

(2) Remove the side access cover, slacken the grub screw in the bottom cam and adjust its position so that the appropriate microswitch is just operated (listen for click). Ensure that this cam cannot operate the adjacent microswitch. Lock cam.

(3) Adjust the signal generator frequency above and below 1.75MHz and check that the switch makes and breaks either side of 1.75MHz.

(4) Repeat operation (3) at 2.0MHz adjusting the second cam.

(5) Repeat operation (3) at 2.5MHz adjusting the third cam.

(6) Repeat operation (3) at 3.1MHz adjusting the fourth cam.

(7) Repeat operation (3) at 4.0MHz adjusting the fifth cam.

(8) Repeat operation (3) at 7.5MHz adjusting the sixth cam.

(9) Repeat operation (3) at 12.0MHz adjusting the seventh cam.

Alignment of Fine-Tune Discriminators

17. The fine-tune discriminators can only be aligned when the FMU is connected in the associated Linear Amplifier/Cabinet assembly. A suitable RF signal generator, 50 ohm dummy load with meter capable of handling the linear amplifier output power, and an instrument to measure in-line reflected power up to 500W (e.g. Bird Thruline with 1kW plug-in head) is required.

(1) Ensure all power is off. Remove the Fine-Tune Discriminator unit cover. Set potentiometer 4AR16 to the fully anti-clockwise position.

(2) Connect the reflected power meter in the coaxial cable connected to the input of the FMU.

IMPORTANT NOTE: The additional cable used to connect the instrument should be kept as short as possible.

(3) Terminate the system output in the 50 ohm dummy load.

(4) Connect the RF signal generator to the input of the linear Amplifier and adjust its output to 10MHz and output level to between 25 and 200mW.

(5) Set the FMU range switch to 7.5 - 12MHz and the Line switch to LINE 1.

(6) Refer to the coarse-tune graph (fig. 1) and set the tune and load controls to the 10MHz position.

(7) Switch on all the power and manually tune the FMU for minimum reflected power. Note the output (forward) power.

(8) Switch to LINE 2, retune the FMU, note the output power.

(9) Repeat operation (8) for LINES 3 and 4.

(10) Select the line which gave maximum output power and retune the FMU for minimum reflected power.

(11) Set the switch on the discriminator unit to TUNE and adjust 4AR4 on the Discriminator PC Board to obtain a centre zero indication on the meter.

(12) Set the switch on the discriminator unit to LOAD and adjust 4AR10 on the Discriminator PC Board to obtain a centre zero indication on the meter.

(13) Set the MANUAL switch to AUTO.

(14) Disconnect the signal generator.

(15) Press the TUNE button.

(16) Adjust the signal generator frequency to 3MHz, and re-connect it.

(17) Allow FMU to tune (READY lamp illuminated) then set the MANUAL switch to SERVOS OFF.

(18) If RF power output of transmitter is 820W or above, no further action is required.

(19) If RF power output is below 820W adjust the TUNE manual control to give 820W output.

(20) Set METER switch on the discriminator to OFF and carefully note needle position (which may not be exactly central).

(21) Set METER switch to TUNE and adjust variable resistor 4AR16 until needle is at the same position as noted in operation (20).

(22) Set MANUAL switch to AUTO.

(23) Switch off, remove test equipment and replace covers.

<u>Accessory Kit CA 608</u>

18. The Accessory Kit CA608 comprises the following items

(1) Extenderboards (two) for Tune, Range and Servo Pre Amplifier

(2) Mains connector
(3) 15 way connector
(4) BNC connectors (two)

} for bench use or connection to equipment when removed from cabinet.

(5) Connector assembly (dummy). This allows the TTA 1860 (or other transmitter) to operate when the MA1004 is removed from the cabinet.

CHAPTER 7

DISMANTLING AND REASSEMBLY

INTRODUCTION

1. The Dismantling and Reassembly instructions detailed in the following paragraphs assume that the Feeder Matching Unit has been isolated from all electrical supplies and removed from the Transmitter Terminal Cabinet to a suitable bench.

REMOVAL AND REPLACEMENT OF UNITS

Control Unit

Removal

2. (1) Place the feeder Matching Unit on its side.

(2) Remove the four Control Unit fixing screws from the bottom panel.

(3) Place the MA.1004 on its base and lower the front panel.

(4) Remove the sockets mating with plugs 3PL1 and 3PL2.

(5) Remove the 2 fixing screws at the top of the Control Unit cover.

(6) Remove the 2 fixing screws at the top of the AUTO/MANUAL switch mounting plate.

(7) Release the retaining arms at each side of the MA.1004 panel and lower the front panel to its fullest extent.

(8) Remove the Control Unit by sliding it forward and tilting it slightly to clear the lower flange of the MA.1004.

Replacement

3. (1) Replace the Control Unit in the MA.1004.

(2) Replace but do not tighten the 4 front panel fixing screws.

(3) Place the unit on its side and replace but do not tighten the 4 fixing screws on the bottom panel.

(4) Tighten the front panel fixing screws.

(5) Tighten the bottom panel fixing screws.

Counter and Drive Assemblies

Removal

CAUTION: A COUNTER AND DRIVE ASSEMBLY MUST NOT BE REMOVED WHEN AN RF INPUT IS APPLIED TO THE FMU.

4. (1) Remove the top cover of the Feeder Matching Unit.

(2) Lower the front panel and remove the 4 fixing screws securing the appropriate assembly.

(3) Remove the Counter and Drive Assembly ensuring that the drive coupling does not fall down inside the unit

Replacement

5. Replacement of a Counter and D ive Assembly is effected by reversing the procedure detailed in para. (1) to (3). Before replacing an assembly refer to the Re-alignment Procedure detailed in Chapter 6 para.9.

Power Supply

Removal

6. (1) Remove the top cover of the MA.1004

(2) Lower the front panel and disconnect the socket mating with 2PL1.

(3) Remove the 4 Power Supply Unit fixing screws located near each corner of the aperture for the circuit breakers 2CB1, 2CB2 and 2CB3.

(4) Remove the 2 screws at the bottom rear of the Power Supply Unit, and disconnect the RF output cable braid from the right hand side of the unit.

(5) Slide the Power Supply back to its fullest extent and lift it out, front first, from the MA.1004.

(6) To obtain access to the Power Supply components, place the Power Supply Unit on a bench, remove the five cover securing screws on each side of the unit and lift off the cover.

Replacement

7. Replace the Power Supply by reversing the procedures in 6(1) to 6(5).

Loading Coil and Gearbox Assembly

Removal

8. (1) Remove the Power Supply Unit, refer to para. 6.

(2) Refer to para. 4 and remove Counter and Drive Assembly.

(3) Disconnect the RF output cable.

(4) Slacken off the fanning strip securing screws and remove the fanning strip.

(5) At the capacitor bank, disconnect the strap connected between the capacitor bank and the loading coil.

(6) Support the coil and remove the 6 screws securing the assembly to the side member.

(7) Lift the assembly clear from the Feeder Matching Unit.

Note: Do not remove the black (Aquadag) coating on coil.

Replacement

9. (1) Return the Loading Coil and Gearbox Assembly to its position in the MA. 1004

(2) Support the coil and replace but do not tighten the 6 screws securing the assembly to the side member.

(3) Replace the Counter and Drive Assembly.

(4) Slide the Coil and Gearbox forward to its fullest extent to engage the coupling and tighten the 6 screws securing the assembly to the side member.

(5) Replace the strap connected between the capacitor bank and the loading coil.

(6) Replace the fanning strip.

(7) Replace the RF output cable and the silver plated fixings.

(8) Replace the Power Supply Unit; refer to para. 7.

(9) Re-align the Counter and Drive Assembly (Chap. 6 para. 9)

(10) Carry out the Coarse-Tune Tracking procedure (Chap. 6 para. 15)

Tuning Coil and Gearbox Assembly

Removal

10. (1) Remove the Power Supply Unit, refer to para.6.

(2) Disconnect the coil end of the strap from the Discriminator Unit.

(3) Remove the strap connected to the capacitor bank.

(4) Slacken off the fanning strip securing screws and remove the fanning strip.

(5) Remove the access cover on the rear panel of the MA.1004.

(6) Look through the access hole in the rear panel to locate the coupling to the microswitch bank.

(7) Loosen the two bottom 6-32 UNC grub screws on the coupling, rotating the Tune Control to locate the screws.

(8) Remove the Counter and Drive Assembly, refer to para.4.

(9) Support the coil and remove the 6 screws securing the assembly to the side member.

(10) Lift the assembly from the Feeder Matching Unit.

Note: Do not remove the black (Aquadag) coating on coil.

Replacement

11. (1) Return the Tuning Coil and Gearbox assembly to its position in the MA.1004 and ensure that the coupling mates with the microswitch bank shaft. Do not tighten the grub screws.

(2) Replace but do not tighten the 6 screws securing the assembly to the side member.

(3) Replace the Counter and Drive Assembly.

(4) Slide the Coil and Gearbox forward to its fullest extent and tighten the 6 screws securing the assembly to the side member.

(5) Re-align the Counter and Drive Assembly (Chap.6 para.9)

(6) Re-align the Microswitch Bank mechanically (Chap.6 para.10).

(7) Replace the straps and fanning strip removed in (3), (4) and (5) respectively.

(8) Replace the Power Supply Unit, refer to para.7.

(9) Carry out the Coarse-Tune Tracking Procedure (Chap.6 para.15)

(10) Carry out the Electrical Microswitch Bank Alignment Procedure (Chap.6 para.16).

(11) Switch off and replace covers.

Discriminator Unit

Removal

12. (1) Remove the top cover of the MA.1004

(2) Remove the Power Supply Unit, refer to para.6.

(3) Disconnect the strap between the Discriminator and the Tuning Coil.

(4) Lower the front panel and remove the Discriminator Unit cover.

(5) Use a soldering iron to remove the connections to pins 3,4,6 and 7 of the PCB, noting their positions for replacement.

(6) Release the retaining arm on the left hand side of the front panel and lower the front panel to its fullest extent.

(7) Remove the fixing screws securing the unit and withdraw it from the MA.1004.

Replacement

13. Replacement of the Discriminator Unit is effected by reversing the procedures detailed in para.12(1) to (7).

Capacitor Bank

Removal

14. (1) Remove the top cover of the MA.1004

(2) Remove the strap connecting the capacitor bank to the Tuning Coil.

(3) At the capacitor bank disconnect the strap to the Loading Coil.

(4) Remove the 4 corner fixing screws and lift the capacitor bank out from the MA.1004.

Replacement

15. To replace the capacitor bank reverse the procedures detailed in para.14(1) to (4).

Microswitch Bank

Removal

16. (1) Remove the access cover on the rear panel,

(2) Rotate the tune control to locate the screws in the coupling and slacken only the bottom 2 6-32UNC grub screws in the coupling.

(3) Place the MA.1004 on its right hand side (as viewed from front).

(4) Remove the bottom panel.

(5) Disconnect the fanning strip from the microswitch bank.

(6) Remove the 4 fixing screws and remove the microswitch bank.

Replacement

17. Replacement of the microswitch bank is effected by reversing the procedures detailed in para.16(1) to (6). Before tightening the grub screws in the coupling refer to the Relalignment Mechanical and Electrical Procedures detailed in Chap.6 paras 10 and 16.

Capacitor Bank Solenoids 1RLA to 1RLD

Removal

18. (1) Remove the capacitor bank, refer to para.14.

(2) Remove the bottom cover and disconnect the two wires to the appropriate solenoid.

(3) Remove the two screws securing the solenoid to the platform and remove the solenoid.

Replacement

19. Replacement of a capacitor bank solenoid is effected by reversing the procedures detailed in para.18(1) to (3).

Coil Solenoids 1RLE and 1RLF

20. (1) Remove the appropriate Coil and Gearbox Assembly, para. 8 or 10

(2) Remove the bottom cover and disconnect the two wires to the solenoid,

(3) Remove the two fixing screws and remove the solenoid.

NOTE: Solenoids 1RLE and 1RLF carry insulating caps at the end of the plungers; solenoids 1RL2 to 1RLD do not. All solenoids are otherwise identical.

Replacement

21. Replacement of a coil solenoid is effected by reversing the procedures detailed in para.20 (2) and (3) and referring to the replacement procedure for the appropriate Coil and Gearbox Assembly.

ALTERNATIVES

ertain recommended alternative components are listed below. These alternative components ay be used when the appropriate item given in the following components list is no longer vailable.

ct. ef.	Value	Description	Rat.	Tol. ± %	Racal Part Number	Manufacturer
		Constant Voltage Amplifier MS.452				
PL1	Plug	Bulkhead Receptacle Male			925439	Kings, kc-79-59
		Power Supply Unit MS448 and PS57				
AC3 & AC4	15μF	Electrolytic	63V	-10+50	926525	Mullard 108-18159
AC9 & AC10	2.2μF	Electrolytic	63V	-10+50	926526	Mullard 108-18228
		Motor and Gearbox Assembly (MS451)				
ME1	28V				919929 or 916281	Vactric 18P409 Evershed FAZ203/12/C

CHAPTER 8

COMPONENTS LIST

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
			MAIN CHASSIS			
	Resistors					
	Ohms		W			
1R1	470	Metal Oxide		2	918030	Electrosil TR5
1R2	2.7k	Metal Oxide		5	906347	Electrosil TR5
	Capacitors					
	F		V			
1C1	510p		6k	5	941954	Corning P S 55 R85
1C2	390p		5k	5	941953	Corning P S 40 R85
1C3	100p		5k	5	941952	Corning P S 40 R42
1C4	82p		7k	5	941951	Corning P S 40 R42
1C5	82p		7k	5	941951	Corning P S 40 R42
1C6	5p	Ceramic	4k	10	917977	Plessey 10
1C7	270p	Silver Mica	350	2	902171	Lemco MS611-I-R-270
	Inductors					
1L1		See page8-23(Part of Coil, Motor and Gearbox Assembly)				
1L2		See page8-23(Part of Coil, Motor and Gearbox Assembly)				
	Indicator Lamps					
1LP1		Lamp Filament	24V		921899	Hivac
1LP2		Lamp Filament	24V		921899	Hivac
1LP3		Lamp Filament	24V		921899	Hivac
1LP4		Lamp Filament	24V		921899	Hivac
	Plugs					
1PL1		Supply input			915655	Amphenol 62GB-57A8-3.3p
	Sockets					
1SK1		Connector			917555	Transradio C4/5CH
1SK2		Bulkhead receptacle			900061	Transradio BN12/5
1SK4					915970	Cannon DB25S
1SK5					915970	Cannon DB25S
1SK6					900905	Cannon DA15S
1SK7					900905	Cannon DA15S
1SK8					900905	Cannon DA15S
1SK9					915970	Cannon DB25S

Cct. Ref.	Value	Description	Ratio	Tol %	Racal Part Number	Manufacturer
		MAIN CHASSIS (Cont'd)				
	Solenoids					
1RLA					603285	
1RLB					603285	
1RLC					603285	
1RLD					603285	
1RLE					603285	
1RLF					603285	
	Switches					
1SA		Supply, micro key			915362	TMC S526893
1SB		Tune, push button			906678	TMC S325595
	Miscellaneous					
1TS1		Fanning strip			922218	Carr 44/77/534/8LH
1TS2		Fanning strip			922219	Carr 44/77/534/8RH
1TS3		Fanning strip			921445	Klippon MF2/12-2417
		Adaptor, by-pass (used when MA.1004 is by-passed)			901735	Transradio C3/5A
		Contact capacitors 1C1 to 1C5			603281	
		Lampholder, 1LP3 & 1LP4			917200	TMC S527266
		Knob for indicator lamps			914256	TMC S528914
		Diffuser for indicator lamps			915980	TMC S531962
		Clear lens for indicator lamps			915959	TMC S528926
		Filter, Green for indicator lamps			921657	TMC S531412
		Filter, Red for indicator lamps			921658	TMC S531410
		Filter, Amber for indicator lamps			922428	TMC S531411
		Connector Assembly Dummy (used with TTA.1860 type equipments when MA.1004 is by-passed)			AA.605761	Part of Accessory kit CA.608

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		POWER SUPPLY UNIT (MS448 and PS57) DA603514				
	Resistors ohm		W			
2R1	2.2	Wirewound	9	5	922033	Welwyn W23
2AR1	120	Metal Oxide		5	906021	Electrosil TR5
2AR2	2.2k	Metal Oxide		±2	916546	
2AR3	4.7k	Metal Oxide		±2	913490	
2AR4	1k	Metal Oxide		±2	913489	
2AR5	1k	Metal Oxide		±2	913480	
2AR6	4.7k	Metal Oxide		±2	913490	
2AR7	2.2k	Metal Oxide		±2	916546	
2AR8	560	Metal Oxide		±2	917061	
2AR9	560	Metal Oxide		±2	917061	
2AR10	1	Wirewound	2.5	5	917137	Welwyn W21
2AR11	4.7	Wirewound		5	917145	Welwyn W21
2AR12	1.2k	Metal Oxide		±2	911179	
2AR13	10k	Metal Oxide		±2	914042	
2AR14	10k	Metal Oxide		±2	914042	
2AR15	1k	Metal Oxide		±2	913489	
2AR16	1.2k	Metal Oxide		5	906346	Electrosil TR4
2AR17	1.2k	Metal Oxide		5	906346	Electrosil TR4
2AR18	2.2k	Metal Oxide		±2	916546	
2AR19	2.2k	Metal Oxide		±2	916546	
2AR20	2.2k	Metal Oxide		±2	916546	
2AR21	2.2k	Metal Oxide		±2	916546	
2AR22	330	Metal Oxide		±2	915690	
2AR23	2.2k	Variable			920518	Plessey MPWT
2AR24	2.2k	Metal Oxide		±2	916546	
2AR25	2.2k	Metal Oxide		±2	916546	
2AR26	2.2k	Variable			920518	Plessey MPWT
2AR27	330	Metal Oxide		±2	915690	
	Capacitors F		V			
2C1	3300μ	Electrolytic	63		945349	BH ALT-10A332CB063
2C2	3300μ	Electrolytic	63		945349	BH ALT-10A332CB063
2AC1	1μ	Fixed			915370	ITT, PMC2R/1.0/M100
2AC2	0.1μ	Fixed	100	20	914173	ITT, PMC2R
2AC3	16μ	Electrolytic	64		921662	Mullard C428ARH16
2AC4	16μ	Electrolytic	64		921662	Mullard C428ARH16
2AC5	.01μ	Ceramic Disc	25	+50 -20	926386	Erie 861/T/25V

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		POWER SUPPLY UNIT (Cont'd)				
	Capacitors (Cont'd)					
	F		V			
2AC6	.01μ	Ceramic Disc	25	+50 -20	926386	Erie 861/T/25V
2AC7	.01μ	Fixed			920713	PMC 2R0.01K400
2AC8	.01μ	Fixed			920713	PMC 2R0.01K400
2AC9	2.5μ	Electrolytic			921663	Mullard C428ARH2.5
2AC10	2.5μ	Electrolytic			921663	Mullard C428ARH2.5
2AC11	.01μ	Ceramic Disc	25	+50 -20	926386	Erie 861/T/25V
2AC12	.01μ	Ceramic Disc	25	+50 -20	926386	Erie 861/T/25V
2AC13	.01μ	Ceramic Disc	25	+50 -20	926386	Erie 861/T/25V
2AC14	.01μ	Ceramic Disc	25	+50 -20	926386	Erie 861/T/25V
	Transformers					
2T1		Mains			CT603517	
	Diodes					
2D1		5SB20			922955	
2D2		5SB20			922955	
2AD1		IN4149			914898	
2AD2		IN4149			914898	
2AD3		BZX79C18			930318	
2AD4		BZX79C18			930318	
	Transistors					
2TR1		2N3055			915654	
2TR2		2N5194			923704	
2ATR1		BSS68			927901	
2ATR2		2N2484			908970	
2ATR3		2N2484			908970	
2ATR4		BSS68			927901	
2ATR5		BFY51			908753	
2ATR6		BC107			911929	
2ATR7		BCY71			911928	
2ATR8		BSS68			927901	
	Circuit Breakers					
2CB1					921660	Highland APL1-1-6-2-252
2CB2					922513	Highland APL1-5-5-2-252
2CB3					921661	Highland APL1-5-2-252

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		POWER SUPPLY UNIT (Cont'd)				
	Plugs					
2PL1					909729	Cannon DA15P
	Sockets					
2SK1	(TP1) Red 1 Way				938949	Belling Lee L1737
2SK2	(TP2) Red 1 Way				938949	Belling Lee L1737

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		CONTROL UNIT (MS450) DA603422				
	Resistors					
	ohm		W			
3R1	22	Wirewound	6	5	903702	Welwyn W22
3R2	680	Metal Oxide		±2	910113	
3AR1	470	Metal Oxide		±2	920758	
3AR2	470	Metal Oxide		±2	920758	
3AR3	Not Used					
3AR4	470	Metal Oxide		±2	920758	
3AR5	470	Metal Oxide		±2	920758	
	Capacitors					
	F		V			
3C1	1μ	Fixed			919311	PMC 2R/1.0/M100
3AC1	1000p	Fixed	500	20	917419	Erie 831/K350081
3AC2	1000p	Fixed	500	20	917419	Erie 831/K350081
3AC3	1000p	Fixed	500	20	917419	Erie 831/K350081
3AC4	1000p	Fixed	500	20	917419	Erie 831/K350081
3AC5	1000p	Fixed	500	20	917419	Erie 831/K350081
3AC6	0.1μ	Fixed		20	914173	PMC 2R/0.1/M100
3AC7	0.1μ	Fixed		20	914173	PMC 2R/0.1/M100
	Inductors					
3L1	10μH				922281	Cambion 2960-40-02
	Diodes					
3AD1		IN4149			914898	Mullard
3AD2		IN4149			914898	Mullard
2AD3		IN4149			914898	Mullard
	Transistors					
3TR1		2N3055			915654	Mullard
	Switches					
3SA		Rotary			BD603757	
3SB		Toggle, black			921672	Arrow TS3BP
3SC		Rotary			BD603758	
	Relays					
3RLA					937859	Clare FWH11G00

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
			CONTROL UNIT (Cont'd)			
	Plugs					
3PL1					916489	Cannon DP25P
3PL2					916489	Cannon DP25P
	Sockets					
3SK1	(TP1)	Red 1 Way			938949	Belling Lee L1737
3SK2	(TP2)	Red 1 Way			938949	Belling Lee L1737
3ASK1					917087	Varicon 8129-015-603-002
3ASK2					917087	Varicon 8129-015-603-002
3ASK3					919406	Varicon 8131-032-603-003
3ASK4					919406	Varicon 8131-032-603-003

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
			RANGE P.C. BOARD (PS60) ED 603645			
	Resistors ohms		W			
3BR1	3.9k	Metal Oxide		±2	915074	
3BR2	1k	Metal Oxide		±2	913489	
3BR3	1M	Metal Oxide		5	914036	Electrosil TR5
3BR4	56	Metal Oxide		±2	917055	
3BR5	220k	Metal Oxide		±2	921771	
3BR6	220k	Metal Oxide		±2	921771	
3BR7	47k	Metal Oxide		±2	913496	
3BR8	56	Metal Oxide		±2	917855	
3BR9	470k	Metal Oxide		5	905577	Electrosil TR
3BR10	120k	Metal Oxide		±2	915373	
3BR11	10k	Metal Oxide		±2	914042	
3BR12	47k	Metal Oxide		±2	913496	
3BR13	56	Metal Oxide		±2	917055	
3BR14	470k	Metal Oxide		5	905577	Electrosil TR5
3BR15	68k	Metal Oxide		±2	916478	
3BR16	1k	Metal Oxide		±2	913489	
3BR17	3.3k	Metal Oxide		±2	910111	
3BR18	1k	Metal Oxide		±2	913489	
3BR19	5.6k	Metal Oxide		±2	918129	
3BR20	180	Metal Oxide		±2	915465	
3BR21	180	Metal Oxide		±2	915465	
3BR22	1k	Metal Oxide		±2	913489	
3BR23	180	Metal Oxide		±2	915465	
3BR24	1k	Metal Oxide		±2	913489	
3BR25	180	Metal Oxide		±2	915465	
3BR26	1k	Metal Oxide		±2	913489	
3BR27	180	Metal Oxide		±2	915465	
3BR28	1k	Metal Oxide		±2	913489	
3BR29	180	Metal Oxide		±2	915465	
3BR30	1k	Metal Oxide		±2	913489	
3BR31	180	Metal Oxide		±	915465	
3BR32	1k	Metal Oxide		±2	913489	
3BR33	180	Metal Oxide		±2	915465	
3BR34	1k	Metal Oxide		±2	913489	
3BR35	680	Metal Oxide		±2	910113	
3BR36	4.7k	Metal Oxide		±2	913490	

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		RANGE P.C. BOARD (Cont'd)				
	Capacitors					
	F		V			
3BC1	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC2	1µ	Fixed		20	915370	ITT PMC2R/1.0/M100
3BC3	1µ	Fixed	20	20	915370	ITT PMC2R/1.0/M100
3BC4	1µ	Fixed		20	915370	ITT PMC2R/1.0/M100
3BC5	1µ	Fixed		20	915370	ITT PMC2R/1.0/M100
3BC6	.01µ	Polyester	400	20	918967	ITT PMC2T/.01/M400
3BC7	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC8	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC9	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC10	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC11	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC12	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC13	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC14	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC15	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC16	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC17	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC18	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC19	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC20	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC21	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC22	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC23	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC24	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC25	0.1µ	Fixed		20	914173	ITT PMC2R/0.1/M100
3BC26	0.01µ	Polyester	400	20	918967	ITT PMT2R/0.01/M400
	Transistors					
3BTR1		BFY51			908753	Mullard
3BTR2		BCY71			911928	Mullard
3BTR3		BFX29			915267	Mullard
3BTR4		BC107			911929	Mullard
3BTR5		BFY51			908753	Mullard
3BTR6		BCY71			911928	Mullard
3BTR7		BCY71			911928	Mullard
3BTR8		BFX29			915267	Mullard
3BTR9		BC107			911929	Mullard
3BTR10		BCY71			911928	Mullard
3BTR11		BC107			911929	Mullard
3BTR12		BFY51			908753	Mullard
3BTR13		BCY71			911928	Mullard

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer

RANGE P.C. BOARD (Cont'd)

Diodes

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
3BD1		BZX79C5V6			921749	Mullard
3BD2		BZX79C5V6			921749	Mullard
3BD3		IN5232B			924967	Motorola
3BD4		BZX79C5V6			921749	Mullard
3BD5		BZX79C5V6			921749	Mullard
3BD6		IN4002			911460	ITT
3BD7		BZX79C5V6			921749	Mullard
3BD8		IN4149			914898	Mullard
3BD9		IN4149			914898	Mullard
3BD10		IN4149			914898	Mullard
3BD11		1N4149			914898	Mullard
3BD12		1N4002			911460	ITT
3BD13		1N4002			911460	ITT
3BD14		1N4002			911460	ITT
3BD15		1N4149			914898	Mullard
3BD16		IN4149			914898	Mullard
3BD17		IN4149			914898	Mullard
3BD18		IN4149			914898	Mullard
3BD19		IN4149			914898	Mullard
3BD20		IN4149			914898	Mullard
3BD21		IN4002			911460	ITT
3BD22		IN4149			914898	Mullard
3BD23		BZX79C10			930230	Mullard

Silicon Controlled Rectifiers (SCR's)

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
3BSCR1		S2600B			933758	
3BSCR2		S2600B			933758	
3BSCR3		S2600B			933758	
3BSCR4		S2600B			933758	
3BSCR5		S2600B			933758	
3BSCR6		S2600B			933758	
3BSCR7		S2600B			933758	

Plugs

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
3BPL1					919362	Varicon 8131-032-610-001

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		TUNE P.C. BOARD (PS59) ED 603642				
	Resistors ohm		W			
3CR1	1k	Metal Oxide		±2	913489	
3CR2	1k	Metal Oxide		±2	913489	
3CR3	10k	Metal Oxide		±2	914042	
3CR4	10k	Metal Oxide		±2	914042	
3CR5	10k	Metal Oxide		±2	914042	
3CR6	10k	Metal Oxide		±2	914042	
3CR7	1M	Metal Oxide		5	914036	Electrosil TR5
3CR8	4.7k	Metal Oxide		±2	913490	
3CR9	4.7k	Metal Oxide		±2	913490	
3CR10	15k	Metal Oxide		±2	920645	
3CR11	10k	Metal Oxide		±2	914042	
3CR12	33	Metal Oxide		±2	917060	
3CR13	270	Metal Oxide		±2	910391	
3CR14	68k	Metal Oxide		±2	916478	
3CR15	2.2k	Metal Oxide		±2	916546	
3CR16	1M	Metal Oxide		5	914036	Electrosil 'R5
3CR17	4.7k	Metal Oxide		±2	913490	
3CR18	1k	Metal Oxide		±2	913489	
3CR19	4.7k	Metal Oxide		±2	913490	
3CR20	330	Metal Oxide		±2	915690	
3CR21	150	Metal Oxide		±2	910389	
3CR22	47k	Metal Oxide		±2	913496	
3CR23	47k	Metal Oxide		±2	913496	
3CR24	4.7k	Metal Oxide		±2	913490	
3CR25	10k	Metal Oxide		±2	914042	
3CR26	1k	Metal Oxide		±2	913489	
3CR27	27k	Metal Oxide		±2	913494	
3CR28	68k	Metal Oxide		±2	916478	
3CR29	33	Metal Oxide		±2	917060	
3CR30	680	Metal Oxide		±2	910113	
3CR31	1.8k	Metal Oxide		±2	911148	
3CR32	27k	Metal Oxide		±2	913494	
3CR33	3.9k	Metal Oxide		±2	915674	
3CR34	120	Metal Oxide		±2	920751	
3CR35	47k	Metal Oxide		±2	913496	

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		TUNE P.C. BOARD (Cont'd)				
	Resistors (Cont'd)					
	ohm		W			
3CR36	470	Metal Oxide		±2	920758	
3CR37	18k	Metal Oxide		±2	900994	
3CR38	330	Metal Oxide		±2	915690	
3CR39	18k	Metal Oxide		±2	900994	
3CR40	1k	Metal Oxide		±2	913489	
3CR41	1k	Metal Oxide		5	913489	
3CR42	27k	Metal Oxide		±2	913494	
3CR43	10k	Metal Oxide		±2	914042	
3CR44	330	Metal Oxide		±2	915690	
3CR45	330	Metal Oxide		±2	915690	
3CR46	10k	Metal Oxide		±2	914042	
3CR47	10k	Metal Oxide		±2	914042	
3CR48	1k	Metal Oxide		±2	913489	
3CR49	10k	Metal Oxide		±2	914042	
	Capacitors					
	F		V			
3CC1	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC2	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC3	33μ	Fixed	16		943677	
3CC4	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC5	6.8μ	Fixed		20	910129	Union Carbide K6R8J35S
3CC6	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC7	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC8	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC9	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC10	100μ	Fixed	63		920246	Mullard 108 18101
3CC11	100μ	Fixed	63		920246	Mullard 108 18101
3CC12	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC13	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC14	100μ	Fixed	63		920246	Mullard 108 18101
3CC15	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC16	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC17	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
3CC18	0.1μ	Fixed		20	914173	STC PMC2R/0.1/M100
	Transistors					
3CTR1		BFY51			908753	Mullard
3CTR2		BFY51			908753	Mullard
3CTR3		BC107			911929	Mullard
3CTR4		BC107			911929	Mullard
3CTR5		BC107			911929	Mullard

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer

TUNE P.C. BOARD (Cont'd)

Transistors (Cont'd)

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
3CTR6		BCY71			911928	Mullard
3CTR7		BCY71			911928	Mullard
3CTR8		BFY51			908753	Mullard
3CTR9		BC107			911929	Mullard
3CTR10		BC107			911929	Mullard
3CTR11		NOT USED				
3CTR12		BFY51			908753	Mullard
3CTR13		BC107			911929	Mullard
3CTR14		BC107			911929	Mullard
3CTR15		BC107			911929	Mullard
3CTR16		BCY71			911928	Mullard
3CTR17		BCY71			911928	Mullard
3CTR18		BFX29			915267	Mullard
3CTR19		BC107			911929	Mullard
3CTR20		BCY71			911928	Mullard
3CTR21		BFX29			915267	Mullard
3CTR22		BFY51			908753	Mullard
3CTR23		BFY51			908753	Mullard

Diodes

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
3CD1		IN4149			914898	Mullard
3CD2		IN4149			914898	Mullard
3CD3		IN4149			914898	Mullard
3CD4		BZX79C18			930318	Mullard
3CD5		IN4002			911460	Texas
3CD6		IN4149			914898	Mullard
3CD7		IN4149			914898	Mullard
3CD8		BZX79C8V2			923962	Mullard
3CD9		IN4002			911460	Texas
3CD10		IN4149			914898	Mullard
3CD11		IN4149			914898	Mullard
3CD12		IN4149			914898	Mullard
3CD13		IN4149			914898	Mullard
3CD14		IN4149			914898	Mullard
3CD15		NOT USED				
3CD16		IN4002			911460	Texas
3CD17		NOT USED				
3CD18		IN4149			914898	Mullard
3CD19		IN4149			914898	Mullard
3CD20		IN4149			914898	Mullard

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
			TUNE P.C. BOARD (Cont'd)			
	Diodes (Cont'd)					
3CD21		IN4002			911460	Texas
3CD22		IN4149			914898	Mullard
3CD23		BZY88C8V2			917622	Mullard
3CD24		IN4002			911460	Texas
3CD25		IN4149			914898	Mullard
3CD26		BZY88C8V2			917622	Mullard
3CD27		IN4149			914898	Mullard
3CD28		IN4149			914898	Mullard
3CD29		NOT USED				
3CD30		BZY88C8V2			917622	Mullard
3CD31		IN4149			914898	Mullard
	Relays					
3CRLA					921505	Leach ER2-2A A1A
3CRLC					921505	Leach ER2-2A A1A
	Plugs					
3CPL1					919362	Varicon 8131-032-610 -001

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		SERVO PRE-AMPLIFIER P.C. BOARD (PS108) CC601093				
		All components are pre-fixed PS108				
	Resistors					
	ohm		W			
R1	10k	Metal Oxide		±2	914042	
R2	150k	Metal Oxide		±2	917954	
R3	1k	Metal Oxide		±2	913489	
R4	100k	Variable		20	916411	Morganite Type 80
R5	100k	Metal Oxide		±2	915190	
R6	1.2k	Metal Oxide		5	916347	Electrosil TR6
R7	220k	Metal Oxide		5	906025	Electrosil TR5
R8	220k	Metal Oxide		5	906025	Electrosil TR5
R9	22k	Metal Oxide		±2	913493	
R10	1M	Metal Oxide		5	911692	Electrosil TR5
R11	1k	Metal Oxide		±2	913489	
R12	1k	Metal Oxide		5	906031	Electrosil TR5
R13	10	Metal Oxide		5	908471	Electrosil TR5
R14	1.5k	Metal Oxide		±2	911166	
R15	1k	Metal Oxide		±2	913489	
R16	15k	Metal Oxide		±2	920645	
R17	51	Metal Oxide		±2	917056	
R18	2.2k	Metal Oxide		5	908270	Electrosil TR4
R19	10k	Variable		20	916410	Morganite Type 80
R20	10k	Metal Oxide		±2	914042	
R21	2.2k	Metal Oxide		5	908270	Electrosil TR4
R22	1k	Metal Oxide		±2	913489	
R23	5.6k	Metal Oxide		5	916348	Electrosil TR6
R24	180	Metal Oxide		±2	915465	
R25	5.6k	Metal Oxide		5	916348	Electrosil TR6
R26	100	Metal Oxide		±2	910388	
R27	100	Metal Oxide		±2	910388	
R28	100	Metal Oxide		±2	910388	
R29	100	Metal Oxide		±2	910388	
R30	10k	Metal Oxide		±2	914042	
	Capacitors		(Volts)			
C1	0.01μ	Polyester	250	10	915918	Mullard 344-41103
C2	2.2μ	Electrolytic	50	20	916359	Plessey 402/8/50043/002
C3	0.1μ	Polycarbonate	100	10	915075	Mullard 344-21104
C4	0.47μ	Polycarbonate	100	10	915172	STC PMA 047M100
C5	0.1μ	Polycarbonate	100	10	915075	Mullard 344-21104

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		SERVO PRE-AMPLIFIER P.C. BOARD (Cont'd)				
	Capacitors (Contd)		(Volts)			
C6	0.1μ	Polycarbonate	100	10	915075	Mullard 344-21104
C7	0.01μ	Polyester	250	10	915918	Mullard 344-41103
C8	0.1μ	Polycarbonate	100	10	915075	Mullard 344-21104
	Transistors					
TR1		Silicon n-p-n			908753	Mullard BFY 51
TR2		Silicon n-p-n			908753	Mullard BFY 51
TR3		Silicon p-n-p			915497	STC 2N 4033
TR4		Silicon p-n-p			915497	STC 2N 4033
TR5		Silicon n-p-n			915496	STC BSY 56
TR6		Silicon p-n-p			915497	STC 2N 4033
	Diodes					
D1		Zener: 3.3V	400mW	5	912567	Mullard BZY 88 C3V3
D2		Zener 3.3V	400mW	5	912567	Mullard BZY 88 C3V3
D3		Silicon			900651	Mullard 1N 914
D4		Silicon			900651	Mullard 1N 914
D5		Zener: 6.2V	400mW	5	911682	Mullard BZY 88 C6V2
D6		Zener: 6.2V	400mW	5	911682	Mullard BZY 88 C6V2
D7		Zener: 6.2V	400mW	5	911682	Mullard BZY 88 C6V2
	Integrated Circuits					
IC1		Wideband Amplifier			938905	Fairchild uA702 HMBQ
	Connectors					
		15-way PCB Connector			916412	Varicon 8129-015-610-001

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		FINE TUNE DISCRIMINATOR (MS449&PS56) CA603454				
	Resistors ohm		W			
4R1	10k		7	5	921426	Electrosil FP7
4R2	10k		7	5	921426	Electrosil FP7
4R3	12k	Metal Oxide		±2	917952	
4R4	15k	Metal Oxide		±2	920645	
4AR1	18k	Metal Oxide		±2	900994	
4AR2	39	Metal Oxide		5	906343	Electrosil TR5
4AR3	39	Metal Oxide		5	906343	Electrosil TR5
4AR4	22k	Variable			919816	Plessey MPWT
4AR5	39	Metal Oxide		5	906343	Electrosil TR5
4AR6	39	Metal Oxide		5	906343	Electrosil TR5
4AR7	18k	Metal Oxide		±2	900994	
4AR8	1k	Metal Oxide		±2	913489	
4AR9	18k	Metal Oxide		±2	900994	
4AR10	22k	Variable			919816	Plessey MPWT
4AR11	39			5	922615	Electrosil TR8
4AR12	1k	Metal Oxide		±2	913489	
4AR13	18k	Metal Oxide		±2	900994	
4AR14	330	Metal Oxide		5	908153	Electrosil TR5
4AR15		NOT USED				
4AR16	1k	Variable			916051	Morganite 81E
	Capacitors; F		V			
4C1	5p	Ceramic	4k		917977	Plessey 10
4AC1		NOT USED				
4AC2	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
4AC3	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
4AC4	120p	Silver Mica	350	2	902163	Lemco M5611/1/R/120
4AC5	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
4AC6	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
4AC7	120p	Silver Mica	350	2	902163	Lemco M5611/1/R/120
4AC8	0.1μ	Fixed			914173	ITT PMC2R/0.1/M100
4AC9	0.1μ	Fixed			914173	ITT PMC2R/0.1/M100
4AC10	0.1μ	Fixed			914173	ITT PMC2R/0.1/M100
4AC11	0.1μ	Fixed			914173	ITT PMC2R/0.1/M100
4AC12	10p	Disc Ceramic	500		917746	Erie 831/NPO
4AC13	10p	Disc Ceramic	500		917746	Erie 831/NPO
	Inductors					
4L1		Coil Assembly			BT603391	
4L2		Coil Assembly			BT603391	
4AL1	10 H	Choke			922364	Cambion 550-3640-45-02
4AL2	10 H	Choke			922364	Cambion 550-3640-45-02

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		FINE TUNE DISCRIMINATOR (Cont'd)				
	Diodes					
4D1		IN4149			914898	Mullard
4D2		IN4149			914898	Mullard
4AD1		IN4149			914898	Mullard
4AD2		IN4149			914898	Mullard
4AD3		IN4149			914898	Mullard
4AD4		IN4149			914898	Mullard
4AD5		IN4149			914898	Mullard
4AD6		IN4149			914898	Mullard
	Switches					
4SA		Toggle, black			921425	Arrow TC38P
	Meter					
4M1		Meter 50-0-50uA			921424	Turner 125E

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		CONSTANT-VOLTAGE AMPLIFIER (MS452 & PS58) DC603545				
	Resistors					
	ohm		W			
5AR1	3.3k	Metal Oxide		±2	910111	
5AR2	1k	Variable			919805	Plessey MPWT
5AR3	1k	Metal Oxide		±2	913489	
5AR4	4.7k	Metal Oxide		±2	913490	
5AR5	2.2k	Metal Oxide		±2	916546	
5AR6	1k	Metal Oxide		±2	913489	
5AR7	4.7k	Metal Oxide		±2	913490	
5AR8	820	Metal Oxide		±2	917065	
5AR9	10k	Metal Oxide		±2	914042	
5AR10	1k	Metal Oxide		±2	913489	
5AR11	1.8k	Metal Oxide		±2	911148	
5AR12	1.8k	Metal Oxide		±2	911148	
5AR13	1k	Metal Oxide		±2	913489	
5AR14	560	Wirewound	2.5	5	913614	Welwyn W21
5AR15	10	Metal Oxide		±2	920736	
5AR16	1k	Metal Oxide		±2	913489	
5AR17	47	Metal Oxide		±2	917063	
5AR18	51	Metal Oxide		±2	917056	
5AR19	51	Metal Oxide		±2	917056	
5AR20	1.8k	Metal Oxide		±2	911148	
5AR21	1.8k	Metal Oxide		±2	911148	
5AR22	330	Wirewound	2.5	5	913608	Welwyn W21
5AR23	33	Metal Oxide		±2	917069	
5AR24	10	Metal Oxide		±2	920736	
5AR25	330	Metal Oxide		±2	915690	
5AR26	51	Metal Oxide		±2	917056	
5AR27	820	Metal Oxide		5	906024	Electrosil TR5
5AR28	4.7k	Metal Oxide		±2	913490	
5AR29	47	Metal Oxide		±2	917063	
5AR30	51	Metal Oxide		±2	917056	
5AR31	120	Metal Oxide		5	918048	Electrosil TR5
5AR32	4.7k	Metal Oxide		±2	913490	
5AR33	4.7k	Metal Oxide		±2	913490	
5AR34	47k	Metal Oxide		±2	913496	
5AR35	1M	Metal Oxide		5	914036	Electrosil TR5
5AR36	15k	Metal Oxide		±2	920645	
5AR37	120	Metal Oxide		5	906021	Electrosil TR5
5AR38	220k	Metal Oxide		±2	921771	
5AR39	10k	Metal Oxide		±2	914042	
5AR40	120	Metal Oxide		±2	918048	

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		CONSTANT-VOLTAGE AMPLIFIER (Cont'd)				
	Resistors (Cont'd)					
	ohm		W			
5AR41	100k	Metal Oxide		±2	915190	
5AR42	68	Wirewound	2.5	5	913592	Welwyn W21
5AR43	100k	Metal Oxide		±2	915190	
5AR44	47k	Metal Oxide		±2	913496	
5AR45	1k	Metal Oxide		±2	913489	
5AR46	150	Metal Oxide		±2	910389	
	Capacitors					
	F		V			
5AC1	0.1μ	Fixed		20	914173	ITT PMC2R/M100
5AC2	100μ	Fixed	20	10	913445	Kemet K100 J20KS
5AC3	1000pF	Fixed	20	500	917419	Erie 831/K350081
5AC4	1000pF	Fixed	20	500	917419	Erie 831/K350081
5AC5	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC6	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC7	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC8	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC9	.01μ	Fixed		+50 -25	926386	Erie 861/T/25V
5AC10	68p	Fixed		10	917737	Erie 831/2200
5AC11	.01μ	Fixed		+50 -25	926386	Erie/861/T/25V
5AC12	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC13	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC14	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC15	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC16	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC17	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC18	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC19	0.1μ	Fixed		20	914173	ITT PMC2R/0.1/M100
5AC20	100p	Fixed	500	10	917417	Erie 831IN3300
5AC21	470p	Fixed	500	10	917453	Erie 831K170051
5AC22	0.1μ	Fixed		20	914973	ITT PMC2R/0.1/M100
	Inductors					
5AL1	10μH	Choke			922364	Cambion 550-3640-45-02
	Transformers					
5AT1					CT603711	
5AT2					CT603710	

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		CONSTANT-VOLTAGE AMPLIFIER (Cont'd)				
	Transistors					
5ATR1		BC107			911929	Mullard
5ATR2		BC107			911929	Mullard
5ATR3		BC107			911929	Mullard
5ATR4		BYC71			911928	Mullard
5ATR5		BFY51			908753	Mullard
5ATR6		BSX61			916632	Mullard
5ATR7		BSX61			916632	Mullard
5ATR8		BSX61			916632	Mullard
5ATR9		BC107			911929	Mullard
5ATR10		BSX61			916632	Mullard
5ATR11		BC107			911929	Mullard
5ATR12		BC107			911929	Mullard
5ATR13		BC107			911929	Mullard
5ATR14		BC107			911929	Mullard
5ATR15		BC107			911929	Mullard
5ATR16		BCY71			911928	Mullard
5ATR17		BCY71			911928	Mullard
	Diodes					
5AD1		BZX79C5V6			921749	Mullard
5AD2		IN4149			914898	Mullard
5AD3		BZX79C12			928372	Mullard
5AD4		NOT USED				
5AD5		IN4149			914898	Mullard
5AD6		IN4149			914898	Mullard
5AD7		IN4149			914898	Mullard
5AD8		BZXC6V8			921750	Mullard
5AD10		IN4149			914898	Mullard
5AD11		IN4149			914898	Mullard
5AD12		IN4149			914898	Mullard
5AD13		BZXC6V8			921750	Mullard
5AD14		BZXC12			928372	Mullard
5AD15		IN4149			914898	Mullard
5AD16		IN4149			914898	Mullard
5AD17		BZXC12			928372	Mullard
5AD18		IN4149			914898	Mullard
5AD19		IN4002			911460	ITT
5AD20		IN4149			914898	Mullard
5AD21		IN4149			914898	Mullard
5AD22		IN4002			911460	ITT
5AD23		IN4149			914898	Mullard

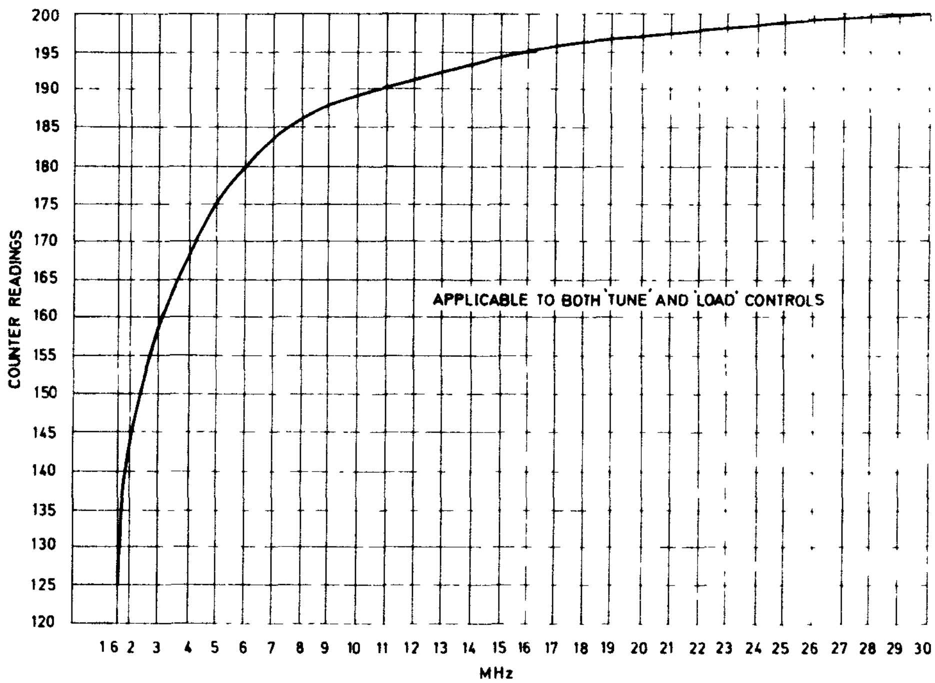
Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		CONSTANT-VOLTAGE AMPLIFIER (Cont'd)				
	Relays					
5ARLA					921505	Leach ER2-2A-A1A
	Plugs					
5PL1		Coaxial			917970	Transradio BN14/5
5PL2					909729	Cannon DA15P
5PL3					916489	Cannon DB25P
	Sockets					
5SK1		Coaxial			900061	Transradio BN12/5
	Miscellaneous					
5AFB1		Ferrite bead			907488	Mullard FX1242
5AFB2		Ferrite bead			907488	Mullard FX1242
5AFB3		Ferrite bead			907488	Mullard FX1242
5AFB4		Ferrite bead			907488	Mullard FX1242

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
	'TUNE' COIL, MOTOR AND GEARBOX ASSEMBLY (MS451) CC603155/A					
	LOAD COIL, MOTOR AND GEARBOX ASSEMBLY (MS451) CC603155/B					
	NOTE: The 'Tune' and 'Load' Assemblies are identical except for the Contacts for IL1 and IL2.					
	Resistors					
	ohm		W			
6R1	56	Metal Oxide		5	908289	Electrosil TR4
6R2	10	Metal Oxide		5	912868	Electrosil TR4
6R3	220	Metal Oxide	7	10	923147	Electrosil FP7
	Capacitors					
	F					
6C1	0.1μ	Fixed			930563	M2B 101 OSA
6C2	395p	Variable			AD603233	
6C3	1000p	Fixed		10	917419	Erie H1-K831/K350081
	Diodes					
6D1		BYX38300			910957	
6D2		BYX38300			910957	
6D3		BYX38300			910957	
6D4		BYX38300			910957	
	Switches					
6SA		Micro			907169	Burgess M1
6SB		Micro			907169	Burgess M1
	Motor					
6ME1		28V			941759	Moore Reed 42MM018
	Terminal Strip					
6TB1					901605	Carr R44-00030-008
	Miscellaneous					
		Contact for IL1			CD603603	
		Contact for IL2			CD603604	

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		COARSE-TUNE DISCRIMINATOR (PS106) BC600506				
	Resistors					
	ohm		W			
6AR1	560	Metal Oxide		±2	917061	
6AR2	470	Metal Oxide		±2	920758	
6AR3	560	Metal Oxide		±2	917061	
6AR3	680	Metal Oxide (BC600506/C) ONLY		±2	910113	Electrosil TR4
6AR4	1k	Metal Oxide		±2	913489	
6AR5	1k	Metal Oxide		±2	913489	
6AR6	47k	Metal Oxide		±2	913496	
6AR7	220	Variable		20	940803	Plessey MPD PC 404/8/02857
	Capacitors					
	F		V			
6AC1	4-60p	Variable	375		916940	Mullard 908-07011
6AC2	0.01μ	Ceramic Disc	100	-20+80	900067	Erie CD801/K800011
6AC3	220p	Silver Mica	350	2	902242	Lemco MS119/1/R
6AC4	0.01μ	Ceramic Disc	100	-20+80	900067	Erie CD801/K800011
6AC5	0.01μ	Ceramic Disc	100	-20+80	900067	Erie CD801/K800011
6AC6	0.01μ	Ceramic Disc	100	-20+80	9000	Erie CD801/K800011
6AC7	1000p	Ceramic	350	20	902122	Erie K350081AD/PL107
	Transformers					
6AT1		Coil Assembly			CT600833/B	
	Diodes					
6AD1		1N4149			914898	Mullard
6AD2		1N4149			914898	Mullard
6AD3		1N4149			914898	Mullard
6AD4		1N4149			914898	Mullard

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		SWITCHBANK ASSEMBLY CA603351				
	Capacitors					
	F		V			
7C1	0.01u	Polyester	400	20	928390	ITT PMT R/0.01/M400
7C2	0.1u	Polyester	160	20	930563	Ashcroft A2B1015A
7C3	0.1u	Polyester	160	20	930563	Ashcroft A2B1015A
7C4	0.1u	Polyester	160	20	930563	Ashcroft A2B1015A
7C5	0.1u	Polyester	160	20	930563	Ashcroft A2B1015A
7C6	0.1u	Polyester	160	20	930563	Ashcroft A2B1015A
7C7	0.1u	Polyester	160	20	930563	Ashcroft A2B1015A
7C8	0.1u	Polyester	160	20	930563	Ashcroft A2B1015A
7C9	0.1u	Polyester	160	20	930563	Ashcroft A2B1015A
	Switches					
7SA		Microswitch			919551	Burgess V4T7YR1
7SB		Microswitch			919551	Burgess V4T7YR1
7SC		Microswitch			919551	Burgess V4T7YR1
7SD		Microswitch			919551	Burgess V4T7YR1
7SE		Microswitch			919551	Burgess V4T7YR1
7SF		Microswitch			919551	Burgess V4T7YR1
7SG		Microswitch			919551	Burgess V4T7YR1
	Terminal Strip					
7TB1		12-way			922181	Klippon MKL2/12 2413

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number	Manufacturer
		SERVO POWER AMPLIFIER (MS265)CC600191				
	Resistors					
	ohm		W			
9R1	1.1	Wirewound	12	5	940696	Welwyn W24
9R2	4.7k	Metal Oxide		5	911002	Electrosil TR5
9R3	1.5k	Metal Oxide		5	906027	Electrosil TR5
9R4	680	Metal Oxide		5	908390	Electrosil TR4
9R5	680	Metal Oxide		5	908390	Electrosil TR4
	Capacitors					
	F		V			
9C1	0.1μ	Polyester	250	10	915918	Mullard 344-41103
9C2	0.1μ	Polyester	100	20	927111	ITT PMC2R/0.1/M100
9C3	0.1μ	Polyester	160	20	930563	Ashcroft A2B1015A
9C4	0.1μ	Polyester	160	20	930563	Ashcroft A2B1015A
	Transistors					
9TR1		Silicon n-p-n			917389	Mullard BSW66A
9TR2		Silicon n-p-n, Power			917289	Westinghouse 2N 3233
9TR3		Silicon p-n-p, Power			938906	RCA 2N4036
9TR4		Silicon n-p-n, Power			917289	Westinghouse 2N 3233
	Diodes					
9D1		Silicon			900651	Mullard 1N 914
9D2		Zener: 1.3V	400mW	5	936609	Mullard BZV46-1V5
9D3		Zener: 1.3V	400mW	5	936609	Mullard BZV46-1V5
9D4		Silicon			900651	Mullard 1N 914
9D5		Zener: 1.3V	400mW	5	936609	Mullard BZV46-1V5
9D6		Zener: 1.3V	400mW	5	936609	Mullard BZV46-1V5
9D7		Silicon			911460	Texas 1N 4002
9D8		Silicon			911460	Texas 1N 4002
	Connectors					
9PL1		15-way Plug			909729	Cannon DA 15P
9TR1		6-way Terminal Block			915495	Wingrove & Rogers TS6-06



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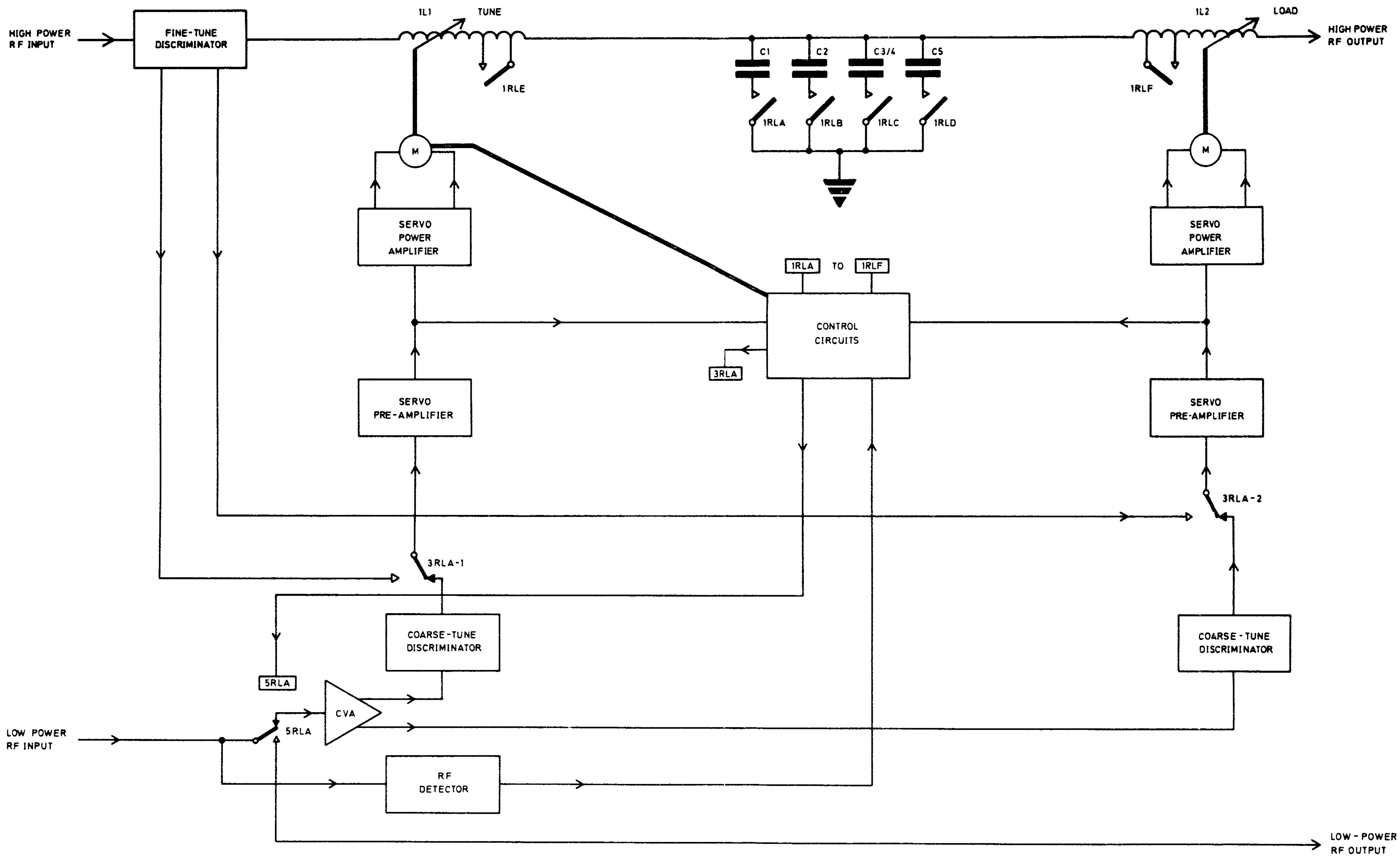
Manual Coarse - Tuning Graph MA.1004

Fig.1



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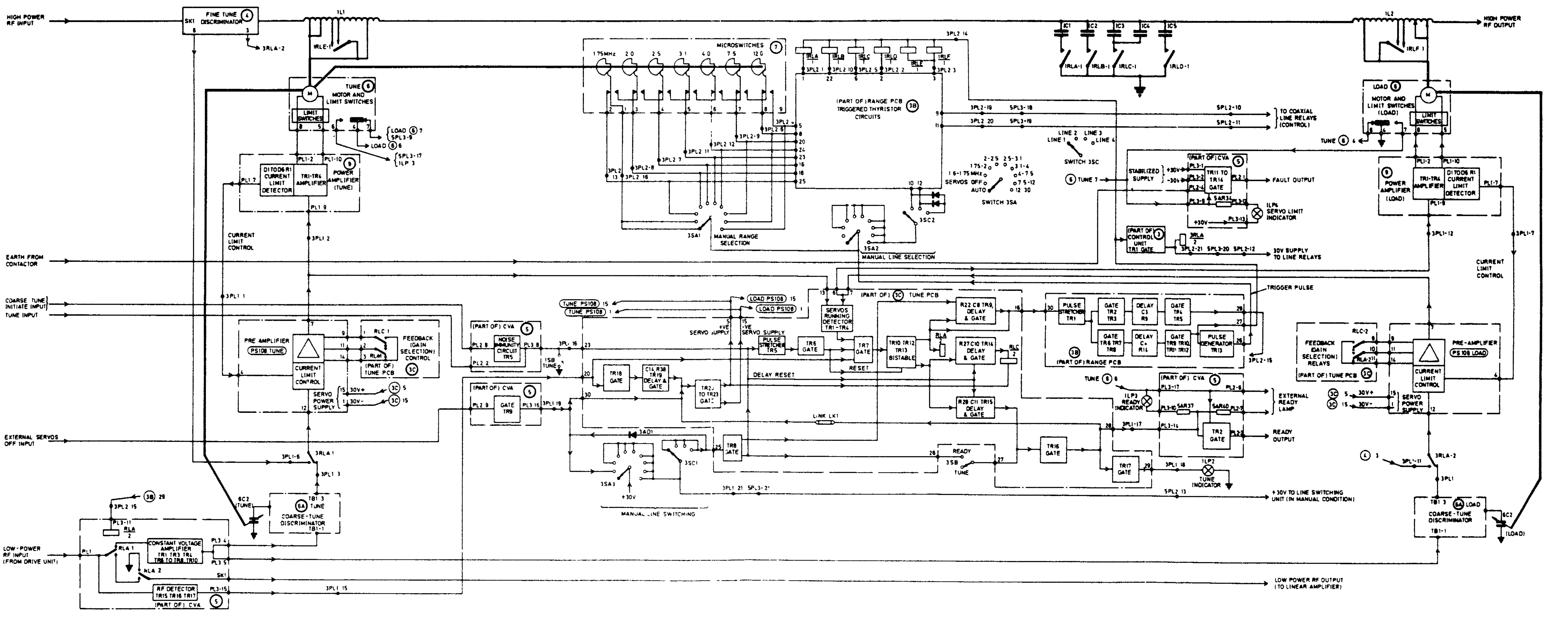
Simplified Block Diagram MA1004

Fig. 2



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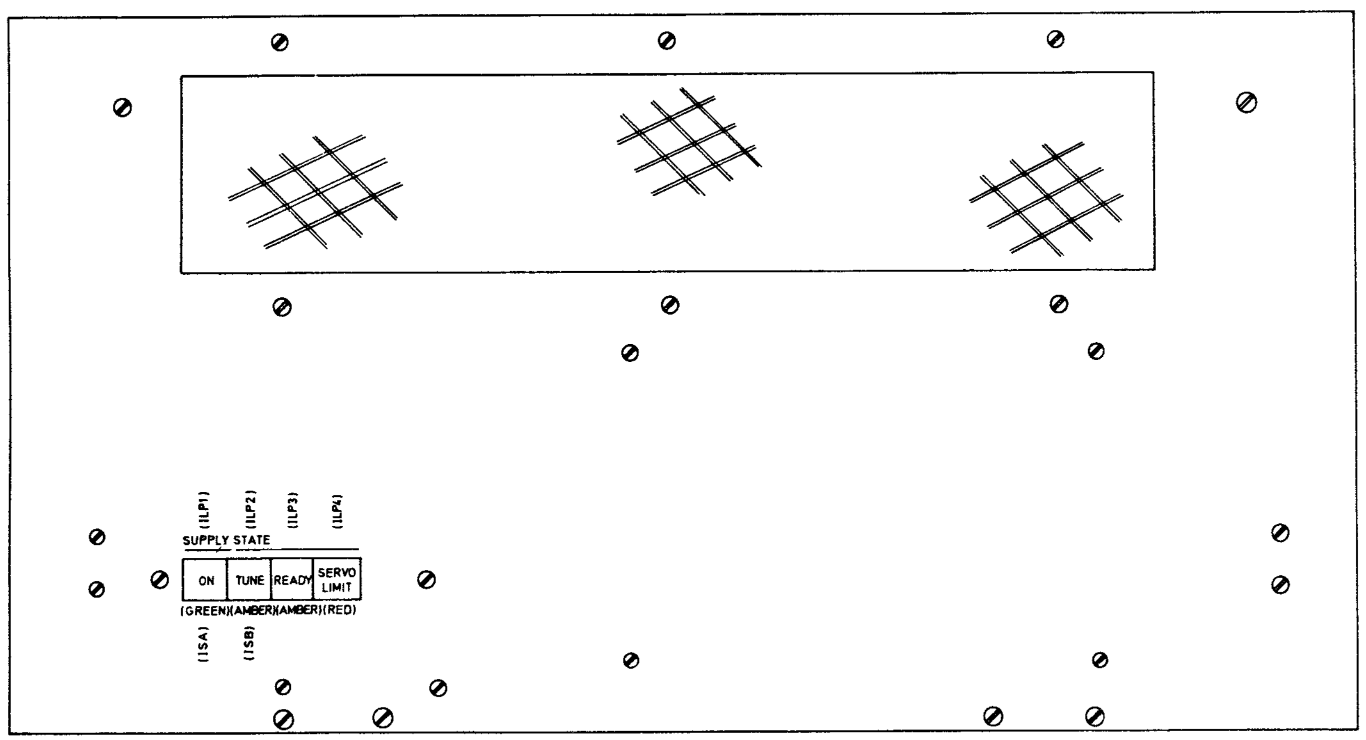
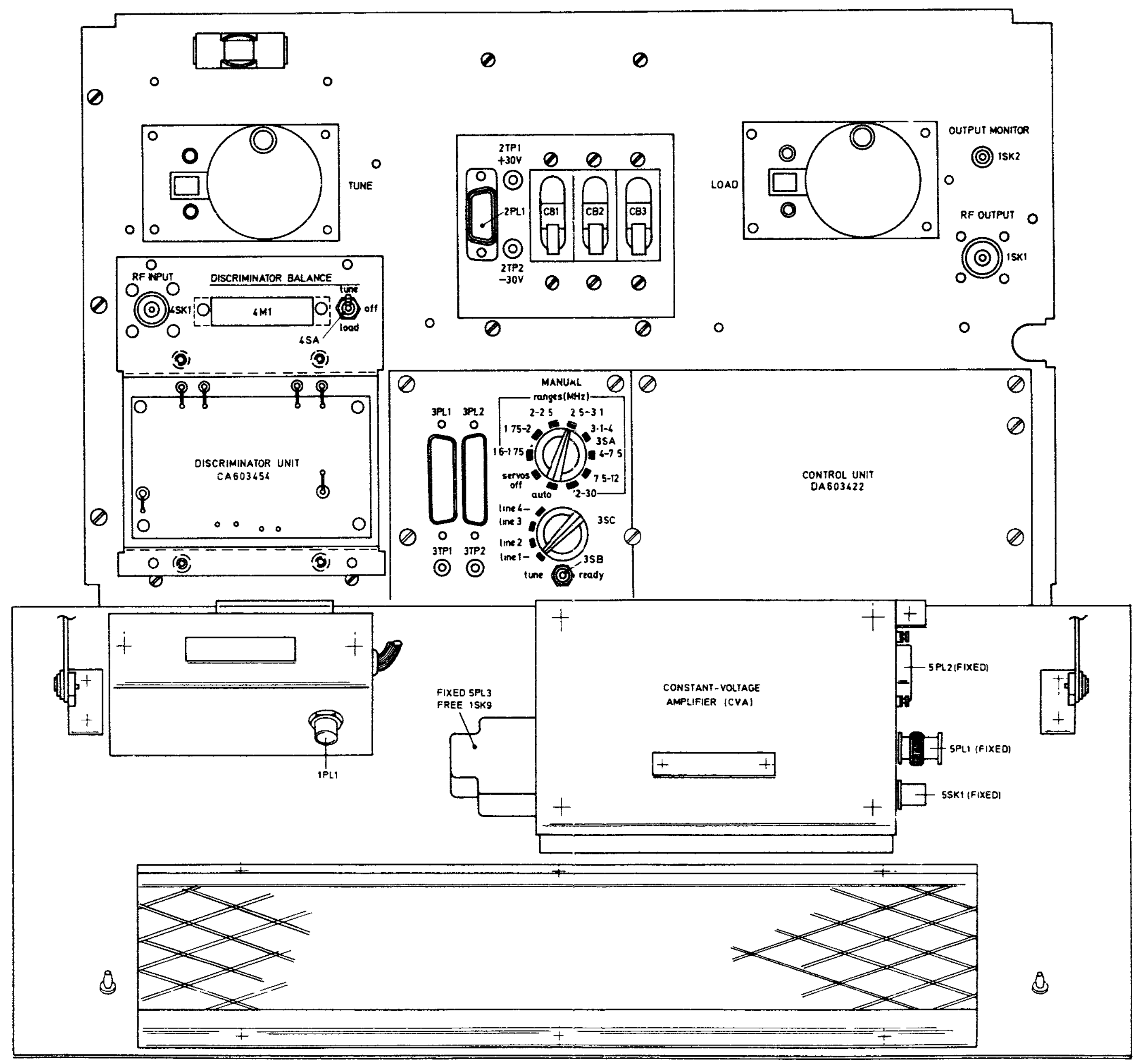
Functional Diagram : MA1004 FMU

Fig. 3

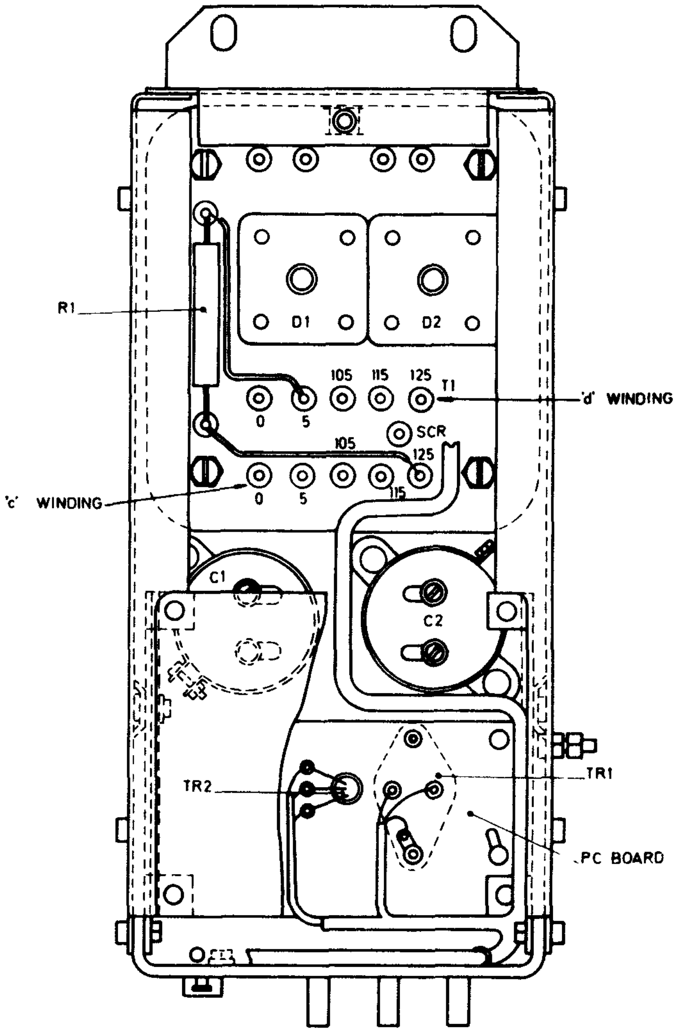




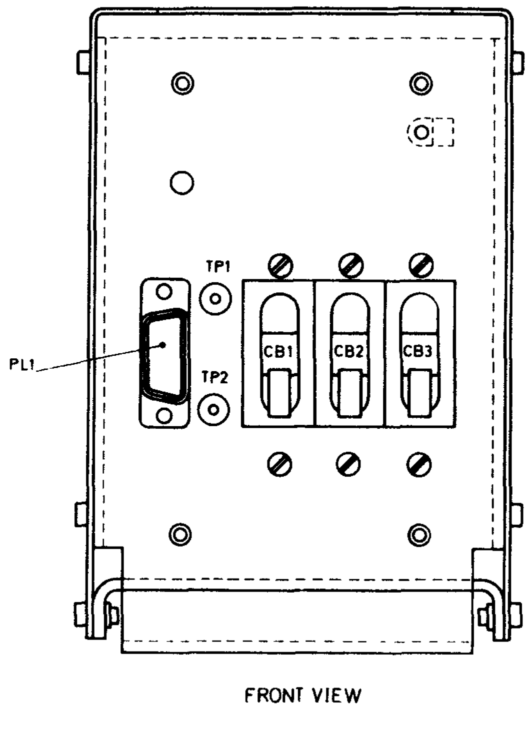
VIEW WITH FRONT PANEL LOWERED

Layout: Front and Sub-front Panels MA.1004

Fig.4



TOP VIEW

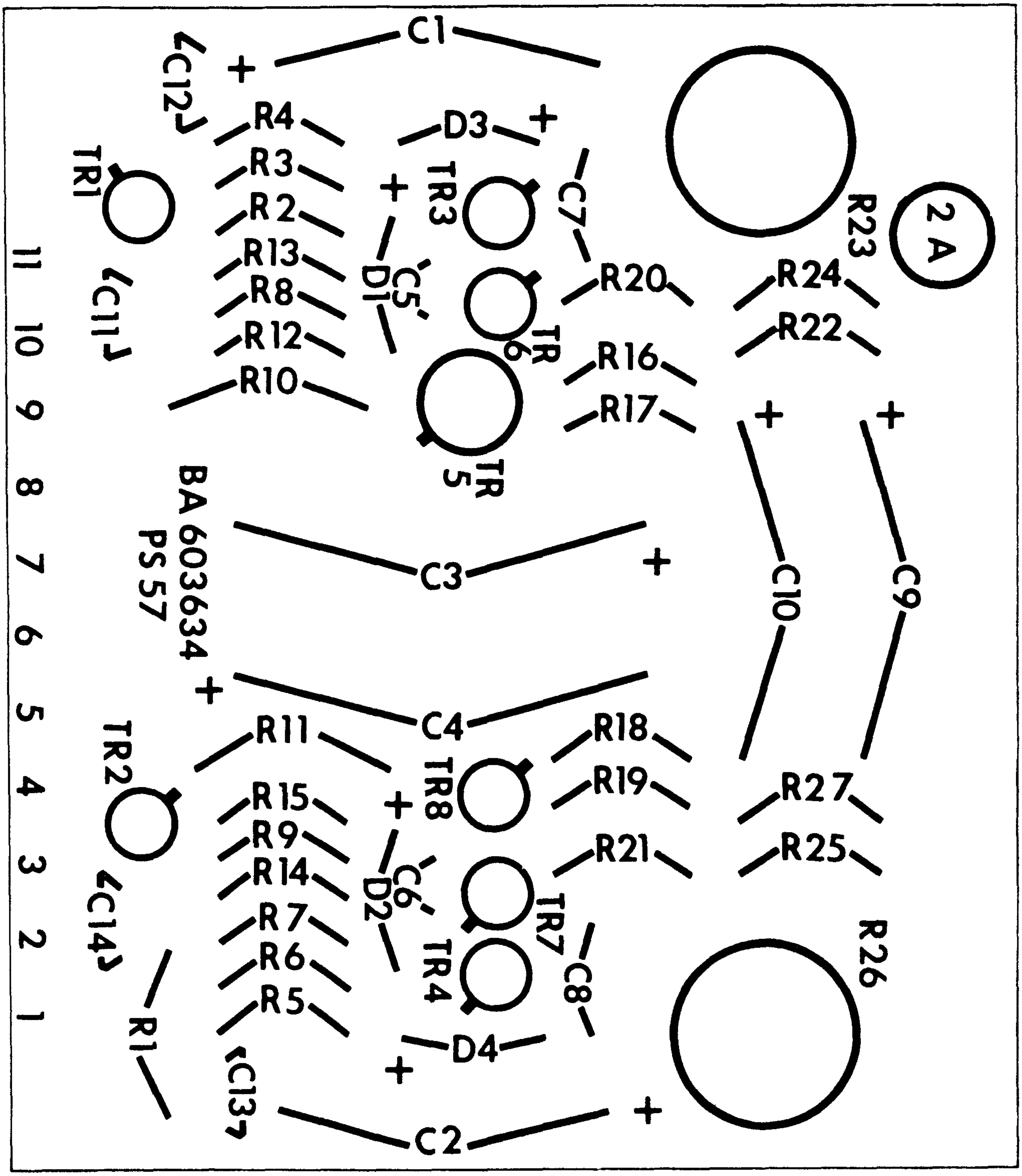


FRONT VIEW

WOH 3043

Layout: Power Supply Unit (MS448)

Fig.5

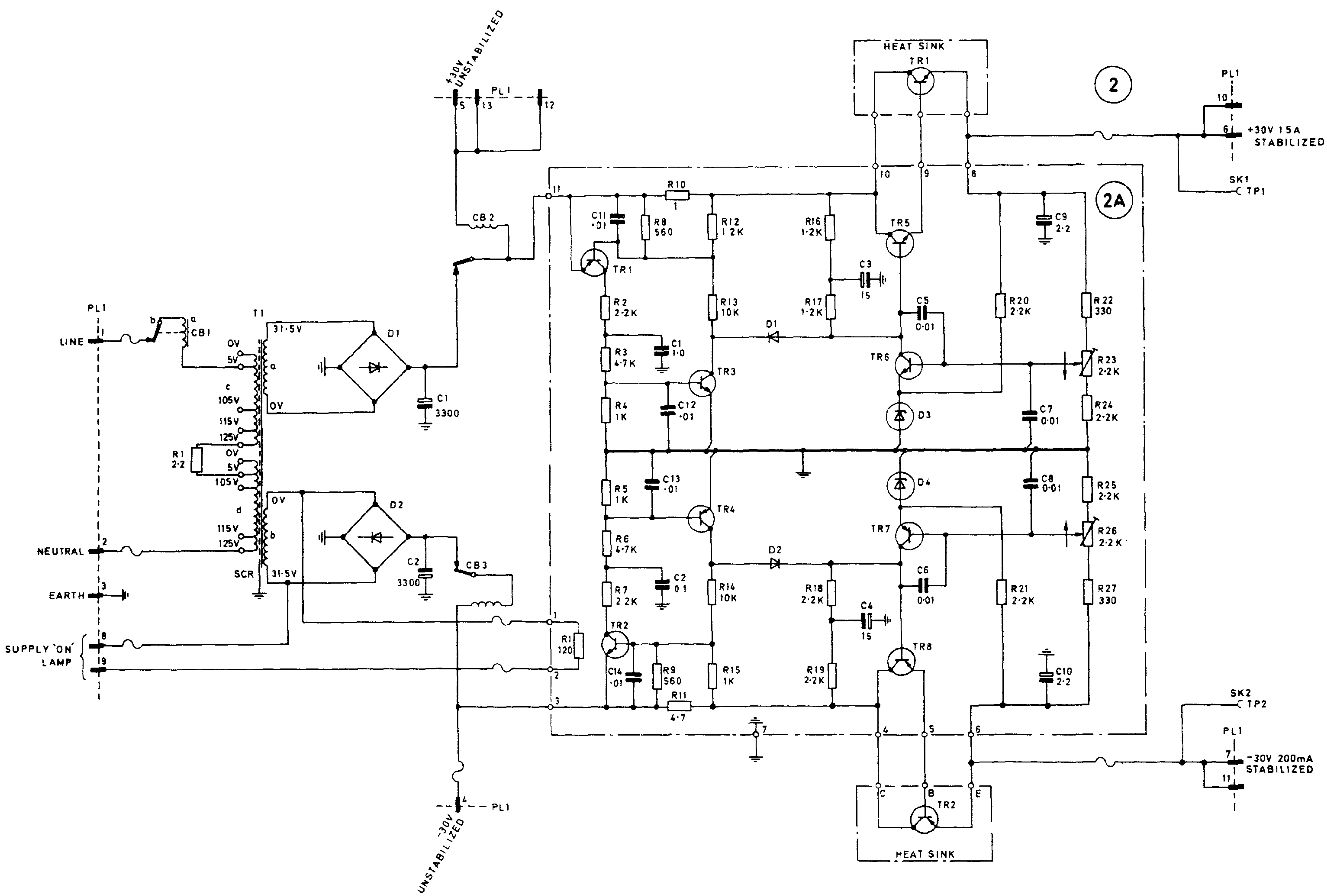


2A

Layout:
Power Supply Unit PC Board (PS57)

Fig. 6

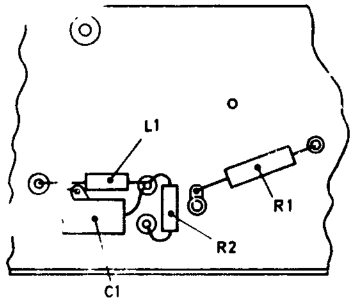
WOH 3043	DD603636
C	



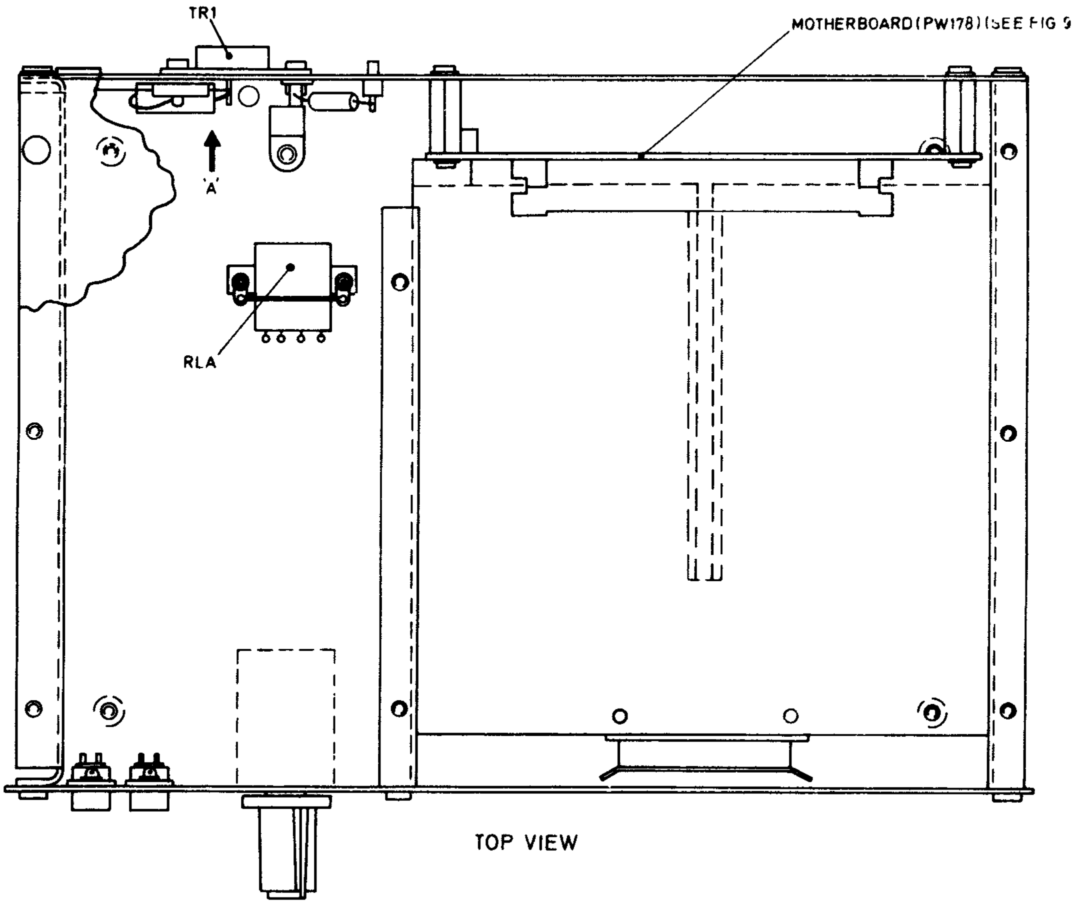
WOH3043 DC603514
ISSUE K 1 2 5 6

Circuit: Power Supply Unit (MS448 & PS57)

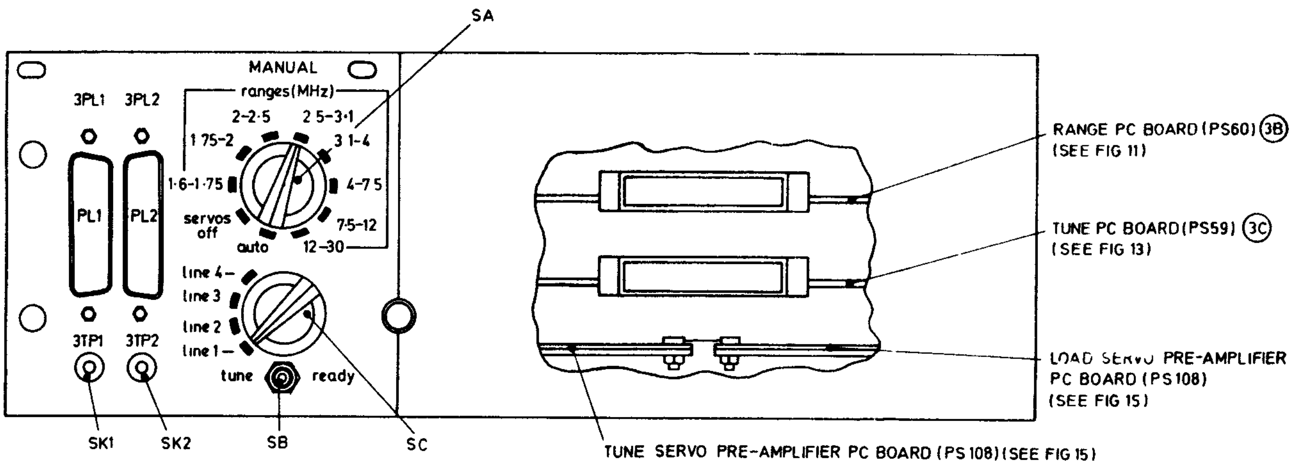
Fig. 7



SCRAP VIEW IN DIRECTION OF ARROW 'A'



TOP VIEW

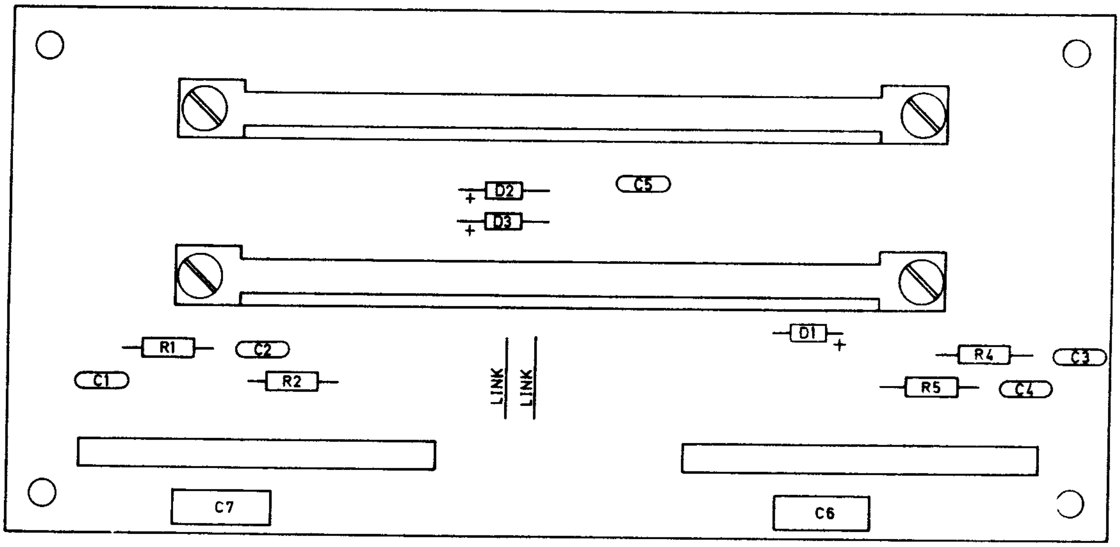


FRONT VIEW

WOH 3043

Layout : Control Unit

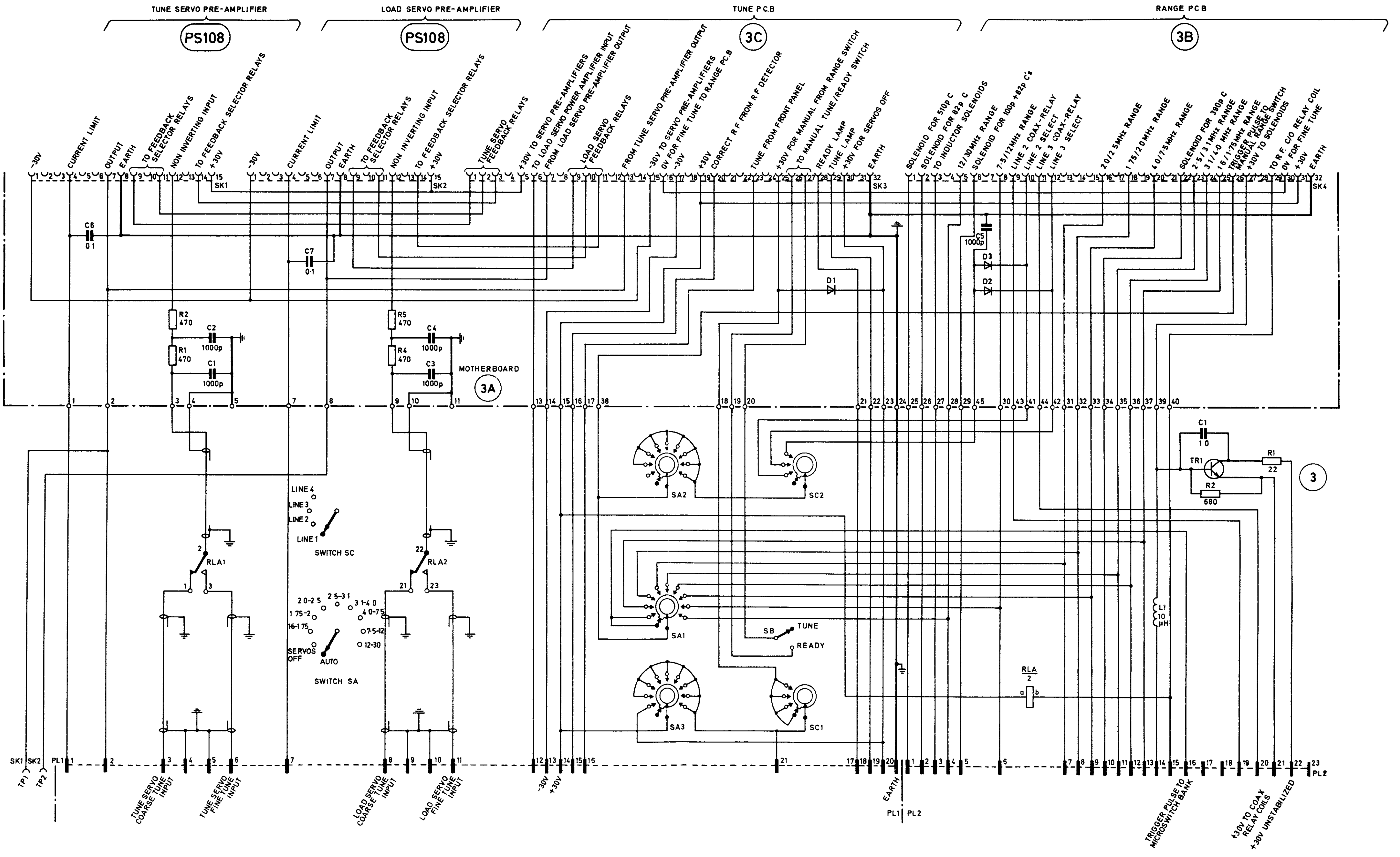
Fig.8



WOH3043

Layout : Motherboard (PW178)

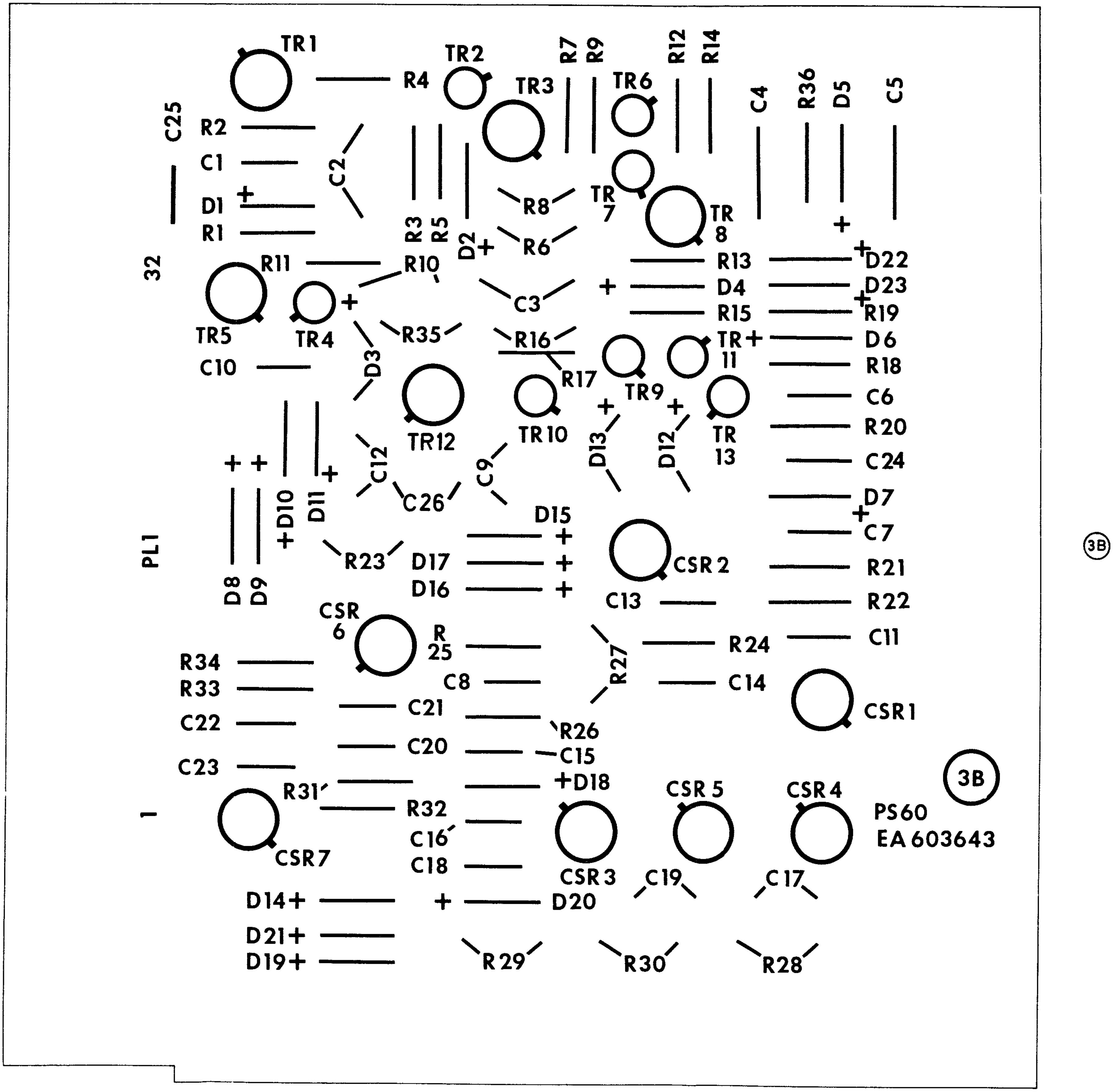
Fig. 9



WOH 3043 | DC603422
ISSUE C | 1 | 2

Circuit : Control Unit (MS450)

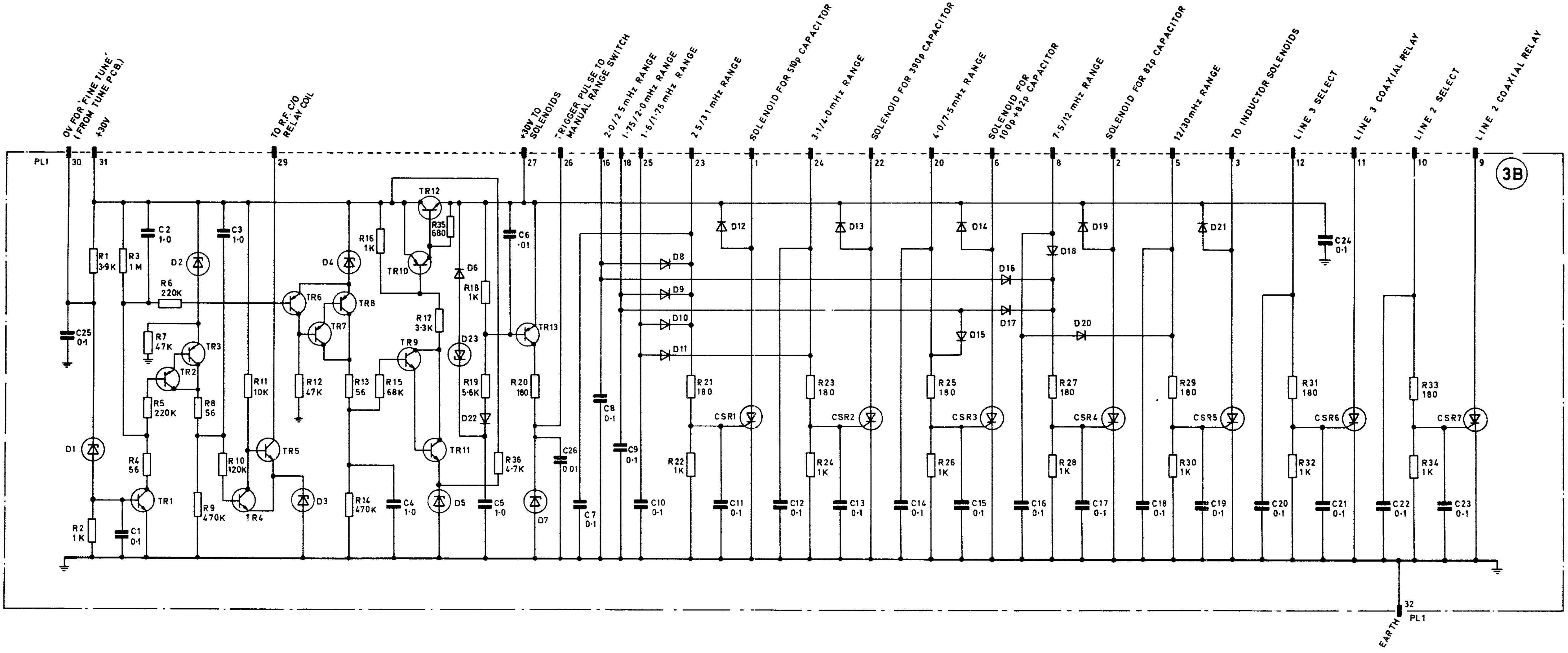
Fig.10



WOH 3043 | ED603645
G | 1 | 2 | 3 | 4 | 5

Layout: Range PC Board (PS60)

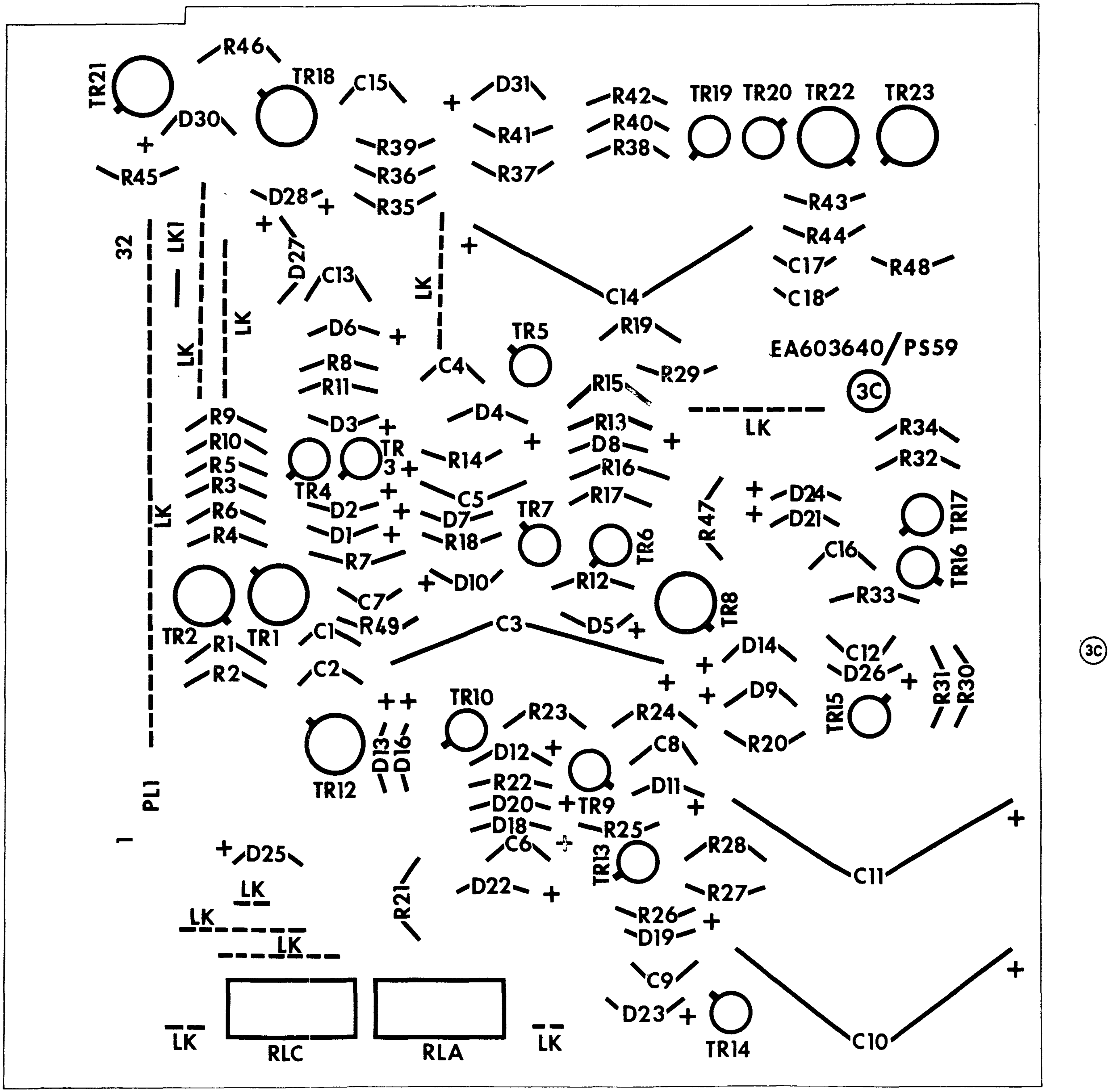
Fig. 11



Circuit : Range P.C. Board (PS60)

Fig.12

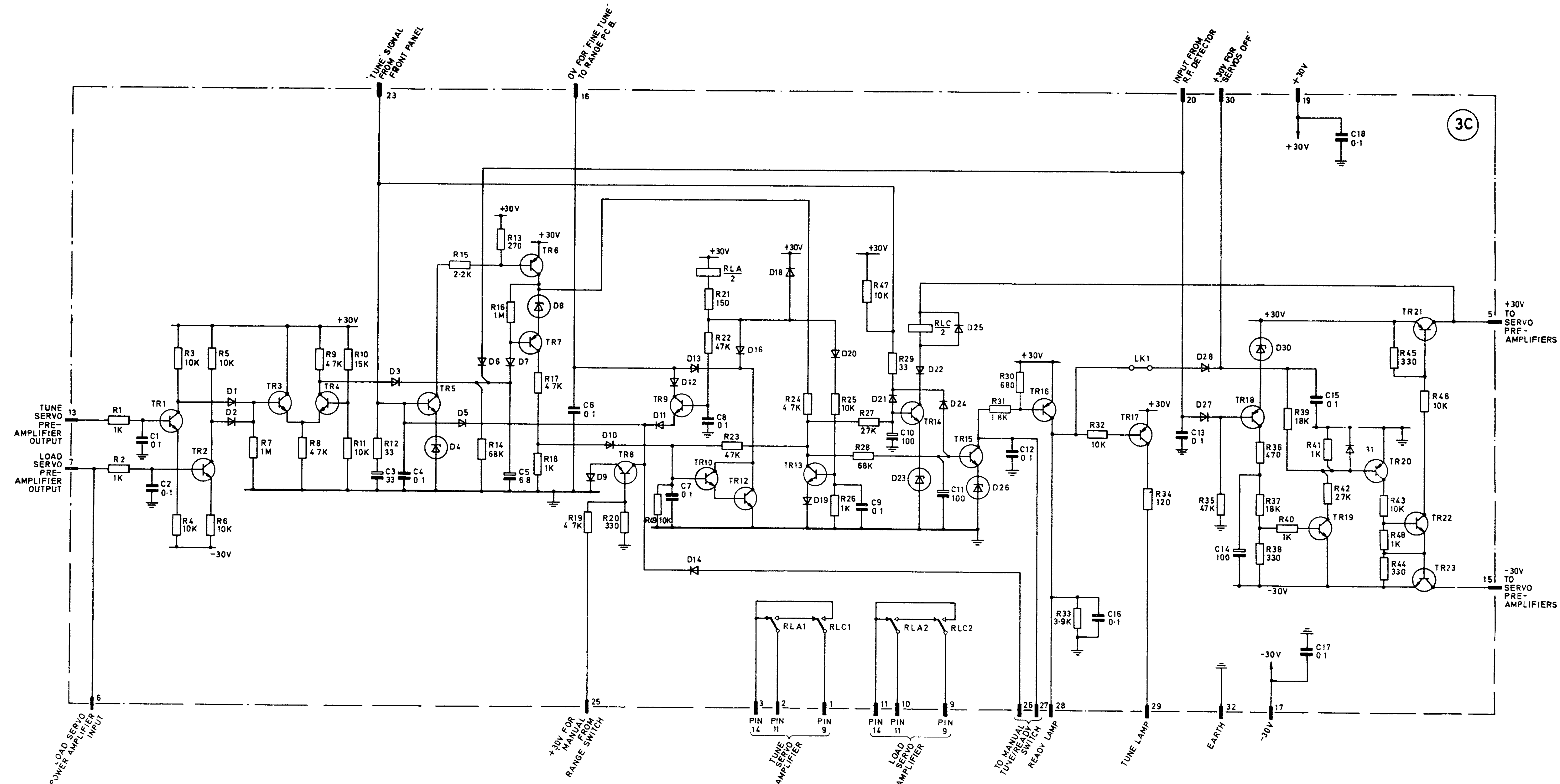
WOH 3043	DC603643		
ISSUE	G	1	2



WOH 3043 | ED603642
F 1 7

Layout: Tune PC Board (PS59)

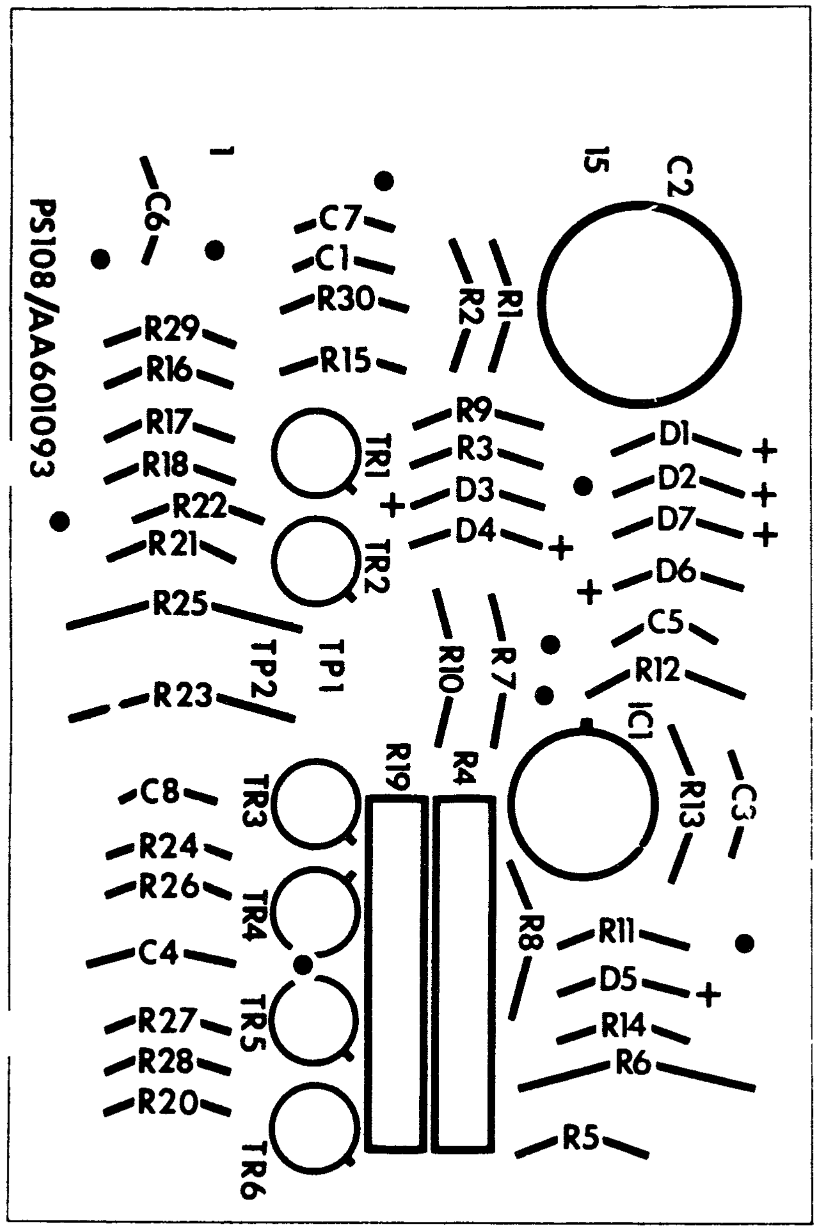
Fig. 13



WOH 3043	DC603640						
ISSUE	F	1	2	3	4	5	8

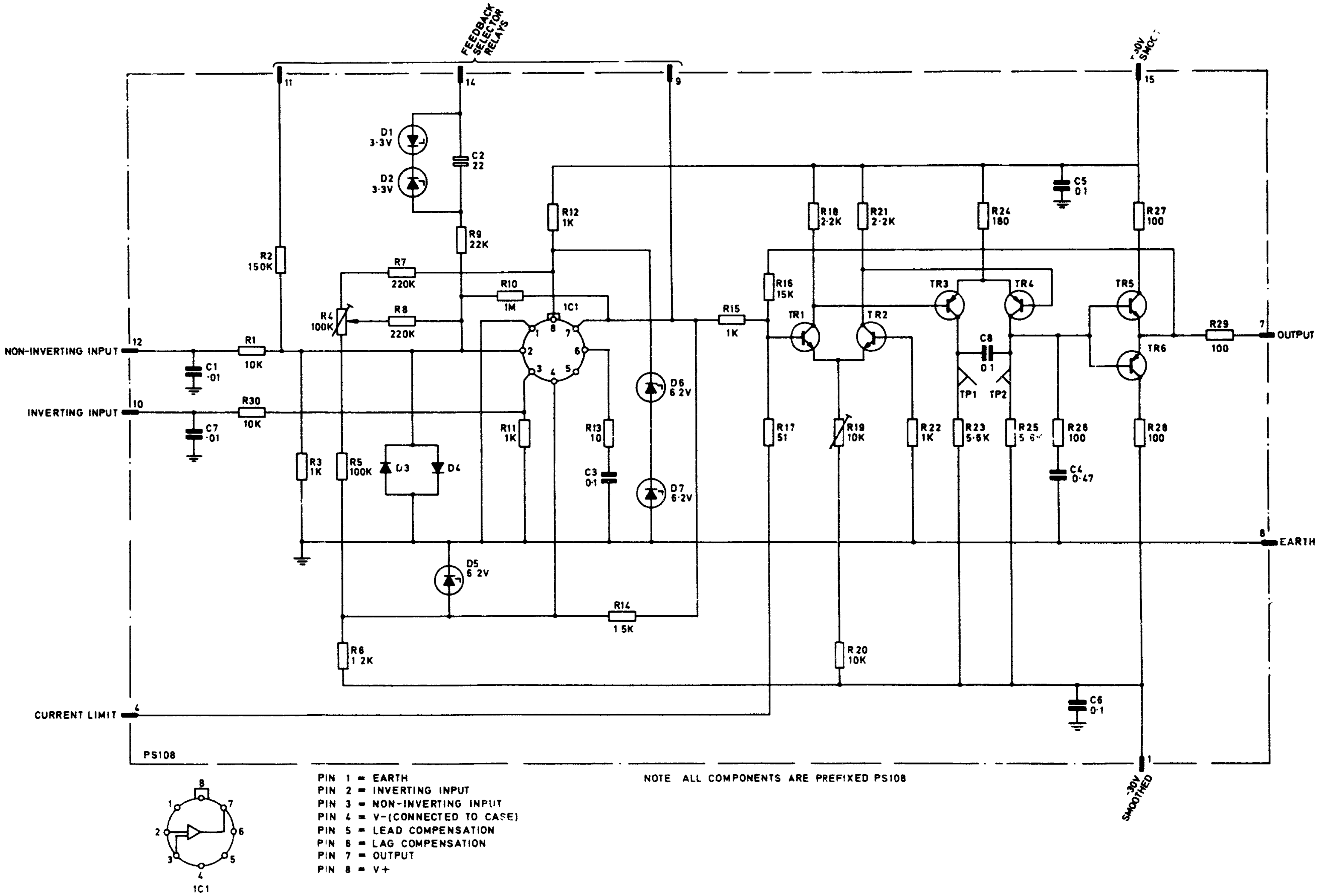
Circuit : Tune P.C. Board (PS 59)

Fig. 14



PC42255 SHT 3

LAYOUT



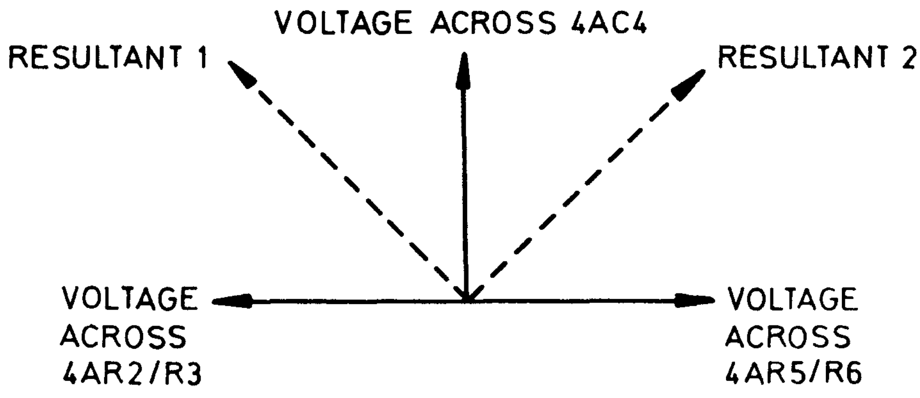
CC601093

CIRCUIT

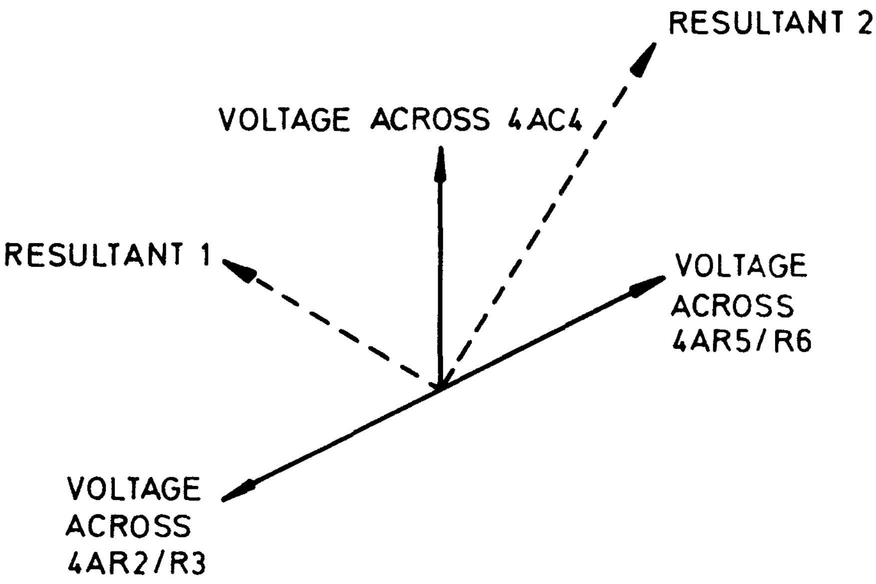
ALH 3047

Circuit and Layout: Servo Pre-Amplifier PC Board (PS108)

Fig.15



(A) INPUT IMPEDANCE RESISTIVE

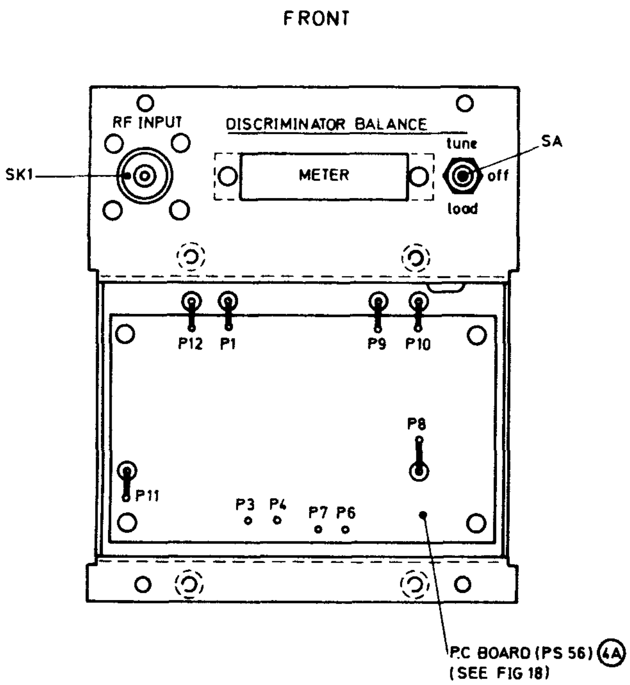


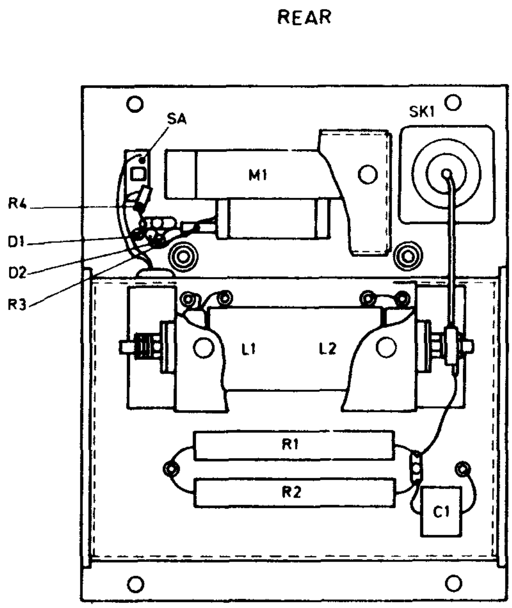
(B) INPUT IMPEDANCE REACTIVE

WOH3043

Phase Discriminator
Vector Diagrams: MA.1004

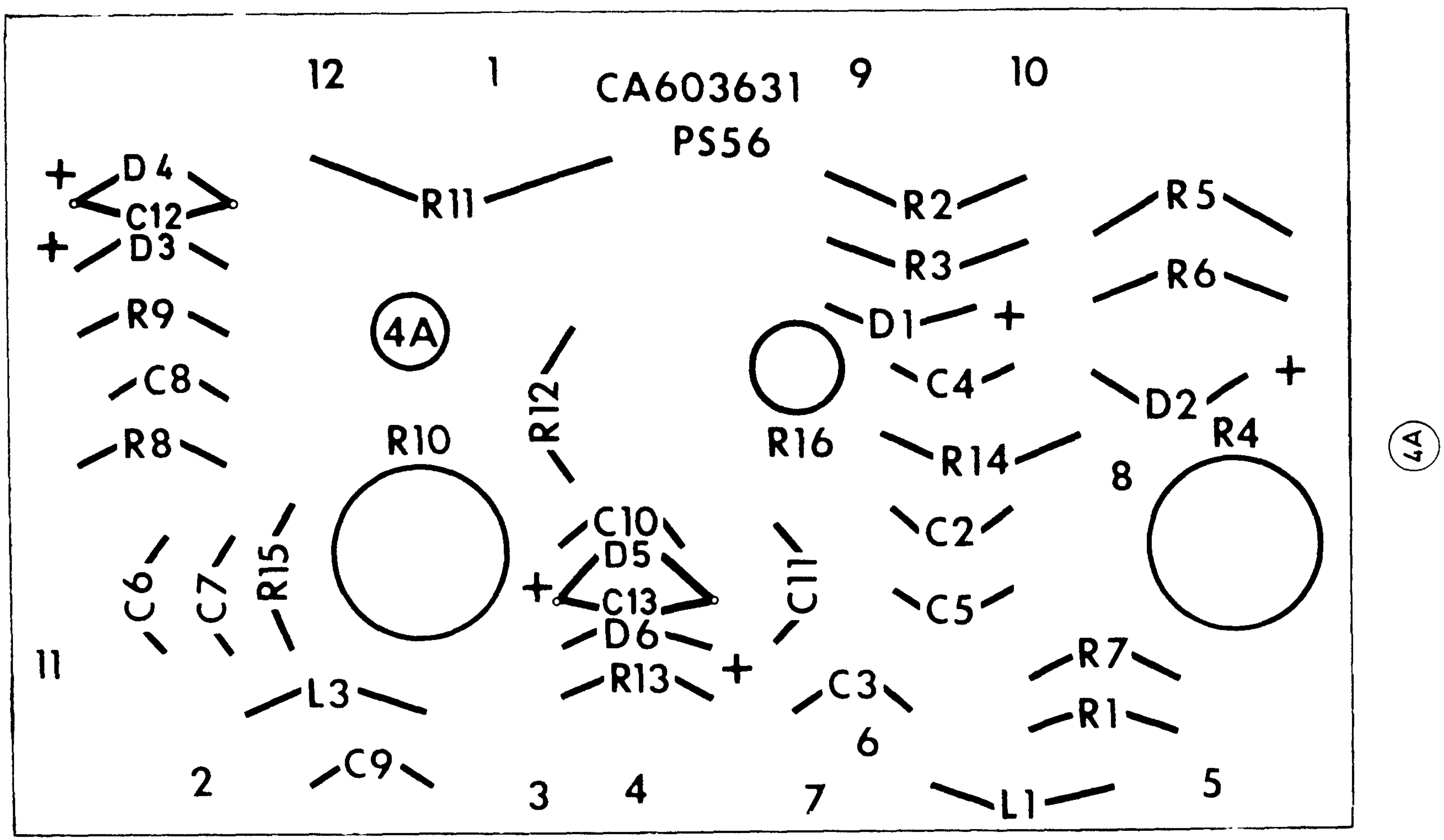
Fig. 16





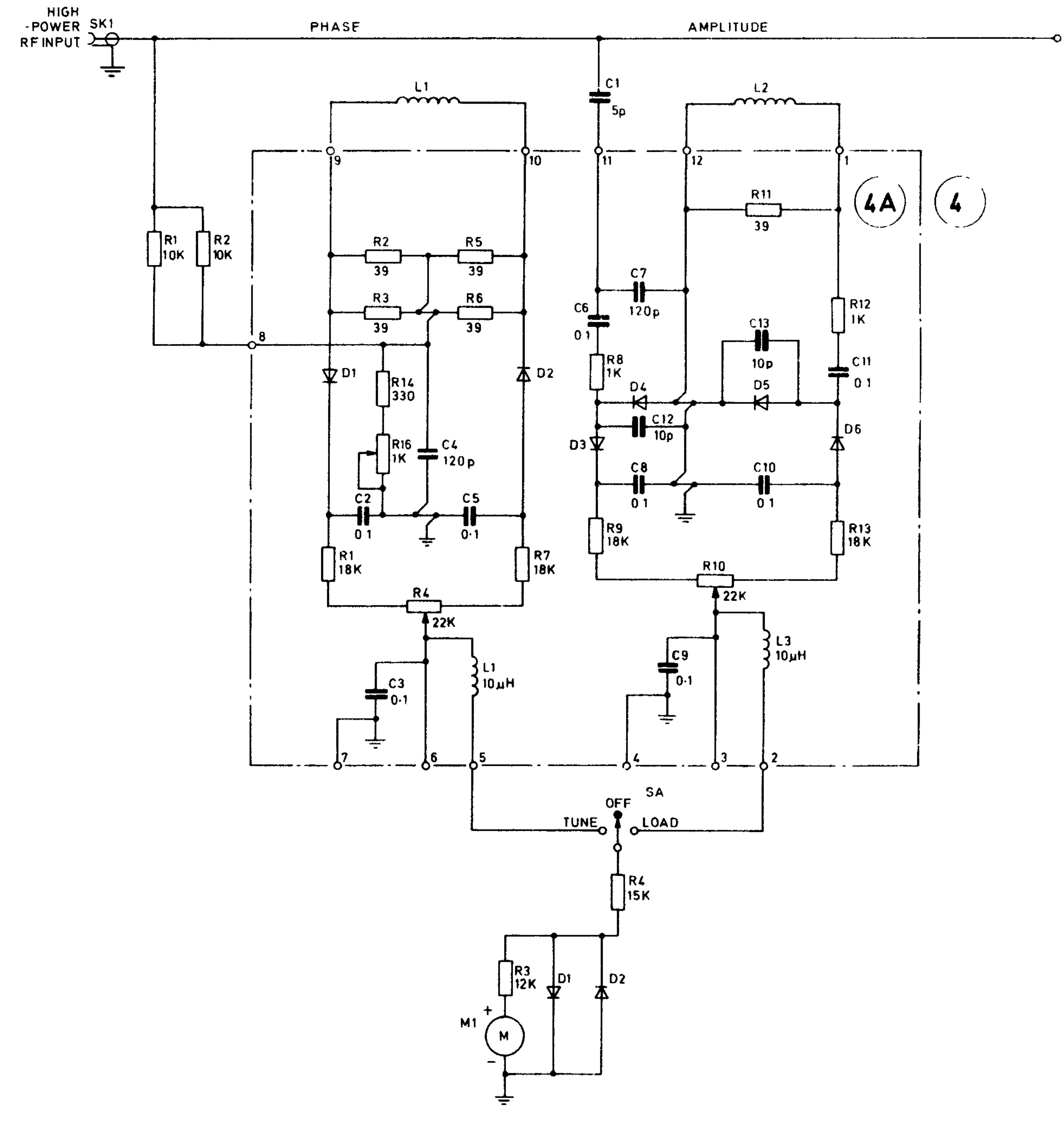
WOH 3043

Layout: Fine-Tune Discriminator (MS 449) Fig. 17



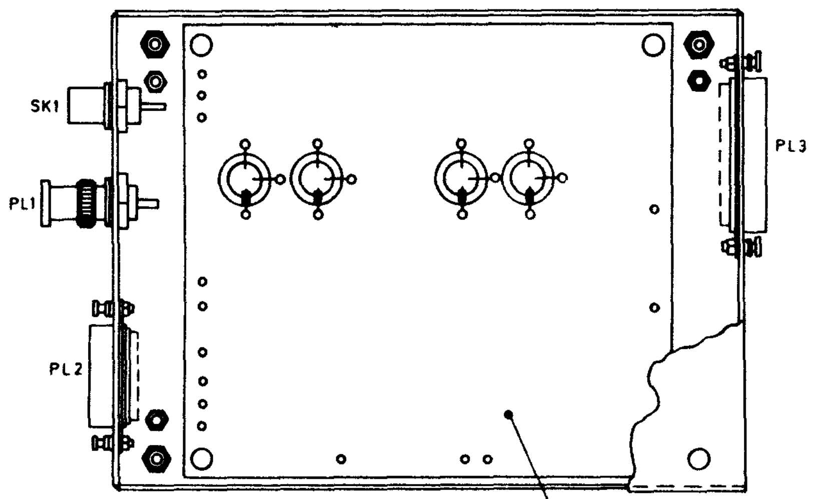
Layout: Fine-Tune Discriminator
PC Board (PS56)

WOH 3043 DD603633 E 1

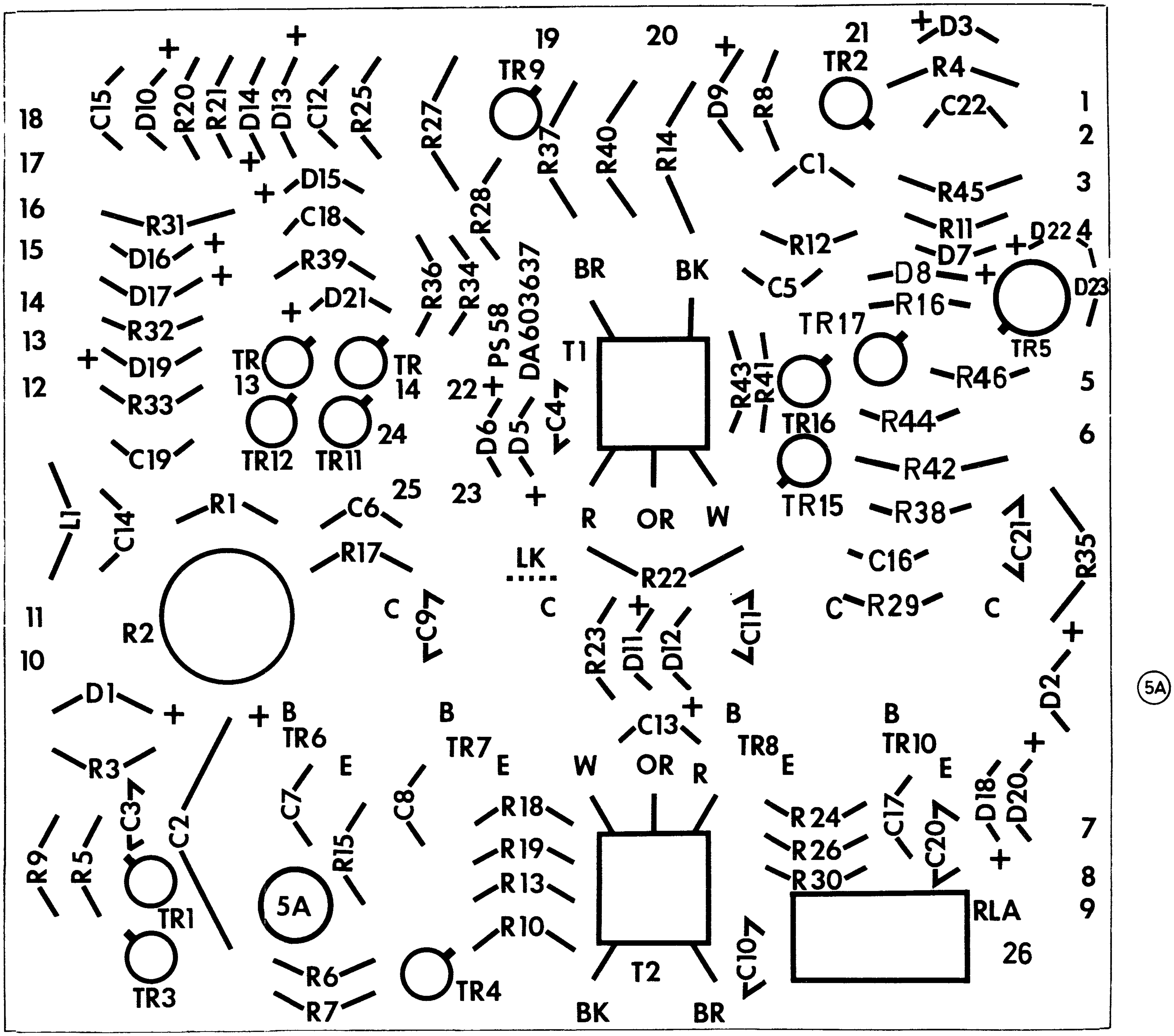


WOH 3043	CC603454
ISSUE F 1 2	

Circuit : Fine-Tune Discriminator (MS449 & PS56) Fig.19



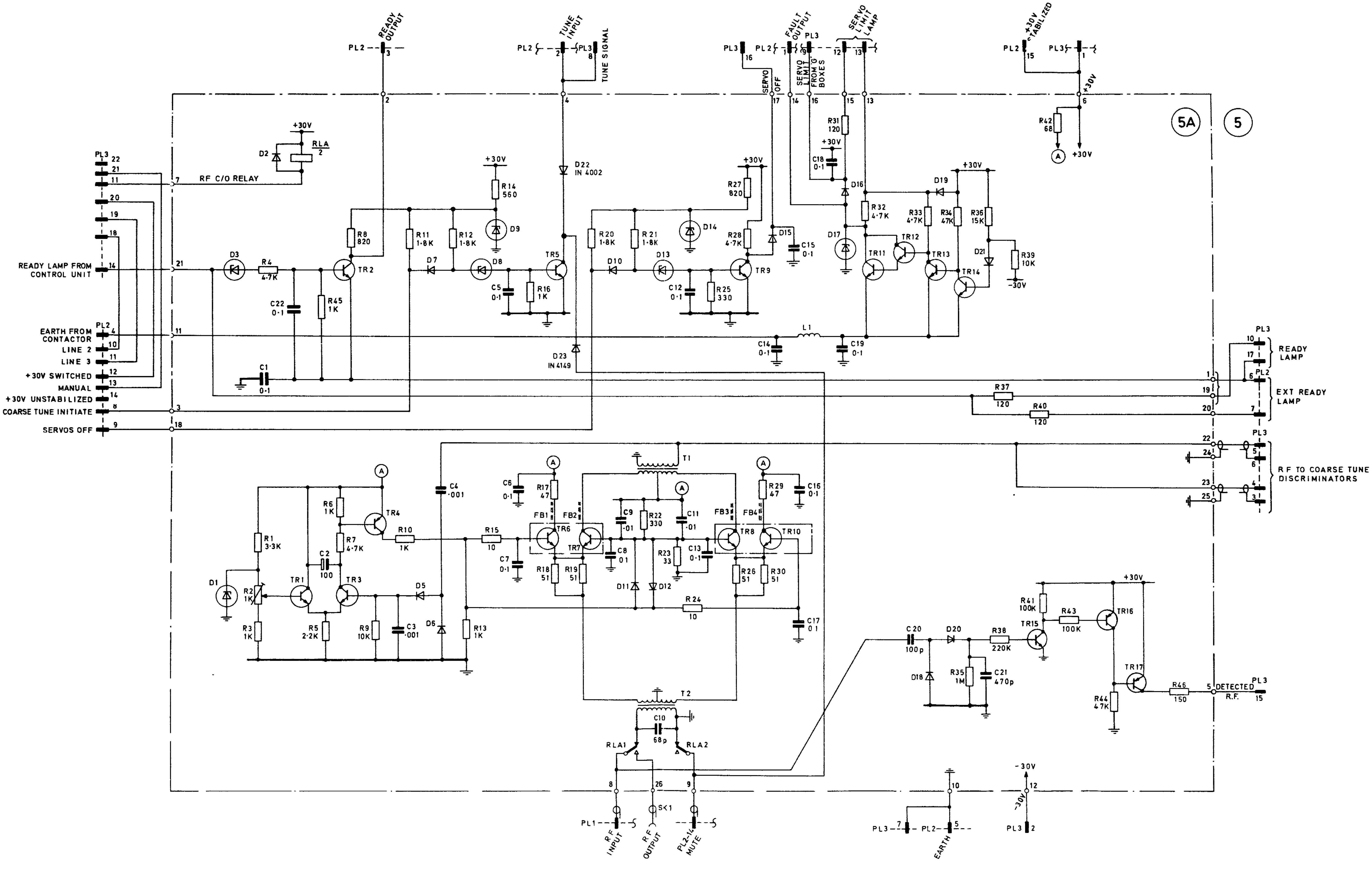
WOH 3043 Layout: Constant Voltage Amplifier (CVA) (MS452) Fig. 20



WOH 3043	DD603639
E 1 2 5	

Layout: CVA PC Board (PS58)

Fig. 21

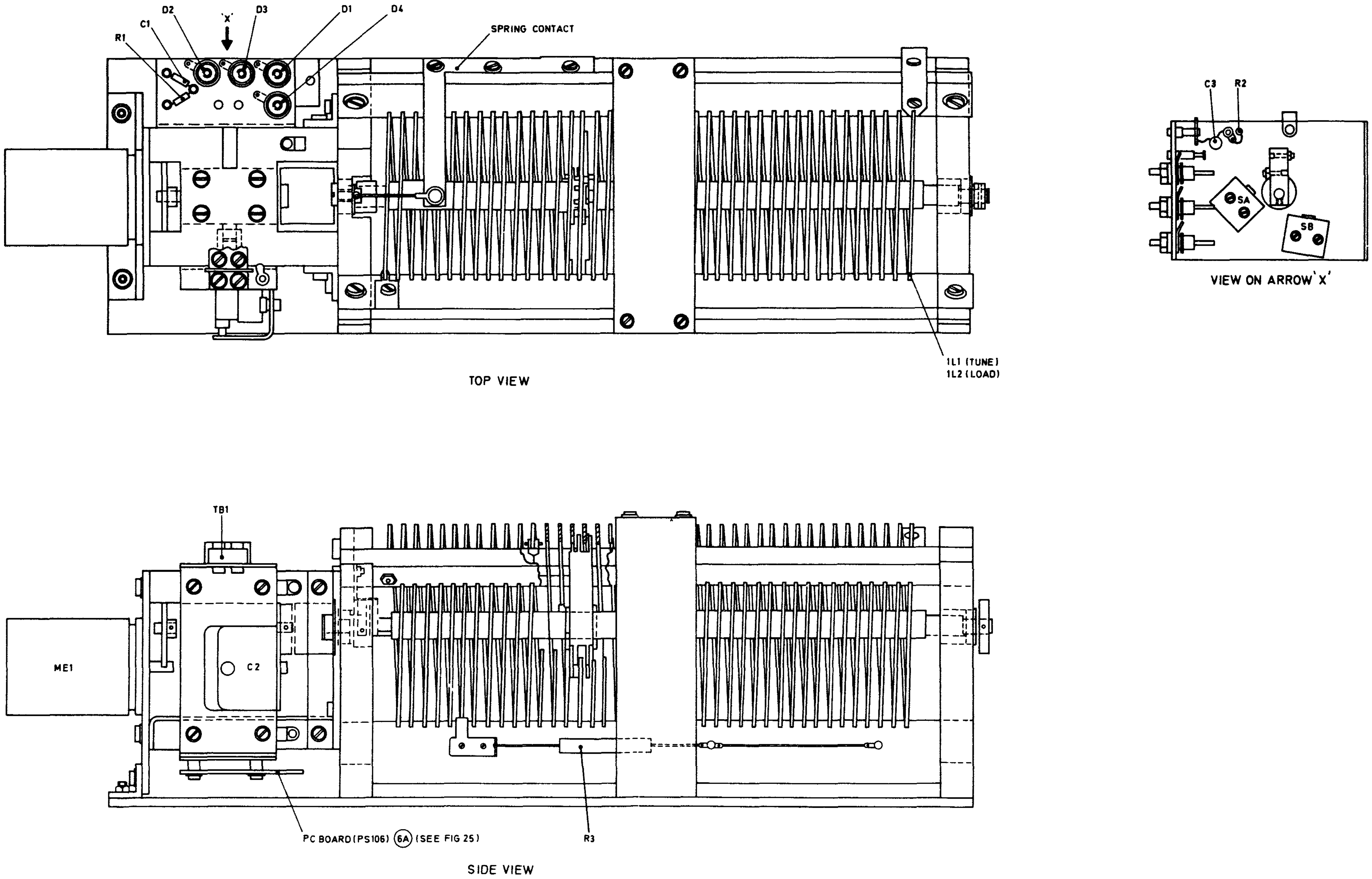


WOH3043 DC603545
ISSUE G 1 2 3

Circuit: Constant Voltage Amplifier (CVA) (MS452 & PS58)

Fig.22

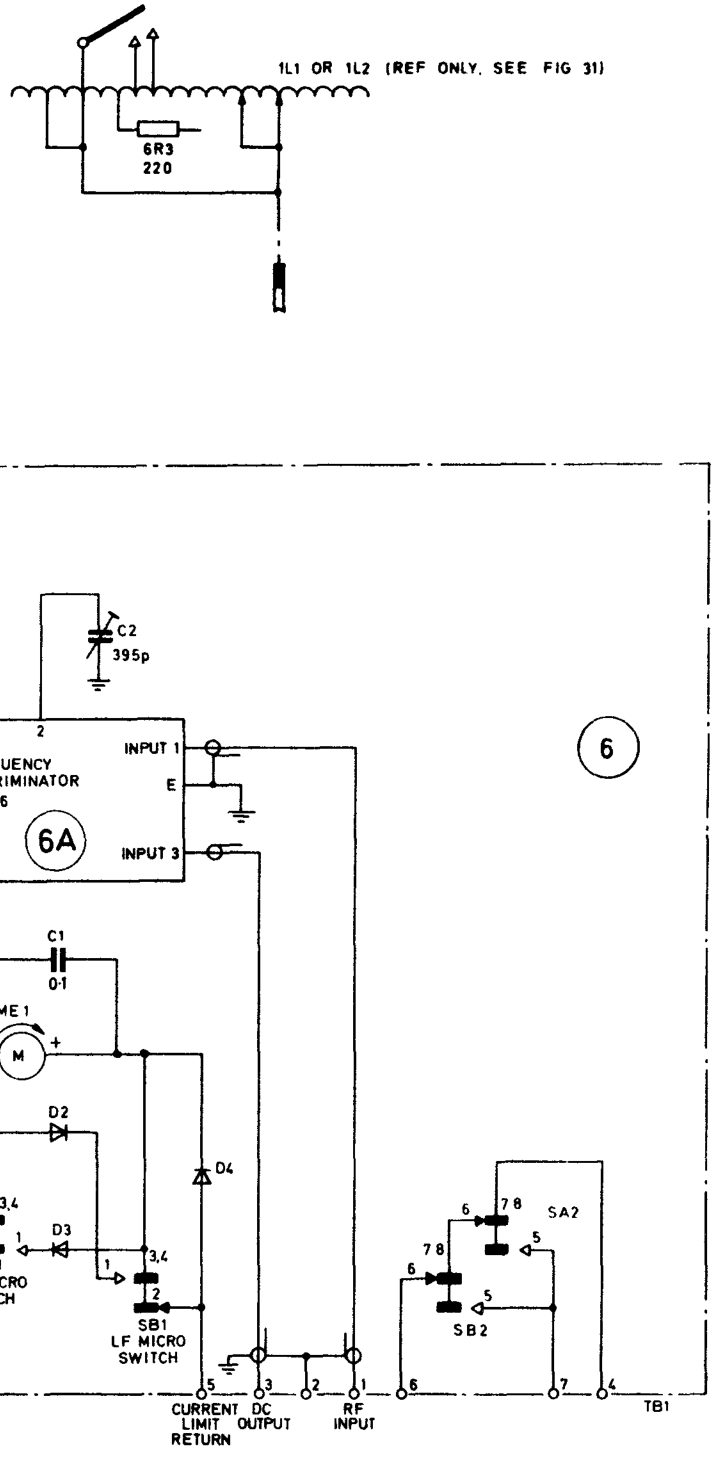
EXCEPT 1L1 & 1L2 (6)



WOH 3043

Layout: Coil, Motor and Gearbox (MS451)

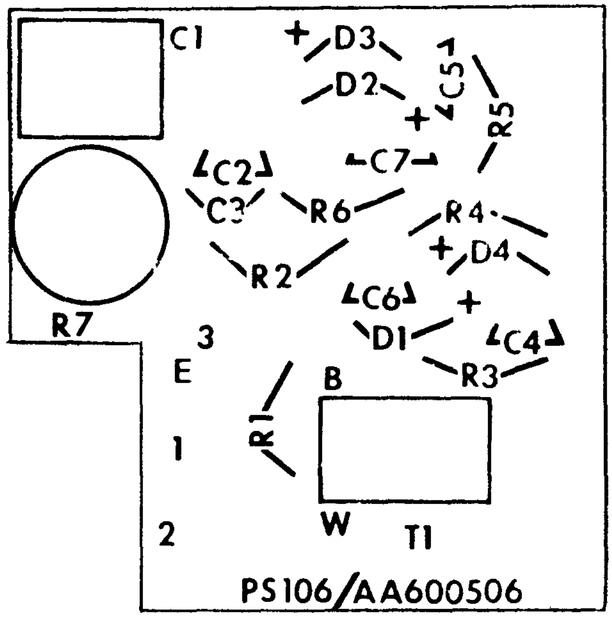
Fig.23



NOTE - MOTOR TERMINALS
VIEWED FROM REAR

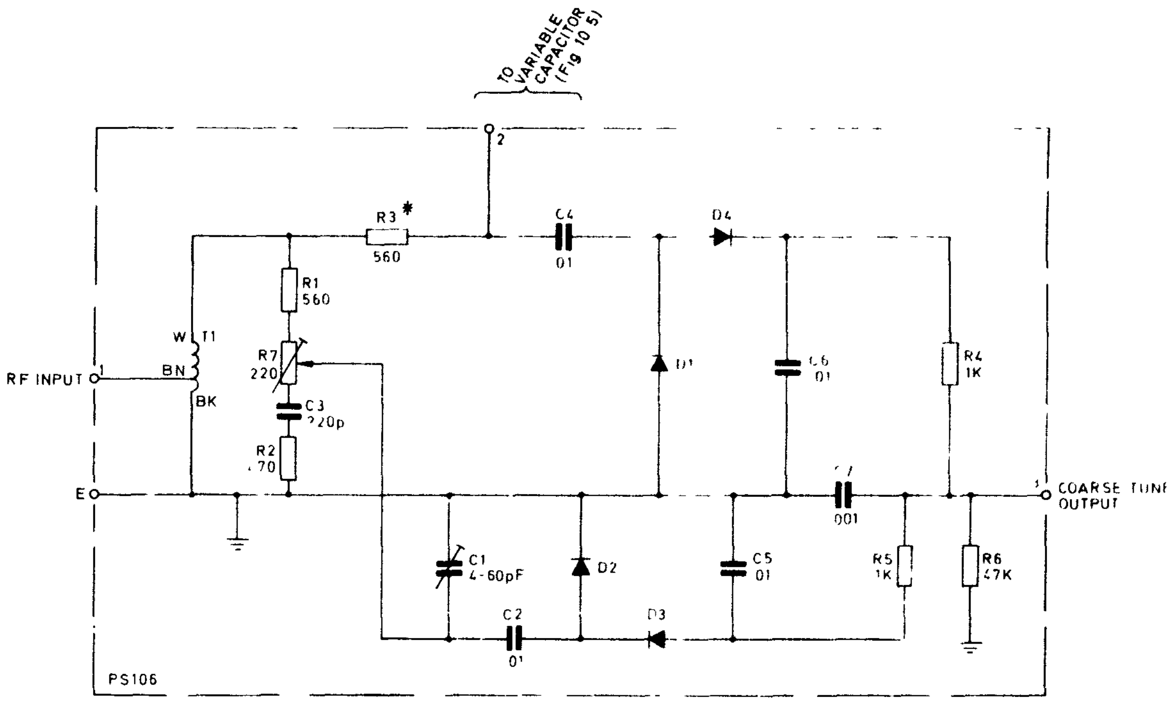
WOH 3043	CC603155
ISSUE D 1	

Circuit : Motor and Gearbox (MS451) Fig.24



PC42241 SHT 3

LAYOUT



NOTE ALL COMPONENTS ARE PREFIXED PS106

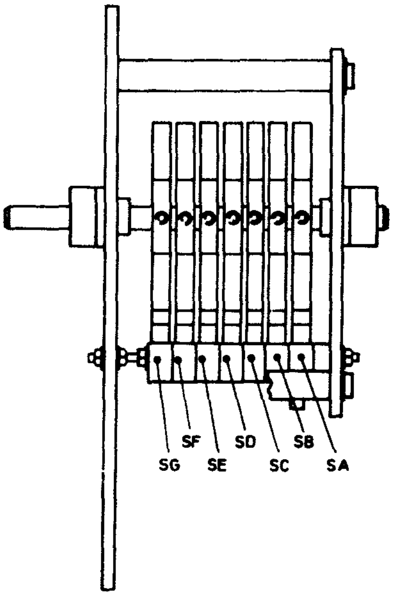
BC 600506

* NOTE FOR BC 600506/C R3 TO BE 680Ω

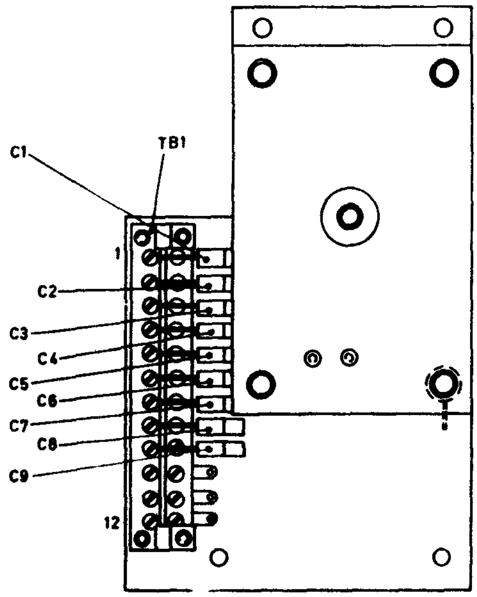
CIRCUIT

WOH 3043

Circuit and Layout: Coarse Tune Discriminator PC Board (PS106) Fig 25

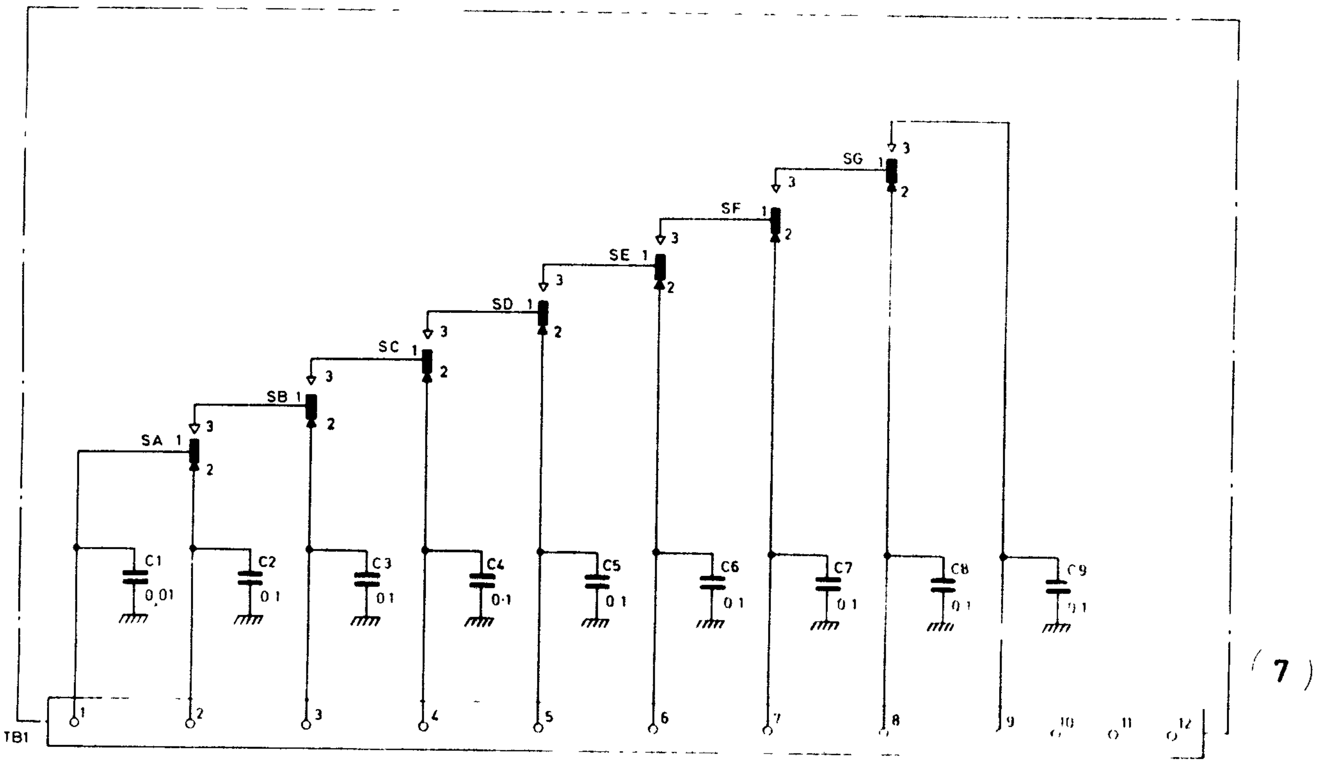


VIEW WITH TERMINAL BLOCK AND CAPACITORS REMOVED



Layout : Switchbank Assembly

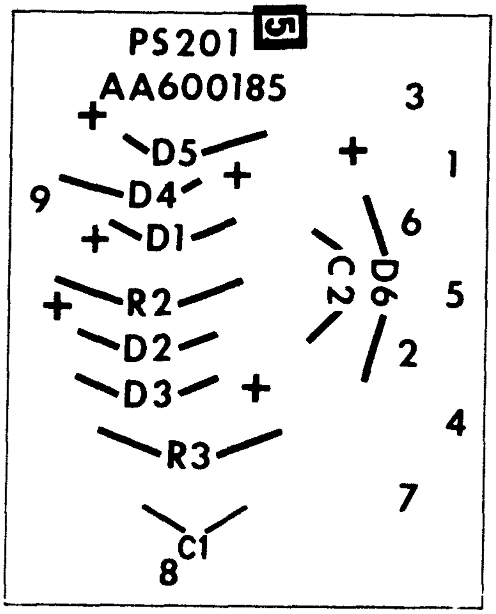
Fig. 26



WOH 3043	BC603351
ISSUE B 1 2	

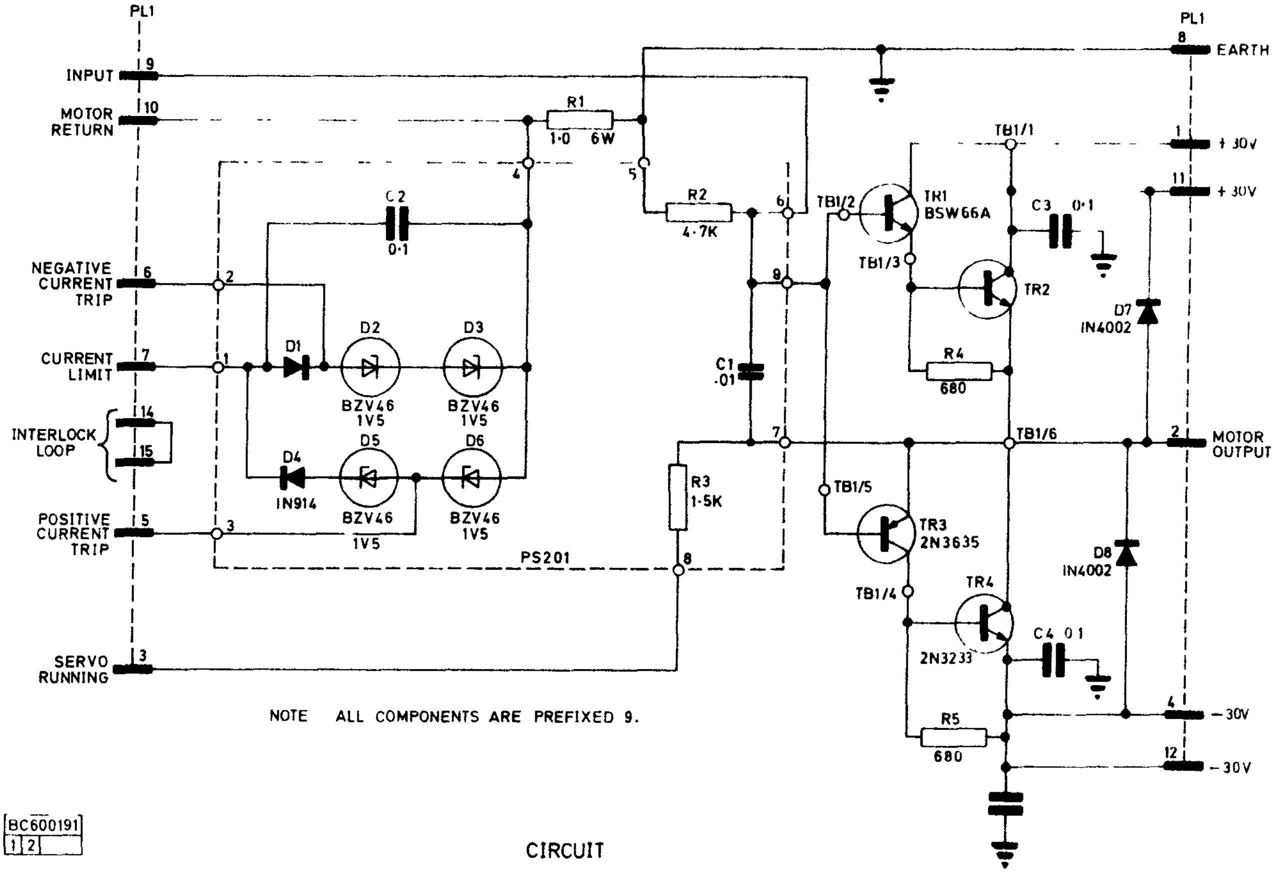
Circuit : Switchbank Assembly

Fig. 27



PC42201 SHT 2
1

LAYOUT



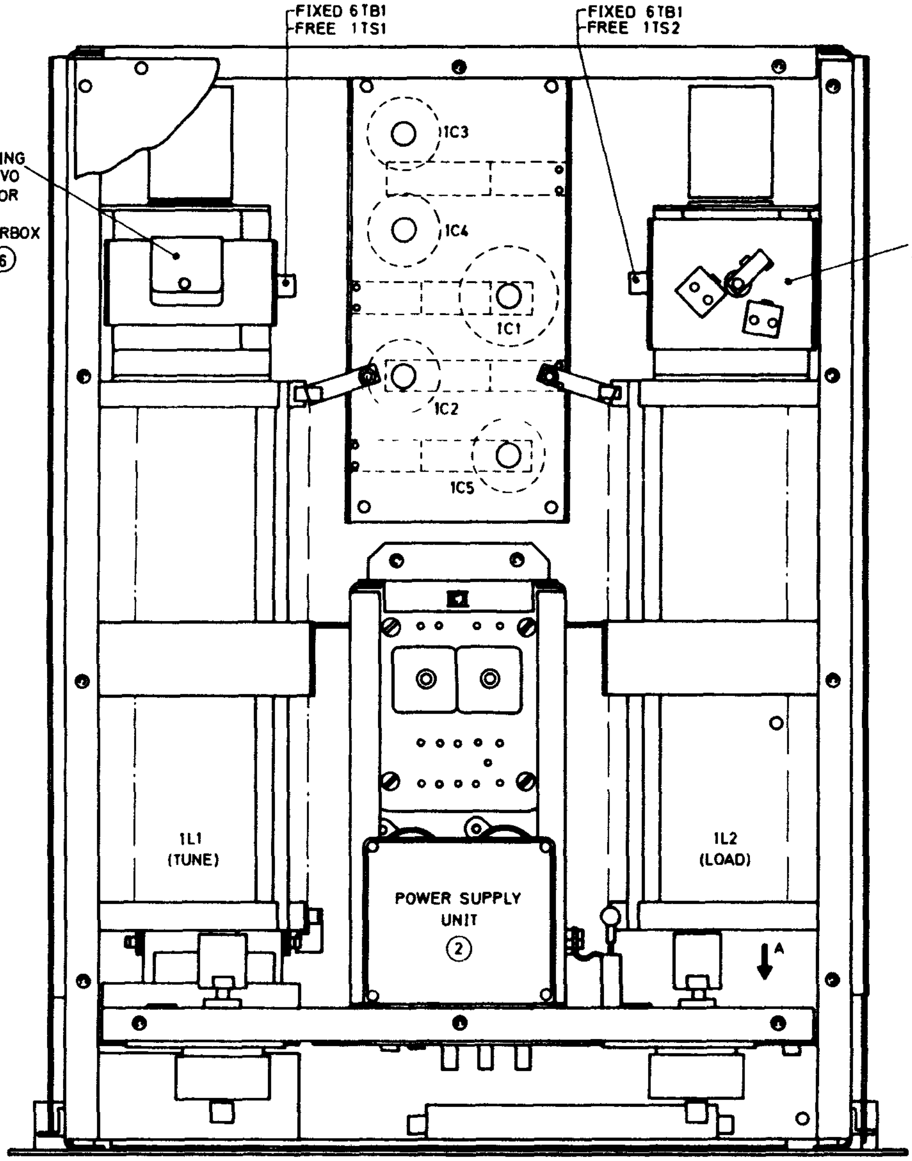
BC600191
1 2

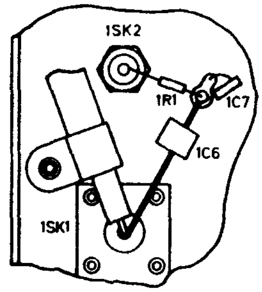
CIRCUIT

RACAL
WOH3043

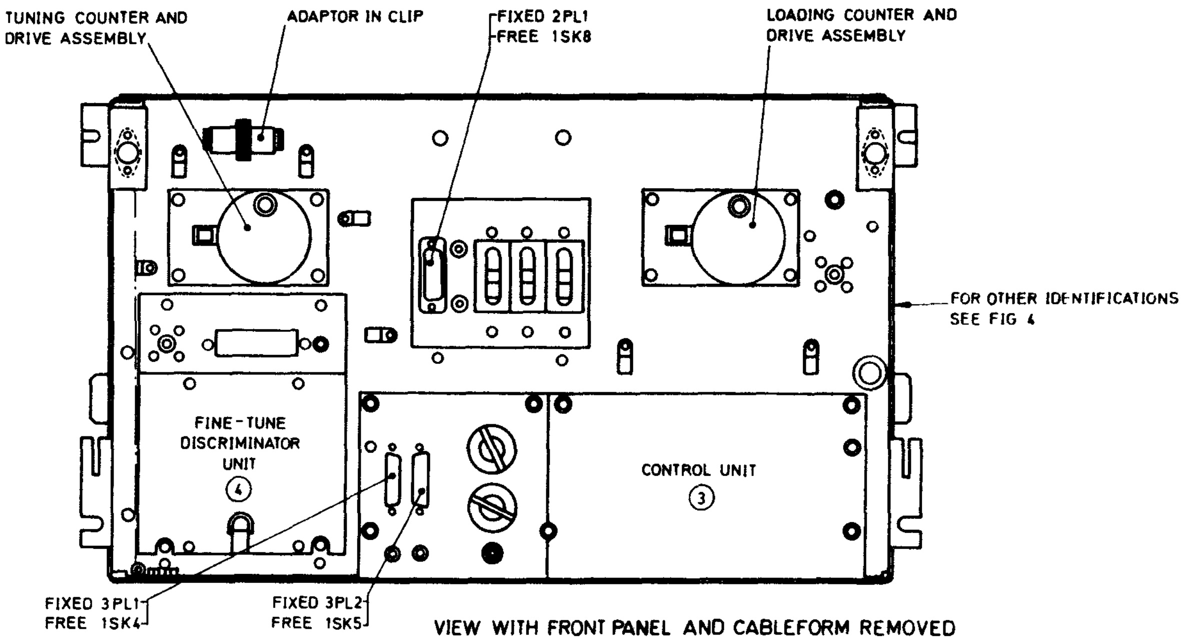
Circuit and Layout: Servo Power Amplifier (MS265 and PS201)

Fig. 28





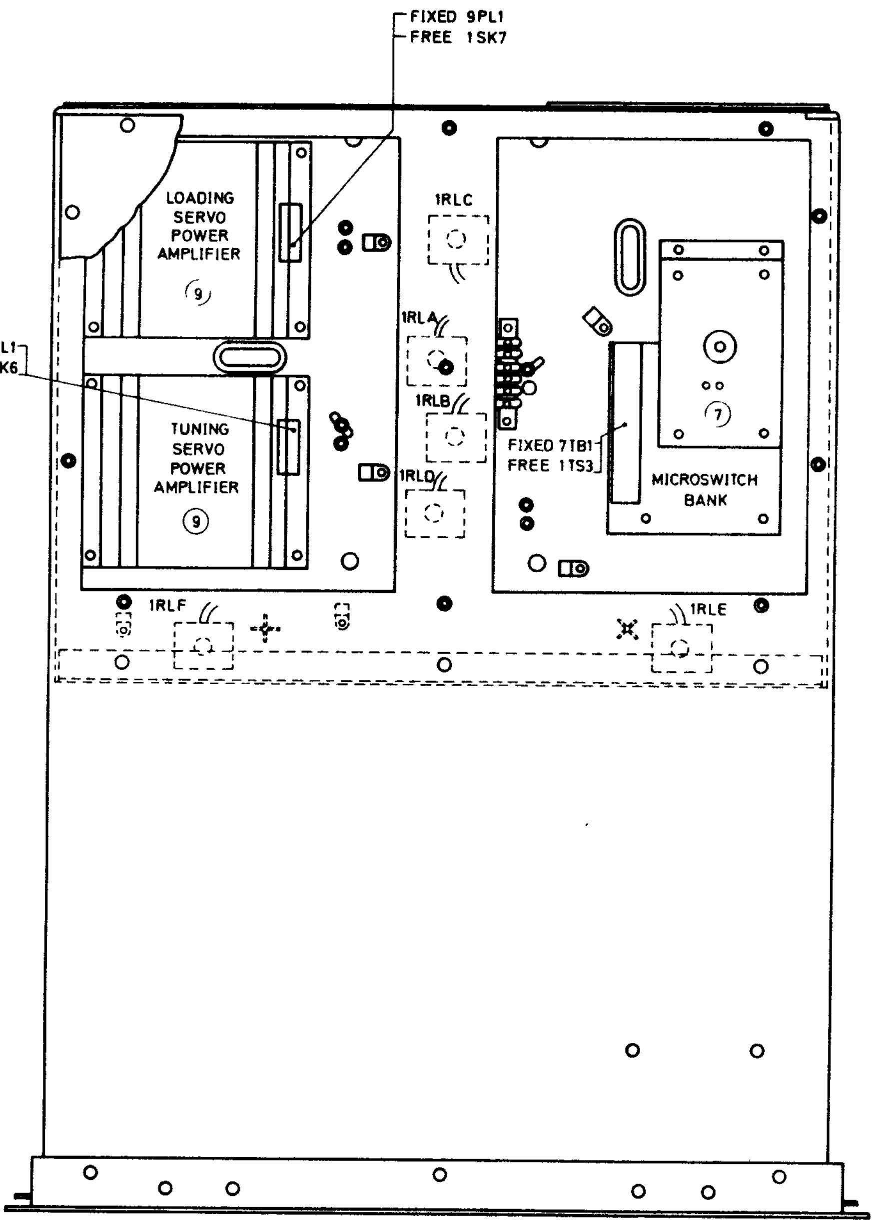
SCRAP VIEW IN DIRECTION OF ARROW 'A'



VIEW WITH FRONT PANEL AND CABLEFORM REMOVED

WOH 3043

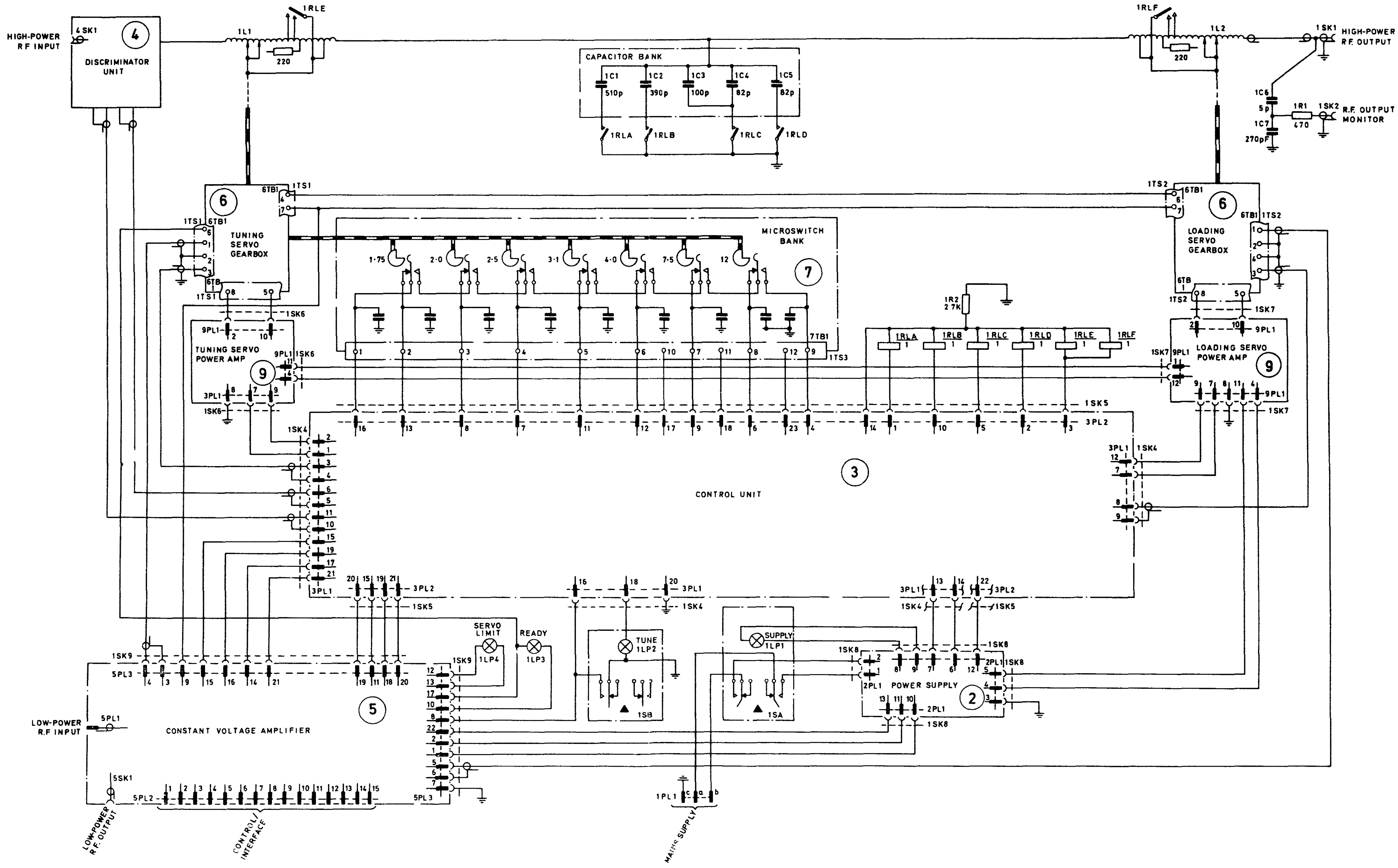
Layout : Top View and Sub-Front Panel MA.1004 Fig. 29



WOH 3043

Layout : Underside View MA.1004

Fig. 30



WOH 3043 | DC603133
ISSUE A 1 3

Interconnection Diagram: MA 1004 Feeder Matching Unit

Fig 31

LINE SWITCHING MODULE

MS 139

REF: WOH 3115
ISSUE: 1
Feb. 91 — 25

LINE SWITCHING MODULE MS 139

CONTENTS

ILLUSTRATIONS

LINE SWITCHING MODULE MS 139

INTRODUCTION

1. The Line Switching Module MS 139 is used in the Racal range of HF solid-state transmitter terminals to provide the appropriate length of coaxial cable, for channel frequency selected, between the TA1810 Linear Amplifier and Filter Switching Unit (MA.1034) or the Feeder Matching Unit (MA.1004).

2. To optimise power output performance, the transmitter terminals employ two pairs of coaxial relays which enable any one of four coaxial cable lengths to be selected for each operating frequency.

3. The Line Switching Module operates the coaxial relays to sequentially select the coaxial cable lines and also samples the forward output power from the transmitter terminal for each line selected. The module then automatically selects the line with maximum forward output power.

Mechanical Details

4. The module comprises a printed circuit board which is housed in a metal case measuring 250mm x 130mm x 25mm. A voltage regulator and a 15 way plug, for connection to the transmitter terminal, are mounted on the case.

5. The Line Switching Module is mounted in the right hand side of the transmitter terminal cabinet adjacent to the Filter Switching Unit (MA.1034) or the Feeder Matching Unit (MA.1004).

BRIEF TECHNICAL DESCRIPTION

Fig.1

6. The Line Switching Module MS139 contains the following stages:

(a) Output Power Sampler and Store

(b) Shift Register

(c) Line Decoding Logic

(d) Muting Monostable

(e) A clock

(f) Control Logic

Output Power Sampler and Store

7. The Output Power Sampler and Store samples forward power from each of the four coaxial cable lines and sets the output store to a logic '1' or logic '0' state,

depending upon the forward power voltage received from the Transmitter Terminal V.S.W.R. Unit (MS.447).

8. When sampling commences the logic state of the output store is set to '0', after the first line has been sampled it is then set to logic '1' and the second line is sampled.

9. If the forward power voltage of the second line is less than that of the first line, the logic state of the output store will not change and will remain at '1'.

10. If the forward power voltage of the second line is greater than that of the first line, the logic state of the output store will change to '0'.

11. Each succeeding line is compared to the previous best line and if the forward power voltage of the new line is greater the output store is set to logic '0', if it is less the output store remains at logic '1'.

Shift Register

12. The Shift Register stores the information from the Output Power Sampler and Store and is initially preset to all logic '1' state. When each sample has been taken the register is clocked to store the logic state of the output store, after the outputs from all four lines have been sampled the logic state of the Shift Register enables the Line Decoding Logic to select the best line.

Line Decoding Logic

13. The Line Decoding Logic enables each line to be selected in turn for sampling and when all four lines have been sampled, it selects the best line using the information stored in the Shift Register.

Muting Monostable;

14. To prevent damage to the coaxial relay contacts, the Muting Monostable provides a muting signal to the Linear amplifier each time a new line is selected.

Clock

15. The clock controls the sequence of sampling, line switching and muting.

Control Logic

16. The Control Logic provides interfacing for the external control signals and has two modes of operation, manual and automatic.

17. For manual operation the Shift Register is preset to all logic '1' condition which enables the Line Decoding Logic to select Line 1 which corresponds to the relay drivers in the open circuit condition, i.e. both relays inoperative. The coaxial cable lines

ay now be selected manually by means of a switch.

B. For automatic operation the Control Logic allows the clock to control the line switching sequence.

9. When a Feeder Matching Unit Type MA.1004 is used in the transmitter terminal the Line Decoding Logic applies a 'Servos Off' signal to switch off the servo motors in ıe Feeder Matching Unit during the line switching sequence.

D. When the line selection sequence has been completed the "Servos Off" signal is removed to enable the Feeder Matching Unit (MA.1004) to complete fine tuning .

I. On completion of fine tuning, the Control Logic re-applies the 'Servos Off' signal to the Feeder Matching Unit (MA.1004) and also applies a 'Ready' signal to the ansmitter terminal Exciter Unit.

2. When a Filter Switching Unit Type MA.1034 is employed in the transmitter terminal, the fine tuning sequence is not required and a link may be removed from the Control ›gic Circuitry to reduce the overall tuning time.

IRCUIT DESCRIPTION Fig.3

'utput Power Sampler and Store

3. The Output Power Sampler comprises transistors TR2, TR4, TR5, TR9, TR10, TR11 and TR12 and associated components whilst the D-type flip-flop ML2 is the output store.

4. Initially C7 is discharged by TR9 and TR2 is switched on. When the first line is sampled, TR2 is switched off allowing C7 to charge up, via the emitter follower TR4, approximately the Forward Power voltage from the V.S.W.R. Unit (MS.447) in the ansmitter terminal. The collector current pulse in TR4 required to charge up C7 switches the ›llector of TR5 to +16V, this switches off TR10 and TR11 and switches on TR12. As the ›llector voltage of TR12 falls to 0v the output store, a D-type flip-flop, is set to logic '0'.

5. When the first line has been sampled, transistor TR2 is switched on, reverse biasing transistor TR4 and diode D6, capacitor C7 stores the forward power voltage of the ·st line. The output store is reset to logic '1' before the second line is sampled.

6. If the forward power voltage of the second line is less than that for the first line, C7 will not receive any extra charge, transistor TR4 will not take any collector current ıd the logic state of the output store will remain at '1'. If the forward power voltage is eater, C7 will charge up to this higher voltage and the collector current taken by TR4 will ·itch transistors TR5 to TR12 and set the output store to logic '0'.

7. As lines are sampled, capacitor C7 stores the forward power voltage of the best line, thus each succeeding line is compared to the previous best line. If the forward power ›ltage of the new line is greater the output store is set to logic '0'; if it is less the output

store is left in the '1' state.

Line Decoding Logic

28. The Line Decoding Logic comprises gates G7, G8, G9, G10 and G11. The four transistors TR15, TR16, TR17 and TR18 form a pair of relay driver circuits to interface with the TTL logic levels.
The Line Decoding Logic performs two basic functions:

(1) It enables each line to be selected in turn for sampling.

(2) When all four lines have been sampled it selects the best one using the information stored in the Shift Register.

The truth table for this logic is shown in Table 3.

29. At the start of the sampling sequence the Shift Register is preset to State No. 1 (i.e. all '1's). This selects Line 1 by switching off both relay drivers. As C7 is initially discharged when Line 1 is sampled, TR4 will conduct to charge this capacitor, thus the output store will be set to '0'. At the end of the sampling period this state is clocked into the Shift Register.

30. The Shift Register is now at State No.2 and Line 2 is selected for sampling as outlined in paragraphs 25 and 26. After Line 2 is sampled the Shift Register will be clocked to State 3 or State 4 depending upon the forward power voltage of Line 2. Both these states select Line 3 for the next stage of sampling.

31. After sampling Line 3 the Shift Register will be clocked to one of the States 5 to 8, depending upon the forward power voltages from the lines sampled, any of these states selects Line 4 for the final stage of sampling.

32. Finally, after Line 4 is sampled, the Shift Register is clocked to one of the remaining 8 states, numbered 8 to 15. The presence of a '0' in bit 4 of the Shift Register indicates that sampling is complete. The Line Decoding Logic now selects the best line as shown in the truth table.

33. As an example consider State 11. The '0' in bit 4 shows that sampling is complete. The '1' in bit 3 shows that Line 2 was worse than Line 1. The '0' in bit 2 shows Line 3 was better than Line 1 and Line 2. Finally, the '1' in bit 1 shows that Line 4 was worse than Line 3. Therefore Line 3 is the best line.

Muting Monostable

34. Each time a new line is selected it is necessary to remove the RF signal to avoid burning the relay contacts. This is done by muting the amplifier for a short period, approximately 50mS. This muting pulse is provided by ML8, a monostable multivibrator.

35. A transition from '1' to '0' on pin 6 of ML2 will be inverted by G5 and thus clock the shift register. The negative going transition is also sent to the 'A' inputs of the

ıonostable to clock it each time a new line is selected. TR14 and its associated components nterface between the TTL monostable output and the external muting signal levels. Diodes)12 and D13 permit the muting of the amplifier by the exciter.

.6. At the end of each muting pulse the positive transition on pin 1 of ML8 is used to clock the output store back to '1' state.

:lock

7. The sequence of sampling, line switching and muting is controlled by the clock. TR1 and TR6 are used in a collector base coupled astable multivibrator. The timing ɔmponents are C3, C5, R7, R8, R9 and R12. By adjustment of R7 the period of oscillation ; set to 100mS. The diodes D1 and D7 stop negative noise pulses on the supply line ffecting the timing of the astable, D8 and R18 are included to improve the rise time of the utput.

8. The output of the astable multivibrator is used to clock the D-type flip-flop ML2 which is connected to perform a divide-by-2 function. The flip-flop outputs are :1 mark/space ratio square waves. When the Q output, pin 5, is at '0' the line is ampled and when the Q output, pin 6, undergoes a transition from '1' to '0' the next line ; selected.

9. When TR3 is switched on, TR1 is held off and thus the clock is inhibited. This will occur if either the output of G2 or pin 8 of ML6 is the '1' state.

ontrol Logic

0. This comprises gates G1, G2, G3, G4, G6, G12, G13 and G14 and the monostable ML9. Transistors TR7, TR8, TR19 and TR20, along with their associated ɔmponents provide interfacing for the external control signals. The control logic has two istinct modes of operation, manual and automatic.

lanual Operation

1. The +30V manual control signal on pin 11 switches on transistor TR8 to produce a logic '0' input to gates G1 and G2. The logic '1' output of gate G1 is used to open ate G3 whilst the '1' output from gate G2 will inhibit the clock and preset all the bistables logic '1' via the inverting gate G4.

2. Pin 8 of ML6 is preset to '0' holding the output of G12 at '1'. Pin 2 of G6 is also at '0' holding the output of G6 at '1'. Thus both inputs to G13 are at '1' setting e output to '0'. This switches TR19 off, allowing the tuning unit servos to run if quired.

3. As the output of G12 is at '1', G14 is held open and the 'Ready' input signal from the tuning unit thus has a direct path to the 'Ready' Output pin 9 via TR7, G3, G14 d TR20.

44. As all the bistables are preset to the '1' state the Line Decoding Logic selects Line 1, which corresponds to both relay drives open circuit, the lines may now be manually selected by switches in parallel with the relay driver outputs.

Automatic Operation

45. The absence of a Manual signal switches TR8 off allowing its collector to rise to the '1' state. The output of G1 is therefore held at '0' closing gate G3 and holding its output at '1' .

46. When a new tuning sequence is initiated the 'Ready' input signal will not be present, allowing TR7 to switch on via R3 and D4. The '0' state on pin 12 of G2 sets the output of G2 to '1'. This inhibits the clock, switches on TR9 thus discharging C7 and presets all bistables to '1' via the inverting gate G4.

47. On receipt of the 0V 'Ready' signal to the 'Ready' input pin 12 (from the MA.1004 Feeder Matching Unit or the MA. 1034 Filter Switching Unit) transistor TR7 will switch off, both inputs to gate G2 will be at logic '1' and the output of G2 will be at logic '0'. The output of G4 will go to logic '1' to remove the preset signal on the bistables. Transistors TR3 and TR9 are switched off allowing the clock to take over control of the line selection sequence.

48. During the line selection sequence pin 9 of ML6 is at '1'. Thus all the inputs of G6 are at '1' setting the output to '0'. This holds the output of G13 at '1', switching on TR19 to send a 'Servos Off' signal to the Feeder Matching Unit (MA.1004).

49. On completion of the line selection sequence pin 9 of ML6 will change from '1' to '0'. This sets the output of G6 to '1'. Hence as both inputs of G13 are '1' its output is '0' switching off TR19. This allows the Feeder Matching Unit (MA.1004) to complete fine tuning.

50. At the same time pin 8 of ML6 changes from '0' to '1' switching on TR3 via R33 to inhibit the clock. Monostable ML9 is triggered by the positive edge of the pulse output $\overline{Q}$ changes from 1-0 and after a delay reverts from 0-1. This delay is determined by C20 and R36 and is necessary to allow the Feeder Matching Unit (MA.1004) to complete fine tuning before signalling 'Ready' back to the exciter.

Note: When the Filter Switching Unit (MA.1034) is used in the Transmitter Terminal the delay for fine tuning is not required and can be eliminated by removing link LK2.

51. When the output of ML9 changes to '0' the output of G12 will remain at '1' until the monostable reverts to its original state. When this happens the output of G12 reverts to '0' setting the outputs of G13 and G14 to '1'. Transistor TR19 and TR20 will now switch on to signal 'Ready' to the exciter and switch off the servos in the Feeder Matching Unit (MA.1004).

Note: If required, the servos in the MA.1004 Feeder Matching Unit may be left on after the 'Ready' signal has been sent to the exciter, this is done by removing link LK3.

52. The waveforms for automatic operation are shown on Fig.2.

53. Table 1 and Table 2 summarise the inputs to, and the outputs from, the Line Switching Module MS.139, whilst Table 3 is the Truth Table for the Line Decoding Logic and the Shift Register.

Table 1 Inputs

PL1 Pin No.	Source	Function	Signal ON Condition	Signal OFF Condition
14	Transmitter Terminal VSWR Unit (MS.447)	Forward Power Voltage Typically +3V to +12V		
12	MA 1004 or MA 1034	'Ready' Input	0V	+12V
7	Exciter	Exciter Mute	0V	+12V
11	Manual/Auto Switch (MA.1004 or MA.1034)	Manual	+28V	Open Circuit

Table 2 Outputs

PL1 Pin No.	Function	Sent to	Signal ON Condition	Signal OFF Condition
4	Select Line 3 Relay	Line Switching Relay	0V	Open Circuit
5	Select Line 2 Relay	Line Switching Relay	0V	Open Circuit
6	Amplifier Mute	Linear Amplifier	0V	+12V
8	Servos off	Feeder Matching Unit (MA.1004)	0V	+12V
9	'Ready' Output	Exciter	0V	+12V

Table 3 Truth Table for Line Decoding Logic and Shift Register

STATE No.	SHIFT REGISTER STATES				LINE SELECTED	LINE 2 RELAYS	LINE 3 RELAYS
	BIT1	BIT2	BIT3	BIT4			
1	1	1	1	1	1	0	0
2	0	1	1	1	2	1	0
3	1	0	1	1	3	0	1
4	0	0	1	1	3	0	1
5	1	1	0	1	4	1	1
6	0	1	0	1	4	1	1
7	1	0	0	1	4	1	1
8	0	0	0	1	4	1	1
9	1	1	1	0	1	0	0
10	0	1	1	0	4	1	1
11	1	0	1	0	3	0	1
12	0	0	1	0	4	1	1
13	1	1	0	0	2	1	0
14	0	1	0	0	4	1	1
15	1	0	0	0	3	0	1
16	0	0	0	0	4	1	1

Power Supply

54. Power for the MS 139 is received from the stabilized power supplies of the associated Feeder Matching Unit (MA.1004) for Filter Switching Unit (MA.1034). The nominal input voltage is between +27V and +30V, current consumption is typically 200mA.

55. Transistor TR13 and associated components stabilize the supply voltages from the Feeder Matching Unit (MA.1004) or the Filter Switching Unit (MA.1034) and provide +12V and +16V outputs.

56. The +16V is used to power the Output Power Sampler and Store whilst the +12V is used for the noise immunity circuits of the Control Logic.

57. The regulator X1 which is mounted on the case of MS 139 provides +5V for the TTL Logic circuitry.

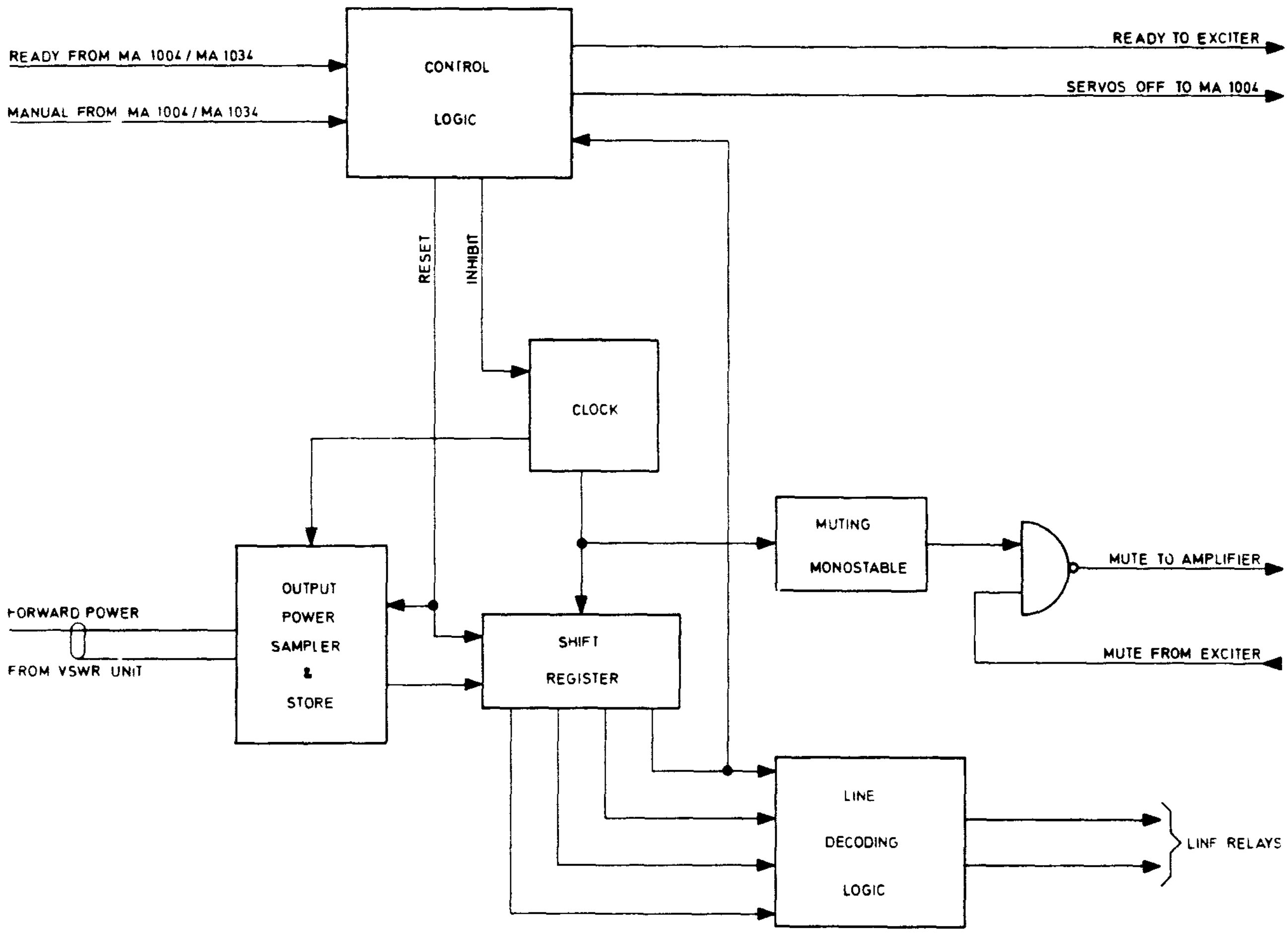
COMPONENTS LIST

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer
Resistors (ohm)						
R1	560	Metal Oxide		5	909841	Electrosil TR4
R2	10k	Metal Oxide		5	914042	Electrosil TR4
R3	1.8K	Metal Oxide		5	908283	Electrosil TR4
R4	4.7K	Metal Oxide		5	913490	Electrosil TR4
R5	39k	Metal Oxide		5	900993	Electrosil TR4
R6	47K	Metal Oxide		5	913496	Electrosil TR4
R7	22K	Variable			919816	Plessey MPWT
R8	4.7K	Metal Oxide		5	913490	Electrosil TR4
R9	10K	Metal Oxide		5	914042	Electrosil TR4
R10	4.7K	Metal Oxide		5	913490	Electrosil TR4
R11	47K	Metal Oxide		5	913496	Electrosil TR4
R12	4.7K	Metal Oxide		5	913490	Electrosil TR4
R13	560	Metal Oxide		5	909841	Electrosil TR4
R14	560	Metal Oxide		5	909841	Electrosil TR4
R15	270K	Metal Oxide		5	923598	Electrosil TR4
R16	180	Metal Oxide		5	915465	Electrosil TR4
R17	560	Metal Oxide		5	909841	Electrosil TR4
R18	4.7K	Metal Oxide		5	913490	Electrosil TR4
R19	10K	Metal Oxide		5	914042	Electrosil TR4
R20	4.7K	Metal Oxide		5	913490	Electrosil TR4
R21	4.7K	Metal Oxide		5	913490	Electrosil TR4
R22	47K	Metal Oxide		5	913496	Electrosil TR4
R23	4.7K	Metal Oxide		5	913490	Electrosil TR4
R24	560	Metal Oxide		5	909841	Electrosil TR4
R25	47K	Metal Oxide		5	913496	Electrosil TR4
R26	4.7K	Metal Oxide		5	913490	Electrosil TR4
R27	47K	Metal Oxide		5	913496	Electrosil TR4
R28	47K	Metal Oxide		5	913496	Electrosil TR4
R29	4.7K	Metal Oxide		5	913490	Electrosil TR4
R30	1.8K	Metal Oxide		5	908283	Electrosil TR4

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer
Resistors (ohm) continued						
R31	270	Wirewound			913606	Welwyn W21
R32	68	Metal Oxide			907494	Electrosil TR5
R33	47	Metal Oxide		5	913496	Electrosil TR4
R34	68	Wirewound			913690	Welwyn W22
R35	18K	Metal Oxide		5	900994	Electrosil TR4
R36	18K	Metal Oxide		5	900994	Electrosil TR4
R37	1.8K	Metal Oxide		5	908283	Electrosil TR4
R38	1.8K	Metal Oxide		5	908283	Electrosil TR4
R39	1.8K	Metal Oxide		5	908283	Electrosil TR4
R40	1.8K	Metal Oxide		5	908283	Electrosil TR4
R41	4.7K	Metal Oxide		5	913490	Electrosil TR4
R42	4.7K	Metal Oxide		5	913490	Electrosil TR4
R43	4.7K	Metal Oxide		5	913490	Electrosil TR4
R44	390	Metal Oxide		5	916531	Electrosil TR4
R45	560	Metal Oxide		5	917061	Electrosil TR4
R46	4.7K	Metal Oxide		5	913490	Electrosil TR4
R47	4.7K	Metal Oxide		5	913490	Electrosil TR4
R48	390	Metal Oxide		5	908472	Electrosil TR4
R49	560	Metal Oxide		5	909841	Electrosil TR4
R50	4.7K	Metal Oxide		5	913490	Electrosil TR4
R51	4.7K	Metal Oxide		5	913490	Electrosil TR4
R52	4.7K	Metal Oxide		5	913490	Electrosil TR4
R53	4.7K	Metal Oxide		5	913490	Electrosil TR4
R54	4.7K	Metal Oxide		5	913490	Electrosil TR4
R55	1.8K	Metal Oxide		5	911148	Electrosil TR4
R56	820	Metal Oxide		5	917065	Electrosil TR4
Capacitors						
	uF					
C1	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C2	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C3	4.7	Electrolytic	10V		905388	ITT TAA 4.7 K10A
C4	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C5	4.7	Electrolytic	10V		905388	ITT TAA 4.7 K10A

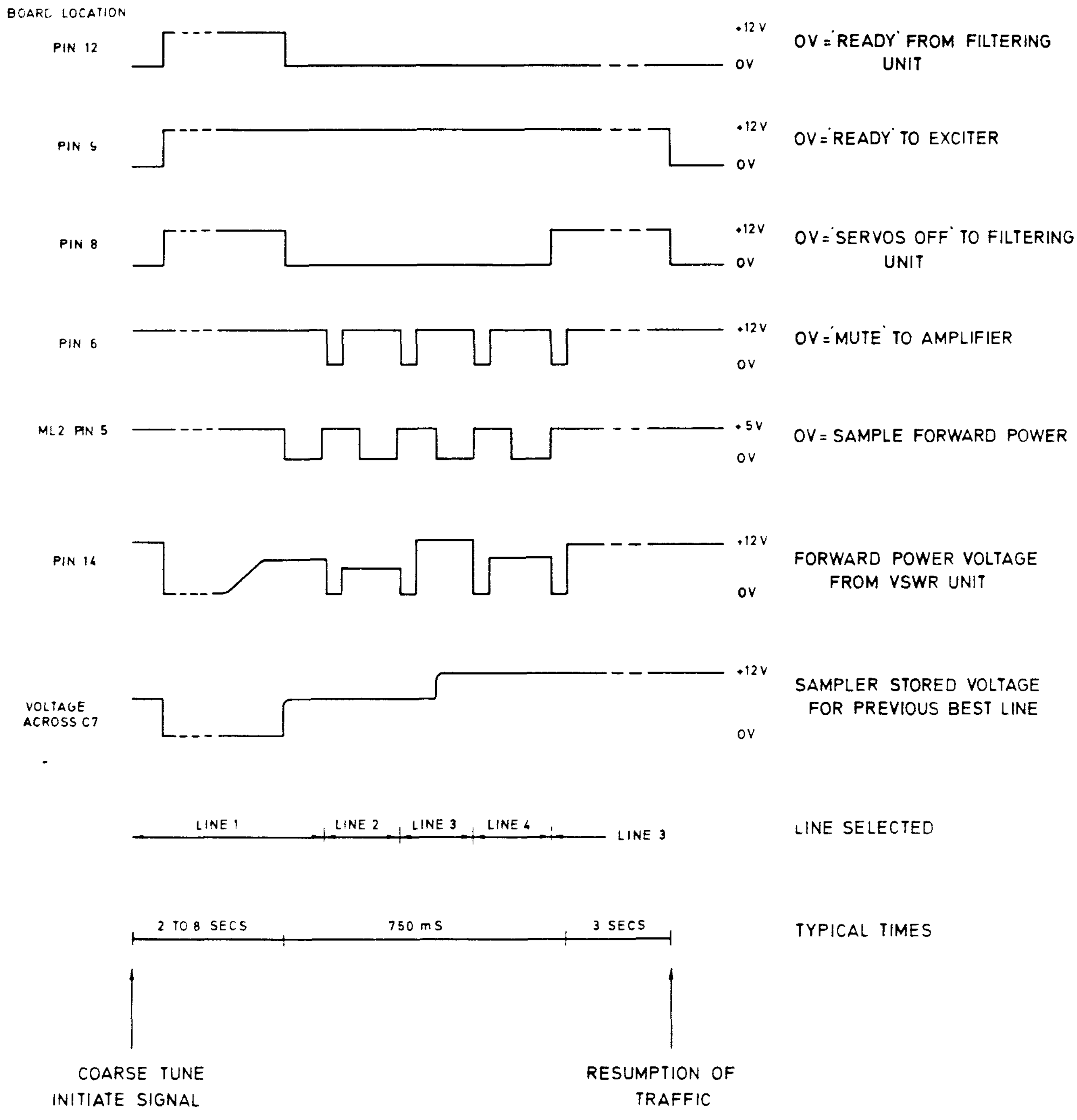
Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer
Capacitors Continued						
	uF					
C6	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C7	1.0	Ceramic	100V	20	915370	PMC 2R/1.0/M100
C8	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C9	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C10	1000p	Disc Ceramic	500V	20	919194	ITTRT12K1
C11	15	Electrolytic	35V	20	922417	ITT TAG 15/35
C12	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C13	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C14	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C15	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C16	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C17	15	Electrolytic	35V	20	922417	ITT TAG 15/35
C18	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C19	10	Electrolytic	20V	20	905399	STC TAAB/10/M20
C20	150	Electrolytic	6.3V	20	922419	ITT TAG 150/6.3
C21	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C22	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C23	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
C24	0.1	Ceramic	100V	20	914173	PMC 2R/0.1/M100
Transistors						
TR1		Silicon n-p-n			911929	Mullard BC107
TR2		Silicon n-p-n			911929	Mullard BC107
TR3		Silicon n-p-n			911929	Mullard BC107
TR4		Silicon n-p-n			911929	Mullard BC107
TR5		Silicon p-n-p			911928	Mullard BCY71
TR6		Silicon n-p-n			911929	Mullard BC107
TR7		Silicon n-p-n			911929	Mullard BC107
TR8		Silicon n-p-n			911929	Mullard BC107
TR9		Silicon n-p-n			911929	Mullard BC107
TR10		Silicon p-n-p			911928	Mullard BCY71
TR11		Silicon n-p-n			911929	Mullard BC107
TR12		Silicon n-p-n			911929	Mullard BC107
TR13		Silicon n-p-n			908753	Mullard BFY51
TR14		Silicon n-p-n			911929	Mullard BC107
TR15		Silicon n-p-n			911929	Mullard BC107

Cct. Ref.	Value	Description	Rat.	Tol. %	Racal Part Number	Manufacturer
Transistors continued						
TR16		Silicon n-p-n			911929	Mullard BC107
TR17		Silicon n-p-n			911929	Mullard BC107
TR18		Silicon n-p-n			908753	Mullard BFY51
TR19		Silicon n-p-n			911929	Mullard BC107
TR20		Silicon n-p-n			911929	Mullard BC107
Diodes						
D1		Silicon			914898	ITT IN4149
D2		Silicon			914898	ITT IN4149
D3		Zener			923962	Mullard BZX79 C8V2
D4		Zener			911682	Mullard BZY88 C6V2
D5		Zener			941639	Mullard BZX79 C7V5
D6		Silicon			921716	Mullard BAX 13
D7		Silicon			914898	ITT IN4149
D8		Silicon			914898	ITT IN4149
D9		Zener			923962	Mullard BZX79 C8V2
D10		Zener			923962	Mullard BZX79 C8V2
D11		Zener			941517	Mullard BZX79 C3V3
D12		Silicon			914898	ITT IN4149
D13		Silicon			914898	ITT IN4149
D14		Silicon			914898	ITT 1N4149
Integrated Circuits						
ML1		Quad 2 input Nand Gate			918366	Transitron 7400J
ML2		Dual D Flip-flop			917509	Transitron 7474J
ML3		Quad 2 input Nand Gate			918366	Transitron 7400J
ML4		Dual D Flip-flop			917509	Transitron 7474J
ML5		Triple 3 input Nand Gate			922206	ITT 7412J
ML6		Dual D Flip-flop			917509	Transitron 7474J
ML7		Triple 3 input Nand Gate			922206	ITT 7412J
ML8		Monostable Multivibrator			921258	Transitron 74121J
ML9		Monostable Multivibrator			921258	Transitron 74121J
X1		Voltage Regulator			924113	National Semiconductor LM.309K
Connector						
PL1		Connector 15-way			909729	Cannon DA15P



WOH 3115

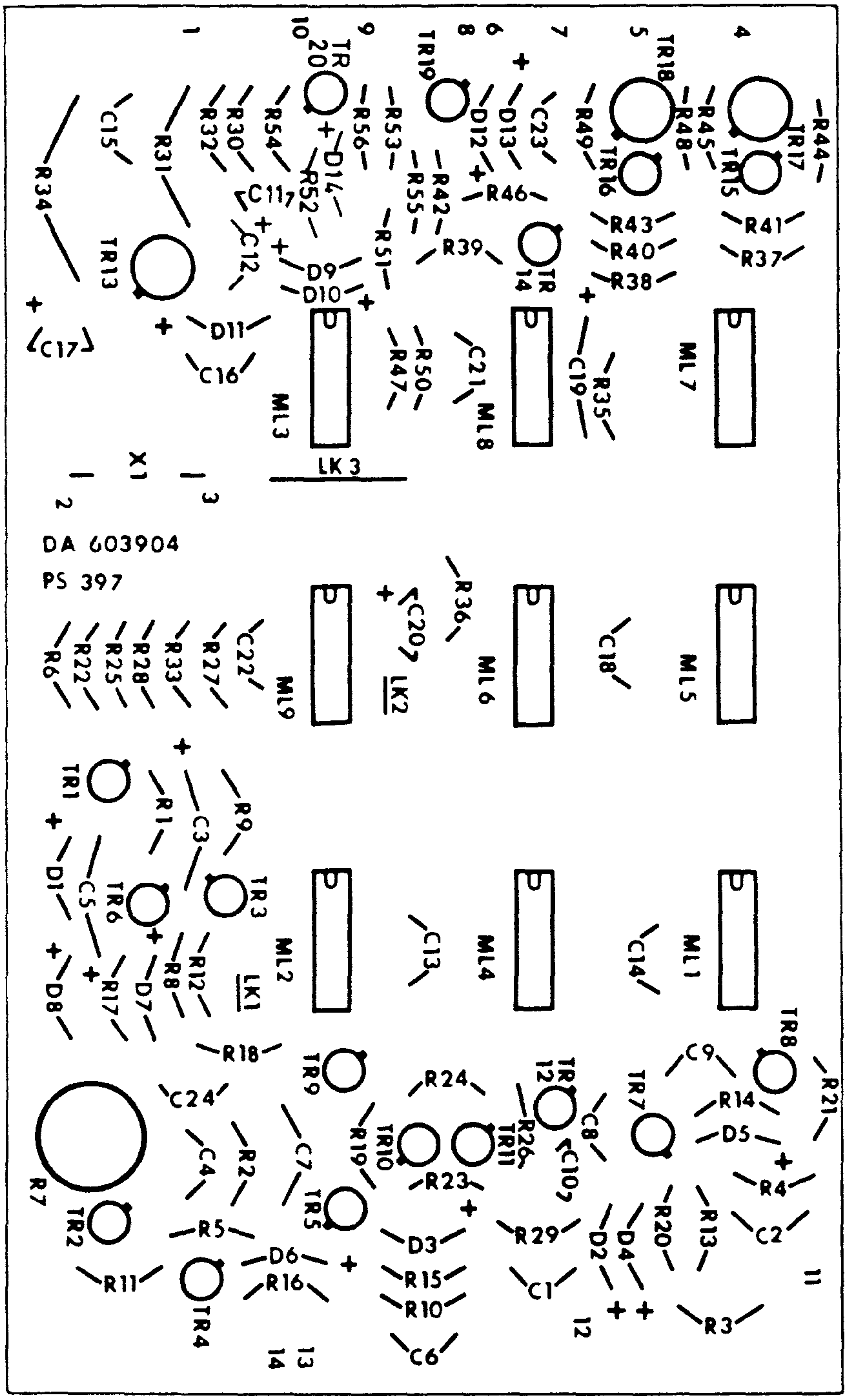
Block Diagram : Line Switching Module MS139 Fig.1



WOH 3/5

Waveform Diagram: Automatic Operation Of MS 139

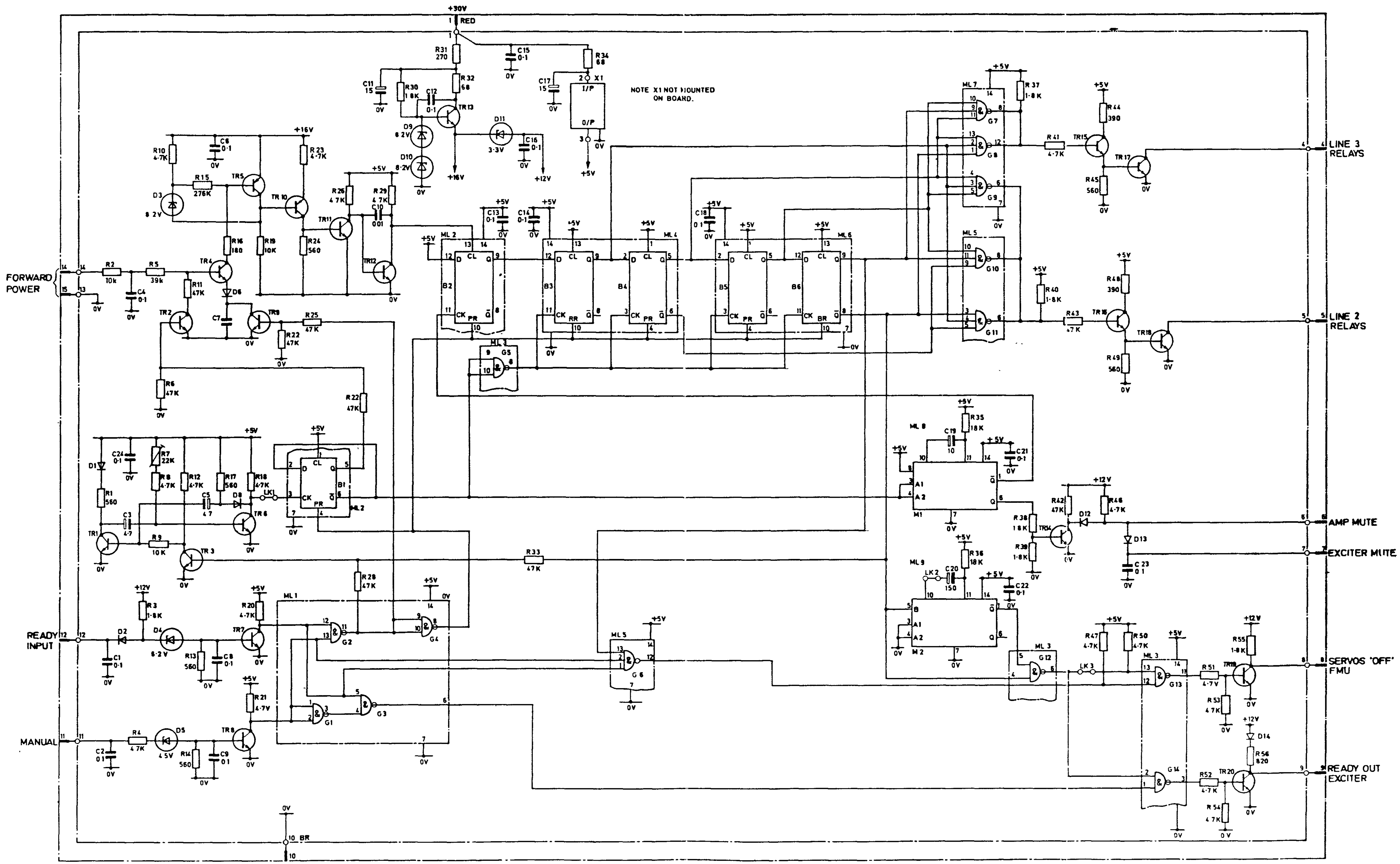
Fig. 2



Component Layout:
Line Switching Module MS139

Fig. 3

WOH 3115	DD603906 SHT4	
PL	4	



WOH3115	DC603892
B 2 3 4 5	

Circuit: Line Switching Module MS139

Fig. 4