EDDYSTONE

DISPLAY UNIT

MODEL 1535

Manufactured in England by

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Cables: Eddystone Birmingham Telex: 337081

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The manufacturer reserves the right to modify the content of this publication to accommodate modifications, design improvements etc. Amendment Sheets will be incorporated where applicable at date of issue.

GENERAL DESCRIPTION

The Display Unit 1535 is a seven digit readout frequency counter with the facility of each digit to be programmed with a fixed number. The programmed number can be either added or subtracted from the counted number. When programmed with a number corresponding to the receiver's IF frequency, the received frequency of a receiver can be read directly and accurately, without the operator having to make calculations, which would be the case if a conventional frequency counter was used.

The display requires only two connections to the receiver, one to the local oscillator and one to the frequency range change switch. (The second connection can be omitted when using receivers that have their local oscillators fixed to oscillate either above or below the received frequency on all bands).

The display can also be used as a general purpose frequency counter when the digits are programmed to zero.

The unit will operate from 110V or 240V AC 50 Hz mains.

GENERAL SPECIFICATION

Input	Range:	40–525 MHz
	Sensitivity:	–11 dBm (63mV)
	Dynamic Range:	25 dB
	Input Impedance:	Nominally 50 ohm
	Coupling:	a.c.
	Connector:	BNC female
Time Base	Crystal frequency:	1 MHz
	Aging:	± 2 in 10^6 per year
	Temperature:	0° to 50°C
	Stability	± 1 part in 10^7
General	Accuracy:	± 1 count (LSD)
	Resolution:	100 Hz
	Display	7 digit high brightness sectionalized LED display
	Programming:	All display digits independently pre-setable by thumbwheel switches.

IF Offset Used in conjunction with a receiver the actual frequency of the received signal is displayed.

OPERATING TEMPERATURE: 0° to 50°C

POWER: 240V $\pm$10%) or 110V $\pm$10%) 50 Hz

Mains Connection

AC Mains is applied via the 3 pin rectangular I.E.C. socket.
The moulded plug lead should be connected as follows:

Brown	–	Live
Blue	–	Neutral
Green/Yellow	–	Earth

The unit is normally supplied for 240V AC mains operation.
To change to 110V AC mains see page 15.

Input Connection

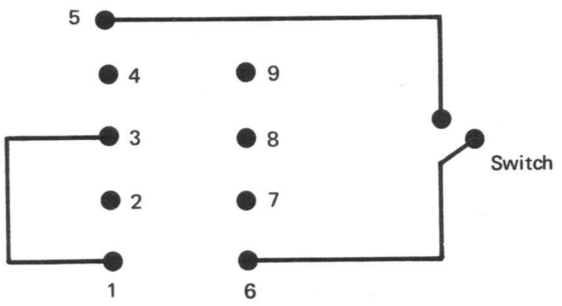
The **Input** connector is a 50Ω (nominal) BNC socket mounted on the centre of the rear panel. When the display unit is being used with a receiver its **Local Oscillator Output** should be connected to the **Input** of the display unit.

Remote OSC High/Low Selection

As an alternative to front panel selection **OSC High** or **OSC Low** can be selected remotely using the **Remote Offset Control** socket on the rear panel. This is a nine pin Cannon 'D' socket. For front panel control no connection should be made to this socket.
For remote control a mating plug (supplied with the instrument) should be wired as follows:

Link Pin 1 to Pin 3
Link Pin 5 to Pin 6 via on/off Switch

FIG 1



Switch **Open** selects **OSC High**
Switch **Closed** selects **OSC Low**

When wired as above the front panel control is inoperative.

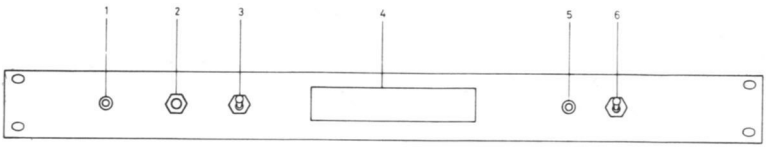


FIG. 2

CONTROL AND INDICATOR FUNCTIONS
FRONT PANEL FIG 2

Supply On/Off Switch (6) This controls the mains supply to the Instrument.

Supply Indicator Lamp (5) Indicates that the supply is on and that the internal 5V DC rail is present.

Oven Indicator (1) Shows that the 12V DC supply to the oven is present.

Display (4) This consists of seven high brightness LED displays indicating in MHz with a fixed decimal point.

Lamp Test (2) This push button checks that all segments of display (4) are operating. When pressed all display segments should light whether or not a signal is present. When the button is pressed the display should indicate;

OSC. High/Low Switch (3) This switch is set according to the receiver in use with the display.
If the receiver has its local oscillator running below its incoming signal set to **OSC. Low.** If it has its local oscillator running above its incoming signal set to **OSC. High.**

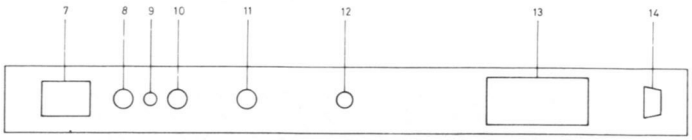


FIG. 3

REAR PANEL FIG 3

Mains Input Socket (7) — AC mains is applied to the instrument via this connector.

Fuses — **AC Fuse (8)** This fuse is in the mains supply.
5V DC Fuse (10)
12V DC Fuse (11)

Earth Screw (9) — Provides a direct earth for the equipment.

Input Socket (12) — The signal to be measured is applied to this socket.

Offset Select (13) — A seven digit thumbswitch is used to select the required frequency offset. The digits correspond to the front panel display.

Remote Offset Control (14) — When wired as detailed on page 7 this socket overrides the front panel **OSC High/Low** switch.

USING DISPLAY WITH A RECEIVER

1. Connect the instrument as described under 'Installation'.

2. Set **supply switch** to **'ON'.**

3. Check that **supply** and **oven** lamps light.

4. Check **display segments** are all operating by pressing **LP Test.**

5. Allow 5 minutes for crystal oven to warm up.

6. Dial up the IF frequency of the receiver on the **'offset select'** switch on the rear of the display unit.

7. Select **OSC High** or **OSC Low** as appropriate; if the receiver local oscillator frequency is lower than the received signal select **'OSC Low'**, if the local oscillator frequency is higher than the received signal select **'OSC High'.**
   If the **IF** frequency is unknown or its relationship to the received signal is not known, use the display unit in the **Counter Mode** as described on page 13.
   Tune the receiver to any convenient known signal and measure the frequency at the local oscillator output socket. Subtract the **LO** from the **RF** (known frequency). The resultant is the **IF** frequency. If this is positive the **LO** is high, if negative the **LO** is low. Set the thumbwheel switch to the **IF** frequency and the **OSC High/Low** switch as appropriate. The display will then read the received frequency.

USING DISPLAY IN A COUNTER MODE

When used in this mode the display unit acts as a normal counter with no offset.

1. Connect the instrument as described under **'Installation'.**
2. Set **Supply Switch** to **'ON'.**
3. Check that **supply** and **oven** lamps illuminate.
4. Check **display segments** by pressing **LP Test.**
5. Allow 5 minutes for crystal oven to warm up.
6. Select **OSC Low** on **OSC High/Low switch.**
7. Dial up 0000000 on the **'offset select'** switch on the rear of the display unit.
8. Connect signal to be measured to the **input** socket.
9. The display unit will now read the applied input signal frequency.

MECHANICAL CONSTRUCTION

The **Display Unit 1535** is in a 1¾ inch high 19 inch rack mounting cabinet.

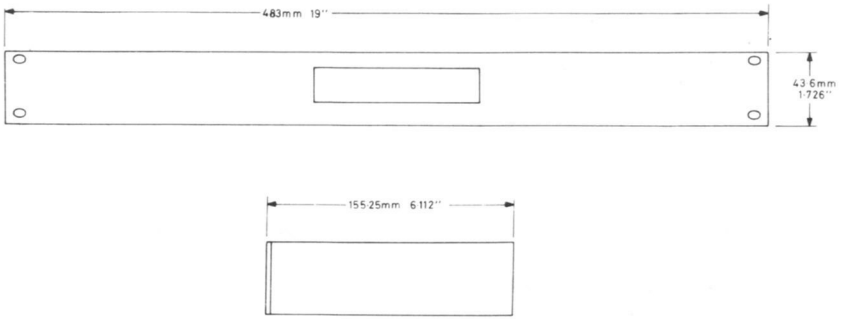


FIG 4

MAINS VOLTAGE ADJUSTMENT

The primary of the mains transformer consists of two windings. For 240V operating they are wired in series. For 110V operation they are wired in parallel.

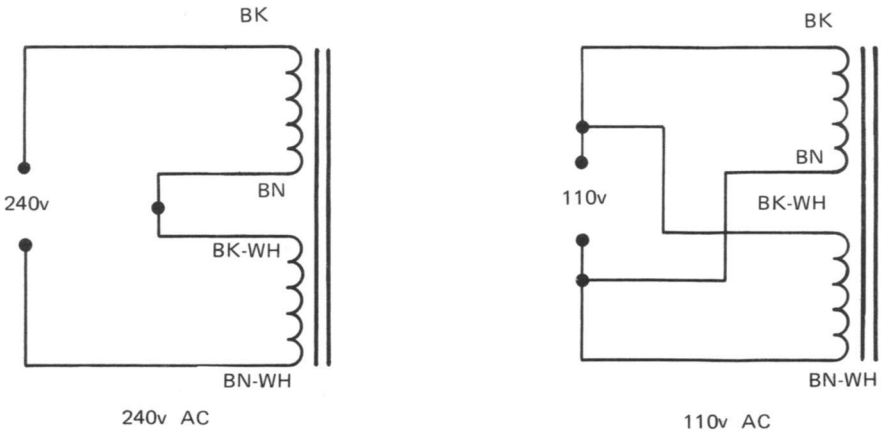


FIG 5

MAINTENANCE

GENERAL

The **Display Unit 1535** has been designed for maximum reliability and should require very little in the way of routine maintenance even when used continuously under arduous operating conditions.

FUSE REPLACEMENT

Belling Lee L1427B quick action glass cartridge fuses are fitted. (5mm x 20mm).

Fuse ratings are as follows:—

AC FUSE	1A (240V) 2A (110V)
DC FUSES	2A

ACCESSIBILITY FOR SERVICING

There are two covers on **Display Unit 1535.**
The smaller cover houses the **power supply. Mains voltages are present here and great care must be taken.**
The larger cover houses all the other circuits.

The layout of the unit with covers removed is shown in Fig. 6.

Parts shown are

1 Mains transformer

2 Display PCB

3 Main PCB

4 Mains Input Connector

5 Power Supply PCB

6 Offset select switch

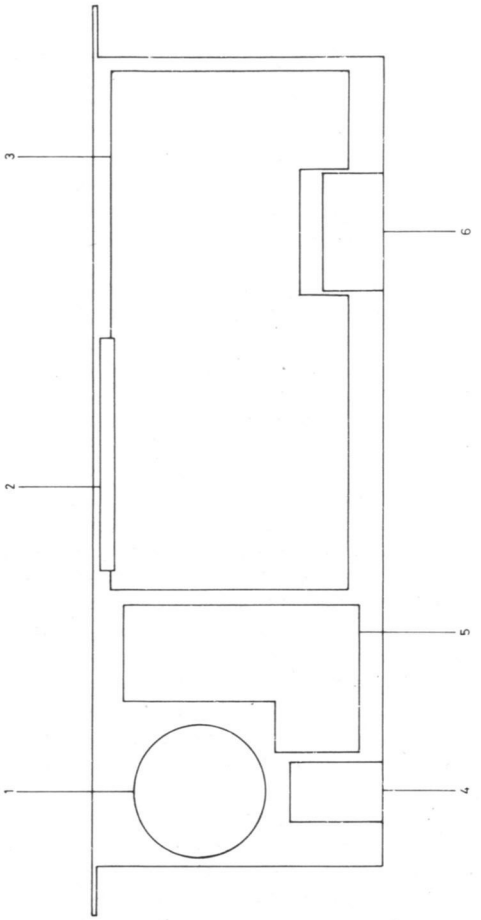


FIG. 6

CIRCUIT DESCRIPTION

The local oscillator output from the receiver is applied to SK1 and passes through the DC isolating capacitor C1, impedance normalising network R1/R2 and is coupled via C2 to gate 1 of TR1. From the drain of TR1 the signal is passed through emitter follower TR2 to the three stage amplifier comprising TR3, TR4 and TR5, each operated in common emitter mode. From the collector of TR5 the signal is coupled through C14 to the A.G.C. detector D1. The A.G.C. voltage is amplified by TR6 and passed to gate 2 of TR1 which operates as a voltage controlled attenuator. The signal at TR5 collector is also coupled via C15 to the ÷ 10 prescaler IC1. The output of IC1 is coupled to the ÷ 2, IC2. From IC2 the signal passes to TR7 which operates as an E.C.L. to T.T.L. translator. The output at the collector of TR7 is a T.T.L. signal at 1/20 of the l.o. frequency.

The output from the prescaler is gated via IC3 to the decade counters IC4, IC6, IC8, in cascade. These counters are preset by ICs 5, 7 and 9 respectively, and their B.C.D. outputs are applied to latch seven segment decoder ICs 10, 11 and 12. The divided output of IC8 after logic level translation by TR9 is passed to the six decade PMOS counter IC27. The two most significant decades are not used. IC27 has multiplexed seven segment and digit enable outputs. Each decade can also be preset via IC31, as the digit enable for the appropriate decade controls B.C.D. thumbwheel switches S4, 5, 6 and 7, the outputs of which are fed to the B.C.D. inputs of IC31 via the isolating diodes D5-D8, D11-D14, D17-D20, D23-D26. IC13 contains the digit dirvers for ND1-4. The seven segment output from IC27 for the number six is 6 and for nine is 9, whereas for ICs 10, 11 and 12 it is b and q. ICs 28 and 29 remove segment 'a' on six and segment 'd' on nine to make the display of all seven decades compatible. The modified seven segment data is gated via ICs 25 and 26 to IC24, the segment drivers. LAMP TEST is obtained by a logic level 'l' on the appropriate inputs of ICs 25 and 26 by operating push-button S3. Simultaneously, a logic level '0' is applied to pin 3 of ICs 10, 11 and 12 which turns on all segment outputs.

TCX01 is a temperature compensated crystal oscillator, the output of which is a T.T.L. signal of 1 MHz which is maintained to an accuracy of ± 1 part in 10^7 from -10°C to $+60^{\circ}$C. This output is divided by the chain of ICs 16, 15 and 14. B.C.D. bits 'B' and 'C' of IC14 are combined by two gates of IC17 such that the input at pin 11 of IC21 is a 10 Hz waveform. The output at pin 9 of IC21 is 5 Hz. The output at pin 5 of IC21 is a pulse of 400 ms duration which, after buffering by two inverters of IC18, becomes the sampling gate pulse at pin 13 of IC3. At the end of this time period, the logic transition at pin 6 of IC21 triggers the first half of IC23, which is a dual monostable. The output pulse is of approximately 1 ms duration, and during this time the latches in ICs 27, 10, 11 and 12 are loaded with the B.C.D. data of their associated decade counters. At the end of this period the logic transition at pin 4 of IC23 triggers the second half of IC23, which produces the reset pulse of approximately 1 ms for the decade counters. Simultaneously with the beginning of the counter reset pulse, both halves of IC22 (also a dual monostable) are triggered. The first half produces a pulse of approximately 4.7 ms which resets ICs 16, 15 and 14. The second half of IC22 produces a pulse of approximately 10 ms which, after buffering, causes ICs 4, 6 and 8 to be preset with B.C.D. information from ICS 5, 7 and 9. This pulse also enables the 'Load Counter' control of IC27 via IC20. To prevent the transfer of invalid B.C.D. data from IC31 into IC27, the digit enable pulse on pin 24 of IC27 is applied to IC20 to synchronise the load counter signal at pin 31 of IC27.

As previously noted, ICs 5, 7, 9 and 31, in conjunction with the B.C.D. switches, preset their associated decades of the counter. The logic level on pin 5 of these ICs determines whether the B.C.D. outputs are true, or the '9's compliment of the input data. When the oscillator high-low switch S2 is in the low position, or is externally overridden by a low control signal on SK2, the B.C.D. outputs are true. If the B.C.D. switches are set to the receiver intermediate frequency this number is then added to the counted oscillator frequency. When S2 is in the high position, or is externally overridden by a high control signal on SK2, the B.C.D. outputs are the '9's compliment of the I.F. set on the B.C.D. switches. Therefore, the I.F. is effectively subtracted from the local oscillator frequency as the counter has to count the number of cycles of the I.F. before reaching the state of zero.

The mains supply passes through the mains filter, integral with the input connector, to the fuse FS1, and via the double-pole power switch S1 to the appropriate inputs of T1. T1 has two secondaries of 18V and 12V nominal. The 18V secondary is connected to the bridge rectifier REC1, the output voltage of which is smoothed by C40 and applied to IC40. IC40 is a voltage regulator which provides an output of +12V. The 5V supply is provided by REC2, C41 and IC41, operating in a similar manner. C44, C45, C46 and C47 prevent high frequency oscillation occuring in IC40 and IC41. D30 and D31 are light emitting diodes which indicate the operation of the +12V and +5V supplies.

ND1 – ND7 are seven segment L.E.D. numeric displays. ND1 – ND4 are driven by the multiplexed outputs of IC27. ND5 is driven by IC12 via current limiting resistors R93 – R99. Similarly, ND6 by IC11 via R100 – R106; and ND7 by IC10 via R107 – R113.

Offset Frequency Counter 1535 – Main PCB
Items List FC3000/1&2

Item	Description			Qty	CCT Ref	Manufacturer
1	Display PCB	FC3000-1		1		Classical Circuits
2	Main PCB	FC3000-2		1		" "
3						
4	Integrated Circuits	SP8630B	DG14	1	IC1	Plessey
5	"	MC10131P	Plastic	1	IC2	Motorola
6	"	MC14561B	"	4	IC5, 7. IC9. 31	"
7	"	MM74C00N	"	3	IC17.28/9	National/Teledyne
8	"	MM74C74N	"	1	IC21	" "
9	"	MM74C90N	"	1	IC16	" "
10	"	MM74C221N	"	2	IC22/3	" "
11	"	CA 3081	"	1	IC19	RCA
12	"	CA 3082	"	1	IC24	"
13	" 4013	DIL	"	1	IC20	RCA/Motorola
14	" 4071	"	"	2	IC25/6	" "
15	" 4511	"	"	3	IC10-12	" "
16	" 4518	"	"	2	IC14/5	" "
17	" 74LO4	"	"	2	IC18.30	Fairchild
18	" 74LS00	"	"	1	IC3	"
19	" 74LS196	"	"	3	IC4, 6, 8	"
20	" 75492A	"	"	1	IC13	Fairchild
21	" MK50395N	"	"	1	IC27	Mostek

Offset Frequency Counter 1535 – Main PCB
Items List FC3000/1&2

Item	Description	Qty	CCT Ref	Manufacturer
22	L.E.D. Display 5082-7663	7	ND1-7	Hewlett Packard
23				
24	Transistor SD304	1	TR1	Signetics
25	" ZTX326	4	TR2-5	Ferranti
26	" E270	1	TR6	Siliconix
27	" MPS3640/2N3640	1	TR7	Motorola
28	" BC108B	2	TR8.9	"
29				
30	Diode 5082-2810	2	D1, 2	Hewlett Packard
31	" 1N4148	17	D5-8, 11-14 17-20, 23-27	Mullard
32				
33	Capacitor 632 10129 12pF	3	C8.11.13	Mullard
34	" 632 34569 56pF	3	C7.9.12	"
35	" 632 58271 270pF	1	C30	"
36	" 62902102 1000pF	13	C1-3.5.6.14/5 17-19.22.35/6	"
37	" 861T DISC 0.01μF 25V	5	C24/5/9 32/7	Erie
38	" 801T DISC 0.047μF 25V	1	C26	Erie
39	" 811T DISC 0.1μF 25V	1	C27	Erie
40	" TAG 2.2μF 16V	1	C16	ITT
41	" TAG 22μF 16V	5	C4, 10 20/1.31	ITT
42	" TAG 47μF 16V	1	C38	ITT

Offset Frequency Counter 1535 – Main PCB
Items List FC3000/1&2

Item	Description		Qty	CCT Ref	Manufacturer
43	016.15151 Capacitor	150µF 16V	1	C28	Mullard
44	017 16471 "	470µF 25V	1	C39	"
45					
46	CR25 Resistor 1/8W5%	10R	1	R11	Mullard
47	– " –	47R	4	R2.14 17.23	"
48	– " –	180R	25	R60-66 95-113	"
49	– " –	2K2	2	R30.42	"
50	– " –	10K	5	R18. 37-40	"
51	– " –	22K	2	R12/5	"
52	– " –	33K	1	R9	"
53					
54	PR25 Resistor 1/4W 5%	22R	1	R1	Piher
55	– " –	33R	2	R28.117	"
56	– " –	82R	1	R6	"
57	– " –	100R	2	R5, 8	"
58	– " –	180R	1	R29	"
59	– " –	330R	2	R26/7	"
60	– " –	470R	1	R126	"
61	– " –	560R	3	R10/3/6	"
62	– " –	1K	1	R20	"
63	– " –	1K2	3	R123/4/5	"

Offset Frequency Counter 1535 – Main PCB
Items List FC3000/1&2

Item	Description		Qty	CCT Ref	Manufacturer
64	Resistor PR25 1/4W5%	1K5	1	R22	Piher
65	– " –	2K2	7	R7. 30/6.41/9 50.116	"
66	– " –	4K7	1	R119	"
67	– " –	10K	4	R37-40	"
68	– " –	12K	11	R21, 35, 43-8 51, 114/5	"
69	– " –	15K	22	R53-59 79-92.121	"
70	– " –	27K	1	R4	"
71	– " –	47K	1	R3	"
72	– " –	100K	17	R19. 31-4 67-78	"
73					
74	Crystal Oscillator	1MHz	1	QC1311/2A-1	Salford
75					
76	Terminal Pins	433.854	66		RS
77	A1236 NYL Transistor Mounting Pads		2	TR8/9	Jermyn
78	I.C. Holder 40 Pin ICY406 S4		1	IC27	Conway
79	Tinned Copper Wire 22 SWG		2 metres		355079 RS
80					
81					
82					
83					
84					

Offset Frequency Counter 1535 – Power Supply PCB
Items List FC3000/2

Item	Description		Qty	CCT Ref	Manufacturer
1	PSU PCB	FC3000-3	1		Classical Circuits
2					
3	Regulator	7805uc	1	IC41	Fairchild
4	"	7812uc	1	IC40	"
5	Bridge Rectifier	W001	2	REC 1&2	Micro-electronics
6					
7	Capacitor	C280 AE P100K 0.1μF 250V	4	C44-7	Mullard
8	"	47μF 16V TAG	2	C42, 3	ITT
9	"	211 2200μF 25V	2	C40, 1	Erie
10					
11	Terminal Pin	433 854	6		RS
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					

Offset Frequency Counter – Main Assembly
Items List

Item	Description	Qty	Manufacturer
1	Chassis	1	
2	Cover 1	1	
3	Cover 2	1	
4	Front Panel	1	
5	Front Panel Sprayed	1	
6	Front Panel Screened	1	
7	Heatsink		
8			
9	LED & Clip MV5153	1	Monsanto
10	Thumbswitch SMFB 10N 1248 7 Station	1	Cosmocord
11	Transformer	1	Avel Lindberg
12	Fuseholder L2006	1	Belling Lee
13	Fuse	1	
14	Mains Connector L2131AL	1	Belling Lee
15	Mains Lead L1949BK	1	"
16	BNC Socket BN12/5 NP	1	Transradio
17	BNC Solder Tag	1	
18	Switch Min Toggle DPDT	1	
19	" SPDT	1	
20	" Min Push SPDT	1	
21	Earth Terminal	1	
22	Window	1	
23			
24	Solder Tags		
25	Coax		
26	Screws		

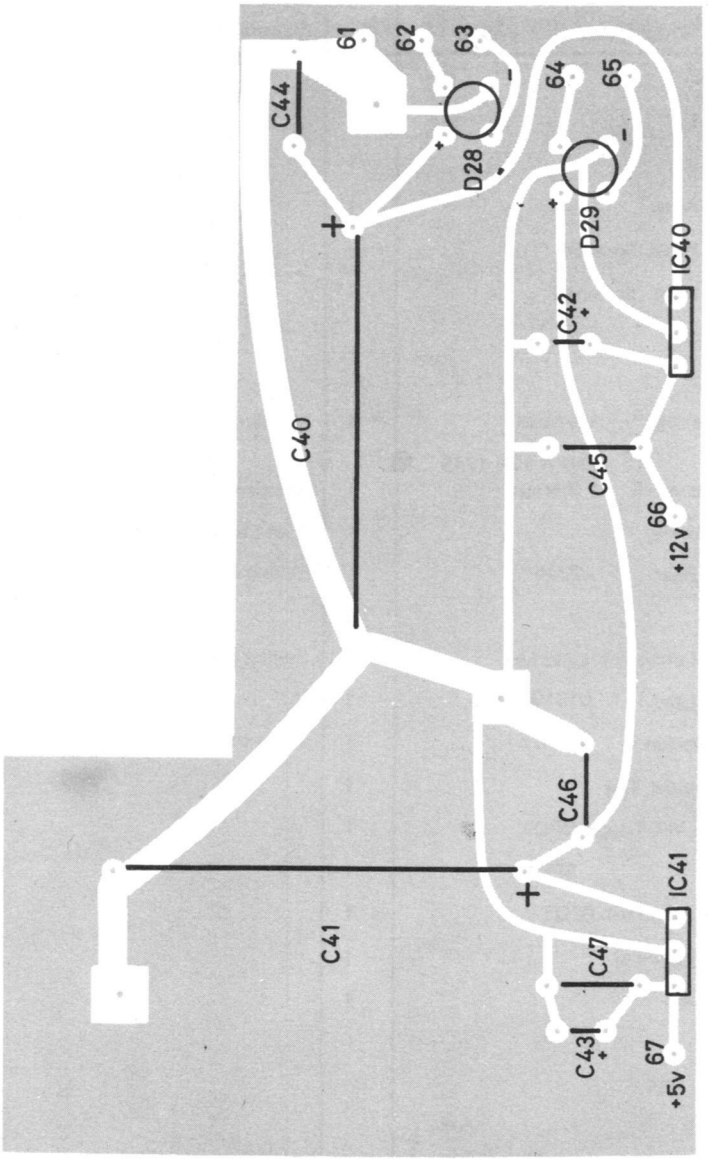
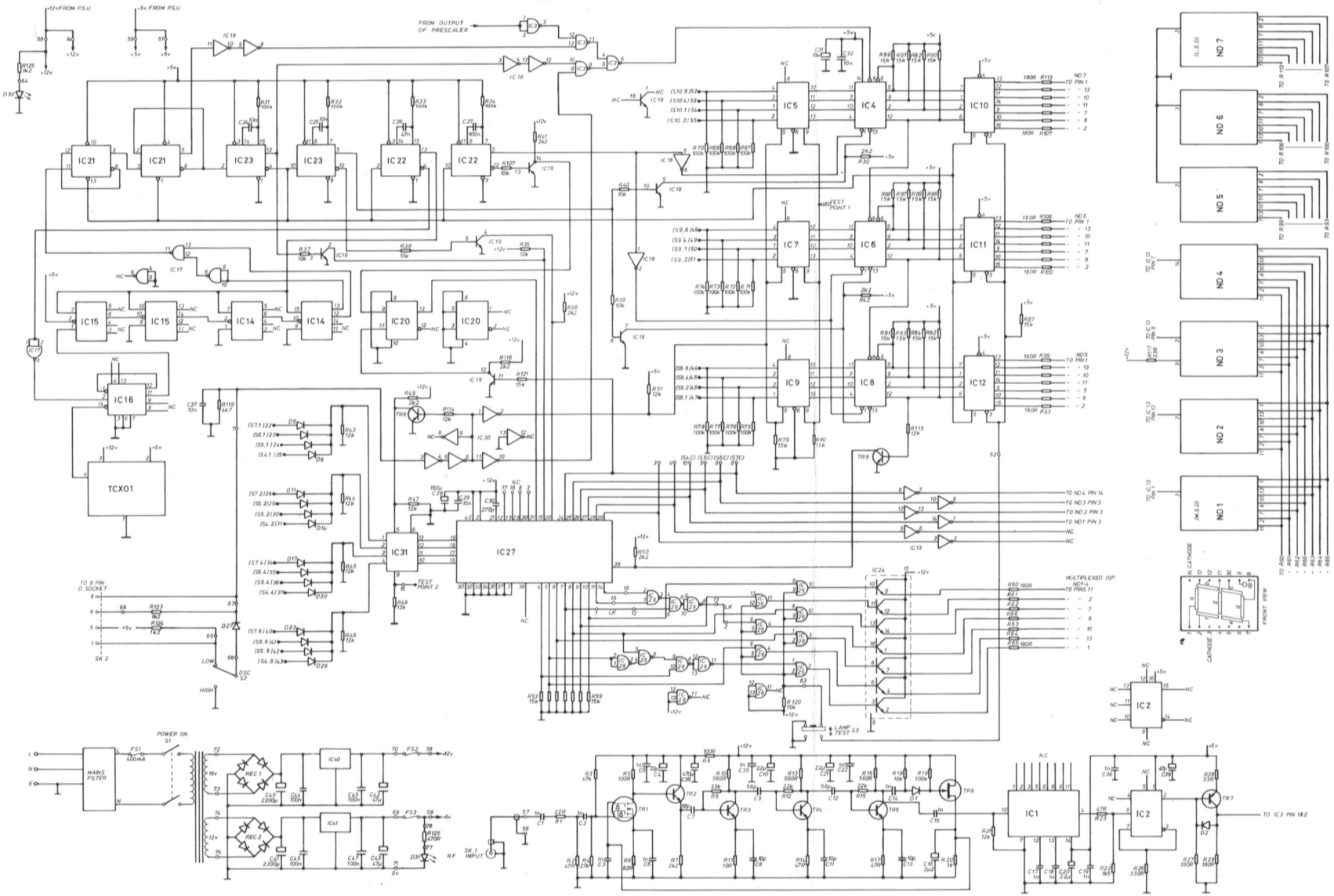


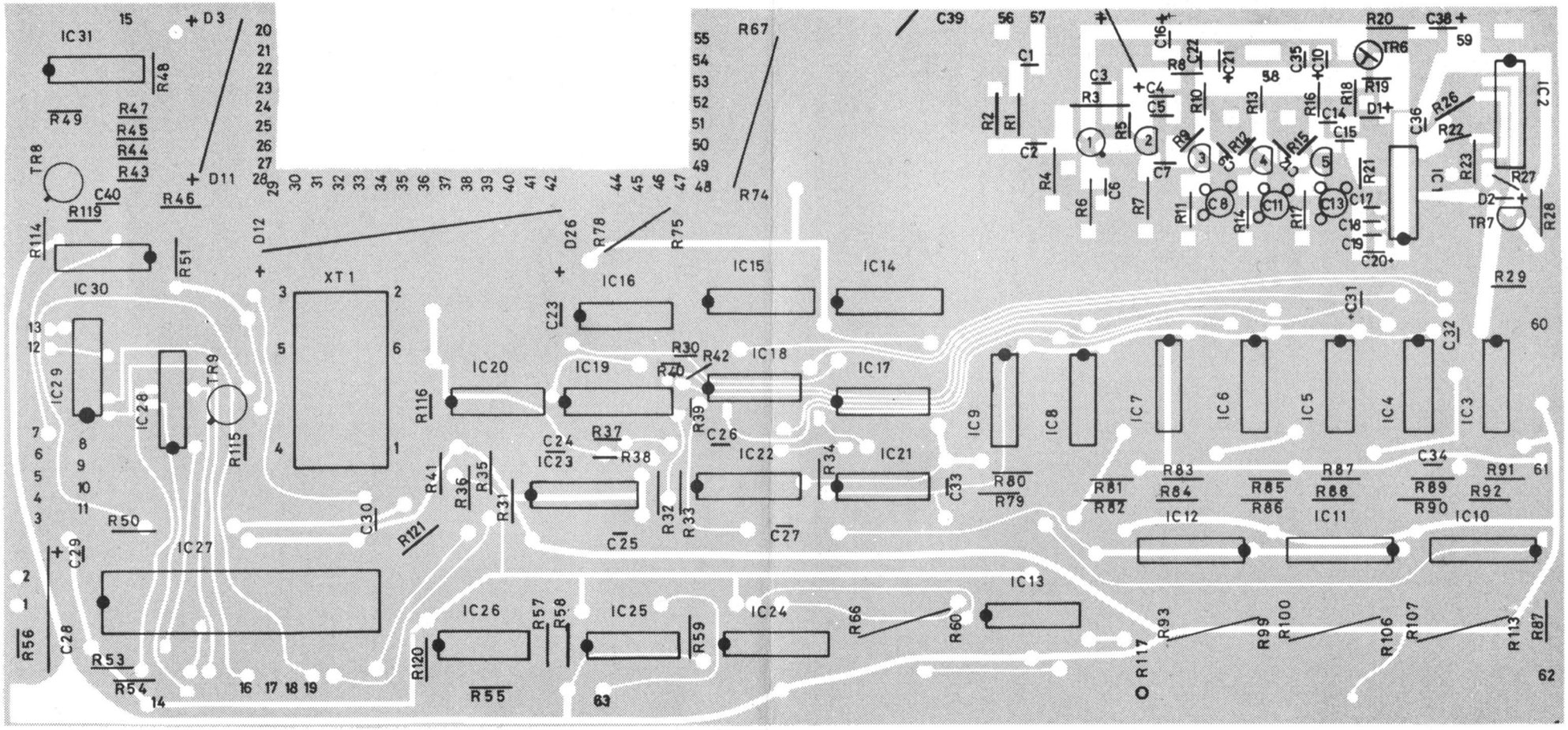
FIG. 7

POWER SUPPLY BOARD LAYOUT



CIRCUIT DIAGRAM

FIG. 9



MAIN PCB LAYOUT

FIG. 8