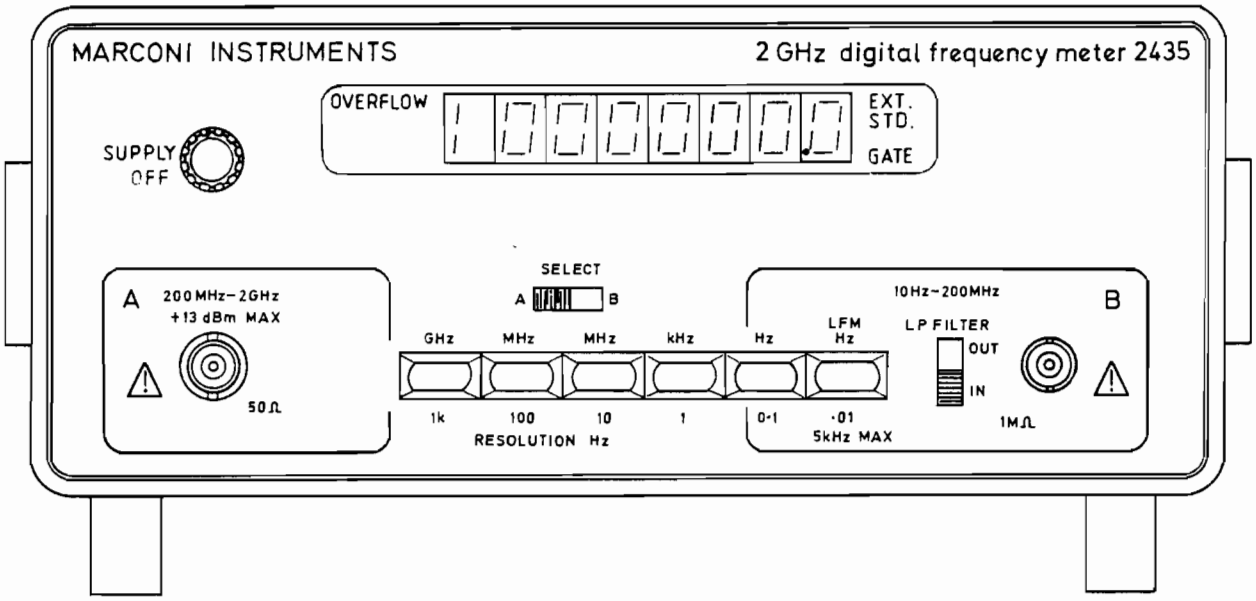
Marconi
Instruments

2435

2 GHz
DIGITAL FREQUENCY METER



Service Manual

2 GHz Digital Frequency Meter
2435

Code nos. 52435-302A, -303Z

The following amendments are incorporated in this manual.

Amendment No.	Date	Issued at Ser. No.
-	Sep. 80	187001/001
Am. 1	Feb. 84	187025/001
Am. 2	May 87	187147/001
Am. 3	Jan. 88	187154/001

MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

Part No. 46881-358P
Print code : F-1/88, MI 0.5c

CONTENTS

HAZARD WARNING SYMBOLS

The following symbols appear on the equipment :-

Symbol	Type of hazard	Reference in manual
⚠	Input voltage limit	See operating manual
⚠	AC supply switches setting	
⚠	Static sensitive device	Prelim. page (iv) and Chaps. 5, 6 and 7

Note...

Each page bears the date of the original issue or the code number and date of the latest amendment (Am. 1, Am. 2 etc.). New or amended material of technical importance introduced by the latest amendment is indicated by triangles positioned thus >.....< to show the extent of the change. When a chapter is reissued the triangles do not appear.

Any changes subsequent to the latest amendment state of the manual are included on inserted sheets coded C1, C2 etc.

NOTES AND CAUTIONS

ELECTRICAL SAFETY PRECAUTIONS

This equipment is protected in accordance with IEC Safety Class I. It has been designed and tested according to IEC Publication 348, 'Safety Requirements for Electronic Measuring Apparatus', and has been supplied in a safe condition. The following precautions must be observed by the user to ensure safe operation and to retain the equipment in a safe condition.

Defects and abnormal stresses

Whenever it is likely that protection has been impaired, for example as a result of damage caused by severe conditions of transport or storage, the equipment shall be made inoperative and be secured against any unintended operation.

Removal of covers

Removal of the covers is likely to expose live parts although reasonable precautions have been taken in the design of the equipment to shield such parts. The equipment shall be disconnected from the supply before carrying out any adjustment, replacement or maintenance and repair during which the equipment shall be opened. If any adjustment, maintenance or repair under voltage is inevitable it shall only be carried out by a skilled person who is aware of the hazard involved.

Note that capacitors inside the equipment may still be charged when the equipment has been disconnected from the supply. Before carrying out any work inside the equipment, capacitors connected to high voltage points should be discharged; to discharge mains filter capacitors, if fitted, short together the L (live) and N (neutral) pins of the mains plug.

Mains plug

The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension lead without protective conductor. Any interruption of the protective conductor inside or outside the equipment is likely to make the equipment dangerous.

Fuses

Note that there is a supply fuse in both the live and neutral wires of the supply lead. If only one of these fuses should rupture, certain parts of the equipment could remain at supply potential.

To provide protection against breakdown of the supply lead, its connectors, and filter where fitted, an external supply fuse (e.g. fitted in the connecting plug) should be used in the live lead. The fuse should have a continuous rating not exceeding 6 A.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse holders shall be avoided.

RADIO FREQUENCY INTERFERENCE

This equipment conforms with the requirements of IEC Directive 76/889 as to limits of r.f. interference.

WARNING : HANDLING HAZARDS

This equipment is formed from metal pressings and although every endeavour has been made to remove sharp points and edges care should be taken, particularly when servicing the equipment, to avoid minor cuts.

WARNING : TOXIC HAZARD

Many of the electronic components used in this equipment employ resins and other chemicals which give off toxic fumes on incineration. Appropriate precautions should therefore be taken in the disposal of these items.

CAUTION : STATIC SENSITIVE COMPONENTS

Components identified with the symbol ⚠ on the circuit diagrams and/or parts lists are static sensitive devices. The presence of such devices is also indicated in the equipment by orange discs, flags or labels bearing the same symbol. Certain handling precautions must be observed to prevent these components being permanently damaged by static charges or fast surges.

(1) If a printed board containing static sensitive components (as indicated by a warning disc or flag) is removed, it must be temporarily stored in a conductive plastic bag.

(2) If a static sensitive component is to be removed or replaced the following anti-static equipment must be used.

A work bench with an earthed conductive surface.

Metallic tools earthed either permanently or by repeated discharges.

A low-voltage earthed soldering iron.

An earthed wrist strap and a conductive earthed seat cover for the operator, whose outer clothing must not be of man-made fibre.

(3) As a general precaution, avoid touching the leads of a static sensitive component. When handling a new one, leave it in its conducting mount until it is required for use.

Chapter 4-2

TECHNICAL DESCRIPTION

CONTENTS

INTRODUCTION

1. Two versions of 2435 are available. They differ only in the stability of their frequency standards.

2. The standard version fitted with a temperature compensated crystal oscillator is Code no. 52435-302A and the high stability version, fitted with an oven controlled crystal oscillator is Code no. 52435-303Z.

3. A simplified block diagram of the frequency meter is given in Fig. 1. Interconnection wiring details are shown in Chap. 7, Fig. 1. Circuit diagram references are included with the following descriptions.

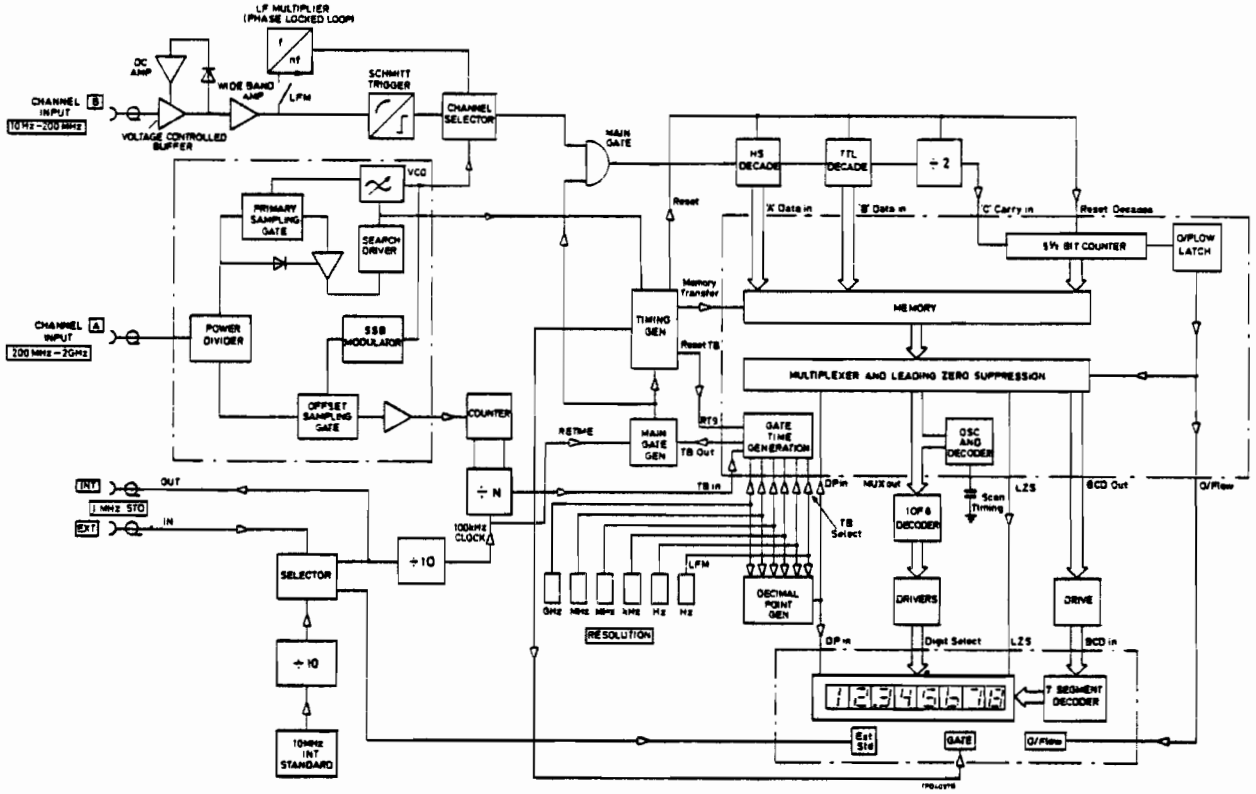


Fig. 1 2435 Simplified block diagram

10 Hz - 200 MHz INPUT (Channel B)

Circuit diagram : Chap. 7, Fig. 3

4. The input signal is fed into an input buffer comprising a dual gate m.o.s. f.e.t. and emitter follower whose gain and, for high level signals, attenuation can be controlled by a d.c. voltage applied to the m.o.s. f.e.t. The output of the buffer is detected and converted into a proportional d.c. voltage which controls the buffer.

5. The output signal from the subsequent wide band amplifier is of constant amplitude and its level just exceeds the hysteresis window of the Schmitt trigger thus ensuring reliable triggering even when the signal has a poor signal-to-noise ratio.

6. The output from the Schmitt trigger is selected by the channel selector and fed through the main gate to the high speed decade circuit. The pulse train input is counted by an eight decade counter, two and a half decades of which are discrete i.c.'s and the remainder part of a custom designed l.s.i. m.o.s. i.c.

200 MHz to 2 GHz INPUT (Channel A)

Simplified block diagram : Fig. 2

7. The signal input is fed to the transfer oscillator unit which converts the input frequency to a sub-harmonic within the counting capability of the main counter and determines the harmonic number N. Gate time for the counter is lengthened by a factor of N enabling the display to indicate the signal input frequency.

Transfer oscillator unit

8. This is a factory tested unit, set up and calibrated under very accurately controlled conditions and then sealed.

CAUTION ...

The unit must not be opened to effect repair. If the seals are broken the instrument warranty will be invalid.

9. The following information describes the circuits within the transfer oscillator unit and is given in order to complete the technical description for the whole of channel A operation.

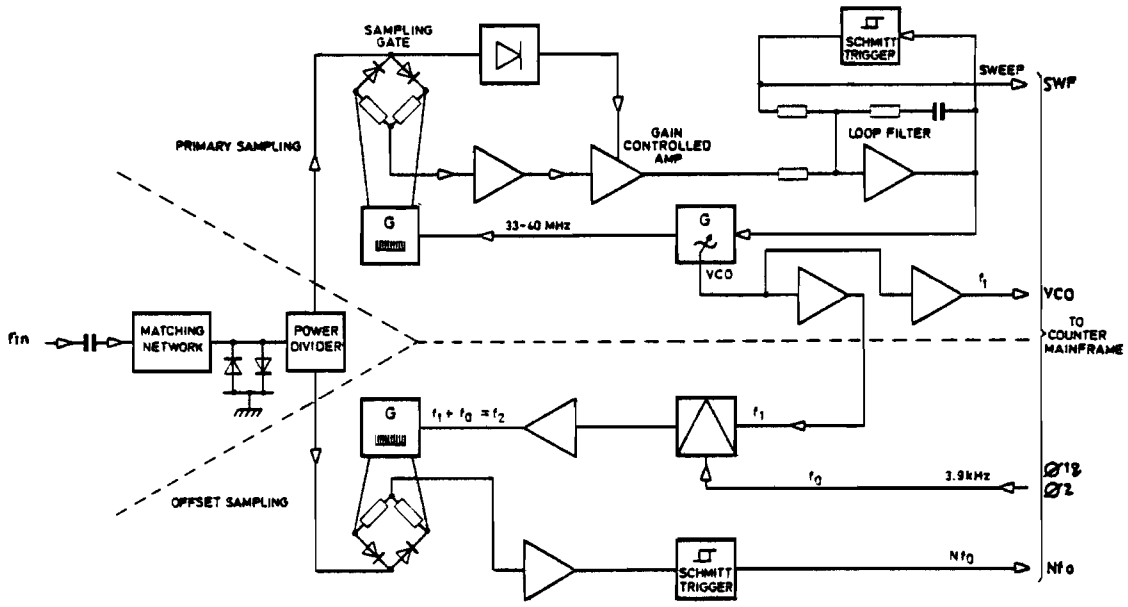


Fig. 2 Transfer oscillator : simplified block diagram.

10. The power divider provides p.i.n. diode limiting, protecting the instrument from high incident power up to 10 W c.w. The input signal (f_{in}) is split into two components with 10 dB attenuation per channel. Each component is then fed to a separate sampling circuit.

Primary sampling circuit

11. In the absence of an input signal the loop filter serves as an integrator for the voltage generated by the search driver Schmitt trigger and produces a rectangular wave sweeping the voltage controlled oscillator between 33 MHz and 40 MHz. The output of the search driver (SWP) is fed to the main counter where it is used as a lockout to prevent counting while the loop is searching and avoids a misleading display.

12. The v.c.o. signal is amplified and used to drive a step recovery diode which generates very narrow pulses that are then fed to the diode sampling bridge. These pulses turn on the diodes for about 300 ps.

13. When an r.f. input signal is applied the output of the sampling gate is proportional to the phase and level of the input. This output level is detected, amplified and used to drive a gain controlled amplifier. Amplifier gain is inversely proportional to the r.f. input level and results in a constant loop gain for the phase locked loop. When sufficient signal level is present at the input to the loop filter to overcome the search driver the loop will lock up.

14. One buffered output of the v.c.o. is fed to the channel selector where it is passed on through the main gate to the decade counters.

Offset sampling circuit

15. A second buffered output f_1 from the v.c.o. is fed to the offset sampling circuit which contains a single sideband modulator. The modulator is driven by two phase shifted offset signals f_0 generated in the main frame (Ø1 and Ø2). The resultant output frequency f_2 is used to drive the offset sampling gate whose output frequency is amplified and converted to a digital pulse train at rate Nf_0.

16. This pulse train is fed to the N counter in the mainframe. The resulting value for N programs a frequency divider which provides the time base to the gate generator. This lengthens the main gate time by a factor of N.

17. The contents of the counting circuit are transferred to the display which now indicates N x f_1, that is the r.f. input frequency f_{in}. An example of the overall frequency conversion with an input of 2 GHz and the v.c.o. locked at 40 MHz is shown in Fig. 3.

OFFSET FREQUENCY AND N COUNTER GATE GENERATOR

Circuit diagram : Chap. 7, Fig. 5.

18. The 1 MHz INT CK frequency is divided by 32 in a binary counter and then by a further 8 in a sine wave ring counter. This produces a frequency of 3.90625 kHz (f_0)

which is generated into two phase shifted signals. These signals (Ø1 and Ø2) drive the single sideband modulator in the transfer oscillator unit.

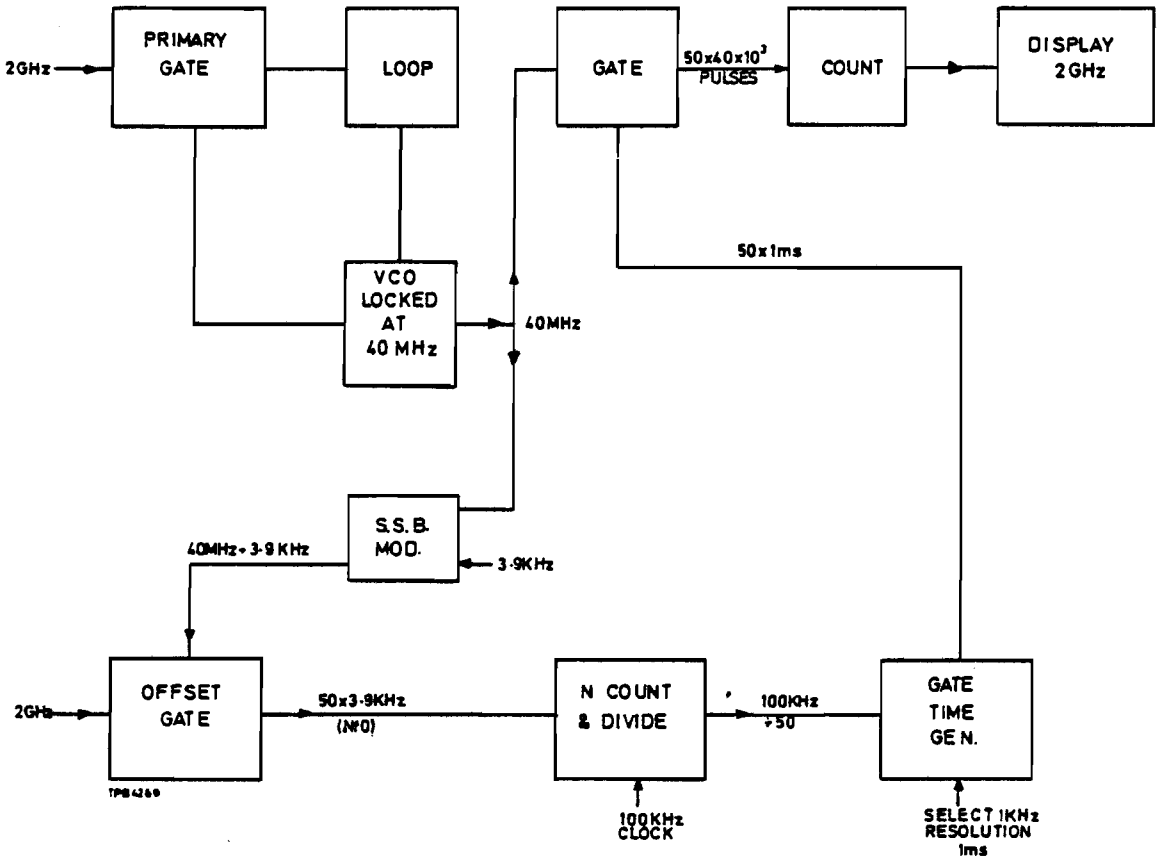


Fig. 3 Frequency conversion example : simplified block diagram.

19. A further division of the 1 MHz frequency, this time by 1024 provides a gating pulse of duration 4 x f_0 for the N counter.

REFERENCE CLOCK SELECTION AND GATE TIME GENERATOR

Circuit diagram : Chap. 7, Figs. 3 & 5

20. An internal 10 MHz crystal oscillator, frequency divided by 10 provides the 1 MHz signal (INT CK) to the N counter gate generator on the control board. Further division by 10 provides the counters 100 kHz main reference clock (CK). The 1 MHz signal and the main clock (after division by 10 in the second divider stage) can alternately be introduced from a 1 MHz source via the EXT STD input socket. This will automatically override the internal standard.

21. The 100 kHz main clock is fed to the N counter/divider and to the time base selector circuit. For channel A operation the clock frequency is divided by N and passed via the TB selector to provide the time base input (TB IN) to the gate time generator in the main integrated circuit. The clock frequency divider N is directly dependent on the channel A r.f. input frequency.

22. When using channel B, the N counter/divider output is 0 and the TB selector selects the 100 kHz clock frequency for the time base input. While making ratio measurements the overriding EXT STD frequency (10 kHz to 1 MHz) is divided by 10 to provide the reference clock and thus the time base input frequency.

23. The gate time generator divides down by a ratio determined by the RESOLUTION switches to produce the time base output (TBO). This output is divided by 2 and retimed from the reference clock (CK) to ensure accuracy of the timing signal delivered to the main gate circuit and to the timing generator.

TIMING GENERATOR

Circuit diagram : Chap. 7, Fig. 5

24. TTL monostable integrated circuits generate a timing sequence which determines the display time, memory transfer and reset times. Waveform diagrams which show the timing sequences for channel B operation are illustrated in Fig. 4.

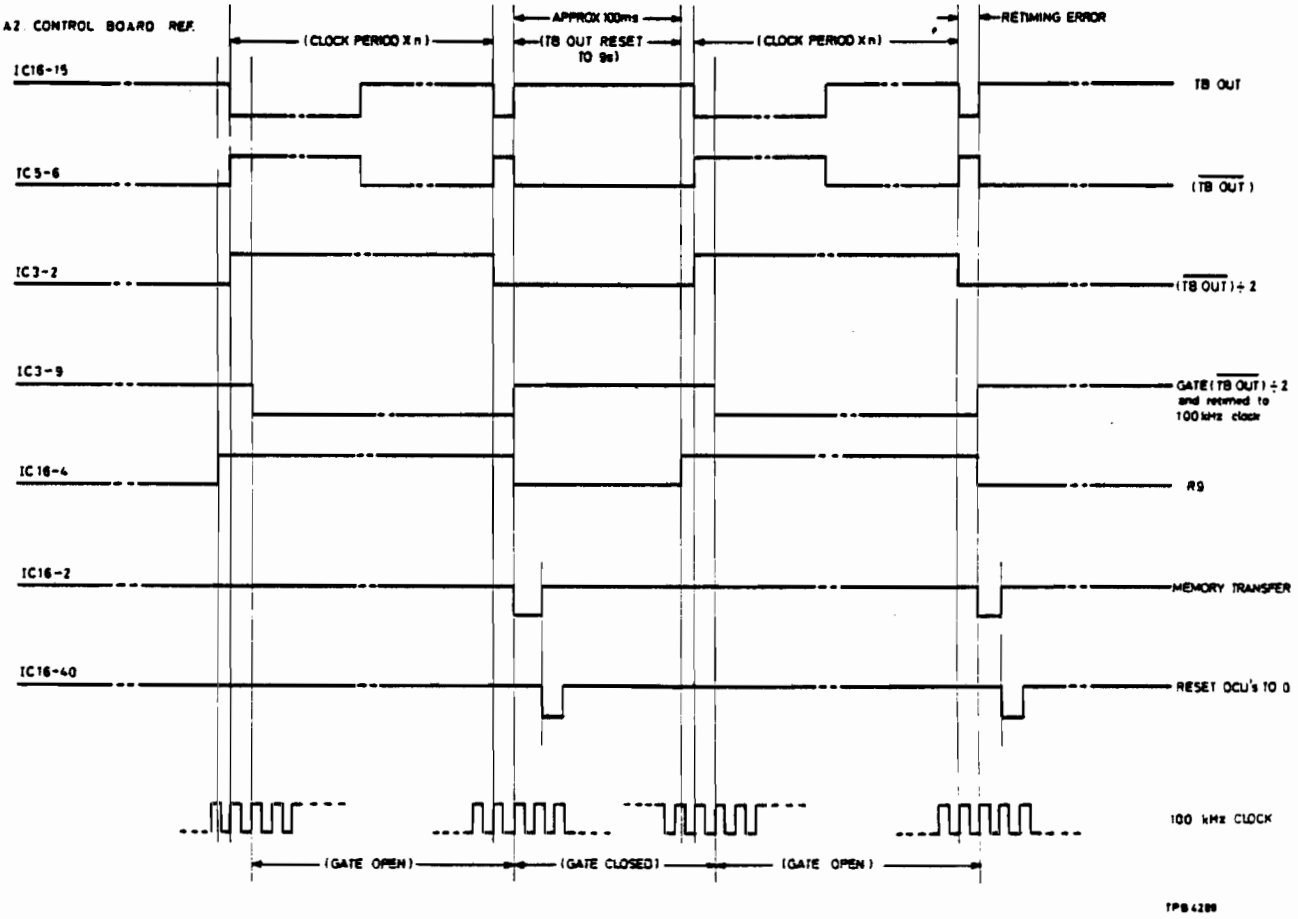


Fig. 4 Channel B timing sequences.

25. Channel A operation requires additional timing waveforms to provide the lock-out sequence (no r.f. input condition) and to compute the 'N' divider for the time base input signal. Waveforms and timing sequences are shown in Fig. 5.

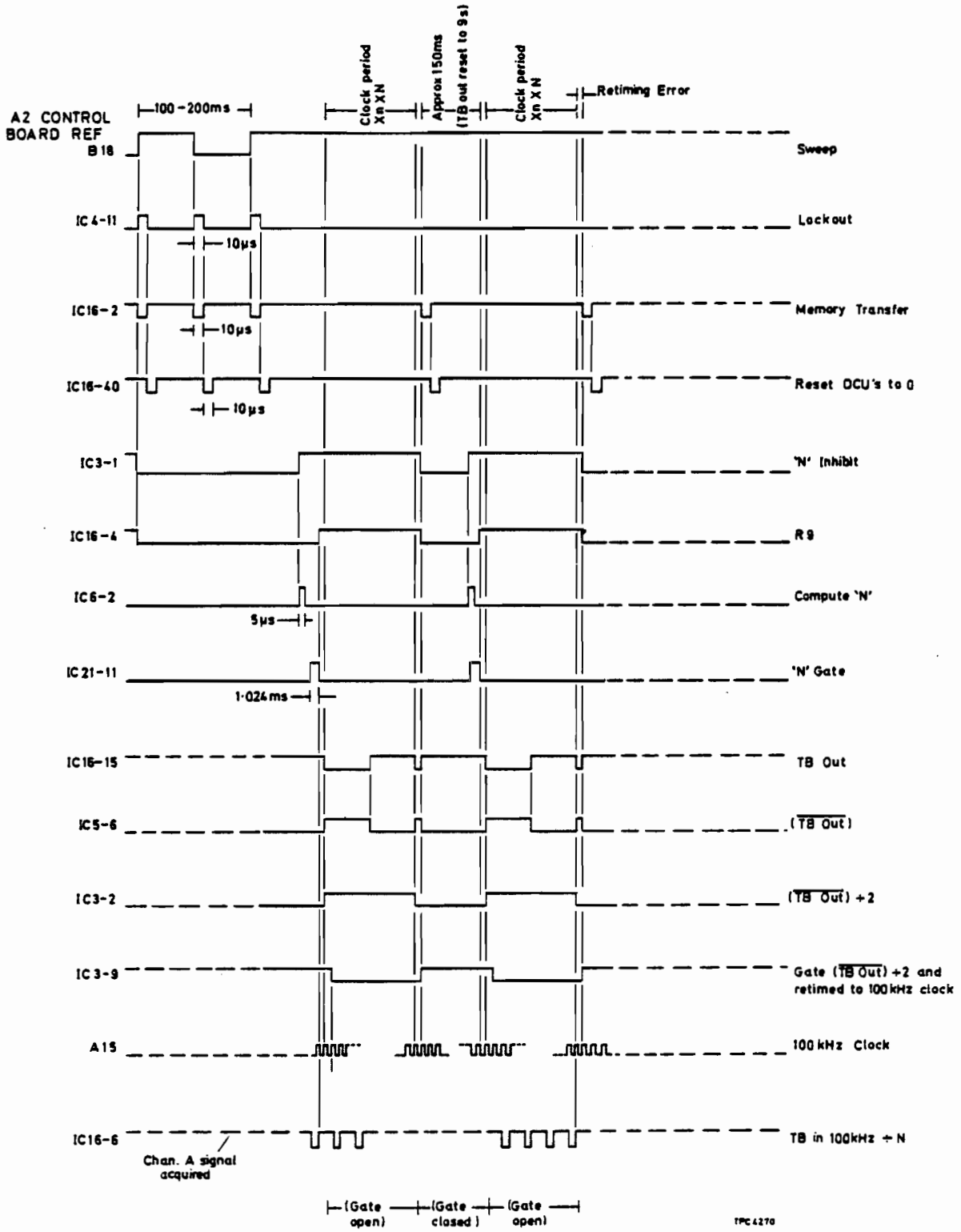


Fig. 5 Channel A timing sequences.

LOGIC CIRCUIT

Circuit diagram : Chap. 7, Fig. 5

26. A custom designed l.s.i. m.o.s. integrated circuit is the heart of the counter and contains all the digital logic that does not need to run at high currents or speeds.

27. The i.c. contains a $5\frac{1}{2}$ decade counter with overflow latch and an eight decade memory. Two and a half decades of the memory have a parallel data loading capability to enable the i.c. to be used with higher speed logic. The data from the memories are fed into a multiplexer which is controlled by an on-chip oscillator and 1 of 8 encoder. A signal for providing leading zero suppression is generated in the i.c. The 40 pin package also contains a time base section comprising a seven decade divider and a 1 of 7 data selector.

SWITCHING

Circuit diagram : Chap. 7, Fig. 3

28. For channel B input the front panel push switches select one of six gate times. The 1 ms, 10 ms, 100 ms, 1 s, 10 s and 1 s gates give display resolutions of 1 kHz, 100 Hz, 10 Hz, 1 Hz, 0.1 Hz and .01 Hz respectively and determine the decimal point position.

29. The l.f.m. (low frequency multiplier) range switch brings into operation a phase locked loop and frequency multiplier circuit for input frequencies up to 5 kHz. Input frequency is multiplied by 100 and using a 1 s gate provides a resolution of .01 Hz.

30. With channel A input the resolutions available are 1 kHz, 100 Hz, 10 Hz and 1 Hz. Gate times are dependent on the input frequency and the frequency at which the v.c.o. locks. For example, if input frequency is 950 MHz and v.c.o. locks at 38 MHz, then with 100 Hz resolution selected gate time will be

$$\frac{950 \text{ MHz}}{38 \text{ MHz}} \times 10 \text{ ms} = 250 \text{ ms}$$

31. A general approximation can be made by increasing the 1 ms, 10 ms, 100 ms or 1 s selected resolution times by a factor of $\frac{\text{input frequency}}{35}$ (MHz)

DISPLAY BOARD

Circuit diagram : Chap. 7, Fig. 7

32. The display board contains the 7-segment l.e.d. displays and b.c.d. to 7-segment encoder with its associated current limiting resistors. The board requires 1 of 8 digit drive multiplexed b.c.d. information, a decimal point signal and leading zero suppression signal. Three lamps are mounted on this board and indicate GATE period, OVERFLOW and EXTERNAL STANDARD operation.

LOW PASS FILTER

Circuit diagram : Chap. 7, Fig. 3

33. A front panel slider switch selects a low pass filter at the 10 Hz to 200 MHz input. This reduces sensitivity above 10 kHz, thereby attenuating any high frequency noise superimposed on an audio signal.

10 MHz CRYSTAL OSCILLATOR

Temperature compensated version (52435-302A

34. The crystal, manufactured to exhibit a near linear negative frequency/temperature coefficient over the temperature range, is used in a parallel resonance mode. Compensation is effected by applying a voltage to a varactor diode that opposes the temperature coefficient of the crystal.

35. The compensating voltage is determined by a resistor/thermistor network whose exact characteristics are determined by computer optimization techniques.

Oven controlled version (52435-303Z)

36. The AT cut crystal used is operated at the inversion point on its frequency/temperature curve at a temperature of approximately 75°C. The temperature of the crystal is maintained within ±0.2°C by a thermistor bridge.

POWER SUPPLY

Circuit diagram : Chap. 7, Fig. 3

37. The mains transformer, with primary tappings variable to suit the mains supply available, has three secondary windings each feeding a bridge rectifier circuit. Each rectifier output is smoothed and voltage regulated to provide +12 V, -12 V and two +5.1 V supplies.

38. Voltages +5.1 VF, +12 VF and -12 VF provide the main supplies to the function board.

39. +5.1 VC and -12 VF are connected to the control board via SKD and the link board.

40. +5.1 VC is further connected to the display board via the 8-way edge connector sockets, SKA.

41. For channel A operation, voltage +5.1 VF is connected via the channel selector switch to supply line +5.1 VSA. This enables the channel selector i.c. for channel A operation while the transfer oscillator unit is supplied by +5.1 VSA, -12 VF and +12 VF.

42. These voltages are critical and must be accurately set by the SET VOLTS control (R104) to ensure the correct operation of channel A (see Chap. 5).

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Chapter 5

MAINTENANCE

CONTENTS

INTRODUCTION

1. This chapter contains information for maintaining the frequency meter in good working order, checking its overall performance and details of adjustment procedures that may be necessary after replacement of components.

2. Before attempting any maintenance, the information given should be read with reference to the preceding Technical Description chapter.

3. The only part of the frequency meter which should need regular attention is the 10 MHz oscillator. This should be periodically checked to ensure that it is operating at the correct frequency, and adjusted to offset any aging drift that has taken place. (see para. 23).

4. Integrated circuits and semiconductor devices are used throughout this instrument, and although these have inherent long term reliability and mechanical ruggedness, they are susceptible to damage by overloading, reversed polarity and excessive heat or radiation. Avoid hazards such as prolonged soldering, strong r.f. fields or other forms of radiation, the use of insulation testers or accidentally applied short circuits.

5. Static sensitive components ⚠ . The c.m.o.s. integrated circuits used in this instrument have extremely high input resistance and can be damaged by accumulation of static charges. (see preliminary pages, Notes and Cautions).

ACCESS AND LAYOUT

Fuses

6. The frequency meter is protected by fuses in both the live and neutral conductors of the mains supply. Access is by means of screw caps on the rear panel.

Removing covers

7. The cover is retained by two screws at the rear of the instrument. These screws also hold the protective foot and clamp assemblies and their removal allows the case to be slid backwards over the rear panel. The separation of instrument and case is best achieved with the instrument upside down.

Internal layout

8. The function board, control board and transformer support chassis are held between the two side frames of the uncased instrument. The transfer oscillator is fitted in a sealed compartment mounted on the left hand side chassis frame. Component layout illustrations of the function, control and display printed circuit boards are contained in Chap. 7.

Transfer oscillator

9. The transfer oscillator assembly box is a self contained sealed unit complete with 50 Ω input socket. Supplies and signals are coupled via a multiway cable and plug to the function board alongside.

Function board

10. The function board amplifier and buffer input circuits are located near the channel B input socket on the right hand side. They are shielded by a metal screen above and below the board and held in position by retaining screws. Access to the top screen retaining screw is obtained by removing the control board/display board assembly.

11. Electrical connections between the function board and the control board mounted above are provided by a 20-way edge connector and interconnecting link board.

Control board and display board

12. The control board is connected to the display board via two 8-way edge connectors (SKA) at the front of the instrument. The control board itself is fixed to the top of the instrument and electrically connected to the lower function board via a 20-way edge connector and double sided link board.

13. With the control board retaining screws removed from the chassis side frames the control board/display board assembly can be withdrawn from the instrument. The display board may be separated from the control board by simply unplugging the display board edge connectors.

14. For servicing purposes, the control board/display board assembly can be fitted direct into the edge connector on the function board as shown in Fig. 1, after removing the link board that normally provides the interconnection. (The front panel need not be removed.) The instrument will still operate in this position.

Power supply

15. TR1, TR2 and TR3, the +5.1 VF, +5.1 VC and +12 VF line regulators, are mounted on the instrument back panel with their connections wired directly to the function board circuits. The remaining power supply components are on the function board below the transformer support chassis. Access to these can be gained by hinging the support chassis forward into a vertical position. (shown in Fig. 1).

16. This is done by removing the two chassis retaining screws on the back panel and the rear two screws holding the chassis to the side frames. The remaining side frame screws should then be slackened, so that the chassis may hinge about them, and tightened to hold it in a convenient position. No electrical connections need to be removed.

PERFORMANCE TESTS AND ADJUSTMENTS

17. The tests in this section are simplified and of restricted range compared with those which would be needed to demonstrate complete compliance with the specification. They should be regarded only as providing a check procedure, for use during routine maintenance, to determine whether adjustment or repair is necessary.

18. The performance limits quoted are for guidance and should not be taken as guaranteed performance specifications unless they are also quoted in the Performance Data in Chap. 1 (Vol. 1).

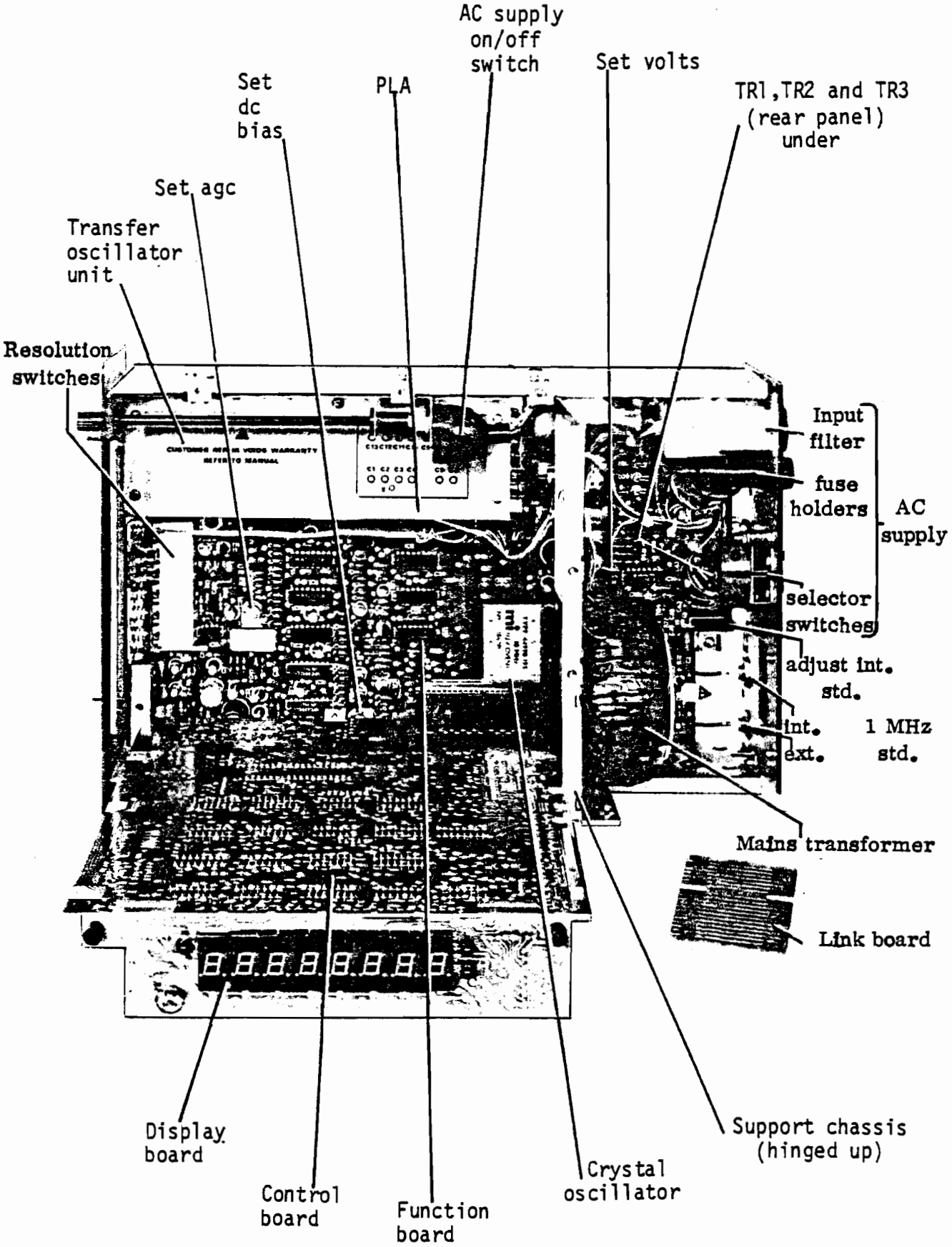


Fig. 1 2435 Internal view, servicing position (amplifier top screen removed).

19. When making tests to verify that the instrument meets the stated performance limits, allowance must always be made for the uncertainty of the test equipment used.

20. In case of difficulties which cannot be resolved with the aid of this manual, please contact our Service Division at the address given inside the rear cover, or your nearest Marconi Instruments representative. Always quote the type or model number and serial number found on the label at the rear of the instrument.

TABLE 1 TEST EQUIPMENT

Item	Description	Recommended model Marconi Instruments unless stated otherwise.
a b	1 MHz ±0.1 Hz frequency source 10 MHz ±0.1 Hz frequency source	Derived from an off-air frequency standard
c	10 Hz and 100 kHz signal source	2104
d	70 MHz and 200 MHz signal source	2015
e	200 MHz and 2 GHz signal source	6055B
f	LF millivoltmeter with T connector	2600B
g	RF millivoltmeter with coaxial T connector	2603
h	2 GHz power meter and power head	6460 and 6420
i	Power splitter to cover frequency range 200 MHz to 2 GHz	Hewlett Packard 11667A
j	50 MHz oscilloscope	Telequipment D83
k	Digital multimeter ranges : 0-20 V a.c. 0-15 V d.c. accuracy : better than ±0.2%	

Sensitivity

Channel A

Test equipment : items a, e, h and i.

21. Check that the counter indicates correctly with an input of -12 dBm at the low and high limits of the frequency range as follows.

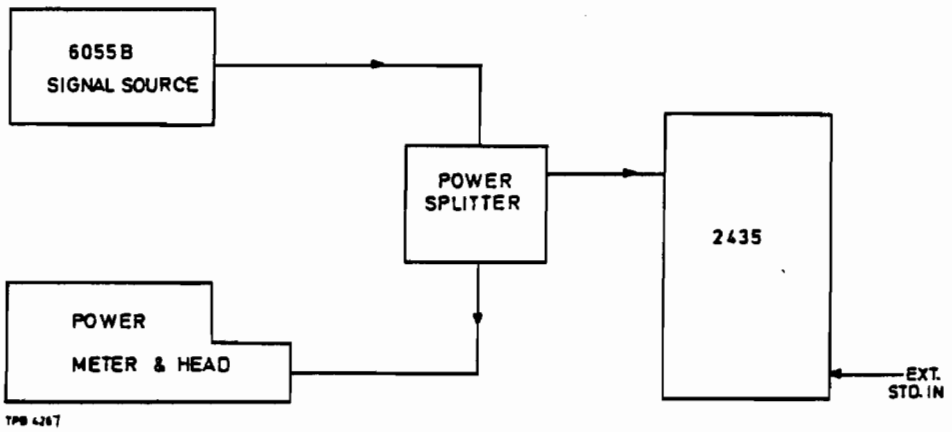


Fig. 2 Test gear arrangement to check channel A sensitivity.

21.1 Low limit 200 MHz

(1) Connect the test equipment as shown in Fig. 2.

(2) Connect an accurately known 1 MHz standard frequency signal to the EXT STD input socket. Level to be within 150 mV to 10 V r.m.s.

CAUTION ...

EXT STD input voltage must not exceed 10 V r.m.s.

(3) Set signal frequency to 200 MHz and adjust input power level for a reading of -12 dBm on the power meter.

(4) Check EXT STD indicator is lit.

(5) Select 100 Hz RESOLUTION (MHz readout).

(6) Check counter indicates correctly.

21.2 High limit 2 GHz

(1) With test equipment still connected as shown in Fig. 2, change signal frequency to 2 GHz and adjust input power level for a reading of -12 dBm on the power meter.

(2) Select 1 kHz RESOLUTION (GHz readout).

(3) Check counter indicates correctly.

Channel B

Test equipment : items a, c, d, f and g.

22. Check that the counter indicates correctly with a 10 mV input over the range 10 Hz to 70 MHz and with a 25 mV input over the range 70 MHz to 200 MHz as follows.

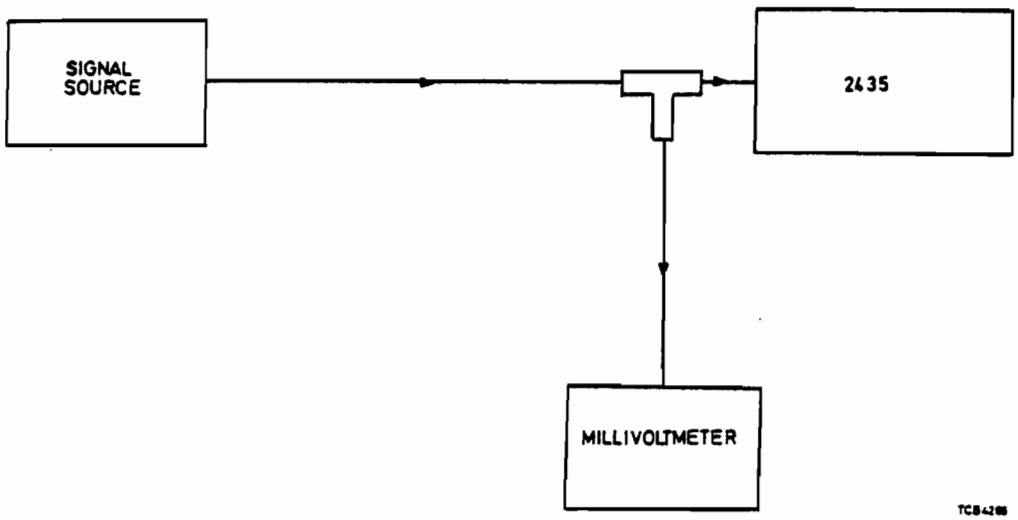


Fig. 3 Test gear arrangement to check channel B sensitivity.

22.1 10 Hz to 70 MHz

(1) Connect the test equipment as shown in Fig. 3 using a 10 Hz signal source and an l.f. millivoltmeter.

(2) Connect an accurately known 1 MHz standard frequency signal to the EXT STD input socket. Level to be within 150 mV to 10 V r.m.s.

CAUTION ...

EXT STD input voltage must not exceed 10 V r.m.s.

(3) Adjust the 10 Hz signal source input level to 10 mV r.m.s. (sine wave).

(4) Check EXT STD indicator is lit.

(5) Select 0.1 Hz RESOLUTION (Hz readout).

(6) Check counter indicates correctly.

(7) Select .01 Hz RESOLUTION LFM (Hz readout).

(8) Check counter indicates correctly (digits and decimal point have shifted one place to left).

(9) Change signal source frequency to 70 MHz and change l.f. voltmeter for r.f. voltmeter with coaxial T connector.

(10) Adjust signal input level to 10 mV r.m.s. (sine wave).

(11) Select 10 Hz RESOLUTION (MHz readout).

(12) Check counter indicates correctly.

22.2 70 MHz to 200 MHz

(1) With test equipment still connected as in 22.1 (9) adjust signal input level to 25 mV r.m.s. (sine wave).

(2) Check counter indicates correctly.

(3) Change signal source frequency to 200 MHz and adjust input level to 25 mV r.m.s. (sine wave).

(4) Check counter indicates correctly.

(5) Select 1 Hz RESOLUTION (kHz readout) and check that OVERFLOW indicator lights.

Internal standard frequency

Test equipment : item b

23. The accuracy of the internal 10 MHz standard frequency can be checked by comparing it with an accurately known standard external frequency as follows.

(1) Disconnect the EXT STD input.

(2) Connect a known external frequency to channel B input socket and select 1 Hz RESOLUTION (Hz readout). The value of the frequency is unimportant although higher frequency allows greater discrimination. A suggested frequency is 10 MHz, set to within ±0.1 Hz.

(3) Check counter indicates the input frequency within ±1 Hz. If necessary fine adjustment of the internal standard frequency can be made to achieve the correct indication. This is done by means of the ADJUST INT STD control (R101) at the rear panel.

24. If the amount of adjustment required is outside the range of this fine control, centralize control and adjust the coarse control on the oscillator unit to bring within range.

25. Access to this preset variable capacitor is obtained by removal of the clip-on oscillator unit cover. Allow time for the temperature to stabilize before making adjustment. If a fault is diagnosed in this unit, do not attempt to repair but replace complete assembly (see Chap. 6).

Internal standard output

Test equipment : item j.

26. The internal 10 MHz standard frequency is divided by 10 and made available at the rear panel. Check the output level as follows :

(1) Connect the INT STD output socket on the rear panel to the oscilloscope terminated with 50 Ω.

(2) Check the amplitude of 1 MHz oscillation is greater than 100 mV p-p (approx. 4 V e.m.f.).

Transfer oscillator

Test equipment : item j.

27. This is a factory tested unit, set up and calibrated under very accurately controlled conditions and then sealed.

CAUTION ...

The unit must not be opened to effect repair. If the seals are broken the instrument warranty will be invalid.

28. When checking channel A operation the mainframe must always be proved correct before suspecting a fault in the transfer oscillator unit.

29. Unit power supplies and in particular the -12 VF line must be checked first (see para. 43).

30. The following information is given as a guide to the correct input and outputs of the transfer oscillator unit. Use the oscilloscope to monitor the waveforms at plug A. Chap. 7, Fig. 3 shows connections.

SWP output (plug A, pin 7)

31. With no r.f. signal input to channel A the SWP output is a rectangular waveform as shown in Fig. 4.

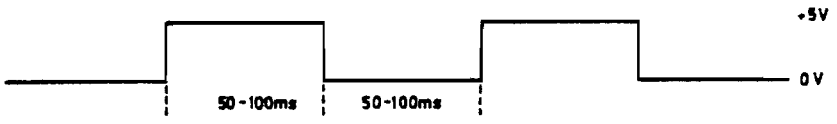


Fig. 4 SWP output.

32. If the SWP output waveform period is greater than 200 ms or there is no waveform then the gate lamp will flash and/or random readings will be indicated on the display.

33. When the transfer oscillator unit locks to an input signal the SWP output voltage is held at the prevailing level, i.e. the output remains at 0 V or +5 V.

VCO output (plug A, pin 4)

34. The VCO output signal is a sinewave in the frequency range 33 MHz to 40 MHz as shown in Fig. 5.

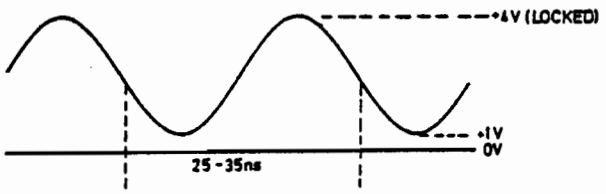


Fig. 5 VCO output.

35. With no r.f. signal input to channel A the VCO is swept in synchronization with the SWP output as shown in Fig. 6.

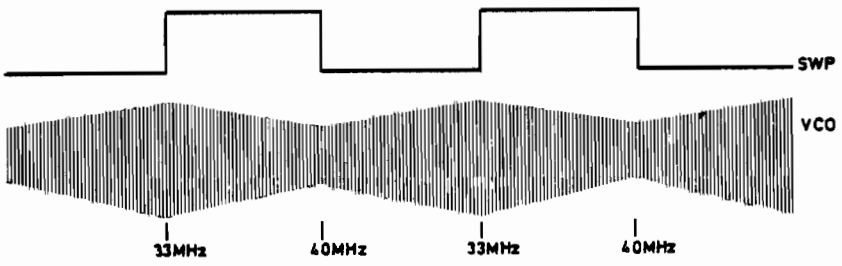


Fig. 6 VCO output (no signal input)

Ø1 and Ø2 inputs (plug A, pins 10 and 9)

36. Ø1 and Ø2 inputs are 3.90625 kHz sine waves with a phase difference of 90° as shown in Fig. 7

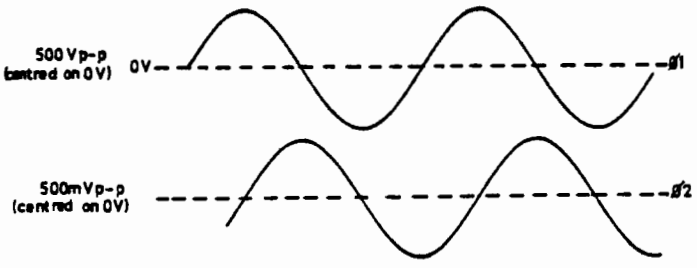


Fig. 7 Ø1 and Ø2 inputs.

Nf0 output (plug A, pin 6)

37. When the transfer oscillator locks to an input signal, the Nf0 output is a +5 V square wave of frequency N x 3.90625 kHz. A small amount of incidental fm is present and the waveform as shown in Fig. 8, is best observed in synchronization with the Ø1 or Ø2 input signal.

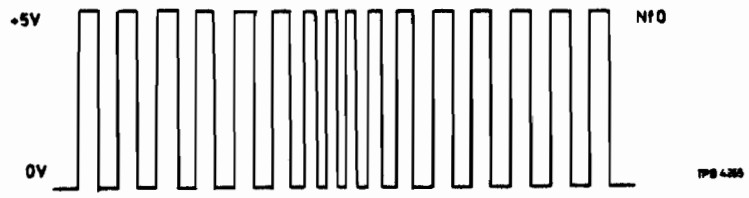


Fig. 8 Nf0 output.

Unit replacement

38. If an internal fault is diagnosed the assembly must be replaced as per the code number given in Chap. 6, which identifies a complete factory tested, direct replacement unit.

Amplifier adjustments

Test equipment : items c, d, f, g and i.

39. The following adjustment procedures should only be undertaken if repairs have been carried out on the function board amplifier circuits.

Set a.g.c. - R63

39.1 Adjust this control as follows.

(1) Disconnect input to counter.

(2) Monitor pin 6 of IC6 (a.g.c. drive) with the oscilloscope.

(3) Set oscilloscope to 1 V/cm d.c. coupled.

(4) Adjust R63 (set a.g.c.) so that the voltage on pin 6 is +4.5 V d.c.

Set d.c. bias - R11

39.2 Adjust this control as follows.

(1) Select channel B input position.

(2) Connect the 100 kHz signal source to channel B input via the T connector and monitor level with the l.f. millivoltmeter at the input socket.

(3) Set input level to 7 mV r.m.s. (sine wave).

(4) Adjust R11 (set d.c.) slowly anti-clockwise from the fully clockwise position (viewed and adjusted from track side of board) until the frequency meter just counts the 100 kHz signal.

39.3 Recheck channel B sensitivity with an input frequency of 70 MHz as detailed in para. 22.

Low-pass filter

Test equipment : items c and f.

40. The low-pass filter attenuates input frequencies above 100 kHz by at least 20 dB. Check as follows.

(1) Switch low-pass filter OUT.

(2) Connect the 100 kHz signal source to the channel B input via the T connector and monitor with the l.f. millivoltmeter.

(3) Determine the minimum level at which the frequency meter just counts the 100 kHz signal correctly.

(4) Switch the low-pass filter IN.

(5) Determine again the minimum level at which the frequency meter just counts the 100 kHz signal correctly.

(6) The difference between the two levels should be at least 20 dB.

Power supply

Test equipment : item k.

41. Before carrying out any fault finding checks on the power supply, isolate the transfer oscillator and control board/display board circuits (if not required) to avoid the risk of accidental damage. Isolate the transfer oscillator unit by unplugging SKA and control board/display board assembly by disconnecting from the edge connector.

42. The output of the +5 V bridge rectifier is connected via a link between pins 3 and 4 on the connector PLB. This link can be removed to isolate the rectifier from the control and regulator circuits. Adjustment of the preset variable R104 should be carried out with this link in position, i.e. with load on the supply.

43. The following voltages are given as a guide to the correct working voltages of the transformer secondaries and d.c. supply circuits. Release all range buttons checking that display shows all eights and select channel A (with no input there should be no gate lamp illumination). Check the voltages with respect to chassis.

Mains input supply :		230 V to 240 V a.c.
Mains transformer secondaries :		sec. 1 : 7.4 V to 8.4 V a.c. sec. 3 : 14 V to 16 V a.c. sec. 4 : 14 V to 16 V a.c.
Function board, A1		
-12 VF line	Tag 4 next to plug A use tag 7 as earth	: -11.99 V to -12.02 V d.c. (set with R104)

Note ...

The remaining supply line voltages are partly dependent on the setting of R104. Accurate setting of the -12 VF line is essential to the correct operation of channel A.

+5.1 VSA line	Tag 3 next to plug A	: +5.1 V to +5.12 V d.c.
+12 VF line	Plug A, pin 1	: +11.6 V to +12.2 V d.c.
Control board, A2		
+5.1 VC line	IC16, pin 1	: +5.0 V to +5.2 V d.c.

Chapter 6

REPLACEABLE PARTS

CONTENTS

INTRODUCTION

1. This chapter lists the code numbers for components and miscellaneous mechanical parts of the frequency meter.

2. Each sub-assembly or printed circuit board in this instrument has been allocated a unit identification, e.g. A0, A1, A2 etc.

3. The complete component reference carries its unit number as a prefix, e.g. A1 C1 (capacitor C1 on board A1) but for convenience in the text and on circuit diagrams the prefix is not used. However, when ordering replacements or in correspondence the complete component reference must be quoted.

ABBREVIATIONS

4. The components are listed in alphanumerical order of the complete circuit reference and the following abbreviations are used :

C	:	capacitor	R	:	resistor
Carb	:	carbon	S	:	switch
Cer	:	ceramic	SK	:	socket
D	:	semiconductor diode	T	:	transformer
Elec	:	electrolytic	Tant	:	tantalum
FS	:	fuse	TR	:	transistor
IC	:	integrated circuit (package)	Var	:	variable
L	:	inductor	W	:	watts at 70°C
LP	:	lamp l.e.d.	†	:	value selected during test : nominal value listed
Met	:	metal			
PL	:	plug	⚠	:	static sensitive component
Plas	:	plastic dielectric			

COMPONENT VALUES

5. One or more of the components fitted in this instrument may differ from those listed in this chapter for any of the following reasons :

(a) Components indicated by a † have their values selected during test to achieve particular performance limits.

(b) Owing to supply difficulties, components of different value or type may be substituted provided the overall performance of the instrument is maintained.

(c) As part of a policy of continuous development, components may be changed in value or type to obtain detail improvements in performance.

When there is a difference between the component fitted and the one listed, always use as a replacement the same type and value as found in the instrument.

ORDERING

6. When ordering replacements, address the order to our Service Division (address inside rear cover) or nearest agent and specify the following for each component required :

(1) Type* and serial number of instrument.

(2) Complete circuit reference.

(3) Description.

(4) Marconi Instruments code number.

*As given on the serial number label at the rear of the instrument; if this is superseded by a model number label, quote the model number instead of the type number.

Circuit reference	Description	Code no.
	COMPONENTS	
7.	Unit A0 Chassis assembly	
	When ordering, prefix circuit reference with A0	
FS1	250 mA (time delay) (210-240 V a.c. supply)	23411-055P
	500 mA (time delay) (105-120 V a.c. supply)	23411-056X
	Fuse holder	23416-192R
	Cover for fuse holder	23416-198E
FS2	250 mA (time delay) (210-240 V a.c. supply)	23411-055P
	500 mA (time delay) (105-120 V a.c. supply)	23411-056X
	Fuse holder	23416-192R
	Cover for fuse holder	23416-198E
PLA	Mains plug filter assembly	23423-150L
	Cover for mains filter	37590-150P
SA	Mains voltage selector d.p.c.o. (slider)	23467-161W
SB	Mains voltage selector d.p.c.o. (slider)	23467-161W
	Cover for SA and SB	37590-245S
SC	SUPPLY ON/OFF (d.p.d.t. (semi rotary)	23462-353A
	Cover	37590-246W
	Extension spindle for SC	37590-244V
SKB	EXT STD BNC 50 Ω connector	23443-442B
SKC	INT STD BNC 50 Ω connector	23443-442B
T1	Mains transformer	43490-063P
*	Cushion pad for T1	37490-263X
TR1	2N 4918	28434-896Y
TR2	2N 4918	28434-896Y
TR3	2N 4918	28434-896Y
X1	Ring core	23635-913Z
*	Replace pad when replacing T1	
	Unit A1 Function board	
8.	When ordering, prefix circuit reference with A1	
	Complete board	44827-922S
C1	Cer 22pF ±2.5% 750V	26324-715T

Unit A1 Function board (continued)

Circuit reference	Description	Code no.
C2	Plas 0.1µF ±20% 250V	26582-799N
C3	Cer 0.047µF +80-20% 25V	26383-017U
C4	Cer 0.047µF +80-20% 25V	26383-017U
C5	Cer 0.047µF +80-20% 25V	26383-017U
C6	Elec 100µF +100-20% 25V	26423-243M
C7	Tant 4.7µF ±20% 35V	26486-219P
C8	Tant 47µF ±20% 6V	26486-232A
C9	Tant 47µF ±20% 6V	26486-232A
C10	Tant 47µF ±20% 6V	26486-232A
C11	Cer 22pF ±5% 63V	26343-469N
C12	Elec 220µF +100-20% 25V	26423-254E
C13	Cer 39pF ±5% 63V	26343-472N
C14	Cer 0.047µF +80-20% 25V	26383-017U
C15	Cer 0.047µF +80-20% 25V	26383-017U
C16	Cer 0.047µF +80-20% 25V	26383-017U
C17	Cer 0.047µF +80-20% 25V	26383-017U
C18	Cer 22pF ±5% 63V	26343-469N
C20	Cer 0.047µF +80-20% 25V	26383-017U
C21	Tant 22µF ±20% 15V	26486-230B
C23	Tant 2.2µF ±10% 35V	26486-214V
C24	Cer 47pF ±5% 63V	26343-473L
C25	Cer 0.047µF +80-20% 25V	26383-017U
C26	Cer 33pF ±5% 63V	26343-471Y
C27	Plas 0.1µF ±20% 250V	26582-799N
C28	Cer 10pF ±0.5pF 63V	26343-465H
C29	Tant 0.47µF ±20% 35V	26486-207L
C30	Tant 0.47µF ±20% 35V	26486-207L
C32	Cer 0.022µF +50-20% 18V	26383-007R
C33	Cer 22pF ±2.5% 750V	26324-715T
C34	Plas 0.1µF ±20% 250V	26582-799N
C35	Cer 100pF ±2% 63V	26343-477V
C36	Cer 0.0047µF ±10% 63V	26383-591B
C37	Cer 180pF ±10% 63V	26383-594Z
C40	Tant 22µF ±20% 15V	26486-230B
C41	Tant 22µF ±20% 15V	26486-230B
C42	Tant 22µF ±20% 15V	26486-230B
C43	Tant 22µF ±20% 15V	26486-230B
C44	Cer 0.047µF +80-20% 25V	26383-017U
C45	Elec 220µF +100-20% 25V	26423-254E
C46	Elec 1000µF +100-20% 10V	26415-826D
C47	Elec 4700pF +50-10% 16V	26426-091P
C48	Elec 1000µF +100-20% 10V	26415-826D
C49	Elec 220µF +100-20% 25V	26423-254E

Unit A1 Function board (continued)

Circuit reference	Description	Code no.
C56	Tant 22µF ±20% 15V	26486-230B
C57	Tant 22µF ±20% 15V	26486-230B
C58	Tant 22µF ±20% 15V	26486-230B
C59	Tant 22µF ±20% 15V	26486-230B
C60	Tant 22µF ±20% 15V	26486-583L
C61	Tant 22µF ±20% 15V	26486-583L
C62	Cer 0.047µF +80-20% 25 V	26383-017U
C63	Cer 0.022µF +50-25% 18V	26383-007R
C65	Cer 0.022µF +50-20% 18V	26383-007R
C66	Cer 0.047µF +80-20% 25V	26383-017U
C67	Cer 0.047µF +80-20% 25V	26383-017U
C68	Cer 0.047µF +80-20% 25V	26383-017U
C69	Cer 0.047µF +80-20% 25V	26383-017U
C70	Cer 0.0047µF ±10% 63V	26383-591B
C71	Cer 0.047µF +80-20% 25V	26383-017U
D1	1N4148	28336-676J
D2	Z5B 5.1	28371-403N
D3	1N4148	28336-676J
D4	Z5B 5.1	28371-403N
D5	BAY72	28337-126P
D6	1N4148	28336-676J
D7 ⚠	HP 5082-2835	28349-006H
D8 ⚠	HP 5082-2835	28349-006H
D9	1N4148	28336-676J
D10 ⚠	HP 5082-2835	28349-006H
D11 ⚠	HP 5082-2835	28349-006H
D12	1N825	28371-494Z
D13	Z5B 3.9	28371-253K
D14	1N4148	28336-676J
D15	1N4148	28336-676J
D16	1N4148	28336-676J
D17	Z5B 5.1	28371-403N
D18	Z5B 5.1	28371-403N
D19	Z5B 5.1	28371-403N
D20	1N825	28371-494Z
D21	Z5B 9.1	28371-753S
D22	1N4148	28336-676J
D23	1N4148	28336-676J
D24	1N4148	28336-676J
D25	1N4148	28336-676J
D26	Z5B12	28372-143U
D27	1N5401	28355-723N
D28	1N5401	28355-723N
D29	1N5401	28355-723N
D30	1N5401	28355-723N
D31	1N4004	28357-028K

Circuit reference	Description	Code no.
	Unit A1 Function board (continued)	
D32	1N4004	28357-028K
D33	1N4004	28357-028K
D34	1N4004	28357-028K
D35	1N4004	28357-028K
D36	1N4004	28357-028K
D37	1N4004	28357-028K
D38	1N4004	28357-028K
D39	1N4148	28336-676J
IC1	MC 1692L	28469-170N
IC2	MC 1692L	28469-170N
IC3	MC 10105P	28466-105Z
IC4	MC 10231	28462-610K
IC5	MC 10131	28462-605R
IC6	µA 741	28461-304T
IC7	µA 741	28461-304T
IC8 ⚠	4046	28461-917W
IC9 ⚠	4518	28464-109J
IC10	74LS90	28464-014S
IC11	74LS132	28469-205N
IC12	74LS90	28464-014S
IC13	7472	28462-003L
IC14	74LS90	28464-014S
IC15	TL084	28461-332V
L1	RF choke 0.68µH	23642-548N
PLA	Pin post (12 of each)	23435-188
PLB	Pin post (12 of each)	23435-188
	Connector link 2-way for PLB	43129-375S
R1	Met film 1MΩ ±2% 1/4W	24773-346E
R2	Carb 10MΩ ±10% 1/8W	24321-885W
R3	Met film 1kΩ ±2% ¼W	24773-273A
R4	Met film 33Ω ±2% ¼W	24773-237K
R5	Met film 100Ω ±2% ¼W	24773-249J
R6	Met film 560Ω ±2% ¼W	24773-267R
R7	Met film 1kΩ ±2% ¼W	24773-273A
R8	Met film 2.2Ω ±2% ¼W	24773-209E
R9	Met film 220Ω ±2% ¼W	24773-257W
R10	Met film 10kΩ ±2% ¼W	24773-297M
R11	Var 10kΩ ±10% ½W	25711-543D
R12	Met film 22kΩ ±2% ¼W	24773-305R
R13	Met film 1kΩ ±2% ¼W	24773-273A
R14	Met film 680Ω ±2% ¼W	24773-269K
R15	Met film 15kΩ ±2% ¼W	24773-301P
R16	Met film 510Ω ±2% ¼W	24773-266C

Unit A1 Function board (continued)

Circuit reference	Description	Code no.
R17	Met film 10kΩ ±2% ¼W	24773-297M
R18	Met film 510Ω ±2% ¼W	24773-266C
R19	Met film 100kΩ ±2% ¼W	24773-321L
R20	Met film 82Ω ±2% ¼W	24773-247N
R21	Met film 390Ω ±2% ¼W	24773-263P
R22	Met film 100Ω ±2% ¼W	24773-249J
R23	Met film 220Ω ±2% ¼W	24773-257W
R24	Met film 1.5kΩ ±2% ¼W	24773-277U
R25	Met film 1kΩ ±2% ¼W	24773-273A
R26	Met film 130Ω ±2% ¼W	24773-252J
R27	Met film 510Ω ±2% ¼W	24773-266C
R28	Met film 56Ω ±2% ¼W	24773-243H
R29	Met film 1.5kΩ ±2% ¼W	24773-277U
R30	Met film 220Ω ±2% ¼W	24773-257W
R31	Met film 510Ω ±2% ¼W	24773-266C
R32	Met film 680Ω ±2% ¼W	24773-269K
R33	Met film 510Ω ±2% ¼W	24773-266C
R34	Met film 510Ω ±2% ¼W	24773-266C
R35	Met film 22kΩ ±2% ¼W	24773-305R
R36	Met film 510Ω ±2% ¼W	24773-266C
R37	Met film 510Ω ±2% ¼W	24773-266C
R38	Met film 22kΩ ±2% ¼W	24773-305R
R39	Met film 510Ω ±2% ¼W	24773-266C
R40	Met film 510Ω ±2% ¼W	24773-266C
R41	Met film 22kΩ ±2% ¼W	24773-305R
R42	Met film 510Ω ±2% ¼W	24773-266C
R43	Met film 22kΩ ±2% ¼W	24773-305R
R44	Met film 510Ω ±2% ¼W	24773-266C
R45	Met film 510Ω ±2% ¼W	24773-266C
R46	Met film 510Ω ±2% ¼W	24773-266C
R47	Met film 510Ω ±2% ¼W	24773-266C
R48	Met film 220Ω ±2% ¼W	24773-257W
R49	Met film 560Ω ±2% ¼W	24773-267R
R50	Met film 1kΩ ±2% ¼W	24773-273A
R51	Met film 560Ω ±2% ¼W	24773-267R
R52 †	Met film 15Ω ±2% ¼W	24773-229X
R55	Met film 1kΩ ±2% ¼W	24773-273A
R56	Met film 100kΩ ±2% ¼W	24773-321L
R57	Met film 10kΩ ±2% ¼W	24773-297M
R58	Met film 1kΩ ±2% ¼W	24773-273A
R59	Met film 470kΩ ±2% ¼W	24773-337R
R60	Met film 750Ω ±2% ¼W	24773-270R
R61	Met film 22kΩ ±2% ¼W	24773-305R

Unit A1 Function board (continued)

Circuit reference	Description	Code no.
R62	Met film 220kΩ ±2% ¼W	24773-329T
R63	Var 10kΩ ±10% ½W	25711-543D
R64	Met film 47kΩ ±2% ¼W	24773-313H
R65	Met film 120kΩ ±2% ¼W	24773-323F
R66	Met film 10kΩ ±2% ¼W	24773-297M
R67	Carb 680kΩ ±5% 1/8W	24311-941Z
R68	Met film 10kΩ ±2% ¼W	24773-297M
R69	Carb 680kΩ ±5% 1/8W	24311-941Z
R70	Met film 22kΩ ±2% ¼W	24773-305R
R71	Met film 4.7kΩ ±2% ¼W	24773-289W
R72	Met film 4.7kΩ ±2% ¼W	24773-289W
R73	Met film 3.3kΩ ±2% ¼W	24773-285F
R74	Met film 100Ω ±2% ¼W	24773-249J
R75	Met film 47Ω ±2% ¼W	24773-241A
R76	Met film 220Ω ±2% ¼W	24773-257W
R77	Met film 1.5kΩ ±2% ¼W	24773-277U
R78	Met film 1kΩ ±2% ¼W	24773-273A
R79	Met film 22kΩ ±2% ¼W	24773-305R
R80	Met film 22kΩ ±2% ¼W	24773-305R
R81	Met film 22kΩ ±2% ¼W	24773-305R
R82	Met film 22kΩ ±2% ¼W	24773-305R
R83	Met film 4.7kΩ ±2% ¼W	24773-289W
R84	Met film 10Ω ±2% ¼W	24773-225W
R85	Met film 1kΩ ±2% ¼W	24773-273A
R86	Met film 22kΩ ±2% ¼W	24773-305R
R87	Met film 10kΩ ±2% ¼W	24773-297M
R88	Met film 4.7kΩ ±2% ¼W	24773-289W
R89	Met film 1kΩ ±2% ¼W	24773-273A
R90	Met film 1kΩ ±2% ¼W	24773-273A
R91	Met film 750Ω ±2% ¼W	24773-270R
R92	Met film 22kΩ ±2% ¼W	24773-305R
R93	Met film 1.2kΩ ±2% ¼W	24773-275H
R94	Met film 3.3kΩ ±2% ¼W	24773-285F
R95	Carb 680kΩ ±5% 1/8W	24311-941Z
R96	Met film 100kΩ ±2% ¼W	24773-321L
R100	Met film 510Ω ±2% ¼W	24773-266C
R101	Var 10kΩ ±10% 1/3W	25748-507X
R102	Met film 750Ω ±2% ¼W	24773-270R
R103	Met film 10kΩ ±2% ¼W	24773-297M
R104	Var 2.2kΩ ±10% ½W	25711-547M
R105	Met film 11kΩ ±2% ¼W	24773-298C
R106	Met film 18kΩ ±0.5% ¼W	24753-513C
R107	Met film 18kΩ ±0.5% ¼W	24753-513C

Circuit reference	Description	Code no.
	Unit A1 Function board (continued)	
R108	Met film 24kΩ ±0.5% ¼W	24753-514R
R109	Met film 18kΩ ±0.5% ¼W	24753-513C
R110	Met film 1kΩ ±2% ¼W	24773-273A
R111	Met film 100Ω ±2% ¼W	24773-249J
R112	Met film 100Ω ±2% ¼W	24773-249J
R113	Met film 100Ω ±2% 1/4W	24773-249J
R114	Met film 270Ω ±2% 1/4W	24773-259T
R115	Met film 100Ω ±2% 1/8W	24773-049H
SA	LP FILTER	23467-157S
SB	SELECT A/B input	23467-157S
SC	GHz	44338-103D
SD	MHz	
SE	MHz	
SF	kHz	
SG	Hz	
SH	Hz	
	Push button switch assembly	
	Button (stone grey)	37590-227A
	Button (orange)	37590-266U
SKA	BNC 50Ω, channel B input	23443-406R
SKD	Edge connector 20-way	23435-056W
	Guide for link board	41700-156E

Circuit reference	Description	Code no.
TR1 ⚠	40673	28459-010V
TR2	BFY90	28452-157R
TR3	BFY90	28452-157R
TR4	BFY90	28452-157R
TR5	BFY90	28452-157R
TR6	2N4258	28431-767E
TR7	BFY90	28452-157R
TR10	BC173C	28452-771P
TR11	BC308	28433-455R
TR12	BC238B	28452-781A
TR13	BC238B	28452-781A
TR14	BC238B	28452-781A
TR15	BC238B	28452-781A
TR16	BC238B	28452-781A
TR20	BC238B	28452-781A
TR21	BC238B	28452-781A
TR22	BC238B	28452-781A
TR23	BC308	28433-455R
TR24	MM3001	28458-406T
	Top screen	35902-528T
	Bottom screen	35902-529P

Circuit reference	Description	Code no.
	Link board	
9.	Links A1 board to A2 board	31827-927W
	Unit A2 Control board	
10.	When ordering prefix circuit reference with A2	
	Complete board	44829-370J
C1	Cer 0.047µF +80-20% 25V	26383-017U
C2	Cer 0.001µF +80-20% 500V	26383-242P
C3	Cer 0.001µF +80-20% 500V	26383-242P
C4	Cer 0.047µF +80-20% 25V	26383-017U
C5	Cer 0.001µF +80-20% 500V	26383-242P
C6	Cer 0.001µF +80-20% 500V	26383-242P
C7	Cer 0.047µF +80-20% 25V	26383-017U
C8	Cer 0.001µF +80-20% 500V	26383-242P
C9	Cer 0.001µF +80-20% 500V	26383-242P
C10	Cer 0.001µF +80-20% 500V	26383-242P
C11	Cer 0.001µF ±10% 63V	26383-585M
C15	Cer 0.047µF +80-20% 25V	26383-017U
C16	Cer 180pF ±2% 63V	26343-480V
C20	Cer 0.001µF ±10% 63V	26383-585M
C21	Tant 4.7µF ±20% 35V	26486-219P
C22	Cer 0.001µF ±10% 63V	26383-585M
C23	Cer 0.001µF ±10% 63V	26383-585M
C24	Cer 0.001µF ±10% 63V	26383-585M
C25	Cer 0.0047µF ±10% 63V	26383-591B
C26	Cer 0.0047µF ±10% 63V	26383-591B
C27	Cer 0.01µF ±10% 63V	26383-055L
C28	Cer 0.0047µF ±10% 63V	26383-591B
C29	Cer 10pF 5% 500V	26343-058W
C30	Tant 4.7µF ±20% 35V	26486-219P
C31	Tant 22µF ±20% 100V	26486-230B
C32	Cer 0.0047µF ±10% 63V	26383-591B
C33	Cer 0.0047µF ±10% 63V	26383-591B
C34	Elec 22µF +100-20% 25V	26415-805K
C35	Elec 22µF +100-20% 25V	26415-805K
C36	Cer 0.047µF +80-20% 25V	26383-017U
C37	Cer 0.047µF +80-20% 25V	26383-017U
C38	Cer 0.0047µF ±10% 63V	26383-591B
C40	Tant 47µF ±20% 6V	26486-232A
C41	Tant 47µF ±20% 6V	26486-232A
C42	Tant 47µF ±20% 6V	26486-232A
C43	Cer 0.047µF +80-20% 25V	26383-017U
C44	Tant 6.8µF ±20% 6V	26486-560W
C45	Cer 0.047µF +80-20% 25V	26383-017U
C46	Cer 0.047µF +80-20% 25V	26383-017U

Unit A2 Control board (continued)

Circuit reference	Description	Code no.
D1	1N4148	28336-676J
D2	1N4148	28336-676J
D5	1N4148	28336-676J
D6	1N4148	28336-676J
D7	1N4148	28336-676J
D8	1N4148	28336-676J
IC1	74LS03	28466-346E
IC2 ⚠	4013	28462-608A
IC3	74S74	28462-607K
IC4 ⚠	4070	28466-402T
IC5	74LS03	28466-346E
IC6 ⚠	4049	28469-162Z
IC7	74LS03	28466-346E
IC8	74145	28465-018E
IC10 ⚠	4001	28466-207Z
IC11 ⚠	4516	28464-112J
IC12 ⚠	4516	28464-112J
IC13 ⚠	4040	28464-108L
IC14	74LS123	28468-309B
IC15	74LS123	28468-309B
IC16 ⚠	E4G 10003	28469-461X
	Socket 40-pin for IC16	28488-047F
IC20 ⚠	4071	28466-403P
IC21 ⚠	4013	28462-608A
IC22 ⚠	4040	28464-108L
IC23 ⚠	4017	28464-008F
PLP	Pin post (5 of each)	23435-188V
Q	Pin post (5 of each)	23435-188V
R	Pin post (5 of each)	23435-188V
S	Pin post (7 of each)	23435-188V
T	Pin post (7 of each)	23435-188V
PLX	Pin post (7 of each)	23435-188V
R1	Met film 1kΩ ±2% ¼W	24773-273A
R2	Met film 3.3kΩ ±2% ¼W	24773-285F
R3	Met film 330Ω ±2% ¼W	24773-261D
R4	Met film 330Ω ±2% ¼W	24773-261D
R5	Met film 3.3kΩ ±2% ¼W	24773-285F
R6	Met film 330Ω ±2% ¼W	24773-261D
R7	Met film 3.3kΩ ±2% ¼W	24773-285F
R8	Met film 3.3kΩ ±2% ¼W	24773-285F
R9	Met film 330Ω ±2% ¼W	24773-261D

Circuit reference	Description	Code no.
	Unit A2 Control board (continued)	
R10	Met film 3.3kΩ ±2% ¼W	24773-285F
R11	Met film 330Ω ±2% ¼W	24773-261D
R12	Met film 3.3kΩ ±2% ¼W	24773-285F
R13	Met film 330Ω ±2% ¼W	24773-261D
R14	Met film 3.3kΩ ±2% ¼W	24773-285F
R15	Met film 330Ω ±2% ¼W	24773-261D
R16	Met film 3.3kΩ ±2% ¼W	24773-285F
R17	Met film 330Ω ±2% ¼W	24773-261D
R18	Met film 3.3kΩ ±2% ¼W	24773-285F
R19	Met film 330Ω ±2% ¼W	24773-261D
R20	Met film 3.3kΩ ±2% ¼W	24773-285F
R21	Met film 330Ω ±2% ¼W	24773-261D
R22	Met film 3.3kΩ ±2% ¼W	24773-285F
R23	Met film 330Ω ±2% ¼W	24773-261D
R24	Met film 1kΩ ±2% ¼W	24773-273A
R25 to R29	Met film 10kΩ ±2% 1/8W	24772-097S
R30	Carb 1MΩ ±5% 1/8W	24311-945Y
R31	Met film 1kΩ ±2% 1/4W	24773-273A
R32	Met film 1kΩ ±2% 1/4W	24773-273A
R33	Met film 1kΩ ±2% 1/4W	24773-273A
R34	Met film 1kΩ ±2% 1/4W	24773-273A
R35	Met film 1kΩ ±2% ¼W	24773-273A
R36	Met film 100kΩ ±2% ¼W	24773-321L
R37	Met film 1kΩ ±2% ¼W	24773-273A
R38	Met film 47kΩ ±2% ¼W	24773-313H
R44	Met film 10kΩ ±2% ¼W	24773-297M
R45	Met film 4.7kΩ ±2% ¼W	24773-289W
R46	Met film 4.7kΩ ±2% ¼W	24773-289W
R47	Met film 330kΩ ±2% ¼W	24773-333P
R48	Met film 4.7kΩ ±2% ¼W	24773-289W
R49	Met film 2.2kΩ ±2% ¼W	24773-281Y
R50	Met film 22kΩ ±2% ¼W	24773-305R
R51	Met film 22kΩ ±2% ¼W	24773-305R
R52	Met film 2.2kΩ ±2% ¼W	24773-281Y
R53	Met film 6.2kΩ ±2% ¼W	24773-292W
R54	Met film 3kΩ ±2% ¼W	24773-284J
R55	Met film 1kΩ ±2% ¼W	24773-273A
R56	Met film 4.7kΩ ±2% ¼W	24773-289W
R57	Met film 4.7kΩ ±2% ¼W	24773-289W
R58	Met film 4.7kΩ ±2% ¼W	24773-289W
R59	Met film 4.7kΩ ±2% ¼W	24773-289W
R60	Met film 10kΩ ±2% ¼W	24773-297M
R64	Met film 560kΩ ±2% ¼W	24773-340R
R65	Met film 1kΩ ±2% ¼W	24773-273A

Unit A2 Control board (continued)

Circuit reference	Description	Code no.
R66	Met film 1Ω ±2% ¼W	24773-201M
R67	Carb 1MΩ ±5% 1/8W	24311-945Y
R68	Met film 10kΩ ±2% ¼W	24773-273A
R69	Met film 220kΩ ±2% ¼W	24773-329T
R70	Met film 20kΩ ±2% ¼W	24773-304C
R71	Met film 62kΩ ±2% ¼W	24773-316Y
R72	Met film 12kΩ ±2% ¼W	24773-299R
R73	Met film 20kΩ ±2% ¼W	24773-304C
R74	Met film 10kΩ ±2% ¼W	24773-297M
R75	Met film 12kΩ ±2% ¼W	24773-299R
R76	Met film 12kΩ ±2% ¼W	24773-299R
R77	Met film 10kΩ ±2% ¼W	24773-297M
R78	Met film 20kΩ ±2% ¼W	24773-304C
R79	Met film 12kΩ ±2% ¼W	24773-299R
R80	Met film 62kΩ ±2% ¼W	24773-316Y
R81	Met film 20kΩ ±2% ¼W	24773-304C
R82	Met film 220kΩ ±2% ¼W	24773-329T
R83	Met film 62kΩ ±2% ¼W	24773-316Y
R84	Met film 62kΩ ±2% ¼W	24773-316Y
R85	Met film 6.2kΩ ±2% ¼W	24773-292W
R86	Met film 3kΩ ±2% ¼W	24773-284J
R87	Met film 1kΩ ±2% ¼W	24773-273A
R88	Met film 2.2kΩ ±2% ¼W	24773-281Y
R89	Met film 2.2kΩ ±2% ¼W	24773-281Y
R90	Met film 2.2kΩ ±2% ¼W	24773-281Y
R91	Met film 2.2kΩ ±2% ¼W	24773-281Y
R92	Met film 1kΩ ±2% ¼W	24773-273A
R93	Met film 1kΩ ±2% ¼W	24773-273A
R94	Met film 1kΩ ±2% ¼W	24773-273A
R95	Met film 1kΩ ±2% ¼W	24773-273A
R96	Met film 1kΩ ±2% 1/4W	24773-273A
R97	Met film 1kΩ ±2% 1/4W	24773-273A
R98	Met film 2K2 ±2% 1/8W	24772-081K
SKA	Edge connector 20-way	23435-056W
TR1	BC238B	28452-781A
TR2	BC238B	28452-781A
TR3	BC238B	28452-781A
TR4	2N5448	28433-838Z
TR5	2N5448	28433-838Z
TR6	2N5448	28433-838Z
TR7	2N5448	28433-838Z
TR8	2N5448	28433-838Z
TR9	2N5448	28433-838Z

Circuit reference	Description	Code no.
	Unit A2 Control board (continued)	
TR10	2N5448	28433-838Z
TR11	2N5448	28433-838Z
TR15	BC238B	28452-781A
TR16	BC308B	28433-455R
TR20	BC308B	28433-455R
TR21	BC308B	28433-455R
TR22	BC308B	28433-455R
TR23	BC308B	28433-455R
TR24	BC308B	28433-455R
	Unit A3 Display board	
11.	When ordering, prefix circuit reference with A3	
	Complete board	44828-135H
C1	Cer 0.047μF +80-20% 25V	26383-017U
C2	Tant 47μF ±20% 6V	26486-232A
D1	Numeric display	28624-216R
D2	Numeric display	28624-216R
D3	Numeric display	28624-216R
D4	Numeric display	28624-216R
D5	Numeric display	28624-216R
D6	Numeric display	28624-216R
D7	Numeric display	28624-216R
D8	Numeric display	28624-216R
IC1	74LS47	28465-020H
LP1	OVERFLOW	28624-109M
LP2	EXT STD	28624-109M
LP3	GATE	28624-109M
R1	Met film 56Ω ±2% ¼W	24773-243H
R2	Met film 56Ω ±2% ¼W	24773-243H
R3	Met film 56Ω ±2% ¼W	24773-243H
R4	Met film 56Ω ±2% ¼W	24773-243H
R5	Met film 56Ω ±2% ¼W	24773-243H
R6	Met film 56Ω ±2% ¼W	24773-243H
R7	Met film 56Ω ±2% ¼W	24773-243H
R8	Met film 47Ω ±2% ¼W	24773-241A
R9	Met film 3.3kΩ ±2% ¼W	24773-285F
SKA	Edge connector 8-way	23435-141K
	Edge connector 8-way	23435-141K
TR1	BC238B	28452-781A

Circuit reference	Description	Code no.
	Unit A4 Transfer oscillator unit	
12.	Complete assembly (includes connecting cable and plug)	44990-309L
	CAUTION ...	
	This is a sealed unit and must not be opened. If the seals are broken the instrument warranty will be invalid.	
SKA	Receptacle pin (11 off)	23435-178U
	Housing (plastic moulding)	23435-180E
	Polarizing plug	23435-190G
	Unit A11 Oscillator (temperature compensated)	
13.	Fitted in Version 52435-302A	
	Complete assembly	44990-273N
	Unit A12 Oscillator (oven controlled)	
14.	Fitted in Version 52435-303Z	
	Complete assembly	44990-419S
	Note ...	
	Units A4, A11 and A12 are factory tested units, set up and calibrated under very accurately controlled conditions. If an internal fault is diagnosed replace the assembly as per the code number given above, which identifies a complete, factory tested direct replacement unit.	
	MISCELLANEOUS MECHANICAL PARTS (Versions 52435-302A & 303Z)	
15.	Item numbers refer to Fig. 1.	
	Order without prefix.	
1	Knob	41149-058W
2	Window	37490-960A
	Window retainer	35902-442H
3	Top cover, dark brown	35902-308Y
	Top cover, stone grey	35904-009F

Circuit reference	Description	Code no.
	MISCELLANEOUS MECHANICAL PARTS (contd.)	
4	Side rail, silver finish	34900-424M
	Side rail, dark brown	34900-949U
5	Flange	37590-221X
6	Spring washer	31119-045W
7	Arm	37590-222M
8	Rear plate fixing	35902-219T
9	Rear foot	37590-225B
10	Cap	37590-219M
11	Boss	37590-220P
12	Handle	35902-220W
13	Rear frame, silver finish	35890-048B
	Rear frame, dark brown	35890-083B
	Strip, r.f. seal (2 required)	35902-969W
14	Rear panel assembly	35902-436K
	Blanking plate	35902-440A
	Locking plate	35902-441Z
15	Handle moulding	37590-226K
16	Bottom cover, dark brown	35902-309N
	Bottom cover, stone grey	35904-010L
17	Front panel assembly	41700-233L
18	Front frame, silver finish	35890-047R
	Front frame, dark brown	35890-083B
19	Stud	37590-223C
20	Foot	37590-224R
	Plastic push button, stone grey	37590-227A

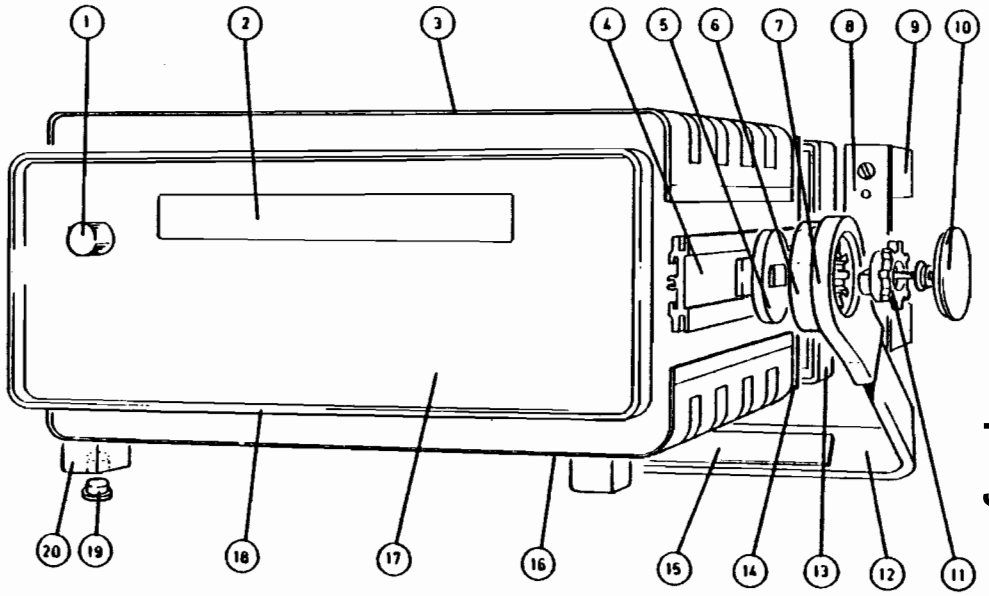


Fig. 1 Miscellaneous mechanical parts : identification (Versions 52435-302A and -303Z)

Chapter 7

SERVICING DIAGRAMS

CONTENTS

CIRCUIT NOTES

Component values

1. Resistors : No suffix = ohms, k = kilohms, M = megohms.

Capacitors : No suffix = microfarads, p = picofarads.

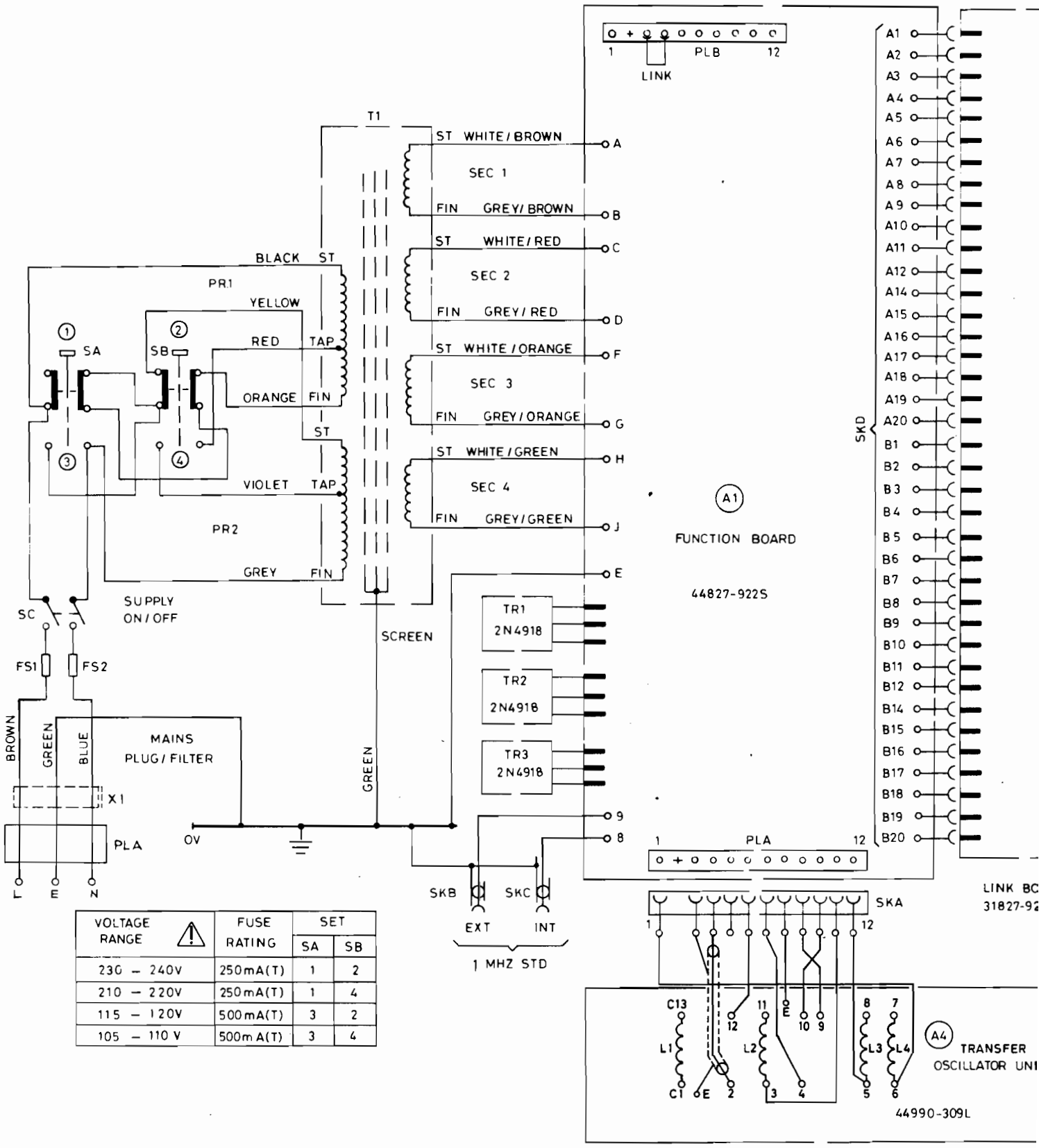
Inductors : μ = microhenries

SIC : Value selected during test, nominal value shown.

Symbols

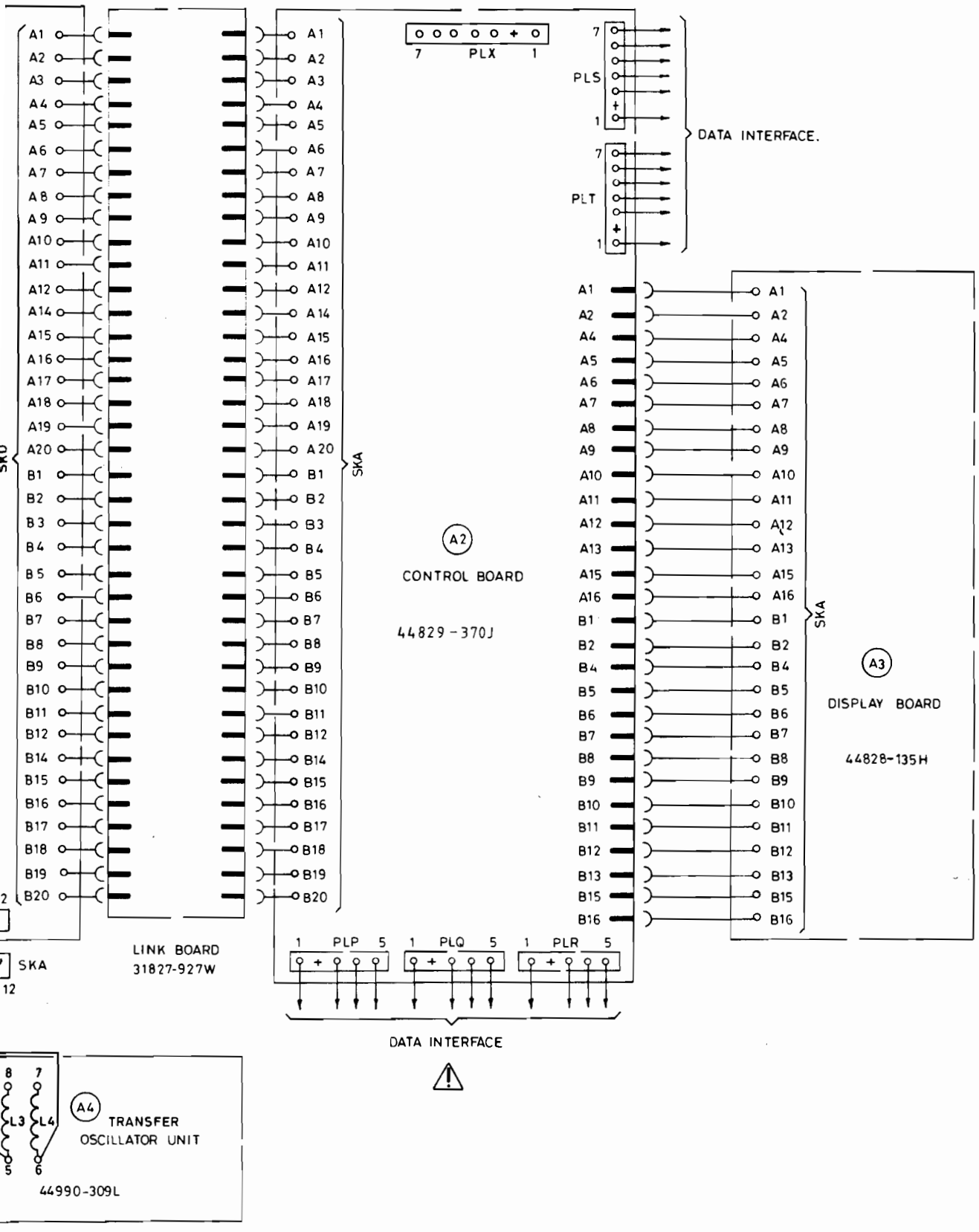
2. Generally in accordance with BS 3939

⚠ Static sensitive device (see Page (iv) Notes and Cautions).



VOLTAGE RANGE ⚠	FUSE RATING	SET SA	SET SB
230 – 240V	250mA(T)	1	2
210 – 220V	250mA(T)	1	4
115 – 120V	500mA(T)	3	2
105 – 110 V	500mA(T)	3	4

Fig. 1 2435 Interconnection diagra



rconnection diagram, A0

Fig. 1
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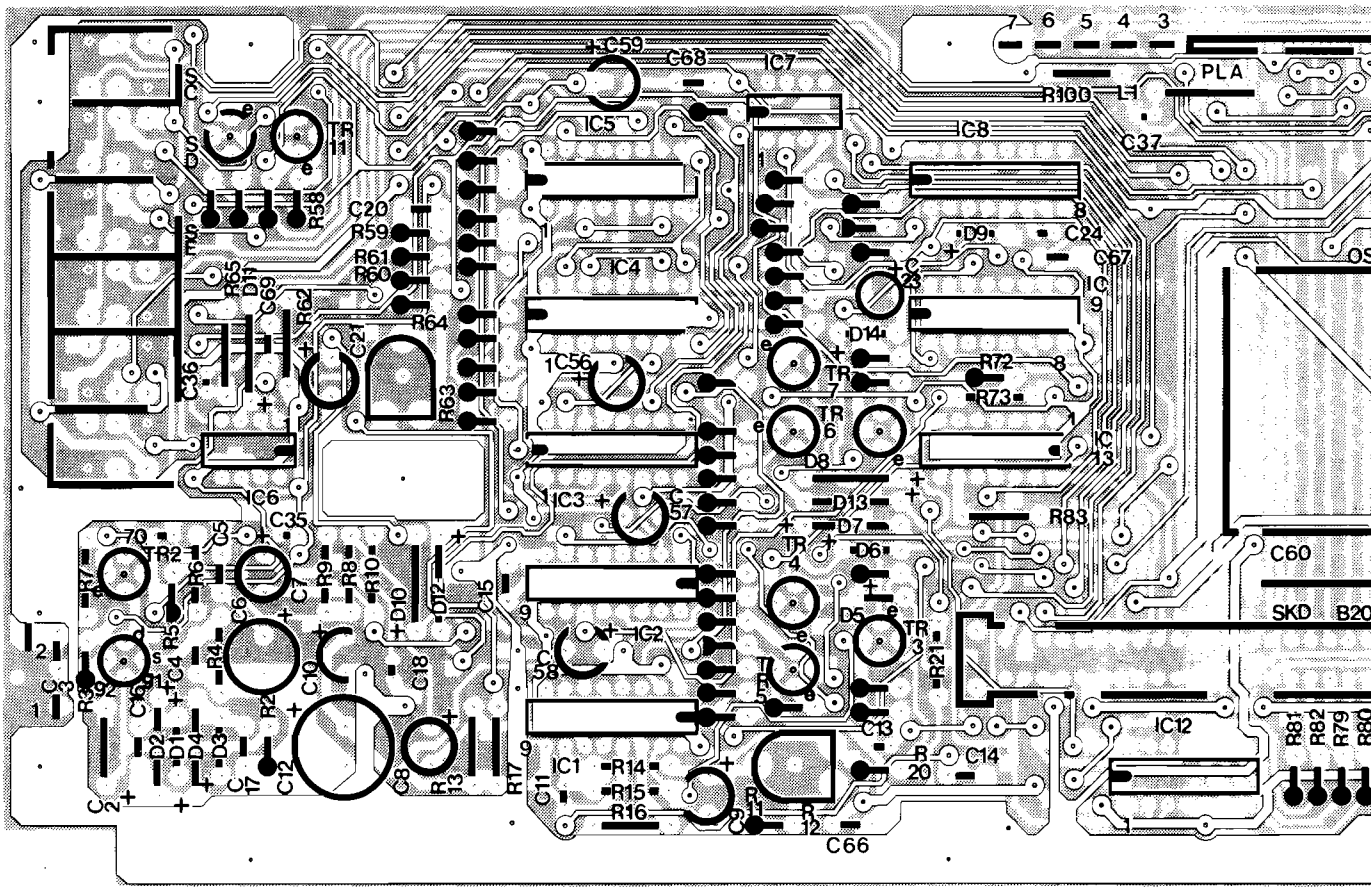
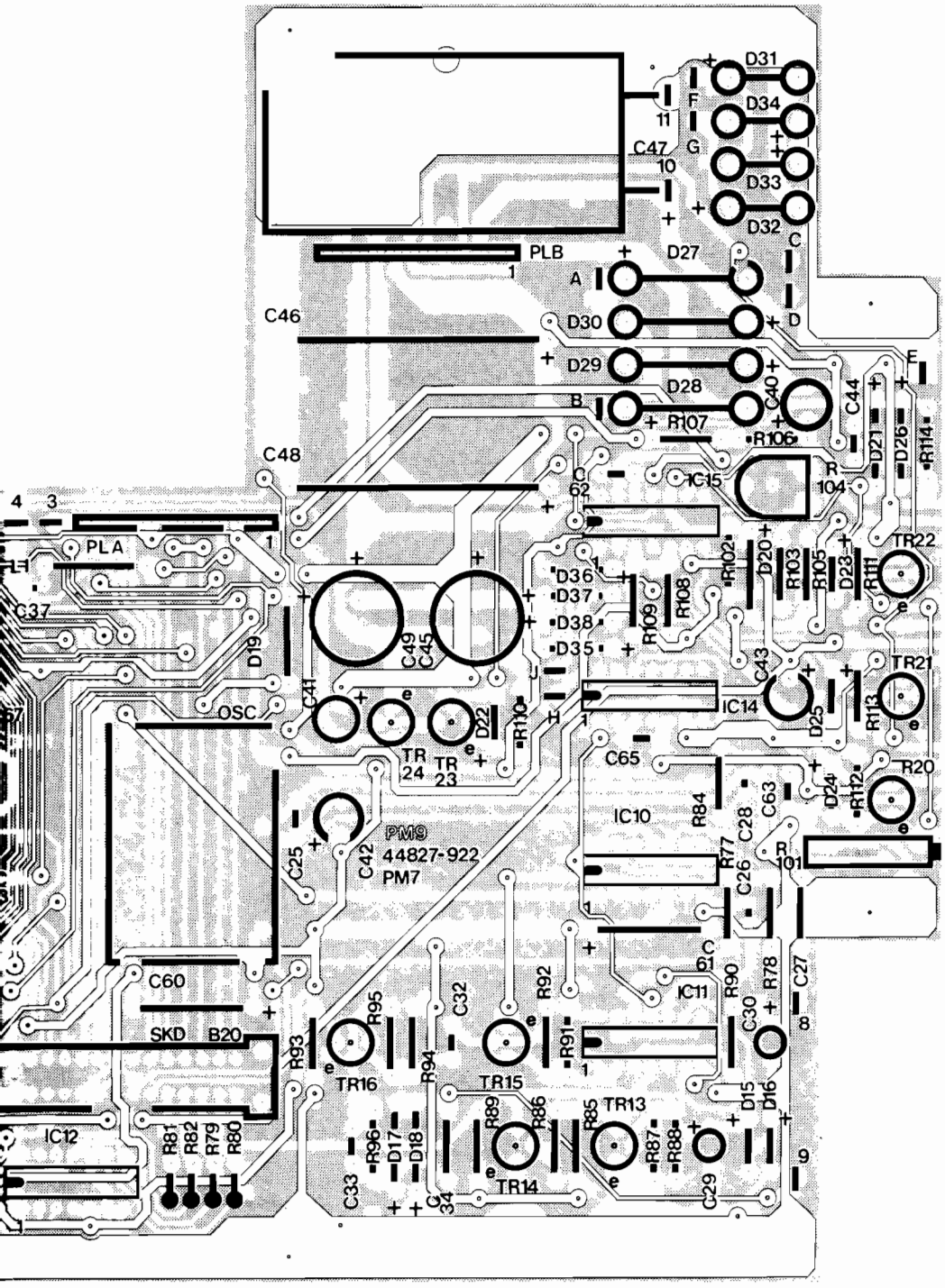
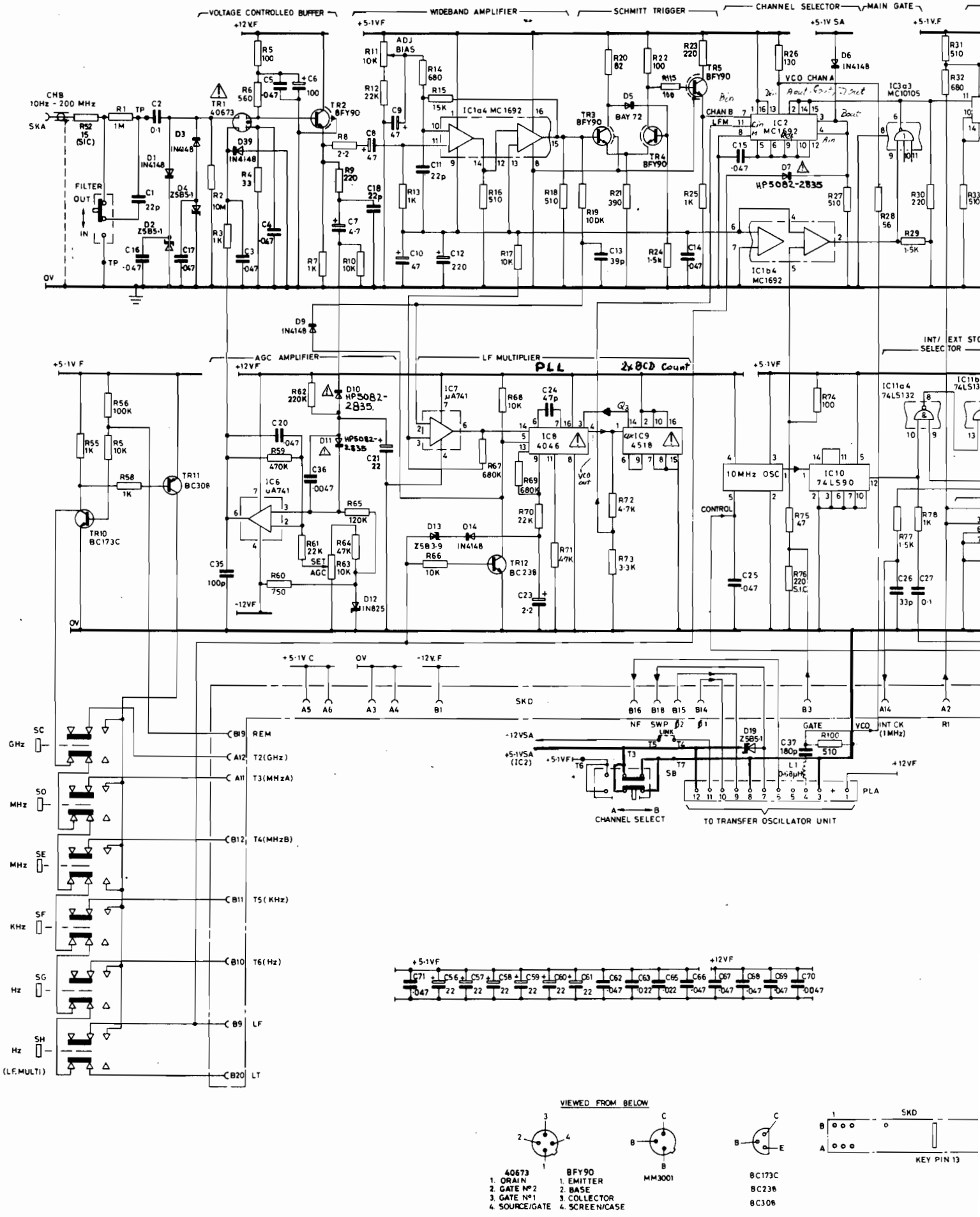


Fig. 2 Function board, A1 : component la



, A1 : component layout

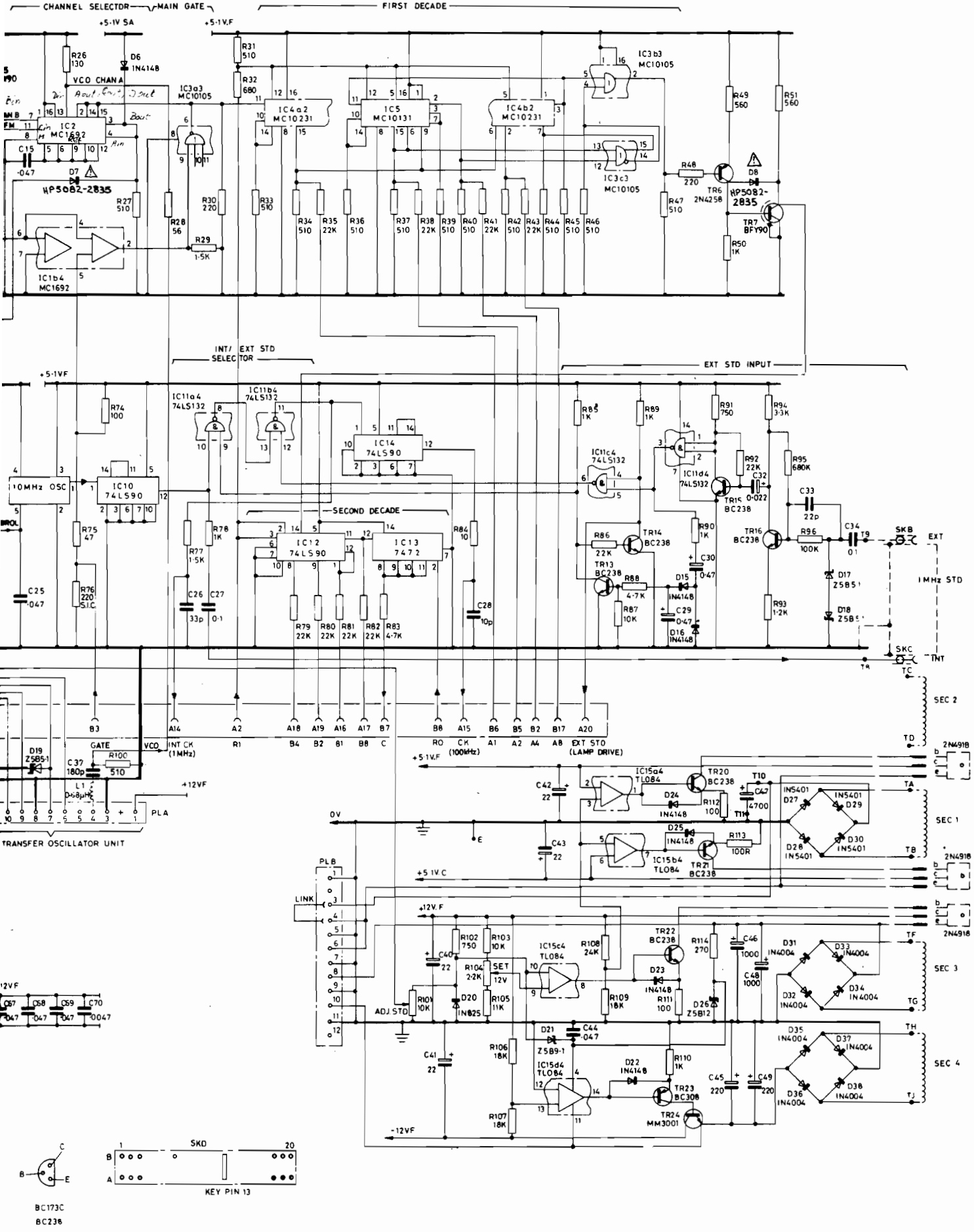
Fig. 2



Z 24827-922S Iss. 12

Fig. 3 Function board, A1 : circuit diag

n. 2)



tion board, A1 : circuit diagram

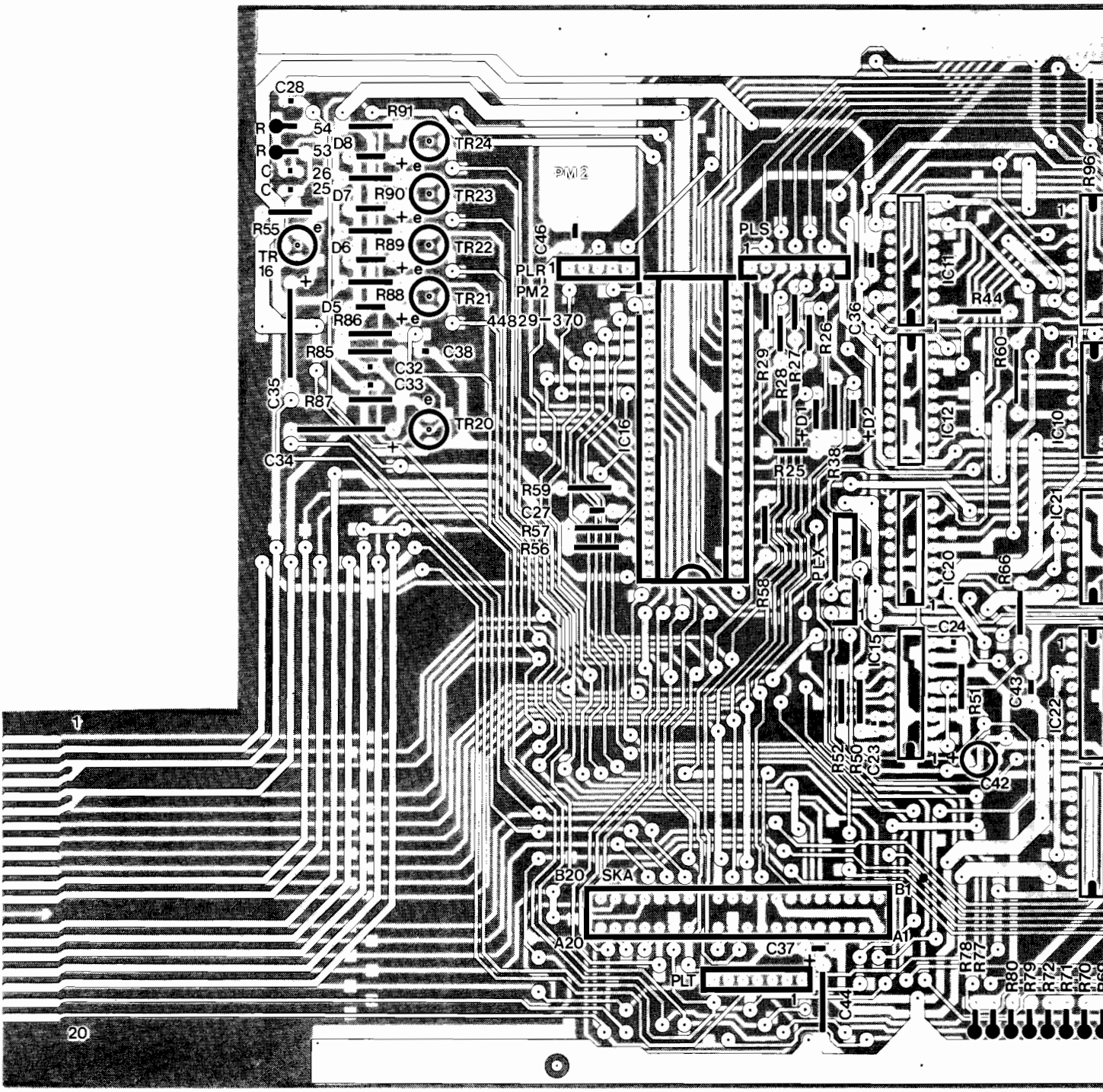
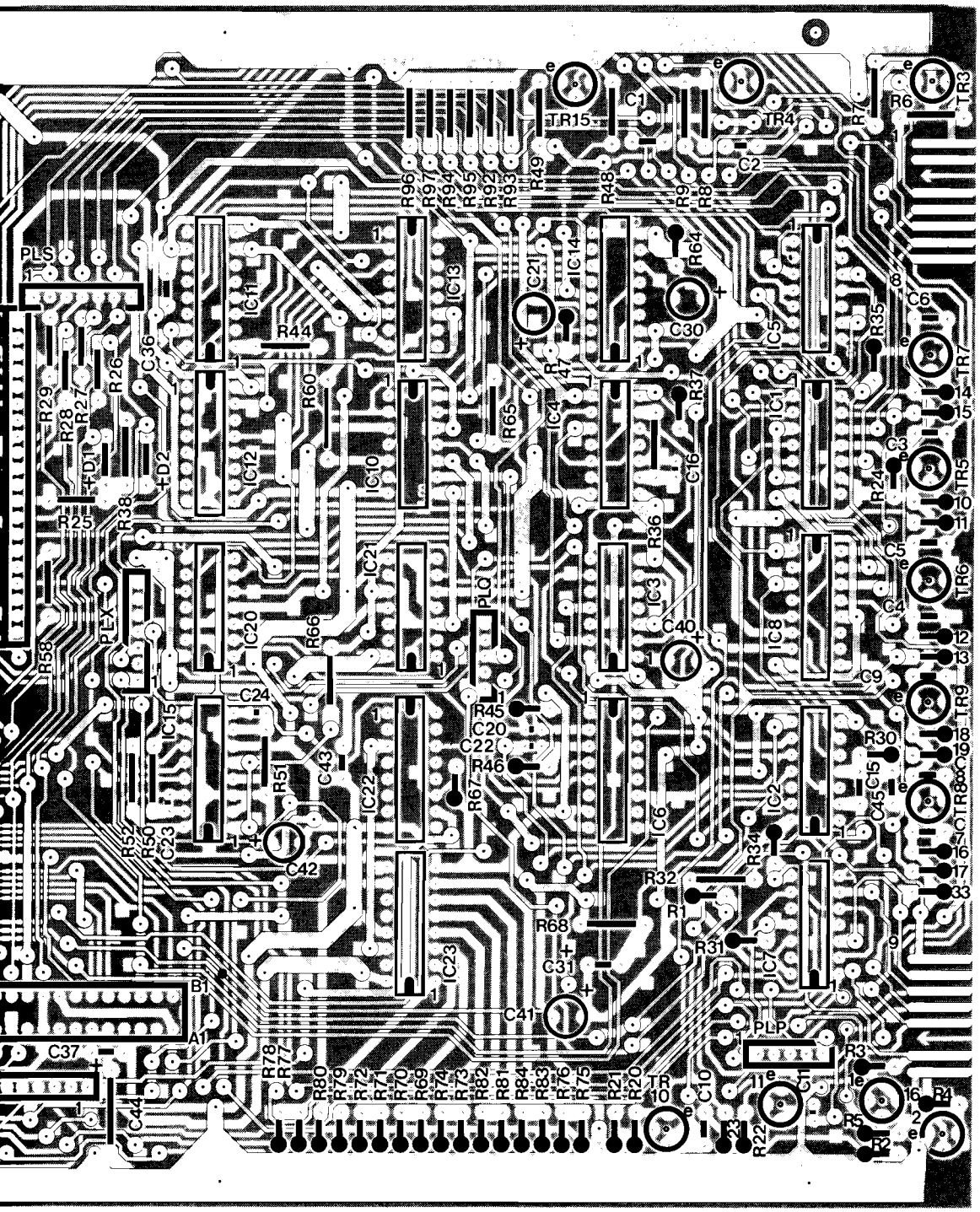


Fig. 4 Control board, A2 : component layout



trol board, A2 : component layout

Fig. 4

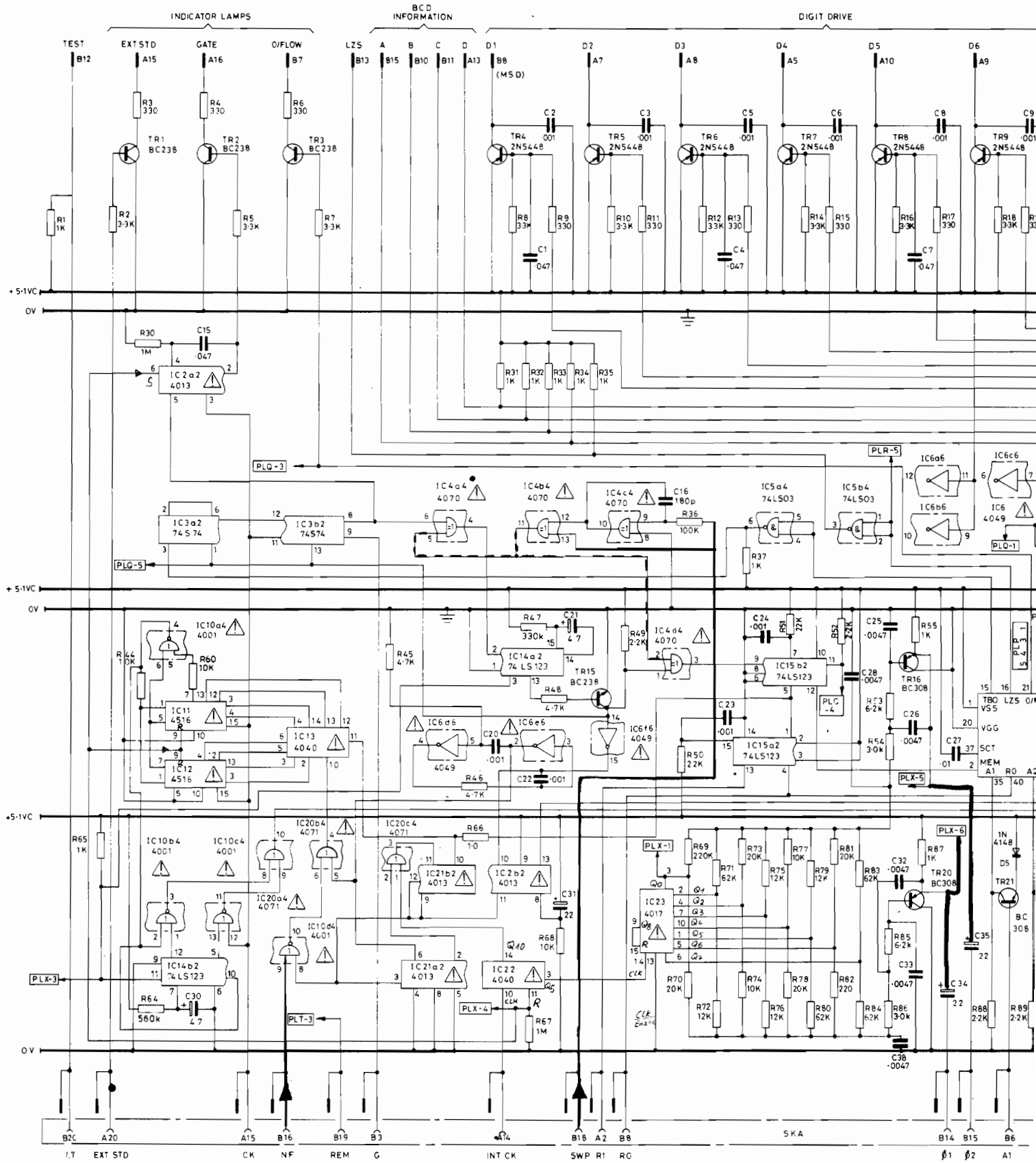


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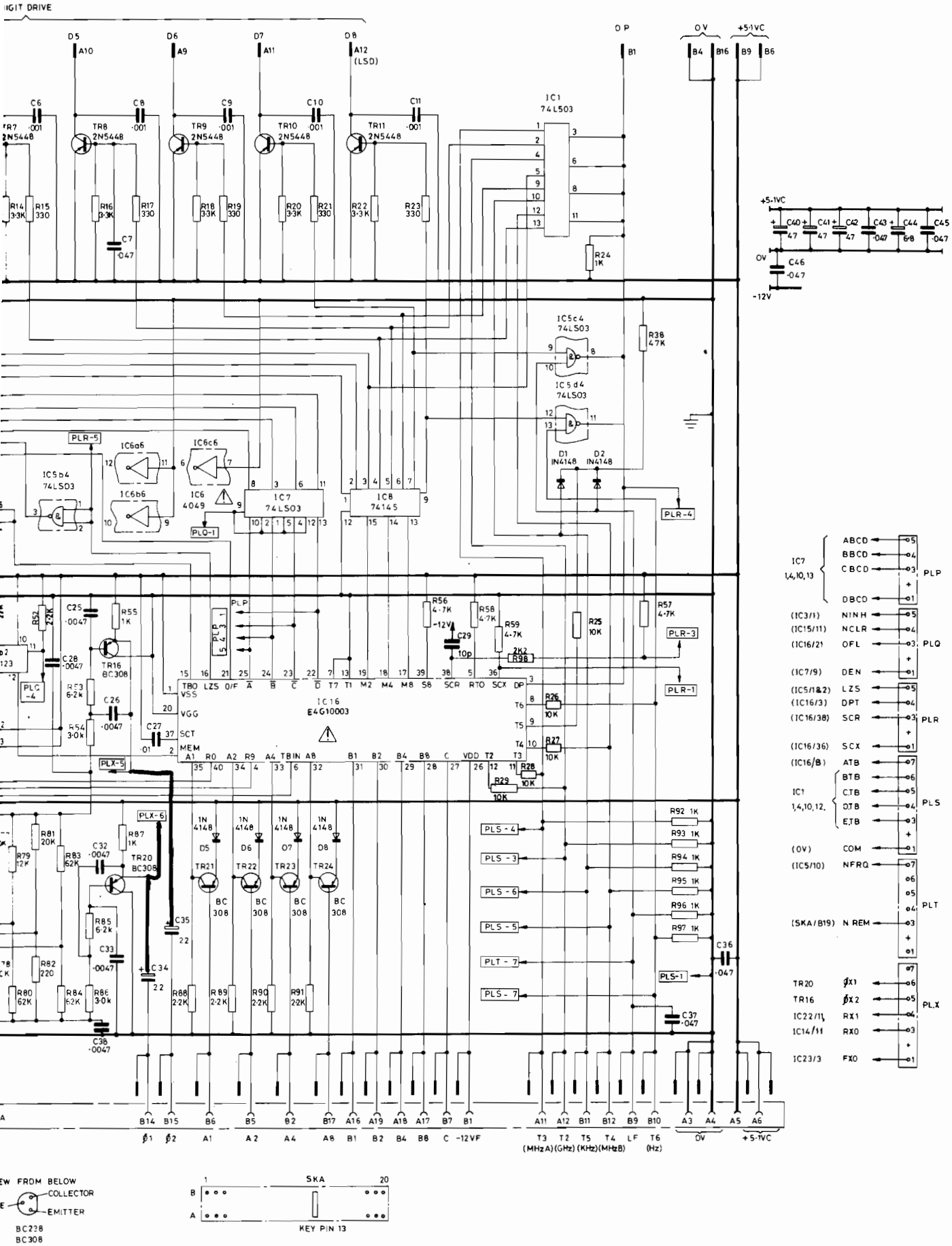
Fig. 5 Control board, A2 : circuit d



ol board, A2 : circuit diagram

Fig. 5
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Page 1

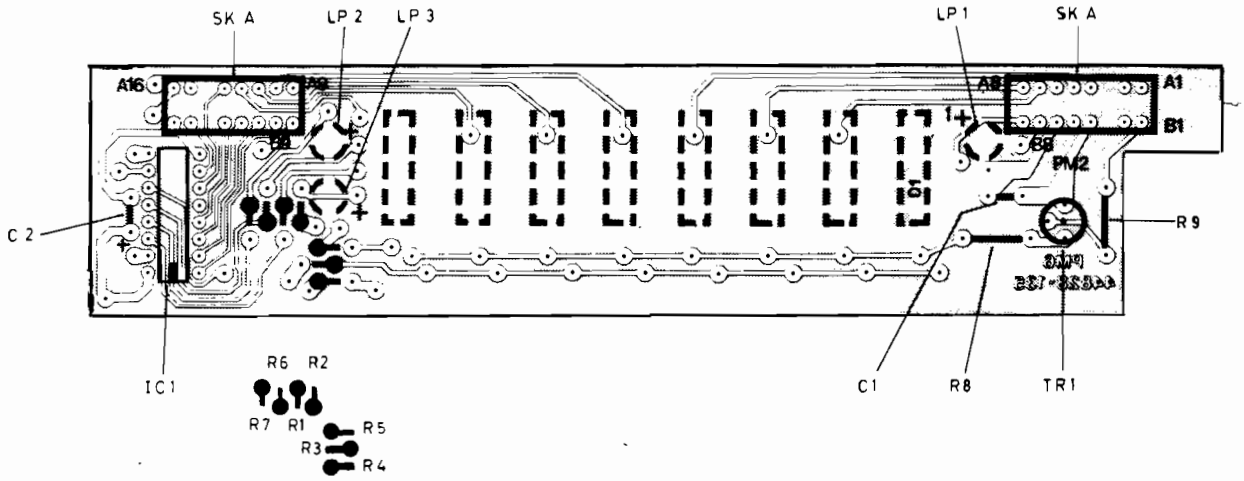
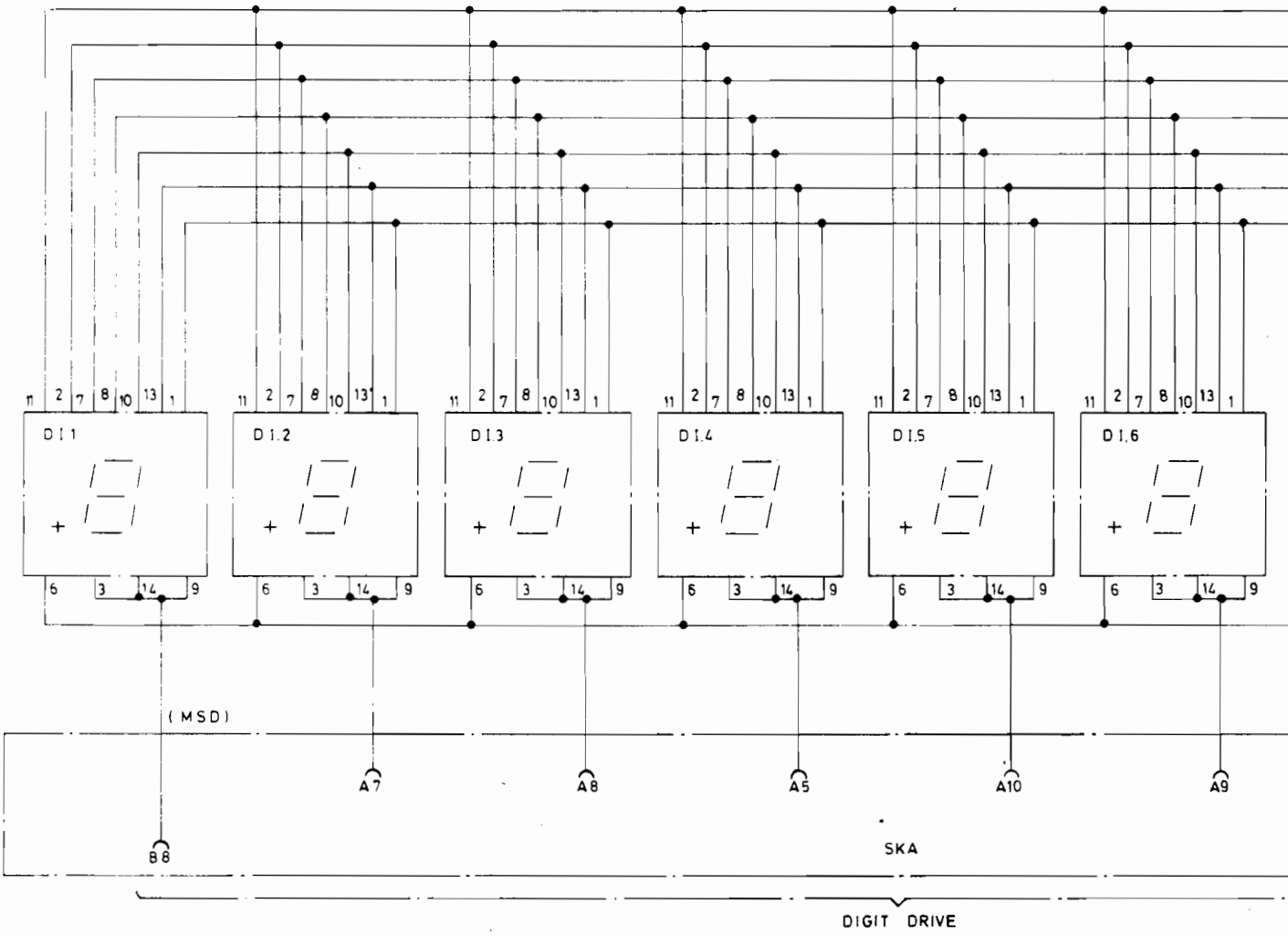
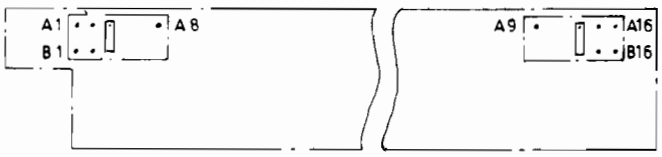
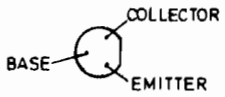


Fig. 6 Display board, A3 : component layout



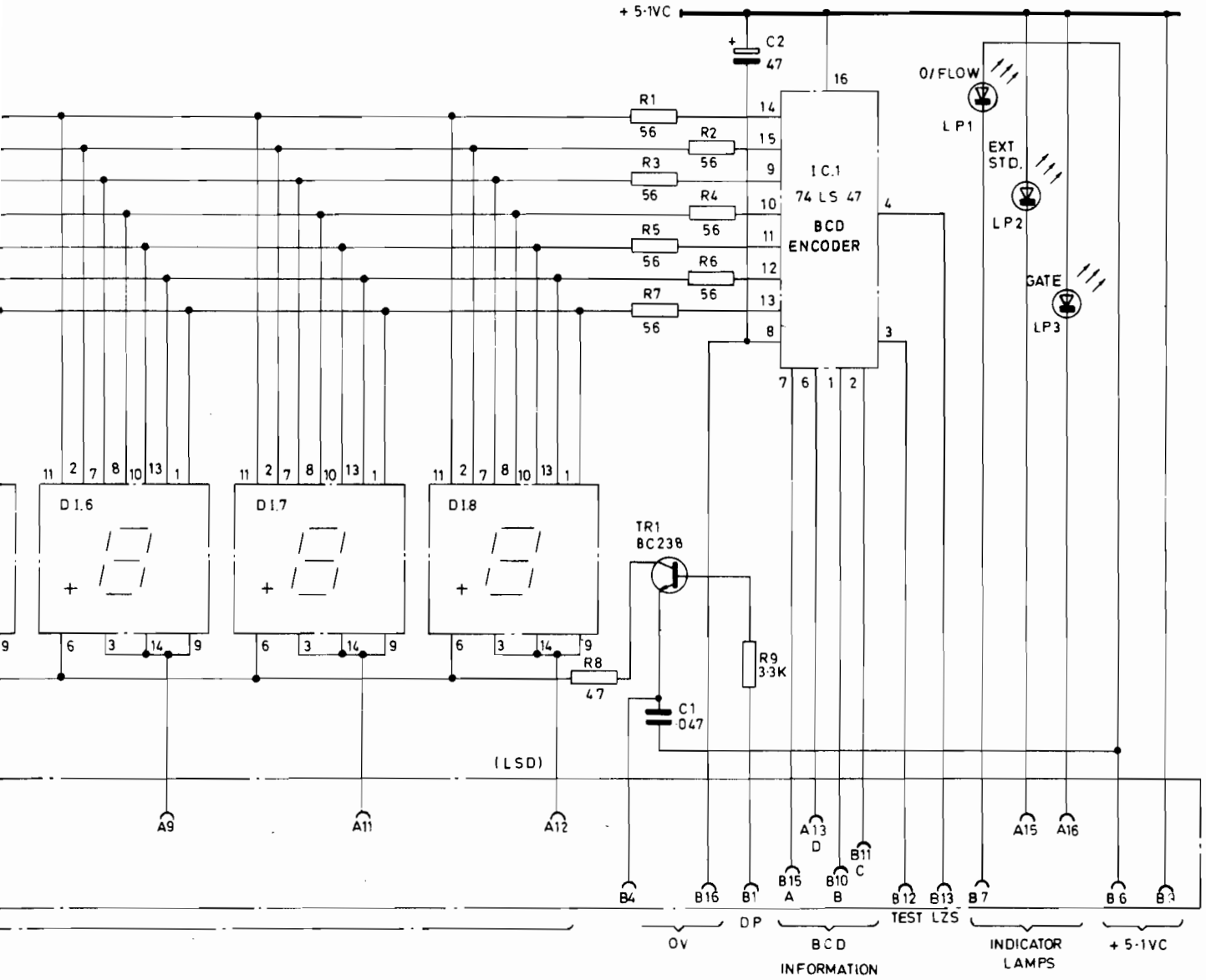


SKA VIEWED FROM FRONT (DISPLAY) SIDE.



BC 238
VIEW FROM BELOW

Fig. 7 Display board, A3 :



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ITTER

BELOW

isplay board, A3 : circuit diagram

Fig. 7
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