

OS1100 30MHz  
DUAL TRACE  
OSCILLOSCOPE  
Instruction Manual



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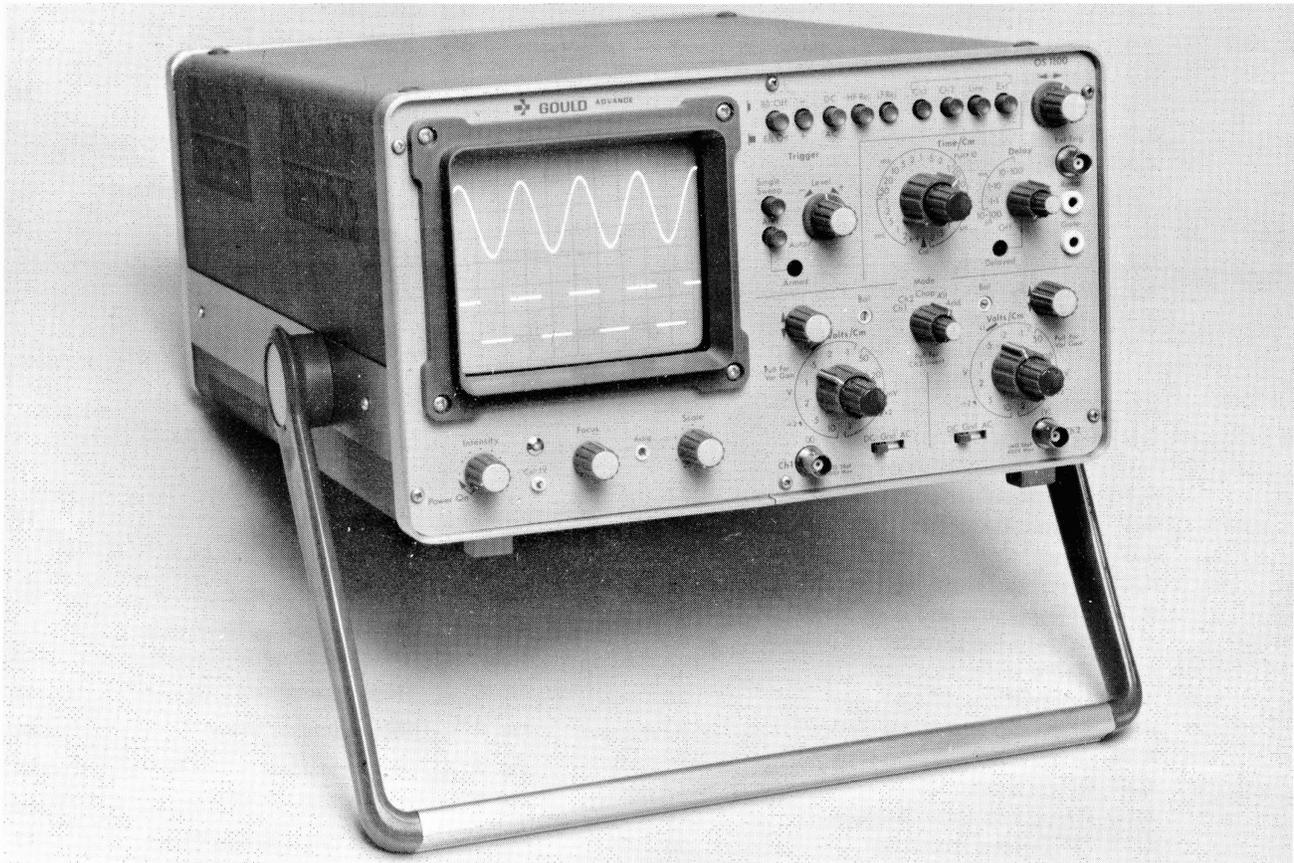
The Gould Advance OS1100 is a 30MHz lightweight dual trace oscilloscope. Its facilities make it particularly suitable for general purpose and high quality laboratory work, and its weight and size suit it for portable servicing applications of an exacting nature such as computers and data processing.

The high sensitivity and fast timebase speeds make the instrument ideal for the display of fast transients, and the

timebase delay facility allows examination of complex waveforms and pulse trains.

The Y channel fine gain feature provides sensitivity variations for each range from  $\div 2$  to  $\times 2$ . This allows overlap between ranges and a maximum instrument sensitivity of 1mV/cm.

Single Shot facilities are provided for the photographic recording of displayed phenomena.



## DISPLAY

8 x 10cm rectangular faced mesh c.r.t. operating with 10kV overall accelerating potential.  
Internal illuminated graticule. 8 x 10cm divisions with 2mm centre divisions.  
Phosphor P31 standard, P7 optional.

## VERTICAL DEFLECTION

Two identical input channels are provided, CH1 and CH2.

### Bandwidth

DC to 30MHz (-3dB) DC coupled.  
2Hz to 30MHz (-3dB) AC coupled

### Rise Time

11ns

### Sensitivity

2mV/cm to 10V/cm in 1:2:5 sequence  
Accuracy  $\pm 3\%$

A variable gain control allows continuous adjustment of sensitivity from  $\div 2$  to  $\times 2$ , giving 1mV/cm maximum sensitivity. Bandwidth at maximum gain  $> 25$ MHz.

### Input Impedance

1M $\Omega$ /28pF constant on all ranges.

### Maximum Input

$\pm 400$ V (dc + pk. ac)

### Signal Delay

Signal delay allows at least 1cm of visible delay at the fastest timebase speed.

### Operating Modes

CH1 only  
CH2 only  
CH1 and CH2 alternate  
CH1 and CH2 chopped (500kHz approx)  
CH1 and CH2 added. CH2 may be inverted.

### X-Y

CH1 input gives X deflection  
CH2 input gives Y deflection  
X Bandwidth 1MHz. Phase shift  $< 3^\circ$  at 500kHz.

## HORIZONTAL DEFLECTION

### Timebase

0.2 $\mu$ s/cm to 2s/cm in 1:2:5 sequence.  
An uncalibrated variable control covers a range of  $> 2.5:1$  giving slowest speed of approximately 5s/cm.

### Accuracy

$\pm 3\%$

### Expansion

X 10 expansion gives 20ns/cm fastest sweep speed.  
Accuracy  $\pm 5\%$ .

## TRIGGER

### Sources

CH1, CH2, Line, External.

### Slope

+ or -

## Input Coupling

DC, AC, HF reject, LF reject

**HF reject** Attenuates signals above approx. 10kHz.

**LF reject** Attenuates signals below approx. 10kHz.

## External Trigger

Input impedance 100k $\Omega$ /10pF

## Modes

Switched Auto level with Bright Line, 40Hz-3MHz.  
Variable level. Bright Line may be switched on or off.  
With Bright Line on, minimum frequency of operation is 40Hz.

## Sensitivity

Internal  $< 3$ mm deflection to 3MHz.

$< 1$ cm deflection to 30MHz.

External  $< 300$ mV to 3MHz.

$< 1$ V to 30MHz.

## Single Sweep

A Single Sweep Facility is provided with "armed" indication.

## TRIGGER DELAY

A variable delay is introduced between the acceptance of a trigger and the start of the timebase sweep.

Four ranges are provided:-

10	-	100 $\mu$ s
0.1	-	1ms
1	-	10ms
10	-	100ms

A variable control gives continuous selection of delay time and an l.e.d. indicates when trigger delay is switched in.

## GENERAL

### Calibrator

Square Wave 1V pk-pk  $\pm 1\%$  1kHz approx.

### Ext Z Modulation

Rear panel input. AC coupled.  
Bandwidth 10Hz-20MHz approx.  
10V gives visible modulation. 70V gives full blanking.  
Positive voltage increases brightness.

### Gate Output

0 to +5V

Output impedance 10k $\Omega$  approx.

### Ramp Output

0 to +2.5V

Output impedance 2k $\Omega$  approx.

## SUPPLIES

100, 120, 220, 240V  $\pm 10\%$

45-440Hz

Consumption approx. 40VA.

## OPERATING TEMPERATURE RANGE

0°C to 50°C

Full specification is met over the range 15°C – 35°C

## DIMENSIONS AND WEIGHT

180mm x 314mm x 420mm

11kg approx.

## ACCESSORIES SUPPLIED

Handbook	Pt. No. 37755
Mains Lead	PL98
BNC-Clips lead – 2 off	PL44
X10 Probe Kit – 2 off	PB13
Plug 4mm – 2 off	Pt. No. 1244

## OPTIONAL ACCESSORIES

### Probe Kit PB12

A passive probe kit with switched X1 and X10 attenuations. With X10 attenuation input impedance is 10M $\Omega$ /11pF.

### Viewing Hood PN32264

### Trolleys TR4 or TR6

General purpose oscilloscope trolleys.

### Protective Carrying Case PN36747

A strong carrying case which completely encloses the oscilloscope, with three thicknesses of padded material covering the front panel.

### Tube Option

The OS1100 may be ordered with a long persistence c.r.t. (P7 phosphor).

### Rack Mount Kit PN37155.

## 3.1 SWITCHING ON

Caution: The OS1100 is convection cooled and must always be operated in a position such that air circulation through the bottom and side vents is not restricted.

1. Set the support/carrying handle to the required operating position. The handle is released by pulling outward both fixing bushes when it can then be turned to lock in any of 5 positions.
2. Ensure that the supply voltage selector switches on the rear panel are set to suit the voltage of the supply to be used and that the corresponding fuse is fitted (see 5.1). The selector switches must not be operated while the instrument is switched on. Connect the supply.

THE INSTRUMENT IS INTENDED FOR OPERATION WITH A SUPPLY EARTH WHICH MUST BE CONNECTED.

3. Turn the INTENSITY control clockwise beyond the POWER-ON setting and ensure that the indicator lamp lights.

## 3.2 OBTAINING A TRACE

1. To obtain a trace:-
  - a) Set the CH1 shift control to approximately mid setting.
  - b) Set the MODE switch to CH1.
  - c) Set the X shift control to approximately mid setting.
  - d) Set the BRIGHT LINE ON/OFF switch to ON.
  - e) Set the TRIG COUPLING switch to AC.
  - f) Set the TRIG SOURCE switch to CH1.
  - g) Set the TIMEBASE switch to  $5\mu\text{s}$ .
  - h) Set the Single Sweep push buttons for normal operation.
  - i) Set the TIMEBASE DELAY to OFF.
  - j) Adjust the INTENSITY control to obtain a display of the required brightness.
  - k) Centralise the display by adjusting the CH1 and X shift controls.
  - l) Adjust the FOCUS control and ASTIG preset control to obtain a sharply defined trace.

## 3.3 SETTING THE Y CHANNELS

1. Using one of the coaxial input signal leads (PL44) connect a signal to the CH1 or CH2 input socket.
2. To locate the baseline, set the input slide switch to GND. At this setting, the input signal is open circuit and the input of the amplifier is switched to ground. For vertical movement of the trace, adjust the Y shift control (identified with vertical arrows).
3. For:-
  - a) Direct connection of the input signal, set the input slide switch to DC.
  - b) Capacitive coupling of the input signal through an internal  $0.1\mu\text{F}$  400V capacitor, set the slide switch to AC. This allows examination of low amplitude a.c. signals superimposed on a high d.c. level.

4. a) To adjust the Sensitivity  
Set the VOLT/cm switch to a suitable setting. To minimise pickup at sensitive settings it is advisable to ensure that the ground lead connection is near to the signal point.  
b) If necessary, pull out and adjust the concentric VARIABLE control. This control allows a range of sensitivity of approximately  $\div 2$  to  $\times 2$  about the calibrated ranges, so that its full adjustment provides overlap between ranges and a maximum instrument sensitivity (at reduced bandwidth) of 1mV/cm. An approximate calibrated position is shown by the broad red band on the front panel and the accurate calibrated condition can always be obtained by merely pushing the knob back to its normal position.
5. If, under no signal conditions, trace movement is apparent when the VARIABLE is altered, reset the BAL preset control.

### NOTE:

This control will only need adjustment at infrequent intervals. Before adjusting the BAL preset control however, ensure that the input slide switch is set to the GND setting.

Do not attempt adjustment within the first 15 minutes of operation to allow internal thermal stabilisation.

## 3.4 SINGLE TRACE OPERATION

1. For single trace operation of CH1, set:
  - a) The MODE switch to CH1.
  - b) The CH1 shift control (indicated by double ended vertical arrow) to mid setting.
2. For single trace operation of CH2, set:
  - a) The MODE switch to CH2.
  - b) The CH2 shift control (indicated by double ended vertical arrow) to mid setting.

## 3.5 DUAL TRACE OPERATION

In the dual trace condition, the beam switching function is in operation and results in the independent display of two signals simultaneously. Two modes of beam switching — chopped or alternate — are provided, selected by the setting of the MODE switch. At any fast setting of the timebase from  $0.2\mu\text{s}/\text{cm}$  to  $0.5\text{ms}/\text{cm}$  inclusive, the alternate switching mode is recommended. At slow settings from  $1\text{ms}/\text{cm}$  to  $2\text{s}/\text{cm}$  inclusive, the chopped switching mode is preferable.

For dual trace operation, set:

- a) The CH1 shift control to mid position.
- b) The CH2 shift control to mid position.
- c) Select ALT or CHOP on the MODE switch.

## 3.6 TIMEBASE AND X-Y OPERATION

The sweep speed of the timebase is determined by the setting of the TIME/CM switch.

1. To adjust the time scale of the horizontal axis:-

- (a) Set the TIME/CM switch to the required setting.
- (b) If necessary, adjust the concentric VARIABLE control to reduce the speed.

NOTE: The range of the VARIABLE CONTROL is approximately 3:1. The VARIABLE CONTROL is uncalibrated. At the CALIBRATED setting only the calibration corresponds to the setting of the TIME/CM switch. Selection of the 2sec/cm range and full use of the VARIABLE CONTROL gives a total sweep time of approximately 1 minute.

2. For horizontal shift of the trace, adjust the X shift control (identified by a double arrowed horizontal line above the knob). The control has a COARSE/FINE action. Initial operation provides coarse shift control, the return adjustment over a limited arc provides fine shift control.
3. If a close examination of any portion of the trace, or the fastest sweep rate, is required operate the PULL X10 control. In this setting the effective sweep length is increased to 100cm and the portion of the sweep that occupied the centre of the screen will now occupy the whole of the visible display.

Any portion of this increased sweep length may be selected for viewing on the display by adjusting the X shift control. A particular advantage of this facility is to increase the maximum sweep rate to 20ns/cm.

4. In addition to selection of the speed of the internal timebase the switch has a functional setting, X-Y. In this mode the internal timebase is disabled, the display unblanked and the input to CH1 is directed to the X plates of the c.r.t. while the input to CH2 provides the Y deflecting signal, irrespective of the setting of the mode switch.

In the X-Y mode the X channel gain is set to correspond with the CH1 deflection sensitivities of the VOLT/CM switch. The PULL X10 X gain control is inoperative.

It should be noted that the full range of the X shift control cannot be used in this mode. To avoid limitation of deflection, the X shift movement should be limited to retain the spot on the screen when the CH1 input is grounded.

### 3.7 TRIGGER

Choice of trigger signal source is by one of four push buttons. These are:-

- a) The supply line input frequency derived internally from one of the secondaries of the supply transformer.
- b) CH1 or CH2 amplifiers (these signals are available irrespective of which beam is being displayed).
- c) An external triggering source connected to the EXT. TRIG. input socket.

The trigger polarity (+/-) push button selects the edge from which the triggering signal is derived.

Movement of the trigger LEVEL control away from the switched AUTO position allows selection of the triggering point on the trigger waveform. This allows the start point of the trace to be set to any point of a waveform.

When the LEVEL control is set to AUTO, the trigger circuit automatically selects an a.c. coupled mode and biases to a sensitive level condition. In the absence of a trigger signal in this mode, the timebase will free run (BRIGHT LINE) and maintain a displayed, untriggered, sweep at the selected speed. The AUTO mode should not be used with waveforms of a wide mark/space ratio. The BRIGHT LINE mode may also be retained (B/L ON) in the manual trigger condition. Here, when the input signal is insufficient or the LEVEL control is set for a trigger voltage beyond the amplitude of the input signal waveform, the timebase will BRIGHT LINE and display an untriggered sweep at the selected speed.

However this facility can be rejected in the manual trigger mode by pressing the B/L. ON/OFF button to allow correct operation at low repetition rates of trigger. Auto or B/L. ON modes should not be used for trigger signals below 40Hz.

The choice of trigger signal coupling is by three push buttons as follows, allowing:-

1. A.C. Wide band trigger mode used for most common triggering signals.
2. D.C. A wideband trigger mode but it is most useful at very low frequencies. The Y input coupling must also be d.c. for this mode to be effective on internal trigger.
2. H.F. Rej. An R.C. filter is switched into the circuit to reject high frequencies. It is a useful mode when observing ripple or other low frequencies in the presence of high frequency noise or spikes.
4. L.F. Rej. An R.C. filter is switched into the circuit to reject low frequencies. High frequency triggering may then be effected from complex waveforms such as those with high ripple content, or line triggering from a television video signal waveform.

### 3.8 SINGLE SWEEP FACILITY

To set the timebase to give a single sweep:-

1. Apply a repetitive waveform and obtain a stable, triggered, trace with the single shot switch in the normal (both buttons out) position, by adjusting the manual TRIGGER LEVEL control.
2. Press the SINGLE SWEEP push button.
3. Press and release the spring biased ARM push button.

The circuit is then primed ready to receive the next trigger pulse to initiate one sweep. At the end of this sweep the single shot circuit will be reset, to inhibit further sweeps, until the ARM push button is again

pressed. An l.e.d. indicator shows when the circuit is primed, awaiting a trigger signal.

NOTE: the Single Sweep function will override the setting of the BRIGHT LINE facility.

### 3.9 DELAY FACILITY

In order to examine in greater detail some part of a complex waveform a delay time may be introduced between the receipt of trigger and the start of the corresponding sweep. This allows a faster sweep rate to be employed, with the effect of magnifying the display at the point of interest. This facility is particularly useful when looking in greater detail at one pulse in a chain or one particular line in the video signal in television receivers, where there is no convenient time-related trigger pulse close to the area of interest.

To use this DELAY facility:

1. Set up a stable triggered sweep.
2. Switch the DELAY on (the DELAY ON indicator will light) and increase the range and fine delay control to bring the required portion of the sweep to within the first centimetre of the display.  
Like the X shift control, the fine delay control has a dual action which provides coarse setting with wide movement of the control but fine setting over a limited arc of return travel.
3. Increase the sweep rate to expand the display.
4. Repeat adjustment of the delay time and then the ramp sweep rate until the required resolution is obtained.

NOTE:

1. The accuracy and rate of the timebase are unaffected by any delay setting.
2. There will be a dimming of the display as the effective duty cycle changes when long delays are used on fast sweep speeds. This may be corrected by an increase of INTENSITY.

### 3.10 ADDITIONAL FACILITIES

#### 3.10.1 USE OF THE PASSIVE PROBE

An external probe may be used to extend the voltage-range and increase the input impedance of the Y amplifiers. The input impedance of a Y channel is  $1\text{M}\Omega$  shunted by approximately  $28\text{pF}$ . The effective capacity of the input lead must be added to this and the resultant impedance

will sometimes load the signal source. Therefore it is advisable to use a  $10\text{M}\Omega$  X10 probe such as the PB12 or PB13. This reduces the input capacity and increases the input resistance, at the expense of the sensitivity. The probe contains a shunt R.C. network in series with the input and forms an attenuator with the input R.C. of the Y Channel. To obtain a flat frequency response it is necessary to adjust the capacitance of the probe to match the input capacity of the Y Channel as follows:-

- (1) Set the Y Channel VOLTS/CM switch to  $20\text{mV/cm}$ , and the TIME/CM switch to  $0.2\text{ms/cm}$ .
- (2) Connect the probe to the cal 1V pin just below the tube face.
- (3) Set the adjustable capacitor in the probe tip or termination with a small trimmer tool for a level response with no overshoot or undershoot visible on the display.

#### 3.10.2 CAL 1V

This pin provides a d.c. coupled positive-going square wave of  $1\text{V} \pm 1\%$  amplitude at approximately  $1\text{kHz}$  frequency for calibration checks. The square wave has a source impedance of approximately  $200\Omega$  and a rise time of less than  $100\text{ns}$ .

Shorting the cal pin to ground will produce a square wave current waveform of  $5\text{mA}$  in the shorting link. This can be used for current probe calibration.

#### 3.10.3 GATE OUTPUT

This socket of the front panel provides a d.c. coupled positive-going square pulse of  $5\text{V}$  amplitude with a source impedance of  $10\text{k}\Omega$ , the duration of the pulse being coincident with the appropriate timebase sweep.

#### 3.10.4 RAMP OUTPUT

This socket on the front panel provides a d.c. coupled positive going timing ramp of  $2.5$  volts amplitude, with a source impedance of  $2\text{k}\Omega$ . The ramp may be used as a drive for external frequency swept oscillators to allow display of voltage against frequency.

#### 3.10.5 Z - MOD

This socket on the rear panel provides a.c. coupled blanking to the grid of the tube. Visible modulation can be seen with an input signal of  $10\text{V}$  peak to peak. The voltage necessary for full blanking is a function of the INTENSITY setting but is typically  $50\text{V}$ , negative going. The l.f. input impedance is approx.  $800\text{k}\Omega$ . High frequency input impedance drops to approx.  $150\Omega$  but this shunt path can be disconnected (see section 4.21).

Figures 2, 3 and 4 show the circuit details of the Y amplifier, timebase and power supplies respectively. Fig. 5 shows their inter-connection but for clarity some details of this inter-connection are included in the detailed diagrams also. For convenience, the circuit reference of any component can be used to determine its location in the instrument.

1 – 99	Frame or interconnection
100 – 199	CH1 Pre-amplifiers, trigger amplifier beam switch, beam switch bistable.
200 – 299	CH2 Pre-amplifiers, trigger amplifier.
300 – 399	Delay line drive, equaliser, Y O/P amplifier, bistable drive and X/Y amplifier.
400 – 499	} Trigger Timebase, delay and X O/P amplifier.
500 – 599	
600 – 699	
700 – 799	} Power Supply
800 – 899	
900 – 999	
e.g. R309 is part of the Delay Line Drive.	

The circuit diagrams are generally arranged for each printed board assembly or group of boards. These diagrams include some of the switches, potentiometers etc., closely associated with the circuit although these components may be mounted on the frame. Consequently not all such components appear on the interconnection diagram Fig. 5 and where it makes the circuits easier to follow, some components appear on more than one circuit.

## 4.1 THE BLOCK DIAGRAM

The block diagram for the complete instrument is shown in Fig. 1. It is not intended to be a full working diagram but gives details of the functional points of the circuit and their inter-relation. The circuit can be readily divided into three main sections which are:

Y deflection circuits, X deflection circuits (including timebase delay and trigger circuits) and Power Supply which includes Bright-up functions.

### Y CHANNELS

The switched attenuator, pre-amplifier and trigger amplifier are identical for the two Y channels except that CH1 provides pick-off and amplification for the X/Y signal and CH2 provides invert facilities. The selection of the decade steps of the attenuator and 1. 2. 5. sequence of pre-amplifier gain switching are determined by the sensitivity selected.

The use of the fine gain facility on either channel allows a 2:1 increase or decrease in sensitivity.

The channel switch is a fast electronic switch with the equivalent of a change-over action as shown. It selects either the CH1 or the CH2 signal to be passed to the subsequent stages and is controlled from a J-K flip-flop. The state of the flip-flop and hence the channel selection is

determined by d.c. voltages applied to its preset and clear inputs. In the chop mode, the J-K flip-flop is driven via its clock input and a signal gate from a free running monostable, switching the beam between CH1 and CH2 signals as the X sweep progresses. In the alternate mode, end of sweep pulses are fed from the timebase to the J-K via the signal gate and reverse the beam switch at the end of each timebase sweep, giving alternate CH1 and CH2 sweeps. In the ADD mode, both the CH1 and CH2 switches are closed and the two signals are summed algebraically. On CH1 or CH2, the appropriate switch is closed, allowing only that signal to pass.

The signal from the selected channel is passed via a delay line and amplifiers to the Y deflection plates of the c.r.t. The delay allows examination of that point in the waveform which triggered the sweep since the deflection signal reaches the Y plates after the timebase sweep and bright-up have been initiated.

### THE TIMEBASE

The purpose of the timebase system is to generate a linear ramp to deflect the spot in the X direction. The trigger system initiates each sweep from the incoming or other signals, normally to obtain a stationary display of a repeated waveform.

The internal or external trigger signal as selected is amplified by the trigger amplifier which is biased by the required trigger level, and the resultant is amplified and passed to drive the trigger circuit. If the timebase is ready to commence a sweep, a transition of the trigger circuit will set the timebase bistable which in turn initiates the ramp. This signal is passed via the X amplifier to the X deflection plates of the c.r.t.

At the end of the sweep, the bistable is reset, returning the ramp to the original level. During the period of sweep, the trigger gate is prevented from passing trigger pulses to the bistable and this inhibition is maintained by the hold-off circuit until the ramp generator is fully recovered, ready for the next sweep to commence on the next trigger pulse, when the cycle is repeated.

In the delay mode the timebase bistable is triggered in the same manner but the bistable output to the ramp generator is inhibited for the period of the delay. To allow time for the delay monostable to fully reset there is an additional hold-off control from the delay circuit into the trigger gate. In Single Sweep, the relevant bistable normally inhibits the trigger pulses from reaching the timebase bistable by biasing the hold-off circuit, and hence closing the trigger gate. When the single sweep bistable is armed the trigger gate is opened and the next trigger pulse initiates a sweep. At the end of the sweep the single sweep bistable is reset, preventing the timebase from sweeping again until the manual ARM button is pressed once more.

The trigger signal for the timebase, selected from either internal, external, or line frequency sources, is passed through the required processing filter selected by the



coupling switch, before being applied to the trigger amplifier. The trigger amplifier is biased to the required trigger level and the resultant amplified output is taken to the Schmitt trigger to be squared up before being applied to the polarity circuit.

When Bright Line is selected the output from the polarity circuit will couple into the bright line monostable. In the absence of trigger pulses, the bright line circuit will provide a bias into the trigger gate, causing the timebase bistable to be set at the end of each hold off period, thus giving repeated sweeps for a bright display.

When Auto is selected, in addition to the bright line operation being called for, the trigger signal is a.c. coupled and the amplifier is biased to a sensitive working point.

The bright-up circuits normally hold the c.r.t. beam in the cut-off state. The output of the timebase bistable, which allows the ramp to operate, also feeds the bright up circuit to raise the brilliance of the c.r.t. trace to the level determined by the intensity control. At the end of the sweep, the timebase and bright-up bistables are reset, blanking the trace during the fly back period.

If the Y Channels are being switched in the chop mode an output is fed from the multivibrator via the bright-up gate, to the bright-up circuits, blanking the trace while the Y switching transition takes place.

#### 4.2 INPUT ATTENUATORS AND PRE-AMPLIFIERS

NOTE: The Attenuator and Pre-amplifier in CH1 are identical to those in CH2. Accordingly, only CH1 is described. The circuit references of all board mounted components are arranged such that CH1 pre-amplifier numbers 100- and corresponding components in CH2 200-.

The input signal is applied from the front panel socket SKA to the 3 position slide switch, S11. When the input coupling switch is in the D C. position, the input signal is coupled directly to the input attenuator. In the A C. position, the input signal passes through C11 which prevents the d.c. component of the input signal from passing to the amplifier. The GND position opens the signal path and connects the input circuit of the amplifier to ground. This provides a ground reference without having to disconnect the applied signal from the input connector.

The input attenuators are frequency compensated, voltage dividers. For d.c. and low frequency signals they are primarily resistive dividers and the attenuation is determined by the resistance ratios, the effect of the capacitors being negligible. However, at high frequencies, the reactance of the capacitors decreases and the attenuator becomes primarily a capacitive divider. Each attenuator contains an adjustable series capacitor to provide optimum response for the high frequency components and an adjustable shunt capacitor to set up the input capacity of each section. The component values in each section are arranged to provide the required attenuation and present

the same input R.C. characteristic for all settings of the VOLT/CM switch.

Two attenuator sections are employed to divide by 10 and 100 respectively. These are used singly or cascaded. The basic amplifier provides a maximum sensitivity of 2mV/cm, and gain switching in the amplifier reduces this to provide 5mV/cm and 10mV/cm sensitivities. The X10 attenuator is introduced to provide the 20, 50 and 100mV/cm ranges; the X100 to provide the 200mV, 500mV and 1V/cm ranges and the X10 and X100 cascaded to provide the 2, 5 and 10V/cm ranges.

The X10 attenuator consists of R3 and R9. Capacitor, C13, sets the input capacitance on the 20, 50, 100mV/cm ranges, while C14 corrects the frequency response of the attenuator.

The X100 attenuator consists of R12 and R13. Capacitor, C16, adjusts the input capacitance on the 200mV, 500mV and 1V/cm ranges, while C16 corrects the frequency response of the attenuator. Capacitor, C19, provides adjustment for the input capacity when the attenuators are not in circuit. R18 determines the input resistance of the oscilloscope when the attenuators are not in circuit and forms part of the attenuator resistors on all other ranges.

The output from the attenuator is taken via the input current limiting resistor, R17, to the gate of the field effect transistor, TR101(a). The input stage consists of two transistor feedback pair amplifiers, TR101(a)/TR102 and TR101(b)/TR103, connected as one differential amplifier. The overall gain of each stage is determined by the ratio of the feedback resistor, R111 or R112, to the common source resistor, R40. The single ended input to differential output gain in this arrangement is approximately 5 with S13 in the CAL position.

The signal input is fed to the gate of TR101(a) and balancing potentials to the gate of TR101(b). These transistors are matched and in a common encapsulation, therefore any drift due to temperature changes will be minimised.

The gain of the stage is a function of the common source resistance, hence the VARIABLE GAIN function is available when R42 and the variable control potentiometer, R2, are switched into the circuit.

The field effect transistor gives a high input impedance which does not shunt the attenuator significantly. The signal excursion at the gate of TR101(a) is restricted by the limiting diode, D102, which is returned to the negative supply line. Differential signals from the input stage are fed via R119 and R121 to the gain switching stage, TR104/TR105. A potentiometer, R120, is provided to supply a small balancing current into the source of TR101(b). This gives some variation of the collector potential TR102/103, and allows the emitter potentials of the following stage to be equalised to prevent trace movement when gain switching.

Gain switching is achieved by S12dB, switching resistance, R116, R117 or R118, between the emitters of TR104 and TR105 to give the 2mV, 5mV and 10mV/cm steps. Trimmer capacitors are provided for high frequency compensation. Decoupled resistors, R127 and R128, are included to reduce collector dissipation and keep thermal drift to a minimum. The collector supply is stabilised by the 4.3V zener, D103.

### 4.3 BEAM SWITCH

The CH1 and CH2 signals feed two identical long-tail pair amplifiers, TR151/2 and TR153/4, on the beam switch printed circuit board. In addition to providing signal current feed to the beam switch, provision is made for overall gain adjustment in each channel by means of the two networks, R151/152 and R161/162. C151 and C152 are included to allow the h.f. response of the two channels to be matched. A.O.T. resistor, R199, gives the facility for balancing the currents in CH2 to minimise trace shift when the INVERT switch is operated.

The beam switch for each channel consists of an array of four transistors arranged in common base configuration. The transistors are connected in pairs with their emitters commoned. One collector of each pair is returned directly to the supply and the other collector to the common output load. The base of each transistor in the array is returned via a potential divider to an output from the J-K flip-flop, IC153, which will either be 'HIGH' or 'LOW' depending on the drive at its preset, clear or clock inputs. This gives the facility for turning on or off each transistor in the array and thus diverting signal current into the load or into the supply rail. Signal feed to each common base pair comes from the preceding stage and the shift network also is connected between the common emitters of each pair.

Thus, assuming CH1 is to be selected, Pin 15 on the J-K will be 'HIGH' and Pin 14 'LOW'. In IC151 transistors (3-4-5) and (9-10-11) will be turned on, diverting signals to the load. Transistors (1-2-3) and (6-7-8) will be off.

TABLE SHOWING VOLTAGES IN BEAM SWITCH CIRCUIT

MODE

Circuit Reference	PIN No.	CH1	CH2	CHOP	ALT	ADD	X-Y
IC151	5	3 4	3 4				3 4
	2 – 1Q̄	L (0)	H (1)			L (0) <sup>1</sup>	H (1)
	4 – 1Q	H (1)	L (0)			H (1)	L (0)
	6 – 1Q̄	L (0)	H (1)			L (0) <sup>1</sup>	H (1)
IC152	9 – 1Q	H (1)	L (0)			H (1)	L (0)
	2 – 1Q	H (1)	L (0)			L (0) <sup>2</sup>	L (0)
	4 – 1Q̄	L (0)	H (1)			H (1)	H (1)
	6 – 1Q	H (1)	L (0)			L (0) <sup>2</sup>	L (0)
TR157	9 – 1Q̄	L (0)	H (1)			H (1)	H (1)
	COLL	H (0V)	H (0V)	H (0V)	H (0V)	H (0V)	L (-5.3V)
TR158	COLL	L (-5.3V)	L (-5.3V)	L (-5.3V)	L (-5.3V)	L (-5.3V)	H (0V)
IC155	2 1PR	L (0) (-5.3V)	H (1) (0V)	H (1)		L (-4.7V)	H (0V)
	3 1CL	H (1) (0V)	L (0) (-5.3V)	(-5.3V)		L (-4.7V)	L (-5.3V)

- Notes: 1 Via R190      2 Via R187
- 3 LOW (IC151/152) = -0.35V }  
 4 HIGH (IC151/152) = -0.04V } W.R.T. GND
- 5 Equivalent points on IC153, logic using -1V to -4.6V

In IC152 transistors (3-4-5) and (9-10-11) will be “off”, transistors (1-2-3) and (6-7-8) will be “on”, diverting signals away from the load and into the supply rail. The state of the J-K is determined by the position of the MODE switch, S152, the wiper of which is normally held at  $-5.6\text{V}$  via TR158, being held on through R185 and R188. Since the IC 153 is operated between ground and  $-5\text{V}$  returning any preset or clear input to the MODE switch wiper via a diode will be equivalent to a ‘LOW’ state at that input and set the J-K to the appropriate condition.

In all modes except chop, TR315 is held “on” by the network, R365, D305 and R364. This returns R362 to ground, holding the multivibrator, TR313/314, in a quiescent state.

When CHOP is selected, TR315 is turned off and the multivibrator free runs at approximately 1MHz. Output from the multivibrator feeds the two transistor gate, TR311/312, and then to the clock input of the J-K. Alternate pulses are also fed into the gate from the timebase and in the CHOP mode turn the gate ‘OFF’ during the flyback period. This inhibits beam switching during the flyback period and minimises the effect of chop interference on the trigger circuits just prior to the start of sweep. Chop pulses are also fed to the bright-up circuit to blank the switching transitions.

When ALT. is selected, TR312 is turned off and alternate pulses only are fed to the gate and these clock the J-K at the end of each sweep.

When ADD is selected both preset and clear are taken ‘LOW’ via diodes D160 and D161, thus taking Pins 14 and 15 on the J-K ‘HIGH’. This turns all transistors in the arrays on, feeding signal currents from both channels to the common load. In order to prevent upsetting the shift control d.c. conditions transistors (1-2-3) (6-7-8) on IC151 are turned off by pulling their bases negative via R190 and D159. Similarly transistors (1-2-3) (6-7-8) on IC152 are turned off by pulling their bases negative via R187 and D159.

In order to avoid upsetting the common load d.c. conditions two current sources, TR155/156 are turned on to remove the excess d.c. current via diodes, D152/153.

When the X-Y mode is selected, the timebase range switch connects  $+10\text{V}$  to the base of TR157 via R191, turning it on and TR158 off. Since TR157 is saturated, diodes, D155, are returned to  $5.3\text{V}$ , this is the condition for selecting CH2 and ensures that in X-Y CH2 always becomes the Y deflection irrespective of the setting of the MODE switch.

#### 4.4 DELAY LINE DRIVE, TERMINATION AND EQUALISER

Signals from the beam switch pass to the delay line driver, a further long-tailed pair, TR301/302, fed from a constant current source, TR316. The collector loads R307 and

R308 are arranged to match the characteristic impedance of the balanced printed circuit line which introduces a signal delay of approximately 100ns. This ensures that the trigger point of the signal is always visible on the screen.

The output of the delay line is terminated by the resistors, R310 and R311, and feeds into a common base stage, TR303/304. The network, R348, and potentiometer, R349, allow for any small matching adjustments necessary due to manufacturing tolerances in the line.

The pulse response for the uncompensated delay line can be represented by a fast rise for about 50% of amplitude followed by a considerably longer rise to full amplitude. Correction for this response is provided in part by networks C329/R340, C301/C330/R350, C302/R301 in the delay line driver stage, and also by the following stage TR305/TR306 which in addition raises the signal level to that required to drive the output stage.

#### 4.5 OUTPUT STAGE

The output stage consists of four transistors, TR307, TR308, TR309, TR310, operating as a differential cascode amplifier. High frequency compensation is provided in the collector circuits by L301 and L302 and in the emitter circuit by the networks, C313/R369 and C331/C315/R330.

The outputs are taken to the Y deflection plates via zener diodes, D302 and D303, which raise the Y mean plate potential by 33V.

#### 4.6 Y TRIGGER AMPLIFIER AND X/Y PREAMPLIFIER

The trigger amplifier consist of long tail pairs, TR106/TR107 and TR206/TR207 receiving differential signals from the emitter circuits of the beam switch driver stages and providing a single ended output for the timebase.

R135 and R235 allow the d.c. level on CH1 and CH2 outputs to be set to 0V.

An additional output is taken from the CH1 trigger amplifier and fed to an amplifying and inverting stage, TR316. This provides an output level of approximately 60mV/cm and feeds CH1 signals to the X amplifier when the X-Y MODE is selected. The gain of this stage is set by R373 and phase shift correction is provided by C327 across the feedback resistor, R374.

#### 4.7 TRIGGER SELECTION

The trigger signals from CH1, CH2, Line and Ext. are taken to the push button source selector, S401 to 404. The two internal trigger signals are brought from the Y unit via  $50\Omega$  coaxial cable and terminated by resistors, R405 and R406. The line trigger signal is derived from one of the supply transformer secondaries and attenuated to the correct level by resistors, R402 and R404. The external trigger input, SKE, is connected to S401 via the attenuator network, R401, C401 and R403.

The signal selected by S401-S404 is passed to S405-S407, the coupling network selection switch, which provides:-

1. AC. In this mode the d.c. component of the input signal is blocked by capacitor, C405.
2. HF REJ In this mode all higher frequency component signals are filtered out by the network, R407 and C404.
- 3 LF REJ In this mode the signal is passed through capacitor, C403 to reject the lower frequency components of the input signal.
4. DC. In this mode there is a direct connection from the input selector switch to the input of the trigger amplifier. The AUTO/MANUAL switch, S3a blocks this path in the AUTO mode.

#### 4.8 THE TRIGGER AMPLIFIER

The input signal is taken to the base of TR401, the first stage of a cascade differential amplifier, TR401-TR404. The other input, applied to TR404 is the trigger level voltage as set by R424 (the manual TRIGGER LEVEL control) and modified by the preset mid point control, R423. The d.c. balance preset, R474 allows the current in R475 to be set to offset the base current in TR401 and avoid a change of base potential of TR401 when switching between AC. and DC. coupling.

The transistor switch, TR406, is held on in the Manual condition by R428 and S3b therefore clamping the input via R425 at ground potential.

The gain of this stage is set by R414, with high frequency compensation given by C408. The differential output, taken from the collectors of TR402 and TR403, is fed to the inputs of a second long tailed amplifying stage comprising TR411 and TR412. Here the gain is set by R449 with compensating capacitor, C414, in parallel. The single-ended output from this stage is taken from the collector of TR412 and feeds the base of emitter follower, TR413, via R456.

#### 4.9 AUTO

When AUTO is selected by rotating the LEVEL control to its extreme anti-clockwise position, switches S3a and S3b open. In this mode;

1. The trigger signal is a.c. coupled, regardless of the AC/DC coupling switch position.
2. Transistor TR406 turns off, thereby unclamping the d.c. feedback path from the collector of TR412 via emitter follower, TR405, to the base of TR404. This stabilises the mean d.c. potential from the output of the amplifier to the optimum level required by the Schmitt trigger and preset by R442. R447 and C411 block a.c. feedback to maintain full a.c. trigger sensitivity. Any d.c. out of balance voltage will be fed back via TR411 and TR412, to modify the base potential of TR404.

Switch, S3b, also enables the Bright Line circuit via TR407. (See the section, BRIGHT LINE 4.12.)

#### 4.10 THE SCHMITT TRIGGER AND POLARITY CIRCUITS

The trigger signal is taken via emitter follower, TR413, to the Schmitt trigger circuit, formed by transistors, TR414 and TR415, and associated components, with the current source transistor, TR416, in the tail. With the base of TR414 more positive than the base of TR415, TR414 will conduct. As its base is driven negative, current begins to flow in TR415 at the expense of current in TR414. This means that the potential across the collector resistor, R460, will start to fall and via R466 the base potential of TR415 will start to rise. This positive feedback causes a rapid changeover to TR415 conducting and TR414 turned off. The reverse happens as the base potential of TR414 is driven positive. Both collector outputs are taken to the polarity selection stage of TR417 and TR418.

Operation of the polarity push button switch, S409, causes either diodes, D411 and D413, or diodes, D412 and D414, to conduct through R469 or R472 respectively. This then will clamp the collector voltage of either transistor, TR417 or TR418, at approximately  $-1.4V$ , leaving the other to feed into the common load resistor, R471. For positive slope the trigger signal from TR418 flows through D410 into R471. The collector current of TR417 flows through R469 to the supply line. For negative slope the reverse phase trigger signal from TR417 feeds R471. The voltage developed across R471 is a fast rise square pulse and feeds both the bright line circuit and the time-base gate circuit.

#### 4.11 THE TRIGGER GATE AND BISTABLE CIRCUITS

Transistors, TR429 and TR421, form a gate at the input to the timebase bistable allowing trigger pulses from the polarity circuit or the bright line signal to set the timebase bistable when not inhibited by the hold-off voltage. Transistor, TR429, is a clamp which prevents TR421 from conducting when the hold-off signal, via R612, is positive. (During the hold-off period.)

Positive-going trigger pulses are differentiated by C421 and fed to the base of TR421. With TR429 off, these cause negative-going spikes at the collector which are coupled to the base of transistor, TR420, within the time-base bistable. A positive bright line bias (free run) from TR410 via R440 into the base of TR421 will also drive the collector of TR421 more negative when TR429 is OFF. Diodes, D427 and D428, ensure that the base potential of TR420 will, in the waiting period, sit at  $+0.7V$  while D421 will set the base of TR419 at  $-0.7V$ . Therefore the amplitude of trigger pulses to set the bistable is a negative going transition of  $1.4V$ .

TR419 and TR420 form the timebase bistable, biased such that TR420 is normally conducting. A negative-going

signal applied to its base from TR421 will stop it conducting. Its collector voltage will rise and the cross coupling components, R490 and C423, will turn on TR419. The common emitter potential of the two transistors will rise with the base of TR419, holding off TR420. The collector potential of TR419 will fall allowing the ramp generator to sweep. The negative going ramp is returned via D422 and R491 to the base of TR419. The point at which TR419 turns off and the bistable resets to normal, determines the end of sweep.

Transistor, TR422, forms a buffer on one output from the timebase bistable, via TR428. From this buffer stage outputs are taken to reset the single sweep circuitry, see Section 4.17, and to provide the alternate pulse, being used to operate the channel switch in the ALTERNATE mode. See Section 4.3.

#### 4.12 THE BRIGHT LINE CIRCUIT

If, in the AUTO or BRIGHT LINE mode, the trigger signal for the timebase is lost or becomes too small to trigger reliably, the bright line circuit causes the timebase to free run by applying a positive bias into the trigger gate. In this condition a bright trace is produced irrespective of the timebase speed selected.

Transistors, TR408 and TR409, form a monostable circuit. In the quiescent condition both transistors are off. Negative going trigger input pulses from the polarity circuit via D401, are differentiated by C410 and applied to the base of TR408. The collector potential will rise, with it the base and emitter potential of TR409. The charge on capacitor, C412, will hold TR408 conducting (by the time constant, C412 and R438). With the emitter potential of TR409 high, TR410 is held off, therefore giving no bias into the trigger gate. However, with no trigger pulses into TR408 the emitter of TR409 will fall to a low potential, so that TR410 turns on, thereby giving a positive bias into the trigger gate.

The action of the monostable is controlled by the diode gate, D401 and D404. D401 is reverse biased, inhibiting trigger input signals if D404 is grounded at Pin 8. That is if the transistor switch, TR407, is conducting (S3b closed in Manual) and S408 is closed (B/Line off). In the Single Sweep mode S1a inhibits bright line by directly grounding Pin 8.

#### 4.13 THE RAMP GENERATOR

The basic bootstrap ramp generator is formed by f.e.t., TR441, as a source follower, and the subsequent emitter follower, TR442, with a constant current load, TR443. This constant current produces across the zener diode, D432, a constant voltage difference from the gate potential of TR441. A portion of this voltage is taken from the wiper of R548 and fed back to the gate of TR441 via the selected timing resistor, RT.

In the absence of other influences, the resultant constant current flows to ground through the selected timing capacitor, CT, causing the voltage across this capacitor to

drop linearly. This linear ramp, whose rate is set by the values of RT and CT and the variable sweep control, R548, is fed from the emitter of TR442, via S6cb to the X output amplifier and hence the X deflection plates of the c.r.t.

In the quiescent state, the ramp voltage is held positive by the collector current of TR435 flowing through diodes, D430 and D437, the whole being maintained at balance by the differential amplifier pair, TR437/TR438.

When the timebase bistable is set, the collector voltage of TR419 will fall, turning on TR434. Transistor, TR435, will turn off, thereby reverse biasing diodes, D430 and D437, and allowing a negative-going ramp to commence under the influence of the voltage across RT. The ramp will continue to run negatively until the bias applied to the base of TR419 in the timebase bistable, via the potential divider, R491 and R485, causes it to turn off, whereupon the timebase bistable will assume its reset state, with the collector potential of TR419 high. Transistors, TR434 and TR435, will also assume their original states, with TR435 conducting hard causing diodes, D430 and D437, to conduct, thereby charging the timing capacitor to its original positive potential. Since this flyback current is many times greater than the ramp current through the timing resistor RT, the flyback time is short compared to the ramp time. When the ramp potential reaches the quiescent level, TR438 will conduct, reducing the current in TR435 to balance the current in RT.

#### 4.14 HOLD-OFF

Triggering of the timebase bistable must be prevented or held off during the flyback period until the ramp generator has fully returned to its quiescent state. When a trigger pulse passes through the trigger gate and initiates a sweep, the ramp voltage applied to potential divider, R539 and R540, starts to move negative. This change is coupled via D431 to the base of transistor, TR440, which will turn off. Its collector potential rises and the clamp transistor in the trigger gate circuit, TR429, turns on, due to base current through R612, and inhibits any further trigger pulses passing to the base of TR421.

The selected hold off capacitor ChO, is connected to the base of the transistor, TR440, and is charged by the negative going potential of the ramp applied via diode, D431. At the end of the sweep when the ramp is reset this diode will be reverse biased and subsequently the base potential of TR440 will rise slowly under the influence of ChO and resistor, R532, as the capacitor charges toward +10V. After a period the transistor will turn on, causing its collector potential to fall, and turning off the gate clamp transistor, TR429. This delay or hold-off period allows time for the ramp generator to reach its original quiescent state before any further trigger pulses can be passed by the trigger gate. The hold-off capacitor is selected by S6bb and is the next smallest timing capacitor.

## 4.15 BRIGHT-UP and CHOP GATING (DRIVE SIGNALS)

The display is brightened up during the sweep by unblanking the c.r.t. The drive signal to the bright-up bistable is derived as follows.

The collector voltage of TR419 is coupled to TR428, which with TR430 form a cross coupled stage. The base of TR430 is biased by resistors, R505, R506 and R494, to a lower voltage than the threshold of the ramp start pair, TR434 and TR435. This allows the ramp to be initiated before the bright-up circuitry, so avoiding any interference at the start of the sweep. The output from the collector of TR430 is added to the chop transition blanking voltage obtained via the emitter follower, TR431. The chop blanking voltage is necessary to blank the display during the successive transitions between CH1 and CH2 when operating the Y system in the CHOP mode. The summed output is passed to the Bright-Up circuitry. (See section 4.20.)

## 4.16 DELAY

In this mode a delay is introduced between the acceptance of trigger and the commencement of the sweep and associated bright-up signals. The delay circuit consists of a monostable, comprising the cross coupled common emitter pair, TR423 and TR427, with the associated emitter followers, TR424 and TR426. The timing capacitor, CD, is selected by S5 and is connected between the collector of TR423 (via emitter follower TR426) and the base of TR427.

The delay time is determined by the current from the current source transistor, TR439, and is adjustable over a 10:1 range, set by the potentiometer, R536 and R537 – the coarse and fine delay controls. The monostable is triggered by a pulse from the collector of TR420, in the timebase bistable which is differentiated by C422, to the base of TR423. This will cause TR423 to conduct and, via the cross coupling, turn off TR427. The base of TR427 will slowly rise positively as CD is charged by the current source, TR439. At the threshold voltage the original state will be resumed, with TR423 turned off and TR427 conducting. The diode, D424, allows a fast recharge of CD. The timebase inhibit control is taken from the collector of TR427, which is at a 'high' potential, via emitter followers, TR426 and TR425, to the collector of TR419 in the timebase bistable. Transistor, TR425, acts as a clamp on the collector swing of TR419, preventing the downward excursion which would initiate the ramp and bright-up circuits.

Transistor switch, TR452, is normally held off by S5c but in the delay mode it conducts when TR420 is on. When TR420 turns off on receipt of a trigger signal, TR452 is slow in turning off, maintaining a clamp on the collector of TR419 until maintained by TR425. This prevents a false start of sweep at the beginning of the delay period.

At the end of the delay period, transistor, TR427, will conduct, causing its collector potential to fall, similarly

the base voltage of TR425 will fall. As this happens the collector voltage of TR419 will drop, thus initiating the ramp.

A finite time must elapse following the delay period for the delay timing capacitor to completely discharge before a second delay can be triggered. This hold-off period is achieved as follows. During the delay period the positive output from the emitter follower, TR426, is taken, via emitter follower, TR432, to discharge the capacitor, C.h.o. At the end of the delay period when the input voltage to TR432 falls, the voltage across this hold-off capacitor will fall only slowly, therefore introducing some delay before transistor, TR436, can start conducting. The potential on the collector of TR436 is taken via emitter follower TR454 as a hold-off voltage to the base of the hold-off transistor TR440. Its action is the same as a ramp input to the trigger gate as described in Section 4.14. Transistor, TR453, acts as an input clamp to overcome trigger pick-up during the delay period. Switch S5af either energises the DELAY/ON warning light, D422, or, in the delay OFF condition, biases the input of the monostable, via R495, preventing any trigger pulses from initiating a delay.

## 4.17 SINGLE SWEEP

In this mode, a hold-off bias is applied to TR440 and hence the trigger gate, thereby inhibiting trigger pulses from reaching the timebase bistable. When the ARM button is pressed this bias is removed and the next input trigger pulse will initiate a single sweep of the ramp. At the end of the ramp the reset action of the timebase bistable will set the single sweep circuitry, applying the inhibiting bias to the hold-off circuit, preventing a further sweep until the ARM button is pressed again.

The single sweep circuitry is contained within a dual bistable positive edge operated c.m.o.s. integrated circuit, IC402, which operates between the 0V and -10V lines. The first bistable operates as a slave, following the action of the ARM push button without any bounce interference, while the second bistable controls the bias applied to the hold-off circuit. The output from this second bistable (Pin 12) is normally at 0V, with no resultant effect on the operation of the timebase.

Operation of the Single Sweep push button, S1b, removes the high (0V) input from Pin 10 (the reset input of the second bistable).

At the end of the next sweep the timebase bistable is reset in the normal manner (see Section 4.11), the collector potential of TR419 rises, causing the collector voltage of TR428 to fall. This fall is coupled via zener diode, D435, to the base of TR422. Therefore, at the end of the sweep the collector potential of TR422 will rise giving a positive-going edge which, via R610 and C441 is applied to the set input of the single shot (second) bistable, causing  $\bar{Q}$  (Pin 12) to drop to -10V, D429 conducts via R594, re-applying the hold-off bias to TR440 and preventing further sweeps. It also applies a high voltage via S2 to Pin 6. (The Set input on the first bistable.) This connection drives the Q

output (Pin 2) low, causing no change of state on the second bistable. Operation of the ARM button applies a high voltage while pressed to the reset input (Pin 4) of this slave bistable, giving a corresponding high output at Pin 2. Releasing the ARM button transfers the high input from the reset to the set input (Pin 6) of the slave bistable causing the output  $\bar{Q}$  to be set low again. This high voltage applied to the clock input (Pin 11) of the second bistable, allows  $\bar{Q}$  to rise to 0V therefore removing the hold-off bias. This then allows the next input trigger pulse to initiate one sweep.

At the end of the sweep the second bistable is again set via C441 to inhibit further sweeps until the ARM button is operated again.

While the bistable is armed the output from Pin 12 is high and emitter follower TR449 turns the l.e.d. (D434) on. As the  $\bar{Q}$  output returns to  $-10V$  this l.e.d. ARM indicator is extinguished.

#### 4.18 RAMP AND GATE OUTPUTS

An output from the ramp generator is coupled into transistor, TR444. This inverting stage gives an output which, via zener diode, D441, will swing linearly from ground potential to approximately  $+2.5V$  as the ramp moves across the c.r.t. face from left to right. The gate output pulse is taken from the collector of TR434, via R516 and consists of a positive pulse from ground to approximately  $+5V$ , present during the ramp period.

#### 4.19 THE X OUTPUT AMPLIFIER

The signal selected by S6cb, either the linear ramp as provided by the ramp generator, or the output of TR316 (the horizontal deflecting signal from CH1 in the X-Y mode), is taken to the base of TR445, one half of a long tailed amplifier, TR445 and TR451. The emitter resistor of this stage can be reduced in value to give the X10 gain increase necessary in the 'Pull X10' X condition. The X shift voltage, derived from the shift control potentiometers, R591 and R592, is taken via emitter follower, TR456, to the other input of the long tailed amplifier. R567 and C440 provide high frequency compensation in the X10 mode. The differential output from this stage is taken via emitter followers, TR446 and TR450, to the bases of the long tailed output stage, TR447 and TR448. The outputs to the X deflection plates of the c.r.t. are taken directly from the collectors of these transistors. The gain of this stage being determined by the collector load resistors, R571 and R579, and the parallel/series emitter resistor network of R577 and R574/R580. R576 and C442 provide high frequency compensation.

#### 4.20 THE BRIGHT-UP BISTABLE

TR704 and TR705 form a bistable switch, which is slave to the bright-up input applied via C736 from the timebase. Its function is to control the grid to cathode potential of the c.r.t. The network, R725, C738, R726 and D713, turns on TR705 when the instrument is switched on, ensuring that the bistable is the bright-up state. The

bistable operates at low voltage in order to improve speed and provides a low impedance source to the output stage. This voltage is defined by D716. Drive to the output stage transistor, TR706, is fed by the network, R733, C741 and R732, C740, whose function together with D714 is to prevent TR706 from saturating. When the voltage between the collector and emitter of TR706 drops to about  $1.5V$ , D714 conducts and limits the base current of the transistor. When TR706 and TR705 are conducting the cathode of the tube is most negative and the tube is then in the bright-up mode. When TR706 is switched off, as the bistable switches over, R737 holds the collector positive, and the tube is blanked off. The voltage swing at TR706 being approximately  $50V$ .

During turn off, TR707 turns on to speed up the edge with a differentiated signal applied via C742. The bright-up bistable modulates the cathode directly, and operates at between  $-1425V$  and  $-1375V$  with respect to ground. A supply for this circuit is provided by BR702 and C734.

The e.h.t. voltage is developed across the coupling capacitor, C736, and R730 holds pin 712 safely at ground if the input lead is disconnected. Input from the timebase to the bistable is from the emitter of TR431 (on the timebase board), where the chop blanking and 'end of sweep' blanking signals are summed.

#### 4.21 EXT. Z – MODULATION

External Z-modulation is applied via the 4mm sockets, SKH and SKJ, on the rear panel of the instrument. This signal is applied directly to the grid of the tube via the capacitor, C725. R712 and R713 effectively define the input impedance at the grid at about  $800k\Omega$ . D706 is used to prevent the incoming signal from driving the grid positive with respect to the cathode voltage. An excessively negative voltage at the grid is also prevented by the breakdown action of D706. R716 is used to limit the peak modulation drive current in either of these modes, with C727 acting as an h.f. by-pass capacitor. R715 provides a bleed current to discharge C725 and so prevent any voltage appearing at the input sockets. R742 and C726 provide an h.f. by-pass network which is used to decouple the grid against movement when the normal bright-up waveform is applied to the cathode. The capacitive load of this network reduces the h.f. input impedance seen at the Z MOD sockets, although it is assumed that the driving source impedance will be low when the frequency is such that the network begins to load the input. In applications when h.f. Z MOD input impedance is important, this network may be disconnected by removal of R742 which is soldered on pins on the rear panel p.c.b. Access is available by removing the top cover.

#### 4.22 CALIBRATION

This circuit is situated on the front panel control board assembly. TR802 and TR803 form an emitter-coupled multivibrator with C804 acting as the timing capacitor. The collector current of TR803 is used to turn TR804 on and off and with the series chain, R820-821, provide

a 1V peak to peak positive-going square wave at point 803. R819 is used to accurately set this voltage. The values in the chain are selected such that a 5mA current is available when the output pin is shorted to ground.

## 4.23 THE POWER SUPPLIES

The OS1100 has seven supply lines, +150V, +75V, +50V, +10V, -10V and two e.h.t. lines, -1500V and +8.5kV. The +10V and -10V and the two e.h.t. lines are fully stabilised; full current protection exists on the 10V supplies and a partial protection on the e.h.t. lines. The remaining lines are unstabilised and are protected by the supply fuse, FS1. All supplies are obtained from the secondaries on transformer, T1, with the mains input selected switches, S10 and S9, on the rear panel of the instrument. In the 240-220 voltage input range the two primaries of the transformer are connected in series, with a selection being made on the 100V tap on one of the primaries for the 220V connection. For 100V and 120V supplies the primaries are effectively paralleled. In the case of the 100V connection the supply is applied across the 0-100V taps on the tapped primary; the 120V tap on the same winding then produces a boosted voltage which is used to supply the other primary winding.

Mains supply is applied via the connector, SK G., on the rear panel of the instrument.

### 4.23.1 +10V and -10V LINES

A 26V r.m.s. centre tapped supply is rectified by BR703 and smoothed by C719 and C720. This provides +16V d.c. and -16V d.c. which is fed to each of the 10V supply regulators. The 16V supplies are also used to provide power for the graticule illumination circuit on the front panel control board. In addition, at point 719 part of the a.c. supply is fed via R702 to produce the line trigger signal for the timebase.

Two integrated circuit regulators provide the 10V supplies and incorporate internal current limits and thermal overload protection. The integrated circuits give nominally 8V but are arranged to give 10V with the aid of the divider network, R718/R717, for the +10V line and, R719/R720, for the -10V line. C721 and C722 provide decoupling at the ground pin of the regulator to maintain the ripple rejection of the circuit. R743 and R744 are A.O.T. resistors which are used to set the 10V output to within  $\pm 200\text{mV}$ . D711 is a protection diode to ensure that latch up conditions do not occur during switch on. These 10V outputs are taken to SKL to feed the Y amplifier and timebase, and SKM to feed the front panel control board. C723 and C724 provide local supply decoupling at these output sockets.

### 4.23.2 +150V, +75V and +50V SUPPLIES

The +150V and +75V supplies are used to provide power for the timebase and Y-amplifier deflection circuits. A 64V r.m.s. supply from the transformer is applied via points 707 and 717 to D708, D709, C717 and C718 which comprise a voltage doubler circuit of which D709 anode is made the earthy connection. Outputs across

C718 and C717 are +75V and +150V respectively. A resistive bleed, R721, is used to discharge C718 when the instrument is switched off. Outputs from these supplies are fed to SKL and SKM for the Y-amplifier, timebase and front panel control board.

The +50V supply is used to provide the supply for the bright up circuit and is held at the cathode potential, that is, with the negative connection at -1425V (see Section 4.20 on description of bright-up bistable circuit). A 38V r.m.s. input is applied via points 710 and 711 to provide 50V d.c. with the bridge rectifier, BR702, and smoothing capacitor, C734.

### 4.23.3 E.H.T. SUPPLIES

Two e.h.t. supplies are provided for the cathode ray tube, -1500V for the gun and +8.5kV for the p.d.a. giving an overall accelerating voltage of 10kV. Both supplies are derived from a tapped winding on the transformer, with the p.d.a. supply being obtained by a quadrupler circuit comprising diodes, D901-904, and capacitors, C901-4. R901 is a series resistor for protection purposes to limit the maximum fault current available from the multiplier. R902 and R903 form a resistive bleed to discharge the multiplier when the instrument is switched off. The current from R903 supplies the bias current requirements for the e.h.t. regulator circuit.

The gun supply is derived from the 1300V r.m.s. tap on the transformer which is rectified and smoothed by D710 and C706-710 to form a -1510V supply. Further smoothing is achieved by R701 and C711-715 to provide a line with reduced ripple voltage.

Stabilization of both e.h.t. lines against supply variations is achieved as follows:-

One end of the e.h.t. winding feeds the rectifier diodes in the normal manner, the other end is connected to ground via bridge rectifier, BR701. The alternating current in the winding passes through BR701/TR701, TR702, R703, R740 as a direct current which develops a d.c. voltage across C701 and C702. Over voltage protection of these components is achieved by a chain of zener diodes, D701-3. This d.c. voltage controlled by the conduction of the cascode connected pair of transistors, TR701 and TR702, is subtracted from the peak voltage available at the 'hot' end of the winding; thus by varying the conduction of TR702 the rectified high voltage supplies can be controlled.

The stabilising circuit operates at the negative peak of the waveform from the e.h.t. winding, when current flows from the low side of the winding through Pin 716 and the bridge rectifier, BR701, to 0V. Conduction in the bridge holds the negative side of C703, C704 etc. near 0V. Consequently, for balanced working conditions, potentials at the base of TR702, the emitter of TR703 and hence the base of TR703, must also be near 0V. In fact the diode or base-emitter junction voltage drops in TR703, D704, TR702 and BR701 cancel each other. If the feedback current from the -1500V supply through R710 is not exactly cancelled by that defined by R706 and the preset

control, R707, from the +10V supply, the base potential of TR703 will differ from 0V. The conduction of TR701 and TR702 will vary the voltage across C701 and C702 to correct the -1500V supply level.

At this same peak of the supply cycle, current from the e.h.t. multiplier, via R903 flows via D705 defining the base potential of TR701 just above +10V so that TR701 operates in cascode from TR702. At other points in the cycle, D704 and D705 are reverse biased, and capacitors, C701-4, retain the relevant operating potentials of TR701 and TR702. When the positive peak output from the e.h.t. winding is reached, the same correction voltage across C701 and C702 is subtracted and first order stabilization is applied to the +8.5kV p.d.a. supply. A small additional current from the +150V line via R741 supplements the base current requirements of TR701 and TR702.

#### 4.24 CATHODE RAY TUBE AND ITS INPUTS

The OS1100 employs a mesh p.d.a. tube with a high efficiency aluminised screen.

The interconnection diagram, Fig. 5. shows the connections to the various electrodes for the alternative types of tube used, D14-280 and D14-120.

##### 4.24.1 THE GUN

The beam current and hence the spot intensity is controlled by the differential potential between the grid and cathode. In the bright-up mode the cathode supply is derived directly from the -1.5kV stabilised line via D707. Thus the effective voltage on the cathode under this condition is nominally -1425V. D707 provides a stable 75V supply to give the range for the intensity control R811 and the preset intensity control R810 which are situated on the front panel control board and set the grid potential. R712 and R713, situated on the main power supply board, connect to the wipers of R810 and R811 and determine the amount of control of each potentiometer. The junction of R712 and R713 is connected to the c.r.t. grid in common with the Z Mod input from C725. The tube heater is supplied by a separate 6.3V secondary on the transformer, which is also operating at the -1.5kV potential. In the blanked condition the cathode potential is switched from the -1425V in the bright-up mode to approximately 1375V. Whatever the intensity setting (R811) the grid will be at least 50V negative with respect to the cathode potential, resulting in the cut-off of the tube.

For the D14-120 tube, the amount of focus control is between -1210V and -850V and for the D14-280 tube, it is between -1150V and -980V. The fact that the voltage requirements for the tubes are slightly different is allowed for by the values of R829 and R827 which are different according to the tube fitted. In the D14-280 tube (c.f. interconnection diagram) R708 and D715 on the power supply board provide a +75V stable supply for the A1. The total accelerating potential on the gun then

adds up to -1500V with -1425V on the cathode and +75V for the A1 and mean plate potential. Astigmatism is controlled by R806 from 0 to 150V on the front panel control board. This is joined to A3 on the tube via SKR, SK K. and point 704. Geometry in this tube is preset by R827 which can be controlled from +75V to -100V using part of the focus chain current to achieve the negative potential. This then connects via the same socket arrangement and Pin 703 to the mesh screen electrode on the tube.

In the D14-120 tube, the electrode connections are somewhat different; the A1 and A3 connections are internally linked and these are set by the astigmatism control to point 704. The A1 supply provided by R708 and D715 is therefore not required. Whereas in the D14-280 tube the interplate screen is connected to A1, in the D14-120 it is set at mean plate potential, and this is effected by connecting it to the +75V d.c. supply rail at point 721. In addition, the geometry on this tube is more sensitive to voltage change and so a zener stabilised supply consisting of R826 and D801 is used to achieve this. R827 has a lower value (220k $\Omega$ ) to restrict the range from +100V to +50V, i.e.  $\pm 25V$  about mean plate potential.

##### 4.24.2 THE DEFLECTION SYSTEM

The Y plates are connected to the output of the Y amplifier and the applied differential signal deflects the beam in a vertical direction. The X plates connect to the X output amplifier and the signal deflects the beam in a horizontal direction. Sensitivities for Y and X for the D14-280 are 4.5V/cm and 12V/cm respectively and for the D14-120 4.2V/cm and 16V/cm respectively. The interplate shield, S1, screens the Y deflection plates from the X deflection plates, and is held at the mean plate potential of +75V as previously described. Shield, S2, for geometry control is set for optimum linear deflection on both the X and Y axes.

When it has passed through the deflection plate system the beam is accelerated to the screen which is held at +8.5kV by the e.h.t. multiplier, whereupon the beam strikes the phosphor at high velocity to produce the trace.

##### 4.24.3 THE TRACE ROTATION COIL

A coil, L1, wound around the neck of the c.r.t. within the magnetic shield produces an axial field causing the electron beam to twist. Current in this coil is adjusted by R823 on the front panel board to align the horizontal trace with the graticule lines. The current is provided for this purpose from the +10V and -10V supply lines. When the coil is connected to SK T. position 1 a positive or negative current is available to the coil when only small corrections are required. This provides a method of readily reversing the direction of rotation. For tubes which require larger corrections extra current is available at SK T. position 2 where one end of the coil is connected to +10V and the other end to R823 wiper. The current is unidirectional so

the socket should be reversed if the deflection cannot be corrected by adjustment of R823.

### **4.25 GRATICULE ILLUMINATION**

The internal graticule is illuminated by two small lamps, LP1 and LP2, situated within the tube support moulding.

The supply for these lamps is derived from the emitter follower, TR801, on the front panel control board. It is set by the scale potentiometer, R803. The lamp voltage is determined by the values of R802, R803 and R807 and the maximum current is limited by R801. The supply for these lamps is taken from the unregulated 16V rails.

## 5.1 GENERAL

The instrument is protected by a fuse, F S1, in the a.c. supply which is mounted on the rear panel. A 1A slow blow size 20mm (Pt. No. 34790) is required for the 120V supply ranges and a 500mA slow blow size 20mm (Pt. No. 33685) for the 240V ranges.

The following sections describe how to obtain access to and removal of various printed circuit boards and assemblies as may be found necessary, during fault finding procedures. If, during fault finding, a component needs replacing, it should be cut from the printed circuit board as close as possible to the component, leaving the wires connected to the copper track and protruding through to the component side of the board. The new component should then be soldered into position by attaching it to these protruding wires. This protects the copper track from damage.

If a fault on a printed circuit board cannot be cleared, it is recommended that the instrument be returned to the manufacturer for repair. When faults have been cleared it is recommended that the calibration procedure is followed to ensure that the instrument conforms to the specification.

## 5.2 ACCESS

Figures, 6, 7 and 8 illustrate views of the instrument after the top and bottom covers are removed. This provides immediate access for all preset adjustments.

Each cover is retained in position by four latch fasteners. Each fastener is released by turning it one quarter of a turn counter clockwise.

**WARNING:** Care must be taken if the instrument is operated with the covers removed as dangerous high voltages are exposed.

The construction of the instrument has been arranged so that in general individual boards and assemblies can be checked and components changed without actually removing the assemblies from the main frame or disconnecting the plug and socket system.

Provision has been made however for the timebase assembly to be removed from the frame and mounted vertically on the top support bracket, (See Fig. 6.) the interconnection cables being of sufficient length, that the oscilloscope may be fully operational. This facility gives improved accessibility to the track sides of both timebase and Y amplifier boards.

Alternatively the instrument can be operated on its side with the Y amplifier assembly removed. Additional holes are provided at the back of the two side support bars on this assembly. These allow it to be mounted at right angles to the frame, using the original rear fixings on the side frame and centre panel. Sections 5.2.1 and 5.2.2 describe how these assemblies are removed and the subsequent sections describe how other assemblies are removed.

The control knobs on the front panel have collet fixings. To remove them prise out the central cap and slacken the central retaining screw or nut.

## 5.2.1 TIMEBASE ASSEMBLY

This assembly contains all the trigger, timebase, delay and X output circuitry and controls. To remove it proceed as follows:

1. Remove the relevant knobs on the front panel.
2. Remove the screws holding the output transistor heat sink to the top bar and the brackets to the top bar and the side bar.
3. Remove the two nuts holding the shift potentiometer and the trigger level potentiometer.
4. The unit may now be withdrawn backwards and repositioned vertically, being mounted above the top bar by making use of the threaded insert and the hole in the bracket. (See Fig. 6.)
5. By replacing the control knobs the instrument may be operated with the timebase in this position and access will be gained to both sides of the timebase printed circuit board. Operating the timebase in this position also gives easier access to the Y unit.

## 5.2.2 Y AMPLIFIER ASSEMBLY

This assembly contains all the Y deflection circuit functions up to the output stage and may be removed as a complete unit as follows:

1. Unplug all interconnecting leads.
2. Remove screws holding the units to side frame and the centre support screen.
3. Remove all knobs on the front panel associated with CH1 and CH2 and the nuts on CH1 and CH2 VOLTS/cm selector switches.
4. Slide the unit back, down and out of the frame.
5. Access to the bottom of the attenuator board and the first part of the amplifier may be obtained by removing the bottom screen (4 screws).
6. Access to the attenuator switches, resistors and balance potentiometers may be obtained by removing the upper attenuator screen (6 screws).
7. For fault finding, the unit may be operated partially out of the frame by re-inserting the two rear fixing screws into the side bars. The unit may then pivot on these screws to give access to both sides of the p.c.b., all leads being of sufficient length to remain in position and to allow normal operation.

## 5.2.3 DELAY LINE

1. The Delay Line is held on to the centre screen with four plastic snap in connectors. Access to this can only be obtained by removal of the c.r.t. (See Section 5.2.8.)

## 5.2.4 Y OUTPUT ASSEMBLY

1. Remove the input socket, and the Y deflection leads from Y output board.
2. Remove the single screw holding the board to the centre panel and the two screws to the side frame bracket.
3. The assembly may now be removed from the frame.

## 5.2.5 THE CONTROL BOARD ASSEMBLY

1. Remove the plugs from positions SKU, SKS, SKR and SKT, making a note in particular of the position of SKT.
2. Unsolder the supply 'ON' indicator, D802, (the white lead is the anode) and the wire joining point 803 to the 'cal out' connector.
3. Remove the four screws in each corner of the printed board and the knobs from the INTENSITY control, focus control, SCALE illumination control.

## 5.2.6 THE POWER SUPPLY BOARD

For most purposes access is available to this board by removing the screws holding the rear plastic cover. Access to the areas containing the bright up circuitry is improved by removing the Y-output board. For details refer to section 5.2.4.

If it proves necessary to remove the power supply board from the frame, this is normally done by removing the board and transformer with its retaining bracket as an entire assembly. The procedure is as follows:

1. Remove the screws holding the rear support feet.
2. Unsolder the four mains supply wires from the mains input socket, SKG, and the supply setting switches, S9 and S10, making a note of their order.
3. Remove the screw securing TR701 to its heatsink bracket on the rear frame.
4. Disconnect plugs from the board sockets, SKM, SKL and SK K.
5. Withdraw the c.r.t. socket.
6. Remove the bright-up connection by withdrawing the plug from Pin 39 on the timebase board.
7. Remove the screws retaining the power supply board and transformer mounting plate around the perimeter of the rear frame.
8. Disconnect the two supplies to the e.h.t. multiplier at points 701 and 702 noting their order.
9. Carefully remove both the board and transformer assembly together, ensuring that undue mechanical stress is not transmitted to the leads of IC701, IC702 or the small securing tongue holding the board to the transformer bracket.

## 5.2.7 THE E.H.T. MULTIPLIER

This potted module contains the rectifier/multiplier network to generate the p.d.a. supply.

1. Remove the cavity connector cap from the p.d.a. connection on the cathode ray tube, taking care to ensure that both the output from the multiplier and the tube are discharged by shorting each to the chassis earth via an insulated cable.
2. Unsolder the two wires connecting the multiplier to the power supply board at points 701 and 702 making a note of their order.

3. Unsolder the a.c. input from the 1730V winding connection at the transformer.
4. Unscrew the four screws retaining the assembly to its mounting plate and remove the entire assembly.

## 5.2.8 THE CATHODE RAY TUBE

1. Remove the screws retaining the plastic moulded cover from the rear frame and pull away the cover.
2. Remove the base and p.d.a. connections from the cathode ray tube. (See 5.2.7 for safety details.)
3. Remove the front bezel complete with optical filter by unscrewing the four corner retaining screws.
4. Remove the plug from SKT on the front panel board. Noting its position and polarity.
5. Remove the outer half of the two part clamp from the neck of the tube shield.
6. Unscrew the lower half of the clamp and slide it back towards the rear of the instrument.
7. The tube and shield assembly is removed by first pushing it back towards the aperture in the power supply board. When the assembly is sufficiently far backwards the front can be swung outwards and the assembly so removed.
8. The tube complete with trace rotation coil is removed by fully slackening off the screw which tensions the circular clamp holding the rear of the tube. (The clamp is within the tube shield.)  
The screw should be turned in an anti-clockwise direction.
9. When the tube is removed from the tube shield, the gun shield and trace rotation coil can then be removed. Re-assemble in the reverse order except that the circular clamp should be tightened last, after the tube face is set forward against the filter.

**N.B. DO NOT OVERTIGHTEN THIS CLAMP SINCE THIS MAY RESULT IN DAMAGE TO THE TUBE.**

## 5.2.9 SCALE ILLUMINATION BULBS

1. Remove the clamp securing the bulbs by unscrewing the single screw on the rear of the tube support moulding.
2. Unsolder the defective bulb from the relevant pair of pins on the moulding and remove the bulb.

**N.B. WHEN A NEW BULB IS TO BE INSERTED APPLY RUBBER SLEEVES ONTO CONNECTING LEADS AND ENSURE BULB IS AS FAR FORWARD AS POSSIBLE BEFORE RECLAMPING.**

## 5.3 FAULT FINDING TABLES

Faults may be localised by reference to the Fault Localisation information presented in Fig. 9 and the circuit voltages listed in section 5.4.

This table should be used as a general guide to the voltages obtainable at certain locations within the instrument and can be used as an aid to servicing.

The power supply input voltage should be set to the

mid point of the supply voltage setting. The power supply voltages in the tables are those appearing under these conditions. Other voltages assume that the Y inputs are grounded and the amplifiers are set to 5mV/cm sensitivity. The timebase is set to the auto position with the Y1 channel selected and Y1 trace brought to the centre of the screen.

## 5.4 OPERATING POTENTIALS (Y AMP ASSEMBLY)

The following voltages apply with CH1 selected and trace centred. CH1 and CH2 will be similar.

Drains of TR101 (a) and (b)	+5.5V
Collectors of TR102/103	+0.15V
Emitters of TR102/103	+6.25V
Collectors of TR104/105	+1.95V
Bases of TR151/152	+3.90V
Collectors of TR106/107	+2.65V
Collectors of TR151/152	-0.81V
Pins 5 & 11 (IC151)	+2.30V
Pins 4 & 9 (IC151)	-0.04V
	(-0.35V when CH2 selected)
Bases of TR301/302	+3.90V
Collectors of TR301/302	+5.80V
Delay Line input/output	+8.20V
Collectors TR303/304	+1.20V
Bases of TR305/306	+1.80V
Collectors of TR305/306	+3.00V
Collectors of TR307/308	+7.65V
Collectors of TR309/310	+47V
Mean Plate potential	+81V
Collector of TR317	+4.30V

### OPERATING POTENTIALS (POWER SUPPLY ASS.)

Bright-Up Bistable

Voltage readings taken relative to point 709, the negative end of C734 (-1425V rel. to chassis).

C734 positive lead	+50V
Point 708 (Bright-up Output)	+1V Brightened up
	+48V Blanked

Junction TR704 & 705 emitters	+5.6V
E.H.T. Supply (voltage readings taken relative to chassis)	
Base TR703	0V
Junction D710, R701, R709 & C706	-1510V Nominally
Cathode D706 & D707	-1425V Nominally

LOW VOLTAGE SUPPLIES (voltage readings taken relative to chassis)

Junction R718, R717, C721 & IC701 input	+2V
Junction R719, R720, C722 & IC 702 input	-2V

SCALE ILLUMINATION CIRCUIT (Control Board Assembly)

at full intensity.

TR801 emitter	+18V
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### OPERATING POTENTIALS (TIMEBASE ASSEMBLY)

The following voltages apply when operated with no input signal and Auto trigger.

Collector of TR411	+5V
Collector of TR412	+1V
Collector of TR414	+5V

Under manual trigger conditions:

Collector of TR410	- Brightline ON	+10V
	Brightline OFF	0V
	Ramp period	Hold-off period
Collector of TR419	+6V	+8V
Collector of TR420	+9V	+3V
Base of TR430	+7V	
Base of TR435	+7.5V	
Base of TR437	+3.8V	

Gate of TR441	-.5V at end of Sweep	+5V
Pin 29 (Ramp output)	-1.2V at end of Sweep.	+3.6V

Normal	Pin 2	Pin 10
Normal	-10V	0V
S' Sweep	-10V	-10V
Arm	0V	0V
Delay IC403	Delay period (ON)	Delay waiting and off
Collector of TR423 (Pin 1)	+2V	+8V
Collector of TR427 (Pin 5)	+9V	+4V

Mean plate potential (collectors of TR447 and TR448) +80V

## 5.5 CALIBRATION PROCEDURE

### 5.5.1 TEST EQUIPMENT REQUIRED

1. Variable auto transformer. Output voltage 95 to 260V at 1A with a.c. r.m.s. voltmeter (Variac).
2. Digital Multimeter with an input impedance of 10MΩ or more and voltage input capability to 500V a.c. or d.c. Accuracy within 1%. The meter should be battery operated or have supply isolation to 2kV a.c. or greater, e.g. Gould Advance BETA with battery pack.

3. Voltage calibrator. 1kHz squarewave generator with amplitude 2mV to 100V. Accuracy with 1%.
4. Time Mark Generator. Marker generator of 0.5 $\mu$ s to 1sec. Accuracy within 1%.
5. Squarewave Generator. 1MHz flat top square wave generator with adjustable amplitude 0.1V to 1V into 50 $\Omega$  having a rise time of less than 2ns.
6. R.F. Sinewave Generator. 500kHz to 50MHz with 50kHz reference frequency. Output amplitude 25mV to 5V p.p. into 50 ohms. Amplitude accuracy at 50kHz and 500kHz to 50MHz constant within 3%.
7. L.F. Sinewave Generator.
8. Capacitance standardiser. 1M $\Omega$ /28pF, BNC 50 $\Omega$  Termination (TP19), BNC-BNC connector lead (PL 43).
9. High voltage probe. 0-10kV for use with item 2. Input impedance 1G $\Omega$  or greater.

**NOTE:**

Calibration should be carried out at normal ambient temperature and should not be commenced until the instrument has been operating for at least 15 mins.

**5.5.2 SET SUPPLY RAIL VOLTAGES**

1. Set the switches, S9 and S10, on the rear of the instrument to the desired operating supply voltage.
2. Adjust the variable auto transformer to this voltage and switch on the instrument, leaving the INTENSITY control set to minimum.
3. Check that the SCALE control varies the graticule intensity and that the supply indicator i.e.d., D802, is on.
4. Connect the digital voltmeter with the negative lead to chassis and the positive lead to the +10V rail on the positive output pin of IC701. The +ve output voltage should read 10V  $\pm$  200mV. If it is outside this range the A.O.T. resistor, R743, should be changed. If the output is below 9.8V remove R743 from its pins on the track side of the printed board. If the output is above 10.2V R743 value is made 180 $\Omega$ . (The nominal value for R743 is 470 $\Omega$ .)
5. This procedure is repeated for the other regulator, IC702, by connecting the digital voltmeter between the -10V output pin of IC702 and chassis, adjusting R744 in similar manner to 4 above.
6. Check that the other rails are within the following limits:  
 (+150V rail) actual value 164V  $\pm$  10%  
 (+75V rail) actual value 77V  $\pm$  10%
7. Set the multimeter to a range suitable for d.c. readings of 0-500V and connect it across C701 positive terminal and C702 negative terminal (i.e. across output of BR701).  
 Set R707 so that the reservoir voltage across the regulator reads 245V.  
 N.B. This voltage is floating at up to 500V relative to chassis.

8. Connect the high voltage probe to the multimeter. Connect the earthy end of the probe to chassis and the other to point 709. Check that the voltage is 1425V within  $\pm$  7%.
9. Check that the e.h.t. supply at the tube cavity cap connector is +8.5kV  $\pm$  0.5kV.

**5.5.3 SET TUBE CUT-OFF**

1. Set the timebase to auto and the speed to 1ms/cm. Set the Y-Channel selector to CH1 and GND, adjust the Y-shift control to centre.
2. Adjust the INTENSITY until a trace is obtained. If no trace can be obtained try adjusting R810, on the front panel control board. If a trace is still not available consult the fault location table (Fig. 9). When the trace is available adjust the focus and astig. controls and then turn the INTENSITY control back until it is 1/3 of the way from the start of its travel. Then set R810 (Preset BRILL. control) for a just visible trace. Advance the INTENSITY control fully and check that a good trace brightness can be obtained; return the control to zero and check that the trace is fully blanked.

**5.5.4 ADJUST TRACE ALIGNMENT**

1. Adjust the Y-shift for a trace in the centre of the graticule.
2. Connect SK.T plug on the front panel board to position, Socket No.1. Adjust trace rotation control R823 for a horizontal trace. If there is insufficient range the plug should be removed and connected to SK.T No. 2 position. If R823 can still not align the trace the plug polarity should be reversed and R823 re-adjusted.

**5.5.5 SET GEOMETRY**

1. Adjust R575 on the timebase board for a trace length of about 10cms. Set the timebase sweep frequency to 1ms/cm.
2. Connect the r.f. generator to the CH1 input and insert a frequency of 500kHz at about 2V p-p amplitude. Set the Y attenuator to 0.2V/cm and then adjust the generator output to give 8cms of trace amplitude.
3. Adjust the Geometry control, R827, so that the best compromise square picture can be obtained. Reset FOCUS and ASTIG. controls if necessary.

**5.5.6 CHANNEL 1 and 2 FINE GAIN CONTROL BALANCE**

1. Set CH1 Volts/cm switch to 2mV. INPUT COUPLING switch to GND. Mode switch to CH1. Timebase to Bright Line On.
2. Set the trace on the centre line by means of the CH1 shift control. Adjust the front panel BAL control (R19) to give no trace movement when the CH1 FINE GAIN Control is operated.
3. Repeat procedure for Channel 2, adjusting R39.

**5.5.7 CHANNEL 1 and 2 STEP ATTENUATOR BALANCE**

1. Set Y1 VOLTS/cm switch to 5mV. INPUT COUPLING switch to GND. Mode switch to CH1. Timebase to Bright Line On.
2. Set trace on centre line by means of CH1 shift control. Adjust R124 to give no trace movement when the VOLTS/cm switch is moved to 2mV.
3. Repeat procedure for Channel 2, adjusting R224.
4. Recheck 5.5.6.

**5.5.8 DELAY LINE MATCHING**

1. Set CH1 VOLTS/cm switch to 10mV, inject 1MHz squarewave to give 6cm deflection, adjust trigger to give stable trace.
2. Inspect the top of the waveform for any step occurring approximately 200ns after the start of the pulse.
3. If any step is present adjust R349 to give a flat top to the pulse.

**5.5.9 'INVERT MODE' AMPLIFIER BALANCE**

1. Set the MODE switch to CH2. INPUT COUPLING switch to GND and TRIGGER SELECT to BRIGHT LINE On.
2. Set the trace on the centre line by means of the CH2 shift control.
3. Add a 10k $\Omega$  potentiometer across a.o.t. position R199 and adjust until there is no trace movement when the INVERT CH2 switch is operated.
4. Replace the potentiometer with a fixed resistor of the nearest preferred value.

**5.5.10 CHANNEL 1 and CHANNEL 2 GAIN ADJUSTMENT**

1. Set CH1 VOLTS/cm switch to 5mV INPUT COUPLING switch to DC. FINE GAIN CONTROL pushed in.
2. Inject a 1kHz squarewave having an amplitude of 30mV and adjust R152 to give a deflection of 6cms.
3. Switch VOLTS/cm switch to 2mV and 10mV and inject 12mV and 60mV respectively.  
Check that these ranges are accurate to  $\pm 3\%$ . Make any small adjustment to R152 in order to distribute the errors about the accurate setting.
4. Switch to all other ranges and inject the appropriate signal to give 6cm deflection. Check that all ranges are accurate to within 3%.
5. Repeat the above procedure for Channel 2 adjusting R162.

**5.5.11 CHANNEL 1 and 2 ATTENUATOR COMPENSATION**

1. Ensure that the attenuator cover and bottom screen are correctly fitted.
2. Set CH1 VOLTS/cm switch to 10mV. INPUT COUPLING switch to DC. Inject 120mV 1kHz squarewave via the 28pF/1M $\Omega$  standardiser. Trigger for stable trace.

3. Adjust input trimmer, C19, for square corner.
4. Remove standardiser, switch VOLTS/cm to 0.1V, inject 0.5V squarewave and adjust X10 compensating trimmer, C14, for a square corner.
5. Inject 1V squarewave via standardiser and adjust X10 input trimmer, C13, for square corner.
6. Remove standardiser, switch VOLTS/cm to 1V, inject 5V squarewave and adjust X100 compensating trimmer, C17, for square corner.
7. Inject 10V squarewave via standardiser and adjust X100 input trimmer, C16, for square corner.
8. Remove standardiser and check all attenuator ranges applying the appropriate amplitude to ensure all ranges give a square corner to the applied waveform and are accurate to within  $\pm 3\%$ .
9. Repeat above for Channel 2 the component numbering being increased in each case by '10', i.e. for C13 read C23.

**5.5.12 Y AMPLIFIER OVERALL PULSE RESPONSE**

1. Set CH1 and CH2 VOLTS/cm switch to 10mV. INPUT COUPLING switch to DC. FINE GAIN CONTROL to CAL. Set the following trimmer capacitors to their minimum value: C151, 152, 301, 309, and C315.
2. Select CH1 mode and inject 500kHz to give 6cm deflection. Adjust C301 and if necessary A.O.T. R350 for best flat topped response over first 10% of pulse.
3. Select CH1 Mode and inject 500kHz to give 6cm deflection. Adjust C151 to improve the leading edge response but with a degree of under-compensation. Adjust C309 to fully compensate the edge without overshoot.
4. Change the input frequency to 1MHz. Set timebase to maximum speed (0.2 $\mu$ s X10 exp.) and adjust R330 and C315 to obtain optimum rise time with less than 2% overshoot.
5. Select CH2 and inject 1MHz squarewave to give 6cm deflection. Adjust C152 to give good pulse response agreement with CH1.

**5.5.13 2mV and 5mV h.f. COMPENSATION**

1. Set CH1 and CH2 VOLTS/cm switches to 5mV. INPUT COUPLING switch to DC. FINE GAIN CONTROL to CAL.
2. Select CH1 Mode and inject 1MHz squarewave to give 6cm deflection. Adjust C104 to give a square corner.
3. Switch to 2mV, inject 1MHz squarewave to give 6cm deflection. Adjust C103 to give a square corner.
4. Repeat 2 and 3 for CH2 input, adjusting C204 and C203 respectively.

**5.5.14 BANDWIDTH**

1. Set CH1 and CH2 VOLTS/cm switches to 10mV. INPUT COUPLING switch to DC. FINE GAIN CONTROL to CAL.

2. Select CH1 Mode and inject 50kHz from the Constant Amplitude Generator to give 6cm deflection. Increase the frequency of the generator until the amplitude of the display falls to 4.2cm. This frequency should be greater than 30MHz.
3. Repeat 2 for 5mV and 2mV positions on CH1 and for 10, 5 and 2mV positions on CH2.
4. Repeat on 1mV/cm on both channels, the bandwidth should be greater than 25MHz.

## 5.5.15 THE X DEFLECTION SENSITIVITY

### (a) Sweep

1. Apply 1ms markers from the Time Mark Generator to the CH1 input.
2. Trigger the timebase and adjust the vertical and horizontal controls to obtain a display of 10 pulses across the screen of the c.r.t.
3. Ensure that the 'Pull X10' knob is not operated and that the gain therefore of the X amplifier is in the X1 condition.
4. Rotate the Level control to prevent the timebase from triggering and measure the voltage between Pins 36 and 49. Adjust R547 to give 5.0 volts.
5. With the timebase range switch selecting 1ms/cm and the Variable control in the calibrated position adjust R575 to give one pulse per centimetre.
6. Pull the X10 X gain on and increase the input marker rate to 100 $\mu$ s. Adjust R570 to give one pulse per centimetre.
7. To adjust the trace length apply 1ms markers to the input of CH1 and trigger the timebase. Adjust the a.o.t. resistor, R491, to give a trace length of >10.5cms, using the next preferred value.
8. Return the X gain to off. Select 1 $\mu$ s/cm and apply 1 $\mu$ s markers. Adjust C431 to obtain one pulse per centimetre.

### (b) X-Y sensitivity

Before proceeding ensure that the vertical sensitivities have been correctly adjusted, see section 5.5.10.

1. Apply to the CH1 input a 1kHz squarewave, from the voltage calibrator of sufficient amplitude to give a known deflection of 8 centimetres.
2. Select X-Y operation on the timebase range switch.
3. Set X shift control to display a horizontal line, at each end of which will be a bright spot. Adjust R373 (the X-Y calibration preset) mounted on the Y mother board to give a line length of 8cm.

### (c) X-Y Phase Adjustment

1. Set CH1 and CH2 INPUT VOLTS/cm switches to 0.1V. INPUT COUPLING switches to DC. Timebase Range Switch to X/Y.

2. Apply a sinewave source to CH1 and CH2. Adjust input lead to give a convenient size display which should be a 45° line at low frequencies.
3. Increase the input frequencies to 500kHz and connect 30pF maximum capacitance trimmer across A.O.T. C327. Adjust to just close the ellipse.
4. Replace trimmer with a fixed capacitor of nearest standard value (approximately 12pF).

## 5.5.16 TRIGGER BALANCE

1. Apply a 1kHz sinewave input to CH1 and set up the X and Y controls to display a few cycles with a Y amplitude of about 5 centimetres across the screen.

Using a T Connector or similar means apply this same Y input sinewave to the External Trigger input BNC socket, select Ext. and AC coupling and adjust R474 to obtain triggering from the mid-points of the sinewave.

Alternate between AC and DC coupling, adjusting R474 for no movement of the trigger point.

NOTE: the minimum input for External triggering signal is 300mV peak-peak, therefore apply at least 1.5 volts to the External input socket and adjust the Y volts/cm switch accordingly.

2. Select DC coupling and with the front panel level control set for the mid-point of its mechanical travel, adjust R423 to obtain a display that triggers from the mid-point of the sinewave input.
3. Select CH1 trigger source, DC coupling and adjust R135 in the Y unit (CH1) to obtain the same trigger point as in the AC connection.
4. Reconnect the input to CH2 and set up a similar display as in 3.
5. Adjust R235 in the Y unit (CH2) to obtain the same mid-point trigger level. Re-apply the input to CH1.
6. Select AUTO trigger by rotating the Manual trigger level control fully anti-clockwise to the click position, triggering from CH1. Apply an input of 3mm and adjust R442 to obtain a trace starting from the mid-point of the applied input signal.

## 5.5.17 DELAY

1. Apply markers to CH1 and obtain a display of one pulse every 5 centimetres on the 1ms/cm range.
2. Select the 1 to 10ms Delay range and with the fine Delay control potentiometer in the fully anti-clockwise position adjust R499 for a shift of the marker pulse from Delay on to Delay off of <1cm.
3. Set the fine Delay potentiometer to maximum and adjust R535 for a shift of the Marker of >10cm.
4. Repeat these last two steps until both conditions are satisfied.

## 5.5.18 Z – MODULATION

1. Apply a 1kHz squarewave of 10V p-p amplitude to the Z-Mod. socket on the rear panel. Apply the same signal to the Ext. Trig. input of the timebase.
2. Set the timebase to 1ms/cm and trigger to External. The CH1 beam should be selected and the input grounded.
3. Check that visible modulation can be obtained from the squarewave.

## 5.519 INTERNAL 1V CAL ADJUSTMENT

1. Inject 1V p-p 1kHz square wave into Y1 channel from external calibrator. Set Y1 VOLTS/cm to 0.1V and adjust VARIABLE GAIN control to give exactly 8cm deflection.
2. Substitute internal cal. waveform for signal from external calibrator and adjust R819 to give exactly 8cm deflection.

## ABBREVIATIONS USED FOR COMPONENT DESCRIPTIONS

### RESISTORS

CC	Carbon Composition	$\frac{1}{2}$ W	10%	unless otherwise stated
CF	Carbon Film	$\frac{1}{8}$ W	5%	unless otherwise stated
MO	Metal Oxide	$\frac{1}{2}$ W	2%	unless otherwise stated
MF	Metal Film	$\frac{1}{4}$ W	1%	unless otherwise stated
WW	Wire Wound	6W	5%	unless otherwise stated
CP	Control Potentiometer		20%	unless otherwise stated
PCP	Preset Potentiometer Type MPD,PC		20%	unless otherwise stated

### CAPACITORS

CE(1)	Ceramic		+ 80%	
			- 25%	
CE(2)	Ceramic	500V	$\pm$ 10%	unless otherwise stated
SM	Silver Mica			
PF	Plastic Film		$\pm$ 10%	unless otherwise stated
PS	Polystyrene			
PE	Polyester		$\pm$ 10%	unless otherwise stated
PC	Polycarbonate			
E	Electrolytic (aluminium)		+ 50%	
			- 10%	
T	Tantalum		+ 50%	
			- 10%	

# Component List and Illustrations

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## OS1100 Y AMP

Ref	Value	Description	Tol % ±	Part No	Ref	Value	Description	Tol % ±	Part No
<b>RESISTORS</b>									
R103	39k	CF		28728	R166	820	CF		28724
R104	220	CF		21796	R167	820	CF		28724
R105	220	CF		21796	R168	220	CF		21796
R106	1k2	CF		21800	R169				
R107	47	CF		28714	R170	390	MO		26740
R108	1k2	CF		21800	R171	330	MO		26741
R109					R172	330	MO		26741
R110	10	CF		21793	R173	390	MO		26740
R111	510	MO		26738	R174	470	CF		21797
R112	510	MO		26738	R175	4k7	CF		21805
R113	1k6	MO		28793	R176	4k7	CF		21805
R114	1k6	MO		28793	R177	4k7	CF		21805
R115	470	CF		21797	R178	4k7	CF		21805
R116	116	MF		37549	R179	4k7	CF		21805
R117	330	MF		37550	R180	680	CF		28723
R118	750	MF		37551	R181	100	CF		21794
R119	22	CF		28710	R182	680	CF		28723
R120	10	CF		21793	R183	100	CF		21794
R121	22	CF		28710	R184	15k	CF		28727
R122	220	CF		21796	R185	3k3	CF		21803
R123	68k	CF		21816	R186	10k	CF		21809
R124	22k	PCP		36268	R187	3k3	CF		21803
R125	2k2	MO		26730	R188	15k	CF		28727
R126	2k2	MO		26730	R189	10k	CF		21809
R127	470	CF		21797	R190	3k3	CF		21803
R128	470	CF		21797	R191	15k	CF		28727
R129	270	CF		28720	R192	10k	CF		21809
R130	22k	CF		21812	R193	270	CF		28720
R131	270	CF		28720	R194	330	CF		28721
R132	470	MO		26739	R195	330	CF		28721
R133	270	MO		26742	R196	330	CF		28721
R134	100	CF		21794	R197	330	CF		28721
R135	470	PCP		36263					
R136	270	MO		26742	R203	39k	CF		28728
R137	10	CF		21793	R204	220	CF		21796
R138					R205	220	CF		21796
R139	47	CF		28714	R206	1k2	CF		21800
R140	47	CF		28714	R207	47	CF		28714
R141	180	CF		21795	R208	1k2	CF		21800
					R209				
R151	470	CF		21797	R210	10	CF		21793
R152	470	PCP		38274	R211	510	MO		26738
R153	1k	MO		27346	R212	510	MO		26738
R154	1k	MO		27346	R213	1k6	MO		28793
R155	220	PCP		37536	R214	1k6	MO		28793
R156	820	CF		28724	R215	470	CF		21797
R157	820	CF		28724	R216	116	MF		37549
R158	220	CF		21796	R217	330	MF		37550
R159	10	CF		21793	R218	750	MF		37551
R160	10	CF		21793	R219	22	CF		28710
R161	470	CF		21797	R220	10	CF		21793
R162	470	PCP		38274	R221	22	CF		28710
R163	1k2	CF		21800	R222	220	CF		21796
R164	1k	MO		27346	R223	68k	CF		21816
R165	220	PCP		A4/37839	R224	22k	PCP		36268

# Component List and Illustrations

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## OS1100Y AMP (Cont.)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
<b>RESISTORS (Cont.)</b>									
R225	2k2	MO		26730	R338	47	CF		28714
R226	2k2	MO		26730	R339	47	CF		28714
R227	470	CF		21797	R340	100	CF		21794
R228	470	CF		21797	R341	820	MO		37548
R229	270	CF		28720	R342	820	MO		37548
R230	22k	CF		21812	R343	68k	CF		21816
R231	270	CF		28720	R344	68k	CF		21816
R232	470	MO		26739	R345	2k2	CF		21802
R233	270	MO		26742	R346	220	CF		21796
R234	100	CF		21794	R347	47	CF		28714
R235	470	PCP		36263	R348	270	CF		28720
R236	270	MO		26742	R349	470	PCP		36263
R237	10	CF		21793	R350	220	CF	A.O.T.	21796
R238	180	CF		21795	R351	6k8	CF		21807
R239					R352	6k8	CF		21807
R240	47	CF		28714	R353	1k	CF		21799
R241	47	CF		28714	R354	2k2	CF		21802
R242	180	CF		21795	R355	1k	CF		21799
					R356	8k2	CF		21808
R301	1k5	CF		21801	R357	2k2	CF		21802
R302	150	MO		26745	R358	5k6	CF		21806
R303	270	CF		28720	R359	1k5	CF		21801
R304	270	CF		28720	R360	560	CF		21798
R305	180	MO		26744	R361	10k	CF		21809
R306	180	MO		26744	R362	4k7	CF		21805
R307	75	MO		28780	R363	10	CF		21793
R308	75	MO		28780	R364	10k	CF		21809
R309	470	CF		21797	R365	10k	CF		21809
R310	62	MO		28778	R366	10	CF		21793
R311	62	MO		28778	R367	470	CF		21797
R312	68	CF		28716	R368	27k	CF		21813
R313	68	CF		28716	R369	10	CF		21793
R314	200	MO		28786	R370				
R315	1k5	CF		21801	R371	470	CF		21797
R316	240	MO		28787	R372	18k	CF		21811
R317	240	MO		28787	R373	1k	PCP		36264
R318	180	CF		21795	R374	2k2	CF		21802
R319	270	MO		26742	R375	1k5	CF		21801
R320	270	MO		26742	R376	100	CF		21794
R321	5k6	CF		21806	R377	10k	CF		21809
R322	120	CF		28718	R378	100	CF		21794
R323	910	MO		26735	R379	100	CF		21794
R324	910	MO		26735	R380	47	CF		28714
R325	270	MO		26742	R381	47	CF		28714
R326	270	MO		26742					
R327	220	MO		26743	<b>CAPACITORS</b>				
R328	220	MO		26743	C101	22µF	E	25V	32181
R329	120	CF		28718	C102	1.5pF	S/M		813
R330	100	PCP		36261	C103	1.5/27pF	TRIMMER		36273
R331	120	MO		26746	C104	1.5/9pF	TRIMMER		36272
R332	120	MO		26746	C105				
R333	120	MO		26746	C106	1000pF	CE(2)		22387
R334	10	CF		21793	C107	1000pF	CE(2)		22387
R335	47	CF		28714	C108	.01µF	CE(2)	250V	22395
R336	47	CF		28714	C109	.01µF	CE(2)	250V	22395
R337	47	CF		28714	C110	.01µF	CE(2)	250V	22395

# Component List and Illustrations

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## OS1100Y AMP (Cont.)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
<b>CAPACITORS (Cont.)</b>									
C111	6.8pF	S/M		4617	C320	.01μF	CE(2)	250V	22395
C112	6.8pF	S/M		4617	C321	.01μF	CE(2)	250V	22395
C113	.01μF	CE(2)	250V	22395	C322	.1μF	CE(1)	30V	19647
C114					C323	68pF	CE(2)		22374
C115	1500pF	CE(2)		22388	C324	390pF	PS		31491
C116	1.5pF	S/M		813	C325	.01μF	CE(2)	250V	22395
C117	22μF	E	25V	32181	C326	.1μF	CE(1)	30V	19647
C118	1500pF	CE(2)	20 500V	22388	C327	12pF	CE(2)	A.O.T.	22365
C119	.01μF	CE(2)		22395	C328	.1μF	CE(1)	30V	19647
C151	1.5/9pF	TRIMMER		37802	C329	33pF	CE(2)		22370
C152	1.5/9pF	TRIMMER		37802	C330	27pF	CE(2)		22369
C153	0.1μF	CE(1)	25V	36709	C331	47pF	CE(2)		22372
C154	0.1μF	CE(1)	25V	36709	<b>TRANSISTORS</b>				
C155	3.3pF	S/M		817	TR101		AE31		36243
C156	0.1μF	CE(1)	25V	36709	TR102		2N5771		38089
C157	1000pF	CE(2)		22387	TR103		2N5771		38089
C158	1000pF	CE(2)		22387	TR104		BF371		36275
C201	22μF	E	25V	32181	TR105		BF371		36275
C202					TR106		2N5771		38089
C203	1.5/27pF	TRIMMER		36273	TR107		2N5771		38089
C204	1.5/9pF	TRIMMER		36272					
C205	1.8pF	S/M		814	TR151		2N3640		31781
C206	1000pF	CE(2)		22387	TR152		2N3640		31781
C207	1000pF	CE(2)		22387	TR153		2N3640		31781
C208	.01μF	CE(2)	250V	22395	TR154		2N3640		31781
C209	.01μF	CE(2)	250V	22395	TR155		2N3640		31781
C210	.01μF	CE(2)	250V	22395	TR156		2N3640		31781
C211	6.8pF	S/M		4617	TR157		2N3904		24146
C212	6.8pF	S/M		4617	TR158		2N3904		24146
C213	.01μF	CE(2)	250V	22395					
C214					TR201		AE31		36243
C215	1500pF	CE(2)		22388	TR202		2N5771		38089
C216	1.5pF	S/M		813	TR203		2N5771		38089
C217	22μF	E	25V	32181	TR204		BF371		36275
C218	1500pF	CE(2)		22388	TR205		BF371		36275
C219	.01μF	CE(2)		22395	TR206		2N5771		38089
C301	3/27pF	TRIMMER		36273	TR207		2N5771		38089
C302	68pF	CE(2)		22374					
C303	3300pF	CE(2)		22391	TR301		2N2369		23307
C304	3300pF	CE(2)		22391	TR302		2N2369		23307
C305	2.7pF	S/M		816	TR303		AE17	} Matched Pair	32063
C306	1000pF	CE(2)		22387	TR304		AE17		32063
C307	1000pF	CE(2)		22387	TR305		2N2369		23307
C308	15pF	CE(2)		22366	TR306		2N2369		23307
C309	3/27pF	TRIMMER		36273	TR307		2N2369		52527
C310	120pF	CE(2)		22377	TR308		2N2369		52527
C311	2200pF	CE(2)		22389	TR309		BD529		35840
C312	2200pF	CE(2)		22389	TR310		BD529		35840
C313	33pF	CE(2)		22370	TR311		2N3904		24146
C314	560pF	CE(2)		22384	TR312		2N2369		23307
C315	3/27pF	TRIMMER		36273	TR313		BC212		29327
C316	.01μF	CE(2)	250V	22395	TR314		BC212		29327
C317	.01μF	CE(2)	250V	22395	TR315		2N2369		23307
C318	.01μF	CE(2)	250V	22395	TR316		2N2369		23307
C319	.1μF	PE	160V	31377	TR317		2N2369		23307

# Component List and Illustrations

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## OS1100Y AMP (Cont.)

<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol %±</i>	<i>Part No</i>	<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol %±</i>	<i>Part No</i>
<b>INTEGRATED CIRCUITS</b>									
IC151		CA3046		32961	D203		ZENER	4V3	33926
IC152		CA3046		32961					
IC153		SN74LS76N		36733	D301		1N4148		23802
					D302		ZENER	33V	33947
					D303		ZENER	33V	33947
<b>DIODES</b>									
D102		1N3595		29330	D304		1N4148		23802
D103		ZENER	4V3	33926	D305		ZENER	6V8	33931
					D306		ZENER	3V9	33925
D151		ZENER	5V1	33928	D307		ZENER	6V2	33930
D152		1N4149		1949	D308		1N4148		23802
D153		1N4149		1949					
D154					<b>MISCELLANEOUS</b>				
D155		1N4148		23802	L101		FERRITE FX 1242		26986
D156					L102		FERRITE FX 1242		26986
D157									
D158					L201		FERRITE FX 1242		26986
D159		1N4148		23802	L202		FERRITE FX 1242		26986
D160		1N4148		23802					
D161		1N4148		23802	L301	2.7μH			37801
D162		1N4148		23802	L302	2.7μH			27801
D163		ZENER	3V9	33925					
					S151				37530
D202		1N3595		29330	S152				22628

CAPACITORS	C12 C11 C22 C23 C24 C25 C26 C27 C28 C29	C13 C16 C17 C18 C19 C20	C14 C15 C21 C28	C10 C29	C20 C30	C105 C205	C7 C105 C9 C219 C10	C11 C110 C12 C16 C10	C101 C201 C11 C12 C16	C108 C104 C17 C208 C203 C204 C217	C109 C107 C110	C115 C118 C218 C215	C151 C152	C153 C155	C154	C157 C156	C328 C301 C302	C304 C303	C328 C305 C322	C306 C307 C304 C323	C300 C308 C309 C327	C314 C311 C312 C325	C313 C314 C316 C331	C317 C318 C321 C321	C319		
RESISTORS	R1 R2	R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14	R6 R7 R8 R9 R10 R11 R12 R13 R14	R16 R17 R18 R19 R20 R21 R22 R23 R24 R25	R19 R20 R21 R22 R23 R24 R25	R103 R104 R105 R106 R107 R108 R109 R110 R111 R112 R113 R114 R115 R116 R117 R118 R119 R120 R121 R122 R123 R124 R125 R126 R127 R128 R129 R130 R131 R132 R133 R134 R135 R136 R137 R138 R139 R140 R141 R142 R143 R144 R145 R146 R147 R148 R149 R150 R151 R152 R153 R154 R155 R156 R157 R158 R159 R160 R161 R162 R163 R164 R165 R166 R167 R168 R169 R170 R171 R172 R173 R174 R175 R176 R177 R178 R179 R180 R181 R182 R183 R184 R185 R186 R187 R188 R189 R190 R191 R192 R193 R194 R195 R196 R197 R198 R199 R200 R201 R202 R203 R204 R205 R206 R207 R208 R209 R210 R211 R212 R213 R214 R215 R216 R217 R218 R219 R220 R221 R222 R223 R224 R225 R226 R227 R228 R229 R230 R231 R232 R233 R234 R235 R236 R237 R238 R239 R240 R241 R242 R243 R244 R245 R246 R247 R248 R249 R250 R251 R252 R253 R254 R255 R256 R257 R258 R259 R260 R261 R262 R263 R264 R265 R266 R267 R268 R269 R270 R271 R272 R273 R274 R275 R276 R277 R278 R279 R280 R281 R282 R283 R284 R285 R286 R287 R288 R289 R290 R291 R292 R293 R294 R295 R296 R297 R298 R299 R300 R301 R302 R303 R304 R305 R306 R307 R308 R309 R310 R311 R312 R313 R314 R315 R316 R317 R318 R319 R320 R321 R322 R323 R324 R325 R326 R327 R328 R329 R330 R331 R332 R333 R334 R335 R336 R337 R338 R339 R340 R341 R342 R343 R344 R345 R346 R347 R348 R349 R350 R351 R352 R353 R354 R355 R356 R357 R358 R359 R360 R361 R362 R363 R364 R365 R366 R367 R368 R369 R370 R371 R372 R373 R374 R375 R376 R377 R378 R379 R380 R381 R382 R383 R384 R385 R386 R387 R388 R389 R390 R391 R392 R393 R394 R395 R396 R397 R398 R399 R400 R401 R402 R403 R404 R405 R406 R407 R408 R409 R410 R411 R412 R413 R414 R415 R416 R417 R418 R419 R420 R421 R422 R423 R424 R425 R426 R427 R428 R429 R430 R431 R432 R433 R434 R435 R436 R437 R438 R439 R440 R441 R442 R443 R444 R445 R446 R447 R448 R449 R450 R451 R452 R453 R454 R455 R456 R457 R458 R459 R460 R461 R462 R463 R464 R465 R466 R467 R468 R469 R470 R471 R472 R473 R474 R475 R476 R477 R478 R479 R480 R481 R482 R483 R484 R485 R486 R487 R488 R489 R490 R491 R492 R493 R494 R495 R496 R497 R498 R499 R500 R501 R502 R503 R504 R505 R506 R507 R508 R509 R510 R511 R512 R513 R514 R515 R516 R517 R518 R519 R520 R521 R522 R523 R524 R525 R526 R527 R528 R529 R530 R531 R532 R533 R534 R535 R536 R537 R538 R539 R540 R541 R542 R543 R544 R545 R546 R547 R548 R549 R550 R551 R552 R553 R554 R555 R556 R557 R558 R559 R560 R561 R562 R563 R564 R565 R566 R567 R568 R569 R570 R571 R572 R573 R574 R575 R576 R577 R578 R579 R580 R581 R582 R583 R584 R585 R586 R587 R588 R589 R590 R591 R592 R593 R594 R595 R596 R597 R598 R599 R600 R601 R602 R603 R604 R605 R606 R607 R608 R609 R610 R611 R612 R613 R614 R615 R616 R617 R618 R619 R620 R621 R622 R623 R624 R625 R626 R627 R628 R629 R630 R631 R632 R633 R634 R635 R636 R637 R638 R639 R640 R641 R642 R643 R644 R645 R646 R647 R648 R649 R650 R651 R652 R653 R654 R655 R656 R657 R658 R659 R660 R661 R662 R663 R664 R665 R666 R667 R668 R669 R670 R671 R672 R673 R674 R675 R676 R677 R678 R679 R680 R681 R682 R683 R684 R685 R686 R687 R688 R689 R690 R691 R692 R693 R694 R695 R696 R697 R698 R699 R700 R701 R702 R703 R704 R705 R706 R707 R708 R709 R710 R711 R712 R713 R714 R715 R716 R717 R718 R719 R720 R721 R722 R723 R724 R725 R726 R727 R728 R729 R730 R731 R732 R733 R734 R735 R736 R737 R738 R739 R740 R741 R742 R743 R744 R745 R746 R747 R748 R749 R750 R751 R752 R753 R754 R755 R756 R757 R758 R759 R760 R761 R762 R763 R764 R765 R766 R767 R768 R769 R770 R771 R772 R773 R774 R775 R776 R777 R778 R779 R780 R781 R782 R783 R784 R785 R786 R787 R788 R789 R790 R791 R792 R793 R794 R795 R796 R797 R798 R799 R800 R801 R802 R803 R804 R805 R806 R807 R808 R809 R810 R811 R812 R813 R814 R815 R816 R817 R818 R819 R820 R821 R822 R823 R824 R825 R826 R827 R828 R829 R830 R831 R832 R833 R834 R835 R836 R837 R838 R839 R840 R841 R842 R843 R844 R845 R846 R847 R848 R849 R850 R851 R852 R853 R854 R855 R856 R857 R858 R859 R860 R861 R862 R863 R864 R865 R866 R867 R868 R869 R870 R871 R872 R873 R874 R875 R876 R877 R878 R879 R880 R881 R882 R883 R884 R885 R886 R887 R888 R889 R890 R891 R892 R893 R894 R895 R896 R897 R898 R899 R900 R901 R902 R903 R904 R905 R906 R907 R908 R909 R910 R911 R912 R913 R914 R915 R916 R917 R918 R919 R920 R921 R922 R923 R924 R925 R926 R927 R928 R929 R930 R931 R932 R933 R934 R935 R936 R937 R938 R939 R940 R941 R942 R943 R944 R945 R946 R947 R948 R949 R950 R951 R952 R953 R954 R955 R956 R957 R958 R959 R960 R961 R962 R963 R964 R965 R966 R967 R968 R969 R970 R971 R972 R973 R974 R975 R976 R977 R978 R979 R980 R981 R982 R983 R984 R985 R986 R987 R988 R989 R990 R991 R992 R993 R994 R995 R996 R997 R998 R999 R1000	TRANSISTORS	TR101(a) TR101(b) TR201(a) TR201(b)	TR102 TR103 TR202 TR203	TR104 TR105	TR204 TR205	TR107	TR106 TR207 TR206	TR153 TR154	TR151 TR152	IC151 IC152	TR155 TR156 TR157 TR158	TR301 TR302 TR303 TR304 TR305	TR311 TR312	TR305 TR304 TR313	TR314 TR315 TR316 TR317 TR318 TR319 TR320 TR321 TR322 TR323 TR324 TR325 TR326 TR327 TR328 TR329 TR330 TR331 TR332 TR333 TR334 TR335 TR336 TR337 TR338 TR339 TR340 TR341 TR342 TR343 TR344 TR345 TR346 TR347 TR348 TR349 TR350 TR351 TR352 TR353 TR354 TR355 TR356 TR357 TR358 TR359 TR360 TR361 TR362 TR363 TR364 TR365 TR366 TR367 TR368 TR369 TR370 TR371 TR372 TR373 TR374 TR375 TR376 TR377 TR378 TR379 TR380 TR381 TR382 TR383 TR384 TR385 TR386 TR387 TR388 TR389 TR390 TR391 TR392 TR393 TR394 TR395 TR396 TR397 TR398 TR399 TR400 TR401 TR402 TR403 TR404 TR405 TR406 TR407 TR408 TR409 TR410 TR411 TR412 TR413 TR414 TR415 TR416 TR417 TR418 TR419 TR420 TR421 TR422 TR423 TR424 TR425 TR426 TR427 TR428 TR429 TR430 TR431 TR432 TR433 TR434 TR435 TR436 TR437 TR438 TR439 TR440 TR441 TR442 TR443 TR444 TR445 TR446 TR447 TR448 TR449 TR450 TR451 TR452 TR453 TR454 TR455 TR456 TR457 TR458 TR459 TR460 TR461 TR462 TR463 TR464 TR465 TR466 TR467 TR468 TR469 TR470 TR471 TR472 TR473 TR474 TR475 TR476 TR477 TR478 TR479 TR480 TR481 TR482 TR483 TR484 TR485 TR486 TR487 TR488 TR489 TR490 TR491 TR492 TR493 TR494 TR495 TR496 TR497 TR498 TR499 TR500 TR501 TR502 TR503 TR504 TR505 TR506 TR507 TR508 TR509 TR510 TR511 TR512 TR513 TR514 TR515 TR516 TR517 TR518 TR519 TR520 TR521 TR522 TR523 TR524 TR525 TR526 TR527 TR528 TR529 TR530 TR531 TR532 TR533 TR534 TR535 TR536 TR537 TR538 TR539 TR540 TR541 TR542 TR543 TR544 TR545 TR546 TR547 TR548 TR549 TR550 TR551 TR552 TR553 TR554 TR555 TR556 TR557 TR558 TR559 TR560 TR561 TR562 TR563 TR564 TR565 TR566 TR567 TR568 TR569 TR570 TR571 TR572 TR573 TR574 TR575 TR576 TR577 TR578 TR579 TR580 TR581 TR582 TR583 TR584 TR585 TR586 TR587 TR588 TR589 TR590 TR591 TR592 TR593 TR594 TR595 TR596 TR597 TR598 TR599 TR600 TR601 TR602 TR603 TR604 TR605 TR606 TR607 TR608 TR609 TR610 TR611 TR612 TR613 TR614 TR615 TR616 TR617 TR618 TR619 TR620 TR621 TR622 TR623 TR624 TR625 TR626 TR627 TR628 TR629 TR630 TR631 TR632 TR633 TR634 TR635 TR636 TR637 TR638 TR639 TR640 TR641 TR642 TR643 TR644 TR645 TR646 TR647 TR648 TR649 TR650 TR651 TR652 TR653 TR654 TR655 TR656 TR657 TR658 TR659 TR660 TR661 TR662 TR663 TR664 TR665 TR666 TR667 TR668 TR669 TR670 TR671 TR672 TR673 TR674 TR675 TR676 TR677 TR678 TR679 TR680 TR681 TR682 TR683 TR684 TR685 TR686 TR687 TR688 TR689 TR690 TR691 TR692 TR693 TR694 TR695 TR696 TR697 TR698 TR699 TR700 TR701 TR702 TR703 TR704 TR705 TR706 TR707 TR708 TR709 TR710 TR711 TR712 TR713 TR714 TR715 TR716 TR717 TR718 TR719 TR720 TR721 TR722 TR723 TR724 TR725 TR726 TR727 TR728 TR729 TR730 TR731 TR732 TR733 TR734 TR735 TR736 TR737 TR738 TR739 TR740 TR741 TR742 TR743 TR744 TR745 TR746 TR747 TR748 TR749 TR750 TR751 TR752 TR753 TR754 TR755 TR756 TR757 TR758 TR759 TR760 TR761 TR762 TR763 TR764 TR765 TR766 TR767 TR768 TR769 TR770 TR771 TR772 TR773 TR774 TR775 TR776 TR777 TR778 TR779 TR780 TR781 TR782 TR783 TR784 TR785 TR786 TR787 TR788 TR789 TR790 TR791 TR792 TR793 TR794 TR795 TR796 TR797 TR798 TR799 TR800 TR801 TR802 TR803 TR804 TR805 TR806 TR807 TR808 TR809 TR810 TR811 TR812 TR813 TR814 TR815 TR816 TR817 TR818 TR819 TR820 TR821 TR822 TR823 TR824 TR825 TR826 TR827 TR828 TR829 TR830 TR831 TR832 TR833 TR834 TR835 TR836 TR837 TR838 TR839 TR840 TR841 TR842 TR843 TR844 TR845 TR846 TR847 TR848 TR849 TR850 TR851 TR852 TR853 TR854 TR855 TR856 TR857 TR858 TR859 TR860 TR861 TR862 TR863 TR864 TR865 TR866 TR867 TR868 TR869 TR870 TR871 TR872 TR873 TR874 TR875 TR876 TR877 TR878 TR879 TR880 TR881 TR882 TR883 TR884 TR885 TR886 TR887 TR888 TR889 TR890 TR891 TR892 TR893 TR894 TR895 TR896 TR897 TR898 TR899 TR900 TR901 TR902 TR903 TR904 TR905 TR906 TR907 TR908 TR909 TR910 TR911 TR912 TR913 TR914 TR915 TR916 TR917 TR918 TR919 TR920 TR921 TR922 TR923 TR924 TR925 TR926 TR927 TR928 TR929 TR930 TR931 TR932 TR933 TR934 TR935 TR936 TR937 TR938 TR939 TR940 TR941 TR942 TR943 TR944 TR945 TR946 TR947 TR948 TR949 TR950 TR951 TR952 TR953 TR954 TR955 TR956 TR957 TR958 TR959 TR960 TR961 TR962 TR963 TR964 TR965 TR966 TR967 TR968 TR969 TR970 TR971 TR972 TR973 TR974 TR975 TR976 TR977 TR978 TR979 TR980 TR981 TR982 TR983 TR984 TR985 TR986 TR987 TR988 TR989 TR990 TR991 TR992 TR993 TR994 TR995 TR996 TR997 TR998 TR999 TR1000	DIODES	D102 D202	D103 D203	D151 D152	D153 D154 D155 D156 D157 D158 D159 D160 D161 D162	D301 D302 D303 D304 D305 D306 D307 D308 D309 D310 D311 D312 D313 D314 D315 D316 D317 D318 D319 D320 D321 D322 D323 D324 D325 D326 D327 D328 D329 D330 D331 D332 D333 D334 D335 D336 D337 D338 D339 D340 D341 D342 D343 D344 D345 D346 D347 D348 D349 D350 D351 D352 D353 D354 D355 D356 D357 D358 D359 D360 D361 D362 D363 D364 D365 D366 D367 D368 D369 D370 D371 D372 D373 D374 D375 D376 D377 D378 D379 D380 D381 D382 D383 D384 D385 D386 D387 D388 D389 D390 D391 D392 D393 D394 D395 D396 D397 D398 D399 D400 D401 D402 D403 D404 D405 D406 D407 D408 D409 D410 D411 D412 D413 D414 D415 D416 D417 D418 D419 D420 D421 D422 D423 D424 D425 D426 D427 D428 D429 D430 D431 D432 D433 D434 D435 D436 D437 D438 D439 D440 D441 D442 D443 D444 D445 D446 D447 D448 D449 D450 D451 D452 D453 D454 D455 D456 D457 D458 D459 D460 D461 D462 D463 D464 D465 D466 D467 D468 D469 D470 D471 D472 D473 D474 D475 D476 D477 D478 D479 D480 D481 D482 D483 D484 D485 D486 D487 D488 D489 D490 D491 D492 D493 D494 D495 D496 D497 D498 D499 D500 D501 D502 D503 D504 D505 D506 D507 D508 D509 D510 D511 D512 D513 D514 D515 D516 D517 D518 D519 D520 D521 D522 D523 D524 D525 D526 D527 D528 D529 D530 D531 D532 D533 D534 D535 D536 D537 D538 D539 D540 D541 D542 D543 D544 D545 D546 D547 D548 D549 D550 D551 D552 D553 D554 D555 D556 D557 D558 D559 D560 D

# Component List and Illustrations

# Section 6

## OS1100 TIMEBASE

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
<b>RESISTORS</b>									
R401	100k	CF	1W	19061	R456	100	CF		21794
R402	100k	CF		21819	R457	3k9	CF		21804
R403	3k3	CF		21803	R458	10	CF		21793
R404	560	CF		21798	R459	10	CF		21793
R405	47	CF		28714	R460	200	CF		28786
R406	47	CF		28714	R461	220	CF		21796
R407	4k7	CF		21805	R462	6k8	CF		21807
R408	120	CF		28718	R463	330	CF		28721
R409	22k	CF		21812	R464	3k3	CF		21803
R410	100	CF		21794	R465	200	CF		28786
R411	100	CF		21794	R466	2k2	CF		21802
R412	22k	CF		21812	R467				
R413	390	CF		28722	R468	10	CF		21793
R414	27	CF		28711	R469	680	CF		28723
R415	1k	CF		21799	R470	330	CF		28721
R416	390	CF		28722	R471	220	CF		21796
R417	100	CF		21794	R472	680	CF		28723
R418	1k	CF		21799	R473	10	CF		21793
R419	22k	CF		21812	R474	10k	PCP		36267
R420	100	CF		21794	R475	680k	CF		31839
R421	1M	CF		31840	R476	33	CF		28712
R422	1M	CF		31840	R477	33	CF		28712
R423	10k	PCP		36267	R478	4k7	CF		21805
R424	22k	CP	A4/37534		R479	10	CF		21793
R425	22k	CF		21812	R480	10	CF		21793
R426	150k	CF		21821	R481	10k	CF		21809
R427	1M	CF		31840	R482	680	CF		28723
R428	10k	CF		21809	R483	2k7	CF		28726
R429	10k	CF		21809	R484	1k	CF		21799
R430	47k	CF		21815	R485	15k	CF	A.O.T.	28727
R431	10k	CF		21809	R486	4k7	CF		21805
R432	220k	CF		21823	R487	1k5	CF		21801
R433	22k	CF		21812	R488	1k2	CF		21800
R434	100k	CF		21819	R489	15k	CF		28727
R435	470	CF		21797	R490	5k6	CF		21806
R436	3k3	CF		21803	R491	2k2	CF	A.O.T.	21802
R437	100k	CF		21819	R492	2k2	CF		21802
R438	560k	CF		32359	R493	470	CF		21797
R439	22k	CF		21812	R494	220	CF		21796
R440	6k8	CF		21807	R495	2k2	CF		21802
R441	10k	CF		21809	R496	820	CF		28724
R442	10k	PCP		36267	R497	10	CF		21793
R443	15k	CF		28727	R498	22k	CF		21812
R444	330k	CF		32357	R499	470	PCP		36263
R445	150	CF		28719	R500	470	MO		26739
R446	2k7	CF		28726	R501	2k2	CF		21802
R447	100k	CF		21819	R502	680	MO		22484
R448	270	CF		28720	R503	330	CF		28721
R449	27	CF		28711	R504	820	CF		28724
R450	220	CF		21796	R505	1k8	CF		28725
R451	10	CF		21793	R506	3k3	CF		21803
R452	10	CF		21793	R507	560	CF		21798
R453	270	CF		28720	R508	2k2	CF		21802
R454	100	CF		21794	R509	22k	CF		21812
R455	1k5	CF		21801	R510	100k	CF		21819

# Component List and Illustrations

# Section 6

## OS1100 TIMEBASE (Cont.)

Ref	Value	Description	Tol % ±	Part No	Ref	Value	Description	Tol % ±	Part No
<b>RESISTORS (Cont.)</b>									
R511	22k	CF		21812	R566	10	CF		21793
R512	560	CF		21798	R567	47	CF		28714
R513	4k7	CF		21805	R568	220	CF		21796
R514	1k	CF		21799	R569	2k2	CF		21802
R515	2k2	CF		21802	R570	100	PCP		36261
R526	10k	CF		21809	R571	3k9	MO	6W 5	37546
R517	820	CF		28724	R572	47	CF		28714
R528	1k5	CF		21801	R573	470	CF		21797
R519	10	CF		21793	R574	270	MO		26742
R520	10	CF		21793	R575	1k	PCP		36264
R521	6k8	CF		21807	R576	47	CF		28714
R522	10k	CF		21809	R577	470	CF		21797
R523	47k	CF		21815	R578	47	CF	6W 5	28714
R524	15k	CF		28727	R579	3k9	MO		37546
R525	10k	CF		21809	R580	270	MO		26742
R526	100k	CF		21819	R581	10k	CF		21809
R527	10	CF		21793	R582	470	CF		21797
R528	10	CF		21793	R583	560	CF		21798
R529	1k	CF		21799	R584	75k	MO		28819
R530	220	CF		21796	R585	47	CF		28714
R531	10M	CC		1179	R586	1k2	MO		26734
R532	390k	CF		32358	R587	47	CF		28714
R533	10	CF		21793	R588				
R534	1k5	CF		21801	R589	15k	CF		28727
R535	470	PCP		36263	R590	1k8	CF		28725
R536	10k	} CP	DUAL	37528	R591	10k	} CP	DUAL	37535
R537	10k								
R538	820	CF		28724	R593	3k9	CF		21804
R539	1k	CF		21799	R594	27k	CF		21813
R540	3k9	CF		21804	R595	1k	CF		21799
R541	1k	CF		21799	R596	220k	CF		21823
R542	22k	CF		21812	R597	1k5	CF		21801
R543	1k2	CF		21800	R598	10k	CF		21809
R544	100	CF		21794	R599				
R545	1k	PCP		36264	R600	27k	CF		21813
R546	1k6	MO		28793	R601	100	CF		21794
R547	1k	CF		21799	R602	100	CF		21794
R548	4k7	CP	WITH S7	37532	R603	180	CF		21795
R549	100	CF		21794	R604	56k	CF		28729
R550	100	CF		21714	R605	47	CF		28714
R551					R606	47	CF		28714
R552	220	CF		21796	R607	220	CF		21796
R553	2k	MO		26731	R608				
R554	10k	CF		21809	R609	56k	CF		28729
R555	3k	MO		26727	R610	1k	CF		21799
R556	10	CF		21793	R611				
R557	10	CF		21793	R612	1k2	CF		21800
R558	10	CF		21793	R613	100	CF		21794
R559	100	CF		21794	R614	1k2	CF		21800
R560	10k	CF		21809	R615	3k3	CF		21803
R561	10k	CF		21809	R616	270k	CF		32356
R562	10k	CF		21809	R617	2k2	CF		21802
R563	75k	MO		28819	R618	100	CF		21794
R564	1k2	MO		26734	R619	5k6	CF		21806
R565	470	CF		21797	R620	390	CF		28722

# Component List and Illustrations

# Section 6

## OS1100 TIMEBASE (Cont.)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
<b>RESISTORS (Cont.)</b>									
R621	470	CF		21797	C449	470μF	E		32185
R622	15k	CF		28727	C450	.01μF	CE(2)	250V	22395
R623	10k	CF		21809	C451				
R624	1k8	CF		28725	C452	22μF	E	25V	32181
R625	12k	CF		21810	C454	22μF	E		32181
<b>CAPACITORS</b>									
C401	1.5pF	S/M		813	C460	.01μF	CE(2)	250V	22395
C402	.01μF	CE(2)	250V	22395	C461	.01μF	CE(2)	250V	22395
C403	680pF	CE(2)		22385	C462	.01μF	CE(2)	250V	22395
C404	3300pF	CE(2)		22391	C463	.01μF	CE(2)	250V	22395
C405	.47μF	PE	63V	31362	C464	.01μF	CE(2)	250V	22395
C406	.01μF	CE(2)	250V	22395	C466	.01μF	CE(2)	250V	22395
C407	.01μF	CE(2)	250V	22395	C467	10pF	CE(2)		22364
C408	150pF	CE(2)		22378	<b>TRANSISTORS</b>				
C409	.1μF	CE(2)	25V	36709	TR401		BC108		26110
C410	33pF	CE(2)		22370	TR402		2N2369		23307
C411	22μF	T	20 35V	35932	TR403		2N2369		23307
C412	.1μF	PE	250V	31377	TR404		BC108		26110
C413	.47μF	PE	63V	31362	TR405		2N930		21548
C414	220pF	CE(2)		22379	TR406		2N2369		23307
C415	27pF	CE(2)		22369	TR407		2N2369		23307
C416	.01μF	CE(2)	250V	22395	TR408		BC212		29327
C417	.01μF	CE(2)	250V	22395	TR409		BC107		26790
C418	.01μF	CE(2)	250V	22395	TR410		2N3906		21533
C419	.01μF	CE(2)	250V	22395	TR411		2N3640		31781
C420	.01μF	CE(2)	250V	22395	TR412		2N3640		31781
C421	33pF	CE(2)		22370	TR413				
C422	22pF	CE(2)		22368	TR414				
C423	15pF	CE(2)		22366	TR415				
C424	.01μF	CE(2)	250V	22395	TR416				
C425	1000pF	CE(2)		22387	TR417		2N3640		31781
C426	.01μF	CE(2)	250V	22395	TR418		2N3640		31781
C427	1000pF	CE(2)		22387	TR419		2N2369		23307
C428	27pF	CE(2)		22369	TR420		2N2369		23307
C429	33pF	CE(2)	A.O.T.	22370	TR421		2N2369		23307
C430	.01μF	CE(2)	250V	22395	TR422		2N3906		21533
C431	6/25pF	TRIMMER		23593	TR423				
C432	22pF	CE(2)		22368	TR424		2N3906		21533
C433	.1μF	CE(1)	25V	36709	TR425				
C434	.01μF	CE(2)	250V	22395	TR426		2N3906		21533
C435	.01μF	CE(2)	250V	22395	TR427				
C436	.01μF	CE(2)	250V	22395	TR428		2N3640		31781
C437	.01μF	CE(2)	250V	22395	TR429		2N2369		23307
C438	220pF	CE(2)		22379	TR430		2N3640		31781
C439	.01μF	CE(2)	250V	22395	TR431		2N2369		23307
C440	68pF	CE(2)		22374	TR432				
C441	220pF	CE(2)		22379	TR433				
C442	390pF	CE(2)	A.O.T.	31491	TR434		2N3640		31781
C443	.01μF	CE(2)	250V	22395	TR435		2N3640		31781
C444	1.5pF	S/M		813	TR436		2N3906		21533
C445					TR437				
C446					TR438		2N2369		23307
C447	100pF	CE(2)		22376	TR439		2N3906		21533
C448	47μF	E		32167	TR440		BC108		26110

# Component List and Illustrations

# Section 6

## OS1100 TIMEBASE (Cont.)

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
<b>TRANSISTORS (Cont.)</b>									
TR441	AE13			A32067	D415		1N4148		23802
TR442		PART OF IC404			D416		1N4148		23802
TR443		PART OF IC404							
TR444		PART OF IC404			D420		1N4148		23802
TR445	2N3906			21533	D421		1N4148		23802
TR446	2N3640			31781	D422		TIL209A		35202
TR447	BF380			32902	D423		1N4148		23802
TR448	BF380			32902	D424		1N4148		23802
TR449	2N2369			23307	D425		1N4148		23802
TR450	2N3640			31781	D426		1N4148		23802
TR451	2N3906			21533	D427		1N4148		23802
TR452	2N3906			21533	D428		1N4148		23802
TR453	2N3906			21533	D429		1N4148		23802
TR454	2N3906			21533	D430		1N3595		29330
TR455	2N3904			24146	D431		1N4148		23802
TR456	BC107			26790	D432	4V3	ZENER		1723
					D433		1N4148		23802
					D434		TIL209A		35202
<b>INTEGRATED CIRCUITS</b>									
IC401	CA3046			32961	D435	6V8	ZENER		33932
IC402	MC14013			34954	D436		1N4148		23802
IC403	CA3046			32961	D437		1N4148		23802
IC404	CA3046			32961	D438	6V8	ZENER		33931
					D439		1N4148		23802
<b>DIODES</b>									
D401		1N4148		23802	D440	3V9	ZENER		33925
D402		0A47		4468	D441	2V7	ZENER		33931
D403		0A47		4468	D442	6V2	ZENER		33930
D404		1N4148		23802	<b>MISCELLANEOUS</b>				
D405		1N4148		23802	L401		FERRITE FX 1242		26986
D406		1N4148		23802	L402		FERRITE FX 1242		26986
D407		1N4148		23802					
D408	3V	ZENER		33922	S3		PART OF R424		
D409		1N916		1949					
D410		1N916		1949	S7		PART OF R548		
D411		1N916		1949					
D412		1N916		1949					
D413		1N916		1949	S401-404				37542
D414		1N916		1949	S405-409				37541

RES1E	R406	R407	R408	R409	R410	R411	R412	R413	R414	R415	R416	R417	R418	R419	R420	R421	R422	R423	R424	R425	R426	R427	R428	R429	R430	R431	R432	R433	R434	R435	R436	R437	R438	R439	R440	R441	R442	R443	R444	R445	R446	R447	R448	R449	R450	R451	R452	R453	R454	R455	R456	R457	R458	R459	R460	R461	R462	R463	R464	R465	R466	R467	R468	R469	R470	R471	R472	R473	R474	R475	R476	R477	R478	R479	R480	R481	R482	R483	R484	R485	R486	R487	R488	R489	R490	R491	R492	R493	R494	R495	R496	R497	R498	R499	R500	R501	R502	R503	R504	R505	R506	R507	R508	R509	R510	R511	R512	R513	R514	R515	R516	R517	R518	R519	R520	R521	R522	R523	R524	R525	R526	R527	R528	R529	R530	R531	R532	R533	R534	R535	R536	R537	R538	R539	R540	R541	R542	R543	R544	R545	R546	R547	R548	R549	R550	R551	R552	R553	R554	R555	R556	R557	R558	R559	R560	R561	R562	R563	R564	R565	R566	R567	R568	R569	R570	R571	R572	R573	R574	R575	R576	R577	R578	R579	R580	R581	R582	R583	R584	R585	R586	R587	R588	R589	R590	R591	R592	R593	R594	R595	R596	R597	R598	R599	R600	R601	R602	R603	R604	R605	R606	R607	R608	R609	R610	R611	R612	R613	R614	R615	R616	R617	R618	R619	R620	R621	R622	R623	R624	R625	R626	R627	R628	R629	R630	R631	R632	R633	R634	R635	R636	R637	R638	R639	R640	R641	R642	R643	R644	R645	R646	R647	R648	R649	R650	R651	R652	R653	R654	R655	R656	R657	R658	R659	R660	R661	R662	R663	R664	R665	R666	R667	R668	R669	R670	R671	R672	R673	R674	R675	R676	R677	R678	R679	R680	R681	R682	R683	R684	R685	R686	R687	R688	R689	R690	R691	R692	R693	R694	R695	R696	R697	R698	R699	R700	R701	R702	R703	R704	R705	R706	R707	R708	R709	R710	R711	R712	R713	R714	R715	R716	R717	R718	R719	R720	R721	R722	R723	R724	R725	R726	R727	R728	R729	R730	R731	R732	R733	R734	R735	R736	R737	R738	R739	R740	R741	R742	R743	R744	R745	R746	R747	R748	R749	R750	R751	R752	R753	R754	R755	R756	R757	R758	R759	R760	R761	R762	R763	R764	R765	R766	R767	R768	R769	R770	R771	R772	R773	R774	R775	R776	R777	R778	R779	R780	R781	R782	R783	R784	R785	R786	R787	R788	R789	R790	R791	R792	R793	R794	R795	R796	R797	R798	R799	R800	R801	R802	R803	R804	R805	R806	R807	R808	R809	R810	R811	R812	R813	R814	R815	R816	R817	R818	R819	R820	R821	R822	R823	R824	R825	R826	R827	R828	R829	R830	R831	R832	R833	R834	R835	R836	R837	R838	R839	R840	R841	R842	R843	R844	R845	R846	R847	R848	R849	R850	R851	R852	R853	R854	R855	R856	R857	R858	R859	R860	R861	R862	R863	R864	R865	R866	R867	R868	R869	R870	R871	R872	R873	R874	R875	R876	R877	R878	R879	R880	R881	R882	R883	R884	R885	R886	R887	R888	R889	R890	R891	R892	R893	R894	R895	R896	R897	R898	R899	R900	R901	R902	R903	R904	R905	R906	R907	R908	R909	R910	R911	R912	R913	R914	R915	R916	R917	R918	R919	R920	R921	R922	R923	R924	R925	R926	R927	R928	R929	R930	R931	R932	R933	R934	R935	R936	R937	R938	R939	R940	R941	R942	R943	R944	R945	R946	R947	R948	R949	R950	R951	R952	R953	R954	R955	R956	R957	R958	R959	R960	R961	R962	R963	R964	R965	R966	R967	R968	R969	R970	R971	R972	R973	R974	R975	R976	R977	R978	R979	R980	R981	R982	R983	R984	R985	R986	R987	R988	R989	R990	R991	R992	R993	R994	R995	R996	R997	R998	R999	R1000
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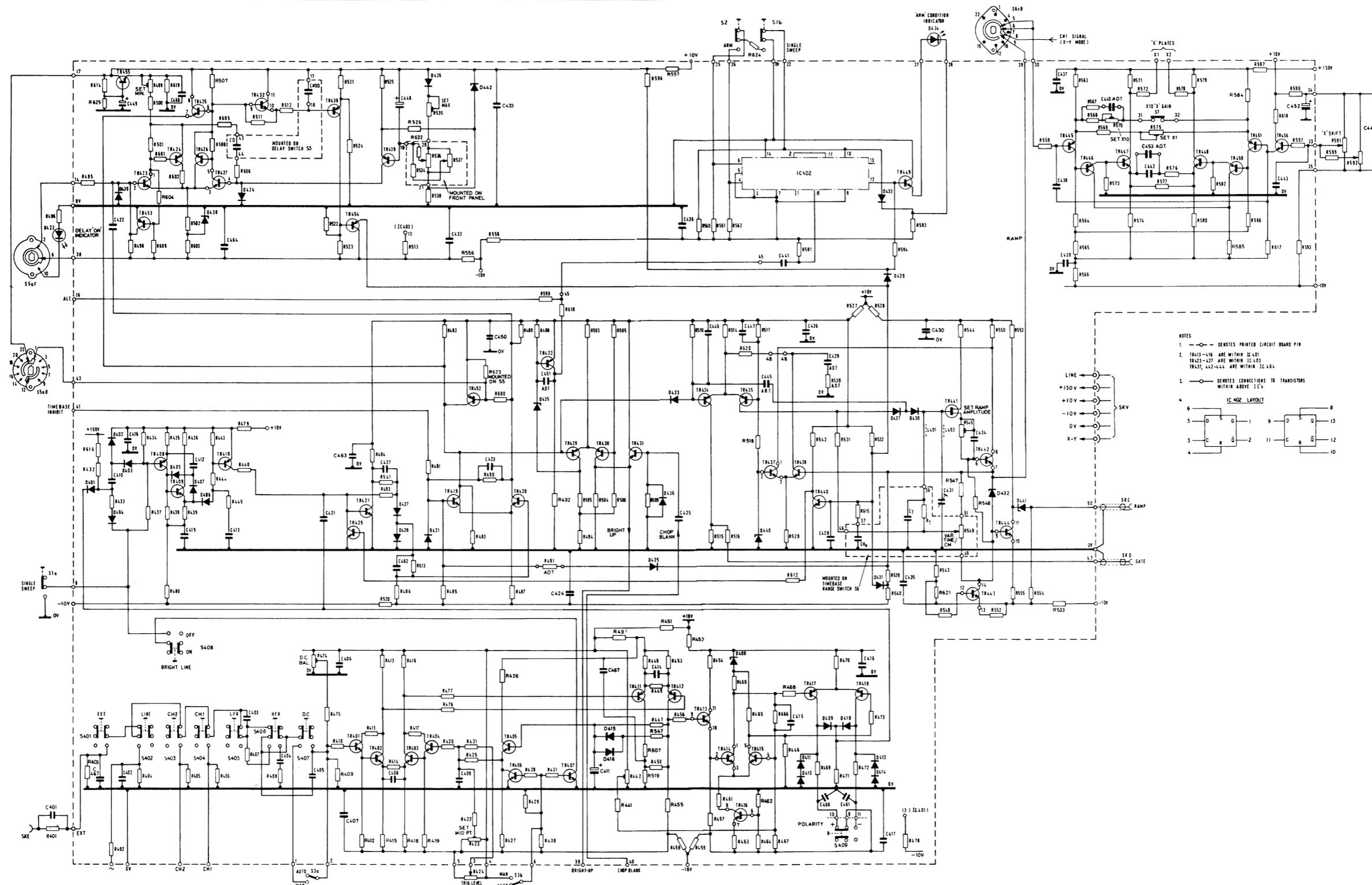


Fig. 3 Timebase Circuit Diagram

# Component List and Illustrations

# Section 6

## OS1100 POWER SUPPLY & MAIN FRAME

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
<b>RESISTORS</b>									
R701	33k	CF		21814	R810	1M	PCP		26867
R702	4k7	CF		21805	R811	1M	PCP	WITH S801	37540
R703	3k3	CF		21803	R812	10	CF		21793
R704	680k	CF		31839	R813	10	CF		21793
R705	22k	CF		21812	R814	5k6	MO		22483
R706	39k	MO		28812	R815	1k3	MO		28792
R707	10k	PCP		28525	R816	4k3	MO		26723
R708	1.2M	CF	Used with Thorn D14-280 only	29166	R817	7k5	MO		28797
R709	220k	CF		21823	R818	470	CF		21797
R710	6M8	MG		37201	R819	680	PCP		26869
R711	470k	CF		32330	R820	1k6	MO		28793
R712	1M2	CF		18587	R821	220	MF		1673
R713	1M8	CF		18589	R822	180	CF		18541
R714	100k	CF		21819	R823	1k	PCP		27156
R715	10M	CC		1179	R824	180	CF		18541
R716	10k	CF		21809	R825	33k	CF		18568
R717	68	MO		28779	R826	33k	CF	Used with Thorn D14280 only	18568
R718	270	MO		26742	R827	470k	PCP	Used with Thorn D14-280 only	28529
R719	270	MO		26742	R827	220k	PCP	Used with Mullard D14-120 only	29363
R720	68	MO		28779	R828				
R721	15k	CF		18564	R829	1M8	MF	Used with Thorn D14-280 only	35752
R722	6k8	CF		21807	R829	3M3	MF	Used with Mullard D14-120 only	36002
R723	6k8	CF		21807	R830	1k	CF		18550
R724	330	CF		28721	R901	4M7	MF	5 1W	37171
R725	100	CF		21794	R902	68M	MF	5 1W	37173
R726	3k3	CF		21803	R903	27M	MF	5 1W	37172
R727	47	CF		28714	<b>CAPACITORS</b>				
R728	220	CF		21796	C701	4.7µF	E	450V	23599
R729	330	CF		28721	C702	4.7µF	E	450V	23599
R730	10k	CF		21809	C703	1µF	E	63V	32193
R731	1k8	WW	5 3W	37547	C704	4.7µF	E	63V	32195
R732	3k9	CF		21804	C705	.01µF	CE(2)	+40 -20 250V	22395
R733	3k9	CF		21804	C706	4.7µF	E	450V	23599
R734	27	CF		28711	C707	4.7µF	E	450V	23599
R735	10	CF		21793	C708	4.7µF	E	450V	23599
R736	2k2	CF		21802	C709	4.7µF	E	450V	23599
R737	10k	CF		18562	C710	4.7µF	E	450V	23599
R738	100	CF		21794	C711	4.7µF	E	450V	23599
R739	1k	CF		21799	C712	4.7µF	E	450V	23599
R740	4k7	CF		21805	C713	4.7µF	E	450V	23599
R741	1M5	CC		7016	C714	4.7µF	E	450V	23599
R742	150	CF		18540	C715	4.7µF	E	450V	23599
R743	470	CF	A.O.T.	21797	C716	.01µF	CE(2)	250V	22395
R744	470	CF	A.O.T.	21797	C717	330µF	E	160V	34378
R801	270	WW		19641	C718	1000µF	E	25V	37558
R802	1k5	CF		18552	C719	3300µF	E	25V	36021
R803	4k7	PCP		37537	C720	3300µF	E	25V	36021
R804	47	CF		28714					
R805	2M7	CC		7434					
R806	100k	PCP		37538					
R807	680	CF		28723					
R808	1M	PCP		37539					
R809	680k	CC		5024					



# Component List and Illustrations

# Section 6

## OS1100 POWER SUPPLY & MAIN FRAME (Cont.)

<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol %±</i>	<i>Part No</i>	<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol %±</i>	<i>Part No</i>
<b>MISCELLANEOUS (Cont.)</b>									
		Fuse 550mA Slo-Blo for 220-240V		33685	T1		Transformer Supply		37523
FS1		Fuse 1A Slo-Blo For 100-120V		34790	V1		Cathode ray tube either D14-280 GH NORMAL or D14-280 GM LONG PERSISTANCE or D14-120 GH NORMAL or D14-120 GM LONG PERSISTANCE		37571 37572 37569 37570
C1	.01μF	+40 -20	250V	22395					

Note that as listed above, two alternative types of c.r.t. may be fitted. The type used in manufacture is indicated by the addition of an M or T to the serial number of the instrument, for the Mullard or Thorn (Brimar) types respectively, D14120 or D14280.

The following components then depend on the type of tube fitted. L1, SKP, R708, D715, D801, R826, R827, R829. Any reference to the Service Dept. should quote the serial number including M or T as applicable.

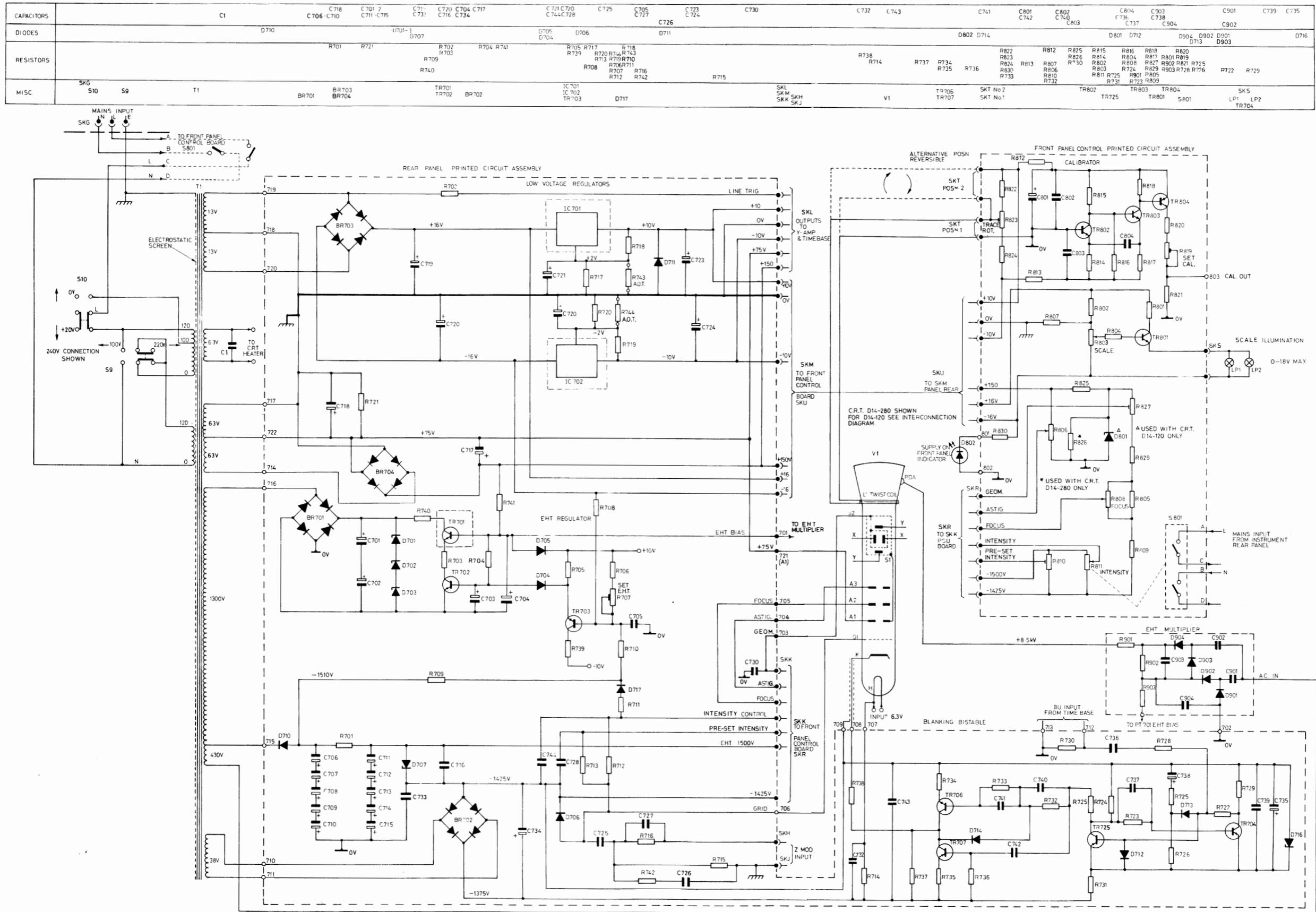


Fig. 4 Power Supply, Bright up and Control Circuit Diagram

# Component List and Illustrations

# Section 6

## OS1100 INTERCONNECTIONS

Ref	Value	Description	Tol %±	Part No	Ref	Value	Description	Tol %±	Part No
<b>RESISTORS</b>									
R1	27	CF		28711	C8	5.6pF	CE(2)		22361
R2	500	CP	WITH S12	37527	C9	47pF	CE(2)		22372
R3					C10	47pF	CE(2)		22372
R4	68	CF		28716	C11	.1μF	P E	400V	29495
R5	68	CF		28716	C12	56pF	CE(2)		22373
R6	10	CF		21793	C13	.7/6pF	TRIMMER		25750
R7	10	CF		21793	C14	.7/6pF	TRIMMER		25750
R8	900k	MF	0.5	31929	C15	47pF	CE(2)		29918
R9	111k	MF	0.5	37779	C16	.7/6pF	TRIMMER		25750
R10	120	CF		28718	C17	.7/6pF	TRIMMER		25750
R11					C18	330pF	CE(2)		31293
R12	990k	MF	0.5	31927	C19	.7/6pF	TRIMMER		25750
R13	10k1	MF	0.5	37778	C20	.01μF	CE(2)		24902
R14	12	CF		28707	C21	.1μF	P E	400V	29495
R15	12	CF		28707	C22	56pF	CE(2)		22373
R16	10	CF		21793	C23	.7/6pF	TRIMMER		25750
R17	330k	CC		4408	C24	.7/6pF	TRIMMER		25750
R18	1M	MF	1	26346	C25	47pF	CE(2)		29918
R19	10k	CP		A4/37533	C26	.7/6pF	TRIMMER		25750
R20					C27	.7/6pF	TRIMMER		25750
R21	27	CF		28711	C28	330pF	CE(2)		31295
R22	500	CP	WITH S22	37527	C29	.7/6pF	TRIMMER		25750
R23					C30	.01μF	CE(2)		24902
R24	68	CF		28716	C31	.01μF	CE(2)		22395
R25	68	CF		28716	C41	1μF	PE	1	24888
R26	10	CF		21793	C42	.1μF	PE	1	24887
R27	10	CF		21793	C43	.01μF	PS	1	24886
R28	900k	MF	0.5	31929	C44	900pF	PS	1	24885
R29	111k	MF	0.5	37779	C45	56pF	CE(2)		34352
R30	120	CF		28718	C46	100pF	CE(2)		22376
R31					C47	.22μF	PE		31396
R32	990k	MF	0.5	31927	C48	.022μF	PE		31373
R33	10k1	MF	0.5	37778	C49	2200pF	CE(2)	20	22389
R34	12	CF		28707	C50	220pF	CE(2)		22379
R35	12	CF		28707	C51	1μF	PE	1	24888
R36	10	CF		21793	C52	.1μF	PE	1	24887
R37	330k	CC		4408	C53	.01μF	PS	1	24886
R38	1M	MF	1	26346	C54	1000pF	PS	1	29847
R39	10k	CP		A4/37533	C55	220pF	CE(2)		22379
R40	220	MO		28786	<b>MISCELLANEOUS</b>				
R41	84k5	MO		38457	S5		WITH R536/537		37528
R42	220	MO		28786	S6		WITH R548/S7		37531
R43	84k5	MO		38457	S11				37614
R44	560	CF		21798	S12		WITH R12		37525
R45	560	CF		21798	S13				37545
RM1		RESISTOR NETWORK		A4/36454	S21				37614
<b>CAPACITORS</b>									
C5	10pF	S/M		34345	S22		WITH R22		37526
C6	10pF	S/M		34345	S23				37545
C7	5.6pF	CE(2)	1pF 500V	22361					

# Component List and Illustrations

# Section 6

## OS1100 INTERCONNECTIONS (Cont.)

<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol %±</i>	<i>Part No</i>	<i>Ref</i>	<i>Value</i>	<i>Description</i>	<i>Tol %±</i>	<i>Part No</i>
<b>MISCELLANEOUS (Cont.)</b>									
LP1	18V		470mW	37178	SKB		SOCKET BNC		1222
LP2	18V		470mW	37178	SKC		SOCKET 4mm		37872
LI	{	TWIST COIL (Thorn C.R.T.)		A3/32495	SKD		SOCKET 4mm		37872
		TWIST COIL (Mullard C.R.T.)		A3/31329	SKE		SOCKET BNC		1222
SKA		SOCKET BNC		1222	SKF		TERMINAL		32310
					SKG		SOCKET SUPPLY		33787

RES	R1	R21	R401	R3	R23	R496	RM1	R12	R611	R24	R25	R5	R32	R4	R14	R15	R44	R40	R35	R26	R6	R8	R10	R45	R7	R41	R9	R18	R28	R29	R16	R17
CAP	C12	C22	C401	C11	C21	C401	C6	C17	C5	C26	C18	C41	C27	C6	C54	C53	C28	C52	C51	C13	C14	C29	C15	C23	C7	C8	C24	C19	C20			
MISC	SKA	S11	S21	SKE	S21	SKE	SKD	S6aF	S6aB	S12aF	S12aF	S6aF	S6aF	S6bF	S6bF	S13	S12bF	S5aB	S23	S12cF												

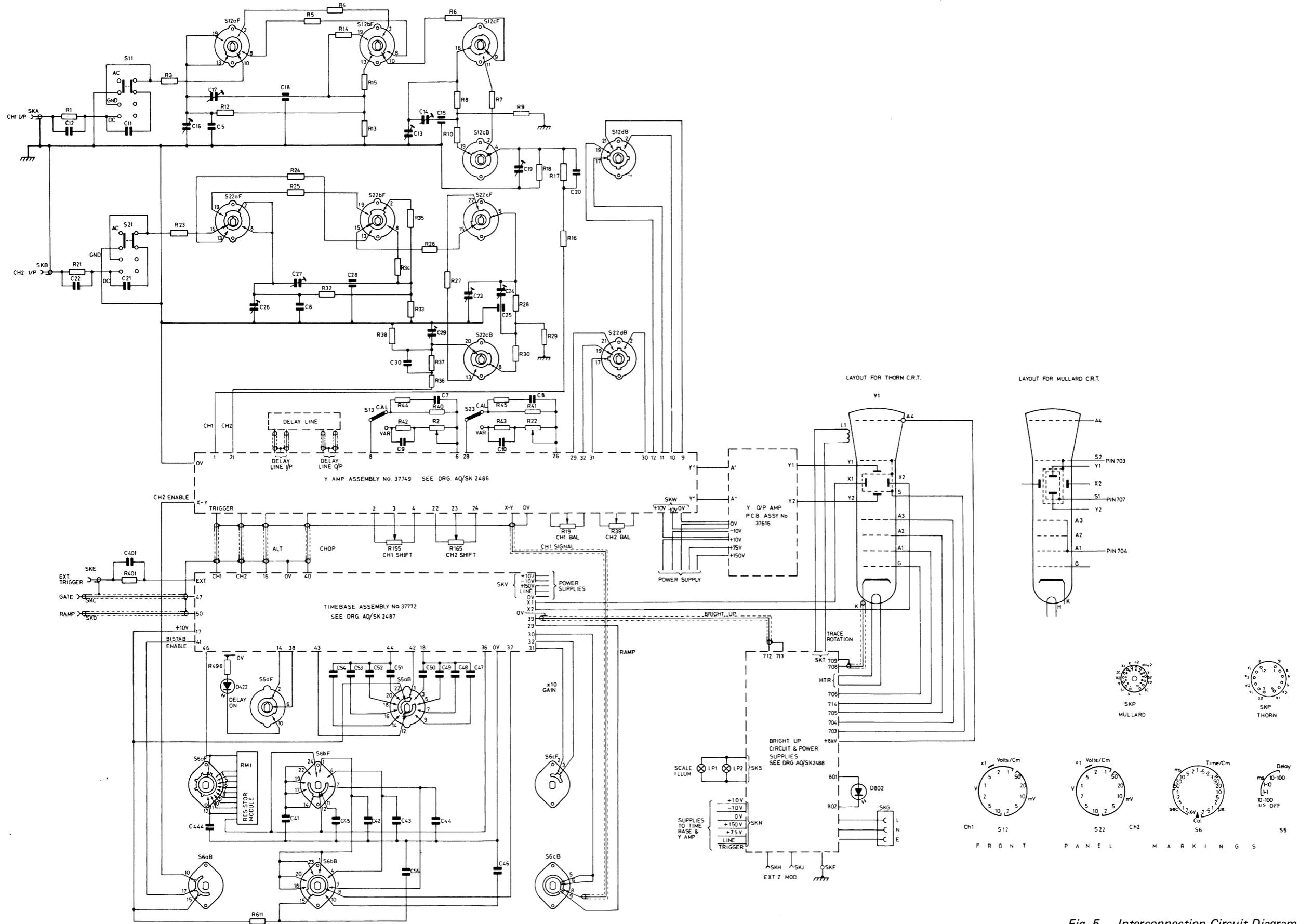


Fig. 5 Interconnection Circuit Diagram

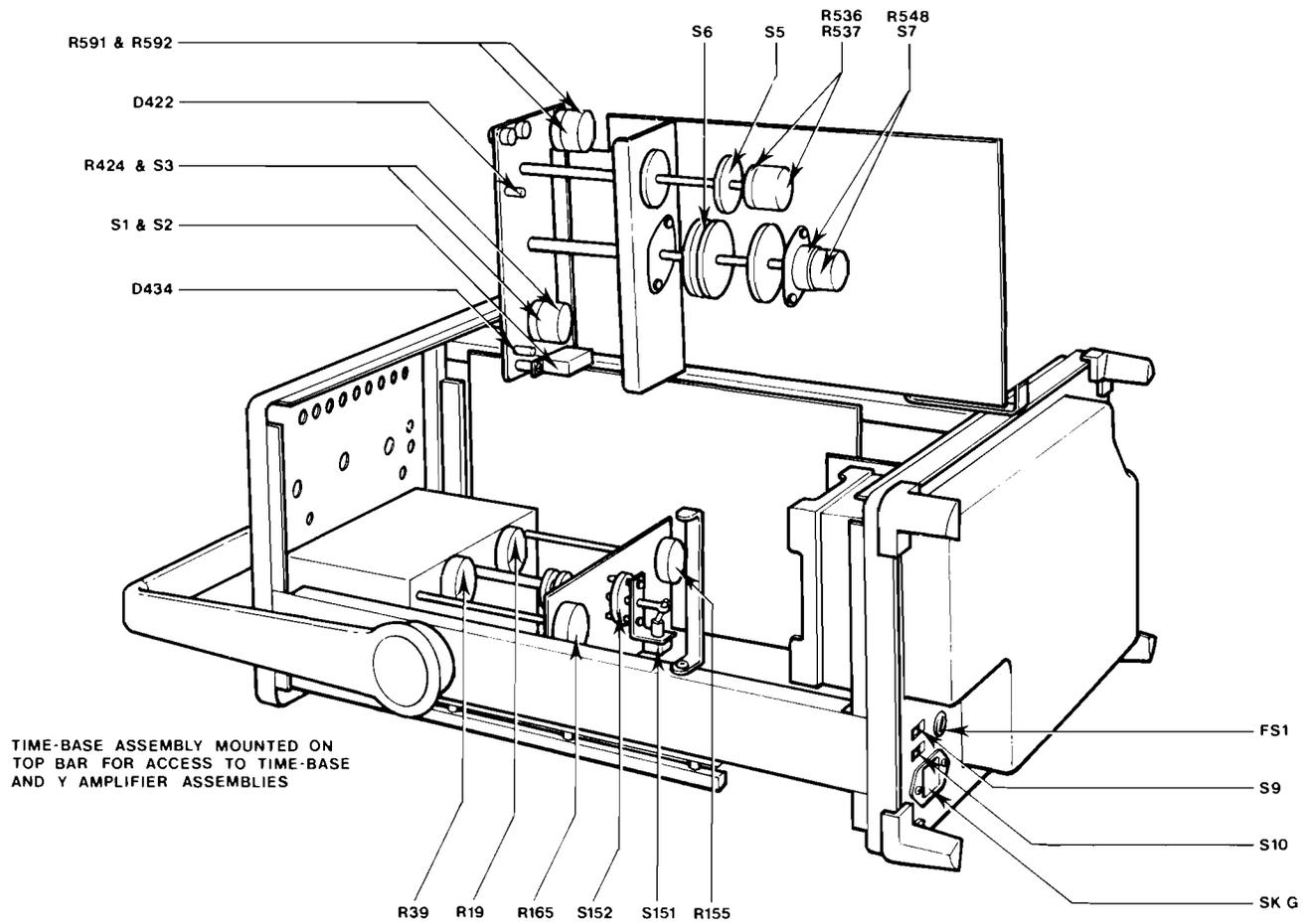


Fig. 6 Maintenance View

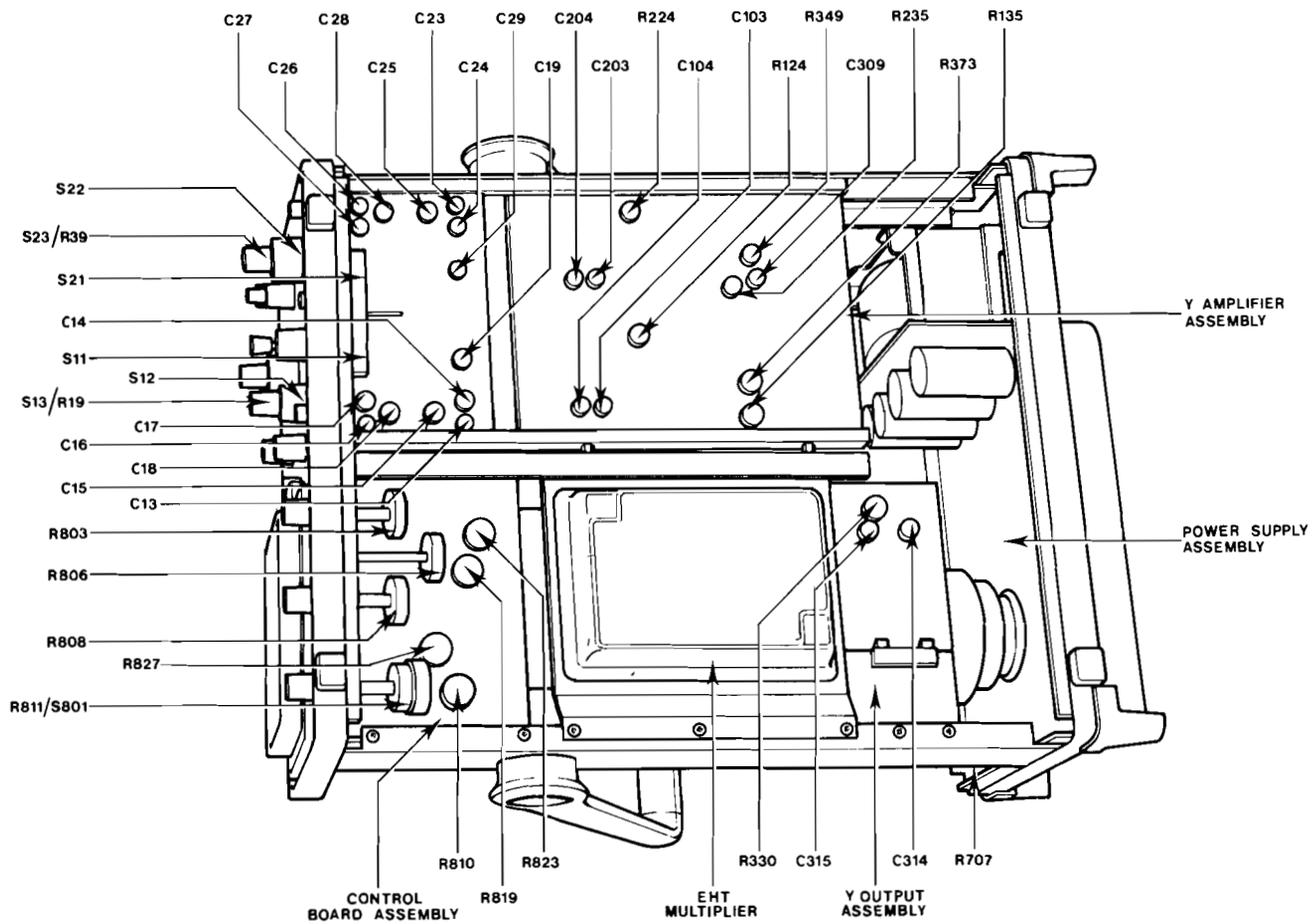


Fig. 7 Bottom View

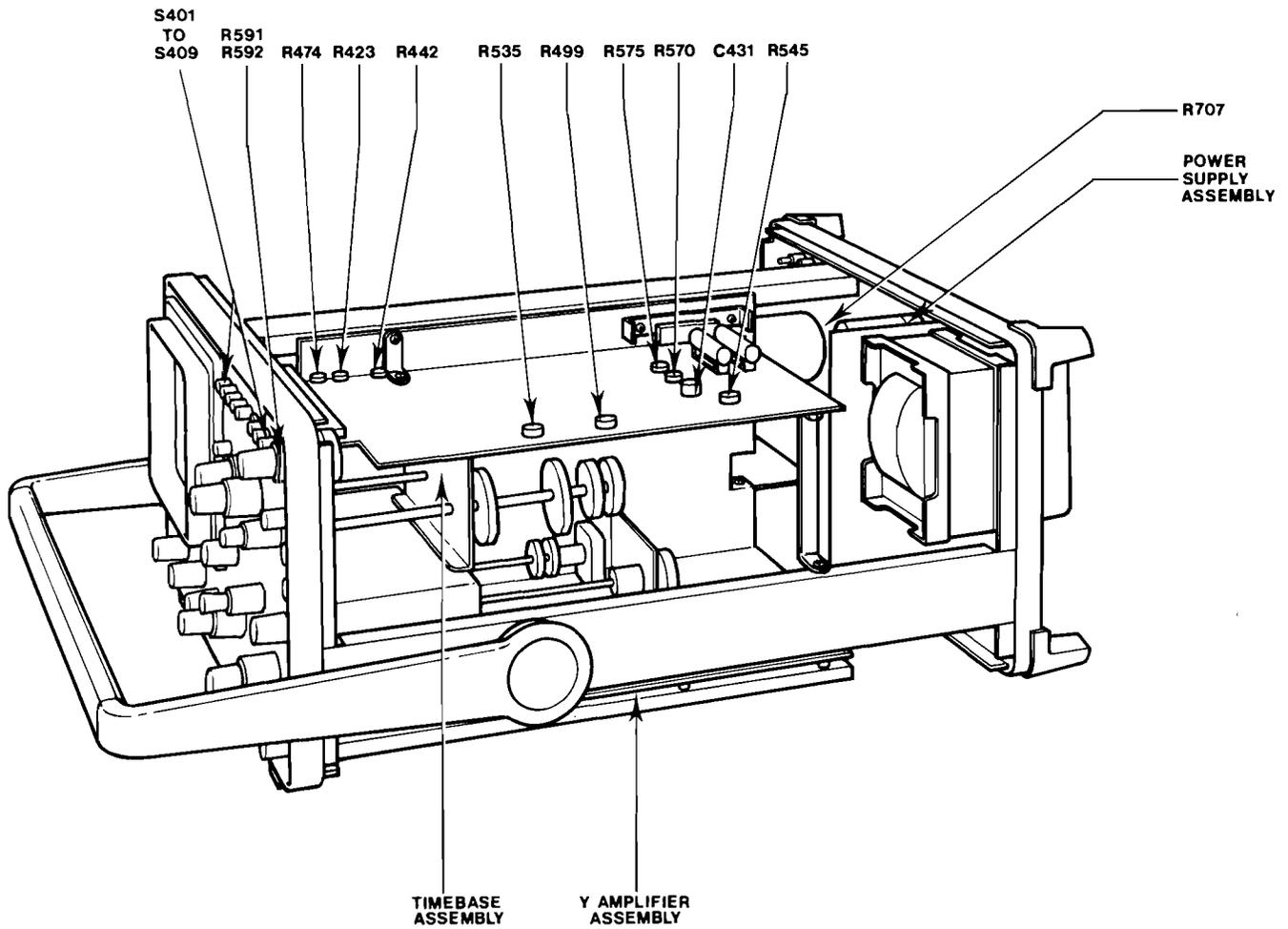
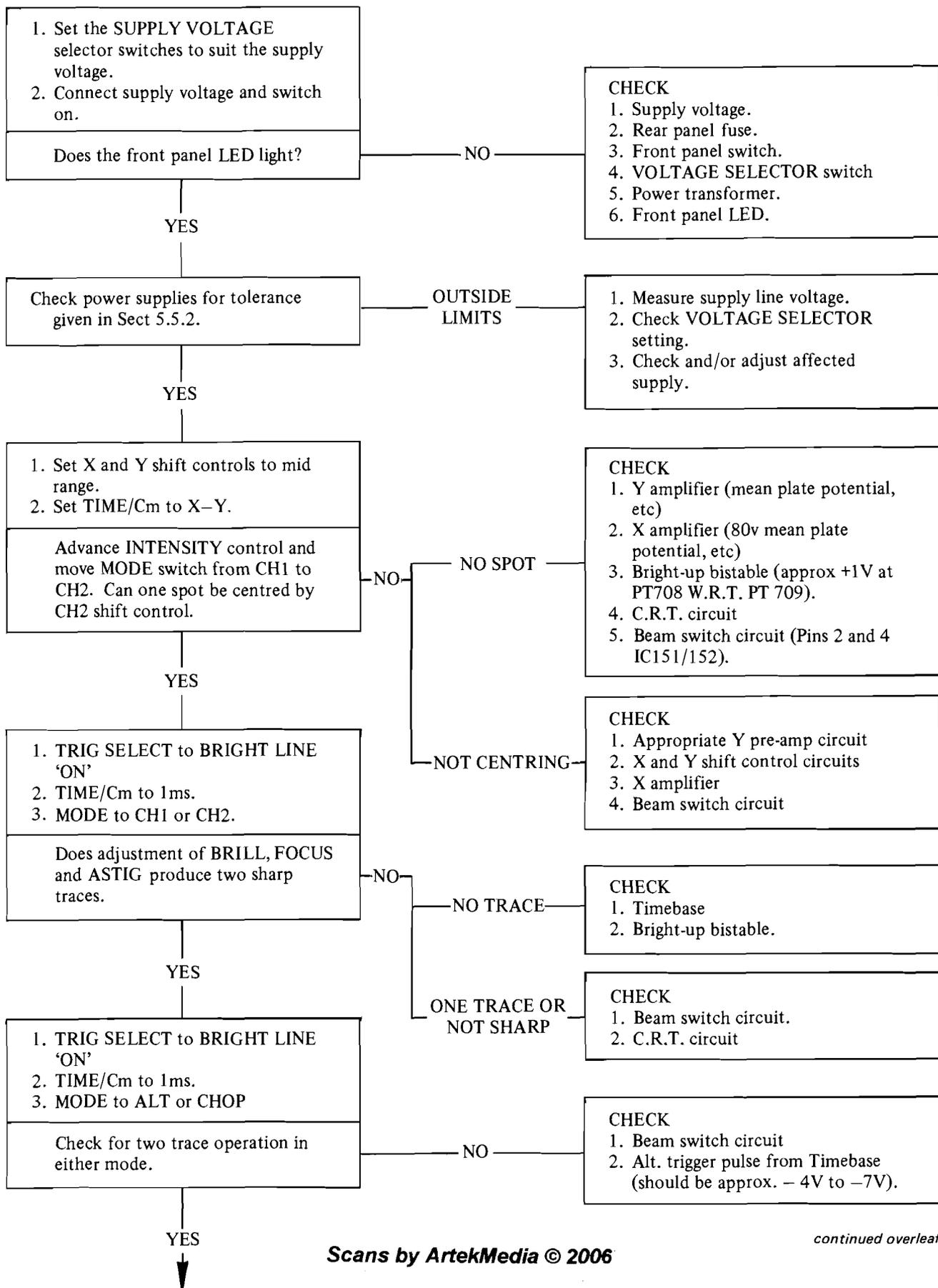


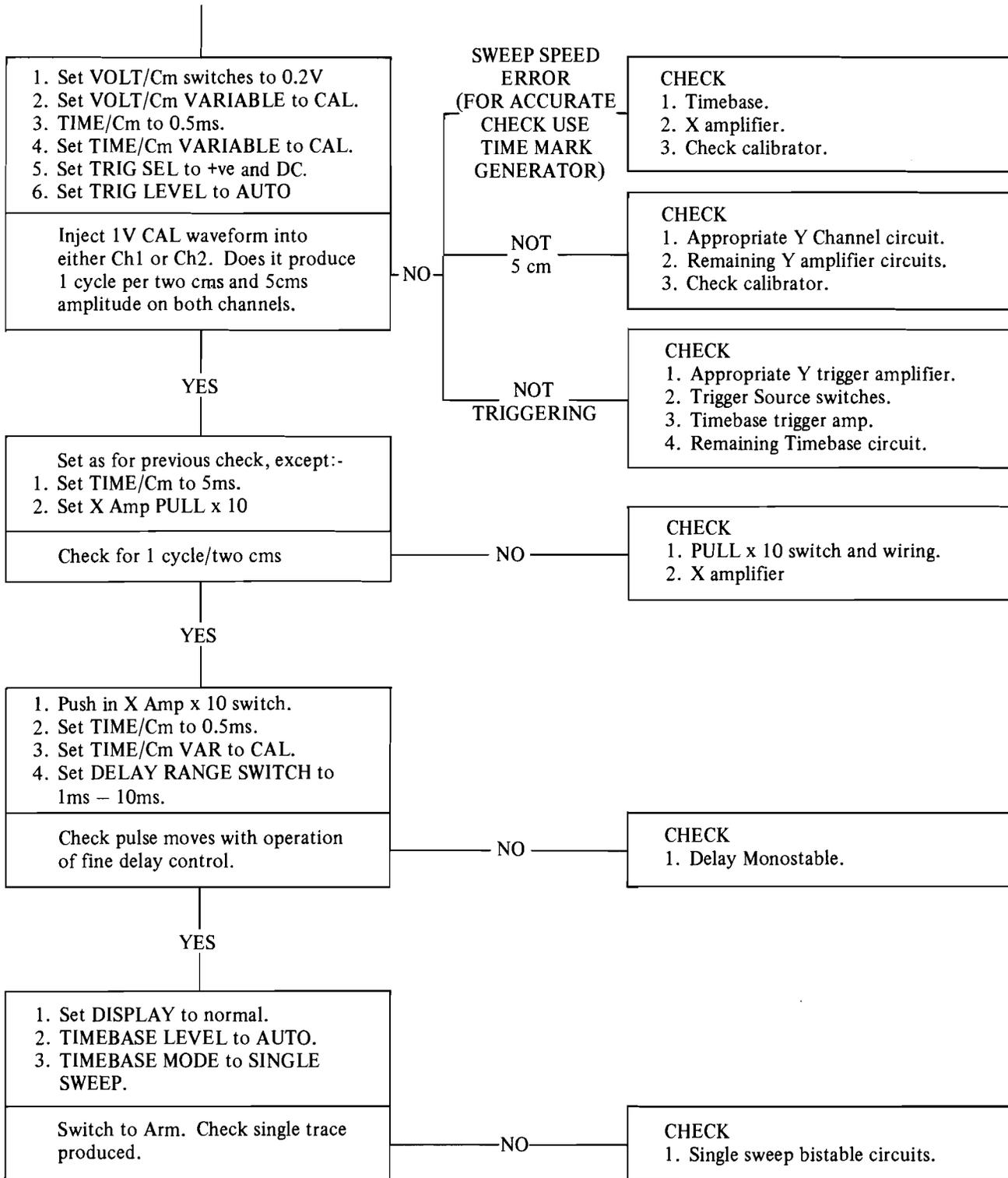
Fig. 8 Top View

FIG 9 FAULT LOCALISATION CHART



continued overleaf

FIG 9 (CONT) FAULT LOCALISATION CHART



# Component List and Illustrations

# Section 6

<i>Ref</i>	<i>Description</i>	<i>Part No</i>
1	Frame Front	37712
2	Frame Rear	37713
3	Bracket Support Side	34460
4	Bracket Support Top	35468
5	Panel Front (Gould)	38763
6	Panel Front Inner (Timebase)	37725
7	Panel Front Inner (Y Amp)	37726
8	Terminal Earth	32310
9	Escutcheon	36351
10	Moulding Tube Support Assy.	37799
11	Trim Side	37860
12	Insert Threaded 4-40	29905
13	Plate Centre Support	37832
14	Plate Support E.H.T.	37075
15	E.H.T. Assy.	37176
16	Panel Rear	37733
17	Cover Rear	37720
18	Fuse Holder	38006
19	Fuse 1A (115V Supply)	34790
20	Foot	37721
21	Handle Assy.	36657
22	Title Strip	37123
23	Spindle	36358
24	Spring	29206
25	Block Index	36635
26	Circlip	10016
27	Screw 6-32 x $\frac{3}{8}$ Pan Head	22816
28	Screw M3 x 8 Pan Head	33069
29	Button Handle	36681
30	Cover Top	36915
31	Cover Bottom	36913
32	Latch	37864
33	'O' Ring	37915
34	Foot Moulded	36329
35	Screen 'Y' Amp. Assy.	37710
36	Screw 4-40 x $\frac{5}{16}$ Pan Head T.T.	22695
37	Washer 6-32 Wavey	4590
38	Screw 4-40 x $\frac{1}{4}$ C'sk Head	22780
39	Screw 6-32 x $\frac{3}{8}$ C'sk Head	22772
40	Washer 4-40	1200
41	Screw 4-40 x $\frac{3}{8}$ Pan Head	22844
42	Screw 4-40 x $\frac{5}{16}$ Pan Head	22843
43	Washer 4-40 Wavey	4591
44	Washer 6-32	1199
45	Screw 6-32 x $\frac{1}{2}$ Pan Head T.T.	50540
46	Screw 4-40 x $\frac{3}{8}$ Pan Head T.T.	22696

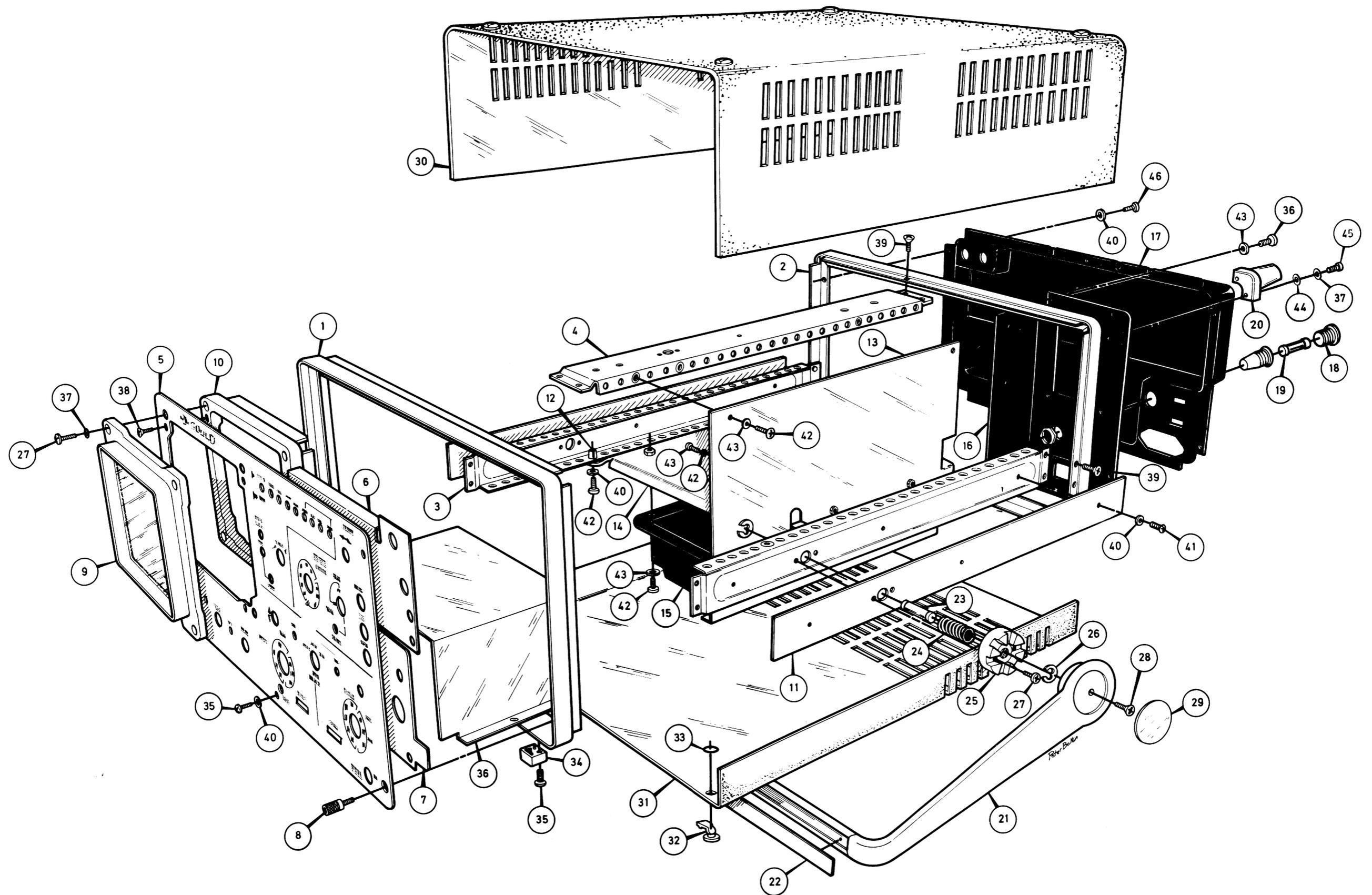


Fig.10 Mechanical Views

This instrument is guaranteed for a period of two years from its delivery to the purchaser, covering faulty workmanship and replacement of defective parts other than cathode ray tubes and batteries (where fitted). Cathode ray tubes are subject to the manufacturers guarantee. This assumes fair wear and tear and usage in the specified environment and does not cover routine recalibrations and mechanical adjustments.

We maintain comprehensive after sales facilities and the instrument should be returned to our factory for servicing if this is necessary. The type and serial number of the instrument should always be quoted, together with full details of any fault and service required.

Equipment returned for servicing must be adequately

packed, preferably in the box in which the instrument was supplied and shipped with transportation charges prepaid. We accept no responsibility for instruments arriving damaged. Should the cause of failure during the guarantee period be due to misuse or abuse of the instrument, or if the guarantee has expired the repair will be put in hand without delay and charged unless other instructions are received.

Our Sales, Service and Engineering Departments are ready to assist you at all times.

The Service Department can provide maintenance and repair information by telephone or letter, if required.

Note: Please check fuses before returning instruments for service.

Service Dept.,  
Roebuck Road,  
Hainault,  
Essex,  
IG6 3UE

Tel: 01-500 1000

Telex: 263785

Telegrams: Attenuate Ilford

## OS1100 AMENDMENT SHEET

Page 5. Specification.

Sensitivity – amend as follows:-

A variable gain control allows continuous adjustment of sensitivity,  $-2$  to  $\times 2$  from calibration setting, giving a maximum sensitivity of  $1\text{mV/cm} \pm 5\%$ , Bandwidth at maximum gain  $> 25\text{MHz}$ .

From serial no. 401 the following two modifications apply:-

### 1. 200V Operation

An additional tap added to the mains transformer allows operation from  $200\text{V} \pm 10\%$  supplies. For this the rear panel tap selection switch offers  $-20\text{V}$  in addition to the original 0 and  $+20\text{V}$  modification of the basic 100V and 220V ranges. However the instrument is not specified to operate at 80V by selection of 100V and  $-20\text{V}$ .

The circuit diagram, Fig. 4, should be modified to show an additional 80V tap on the upper primary winding. S10 should be a 3 position switch, Pt. No. 25869, connected to select the 80V, the 100V or the 120V tap in its  $-20\text{V}$ , 0V or  $+20\text{V}$  positions respectively.

The relevant sentence of section 4.23 should be modified to read "In the 200, 220, 240 voltage input ranges, the two primaries of the transformer are connected in series by S9 while S10 selects the 80V, 100V or 120V tap of one of them".

### 2. Delay Line

The printed circuit delay line mounted on the central partition of the instrument is replaced by a wound delay line, mounted directly on the main Y amplifier board assembly.

Associated component changes are:-

R301	to read	18k	Part No. 21811
R321	to read	1k5	Part No. 21801
R340	to read	1k2	Part No. 21800
R350	to read	330	Part No. 28721
R368	to read	1k	Part No. 21799
C157	to read	220pF	Part No. 22379
C158	to read	220pF	Part No. 22379
C302	to read	33pF	Part No. 22370
C310	to read	82pF	Part No. 22375
C314	to read	33pF	Part No. 22370
C329	to read	10pF	Part No. 22364
TR102	to read	BF479	Part No. 39270
TR103	to read	BF479	Part No. 39270

#### Section 5.2.3 Delay Line

This paragraph should be modified to read:-

This wound component is mounted on the main Y amplifier assembly. If, for any reason, it has to be removed or replaced, it should be wound on the mounting posts in the original manner.

#### Operation

The following addition to section 3.4b is suggested to explain the full use of the Variable Sensitivity facility.

It is possible to set up any particular sensitivity, other than the calibrated steps provided but within the additional range of the variable control. For this the calibrator signal is used to set the Variable control to an equivalent sensitivity on a range to suit the 1V calibrator amplitude and then without moving the VARIABLE control, the sensitivity is switched to the range required.

For example to obtain  $20\text{V/cm}$ , connect the 1V calibrator to the selected channel input and select  $100\text{mV/cm}$ . Adjust the VARIABLE control for 5cm pk/pk deflection ( $200\text{mV/cm}$ ). Without moving the position of the VARIABLE select  $10\text{V/cm}$ , remove the calibrator and connect the unknown signal to the input.