thandar

TG 101 FUNCTION GENERATOR

SERVICE MANUAL

CONTENTS

GENERAL

Service Handling Precautions

Service work should only be carried out by skilled engineers. Please note that the tracks on the printed circuit board are very fine and may lift if subjected to excessive heat. Use only a miniature temperature controlled soldering iron and remove all solder with solder wick or suction before attempting to remove a component.

Dismantling the Instrument

WARNING!
Opening the instrument is likely to expose live parts. The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which it shall be opened. If afterwards, any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the hazard involved.

1. Invert the instrument and remove the 4 rubber feet.

2. Removel the 4 recessed and one surface screw.

3. Holding the case upper and lower together, turn the instrument the right way up and lift off the top.

4. If further dismantling is required to replace components, proceed as follows.

   Remove the two pcb retaining screws and washers. The complete pcb assembly can then be lifted out of the case lower with transformer, chassis and front panel attached.

   The transformer and chassis can be separated from the pcb by desoldering the appropriate connections and removing the nuts from the three pcb studs, two of which also clamp the voltage regulators to the chassis. Note that Q15 is insulated from the metal chassis. It is generally simpler to de-solder the four mains leads from the ON/OFF switch (taking careful note of their positions) and the green/yellow earth lead from the SWEEP IN socket.

   The front panel can be removed as follows. Desolder the two connections from the output attenuator switch and the screened cable connections to the BNC sockets, noting which lead goes to which socket. Desolder the L.E.D. leads from the pcb.

   The moulded range knob is a push fit on its shaft and the aluminium knobs are retained by grubscrews. Note that only the grubscrews in the smaller shaft of the vernier dial assembly need be loosened. The front panel can now be removed with the dial and collar still in place.

5. Reassemble in reverse order.

Operating Voltage

See the Power Supply section for details of changing the operating voltage from 220/240 to 110/120 and vice-versa.

SPECIFICATION

OPERATING RANGE

Frequency range:	<0·02Hz to 200kHz in 5 overlapping decade ranges with fine adjustment by a calibrated vernier.
Internal Mode	
Vernier range:	>1000:1 on each range.
Vernier accuracy:	Better than ±5% of full scale 100Hz to 100kHz ranges; better than ±8% on 10Hz range.
External (Sweep) Mode	
Sweep range:	>1000:1 within each range, typically 10,000:1.
Input impedance:	10kΩ
Input sensitivity:	
Input for 10:1 sweep	~ 4·5V peak-to-peak
Input for 100:1 sweep	~ 4·95V peak-to-peak
Input for 1000:1 sweep	~ 5V peak-to-peak
Maximum allowable input voltage:	±10V
Sweep linearity:	Better than 1%
Maximum slew rate of sweep voltage:	0·1V/μs

OPERATING MODES

(Specifications apply for vernier between 0·2 and 2·0 and output 5V peak-to-peak into 600Ω//20pF termination).

Sine

Distortion:	Less than 1% on 10,100, 1k and 10k ranges, typically 0.5%; less than 2% on 100k range.
Amplitude flatness:	±0·2dB to 200kHz.

Triangle

Linearity:	Better than 99% to 200kHz

Square Wave

Rise and fall times:	<100ns
Mark : Space ratio:	1:1 ±1% to 100kHz

DC

Range:	±5V from 600Ω

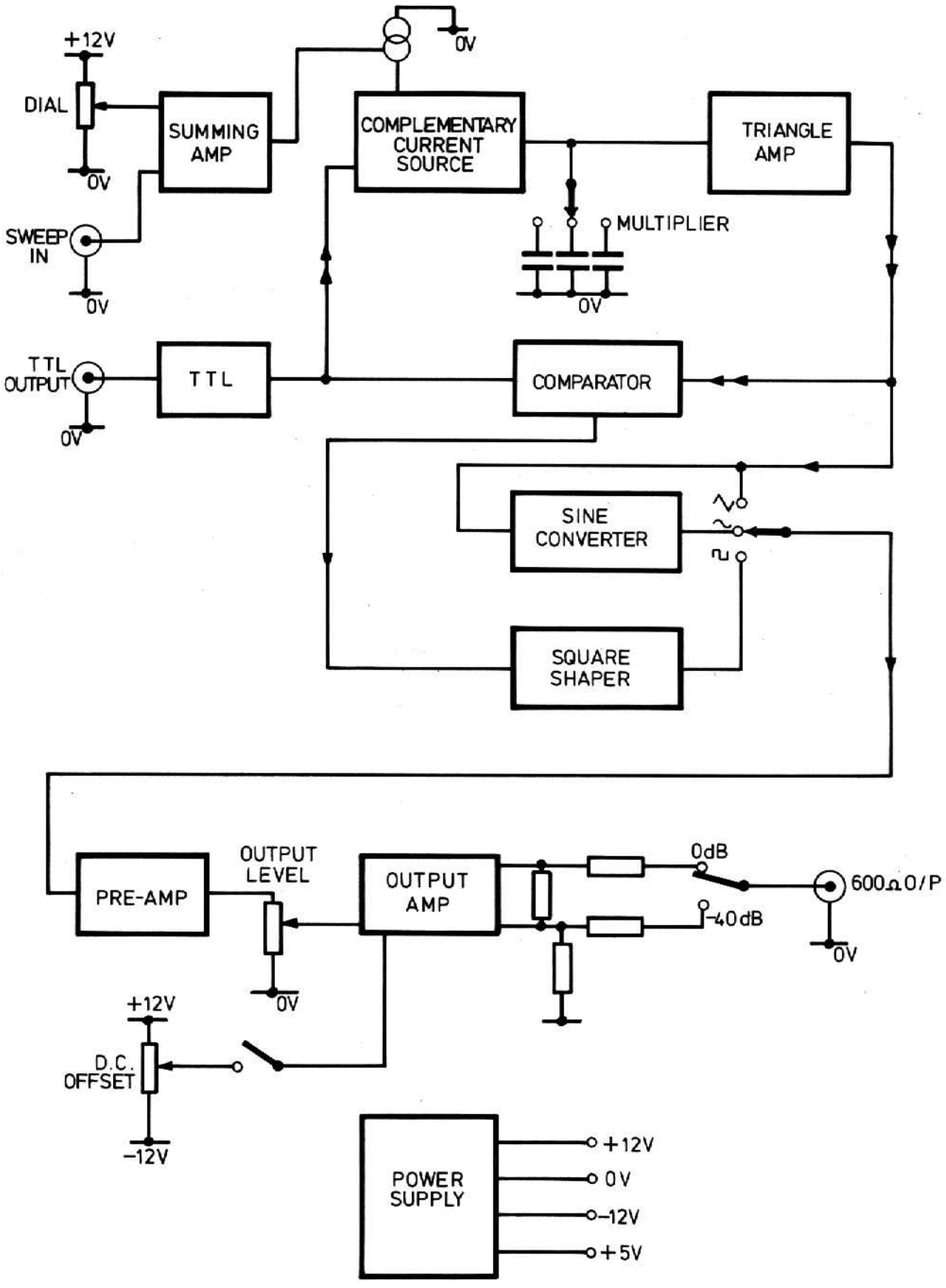
OUTPUTS

600Ω:	Two switch-selectable ranges with >40dB vernier control within each range.
0dB:	0·1V to 10V peak-to-peak from 600Ω (0·05V to 5V into 600Ω).
−40dB:	1mV to 100mV peak-to-peak from 600Ω (0.5mV to 50mV into 600Ω).
DC offset control range:	±5V from 600Ω. DC offset plus waveform attenuated proportionally in −40dB position.
TTL	Capable of driving 20 standard TTL loads.

GENERAL

Power Requirements

Input voltage:	110/120 volts AC nominal 50/60Hz or 220/240 volts AC nominal 50/60Hz, adjustable internally. The TG101 will operate safely and meet specification within normal AC supply variations viz. 100-130 volts AC and 200-260 volts AC respectively.
Power consumption:	Typically 15VA.


+12V
DIAL
0V
SUMMING AMP
0V
COMPLEMENTARY CURRENT SOURCE
TRIANGLE AMP
SWEEP IN
0V
MULTIPLIER
0V
TTL OUTPUT
0V
TTL
COMPARATOR
SINE CONVERTER
SQUARE SHAPER
PRE-AMP
OUTPUT LEVEL
0V
OUTPUT AMP
0dB
-40dB
600Ω O/P
0V
+12V
D.C. OFFSET
-12V
POWER SUPPLY
+12V
0V
-12V
+5V

FUNCTIONAL DESCRIPTION

The relationships between the major circuit elements are shown in the block diagram opposite.

The summing amplifier sums the voltage from the dial and from the sweep input, and its output programmes the current into the complementary current source. This current varies from 0.5μA to 500μA for a 1000:1 frequency change (.002-2.0).

The complementary current source sources or sinks current into or out of the range multiplier capacitor and is controlled by the comparator output. When the comparator output is high current is sourced and the charge on the capacitor will rise, linearly, producing the positive-going triangle slope. When the comparator output is low current is sunk and the charge on the capacitor will fall linearly producing the negative going triangle slope.

The triangle amplifier has a gain of 2 and buffers the triangle wave on the multiplier capacitor to drive the comparator and output circuits.

The comparator operates as a window detector with fixed limit points set to the triangle peaks. Its output directly drives the complementary current source and is also level shifted to drive the TTL and square shaper circuits. When the comparator output to the complementary current source is high the triangle wave is positive-going until it reaches +1.2V when the comparator output switches low. When the comparator output is low the triangle wave is negative-going until it reaches −1.2V when the comparator output goes high and the cycle is repeated. This basic function generator loop is shown by the double arrows in the block diagram. Triangle and squarewave are generated simultaneously as shown.

The TTL circuit buffers the comparator output to drive the TTL output socket.

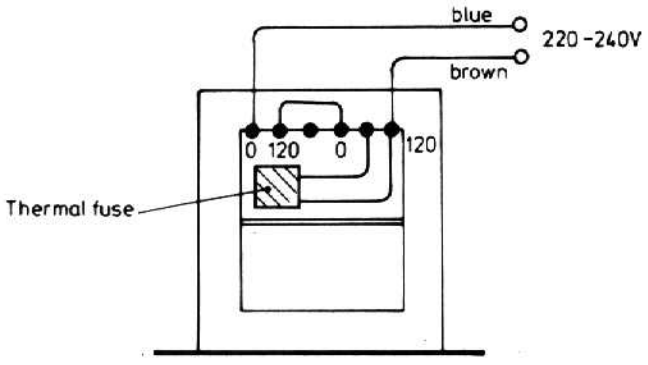
The square shaper converts the comparator output to a current signal and applies it to the square wave function switch. The sinewave converter uses the non-linear characteristics of its diodes to convert the triangle wave into a sinusoidal current, which is applied to the sinewave function switch. The selected function is sent to the pre-amplifier, where it is inverted and buffered and applied to the output level control. The signal is summed with the voltage from the DC offset control at the output amplifier. This amplifier inverts and amplifies the signal up to 10V peak-peak to drive the 600 Ohm output connector.

CIRCUIT DESCRIPTIONS

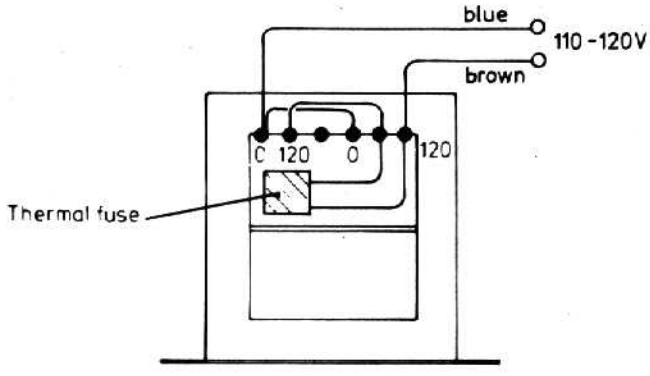
Power Supply - mains connections

The operating voltage of the instrument is shown on the rear panel label. Should it be necessary to change the operating range from 220/240V AC to 110/120V or vice-versa, change the transformer connections following the appropriate diagram below.

220/240V Operation: Primaries in series



110/120V Operation: Primaries in parallel



If a change is made, the operating voltage label should also be changed.

Note: A thermal fuse is fitted in the primary circuit of the transformer. This wil become 'open circuit' in the event of a fault occuring in the instrument which would cause excessive temperature rise of the transformer. Should such a fault occur the thermal fuse should only be replaced with the correct spare part.

WARNING ! THIS INSTRUMENT MUST BE EARTHED

Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited.

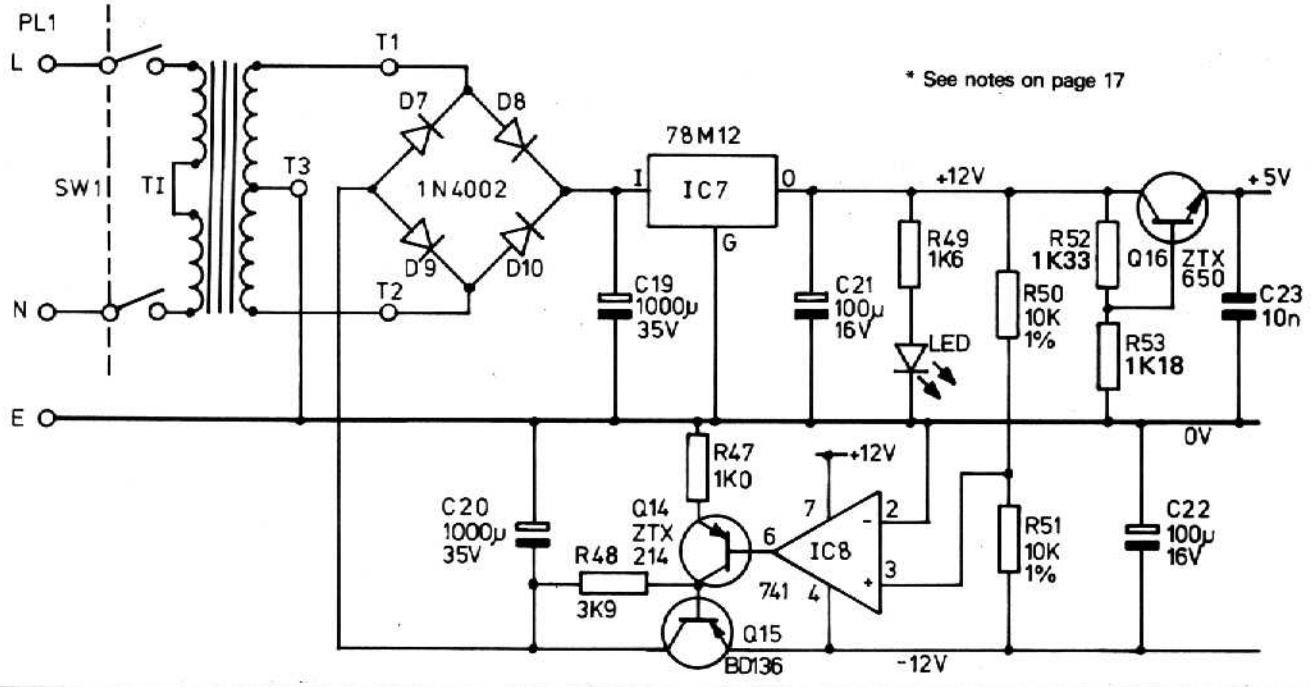
Power Supply — DC Regulation

Diodes D7 to D10 rectify the transformer output and C19 and C20 are the reservoir capacitors of the unregulated DC rails.

IC7 is a + 12V 3-terminal regulator.

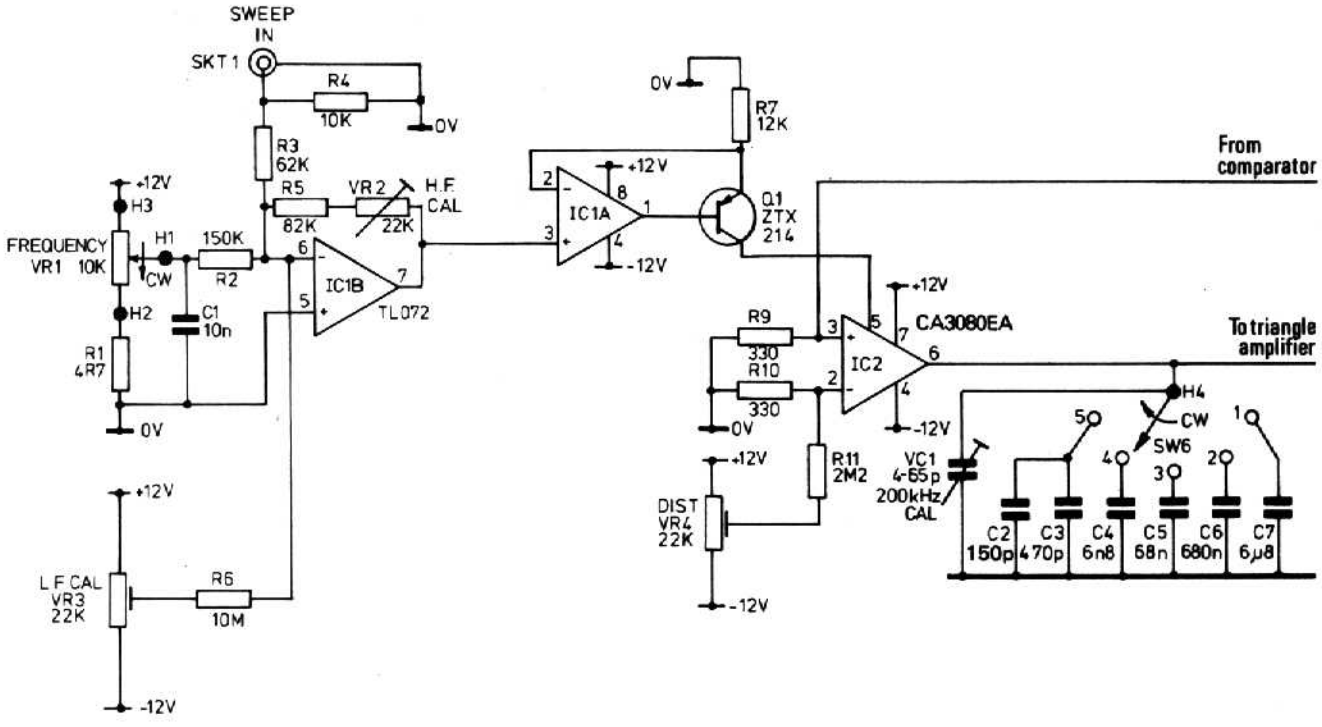
The − 12V regulator is made up of Q14, Q15 and IC8. The − 12V tracks the + 12V by driving the input of IC8 from the centre-tap of R50, R51.

The + 5V rail is derived by dividing down the + 12V rail with R52 and R53, Q16 providing the necessary current gain.



* See notes on page 17

Waveform Generation — Summing Amplifier, Current Sources and Range Selection

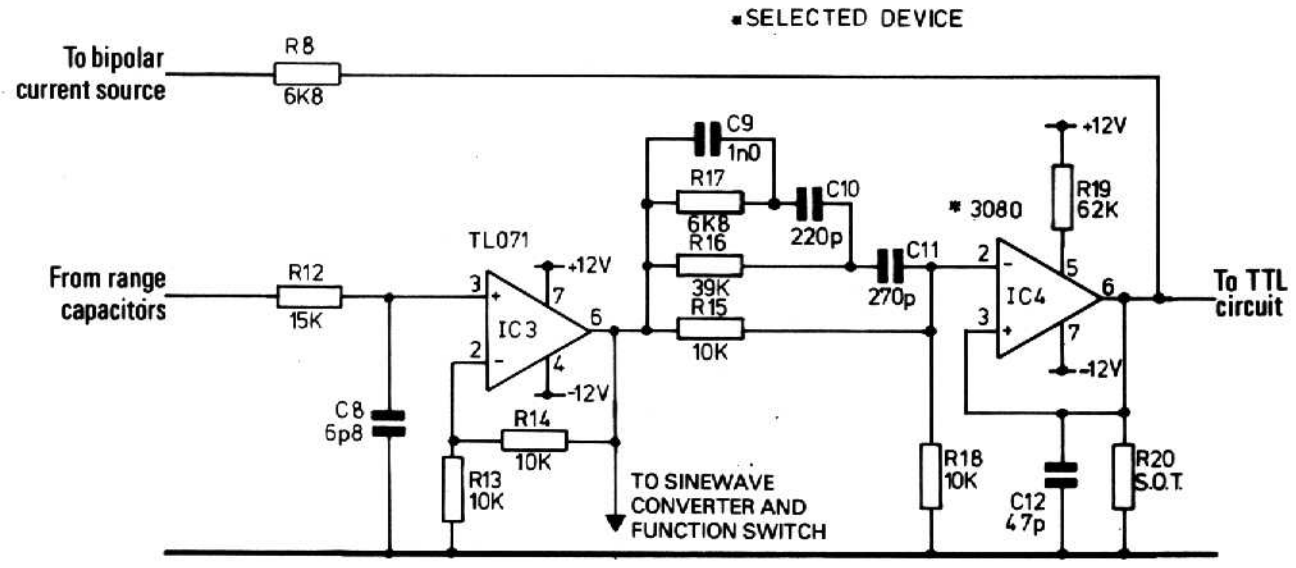


The dial and sweep voltages are summed by IC1B, the gain of which is set by VR2; VR2, in fact, is used to calibrate the high frequency end of the dial. The output range of this amplifier is from a few millivolts below ground (with the dial at .002) to approximately −6.8V (with the dial at 2.0).

This voltage is converted into a current by IC1A and Q1 which form a voltage controlled current source. With the dial at 2.0 the −6.8 volts on the output of the summing amplifier is forced across R7 and the current flowing out of Q1 collector into the complementary current source is therefore 6.8V/12K = 560µA.

IC2, an operational transconductance amplifier, is used as a switchable complementary current source. Its output will either sink or source the programmed current, depending whether pin 3 is low or high respectively. For perfect symmetry the sink and source currents must be equal over at least a 1000:1 range; to ensure this IC2 is an 'A' version. Because symmetry affects sinewave distortion, fine symmetry adjustment is provided by VR4. The range switch, SW6, selects a multiplier capacitor and connects it to the output of the complementary current source.

Waveform Generation — Triangle Amplifier and Comparator.

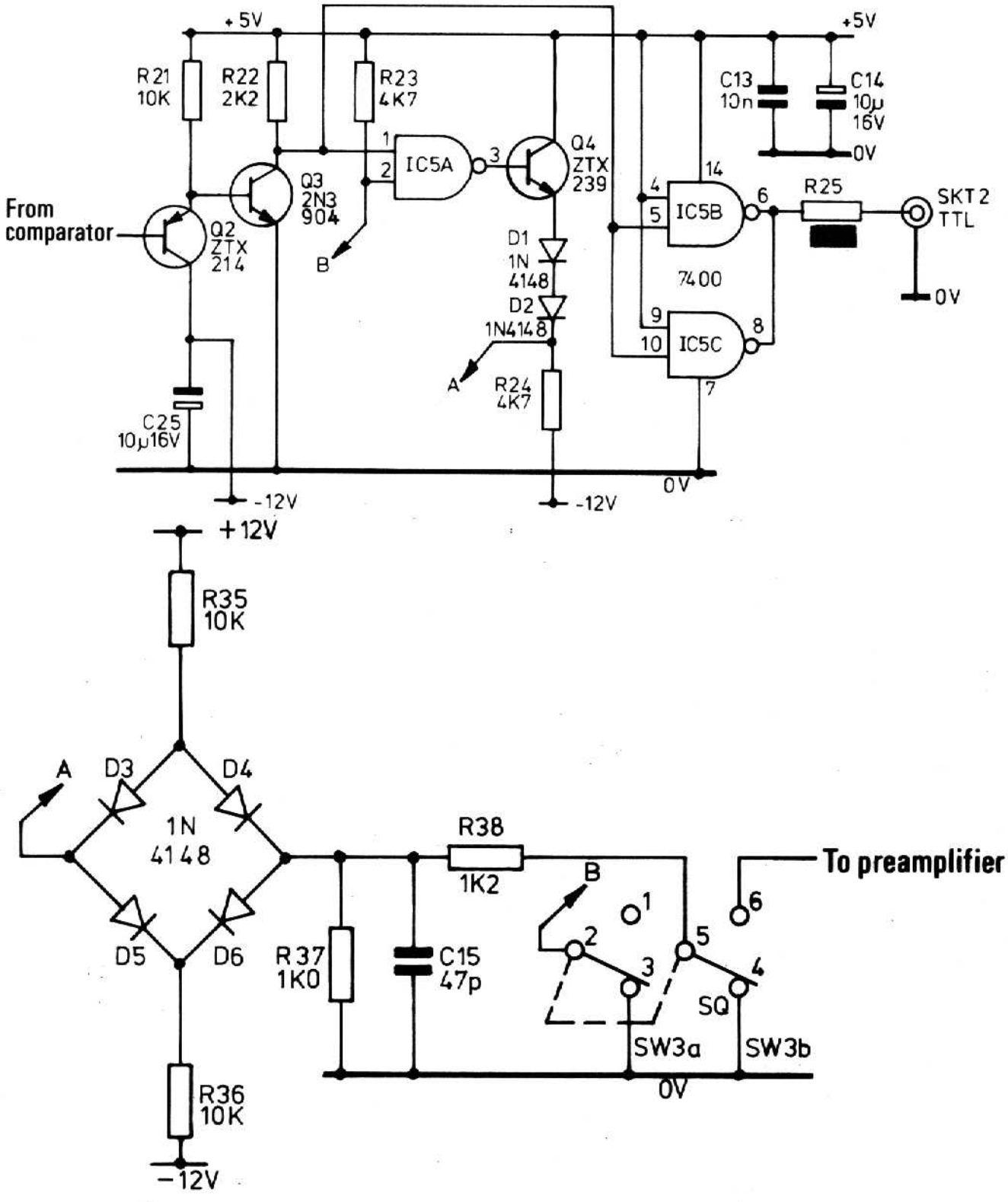


The triangle amplifier uses a BIFET operational amplifier, IC3, to amplify the triangle wave; it has a gain of 2 set by R13 and R14. R12 and C8 on the input of IC3 improve waveform shape at high frequencies. The output of IC3 goes directly to the function switch and to the sinewave converter. It is also halved by R15 and R18 to drive the comparator IC4. R16, R17, C9, C10 and C11 compensate for comparator and other delays in the function generator loop so as to maintain a constant triangle amplitude across the full frequency range.

IC4 is another transconductance amplifier used as a high speed comparator. Because its output is a current, equal to the programmed current at pin 5, the output swing and therefore the triangle amplitude can be determined simply by a resistor R20. IC4 is pre-selected into three current bands and the value of R20 is chosen accordingly, see Parts List. The output of the comparator is approximately -/600mV peak to peak and switches the complementary current source IC2 via R8. When the comparator output is high (600mV), pin 3 of IC2 is held high via R8 and the triangle wave will be on the positive slope. When the triangle amplitude on pin 2 of IC4 reaches +600mV the comparator goes low (−600mV); pin 3 of IC2 is now held low via R8 and the triangle wave will now be on its negative slope until it reaches −600mV which is the new voltage on IC4 pin 3. The comparator then switches high and the cycle is repeated.

Note that the triangle amplitude on the multiplier capacitor is ±600mV; it is then amplified by IC3, which has a gain of 2, and then divided by 2 by R15 and R18 to bring it back to ±600mV at the comparator input.

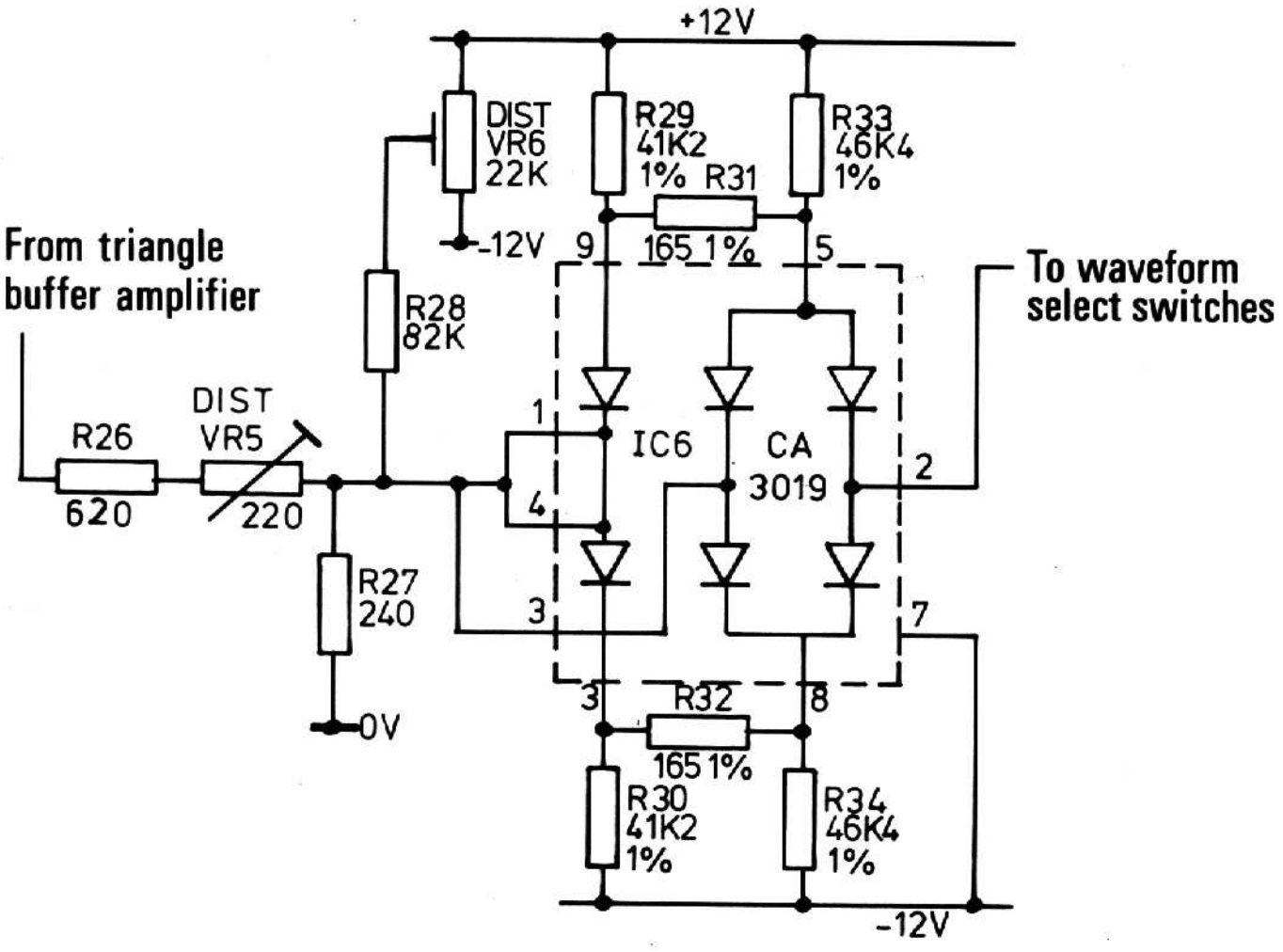
Waveform Generation — TTL Output and Square-wave Shaper



The comparator output is also buffered by emitter follower Q2 and then amplified and level shifted to be TTL compatible by Q3.

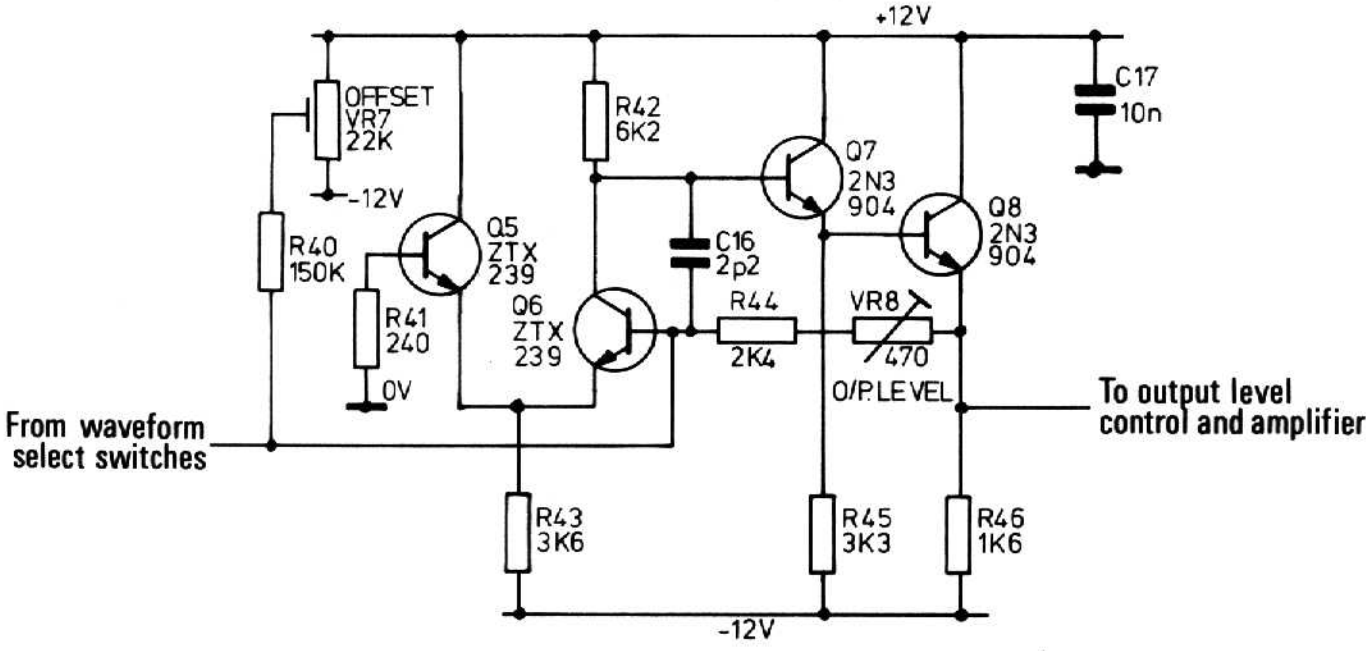
The signal at the collector of Q3 is buffered by paralleled gates IC5B and C to drive the TTL output socket.

The signal at the collector of Q3 also drives one input, pin 1, of IC5A. When squarewave is not selected, pin 2 is held low by SW3a and the output of IC5A is permanently high. When squarewave is selected, SW3a is open and IC5A pin 2 is pulled high by R23 which allows the signal on pin 1 to be inverted by IC5A and output on pin 3. Q4 and diodes D1 and D2 level shift the signal to be switching about ground at A. This then drives the diode bridge D3 to D6 which steers current from either R35 or R36 into R37 and R38. This provides a squarewave with controlled rise and fall times which is symmetrical about ground.



The sinewave converter consists of a diode array IC6 whose non-linear characteristics convert the triangle wave into a sinusoidal current. Three parameters affect sinewave distortion: triangle symmetry which is adjusted by VR4, triangle symmetry about ground which is adjusted by VR6 and the triangle amplitude which is adjusted by VR5.

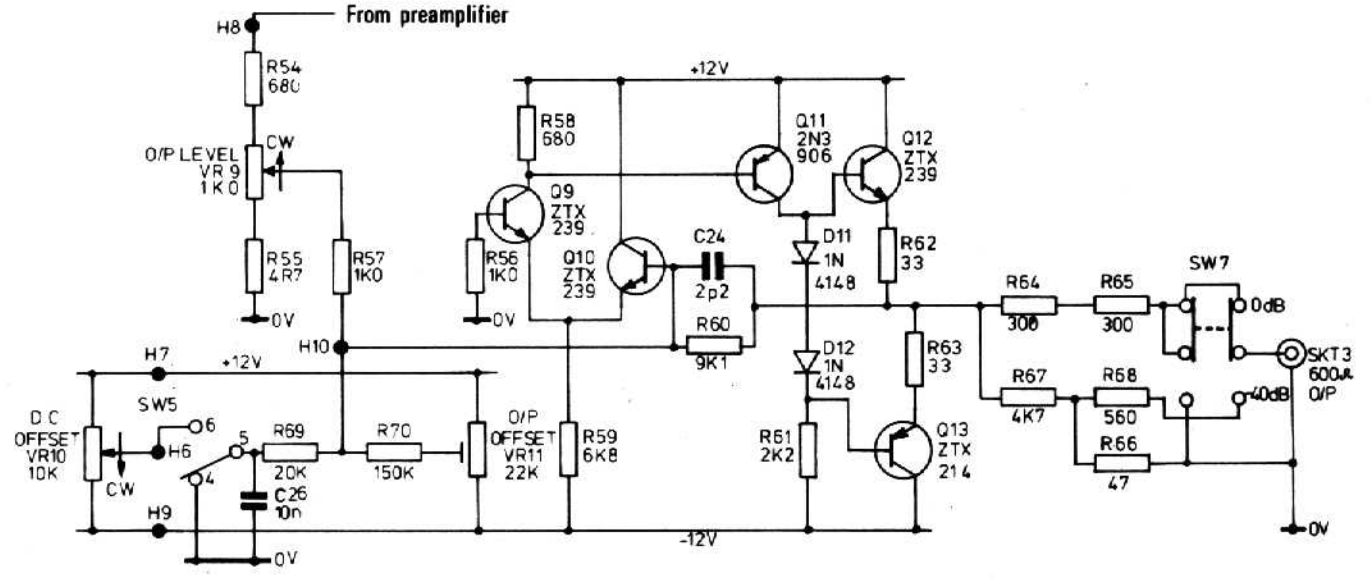
Preamplifier



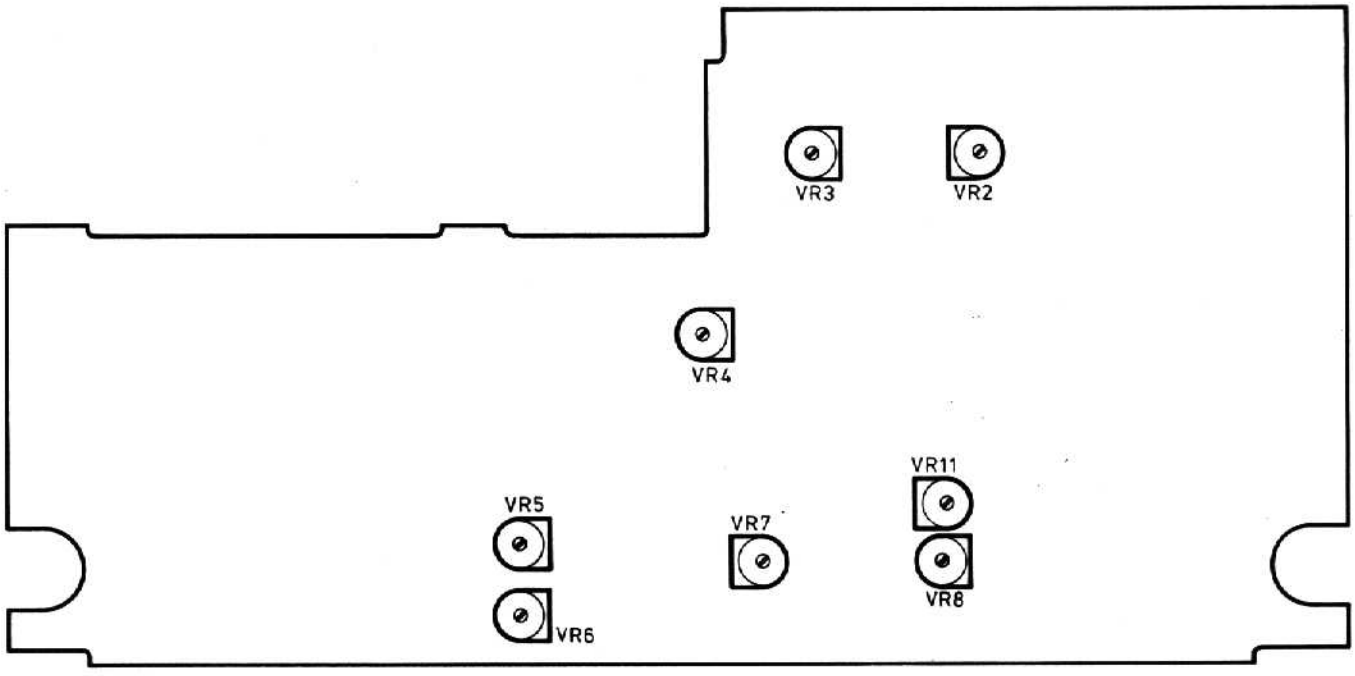
The selected waveform passes to the preamplifier. Q5 and Q6 form a long tailed pair; Q7 and Q8 are two cascaded emitter followers; feedback is via R44 and VR8. VR8 sets the pre-amplifier gain and is adjusted to give 10V peak to peak at the 600 Ohm output.

Output Amplifier and DC Offset

Q9 and Q10 form a long tailed pair. Q11 is a class A common emitter amplifier and driver. Q12 and Q13 form the complementary emitter follower output stage. D11 and D12 provide bias for the output stage. Feedback is via R60 and C24. The DC offset is summed with the signal at the base of Q10.



CALIBRATION



Calibration should be carried out after the instrument has been switched on for a few minutes.

The available calibration points are:

Dial calibration, high frequency (2.0) end, 1Hz to 10k ranges - VR2
Dial calibration, low frequency (.002) end, all ranges - VR3
Dial calibration 100kHz range - VC1
Sinewave distortion - VR4, VR5 and VR6
DC offset of preamplifier - VR7
Maximum output level - VR8
DC offset of output amplifier - VR11

Because some of the above adjustments are interactive, fastest calibration and optimum performance are achieved if the calibrations are carried out in the following order.

1. Turn the fequency vernier (VR1) fully clockwise align the dial mark at .002 with the mark on the front panel; tighten both grub screws evenly.

2. Set dial to 2.0, 1kHz range, VR3 midway, adjust VR2 for 1.98kHz to 2.02kHz.

3. Dial still at 2.0, 100kHz range, adjust VC1 for 195kHz to205kHz.

4. Dial to .002, adjust VR3 for 190Hz to 210Hz.

5. Select 10kHz range, dial at 1.0, sinewave. Using a distortion meter adjust VR4, VR5 and VR6 for minimum distortion. Note that VR4 slightly affects frequency and so the distortion meter will have to be trimmed at the same time as adjusting VR4.

6. Select squarewave and adjust VR8 for 10V peak to peak at the 600 0hm output socket, with the output level control at maximum.

7. Select DC output mode by releasing all the three waveform buttons, ensure that the DC offset button is also out. With the output level control at minimum adjust VR11 for 0 volts ±5mV.

8. Output level control to maximum and adjust VR7 for 0 volts, ±5mV.

Notes on Servicing

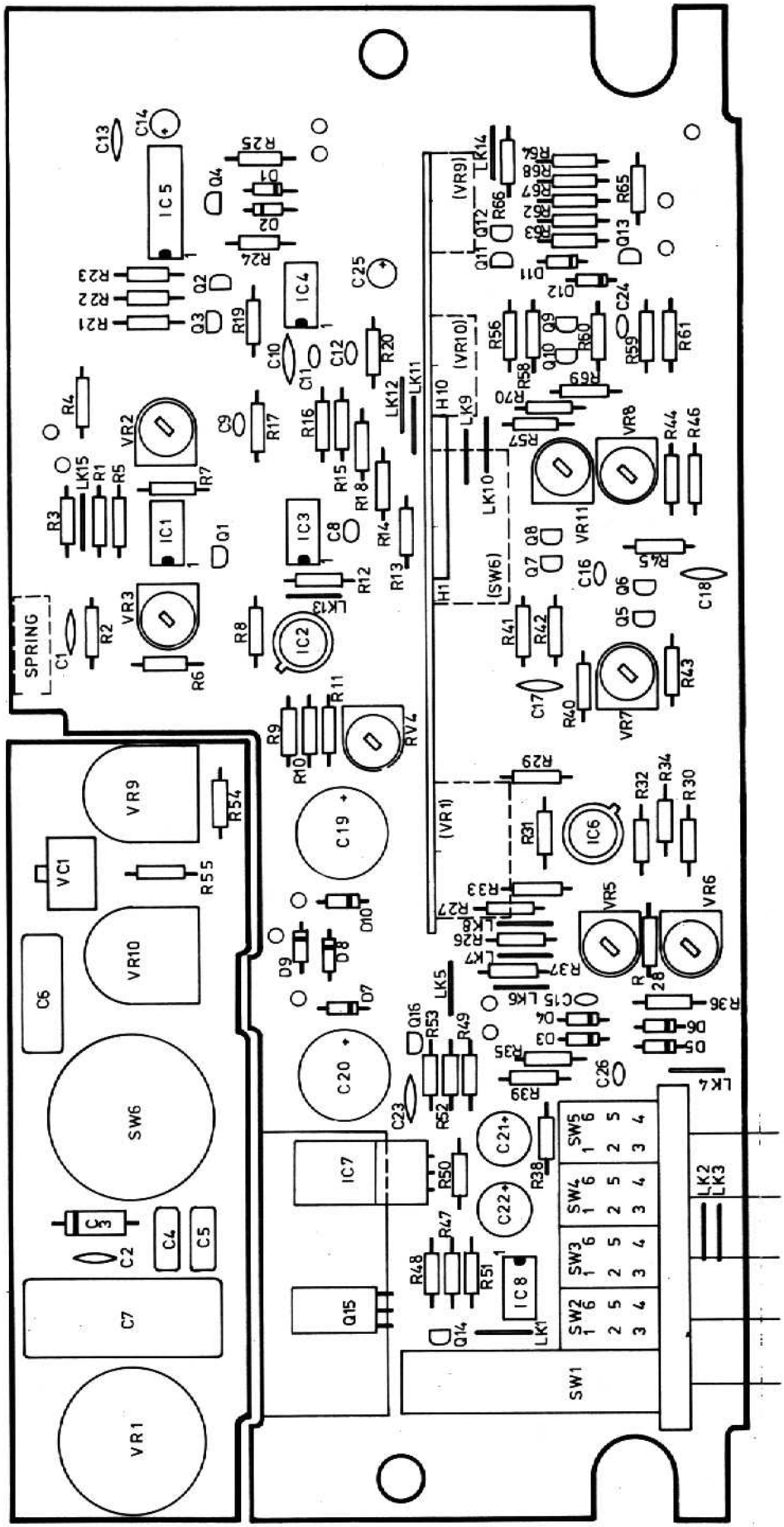
Heatsink compound is applied to IC7 and Q15. Q15 also has an insulating washer beneath.

The supply rails should be:-

12V ±0.5V
−12V within 2% of the +12V
+5V ± 0.3V

The DC supply current should be less than 100mA. IC2 and IC6 are hand preformed when fitted; if replacement is necessary ensure that their leads are correctly orientated. Instability may occur if Q11 is replaced with a device of different manufacture.

COMPONENT LAYOUT (Prior to Issue 7 Pcb) See notes on page 17



PARTS LIST

Resistors

Ref	Description	Part No
R1	4R7J W25 CF	23185-0047
R2	150KJ W25 CF	23285-4150
R 3	62KJ W25 CF	23187-3260
R4	10KJ W25 CF	23185-3100
R5	82KJ W25 CF	23185-3820
R6	10MJ W25 CF	23185-6100
R7	12KJ W25 CF	23185-3120
R8	6K8J W25 CF	23185-3120
R9	330RJ W25 CF	23185-1330
R10	330RJ W25 CF	23185-1330
R11	2M2J W25 CF	23185-5220
R12	15KJ W25 CF	23185-3150
R13	10KJ W25 CF	23185-3100
R14	10KJ W25 CF	23185-3100
R15	10KJ W25 CF	23185-3100
R16	39KJ W25 CF	23185-3390
R17	6K8J W25 CF	23185-2680
R18	10KJ W25 CF	23185-3100
R19	62KJ W25 CF	23187-3620
***R20**	Selected - see below	
R21	10KJ W25 CF	23185-3100
R22	2K2J W25 CF	23185-2220
R23	4K7J W25 CF	23185-2470
R24	4K7J W25 CF	23185-2470
R25	0R0 W25 CF	23185-0000
R26	620RJ W25 CF	23187-1620
R27	240RJ W25 CF	23187-1240
R28	82KJ W25 CF	23185-3820
R29	41K2F W25 MF	23202-3412
R30	41K2F W25 MF	23202-3412
R31	165RF W25 MF	23202-1165
R32	165RF W25 MF	23202-1165
R33	46K4F W25 MF	23202-3464
R34	46K4F W25 MF	23202-3464
R35	10KJ W25 CF	23185-3100
R36	10KJ W25 CF	23185-3100
R37	1K0K W25 CF	23185-2100
R38	1K2J W25 CF	23185-2120
R39	2K2J W25 CF	23185-2220
R40	150KJ W25 CF	23185-4150
R41	240RJ W25 CF	23187-1240
R42	6K2J W25 CF	23187-2620
R43	3K6J W25 CF	23187-2360
R44	2K4J W25 CF	23187-2240
R45	3K3J W25 CF	23185-2330
R46	1K6J W25 CF	23187-2160
R47	1K0J W25 CF	23185-2100
R48	3K9J W25 CF	23185-2390
R49	1K6J W25 CF	23187-2160

Ref	Description	Part No.
R50	10KF W25 MF	23202-3100
R51	10KF W25 MF	23202-3100
R52	1K33F W25 CF	23202-2133
R53	1K18F W25 CF	23202-2118
R54	680RJ W25 CF	23185-1680
R55	4R7J W25 CF	23185-0047
R56	1K0J W25 CF	23185-2100
R57	1K0J W25 CF	23185-2100
R58	680RJ W25 CF	23185-1680
R59	6K8J W25 CF	23185-2680
R60	9K1J W25 CF	23187-2910
R61	2K2J W25 CF	23185-2220
R62	33RJ W25 CF	23185-0330
R63	33RJ W25 CF	23185-0330
R64	300RJ W25 CF	23187-1300
R65	300RJ W25 CF	23187-1300
R66	47RJ W25 CF	23185-0470
R67	4K7J W25 CF	23185-2470
R68	560RJ W25 CF	23185-1560
R69	20KJ W25 CF	23187-3200
R70	150KJ W25 CF	23185-4150
VR1	10K Lin Conductive Plastic Pot	23348-0002
VR2	22K PS/H CF	23377-3220
VR3	22K PS/H CF	23377-3220
VR4	22K PS/H CF	23377-3220
VR5	220R PS/H	23377-1220
VR6	22K PS/H CF	23377-3220
VR7	22K PS/H CF	23377-3220
VR8	470R PS/H CF	23377-1470
VR9	1K0 Lin Pot	23347-0040
VR10	10K Lin Pot	23347-0050
VR11	22K PS/H CF	23377-3220

***R20** - Resistance value is determined by colour code of selected IC4 viz:

IC4 Red,	R20 = 2K4	23187-2240
IC4 Blue,	R20 = 2K2	23185-2220
IC4 Green,	R20 = 2K61	23202-2261

Capacitors

Ref	Description			Part No.
C1	10NZ	63V	Cer	23427-0325
C2	150PG	63V	Cer	23427-0322
C3	470PJ	160V	Poly/S	23647-0513
C4	6N8+1,-2%	100V	Poly/E	23620-0800
C5	68NG	100V	Poly/E	23620-0801
C6	680NG	100V	Poly/E	23620-0802
C7	6U8J	100V	Poly/E	23620-0234
C8	6P8C	100V	Cer	23427-0260
C9	1N0K	63V	Cer	23427-0331
C10	330PG	63V	Cer	23427-0327
C11	270PG	100V	Cer	23427-0347
C12	47PG	63V	Cer	23427-0329
C13	10NZ	63V	Cer	23427-0325
C14	10UF	35V	Elec	23557-0647
C15	47PG	63V	Cer	23427-0329
C16	2P2C	63V	Cer	23427-0528
C17	10NZ	63V	Cer	23427-0325
C18	Not used			
C19	1000UF	35V	Elec	23557-0639
C20	1000UF	35V	Elec	23557-0639
C21	100UF	16V	Elec	23557-0635
C22	100UF	16V	Elec	23557-0635
C23	10NZ	63V	Cer	23427-0325
C24	2P2C	63V	Cer	23427-0528
C25	10UF	35V	Elec	23557-0647
C26	10JZ	63V	Cer	23427-0325
VC1	Trimcap	4-65PF		23984-0007

Semiconductors

D1	Dio	1N4148	25021-0901
D2	Dio	1N4148	25021-0901
D3	Dio	1N4148	25021-0901
D4	Dio	1N4148	25021-0901
D5	Dio	1N4148	25021-0901
D6	Dio	1N4148	25021-0901
D7	Dio	1N4002	25115-0907
D8	Dio	1N4002	25115-0907
D9	Dio	1N4002	25115-0907
D10	Dio	1N4002	25115-0907
D11	Dio	1N4148	25021-0901
D12	Dio	1N4148	25021-0901
Q1	Tran	ZTX214	25341-0214
Q2	Tran	ZTX214	25341-0214
Q3	Tran	2N3904	25381-0404
Q4	Tran	ZTX239	25380-0229
Q5	Tran	ZTX239	25380-0229
Q6	Tran	ZTX239	25380-0229
Q7	Tran	2N3904	25381-0404
Q8	Tran	2N3904	25381-0404
Q9	Tran	ZTX239	25380-0229
Q10	Tran	ZTX239	25380-0229
Q11	Tran	2N3906	25341-0218
Q12	Tran	ZTX239	25380-0229
Q13	Tran	ZTX214	25341-0214
Q14	Tran	ZTX214	25341-0214
Q15	Tran	BD136	25334-0010
Q16	Tran	ZTX650	25388-0206
IC1	TL072CP		27106-0606
IC2	CA3080EA		27106-0514
IC3	TL071CP		27106-0604
*IC4	CA3080 Selected		
IC5	7400N		27220-0000
IC6	CA3019		27164-0600
IC7	78M12UC		27160-0008
IC8	UA741CP		27106-0515
LED1	LED Miniature		25061-0200

***IC4** is a selected item, colour coded as follows:

CA3080 Selected "Red"	27106-0800
CA3080 Selected "Green"	27106-0801
CA3080 Selected "Blue"	27106-0802

Any of these may be fitted, provided the correct value of R20 is used.

Electro/Mechanical, Mechanical & Packaging Parts

Description		Part No
Stud M3 x 10 mmL (Regulator & Chassis)	3 off	20205-0610
*PCB, Main & Control		35515-0860
Pushbutton, Red		37113-0120
Pushbutton, Black		37113-0130
Pushbutton, Grey	3 off	37113-0140
Link LK1-15	15 off	23185-0000
*Switchbank SW1-5		22225-0530
Switch, rotary SW6		22220-0003
Switch, slide SW7		22218-0205
PCB Header 10 Way cut from		22573-0019
IC Socket, 8 pin	4 off	22574-0118
IC Socket, 14 pin		22574-0119
Adhesive pad for LED		10300-0313
Screw M2 x 5mmL (for SW7 (2) Aluminium knobs (2) Stepped collar (1))	5 off	20234-0026
BNC Socket (SKT1, 2, 3)	3 off	22588-0004
Front Panel		33331-0600
Knob, aluminium, dial		37151-0280
Knob, aluminium	2 off	37151-0260
Dial		37571-0050
Knob, grey, plastic		37151-0270
Knob to shaft clip		20620-0009
Collar, stepped, Knob shaft		31125-0030
Bush, grey, front panel	2 off	31122-0190
Transformer, mains (T1)		22115-0020
Chassis, transformer mounting		33145-0300
Earthing spring (PCB to screen)		35358-0480
Cable tie	5 off	20653-0204
Solder tag, shakeproof (transformer)		20037-0400
Mains Input Receptacle		22520-0120
Support bracket, right angled	2 off	33141-0500
Spacer, nylon (brackets to control PCB)	2 off	20661-0223
Washer M3 (Power Skt (2) Transformer (1) Q15 (1) IC7 (1) PCB to Case (2))	7 off	20030-0263
Washer, shakeproof M3 (Power Skt (2) Transformer (1) Chassis to PCB (1) Brackets to PCB (2))	6 off	20037-0301

Description		Part No
Screw M3 x 5mmL self tap (Brackets to main PCB)	2 off	20062-0500
Screw M3 x 8mmL self tap (Brackets to control PCB)	2 off	20062-0501
Screw 6BA x 3/16"L (PCB to case, case upper to lower)	6 off	20134-0501
Screw M3 x 8mmL (transformer)	2 off	20219-0006
Nut M3 (Power skt (3) transformer (2) Q15 (1) IC7 (1) PCB to chassis (1))	7 off	20210-0101
Grubscrew M2 x 2.5mmL (Aluminium knob, dial)	2 off	20220-0001
Screw M3 x 10mmL (Power Skt)	2 off	20234-0011
Fibre washer (PCB to case)	2 off	20612-0010
Screw 6BA x 1.5"L (case upper to lower)		20134-0503
Case, lower		33537-0160
Insulator, case lower		31346-0060
Screen, case lower		31346-0050
Case, upper		33537-0150
Side trim, front	2 off	31332-0490
Side trim, rear	2 off	31332-0500
Handle		31336-0200
Rear panel		33331-0340
Foot, black PVC	4 off	31748-0190
Label, logo		37522-0010
Label, instruction		37558-0430
Mains Lead, tinned ends		22491-0010
Label, wiring instructions for tinned ends		37541-0490
Mains Lead, Euro plug		22491-0020
Mains Lead, USA plug		22491-0040
Warning Label 220/240V		37559-0010
Warning Label 110/120V		37559-0020
Label, Serial No.		37522-0020
Aircap Sheet cut from		10612-0202
Carton		38113-0260
Printed Sleeve		38181-0140
Guarantee Card		48581-0230
Instruction Book		48591-0050

* See notes on page 17

MANUFACTURING AND PARTS LIST CHANGES

From January 1988 the AC line switch (SW1) of the switchbank is obsolete. The PCB layout is modified (raised to Issue 7) such that the ON/OFF switch of the new switchbank switches the DC secondary and not the AC line.

Additional components are included on this layout to ensure that the DC rails do not latch-up at switch-on.

Parts List changes are as follows:-

PCB 35555-0860 revised to Issue 7.

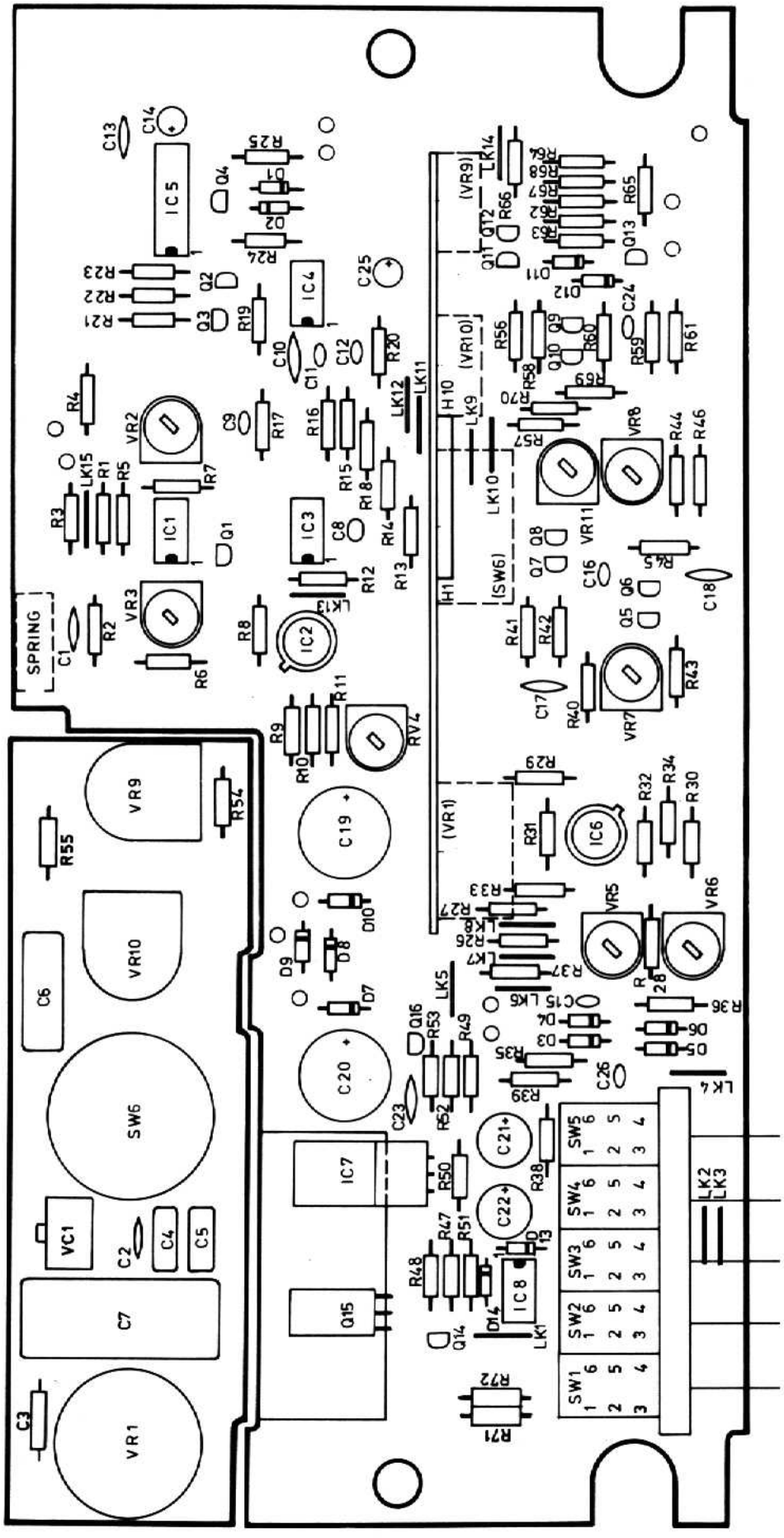
Additions

Ref	Description	Part No.
R71	68KJ W25 CF	23185-3680
R72	68KJ W25 CF	23185-3680
D13	1N4002	25115-0907
D14	1N4002	25115-0907

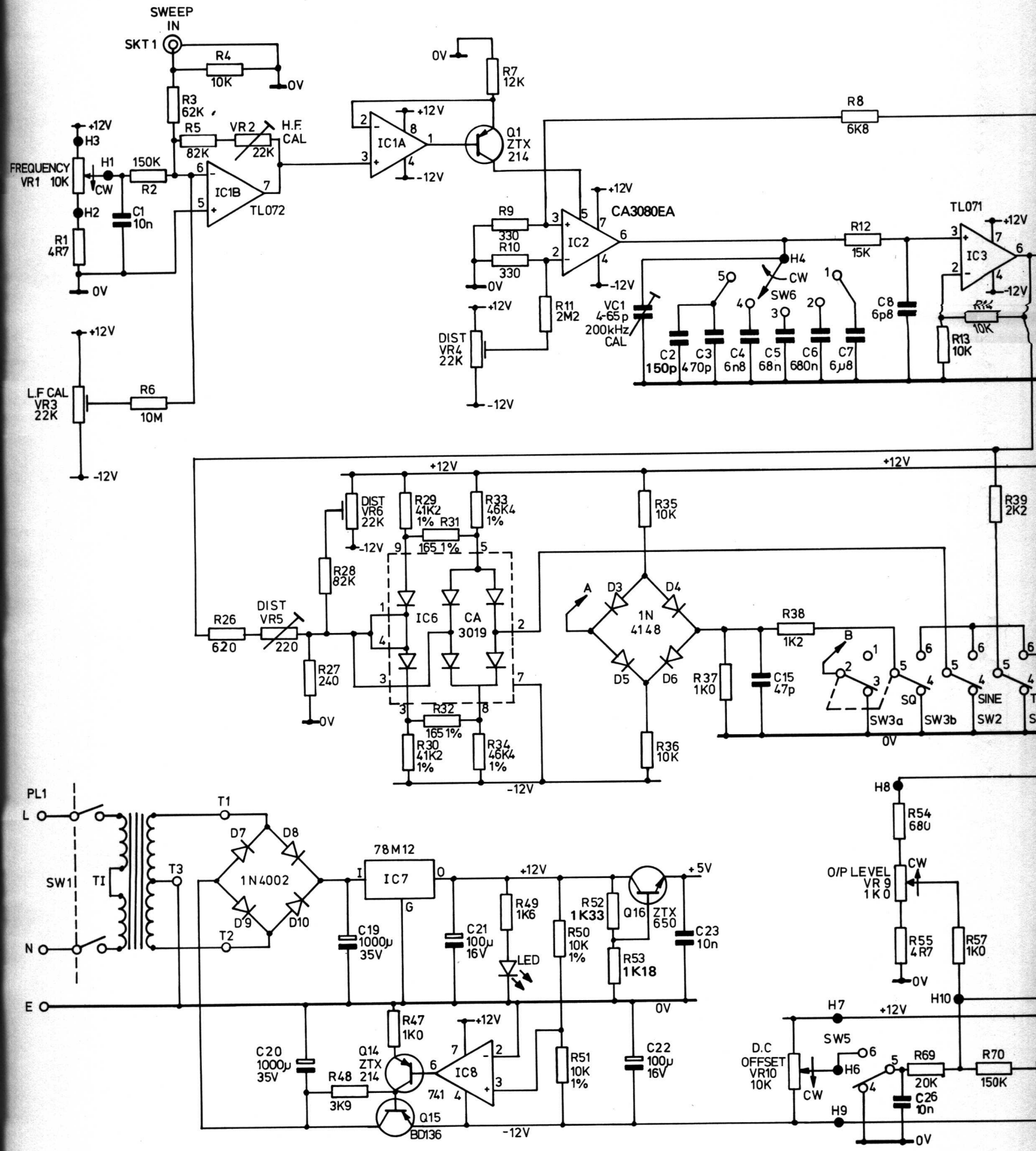
Replacements

Ref	Description		Part No.
	Switchbank	Was	22225-0530
		now	22225-0660

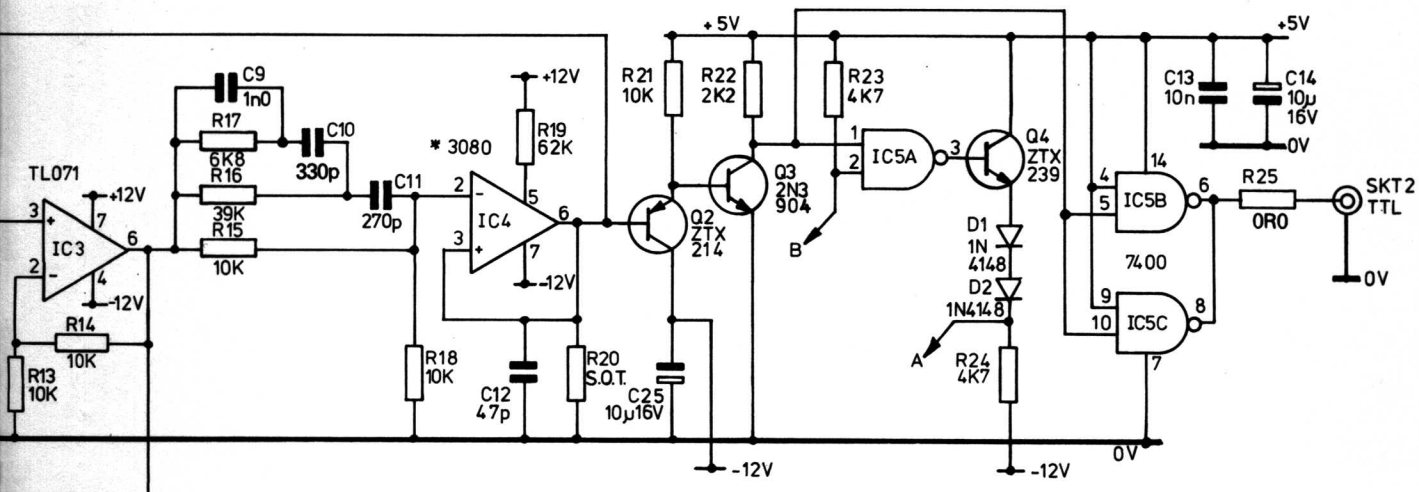
COMPONENT LAYOUT (Issue 7 onwards). See notes on page 17.

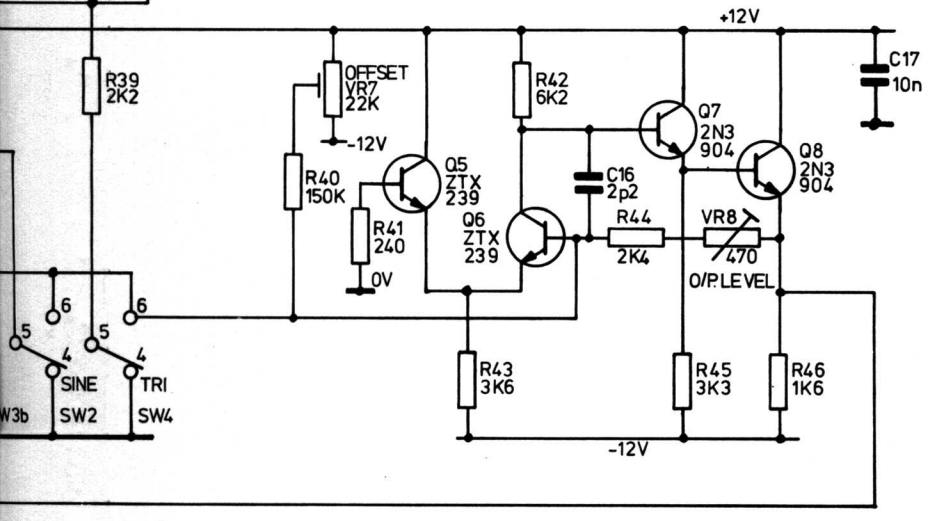


CIRCUIT DIAGRAM (prior to Issue 7 Pcb). See notes on page 17



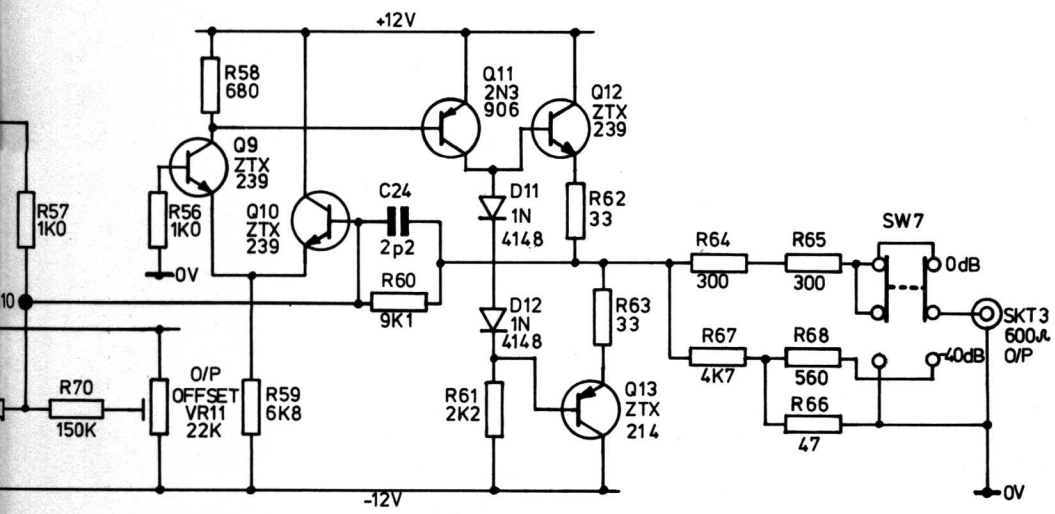
*SELECTED DEVICE



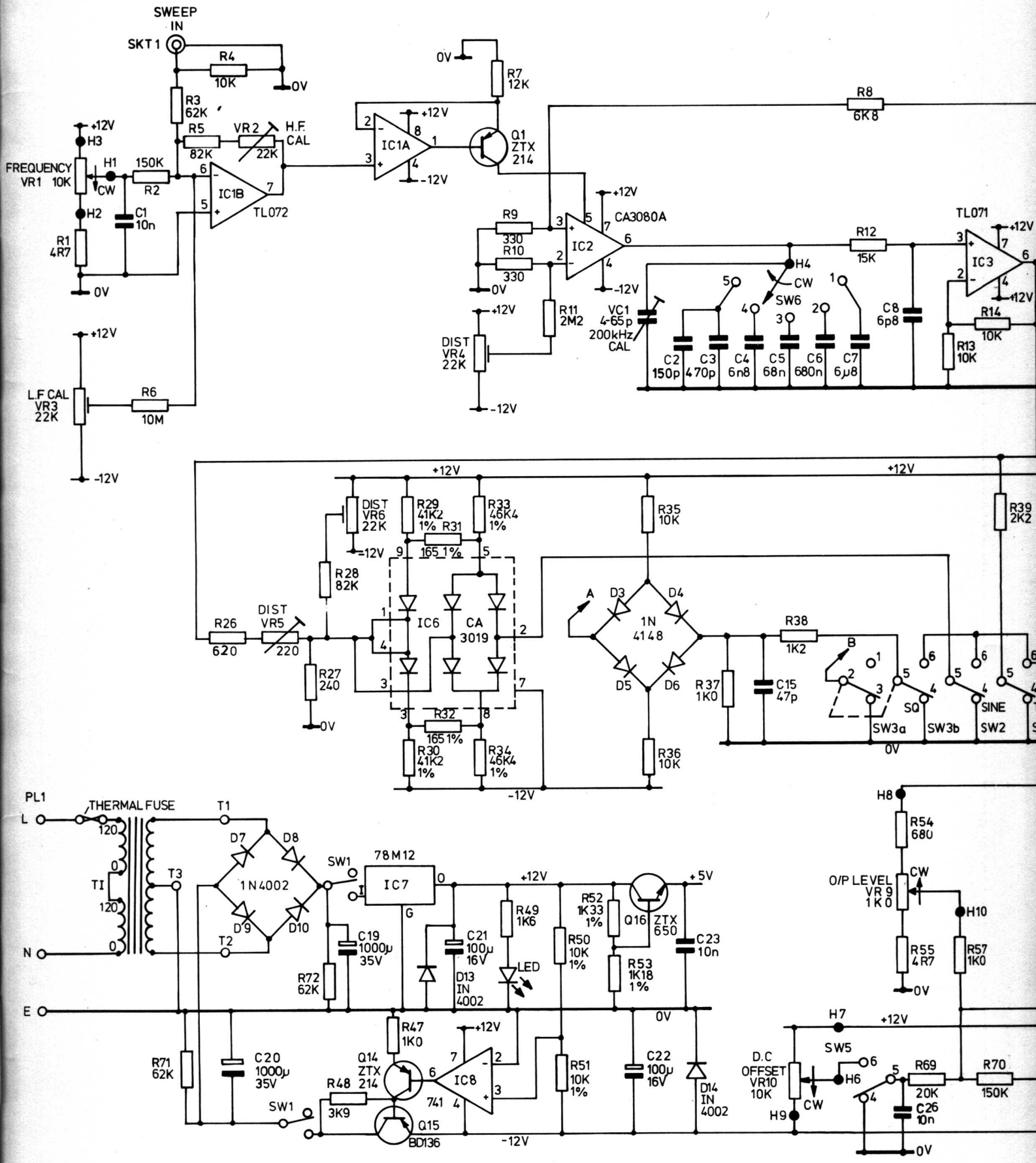


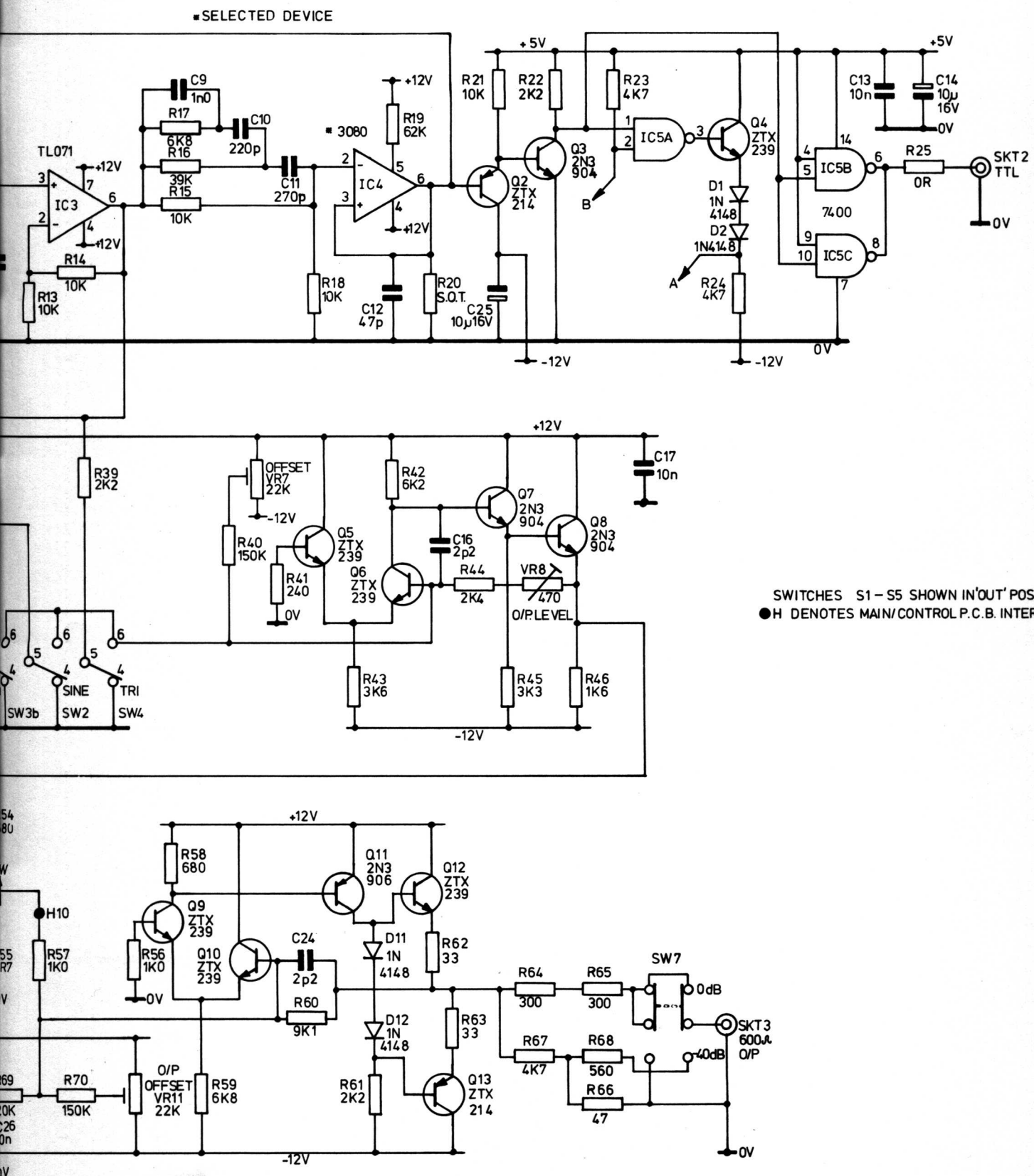
SWITCHES S1 – S5 SHOWN IN 'OUT' POSITION.

●H DENOTES MAIN/CONTROL P.C.B. INTERCONNECTIONS.



CIRCUIT DIAGRAM (Issue 7 onwards). See notes on page 17.




■SELECTED DEVICE
TL071
IC3
+12V
-12V
C9
1n0
R17
6K8
R16
39K
R15
10K
C10
220p
C11
270p
■ 3080
IC4
R19
62K
R18
10K
C12
47p
R20
S.O.T.
C25
10µ16V
R13
10K
R14
10K
+5V
R21
10K
R22
2K2
R23
4K7
Q2
ZTX
214
Q3
2N3
904
B
IC5A
Q4
ZTX
239
D1
1N
4148
D2
1N4148
A
R24
4K7
C13
10n
C14
10µ
16V
0V
IC5B
IC5C
7400
R25
0R
SKT2
TTL
R39
2K2
OFFSET
VR7
22K
R40
150K
Q5
ZTX
239
R41
240
Q6
ZTX
239
R42
6K2
C16
2p2
Q7
2N3
904
Q8
2N3
904
R44
2K4
VR8
470
O/P LEVEL
C17
10n
R43
3K6
R45
3K3
R46
1K6
SW3b
SW2
SINE
SW4
TRI
SWITCHES S1 – S5 SHOWN IN 'OUT' POSITION.
●H DENOTES MAIN/CONTROL P.C.B. INTERCONNECTIONS.
R58
680
Q9
ZTX
239
R56
1K0
Q10
ZTX
239
C24
2p2
R60
9K1
Q11
2N3
906
Q12
ZTX
239
D11
1N
4148
D12
1N
4148
R62
33
R63
33
R64
300
R65
300
SW7
0dB
40dB
SKT3
600Ω
O/P
R67
4K7
R68
560
R66
47
R61
2K2
Q13
ZTX
214
●H10
R57
1K0
R70
150K
O/P
OFFSET
VR11
22K
R59
6K8