DUAL TRACE OSCILLOSCOPE OS1200

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

Contents

ILLUSTRATIONS

SAFETY

This instruction manual contains information and warnings which must be observed by the user to ensure safe operation and retain the apparatus in a safe condition. The instrument has been designed to operate indoors, within the specified limits of temperature. It should not be switched on if there are obvious signs of mechanical damage and it should not be used under wet conditions.

EARTHING

The instrument must be operated with a protective earth connected via the appropriate (yellow/green) conductor of the supply cable. This is connected to the instrument before the line and neutral supply connections when the supply socket is inserted into the plug on the back of the instrument. If the final connection between the instrument and the supply is made elsewhere, the user must ensure that the earth connection is made before line and neutral.

If any supply cable other than that supplied with the instrument is used, it must carry an adequate protective earth conductor.

WARNING

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

Signal connections into the instrument should be connected after and disconnected before the protective earth connection is made, i.e. the supply lead must be connected at all times that signal leads are connected.

LIVE PARTS

The instrument is safe to operate with the covers fitted and these must not be removed under normal usage. The covers protect the user from live parts and they should be removed only by suitably qualified personnel for maintenance or repair purposes. (see maintenance section).

Introduction

Section 1

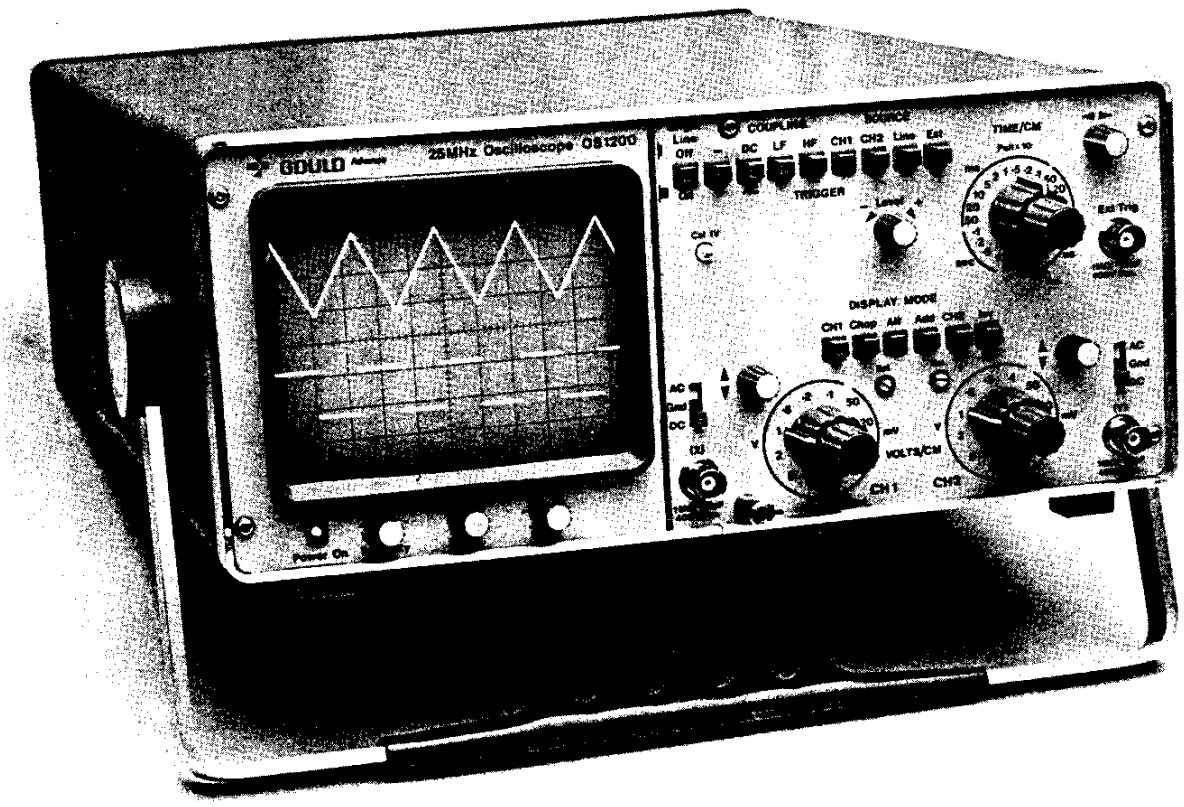
The OS1200 is a wideband general purpose dual channel oscilloscope intended for laboratory, industrial and servicing applications. The full 8 x 10cm rectangular tube provides a bright display against the illuminated calibrated graticule.

It features two identical input channels with a maximum sensitivity of 2mV/cm and a bandwidth from DC to 25MHz. These channels may be displayed separately or together in dual trace display with either chopped or alternate beam switch mode. Alternatively they can be added or subtracted for sum or difference display.

The triggered timebase ranges from 1s/cm to 200ns/cm and a x 10 expansion facility extends this to 20ns/cm. Signal delay is provided to display the leading edge of an input pulse. Independent variable controls are provided for sensitivity and sweep rate. Particular attention has been paid to trigger performance together with h.f. and l.f. filtering. A free run facility is available to provide a bright line in the absence of trigger and simplify trace location. The timebase can be disabled and the CH1 input signal displayed against that of CH2 in an X-Y mode.

Additional facilities include a 1kHz calibrator, DC coupled Z modulation and gate and ramp outputs.

This small instrument is readily portable and its simple internal construction leads to easy access to all components for maintenance and minimises cost of ownership.



Specification

Section 2

DISPLAY

CRT: 8 x 10cm rectangular
EHT: 6kV overall
Graticule: Internal, with 8 x 10cm divisions and 2mm sub-divisions. Continuously variable illumination
Phosphor: P31 standard, P7 option

VERTICAL DEFLECTION

Input Channels: Two identical
Bandwidth: DC-25MHz (–3dB), DC coupled
2Hz-25MHz (–3dB), AC coupled
Rise Time: 14ns
Input Coupling: DC-Ground-AC
Input Impedance: 1MΩ/28pF
Deflection Co-efficient: 2mV/cm to 10V/cm in 12 steps (1:2:5 sequence) with uncalibrated fine gain control giving a 2.5:1 reduction in gain
Accuracy: ±3%
Position Control: Shift range of at least ±8cm
Signal Delay: At least 20ns of visible delay
Max. Input Voltage: 400V (DC plus AC peak)
Display Modes: CH1 only
CH2 only
CH1 and CH2 chopped (500kHz approx.)
CH1 and CH2 alternate
CH1 and CH2 added
N.B. Channel 2 can be inverted

HORIZONTAL DEFLECTION

Display Modes: Internal Timebase

Timebase

Sweep Speeds: 200ns/cm to 1s/cm in 21 steps (1:2:5 sequence)
Fine Sweep Control: Uncalibrated. Reduces sweep rate by at least 2.5 times (slowest sweep approx. 2.5s/cm)
Expansion: X10, gives max. sweep rate of 20ns/cm
Accuracy: ±3% (±5% with X10 expansion)

Trigger

Source: Internal CH1
Internal CH2
External
Line
Slope: Pos./Neg.
Coupling: DC, AC, DC/AC (l.f.), AC (h.f.)
Modes: Manual level
Auto Bright-Line, with manual level

Sensitivity:
Internal: <3mm to 3MHz
<1cm to 25MHz
External: <200mV to 3MHz
<600mV to 25MHz
Level Ranges: Internal ±8cm
External ±5V
External Trigger: Input impedance 1MΩ/28pF approx.
Max. input voltage 400V

Horizontal Amplifier (via CH1)

Bandwidth: 500kHz
Phase Shift: <3° at 250kHz

Z-Modulation
Bandwidth: DC to 10MHz
Sensitivity: +1V from zero gives visible modulation (+40V for complete blanking)
Input Impedance: 27kΩ/10pF approx.

Outputs
Timebase Ramp: Output level –0.6V to +4V approx. from source impedance of 10kΩ
Timebase Gate: Output level zero to +3V from source impedance of 10kΩ

Calibrator
Voltage: 1V ± 1% from a 200Ω source
Frequency: 1kHz approx.

Supplies
Voltage: 100; 120; 220; 240V ± 10%
Frequency: 45–440Hz
Consumption: 48VA

Temperature Range
Operating: 0 to +50°C
Operating within spec. +15 to +35°C

Size and Weight
Size: 30.5cm (w) x 13.3cm (h) x 42.0cm (d) excl. handle and knobs
Weight: 7.6kg (16.8 lbs.) approx.

ACCESSORIES SUPPLIED

Mains Lead PL98

Optional Accessories
Probe Kit PN.PB12, with X10 and X1 switched head
Protective Cover PN42610, a soft padded cover for protecting the instrument when being carried.
Front Panel Cover PN41178, a hard cover for protecting the control panel
Trolleys, PN's TR4 and TR6: general purpose oscilloscope trolleys
Rack Mount Kit PN41180

Caution:
The OS1200 relies on convection cooling and must not be operated in a position which restricts the external circulation of air.

3.1 CONNECTION TO THE SUPPLY

1. Before connecting the OS1200 to the supply, check that the supply range switches are set to suit the supply voltage used and that the correct fuse is fitted. Note that the fuse has to be changed when switching between the 100V and 220V ranges. The switches and fuse holder are mounted on the back panel of the instrument. Do not operate the range selection switches while the OS1200 is switched on.

   SAFETY: The OS1200 is designed to be used with the frame earthed and it is important that the appropriate lead (Green/Yellow) of the supply lead, PL98, is connected to a suitable earth.

3.2 OBTAINING A TRACE

1. After connection to the supply, switch on by turning the INTENSITY control clockwise away from the OFF position, check that the adjacent indicator lamp lights.
2. Push the CH1 DISPLAY MODE push button. Set the CH1 Y-shift control (vertical arrows) to approximately mid setting. Set the CH1 variable sensitivity control (centre knob of VOLTS/CM switch) fully clockwise to the CAL position. Set the CH1 input coupling switch to GND. Set the BRIGHT LINE button out (ON). Push centre knob of TIME/CM switch in, for x1 x-magnification. Set the x shift control (horizontal arrows) to approx. mid setting. Set the TIME/CM switch to 5μs.

   A horizontal trace should appear on the screen as the intensity control is advanced.
3. Adjust the INTENSITY control to obtain a display of the required brightness.
4. Adjust the FOCUS control to obtain a sharply defined trace.
5. Adjust the CH1 Y-shift control and the X-shift control to centralise the trace on the screen.

3.3 SETTING UP Y CHANNELS

1. Using a coaxial input signal lead, connect a signal to the CH1 or CH2 input socket.
2. For:
   (a) Direct connection of the input signal, set the associated AC-Ground-DC slide switch to DC.
   (b) Capacitive coupling of the input signal through an internal 0.1μF 400 volt capacitor, set the slide switch to AC.

NOTE: When examing low amplitude ac signals superimposed on a high dc level, the slide switch should be set to AC and the sensitivity of the Y amplifier increased as in (4).

3. To locate the base line, set the slide switch to GND. At this setting, the input signal is open circuited and the input to the amplifier is connected to ground.
4. To select sensitivity, set the VOLTS/CM switch to the required range. For calibrated operation, the variable sensitivity control (the knob in the centre of the switch) should be set fully clockwise to the CAL position. This control can be used, however, to reduce the gain of the amplifier and obtain any intermediate sensitivity between the calibrated, switched ranges. To set to any particular calibrated sensitivity, the actual variation from the calibrated range can be set by viewing the CAL output on the 0.1V/cm or 0.2V/cm ranges. If the variable sensitivity control is not moved subsequently, the sensitivity will differ from the calibrated value by approximately the same proportion on all settings of the VOLTS/CM switch.

   To minimise pickup at sensitive settings, it is essential to ensure that the ground lead connection is made close to the signal point.
5. For vertical movement of the trace, adjust the Y shift control (identified by vertical arrows).
6. Any trace movement, under no-signal conditions, when the setting of the VOLTS/CM switch is altered, can be overcome by adjustment of the preset front panel BALANCE control.

   This control will need adjustment only at infrequent intervals. Before adjusting the BAL control however, ensure that the input coupling switch is set to GND. No adjustment should be made until a minimum of 15 minutes warm-up time has elapsed after switch on, or immediately after any large change of ambient temperature.

3.4 DISPLAY MODES

The DISPLAY MODE switches determine the form of the display.

1. For single trace display of one Y input against the timebase, the CH1 or CH2 push button should be pushed, and the input signal applied to the appropriate input connector.
2. For simultaneous display of both Y inputs against the timebase, at slow sweep rates (below about 0.2ms/cm), CHOP mode should be selected. Chop mode operates at about 500kHz.
3. For simultaneous display of both Y inputs against the timebase, at sweep rates above about 0.2ms/cm, push the ALT mode push button.
4. In the ADD mode, the single trace generated against the timebase is the algebraic sum of the CH1 and CH2 deflections.

   If the CH2 INVERT button is operated the polarity of the CH2 Y amplifier is reversed. If used in the ADD mode, this facility allows the difference between the CH1 and CH2 inputs to be displayed. The INVERT switch has no effect on internal CH2 trigger.

When examining a small difference between large signals, the effect of small errors between the sensitivities of the 2 channels can be overcome by first connecting one input to both channels and adjusting one or other of the variable sensitivity controls to obtain a straight line.

5. X-Y mode is obtained by turning the TIME/CM switch fully anticlockwise to X-Y and selecting the CH2 DISPLAY MODE. In this mode, the timebase is disabled, CH1 input is displayed on the horizontal deflection, and CH2 as the vertical. CH1 shift control is inoperative, and horizontal shift is obtained with the X-shift control. The X10 magnification control is also inoperative.

   X bandwidth is limited to 500kHz and relative phase shift between X and Y deflections may exceed 3° above 250kHz.

3.5 TIMEBASE AND X EXPANSION

The sweep speed of the internal timebase is determined by the setting of the TIME/CM switch, the variable sweep control (central knob on switch) should be set fully clockwise, in the CAL position, for calibrated operation of the timebase. This control is used to slow the sweep rate to obtain any intermediate sweep rate, between calibrated ranges.

For horizontal shift of the trace, adjust the X-shift control (horizontal arrows). This control has a coarse/fine action. Initial operation provides coarse adjustment and the return movement over a limited arc provides fine control. If close examination of any part of the trace is required, X10 expansion can be introduced by pulling the central knob of the timebase switch.

3.6 TRIGGER

The timebase may be triggered internally from the CH1 or CH2 signals, by operation of the corresponding TRIGGER SOURCE button, irrespective of whether the selected channel is being displayed. When LINE is pressed the timebase may be triggered from the incoming supply line signal, an internal connection automatically connecting a signal derived from the supply transformer. Alternatively, the timebase may be triggered from an external signal applied to the EXT TRIG socket when the EXT TRIGGER button is pushed. The External Trigger input impedance is approx. 1MΩ/28pF and care should be taken not to apply more than 400 volts dc or peak to this socket.

Because of this input impedance value a passive X10 probe may be used on the external trigger socket in the same way as with the Y-input socket. Trigger sensitivities have been arranged such that normal TTL output levels are sufficient for triggering, even when attenuated through a X10 passive probe.

Trigger will occur at a level on the selected signal which may be set by the TRIG LEVEL control with the slope determined by the ± button. When this button is out, it will occur on a positive-going transition of the signal through the trigger level. When it is pushed in, trigger will occur on the negative-going transition.

When the BRIGHT LINE button is out, for ON, the timebase will free-run in the absence of a correct trigger signal, to display a bright line, or unsynchronised display, until the level control is adjusted, and/or the amplitude of the trigger signal is increased. This free-run action, in the absence of trigger, helps in finding the trace and leads to ease of operation.

It is expected that the BRIGHT-LINE OFF mode will be selected only when the instrument is to be used to display signals at repetition rates of less than 40Hz. It will prevent additional free-run sweeps from occurring between correctly triggered low frequency sweeps.

By use of the TRIGGER COUPLING buttons, AC or DC coupling can be selected, and additional filters may be introduced to provide either high frequency (hf) or low frequency (LF) COUPLING. When LF coupling is selected, a high frequency rejection filter is introduced and this can be used to obtain a stable trigger on a low frequency signal with superimposed high frequency noise. Conversely when HF is selected a low frequency rejection filter is introduced to allow stable triggering on high frequency signals with superimposed hum, etc. Both filters are effective from about 10kHz.

For most applications trigger is best set as follows:

(a) with BRIGHT LINE ON, and AC COUPLING, select the trigger source required, either CH1, CH2 or EXT.

(b) select trigger slope for + or – and adjust trigger level control to obtain a stable trace, starting at the required point on the waveform.

3.7 ADDITIONAL FACILITIES

1. Scale Illumination. The calibration graticule can be illuminated by varying the SCALE control. This is particularly useful for emphasising the scale under low ambient light conditions or when photographing the tubeface.

2. Calibrator. This output pin on the front panel provides a positive-going, 1 volt, flat topped square wave at approx. 1kHz. It can be used to check the sensitivity of the instrument or to set to any particular calibrated sensitivity (see section 3.3 (4)). The rise time is less than 1μs and the output impedance is approx. 200Ω, providing 5mA, mA when shorted to ground.

3. Ramp Output. This 4mm socket on the rear panel provides a DC coupled, positive-going ramp, generated by the timebase of about 4 volts peak-to-peak, from an impedance of about 10kΩ. If a lower output level can be tolerated, distortion of fast range output signals due to capacitative loading can be reduced by adding resistive loading to attenuate the signal.

4. Gate Output. This 4mm socket on the rear panel provides a DC coupled positive-going square wave of

roughly 3V amplitude from 10kΩ source impedance. The duration of the pulse is coincident with the duration of the ramp and it can be used for synchronising external equipment with the oscilloscope timebase.

5. Z MOD. This socket on the rear panel allows external modulation of the brightness. The input is DC coupled into approx. 27kΩ/10pF. The sensitivity at normal brightness settings requires about 1 volt to provide visible modulation. Approx. +40 volts is required for full trace blanking.
6. Use of the Optional Passive Probe. A X10 passive probe may be used, both to extend the voltage range and to increase the input impedance of the Y signal pick-off. The input resistance of a Y-channel is 1MΩ, shunted by 28pF. The effective capacitance of the input lead must be added to this and the resultant impedance will often load the signal source. Therefore it is advisable to use a 10MΩ, X10 probe such as PB12 or PB13. This reduces the input capacitance and increases the input resistance, at the expense of a X10 reduction in sensitivity. The probe inserts a shunt RC network in series to form a 10:1 attenuator with the input RC of the Y channel. To obtain a flat frequency response, it is necessary to adjust the capacitance of the probe to match the input capacitance of the Y channel as follows:
   1. Set the Y channel VOLTS/CM switch to 20mV, the TIME/CM switch to 500μs and trigger from the appropriate channel.
   2. Connect the probe to the CAL socket and adjust the trigger controls as necessary.
   3. Adjust the probe compensation to obtain a level trace, i.e. flat top without overshoot or undershoot.
7. Camera. A camera may be used with the oscilloscope to record waveforms. This facility is particularly useful at slow timebase sweep rates. Suitable cameras utilising Polaroid film may be obtained from Polaroid Ltd., and hand held against the tube face. Other oscilloscope cameras may be used but suitable adaptors must be obtained and should be discussed with the tube manufacturer.

NOTE: The allocation of circuit references to components within the instrument is according to the sub-assembly on which the component is mounted.

1 to 99	– Main assembly
101 to 299	– Preamplifier and Beamswitch
301 to 399	– Y Output
401 to 499	– Timebase
701 to 799	– Power Supply
901 to 999	– EHT Oscillator

4.1 GENERAL DESCRIPTION

For the block diagram of the complete oscilloscope, refer to Fig. 1. The circuitry can be divided into three main sections; Y–deflection, X–deflection, (including timebase and trigger) and power supply which includes Bright-Up and Calibrator.

4.1.1 Y CHANNELS

Signals applied to Ch1 and CH2 input sockets are applied via switched attenuators to their respective amplifiers. The attenuator settings and amplifier gains are controlled from the front panel by means of the Volts/cm switches. In order to cover the complete range, the gain of the amplifiers are switched in a 1–2–5 sequence with the input signal passed either straight through or attenuated by 10, 100 or 1000.

An uncalibrated fine gain control is provided on both channels giving a 2.5:1 reduction in gain. CH2 is provided with an invert switch. CH1 or CH2 signals can be displayed separately. When Alternate mode is chosen, one channel is selected on one sweep of the timebase with the other being selected on the next sweep. In the Chop mode, the display is switched between CH1 and CH2 at a 500kHz rate as the sweep progresses. CH1 provides X deflection when X–Y is selected.

When Add mode is selected, both CH1 and CH2 signals are displayed algebraically summed.

A delay line is incorporated in the amplifier. As the trigger signal is taken off before this line the leading edge of a fast waveform can be observed after the timebase sweep has started.

4.1.2 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 by the source selection switch, is modified by the appropriate coupling network, if selected, and passed to the trigger amplifier. The amplifier is biased by the required trigger level and the resultant signal is amplified and passed to drive the Schmitt trigger and signal polarity circuitry. 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 bistable prevents the trigger pulses from passing to the sweep bistable and this inhibition is maintained by the hold off circuitry until the ramp generator has fully recovered, ready for the next sweep to commence on the next trigger pulse when the cycle is repeated.

When Bright Line is selected, the trigger 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 sweep bistable, causing the bistable to be set at the end of each hold off period, thus giving repeated sweeps for a bright display.

An output from the sweep bistable passes to the c.r.t. bright up amplifier, thus enabling the tube to be unblanked during the ramp period, to an intensity as set by the front panel intensity control.

4.2 INPUT ATTENUATORS & PRE-AMPLIFIERS (Fig. 2)

These circuits are shown in Fig. 2.

The attenuators and pre-amplifiers of CH1 are almost identical to those of CH2 and accordingly CH1 will be described with a CH2 description inserted only where it differs from CH1.

The input signal is applied to the attenuator from SKA via the three position slide-switch S11. This switch permits the signal to be directly coupled through in D.C. or through C11 in A.C. In the central GND position, the signal path is left open whilst the amplifier input is grounded.

On the most sensitive ranges, 2mV/cm, 5mV/cm and 10mV/cm, the volts/cm switch S12 couples the signal directly to the pre-amplifier with R105 and C108 providing the input impedance at 1MΩ 28pF. When the 20mV/cm, 50mV/cm and 0.1 Volts/cm ranges are selected. S11 introduces a 10:1 attenuation with a 1MΩ input resistance consisting of R101 (series resistor) and R103 (shunt resistor) C102 and C103 provide correct high frequency compensation. C101 in parallel with C113 gives the correct input capacitance of 28pF. S12 inserts an 100:1, 1MΩ attenuator on the 0.2V/cm, 0.5V/cm and 1V/cm ranges, the series and shunt resistors being R102 and R104 respectively. This attenuator is compensated by C105 and C106. Input capacitance is provided by C107 in parallel with C104.

On the 2V/cm, 5V/cm and 10V/cm ranges, S12 cascades the 10:1 and 100:1 sections, providing an overall attenuation of 1000:1.

Resistor, R107, C109, D117 and D101 limit the maximum voltage which can be applied to the amplifier to ±12V, thus protecting the input.

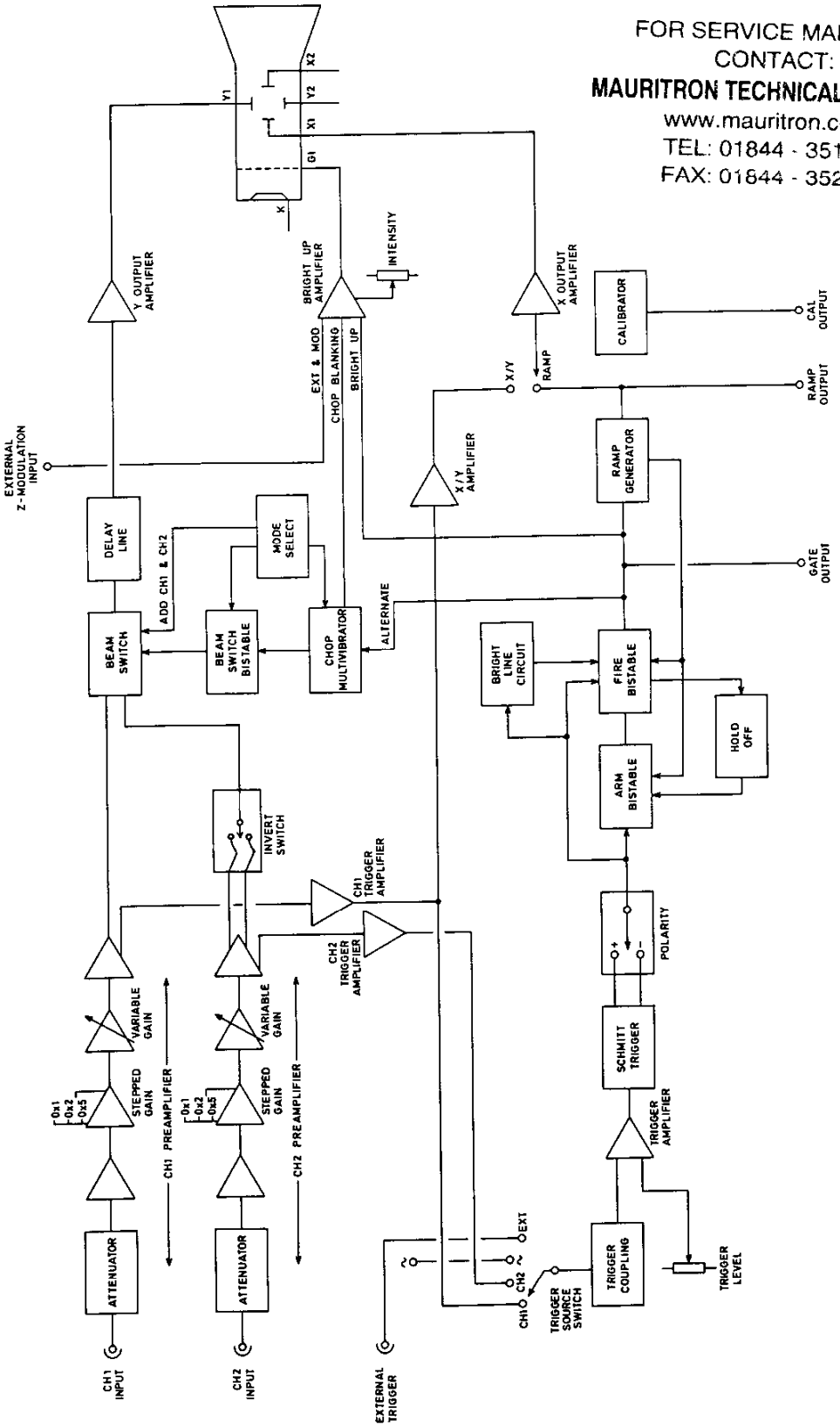


Fig. 1 Block Diagram

A high input impedance to the pre-amplifier is provided by the f.e.t., TR101. The high frequency amplifier whose active elements consisting of TR101 and TR103 has its gain defined by the ratio of R112 to R112 plus R111 (a gain of 3) with its high frequency compensation set by C116. This is enclosed by a low frequency loop to give D.C. stability with active elements IC101 and IC102. The low frequency gain is set to match the H.F. gain by R122.

The output from the collector of TR103 is applied to the differential amplifier stage formed by TR107 and TR108. TR106 defines the tail current of this stage. The gain defining resistors R137, R139 and R140 are switched to give a 1–2–5 gain sequence by S12 with C133 and C134 giving H.F. compensation. The CH1 Bal control R114 uses the external offset facility of IC101 to balance the voltage between the emitters of TR109 and TR108 and thus prevent trace movement when gain switching.

The differential signal in the collectors of TR107, TR108 passes through an attenuator consisting of R130, R131 (series elements), R134, R135 and R136 (shunt elements). The attenuation provided can be raised from almost 1:1 with the Var. Gain control R133 at maximum to 2.5:1 at its minimum. Var. Bal., R135 is set to give zero differential voltage across this attenuator preventing trace movement when using the Var. Gain control.

The signal passes on to a feedback stage consisting of TR104 and TR105. A position centralising control R124 is incorporated in this stage, which is set to centre the trace with the CH1 Shift control set midway. The corresponding preset control R224 in CH2 is set to give a balanced differential current through S23 to cancel trace movement when using Invert.

4.3 BEAM SWITCH & DELAY LINE (Fig. 2)

The next stage consists of TR109 and TR110, CH1 Gain being set by the resistor between emitters R160 H.F. compensation obtained by R161, C124 and C125. The front panel Y shift control R181 determines the differential output currents from TR111 and TR112 to be added to the signal currents from TR109 and TR110. The differential current from this stage directly drives the beam switch (IC102 and IC202). Control voltages applied to pins 9 and 2 of these packages determine whether the signal currents from pins 1 and 11 of IC102 (CH1) or from pins 5 and 8 of IC202 (CH2) are applied to the Delay Line. This in turn connects the resultant signal to the output stages.

The control voltage for the Beam Switch is taken from Q, the output of the bistable consisting of sections b and c of IC103. Refer to table in Fig. 5 for details of voltages in beam switch when the various Y–amplifier modes are selected.

SELECTION OF CH1 or CH2

On selecting CH1, TR151 is turned on, fixing the output of IC103b into its high state. This in turn switches on the transistors in IC102 and IC103 via the bases on pins 9 and 2, routing CH1 to the delay line.

Similarly with CH2 selected, the output at IC103b is forced low switching on the transistors with bases on pins 4 and 6 of IC102 and IC202 routing CH2 to the delay line.

ALTERNATE MODE

With Alternate mode selected, the bistable (IC103 sections c and b) is toggled through TR155, IC103d and TR156 by an edge coincident with the end of sweep. It therefore causes the beam switch to change between CH1 and CH2 at the end of each timebase sweep.

CHOP MODE

In this mode, the above bistable is toggled by a 1MHz oscillator IC103a and b. The beam switch thus alternates between CH1 and CH2 at a 500kHz rate. The oscillator is gated by TR155 to operate only during the sweep period. The trace is blanked during the transition period by a blanking pulse derived from the bistable by TR152, and associated components.

4.4 Y–OUTPUT STAGES (Fig. 3)

The Delay Line output drives a grounded base stage TR301 and TR302 through terminating resistors R301 and R304. This is followed by a balanced amplifier stage consisting of TR303 and TR304 with gain defining resistors R316 and 315 and H.F. compensation provided by C326 in parallel with C305.

The current generated by this stage drives a shunt feedback amplifier TR305 and TR306 which incorporates Schottky diode limiting (D301, D302, D303, D304) to prevent the Y plate driver from bottoming or cutting off. The Y plate driver is a cascode stage formed by TR307, TR308, TR310 and TR311 which drives the c.r.t. Y deflection plates through an m derived bridged –T network composed of L301, L302, R362, R363 and plate capacity. The stage gain being determined by R331 and R332 with high frequency compensation provided by R358, R335, R337, R336, C310, C324, C311, C313 and C312.

4.5 INTERNAL TRIGGER PRE-AMPLIFIERS AND X-Y PRE-AMPLIFIERS (Fig. 2)

The CH1 amplifier consisting of TR113 and TR114 receives its differential input signals from the emitters of TR109 and TR110 (before the delay line) and converts it to a single-ended signal of suitable level. R176, CH1 Trig D.C. Level, sets the output of the amplifier to 0V H.F. compensation is provided by means of C129. This amplifier followed by the feedback stage TR115, also acts as an X–Y amplifier when CH1 is used to provide X deflection. R187 sets X–Y gain with R193

and C131 giving correct phase shift in this mode. The CH2 amplifier, TR213, TR214 is similar to TR113 and TR114 of CH1.

4.6 TRIGGER SOURCE SELECTION AND TRIGGER COUPLING (Fig. 4)

The circuitry for the trigger source selection and coupling is shown in Fig. 4. Switches S401 to S404 are interdependant and select the relevant triggering signal from one of four possible sources. The two internal sources are picked off from the Vertical channel – CH1 or CH2 – quite independant of which channel is displayed. Resistors R405 and R406 terminate the coaxial feed connections from the two trigger pick off preamplifiers within the Y amplifier assembly. The line trigger source is taken via a coupling on the power transformer and attenuated to the appropriate level by resistors R403 and R404, together with R712 on the power supply board. The capacitor C403 prevents spurious trigger caused by spikes or other interference. The external trigger signal from SKC is attenuated to the correct level by resistors, R401 and R402, with capacitors C402 and C401 compensating the network to give an accurate high frequency performance. The input capacitance of 28pF is set by C416.

The output from the source selection switches is passed to S405 to S407, the trigger coupling network selection switches, which provide the following connections.

1. A.C.	In this mode, the d.c. component of the input signal is blocked by capacitor C406.
2. H.F. Coupling	In this mode, the signal is passed through capacitor C404 to reject the lower frequency components of the input signal.
3. L.F. Coupling	In this mode, all higher frequency components of the input signal are filtered out by the network R407 and C405.
4. D.C.	In this mode, there is a direct connection between the input selector switch and the input of the trigger amplifier.

4.7 THE TRIGGER AMPLIFIER (Fig. 4)

The input signal is taken to the gate of the f.e.t. TR401. The f.e.t.'s TR401 and TR402 are a matched dual pair with TR402 connected as a current source with Vgs = 0, and TR401 as a source follower with zero offset between the input gate and the output source. The output from the f.e.t. TR401 is applied to one input of the differential amplifier IC401, the other input being the voltage picked off by the trigger level control R41 and attenuated by resistors, R415 and R417. The gain of this amplifier I.C. is pre-set and trimmed if necessary by A.O.T. resistor, R422, giving a gain of 10 times. The supply lines of +6V and -6V are obtained from the full 12 volt lines via resistors, R420 and R421 respectively and stabilised at the correct level by zener diodes, D402 and D401.

4.8 SCHMITT TRIGGER AND POLARITY CIRCUIT

The Schmitt trigger circuit is formed by two voltage comparators within the dual I.C. package of IC402. By grounding the approporiate strobe connection (S1 or S2) either one or other comparator circuit is enabled. Since the output from the previous amplifier (IC401) is differential, the phase of the output from the trigger circuits can therefore be inverted, giving trigger pulses from either edge polarity of the input signal, depending on the selection of S408, the trigger polarity push button switch.

The degree of positive feedback or backlash of the first comparator is defined by R426 to R423, for the second comparator it is defined by R425 to R424. With the X10 gain within IC401, this gives the necessary sensitivity at the input gate of TR401 of 25mV per centimeter of vertical deflection for internal trigger.

4.9 THE BISTABLE CIRCUITS

A dual bistable timebase is used to control the ramp generator. This prevents trigger jitter, caused by a trigger pulse arriving as hold-off is about to end, thus allowing the ramp to commence erratically. By connecting the two bistables such that the clock (input signal) pulses can only be set the second bistable after the 'arm' bistable has been set will mean that good positive trigger will result without the risk of a spurious trigger pulse.

The JK flip flops are contained within a dual IC package, IC403. The arm bistable, IC403b, is set by clock pulses when not inhibited by the presence of a ramp signal through transistor, TR412, or by hold off from transistor, TR416, or by delayed hold off from TR411. Once IC403b is set, its Q output is coupled to the J input of IC403a thereby allowing the next clock pulse to set that bistable, provided that there are no inhibit signals at the other inputs.

The end of sweep pulse from TR412 will reset both bistables. The potential divider network of resistors, R454 and R417 connected between the ramp voltage (TR428 emitter) and -12V sets this level. The junction of these two resistors is connected to the base of the grounded emitter transistor TR412, which conducts when the ramp voltage reaches approximately +4V.

Outputs from the bistable, IC403a, feed the ramp generator circuit and the bright up circuit. An output is also provided to the alternate sweep circuit for the beam switch drive, this latter connection being via the inverting stage, TR417.

The output voltage for the gate socket is taken via R570 from the Q output of IC403a.

4.10 THE BRIGHT LINE CIRCUIT

If, in the 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 negative bias via TR410 into the preset input of IC403a, the fire bistable. In this condition a new sweep is started immediately the hold off period has finished. The timebase thus free runs to produce a bright trace, irrespective of the timebase speed selected.

Transistors, TR405 and TR406 form a monostable circuit. In the quiescent condition, both transistors are off. Negative going trigger input pulses from the polarity circuit via D403, are differentiated by C410 and applied to the base of TR405. The collector potential will rise, with it the base and emitter potentials of TR406. The charge on the capacitor, C411, will hold TR405 conducting (by the time constant of C411 and R437 via the diode D407). In the absence of trigger input pulses, the emitter potential of TR406 will fall causing a negative bias into the preset input of IC403a via transistor TR410, thereby negating the inhibitor due to the $\overline{Q}$ output from IC403b. This means that, upon receipt of the end of ramp signal and the closely following hold off signal into IC403b, its Q potential will rise setting IC403a and immediately initiating another ramp cycle. However, with trigger input pulses present, the monostable circuit is held with TR406 emitter potential high, enabling transistor TR410 and allowing the normal triggered ramp cycle.

The action of the monostable is controlled by the diode gate, D403 and D404. D403 is reverse biased, inhibiting trigger input signals if D404 is connected to -12V via S409 (the Bright Line on/off switch).

4.11 THE RAMP GENERATOR

The ramp generator is formed by the constant current source transistor, TR420, charging up a timing capacitor, C434, C435 or C438 in parallel with C439. At the end of sweep, the ramp voltage is clamped back to its starting potential by grounded base transistor TR421. By alternately clamping and releasing TR421 the waveform at the junction of the two collectors and the timing capacitor is the required sawtooth shaped linear ramp.

The current supplied by the current source transistor is a function of the emitter resistor and the base potential. The former is determined by a resistor module giving nine step values from 20kΩ to 5MΩ resulting in the required sequence of 1:2:5 timebase speeds. These values are selected by the timebase range switch S41Af. Apart from the slower timebase speeds, the six lower resistor values are each used to cover three decades of sweep speed, the ramp speed of the groups being altered by selection (using S41Ab) of the timing capacitor. The base potential of the current source is set by three potentiometers, R476, R485 and the variable sweep rate control, R44. The two preset controls allow individual adjustment of the sweep ranges covered by Capacitors C434 (1μF) and C435, (.01μF).

The selection of the timing capacitor is controlled by a d.c. current via S41Ab, turning on the transistor switches TR424 or TR425, to ground the required capacitor.

The preset control R476 is only brought into circuit when transistor TR423 is turned on. This occurs on the ranges of sweep speed when C434 is selected (i.e. TR425 is turned on).

The variable rate control, R44, operates on the base potential of TR420 by progressively reducing the voltage normally defined by D424. This is achieved by diverting the current from the diode as the control is turned away from the calibrated position. This will pull the base voltage of TR420 more positive so reducing the voltage across the emitter resistor network and causing a reduction in the current from the collector of the current source, to extend the sweep time. The range of the control potentiometer gives a reduction in sweep speed of at least 2.5 times, ensuring overlap between all timebase ranges.

Control of the clamp transistor TR421 is effected by the $\overline{Q}$ output from IC403a. This signal is low during the sweep period. It is coupled via the resistor network, R471 and R472, and turns TR419 on for the duration of the sweep. This in turn, via resistors R473 and R474 turns TR421 off, thus allowing the timing capacitor to charge toward the positive line under the control of the current source transistor. At the end of sweep, $\overline{Q}$ of IC403a goes high, TR419 is turned off and TR421 turned on to clamp the ramp voltage to ground.

The ramp sawtooth voltage is buffered via the f.e.t. source follower, TR426, and emitter follower TR428 to the diode gate, D433 and D435. In the normal timebase sweep conditions current source transistor, TR429, keeps the gate open, allowing the ramp signal to pass through to the X output amplifier. However, in the X–Y mode TR429 is turned off and the ramp gate is therefore closed. The X–Y signal gate, D434 and D436 is opened, as +12V is connected via S41Bf and R500, allowing the X–Y signal to reach the X amplifier. Table 1 details the above selection state for each mode and range of the Time/cm switch.

4.12 HOLD OFF (Fig. 4)

Triggering of the arm bistable must be prevented or held off during the flyback period, until the ramp generator has fully returned to its quiescent state. This is achieved by introducing a delay at the end of the ramp reset before the arm bistable is capable of being set by an incoming trigger signal from the trigger circuit.

Transistor switches TR413 and TR414 are controlled by the timebase range switch S41 to select the hold off capacitors, C422 and C423, to operate in parallel with C425. This switching corresponds to selection of the

Timing Range	S41 Wafer	P.C. Molex Connector	Circuit Connected
X–Y	S41Bf	PLW4	Via PLS3 gives -12V to control Bright Up on the Power Supply board
	S41Bf	PLW9	+12V to inhibit ramp gate, and enable X–Y gate
	S41Bb	PLAA	Shorted to give X10 X expansion
1s – 2ms	S41Ab	PLW12	+12V to turn TR425 on, calling up C434 (1μF) timing capacitor +12V to turn TR423 on enabling preset calibration control R476 +12V to turn TR413 on, calling up C422 (1μF) hold off capacitor
	S41Af	PLW11	Selecting appropriate value of timing resistor network from 5MΩ to 20kΩ
1ms – 20μs	S41Af	PLW11	Selecting appropriate value of timing resistor network from 306kΩ to 20kΩ
	S41Ab	PLW13	+12V to turn TR424 on, calling up C435 in timing capacitor series with C434, giving .01μF +12V to turn TR424 on, calling up C423 (.01μF) as the hold off capacitor
10μs – 2μs	S41Af	PLW11	Selecting the appropriate value of the timing resistor network from 306kΩ to 20kΩ This leaves the minimum timing capacitor value of approx. 100pF (C438 + C439) and hold off capacitor value 100pF (C425)

Table 1 Timebase Range Switching Sequence (S41)

ramp timing capacitor C434 and C435 as previously described. Before the start of sweep, the Q output of IC403a is low and TR415 conducts as a constant current source. TR416 is turned on and the voltage across the timing capacitors is defined below +5V by conduction of D417 and the base emitter junction of TR416.

During a sweep, the Q output of IC403a goes high and as the ramp voltage increases to approximately 2V TR415 is cut off. The hold off capacitors are charged toward +230V by R455 and R456 but limited at +12V if this potential is reached. TR416 is cut off and the J input to IC403b goes low, inhibiting its turn on again by subsequent clock (trigger) pulses.

At the end of sweep, when the Q output of IC403a goes low, TR415 conducts again. Its current exceeds that through R455 and R456 so that the hold off capacitors are discharged. Only when the original level is reached does TR416 turn on to release the inhibit on IC403b, allowing the circuit to be armed for another sweep. As the discharge period is proportional to the charge period, the hold off is usually of the order of 10 or 20% of the sweep period. The $\bar{Q}$ output of IC403a is coupled into TR416 via C424 to provide additional hold off on the fastest sweep rates when the speed of response of the normal path is inadequate.

4.13 THE X OUTPUT AMPLIFIER (Fig. 4)

The X amplifier is a d.c. connected differential amplifier with along tailed current source stage at the input and a gain defined shunt feedback stage at the output.

The input signal, either the ramp signal or the X–Y signal, is taken from the diode gate circuitry of D433 to D436. The differential input stage comprises TR431, TR439 and the current source transistor TR435. The signal input is applied to the base of TR431 whilst the input to TR439 is taken, via an emitter follower, TR442, from the voltage set by the X shift potentiometers, R42 and R43.

The gain of this stage is set by preset resistor R519 in the X1 condition and by R516 in the X10 X expanded condition. This X10 mode is automatically selected by S41Bb in X–Y or by pulling S42 or when using the timebase in its ramp sweep mode. The current supplied by the long tail is set by R518 to give a linear start to the trace by adjusting the collector potentials of transistors, TR431 and TR439.

The diodes, D439 to D442 and D444 provide signal clamping at the extreme ends of the amplifier range to prevent non-linearities at the start and end of the sweep. The shunt diodes divert the collector currents of TR431 and TR439 to the side which is beginning to limit as its collector voltage falls thereby supplying the additional collector current that is required. Conversely, diodes D439 and D444 are reverse biased when the transistor collector potential rises above the level set by the shunt feedback resistor and the resistor to the -12V line (R509 and R510 respectively, and also R524 and R525).

The signals at the collectors of TR431 and TR439 are taken via emitter follower TR432 and TR438 to the bases of the output transistors. This signal is d.c.

connected to the lower NPN pair and a.c. coupled via capacitors C445 and C449 to the PNP devices. These upper transistors normally form a current source load but with additional a.c. speed up provided by virtue of this capacitive coupling to speed up the output waveform at the commoned collectors.

The c.r.t. plates are coupled directly to these output transistor collectors. The overall gain is set by the value of the shunt feedback resistors R509 and R524.

4.14 BRIGHT-UP AMPLIFIER (Fig. 5)

The bright up amplifier is required to drive the c.r.t. grid with a voltage step between 0V and +60V (depending on intensity control setting) superimposed on a d.c. voltage of about -1400 volts. Bright up and chop blanking signals (from the timebase and Y-preamp respectively) drive TR725 which acts as a switch for constant current generator TR726. TR726 drives current into the virtual earth input of the shunt feedback amplifier formed around TR721, TR722 and TR723. The actual current is determined by the Intensity control R780 and its range is set to prevent output transistors TR722 or TR723 from coming within 4 volts of saturation. The output is further modulated by injecting current into the virtual earth via the external Z mod input. The emitter of TR722 should remain at about +60V, and during the blanking period the collectors of TR722–723 should rest at about +5V. If necessary, overshoot of the amplifier can be corrected by small adjustable capacitor, C734. This is formed from an enamelled wire wrapped round a pin.

The bright up signal must be superimposed on the e.h.t. voltage as determined by the cut-off preset R916. The higher frequencies are coupled directly to the grid via the high voltage capacitor C740, while the lower frequencies are applied to the collector of modulation transistor TR724 via R775 and D715.

Because the base of this transistor has a switching waveform on it, supplied via C742, D706 and R777, from the e.h.t. oscillator, its collector waveform consists of the switching waveform amplitude modulated by the bright up signal. The waveform is coupled, via C739 to the detection circuit formed by D713, D714, D739, C740. The blanking level is set by R916 and the bright up drives the signal grid more positive than this, D716 prevents the grid going more positive than the cathode.

4.15 POWER SUPPLIES (Fig. 5)

The OS1200 has four supply lines +12V, -12V, +120V, +230V and two e.h.t. voltages -1.5kV and +4.5kV. The ±12V and the 120V lines are supplied from tappings off the mains transformer T1. The 230V and the e.h.t. voltages are supplied by the e.h.t. circuit.

The primary of transformer T1 can be switched between ranges 100V, 120V, 220V and 240V, using switches S2 and S3. Switch S2 connects the two 120 volt primary windings either in series or in parallel, making either the 120V or 240V range. Switch S3 puts the live line of the mains input either on the 120V tapping of the 2nd primary, or to the 100V tapping of the winding effectively subtracting 20V giving the ranges 100V and 220V. The transformer is protected by fuse FS1 and disconnected by the double pole switch S1.

4.15.1 +12V & –12V SUPPLIES (Fig.5)

A 30 volt centre tapped secondary winding is rectified by bridge BR701 and smoothed by C701 and C702. IC's 701 and 702 are regulators that are arranged to give the fully protected + and - 12 volt lines. The exact output voltages are adjusted using preset potentiometers R753 and R754. The resistor network R702, R730, R758, R753 divides the output of regulator IC701 to give +4V at its most earthy terminal. C703 smoothes this voltage. The regulator IC702 provides 8 volts between its earthy terminal and its output. Resistor network, R704, R756, R754, divides the output of IC702 to give 10.8V at its earthy end. The voltage is decoupled by C705, and the regulator IC701 gives 1.2 volts between its output and its earthy terminal.

4.15.2 120 VOLT SUPPLY (Fig. 5)

A 120V secondary winding is full-wave rectified by BR701, and smoothed by capacitors C707 and C721. The regulation is by transistor TR702 on the negative output of the bridges such that any excess voltage out of the bridge is dropped across TR702 instead of being at the output. The resistor network R709, R708 and A.O.T. resistor R710 form a potential divider comparing the +120V rail with the -12 volt rail. R710 is altered, if necessary, to give the correct output voltage. Transistor TR703 amplifies any error voltage and feeds it to TR702 to correct that error by negative feedback. To prevent damage to TR702 during turn-on and turn-off, due to too high a potential between its emitter and collector, i.e. above about 40V, the voltage on the emitter of TR701, given by the potential divider R706 and R711, turns on TR701. This in turn turns on both TR703 and TR702, stopping the regulation of the line, but protecting TR702. Fuse FS701 protects the supply against any short circuit on the output.

4.16 CALIBRATOR (Fig. 5)

The calibrator circuit gives a square wave of approximately 1kHz at a p-p voltage of 1 volt. Transistors TR707, TR708 form the basis of an emitter coupled astable multivibrator with C715 as timing capacitor. Because of the cross coupling, the transistors switch on and off alternately. TR709 is an emitter follower, whose output is divided down by R730, R731 and R732. Preset R731 is adjusted to give exactly 1 volt output.

4.17 +230V AND EHT SUPPLIES (Fig. 5)

Three supply rails, +230V, -1500V and +4500V are generated within the e.h.t. box, which contains the e.h.t. oscillator board and the e.h.t. multiplier board.

IC901 is an oscillator which produces an output of variable mark-space ratio. This switches transistor TR901 on and off thus controlling the current through the transformer TR901. There is a 230 volt tap, and the high voltage end of the winding swings from +1500 volts to -1500 volts. D901 with C903 generate -1500V supply. D902, D903, D904, C904, C905 and C906 form a voltage tripler to generate the +4.5kV supply. A feedback stabilisation path compares the -1.5kV rail with a reference and any error voltage is returned to the e.h.t. oscillator to control the mark-space ratio, and correct the error. Thus, the -1.5kV line is fully regulated. The potential on the 230V line is determined directly by the transformer turns ratio. The 4.5kV line changes slightly with the mark-space ratio. Because the supplies which feed the e.h.t. oscillator are current limited, the -1.5kV line is short circuit protected but it is not recommended to attempt a short-circuit while the circuit is operating. The resultant current and voltage pulses are extremely large and are almost certain to damage other circuitry throughout the oscilloscope.

The oscillator, IC901 runs between the -12 volt line and a -3 volt line produced by zener diode D908 and emitter follower TR904. Its off time is determined by C909 and R904. This time must be exactly matched to the resonant period of the transformer, by adjusting R904, as explained in 5.4.3. The on-time is determined by R905 and C911 and by the current injected through D907 and R906 by TR902. TR902 and TR903, with D920, R925, R930, R929, R924, R928, R923, R921 and R920, form an error amplifier. This compares the -1.5kV line with the +12 volts produced by regulator IC902 and using the difference to correct the on-time of the oscillator. The dividing ratio is adjusted by potentiometer, R923, which is used to set the rail to -1500 volts.

While the output (pin 3) of IC901 is high, TR901 is on, and the current through transformer T901 builds up. Diode D905 is on, and capacitor C916 is charged up to 230V. R926 and C915 act as a filter to smooth out the voltage. The value to which the current builds up, and the consequent amount of energy stored in the transformer depends on the on-time.

When TR901 turns off, the high voltage end of the transformer swings in a sinusoidal wave shape (because of the resonant frequency of the coil) towards very large -ve voltage. At -1500V, diode D901 turns on, re-charging capacitor C903 to -1500V, and using up the energy previously stored in the transformer. The voltage at this point then swings back to +1500V. Because of the transformer action, the collector of TR901 follows the same waveshape, at a smaller amplitude. During the on-time, the collector is obviously at -12V; it then swings up to 36 volts, where it stays while C903 is charged. It then falls again, to -12 volts. The oscillator must be arranged so that it is at this point that transistor TR901 turns on again. This is achieved by adjusting R904 while observing the waveform on the collector of TR901.

Chokes L901, L902, L903, L904 and capacitors C901, C902, C912, C913 smooth the +12V and -12V rails against the high current surges and C914 smoothes the -3V rail.

An output from the oscillator is taken, through R911, to supply the modulator circuit that raises the output of the bright up amplifier to the correct d.c. voltage for the grid.

4.18 THE FOCUS CHAIN

The focus chain supplies the voltages for the grid, G1, the cathode, K, and the focus electrode, A2. It also acts as the feedback network for the e.h.t. generator by comparing the -1.5kV output with the output of an IC regulator, IC902.

The cathode is supplied with -1400 volts through a 100 volt zener, D920, and the cut-off voltage for the grid is set, by potentiometer R918 to between -1400V and -1500V. Focusing is achieved by raising the voltage on anode A2, using potentiometer R927. If the focusing range is not correct, it can be adjusted using the A.O.T. resistors R925 and R924, making sure that the total resistance of R924 and R925 in parallel with R929 does not change. If adjustment of R924 and R925 is needed, it may be necessary to readjust R923 to keep the -1.5kV rail correct.

C921, C920 and R920 are a filter to prevent any hum from IC902 being injected into the e.h.t. generator feedback loop.

4.19 THE CATHODE RAY TUBE

The c.r.t. is a spiral p.d.a. tube with an aluminised screen, operating at 6kV between cathode and final anode. It has an auxilliary grid structure, G2, which is not used.

4.19.1 CATHODE AND ANODES, AND SCREEN

The cathode, K, is at 1400 volts, and is internally connected to the heater, H. The heater is supplied with 6.3V rms from a secondary of the mains transformer, T1. Electrons emitted from the cathode are accelerated towards the anodes, while the grid potential is adjusted to regulate the beam current and thus the spot intensity on the screen. The voltage on A3 is adjusted by preset potentiometer R747 to give minimum astigmatism. The voltage on A2 corrects the focus, and preset potentiometer R746 adjusts the voltage on the screen, S, between the X and Y deflection plates to give optimum geometry. Anode A4 is at +4.5kV and accelerates the electrons to give a high maximum spot intensity.

4.19.2 DEFLECTION SYSTEM

The electron beam passes through the Y deflection plates, Y1 and Y2, which have a mean plate potential of

about 80 volts, which can deflect the beam in the Y axis. It then passes through the X deflection plates, X1 and X2, with a mean plate potential of about 115 volts, which can deflect the beam in the X axis. Between the two sets of plates is the screen, S, which is set to a voltage which minimises the interaction between the sets of plates on the electron beam, (i.e. optimises the geometry).

4.19.3 TRACE ROTATION

A coil, L1, is wound around the neck of the c.r.t., within the magnetic tube shield, and produces an axial field causing the electron beam to "twist". Current in this coil is adjusted by preset potentiometer R721 to align a horizontal trace with the graticule lines. The current is supplied from the +12V and -12V lines.

The socket, SKN, is reversible within its plug, PLN, so that the direction of rotation can be reversed by simply reversing SKN. R721 is accessible without removing the cover through the hole underneath the oscilloscope.

4.20 SCALE ILLUMINATION

The tube has an internal graticule to avoid errors due to parallax, and this is illuminated by two small lamps, ILP1 and ILP2, held in a clear plastic moulding at the front of the tube. The supply for these bulbs is derived from the emitter follower, TR710, on the power supply board. It is raised by adjusting the front panel potentiometer R720. The supply for the lamps is taken from the unregulated +16V and -16V rails and R734 limits the maximum voltage across the bulbs to 28 volts.

The front panel supply indicator, the l.e.d. D1 is supplied from the same unregulated +16V rail, and current is limited by R733.

Maintenance

Section 5

5.1 GENERAL

The instrument is protected by an A.C. supply fuse mounted on the back panel. 1A slow blow size 20mm (pt. no. 34790) is required for the 100V supply ranges and a 0.5A slow blow size 20mm (pt. no. 33685) for the 220V ranges. The only internal fuse protects the +120V supply line. This is a standard 250mA, 20mm type (pt. no. 32338). Its reference is FS701 and it is mounted on the power supply assembly.

The following sections describe how to obtain access to and removal of various printed circuit 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 the upper 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 a fault has been cleared, it is recommended that the calibration procedure is followed to ensure that the instrument conforms to specification.

5.2 ACCESS

Figures 7, 8 and 9 illustrate views of the instrument after the cover has been removed. This provides access for all preset adjustments. The slide-on cover is held in position by the back plastic moulding which can be removed after undoing the four screws in its corners.

WARNING!! Disconnect the instrument from the supply before removing the cover. Care must be taken if the instrument is operated with the covers removed as dangerous high voltages are exposed. In addition to the primary and high voltage secondary circuits of the supply transformer, particular care should be taken on the tube base and the p.d.a. cap and the high voltage area of the power supply board.

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

Provision has been made to fold back the timebase assembly and mount it vertically on its support bracket (See Fig. 8). Similarly the Power Supply board can be folded back and mounted vertically on its rear bracket to the back panel.

The control knobs on the front panel have collet fixing. To remove them, prise out the control cap and slaken the retaining screw or nut.

5.2.1 TIMEBASE ACCESS

In order to perform maintenance on the Y preamplifier or on the timebase, remove the timebase printed assembly and remount it from the centre plate as shown in Fig. 8. It is necessary to disconnect both the External Trigger lead from the front panel socket to PLAH and the X10 expansion lead from PLAA to R44. The timebase will function without their re-connection if these facilities are not required but the leads must be extended to use these facilities, with the assembly upright.

5.2.2 Y AMPLIFIER ASSEMBLY

This assembly contains all the Y amplifier circuitry up to the delay line. For the most part fault finding can be carried out without its removal from the frame. Access to both sides of the assembly can be achieved by unscrewing and folding back the Timebase Assembly (see section 5.2.1), removal of the rear screen by undoing the four screws on its component side and by taking off the front attenuator screen held by its three screws.

If it is necessary to remove the Amplifier from the frame the following procedure should be carried out:

1. Unplug all interconnecting leads and unsolder the delay line from the assembly.
2. Remove the front attenuator screen by undoing its three fixing screws.
3. Undo the five screws holding the board to the side pillars and centre panel.
4. Remove all knobs on the front panel associated with CH1 and CH2 and the nuts on CH1 and CH2 Volts/cm selector switches.
5. Remove the five screws which secure the Power Supply printed circuit board to the side pillar, the back panel and the Y Output printed circuit board. The two screws holding the Power Supply heat sink to the centre panel should also be removed.
   WARNING: on no account should the screws in the centre of the Power Supply board securing the heat sink to the board be loosened.
6. Carefully pull out the coupling from the Intensity and Scale controls, fold back the board and secure it in the vertical position by means of its back mounting bracket.
7. After removing the delay lines from its clips, pull the Y amplifier back and out of the instrument.

5.2.3 Y OUTPUT ASSEMBLY

1. Remove the socket and unsolder both the Y deflection leads and the delay line.
2. Undo the two screws securing the board to the side pillar and the Power Supply printed circuit board.
3. Remove the three screws in the black rear heat sink which secure the Y Output heat sink to the back panel.

WARNING: On no account should the screws fixing the heat sink brackets to the board be loosened.

4. The Y Output assembly can now be removed from the instrument.

5.2.4 POWER SUPPLY BOARD

The component side of the power board is accessible without any dismantling. To access the track side of this board it can be mounted perpendicular to its normal position and will operate in this position.

Because the heatsinking to the regulator I.C.'s IC701 and IC702 is reduced, they will run hot, but they are self limiting and will not be destroyed.

To prevent the regulators cutting out the instrument should not be left on unnecessarily long in this position.

The procedure is as follows:

1. Unplug the lead connecting the power board, SKL, to the e.h.t. box, through a hole in the power board.
2. Pull off the extension rods from the intensity potentiometer, R789 the focus potentiometer, R927 and the scale illumination potentiometer, R720.
3. Remove the screw securing TR702's heatsink to the rear panel.
4. Remove the three screws that secure IC701 and IC702 heatsink to the centre panel (this heatsink is on the underside of the assembly).
5. Remove the screw on the corner of the Y output board that holds the spacer on the front corner of the Power board above the c.r.t.
6. Remove the other three screws at the remaining corners of the assembly.
7. Lift up the assembly until it is clear of the locating pins on the e.h.t. box and rotate it into a vertical position.
8. Screw the TR702 heatsink to the rear panel in its new position.
9. Plug the lead back between the e.h.t. box and the power board, SKL.

5.2.5. THE E.H.T. BOX

The e.h.t. box contains the e.h.t. oscillator board and the e.h.t. multiplier board. There is access to preset potentiometer R912 and a test pad on the collector of TR901 through holes in the centre plate of the oscilloscope. There is no access available to the e.h.t. multiplier board because it is filled with potting compound.

The e.h.t. oscillator board is accessible by removing the e.h.t. box. If great care is taken the e.h.t. generator can be operated while removed.

1. Unplug the lead from PL.L on the power board.
2. Unsolder the pink – 1500 volt lead from the -1500V pin on the power supply board, near the focus pot.
3. Unplug the p.d.a. cap from the c.r.t. Touch the p.d.a. cap onto the frame to remove any residual charge.
4. Using a long bladed screwdriver, undo and remove the two screws that hold the box onto the centre panel.
5. Lift the box away from the power board, if necessary pushing the locating pins on it, to help.
6. To turn on the e.h.t. generator while removed, mount the box in a position well away from any metal or circuitry and reconnect the leads that were disconnected at stages 1, 2 and 3 in a way that is convenient.
   BEWARE DANGEROUS HIGH VOLTAGES.

5.2.6 THE CATHODE RAY TUBE

The c.r.t. is held and located at the front by the moulded escutcheon and clamped at the centre. It can be removed as follows:

1. Remove the p.d.a. cap and short the connector to ground to remove any existing charge.
2. Unplug the twist coil socket, SKN, from the power supply board and feed it through, behind the board so that it hangs free.
3. Remove the black finned heatsink from the rear panel.
4. Remove the tube base.
5. Remove the top half of the tube clamp.
6. Slide the tube and tube shield backwards and lift the assembly out.
7. Push the tube and twist coil out of the tube shield. Replace in the reverse order pushing the assembly forward before tightening the clamp (removed 5 above).

5.2.7 SCALE ILLUMINATION BULBS

These are removed by simply unplugging the sockets from the plastic lens at the front of the 'scope and unscrewing the lamps from the sockets.

5.3 OPERATING POTENTIALS

The following nominal levels are listed as an aid to fault finding. Unless otherwise specified, measurements are with respect to ground.

5.3.1 Y AMP ASSEMBLY

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

Drain of TR101	+6.5V
Source of TR101	+1.25V
Collector of TR103	0V
Collector of TR107, TR108	+3.5V
Collector of TR104, TR105	+2V
Collector of TR109, TR110	+4.3V

Pins 3 and 10 of IC102	+5.5V CH1 select +4.6V CH2 select
Base of TR113 and TR114	+1.8V
Collector of TR115	+1.4V
For conditions of IC103 see table in Fig. 2	
Collector TR301, TR302	+5V
Collector TR303, TR304	+1.2V
Collector TR305, TR306	-4V
Collector TR307, TR308	+4V
Base of TR310, TR311	+8V
Collector of TR310, TR311	+70V
Between Collector and emitter TR301 and TR302 (set by R360 on Y O/P board)	2V

5.3.2 POWER SUPPLY ASSEMBLY

Across C701	15V	-20V
Across C702	-15V	-20V
Across C703	10.8V	
Across C705	-8V	
Across C704	12V	
Across C706	-12V	
Across C707	125V	-170V
Across C721	120V	
Emitter of TR725/TR726	-0.6V	
Emitter of TR721	+1.2V	
Emitter of TR722	65V	
Across C921	+12V	
On pin PLL 8	-3.5V	
On pin PLL 1	+220V	

5.3.3 TIMEBASE ASSEMBLY

TR401 gate	signal as selected by S401-S407
IC401 pins 13 or 6	TR401 signal amplified X10 but level dependent upon position of the trigger level control, R41.
IC402 pin 1	pulse waveform at input signal frequency 0.3 to +3.5V. The mark-space ratio being dependent upon the trigger level control setting.
IC403 pin 14	+0.3V during ramp period, otherwise +3.5V. i.e. low during ramp.
IC403 pin 15	high during ramp
TR420 collector	ramp waveform 4V p–p
TR428 emitter	ramp waveform 4V p–p
TR431, TR439 collectors	+7.2V with a spot at centre screen
TR434 and TR436 emitters	+5.6V
TR433, TR434, TR436, TR437 collectors	+115V with a spot at centre screen This is the mean plate potential.

The supply lines into the timebase are stabilised at +12V, -12V and +230V. Within the timebase three additional low voltage lines are generated. These are:

Across diode	D402	+6V	with respect to 0V
" "	D401	-6V	
" "	D419	+5V	

5.4 CALIBRATION PROCEDURE

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 minutes.

5.4.1 TEST EQUIPMENT REQUIRED

1. Variable auto transformer (Variac). Output voltage 95 to 260V at 1A and a.c. r.m.s. voltmeter.
2. Digital multimeter with input impedance of 10MΩ or more and voltage input capability to 500V a.c. or d.c. Accuracy to within 1%. (e.g. Gould Instruments BETA).
3. Voltage calibrator. 1kHz square wave generator with amplitude 2mV to 100V. Accuracy within 1%.
4. Timebase calibrator. Marker generator of 0.2ms to 1 sec with 50MHz output. Accuracy within 1%.
5. Square wave Generator. 1MHz flat top square wave generator having a rise time of less than 2ns.
6. R.F. sinewave generator 500kHz to 50MHz. Output amplitude 25mV to 5V p.p. into 50 ohms. Amplitude accuracy to 50MHz within 3%.
7. L.F. sinewave generator.
8. Capacitance standardiser. 1MΩ/28pF, BNC 50Ω termination.
9. High voltage probe. 0–10kV for use with item 2. Input impedance 1GΩ or greater.
10. Oscilloscope with band width greater than 10MHz (e.g. Gould Advance OS255).

5.4.2 SET SUPPLY RAIL VOLTAGES

1. Disconnect the e.h.t. box by unplugging the lead from plug PLL.
2. Connect the multimeter across electrolytic capacitor C701 to read the output of the +12V regulator. Adjust preset pot R753 to read +12V ±50mV.

3. Connect the multimeter across capacitor C702 to read the output of the -12V regulator. Adjust preset pot R754 to read -12V ±50mV.
4. Measure the voltage between chassis and the fuse FS701, which is the +120 volt rail. It should read +120V ±3V. A.O.T. resistor R710 can be changed to adjust this voltage. Increasing the value of R710 will reduce the voltage of the rail, and decreasing it will raise the voltage.

5.4.3 SET THE E.H.T. OSCILLATOR

1. Touch an oscilloscope probe onto the collector of TR901 through the hole in the centre panel on to the test pad, with the oscilloscope set at 10V/cm vertical sensitivity and 10μs/cm horizontal sensitivity. Preset pot R912 must be adjusted through the other hole in the centre panel to give the wave shape shown in Fig. 10.
2. Connect the high voltage probe for the multimeter to the -1.5kV pin on the power supply board.
3. Adjust preset pot R923, on the power supply board to give -1550 volts ±15V on the multimeter.
4. Repeat step 1 checking the waveform on the collector of TR901.

5.4.4 SET TUBE CUT-OFF

1. Set timebase to Bright-Line, and speed to 1ms/cm. Set Y mode selector to CH1 and GND, adjust the Y-shift control to centre.
2. Adjust the Intensity until a trace is obtained. Adjust the preset Intensity pot R916 on the power supply board so that there is no bright dot at the start of the sweep. Turn the Intensity control fully down and make sure that no trace is visible. Advance the Intensity control fully and check that a good trace brightness is obtained.

5.4.5 TRACE ROTATE, GEOMETRY AND ASTIGMATISM

1. Gound both CH1 and CH2 inputs. Select XY mode, centre the spot and adjust the Focus and Astig. (R747) controls for the best small spot.
2. Select CH1 and set the timebase sweep rate to 0.5μs/cm and obtain a bright line horizontal trace on the centre line of the graticule.
3. Adjust Y shift for a trace in the centre of the screen. Adjust trace rotation pot R721 on the power supply board for alignment with the graticule. The direction of rotation can be reversed, if necessary, by reversing the socket on plug PLN on the power supply board.
4. Set the timebase sweep frequency to 1ms/cm.
5. Connect the r.f. generator to the CH1 input and insert a frequency of 500kHz at about 2V p-p amplitude. Set the Y channel gain to 0.2V/cm and adjust the generator to give 8cm of trace amplitude.
6. Set R519 on the timebase to give a trace length of 10cm.
7. Adjust the geometry control, R746, to give the best compromise square picture. Reset the focus control and the Astig. control, R747, if necessary.

5.4.6 CHANNEL 1 AND CHANNEL 2 ATTENUATOR BALANCE

1. Set Y Volts/cm switch to 5mV. Input Coupling to GND. Mode switch to CH1. Timebase to Bright Line On.
2. Set trace on centre line by means of CH1 shift control. Adjust CH Bal. until no trace movement is noted when switching Volts/cm between 2mV/cm and 5mV/cm.
3. Repeat for CH2 adjusting CH2 Bal.

5.4.7 CHANNEL 1 AND CHANNEL 2 FINE GAIN CONTROL BALANCE

1. Set CH1 Volts/cm switch to 5mV. 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 CH1 shift control. Adjust CH1 Var. Bal. R135, until no trace movement is noted when the CH1 Var. Gain control is operated.
3. Repeat procedure for CH2 adjusting R235.

5.4.8 CH1 POSITION BALANCE

1. Set CH1 Volts/cm switch to 5mV. Input Coupling switch to GND. Mode switching to CH1. Timebase to Bright Line On.
2. Set CH1 shift control mid-way and bring trace to centre line by adjustment of R124.

5.4.9 CH2 INVERT BALANCE

1. Select CH2. Input Coupling switch to GND. Timebase to Bright Line On.
2. Set trace to centre line using CH2 shift control.
3. Adjust Invert Bal. R224 until operating the CH2 Invert produces no movement of the trace.

5.4.10 CHANNEL 1 AND CHANNEL 2 GAIN ADJUSTMENT

1. Set CH1 Volts/cm to 10mV. The Input Coupling to D.C. and the Fine Gain Control to cal.
2. Inject a 1kHz square wave of 60mV amplitude and adjust R160 to give a display amplitude of 6cms.
3. Set CH1 Volts/cm to 5mV inject a 30mV square wave and check that the display amplitude is 6cms accurate to ±3%.
4. Set CH1 Volts/cm to 2mV, inject a 12mV square wave and again check that the display amplitude is 6cms accurate to ±3%. Should this amplitude be outside the ±3% accuracy a slight change can be made to R140 to bring it inside tolerance.
5. Repeat 1, 2, 3, 4 for CH2 adjusting R260 and changing R240 if necessary to bring the 2mV range inside tolerance.

5.4.11 CH1 AND CH2 LOW FREQUENCY COMPENSATION

1. Set CH1 Volts/cm to 10mV. The input coupling to D.C.
2. Inject a 10Hz square wave of 60mV amplitude and set CH1 L.F. Gain R122 to give a flat top to the displayed square wave.
3. Repeat 1 and 2 for CH2 adjusting R222 to give a flat top to the waveform.

5.4.12 CH1 AND CH2 ATTENUATOR COMPENSATION

1. Ensure that the attenuator screen is correctly fitted.
2. Set CH1 Volts/cm switch to 10mV. Input Coupling switch to D.C. Inject a 120mV 1kHz square wave via the 28pF/1MΩ standardiser.
3. Adjust input trimmer C102 to give a square corner. Remove standardiser.
4. Switch CH1 Volts/cm switch to 0.1V, inject a 0.5 volt 1kHz square wave and adjust X10 trimmer C102 to give a square corner.
5. Inject a 1V 1kHz square wave via standardiser and set C101 for a square corner. Remove standardiser.
6. Switch Volts/cm switch to 1V, inject a 5 volt 1kHz square wave and adjust C105 to give a square corner.
7. Inject a 10 volt 1kHz square wave through standardiser and set C104 to give a square corner. Remove standardiser.
8. Check that all Volts/cm ranges are accurate to ±3% and have a square corner by applying the appropriate amplitude of 1kHz square wave on each.
9. Repeat steps 1 to 8 for CH2. For C108 etc. read C208 etc.

5.4.13 Y AMPLIFIER OVERALL PULSE RESPONSE

1. Set CH1 and CH2 Volts/cm to 10mV Input Coupling switch to D.C. Fine Gain control to Cal, Time/cm to 0.2μs and Variable Time/cm to Cal.
2. Set the following trimmer preset controls mid-way C116, C216, C133, C233, C134, C234, C125, C225, C305, C310 and R335. Set C310 to a minimum. The cores on L301, L302 should be in the centre of winding.
3. Select CH2 and inject a 1MHz square wave adjusting amplitude to give a 5cms deflection.
4. Adjust L301 and L302 to give a square corner with zero ring on the displayed waveform.
5. Set C311 along with R335 to make the square wave top level.
6. Set Time/cm switch to 1μ sec. and pull X10.
7. Adjust C305 to improve the leading edge and give a square corner.
8. Adjust C216 and C225 in conjunction with one another to give a square corner with zero hook.
9. Set CH2 Volts/cm to 5mV and adjust the square wave generator to give a displayed amplitude of 5cms. Adjust C234 to give a square corner.
10. Set CH2 Volts/cm to 2mV, adjust the generator to give a 5cms display and adjust C233 to give a square corner.
11. Select CH1 and inject a 1MHz square wave with amplitude adjusted to give 5cms deflection.
12. Adjust C116 and C125 in conjunction with one another to give a square corner without hook. Set C112 to remove any dissimilarities between channels.
13. Repeat 9 and 10 for CH1 setting C134 and C133.

5.4.14 Y AMPLIFIER BANDWIDTH

1. Set CH1 and CH2 Volts/cm to 10mV, Input Coupling switch to D.C. and Fine Gain Control to Cal.
2. Select CH1, inject 50kHz from the Constant Amplitude Generator and set output to give a 6cm deflection. Increase the frequency of the generator until this deflection drops to 4.2cms. This frequency should be greater than 25MHz.
3. Repeat 2 on the 2 and 5mV settings on CH1 and for the 2mV, 5mV and 10mV settings on CH2.

5.4.15 TRIGGER BALANCE

1. Apply a 1.5 volt peak to peak 1kHz sinewave to the input of CH1 and set up the X and Y controls to display a few cycles of about 5cms amplitude.
2. Select CH1 Trigger, A.C. Trigger Coupling and adjust level control to obtain triggering from the sinewave mid-point.
3. Select D.C. Trigger Coupling and set R176 to obtain triggering from the same sinewave mid-point.
4. Select CH2, inject the 1.5 volt sinewave and repeat 1, 2 and 3 adjusting R276 to obtain triggering from the sinewave mid-point on D.C. coupling.

5.4.16 TIMEBASE CALIBRATION

1. Select X–Y operation and CH2 shift spot to centre of the screen. Adjust R518 for 115V on both X plates.
2. Ensure that the Variable sweep is set fully clockwise to the Cal position. Select 1ms/cm and X1 X gain. Apply a 1kHz square wave or time mark generator and set up a good, triggered display.
3. Adjust the X1 X gain preset control, R519, for a 10.5cm trace length.
4. Using the accurate time-marker generator set to 1ms pulses adjust R485 to give 1 pulse per division across the c.r.t. screen.
5. Pull for X10 X expansion and adjust R516 to give 1 pulse over 10 divisions. Return to X1.
6. Apply a 10ms marker rate and select the 10ms/cm timebase range. Adjust R476 to give one pulse per centrimetre on the c.r.t. screen.

7. Apply 1μs pulses on the 1μs/cm timebase range and adjust C438 to give one pulse per division across the c.r.t. screen.
8. Apply 20ns markers on 0.2μs/cm with X10 expansion. Adjust A.O.T. capacitors C444 and C450 for equal spacing between the markers across the screen. These capacitors are copper wire wrapped around an insulated pin and are adjusted by altering the number of turns around the pin.

5.4.17 X–Y GAIN

Apply a 1kHz square wave to CH1 input socket and set up the amplitude to give an 8cm display. Select X–Y operation on the timebase switch and CH2 on the Y mode switch. Adjust R187 to give a line of 8cm length.

X–Y PHASE ADJUSTMENT

1. Set CH1 and CH2 Input volts/cm switches to 0.1V Input Coupling switches to D.C. Timebase range switch to X–Y. Select CH2.
2. Apply a sinewave source to both CH1 and CH2. Adjust input to give a convenient size of display which will be a 45° line at 50kHz.
3. Increase the input frequency to 250kHz and adjust A.O.T. capacitor C131 on Y pre-amp board to just close the ellipse.

5.4.18 INTERNAL CALIBRATOR

1. Inject 1 volt p–p 1kHz square wave into CH1 from external calibrator. Set CH1 Volts/cm to 0.1 V/cm and adjust variable gain control to give exactly 8cm deflection.
2. Substitute the internal calibrator signal, from the pin on the front panel, for the signal from the external calibrator, and adjust R731 to give exactly 8cm deflection.

ABBREVIATIONS USED FOR COMPONENT DESCRIPTIONS

RESISTORS

CC	Carbon Composition	½W	10%	unless otherwise stated
CF	Carbon Film	1/8W	5%	unless otherwise stated
MO	Metal Oxide	½W	2%	unless otherwise stated
MF	Metal Film	¼W	1%	unless otherwise stated
WW	Wire Wound	6W	5%	unless otherwise stated
CP	Control Potentiometer		20%	unless otherwise stated
PCP	Preset Potentiometer Type PT10V		20%	unless otherwise stated

CAPACITORS

CE(1)	Ceramic		+ 80% - 25%	
CE(2)	Ceramic	500V	± 10%	unless otherwise stated
SM	Silver Mica			
PF	Plastic Film		± 10%	unless otherwise stated
PS	Polystyrene	63V	± 2½%	unless otherwise stated
PE	Polyester		± 10%	unless otherwise stated
PC	Polycarbonate			
E	Electrolytic (aluminium)		+ 50% - 10%	
T	Tantalum		+ 50% - 10%	
FT	Foil Trimmer			

OS1200 'Y' PRE-AMP & BEAM SWITCH

Ref	Value	Description	Tol % ±	Part No
RESISTORS				
R100				
R101	900k	MF	0.5	31929
R102	990k	MF	0.5	31927
R103	111k	MF	0.5	31930
R104	10k1	MF	0.5	31928
R105	1M	MF		26346
R106	470k	CF		32330
R107	330k	CC		4408
R108	220	CF		21796
R109	470k	CF		32330
R110	820	MF	2	38592
R111	180	MF	2	38576
R112	390	MF	2	38584
R113	330k	CF	5	32357
R114	22k	CP		A4/41682
R115				
R116	100	CF		21794
R117	10	CF		21793
R118	47k	CF		21815
R119	100	CF		21795
R120	2k2	CF		21802
R121	5k6	CF		21806
R122	2k2	PCP		36265
R123	2k2	CF		21802
R124	220			36262
R125	1k3	MF	2	38597
R126				
R127	1k3	MF	2	38597
R128	680	CF		28723
R129	680	CF		28723
R130	220	CF		21796
R131	220	CF		21796
R132	100	CF		21794
R133				
R134	10k	CF		21809
R135	22k	PCP		36268
R136	10k	CF		21809
R137	124.4	MF	2	41840
R138	27	MF	2	38556
R139	434	MF	2	41839
R140	1k21	MF		41838
R141	1k	MF		41841
R142	1k	MF		41841
R143	2k2	CF		21802
R144	1k	CF		21799
R145	100	CF		21794
R146	27	CF		28711
R147	10	CF		21793
R148	27	CF		28711
R149	82	CF		28717
R150	10	CF		21793
R151	1k8	CF		28725
R152	1k8	CF		28725
R153	22	CF		28710
R154	22	CF		28710
R155	120	CF		28718
R156	120	CF		28718
R157	180	CF		21795
R158	180	CF		21795
R159	100	CF		21794
R160	100	PCP		36261
R161	22	CF		28710
R162	1k8	CF		28725
R163	1k8	CF		28725
R164	10k	CF		21809
R165	1k2	CF		21810
R166	10k	CF		21809
R167	22	CF		28710
R168	22	CF		28710
R169	18k	CF		21811
R170	3k3	CF		21803
R171	3k3	CF		21803
R172	18k	CF		21811
R173	180	CF		21795
R174	3k9	CF		21804
R175	3k9	CF		21804
R176	10k	PCP		36267
R177	12k	CF		21810
R178	10	CF		21793
R179	10	CF		21793
R180	10	CF		21793
R181	1k	CP		A4/41783
R182	4k7	CF		21805
R183	10	CF		21793
R184	10k	CF		21809
R185	27k	CF		21813
R186	10	CF		21795
R187	1k	PCP		36264
R188	1k	CF		21799
R189	18k	CF		21811
R190	1k5	CF		21801
R191	2k2	CF		21802
R192	1k2	CF		21800
R193	100	CF		21794
R194				
R195	4k7	CF		21805
R196	100	CF		21794
R197	33	CF		28712
R198	470	CF		21797
R199	470	CF		21797
R200				
R201	900k	MF	0.5	31929
R202	990k	MF	0.5	31927
R203	111k	MF	0.5	31930
R204	10k1	MF		31928
R205	1M	MF		26346
R206				
R207	330k	CC		4408
R208	220	CF		21796
R209				

OS1200 'Y' PRE-AMP & BEAM SWITCH (Cont)

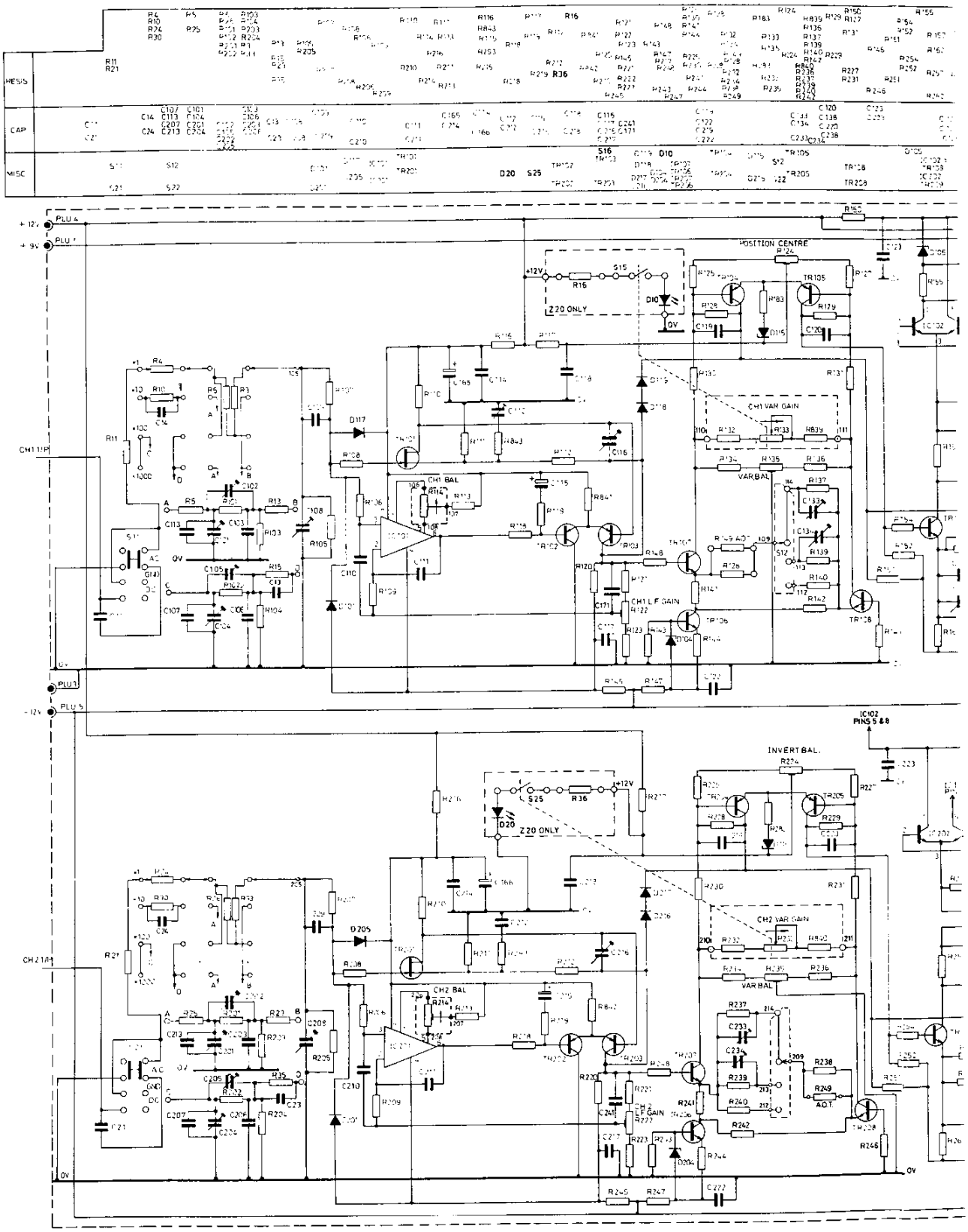
Ref	Value	Description	Tol % ±	Part No
RESISTORS (Cont)				
R210	820	MF	2	38592
R211	180	MF	2	38476
R212	390	MF	2	38584
R213	330k	CF		32357
R214	22k	CP		A4/41682
R215				
R216	100	CF		21794
R217	10	CF		21793
R218	47k	CF		21815
R219	180	CF		21795
R220	2k2	CF		21802
R221	5k6	CF		21806
R222	2k2	PCP		36265
R223	2k2	CF		21802
R224	220	PCP		36262
R225	1k3	MF	2	38597
R226				
R227	1k3	MF	2	38597
R228	680	CF		28723
R229	680	CF		28723
R230	220	CF		21796
R231	220	CF		21796
R232	100	CF		21794
R233				
R234	10k	CF		21809
R235	22k	PCP		36268
R236	10k	CF		21809
R237	124.4	MF	2	41840
R238	27	MF	2	38556
R239	434	MF	2	41839
R240	1k21	MF		41838
R241	1k	MF		41841
R242	1k	MF		41841
R243	2k2	CF		21802
R244	1k	CF		21799
R245	100	CF		21794
R246	27	CF		28711
R247	10	CF		21793
R248	27	CF		28711
R249	82	CF		28717
R250				
R251	1k8	CF		28725
R252	1k8	CF		28725
R243	22	CF		28710
R254	22	CF		28710
R255				
R256				
R257	180	CF		21795
R258	180	CF		21795
R259	100	CF		21794
R260	100	PCP		36261
R261	22	CF		28710
R262	1k8	CF		28725
R263	1k8	CF		28725
R264	10k	CF		21809

Ref	Value	Description	Tol % ±	Part No
RESISTORS (Cont)				
R265	1k2	CF		21800
R266	10k	CF		21809
R267	22	CF		28710
R268	22	CF		28710
R269	18k	CF		21811
R270	3k3	CF		21803
R271	3k3	CF		21803
R272	18k	CF		21811
R273	180	CF		21795
R274	3k9	CF		21804
R275	3k9	CF		21804
R276	10k	PCP		36267
R277	12k	CF		21810
R278	10	CF		21793
R279	10	CF		21793
R280				
R281	1k	CP		A4/41783
R282	4k7	CF		21805
R283	10	CF		21793
R284	10k	CF		21809
R285	27k	CF		21813
R286	10	CF		21793
R287	430	MF	2	38585
R288	430	MF	2	38585
R289	1k	CF		21799
R290	1k	CF		21799
R291	470	CF		21797
R292	470	CF		21797
R293	100	CF		21794
R294	1k	CF		21799
R295				
R296	100	CF		21794
R297	33	CF		28712
R800	100	CF		21794
R801	8k2	CF		21808
R802	100	CF		21794
R803	2k2	CF		21802
R804	5k6	CF		21806
R805	3k9	CF		21804
R806	100	CF		21794
R807	8k2	CF		21808
R808	100	CF		21794
R809	10k	CF		21809
R810	10k	CF		21809
R811	8k2	CF		21808
R812	1k2	CF		21800
R813	1k	CF		21799
R814	100	CF		21794
R815	10k	CF		21809
R816				
R817				
R818	10k	CF		21809
R824	22k	CF		21812

OS1200 'Y' PRE-AMP & BEAM SWITCH (Cont)

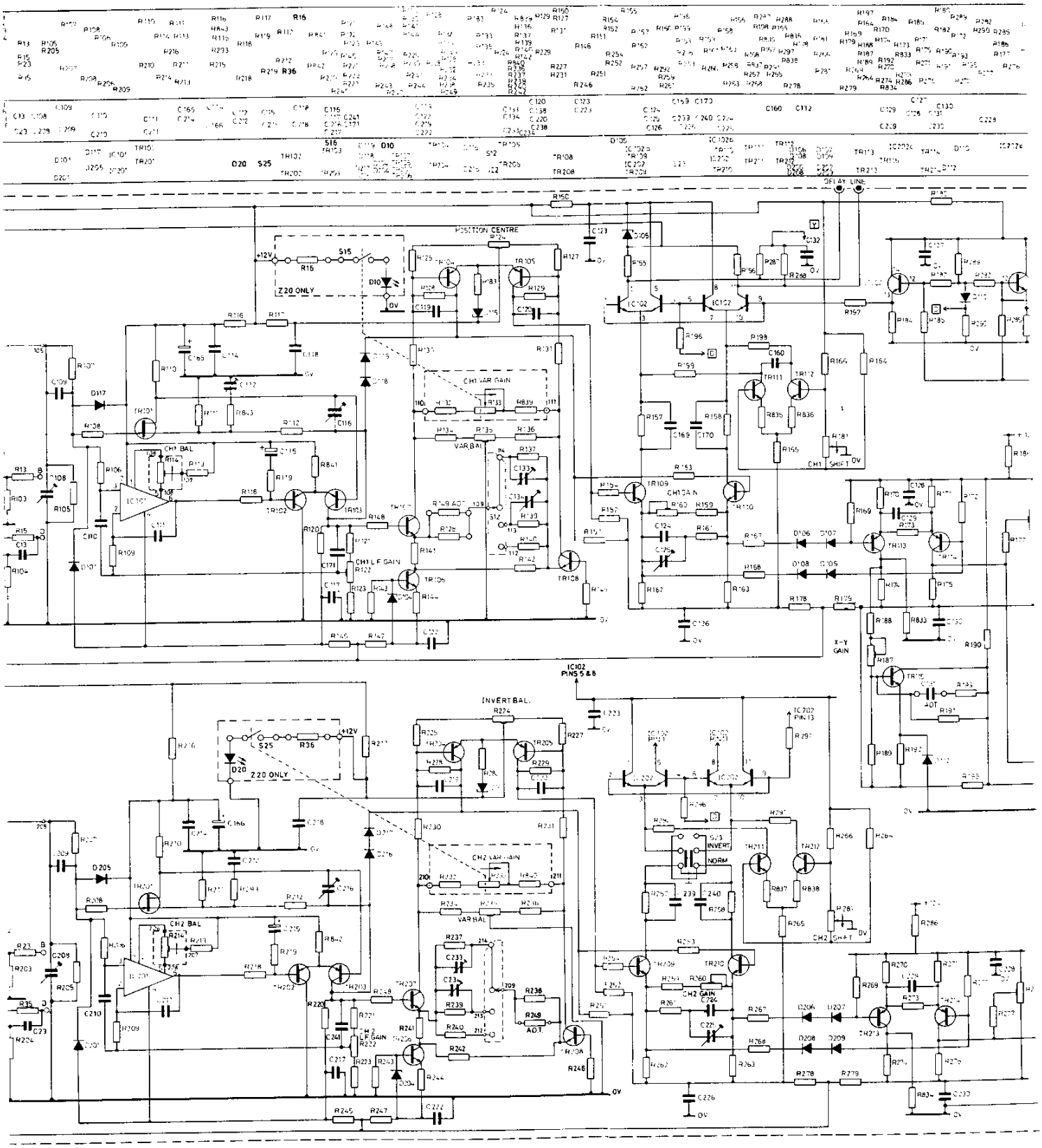
Ref	Value	Description	Tol % ±	Part No
RESISTORS (Cont)				
R825	10k	CF		21809
R826	100	CF		21794
R827	47k	CF		21815
R828	47k	CF		21815
R829	47k	CF		21815
R830	10k	CF		21809
R831	4k7	CF		21805
R832	820	CF		28724
R833	180	CF		21795
R834	220	CF		21796
R835	150	CF		28719
R836	150	CF		28719
R837	150	CF		28719
R838	150	CF		28719
R839	100	CF		21794
R840	100	CF		21794
R841	430	MF	2	38585
R842	430	MF	2	38585
R843	100	CF		21794
R844	10k	CF		21809
CAPACITORS				
C101	0.7/6pF	TF		29421
C102	0.7/6pF	TF		29421
C103	47pF	S/M	160V	685
C104	0.7/6pF	TF		29421
C105	0.7/6pF	TF		29421
C106	470pF	CF(2)		40407
C107	10pF	CE(2)		22364
C108	0.7/6pF	TF		29421
C109	.01µF	CE(2)		24902
C110	1000pF	CE(2)		22387
C111	56pF	CE(2)		22373
C112	1/9pF	TF		36272
C113	3.9pF	SM		36601
C114	0.1µF	CE(2)	25V	36709
C115	10µF	E	16V	32180
C116	1/9pF	TF		36272
C117	0.1µF	CE(2)	25V	36709
C118	.01µF	CE(2)	250V	22395
C119	5.6pF	CE(2)		22361
C120	5.6pF	CE(2)		22361
C122	.01µF	CE(2)	250V	22395
C123	.01µF	CE(2)	250V	22395
C124	33pF	CE(2)		22370
C125	3/27pF	TF		36273
C126	.01µF	CE(2)	250V	22395
C127	0.1µF	CE(2)	25V	36709
C128	.01µF	CE(2)	250V	22395
C129	47pF	CE(2)		22372
C130	.01µF	CE(2)	250V	22395
C131	39pF	CE(2)		22371
C132	.01µF	CE(2)	250V	22395
C133	3/27pF	TF		36273

Ref	Value	Description	Tol % ±	Part No
CAPACITORS (Cont)				
C134	3/27pF	TF		36273
C135	.01µF	CE(2)	250V	22395
C150	0.1µF	CE(2)	25V	36709
C151	0.1µF	CE(2)	25V	36709
C153	1000pF	CE(2)		22387
C154	0.1µF	CE(2)	25V	36709
C155	0.1µF	CE(2)	25V	36709
C156	22pF	CE(2)		22368
C157	5.6pF	CE(2)		22361
C163	10pF	CE(2)		22364
C164	0.1µF	CE(2)	25V	36709
C165	150µF	E	16V	32175
C166	150µF	E	16V	32175
C167	22pF	CE(2)		22368
C168	18pF	CE(2)		22367
C169	1000pF	CE(2)		22387
C170	1000pF	CE(2)		22387
C171	10pF	CE(2)		22364
C172	.01µF	CE(2)	250V	22395
C173	0.1µF	CE(2)	25V	36709
C201	0.7/6pF	TF		29421
C202	0.7/6pF	TF		29421
C203	47pF	SM	160V	685
C204	0.7/6pF	TF		29421
C205	0.7/6pF	TF		29421
C206	470pF	CE(2)	160V	40407
C207	10pF	CE(2)		22364
C208	0.7/6pF	TF		29421
C209	.01µF	CE(2)		24902
C210	1000pF	CE(2)		22387
C211	56pF	CE(2)		22373
C212	6.8pF	CE(2)		22362
C213	3.9pF	SM		36601
C214	0.1µF	CE(2)	25V	36709
C215	10µF	E	16V	32180
C216	1/9pF	TF		36272
C217	0.1µF	CE(2)	25V	36709
C218	.01µF	CE(2)	250V	22395
C219	5.6pF	CE(2)		22361
C220	5.6pF	CE(2)		22361
C221				
C222	.01µF	CE(2)	250V	22395
C223				
C224	33pF	CE(2)		22370
C225	3/27pF	TF		36273
C226	.01µF	CE(2)	250V	22395
C227				
C228	.01µF	CE(2)	250V	22395
C229	47pF	CE(2)		22372
C230	.01µF	CE(2)	250V	22395



FOR SERVICE MANUALS
CONTACT:

MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554


DELAY LINE
POSITION CENTRE
+12V
S15
R16
Z20 ONLY
D10
0V
CH1 VAR GAIN
VAR BAL
CH1 BAL
CH1 LF GAIN
CH1 GAIN
CH1 SHIFT
X-Y GAIN
INVERT BAL.
D20
S25
R36
Z20 ONLY
CH2 VAR GAIN
VAR BAL
CH2 BAL
CH2 LF GAIN
CH2 GAIN
CH2 SHIFT
INVERT
NORM
IC102 PINS 5 & 8
IC202 PIN 13

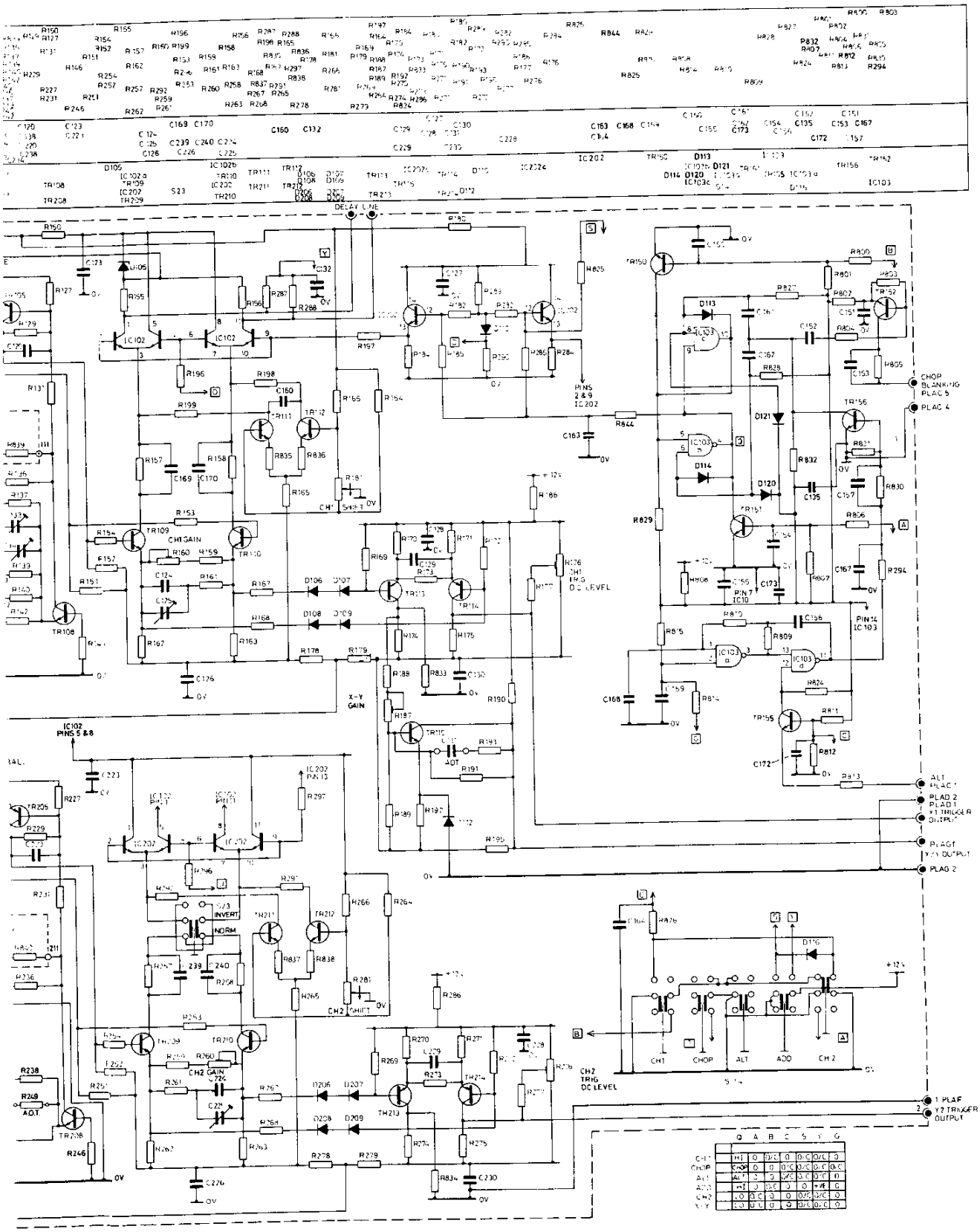


Fig. 2 Y Preamplifier Circuit

OS1200 'Y' PRE-AMP & BEAM SWITCH (Cont)

Ref	Value	Description	Tol %±	Part No
CAPACITORS (Cont)				
C231				
C232				
C233	3/27pF	TF		36273
C234	3/27pF	TF		36273
C239	1000pF	CE(2)		22387
C240	1000pF	CE(2)		22387
C241	10pF	CE(2)		22364
DIODES				
D101		IN3595		29330
D102		IN4148		23802
D103		IN4148		23802
D104	5V6	ZENER		33929
D105	2V7	ZENER		33921
D106		IN4148		23802
D107		IN4148		23802
D108		IN4148		23802
D109		IN4148		23802
D110		IN4148		23802
D111				
D112		IN4148		23802
D113		IN4148		23802
D114		IN4148		23802
D115	6V8	ZENER		33931
D116		IN4148		23802
D117		IN3595		29330
D118		IN4148		23803
D119		IN4148		23802
D120		OA47		4468
D121		OA47		4468
D201		IN3595		29330
D202		IN4148		23802
D203		IN4148		23802
D204	5V6	ZENER		33929
D205		IN3595		29330
D206		IN4148		23802
D207		IN4148		23802
D208		IN4148		23802
D215	6V8	ZENER		33931
D216		IN4148		23802
D217		IN4148		23802

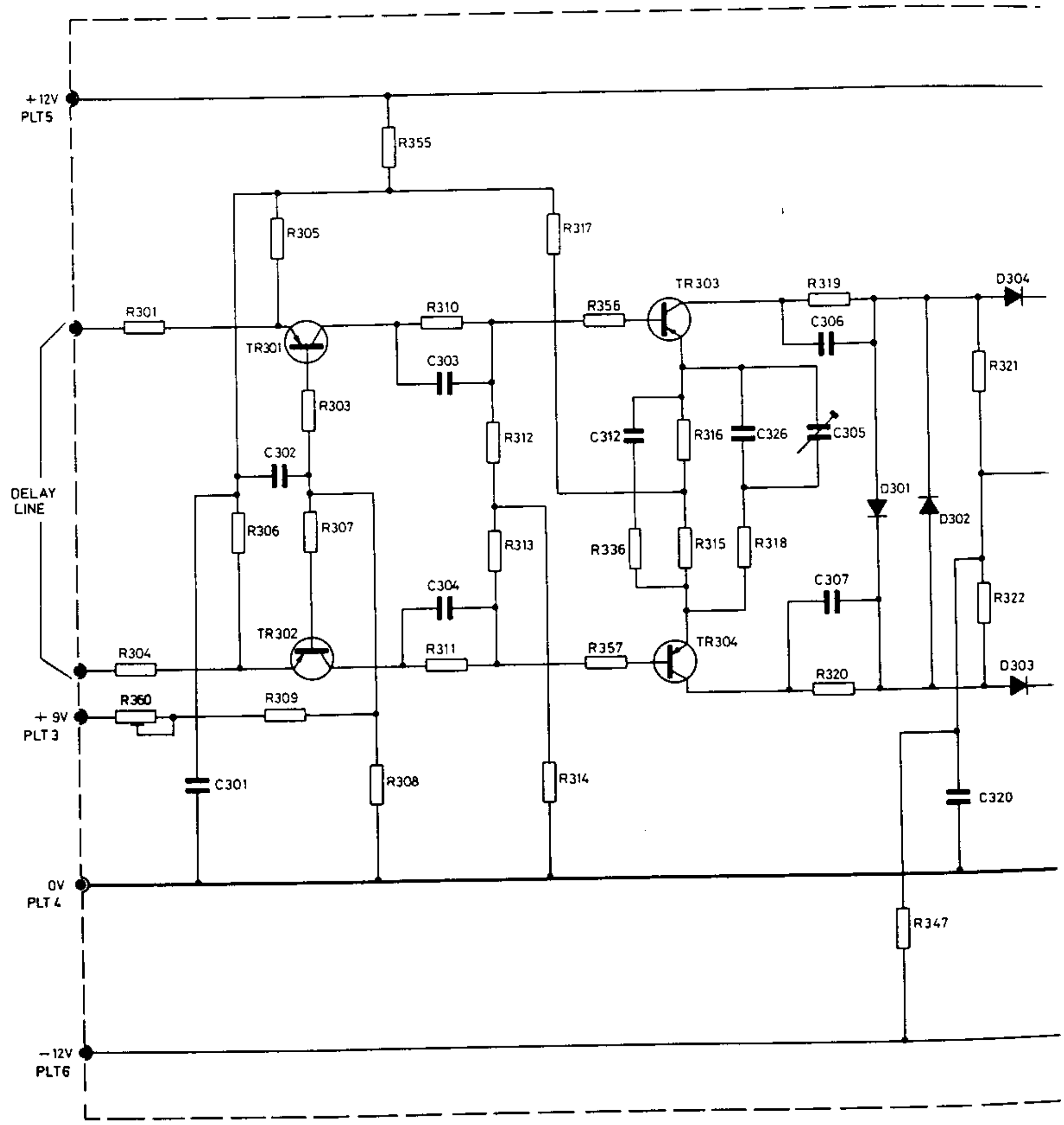
Ref	Value	Description	Tol %±	Part No
TRANSISTORS				
TR101		AE37		40414
TR102		BC212		29327
TR103		2N5771		43212
TR104				
TR105		2N3640		31781
TR106		2N2369		23307
TR107 }		AE13	Matched Pair	31254
TR108 }				
TR109		2N2369		23307
TR110		2N2369		23307
TR111		2N2369		23307
TR112		2N2369		23307
TR113		2N3640		31781
TR114		2N3640		31781
TR115		2N2369		23307
TR150		2N2369		23307
TR151		2N2369		23307
TR152		BC212		29327
TR155		2N2369		23307
TR156		2N2369		23307
TR201		AE37		40414
TR203		2N5771		43212
TR205		2N3640		31781
TR206		2N2369		23307
TR207 }		AE13	Matched Pair	31254
TR208 }				
TR209		2N2369		23307
TR210		2N2369		23307
TR211		2N2369		23307
TR212		2N2369		23307
TR213		2N3640		31781
TR214		2N3640		31781
INTEGRATED CIRCUIT				
IC101		µAF351TC		40130
IC102		CA3046		32961
IC103		MC4011B		34953
IC201		µAF351TC		40130
IC202		CA3046		32961

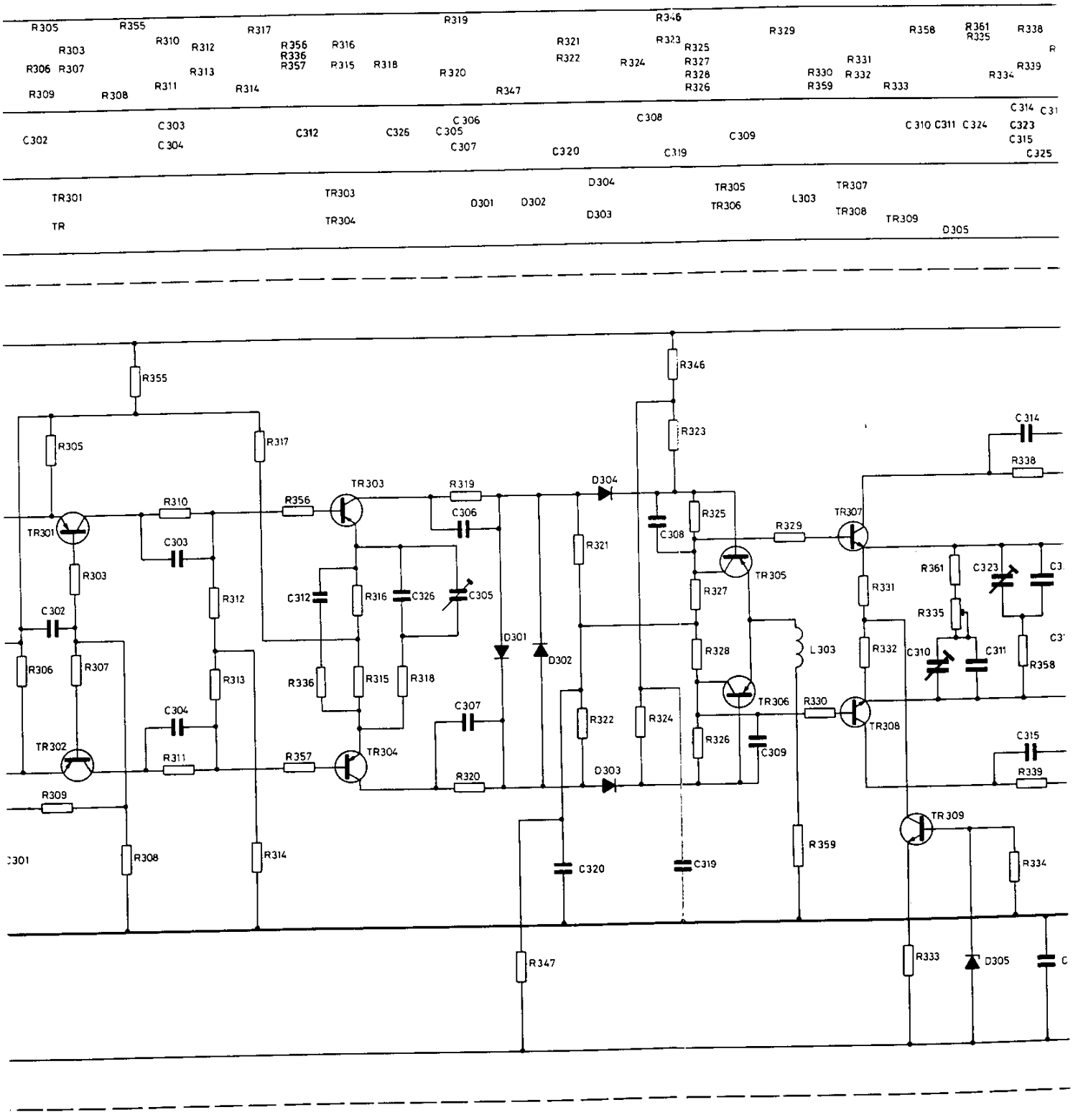
OS1200 'Y' OUTPUT

Ref	Value	Description	Tol % ±	Part No
RESISTORS				
R301	100	CF		21794
R302				
R303	10	CF		21793
R304	100	CF		21794
R305	1k2	MF	2	38596
R306	1k2	MF	2	38596
R307	10	CF		21793
R308	2k7	MF	2	38604
R309	470	CF		21797
R310	270	CF		28720
R311	270	CF		28720
R312	220	CF		21796
R313	220	CF		21796
R314	330	CF		28721
R315	47	MF	2	38562
R316	47	MF	2	38562
R317	470	MF	2	38586
R318	10	CF		21793
R319	270	CF		28720
R320	270	CF		28720
R321	3k	MF		38605
R322	3k	MF		38605
R323	10k	CF		21809
R324	10k	CF		21809
R325	510	MF	2	38587
R326	510	MF	2	38587
R327	330	MF	2	38582
R328	330	MF	2	38582
R329	82	CF		28717
R330	82	CF		28717
R331	39	CF		28713
R332	39	CF		28713
R333	47	MO		26740
R334	820	CF		28724
R335	220	PCP		36262
R336	330	CF		28721
R337	4k7	CF		21805
R338	100	CF		21794
R339	100	CF		27194
R340	39	CF		28713
R341	39	CF		28713
R342	39	CF		28713
R343	39	CF		28713
R344	820	CF		28724
R345	10	CF		21793
R346	10	CF		21793
R347	10	CF		21793
R348	560	MO	5	43291
R349	560	MO	5	41612
R350	560	MO	5	41612
R351	560	MO	5	43291
R352	68	CF		28716
R353	68	CF		28716
R354	10	CF		21793
R355	10	CF		21793

Ref	Value	Description	Tol % ±	Part No
RESISTORS (Cont)				
R356	15	CF		28708
R357	15	CF		28708
R358	15	CF		28708
R359	10	CF		21793
R360	1k	PCP		35875
R361	100	CF		21794
R362	1k	CF		21799
R363	1k	CF		21799
CAPACITORS				
C301	.01µF	CE(2)	250V	22395
C302	.01µF	CE(2)	250V	22395
C303	1500pF	CE(2)		22388
C304	1500pF	CE(2)		22388
C305	3/27pF	TF		36273
C306	1500pF	CE(2)		22388
C307	1500pF	CE(2)		22388
C308	5.6pF	CE(2)		22361
C309	5.6pF	CE(2)		22361
C310	3/27pF	TF		36273
C311	22pF	CE(2)		22368
C312	56pF	CE(2)		22373
C313	47pF	CE(2)		22372
C314	1000pF	CE(2)		22387
C315	1000pF	CE(2)		22387
C316	.01µF	CE(2)	250V	22395
C317	.01µF	CE(2)	250V	22395
C318	.01µF	CE(2)	250V	22395
C319	.01µF	CE(2)	250V	22395
C320	.01µF	CE(2)	250V	22395
C321	.1µF	PE	160V	31377
C322	.1µF	PE	160V	31377
C323	3/27pF	TF		36273
C324				
C325	.01µF	CE(2)	250V	22395
TRANSISTORS				
TR301		2N3640		31781
TR302		2N3640		31781
TR303		2N5771		43212
TR304		2N5771		43212
TR305		2N5771		43212
TR306		2N5771		43212
TR307		ZTX327		39271
TR308		ZTX327		39271
TR309		ZXT327		39271
TR310		MPS UO4		38723
TR311		MPS UO4		38723
DIODES				
D301		FH1100		40352
D302		FH1100		40352
D303		FH1100		40352

RESIS.	R301 R304 R360 R305 R306 R303 R307 R309 R355 R308 R310 R311 R312 R313 R317 R314 R356 R336 R357 R316 R315 R318 R319 R320 R347 R321 R322
CAP	C301 C302 C303 C304 C312 C326 C306 C305 C307 C320
MISC.	TR301 TR TR303 TR304 D301 D302 D304 D303




R305
R355
R310
R312
R317
R356
R316
R319
R346
R321
R323
R329
R358
R361
R338
R303
R336
R357
R315
R318
R320
R322
R324
R325
R327
R328
R326
R330
R359
R331
R332
R333
R335
R339
R306
R307
R313
R311
R314
R347
C302
C303
C304
C312
C326
C306
C305
C307
C320
C308
C319
C309
C310
C311
C324
C314
C323
C315
C325
TR301
TR303
TR304
D301
D302
D304
D303
TR305
TR306
L303
TR307
TR308
TR309
D305
TR
R309
R308
C301

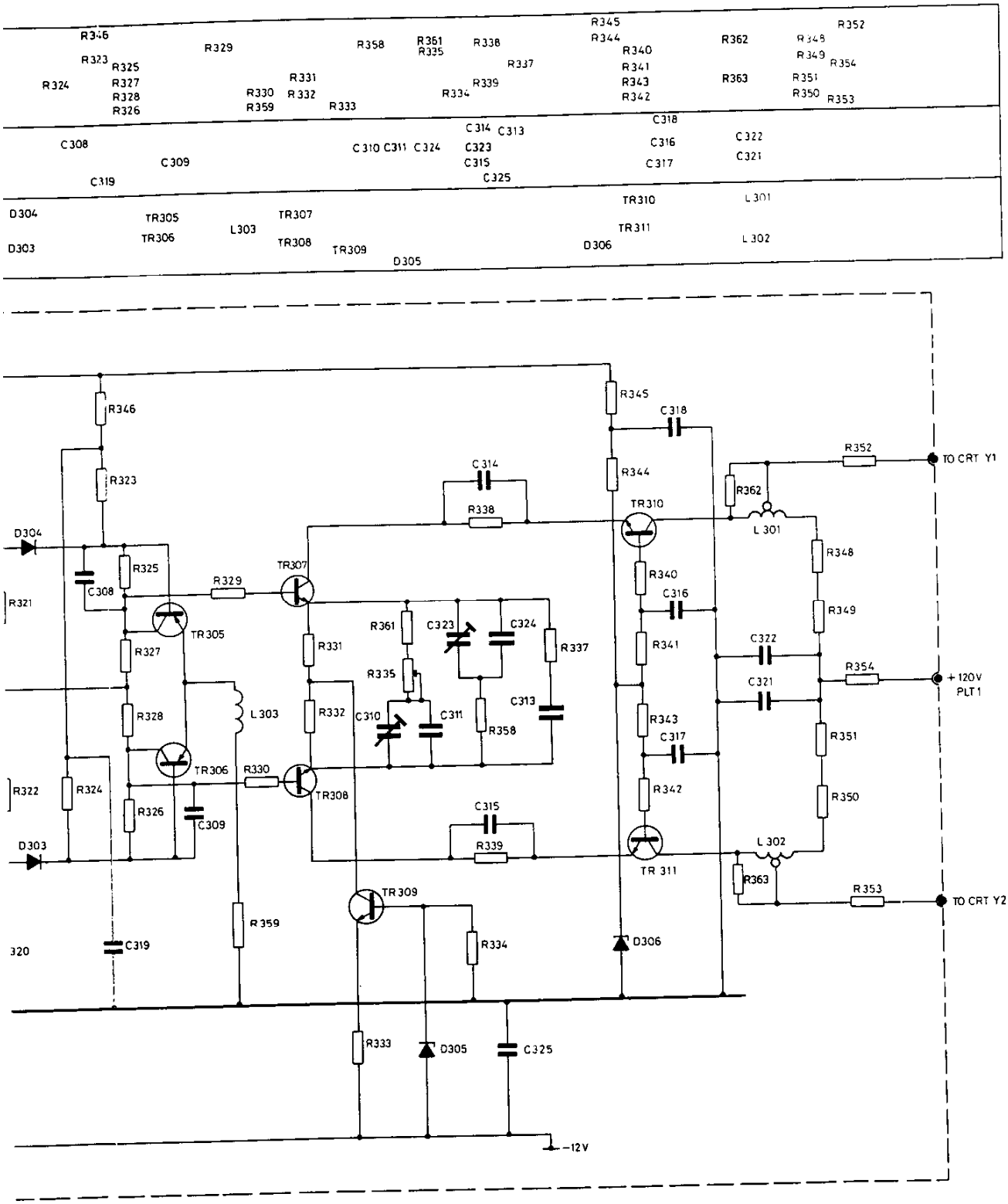


Fig. 3 Y Output Amplifier Circuit

OS1200 'Y' OUTPUT (Cont)

Ref	Value	Description	Tol % ±	Part No
DIODES (Cont)				
D304		FH1100		40352
D305	4V7	ZENER		33927
D306	8V2	ZENER		33933

Ref	Value	Description	Tol % ±	Part No
MISCELLANEOUS				
L301		Tapped choke		A4/41611
L302		Tapped choke		A4/41611
L303		FX1242		26986

OS1200 TIMEBASE

Ref	Value	Description	Tol %±	Part No
RESISTORS				
R401	43k	MF	2	38633
R402	1M	CF		18586
R403	1k	CF		21799
R404	330	CF		28721
R405	220	CF		21796
R406	220	CF		21796
R407	100k	CF		21819
R408	120	CF		28718
R409	100	CF		21794
R410	100	CF		21794
R411	100	CF		21794
R412	1k	CF		21799
R413	8k2	CF		21808
R414	8k2	CF		21808
R415	3k9	CF		21804
R416	330k	CF		32357
R417	2k2	CF		21802
R418	100	CF		21794
R419	1k	CF		21799
R420	220	CF		21796
R421	220	CF		21796
R422		A.O.T.		
R423	220	CF		21796
R424	220	CF		21796
R425	9k1	MF	2	38617
R426	9k1	MF	2	38617
R427	10	CF		21793
R428	10	CF		21793
R429	10	CF		21793
R430	10	CF		21793
R431	270k	CF		32356
R432	270k	CF		32356
R433	22k	CF		21812
R434	100k	CF		21819
R435	560k	CF		32359
R436	220	MF	2	38578
R437	560k	CF		32359
R438	330	CF		28721
R439	33k	CF		21814
R440	1M	CF		31840
R441	10	CF		21793
R442	47	CF		28714
R443	2k2	CF		21802
R444				
R445	220k	CF		21823
R446				
R447	3k9	CF		21804
R448	100k	CF		21819
R449	22k	CF		21812
R450	4k7	CF		21805
R451	8k2	CF		21809
R452	180k	CF		21822
R453	10k	CF		21809
R454	39k	CF		28728
R455	10k	CF		21809
R456	10M	CF		32661
R457	8k2	CF		21808
R458	15k	CF		28727
R459	15k	CF		28727
R460	330k	MF	2	38654
R461	10	CF		21793
R462	22k	CF		21812
R463	220	MF	2	38578
R464	22k	CF		21812
R465	3k9	CF		21804
R466	270	CF		28720
R467	4k7	CF		21805
R468				
R469				
R470				
R471	1k8	CF		28725
R472	12k	CF		21810
R473	1k2	CF		21800
R474	3k3	CF		21803
R475	4k7	CF		21805
R476	4k7	PCP		36266
R477	4k7	CF		21805
R478	22k	CF		21812
R479	470	CF		21797
R480	10k	CF		21809
R481	5k8	CF		28725
R482	47k	CF		21815
R483	560	CF		21798
R484	330	CF		28721
R485	220	PCP		36262
R486	68	CF		28716
R487	220	CF		21796
R488	5R1	MF		38539
R489	12k	CF		21810
R490	470k	CF		32330
R491	470k	CF		32330
R492	3k3	CF		21803
R493	33k	CF		21814
R494	3k3	CF		21803
R495	10k	CF		21809
R496	47k	CF		21815
R497	100	CF		21794
R498	3k3	CF		21803
R499				
R500	4k7	CF		21805
R501	100	CF		21794
R502	18k	CF		21811
R503	10	CF		21793
R504	100	CF		21794
R505	6k8	CF		21807
R506	3k3	CF		21803
R507	10k	CF		21809
R508	220k	CF		21823
R509	120k	MF	2	38644
R510	220k	CF		21823

OS1200 TIMEBASE (Cont)

Ref	Value	Description	Tol % ±		Part No
RESISTORS (Cont)					
R511	4k7	CF			21805
R512	2k4	MF	2		38603
R513	6k8	CF			21807
R514	300	MF	2		38581
R515	2k2	CF			21802
R516	220	PCP			36262
R517	470	CF			21797
R518	220	PCP			36262
R519	22k	PCP			36268
R520	2k4	MF	2		38603
R521	4k7	CF			21805
R522	10k	CF			21809
R523	220k	CF			21823
R524	120k	MF			38644
R525	220k	CF			21823
R526	6k8	CF			21807
R527	3k3	CF			21803
R528	10	CF			21793
R529					
R530	12k	CF			21810
R531	3k3	CF			21803
R532	2k2	CF			21802
R533	8k2	CF			21808
R534					
R535	10	CF			21793
R536	10	CF			21793
R537	1k5	CF			21801
R538					
R539	100	CF			21794
R540	100	CF			21794
R561	10k	CF			21809
R562	1k5	MF	2		38598
R563	330	CF			28721
R564					
R565	3k3	CF			21803
R566	6k8	CF			21807
R567	10	CF			21793
R568	10k	CF			21809
R569	1k	CF			21799
R570	10k	CF			21809
R571	1k	CF			21799
R572	1k	CF			21799
R573	100	CF			21794
R574	10k	CF			21809
R575	10k	CF			21809
CAPACITORS					
C401	120pF	CE(2)			22377
C402	6.8pF	CE(2)			22362
C403	.01μF	CE(2)		250V	22395
C404	47pF	CE(2)			22372
C405	150pF	CE(2)			22378
C406	.047μF	PE	10	250V	31375
C407	.01μF	CE(2)		250V	22395

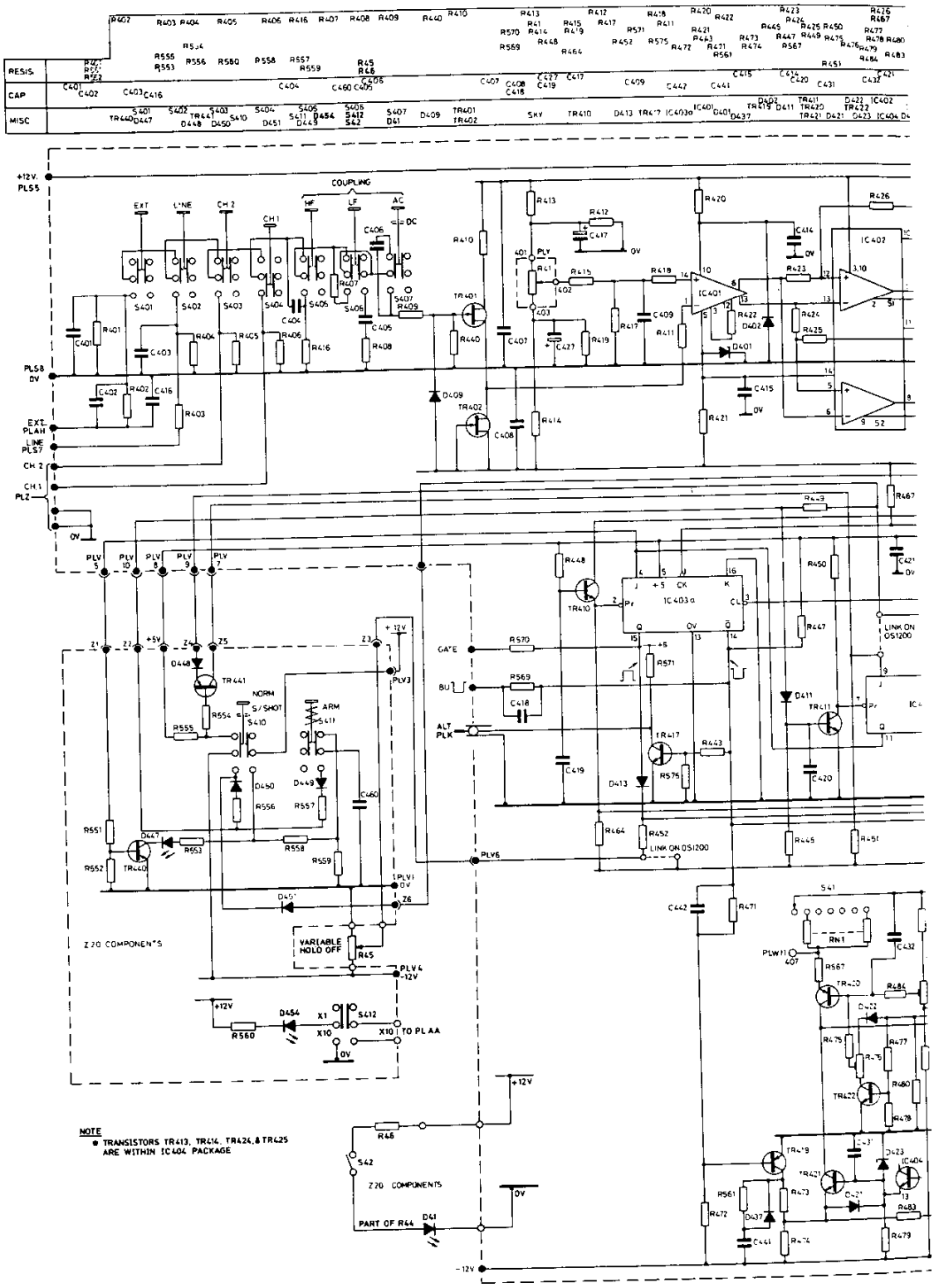
Ref	Value	Description	Tol % ±		Part No
CAPACITORS (Cont)					
C408	.01μF	CE(2)		250V	22395
C409	.01μF	CE(2)		250V	22395
C410	33pF	CE(2)			22370
C411	0.1μF	CE(2)		25V	36709
C412	.01μF	CE(2)		250V	22395
C413	.01μF	CE(2)		250V	22395
C414	.01μF	CE(2)		250V	22395
C415	.01μF	CE(2)		250V	22395
C416	6.8pF	CE(2)			22362
C417	10μF	E		10V	32180
C418	15pF	CE(2)			22366
C419	150pF	CE(2)			22378
C420	100pF	CE(2)			22376
C421	.01μF	CE(2)		250V	22395
C422	1μF	PE	10	63V	31364
C423	.01μF	CE(2)		250V	22395
C424	33pF	CE(2)			22370
C425	100pF	CE(2)			22376
C426	.01μF	CE(2)		250V	22395
C427	10μF	E		10V	32180
C428	0.1μF	CE(2)		25V	36709
C429	.01μF	CE(2)		250V	22395
C430	.01μF	CE(2)		250V	22395
C431	.01μF	CE(2)		250V	22395
C432	0.1μF	CE(2)		25V	36709
C433	180pF	CE(2)			33898
C434	1μF	PE	10	63V	31364
C435	.01μF	CE(2)	1	160V	24886
C436	.01μF	CE(2)		250V	22395
C437	56pF	CE(2)			22373
C438	3/27pF	TF			36273
C439	56pF	SM	1		34352
C440	.01μF	CE(2)		250V	22395
C441	100pF	CE(2)			22376
C442					
C443	10μF	T	20	35V	35931
C444		T.C.W.	A.O.T.		
C445	.01μF	CE(2)		250V	22395
C446	0.1μF	CE(2)	10	160V	31377
C447	27pF	CE(2)			22369
C448	0.1μF	CE(2)	10	160V	31377
C449	.01μF	CE(2)		250V	22395
C450		T.C.W.	A.O.T.		
C451	.01μF	CE(2)		250V	22395
C452	.01μF	CE(2)		250V	22395
C453	0.1μF	CE(2)		25V	36709
C454	0.1μF	CE(2)		25V	36709
C455	18pF	CE(2)			22367
C456	.01μF	CE(2)		250V	22395
C457	0.1μF	CE(2)		25V	36709
C458					
C459					
C460					
C461	0.1μF	CE(2)		25V	36709
C462	0.1μF	CE(2)		25V	36709

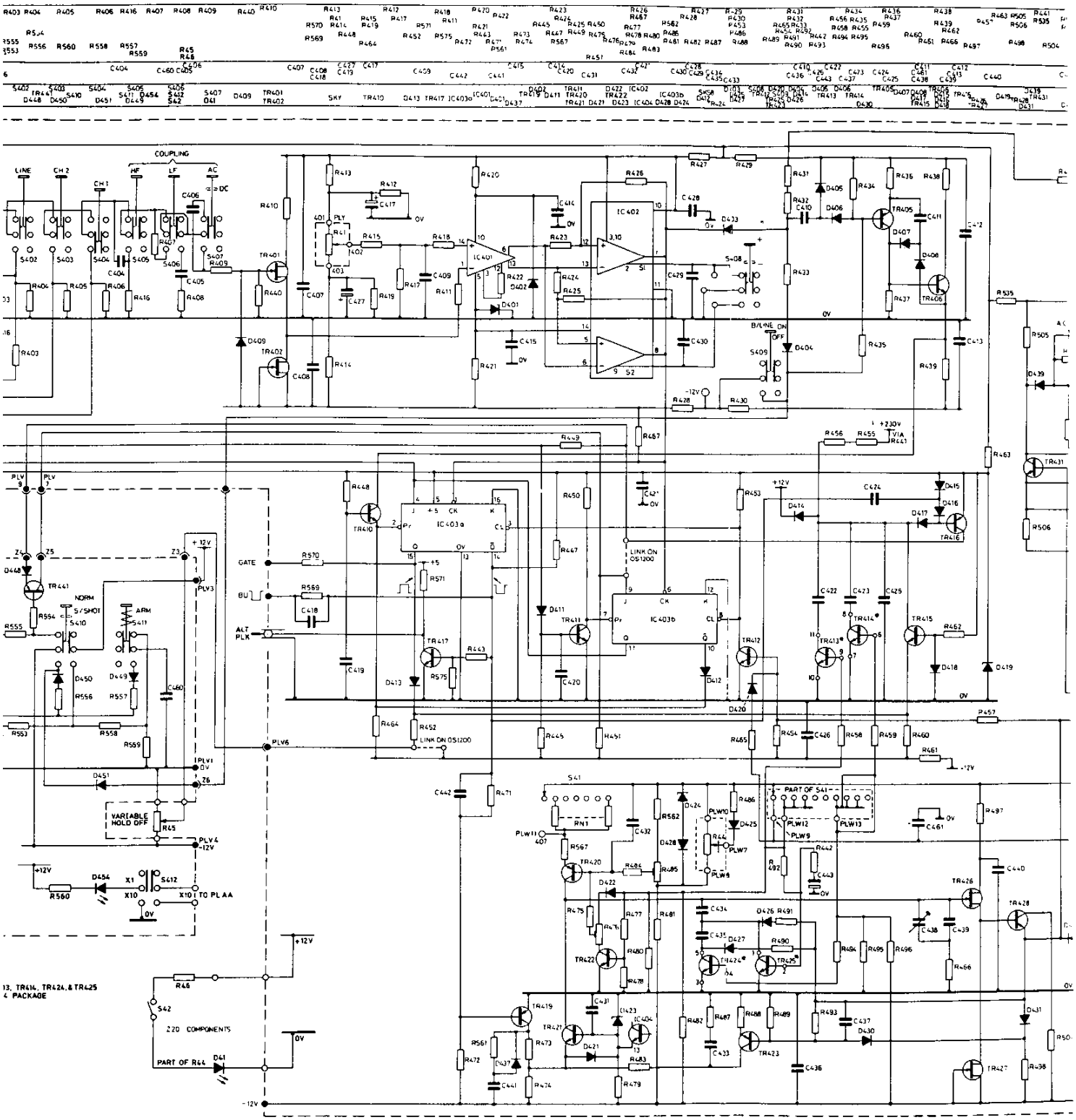
OS1200 TIMEBASE (Cont)

Ref	Value	Description	Tol % ±	Part No
TRANSISTORS				
TR401 }		WD406	Dual f.e.t.	36772
TR402 }				
TR403				
TR404				
TR405		BC212		29327
TR406		BC107		26790
TR407				
TR408				
TR409				
TR410		BC182B		33205
TR411		2N2369		23307
TR412		2N2369		23307
TR413			Part of IC404	
TR414			Part of IC404	
TR415		2N2369		23307
TR416		BC214C		36019
TR417		2N2369		23307
TR418				
TR419		2N3640		31781
TR420		BC214C		36019
TR421		BC182B		33205
TR422		BC182B		33205
TR423		2N3640		31781
TR424			Part of IC404	
TR425			Part of IC404	
TR426 }		WD406		36772
TR427 }				
TR428		2N3905		20818
TR429		2N3906		21533
TR430				
TR431		BC182B		33205
TR432		2N5770		43211
TR433		BF470		38416
TR434		BF469		38418
TR435		BF470		23307
TR436		BF469		38418
TR437		2N5770		43211
TR438		BC182B		33205
TR439		BC182B		33205
DIODES				
D401	6V2	ZENER		33930
D402	6V2	ZENER		33930
D403		IN4148		23802
D404		IN4148		23802
D405		IN4148		23802
D406		IN4148		23802
D407		IN4148		23802
D408		IN4148		23802
D409		IN3595		29330
D410				
D411		IN4148		23802
D412		IN4148		23802
D413		IN4148		23802

Ref	Value	Description	Tol % ±	Part No
DIODES (Cont)				
D414		IN4148		23802
D415		IN4148		23802
D416		IN4148		23802
D417		IN4148		23802
D418		IN4148		23802
D419	5V1	ZENER		33928
D420		IN4148		23802
D421		IN4148		23802
D422		IN4148		23802
D423	5V6	ZENER		33929
D424	3V9	ZENER		33925
D425		IN4148		23802
D426		IN4148		23802
D427		IN4148		23802
D428		IN4148		23802
D429				
D430		IN4148		23802
D431		IN4148		23802
D432				
D433		IN4148		23802
D434		IN4148		23802
D435		IN4148		23802
D436		IN4148		23802
D437		IN4148		23802
D438		IN4148		23802
D439		IN4148		23802
D440		IN4148		23802
D441		IN4148		23802
D442		IN4148		23802
D443	5V6	ZENER		33929
D444		IN4148		23802
D445	5V6	ZENER		33929
D446		IN4148		23802
D447				
D448				
D449				
D450				
D451				
D452		IN4148		23802
D453		IN4148		23802

INTEGRATED CIRCUITS		
IC401	LM733	37394
IC402	LM1414	35682
IC403	74LS76	36733
IC404	CA3046	32961
MISCELLANEOUS		
S401–409	P/B Switchbank 'Trigger'	41605
S410	Z20 Only	A3/42232
S411	Z20 Only	A3/42233
PLS		37882




COUPLING
LINE
CH 2
CH 1
HF
LF
AC
≂ = DC
VARIABLE HOLD OFF
NORM
S/SHOT
ARM
GATE
ALT PLK
LINK ON OS1200
TO PL AA
220 COMPONENTS
PART OF R44
PART OF S41
B/LINE ON
OFF
VIA R441
IC 403a
IC 403b
IC 402
IC 401
+12V
-12V
0V

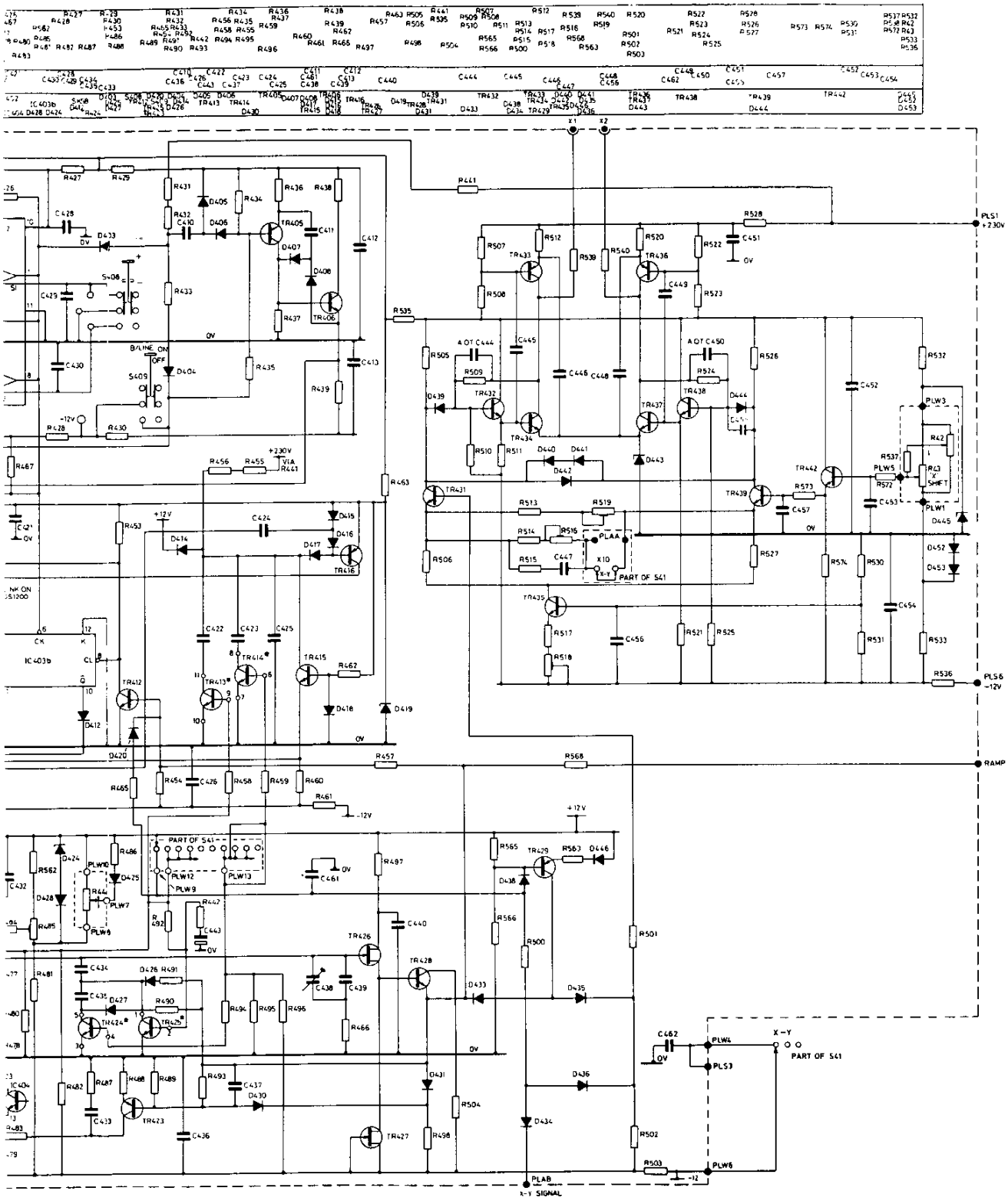


Fig. 4 Timebase & X Output Amplifier Circuit

OS1200 POWER SUPPLY (Cont)

Ref	Value	Description	Tol % ±	Part No
MISCELLANEOUS (Cont)				
T901		Oscillator Transformer		A2/41541
L901	330μH	Choke		40713
L902	330μH	Choke		40713
L903	330μH	Choke		40713
L904	330μH	Choke		40713

OS1200 INTERCONNECTIONS

Ref	Value	Description	Tol % ±	Part No
RESISTORS				
R1				
R3	68	CF		28716
R4	10	CF		21793
R5	10	CF		21793
R6	10	CF		21793
R7				
R8	1k5	CF		21801
R9				
R10	10	CF		21793
R11	10	CF		21793
R12	2k7	CP	'Y' Attenuator	A4/42018
R13	47	CF		28714
R16	1k5	CF		21801
R21	10	CF		21793
R22	2k7	CP	'Y' Attenuator	A4/42018
R23	47	CF		28714
R24	10	CF		21793
R25	10	CF		21793
R26	10	CF		21793
R28	1k	CF		21799
R30	10	CF		21793
R33	68	CF		28716
R41		CP	'Trigger Level'	A4/41539
R42	10k+10k	CP		A4/41409
R43				
R44		CP	'T/B Range' With S41/42	41599
RN1		Module		41681
CAPACITORS				
C11	0.1μF	CE(2)		29495
C12	0.1μF	CE(2)		29495
C14	82pF	CE(2)		36617
C21	0.1μF	CE(2)		29495

Ref	Value	Description	Tol % ±	Part No
CAPACITORS (Cont)				
C24	82pF	CE(2)		36617
MISCELLANEOUS				
FS1	500mA	'Slo-Blo' (20mm) 240V Supply		33685
FS1	1A	'Slo-Blo' (20mm) 115V Supply		34790
D1				39884
L1		Coil Twist c.r.t. Assy.		A3/42875
1LP1		24V Lamp		42697
1LP2		24V Lamp		42697
V1		D14-182GH-82 (Normal)		40022
		D14-181GH (Long persistence)		42509
T1		Power Transformer		A1/41555
S1		DP/DT Slider		A4/4069
S2		DP/DT Slider		A4/4069
S3		CP 'Intensity & Supply' with R780		A4/41538
S11		Slider Switch		37614
S12		Attenuator CH1		42015
S14		P/B 'Y' Function		41604
S21		Slider Switch		37614
S22		Attenuator CH2		42016
S23		'Invert'		42528
S41		'T/B Range' with R44		41599
S42				
SKA		50Ω B.N.C. Connector		1222
SKB		" " "		1222
SKC		" " "		1222
SKD		4mm		40076
SKE		4mm		40076
SKF		4mm		40076
SKG		4mm		40076

OS1200 POWER SUPPLY

Ref	Value	Description		Tol %±		Part No
RESISTORS						
R701						
R702	220	CF				21796
R703	150	CF				28719
R704	270	CF				28720
R705	470	CF				21797
R706	2k2	MO				26730
R707	4k7	CF				21805
R708	3k6	MF				38607
R709	47k	MF				38634
R710	220k	MF	A.O.T.	2		38650
R711	1k	MO				27346
R712	39k	CF				28728
R713	47	CC			1W	4038
R720	4k7	CP	'Scale'			A4/41456
R721	1k	PCP				39108
R722	180	CF				21795
R723	10	CF				21793
R724	10	CF				21793
R725	1k3	MF		2		38597
R726	5k6	MF		2		38612
R727	470	CF				21797
R728	4k3	MF		2		38609
R729	7k5	MF		2		38615
R730	1k8	MF		2		38600
R731	1k	PCP				36264
R732	220	MF		2		38578
R733	1k	CF				21799
R734	62	MO				28778
R735	2k2	CF				21802
R746	100k	PCP				36269
R747	100k	PCP				36269
R748	56k	CF				28729
R749						
R750	56k	CF				28729
R751	56k	CF				28729
R752						
R753	220	PCP				36262
R754	1k	PCP				36264
R755	1k8	CF				28725
R756	270	CF				28720
R757	22k	CF				21812
R758	1k2	CF				21800
R759						
R760	39	CF				28713
R761	39	CF				28713
R762	1k	CF				21799
R763	6k8	CF				21807
R764	3k9	CF				21804
R765						
R766	10k	CF				21809
R767	120k	CF				21820
R768	10	CF				21793
R769	10	CF				21793

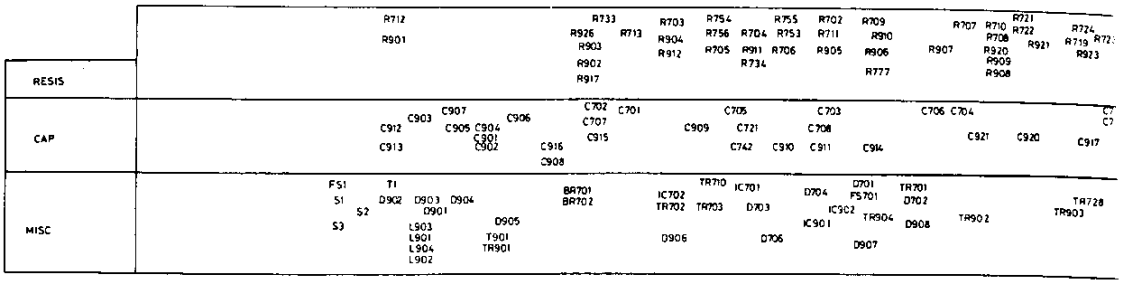
Ref	Value	Description		Tol %±	Part No
RESISTORS (Cont)					
R770	39k	CF		2	38632
R771	120k	CF			21820
R772	15k	CF			28727
R773	100	CF			21794
R774					
R775	33k	CF			21814
R776	1M8	CF			29549
R777	4k7	CF			21805
R778					
R779	120k	CF			21820
R780	2k2	CP	'Intensity' With S3		A4/41538
R781	220	CF			21796
R782	3k3	CF			21805
R783					
R784					
R785	27k	MF		2	38628
R786	180	CF			21795
R901	470k	CF			32330
R902	120	CF			28718
R903	82	CF			28717
R904	39k	MF	A.O.T.	2	38632
R905	47k	MF		2	38634
R906	8k2	CF			21808
R907	10k	CF			21809
R908	100k	CF			21819
R909	1k	CF			21799
R910	560	MO		2	26737
R911	1k	CF			21799
R912	47k	PCP			42172
R913					
R914					
R915					
R916	470k	PCP			36271
R917	180	CF			21795
R918					
R919					
R920	10	CF			21793
R921	22k	CF			21812
R922					
R923	20k	PCP			39235
R924	180k	CF	A.O.T.		21822
R925	180k	CF	A.O.T.		21822
R926	1k	CF			21799
R927	1M	CP	'Focus'		A4/41455
R928	1M8	MF			35752
R929	1M8	CP			29549
R930	470k	CF			32330

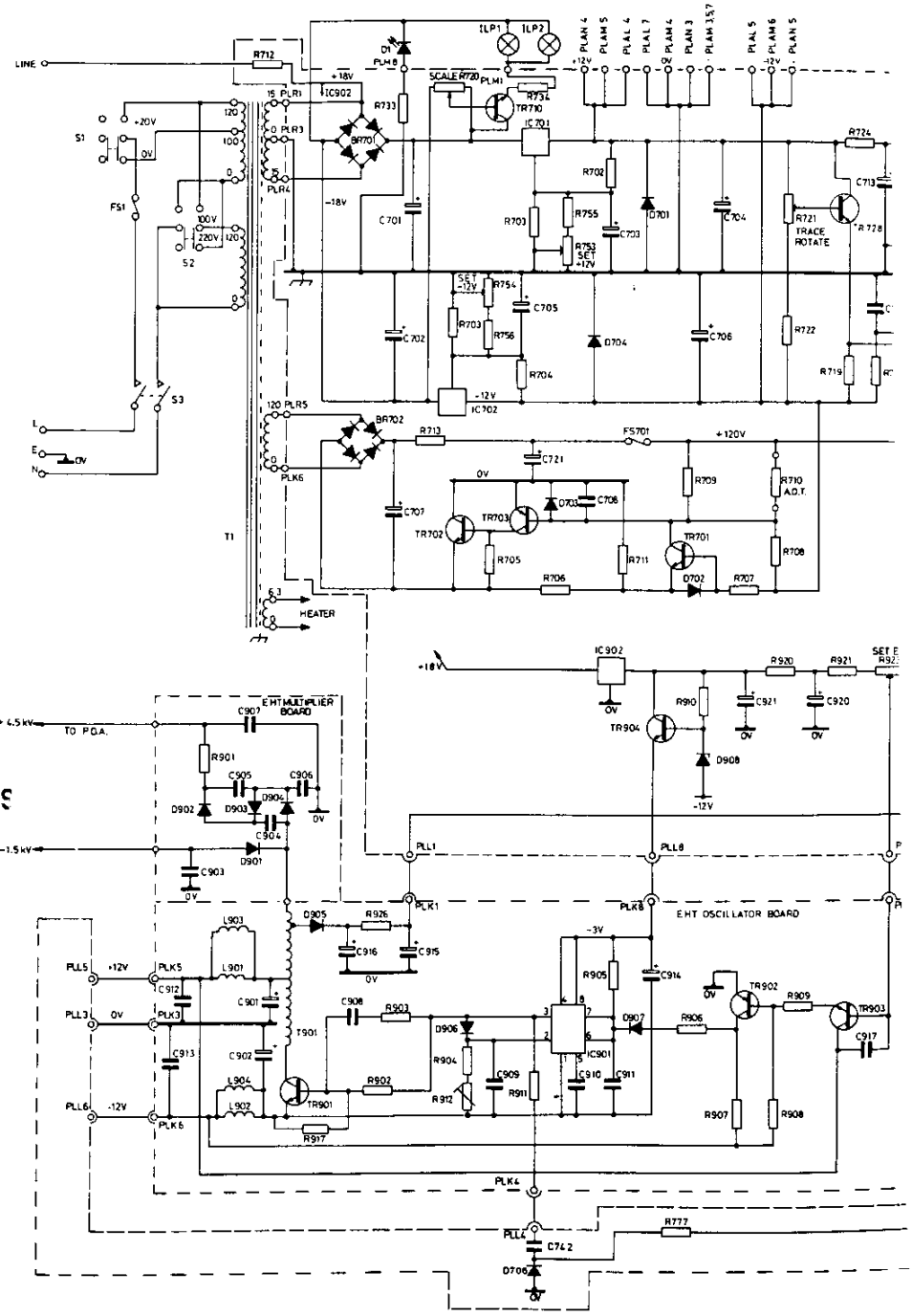
CAPACITORS					
C701	3300µF	E		40V	41615
C702	3300µF	E		40V	41615
C703	10µF	E		25V	32180
C704	33µF	E		16V	32173

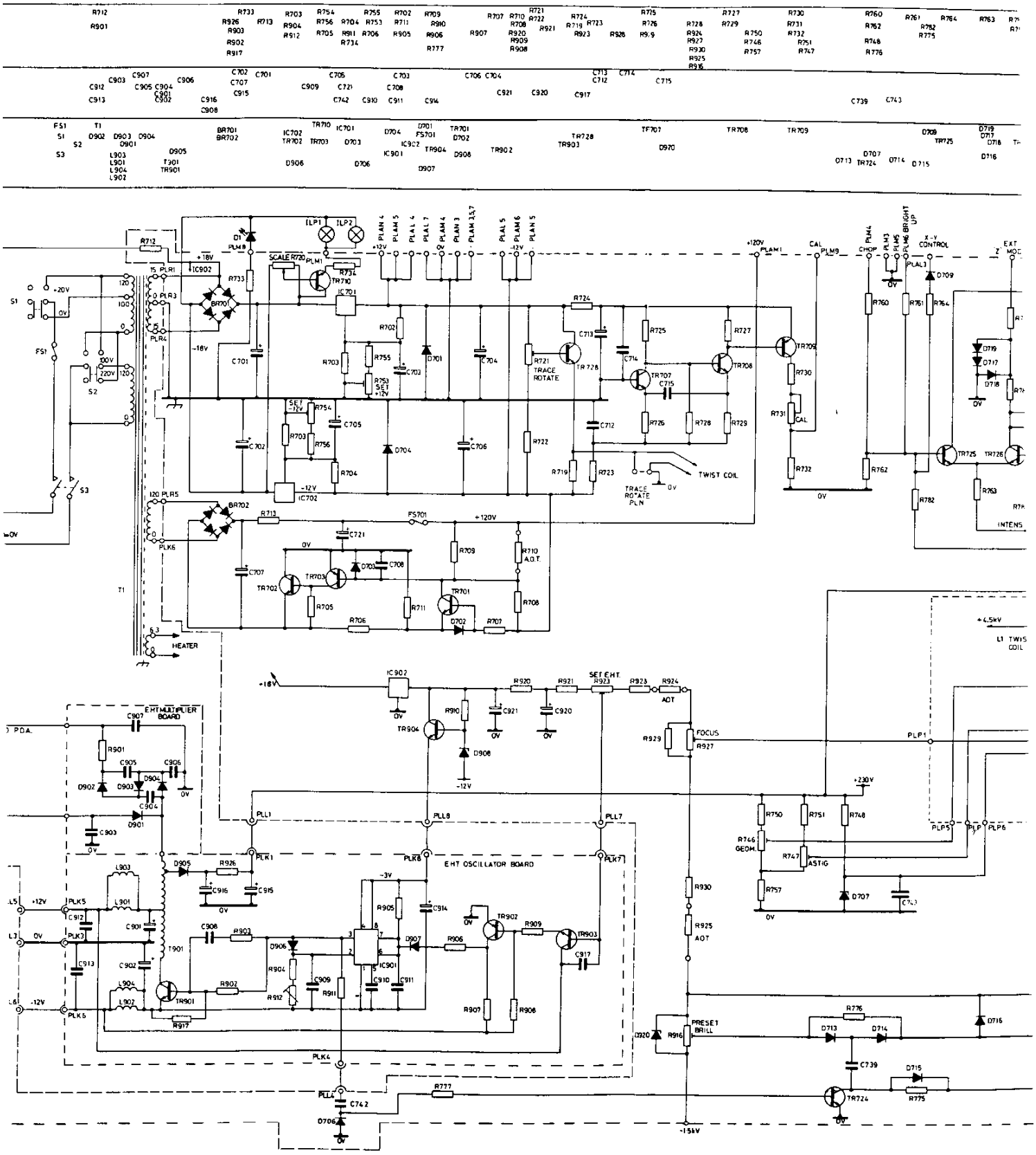
OS1200 POWER SUPPLY (Cont)

Ref	Value	Description	Tol %±	Part No
CAPACITORS (Cont)				
C705	220µF	E	16V	32176
C706	33µF	E	16V	32173
C707	100µF	E	250V	41614
C708	3300pF	CE(2)		22391
C712	.01µF	CE(2)	250V	22395
C713	220µF	E	16V	32176
C714	.01µF	CE(2)	250V	22395
C715	.33µF	CE(2)	250V	35603
C716	.01µF	CE(2)	2kV	32066
C721	100µF	E	250V	41614
C731	.01µF	CE(2)	250V	22395
C732	.01µF	CE(2)	250V	22395
C733	330pF	CE(2)		22381
C734				
C735				
C736				
C737	1µF	E	250V	39327
C738	.01µF	CE(2)	250V	22395
C739	.047µF	PE	1.5kV	36633
C740	.047µF	PE	1.5kV	36633
C741	.01µF	CE(2)	250V	22395
C742	.1µF	CE(2)	25V	36709
C901	150µF	E	16V	32175
C902	150µF	E	16V	32175
C903	.047µF	PE	1.5kV	36633
C904	3000pF	CE(2)	3kV	34381
C905	3000pF	CE(2)	3kV	34381
C906	3000pF	CE(2)	3kV	34381
C907	500pF	CE(2)	10kV	31239
C908	.1µF	CE(2)	25V	36709
C909	1500pF	PS		35919
C910	.01µF	CE(2)	250V	22395
C911	270pF	CE(2)		22380
C912	.1µF	CE(2)	25V	36709
C913	.1µF	CE(2)	25V	36709
C914	10µF	E	25V	32180
C915	1µF	E	250V	39327
C916	1µF	E	250V	39327
C917	1000pF	CE(2)	500V	22387
C918				
C919				
C920	220µF	E	16V	32176
C921	10µF	CE(2)	25V	32180
TRANSISTORS				
TR701		2N2369		23307
TR702		2N5296		28630
TR703		BC212		29327
TR707		2N3904		24146
TR708		2N3904		24146

Ref	Value	Description	Tol %±	Part No
TRANSISTORS (Cont)				
TR709		2N3906		21533
TR710		BFY51		29329
TR721		BC212		29327
TR722		BC449		40129
TR723		BC450		40128
TR724		2N5381		20388
TR725		2N2369		23307
TR726		2N2369		23307
TR901		MJE3055		28770
TR902		BC212		29327
TR903		2N2369		23307
TR904		BFY51		29329
DIODES				
D701		IN4003		23462
D702		IN4148		23802
D703		IN4148		23802
D704		IN4003		23462
D705				
D706		IN4148		23802
D707	100V	ZENER		37557
D708				
D709		IN4148		23802
D710		IN4148		23802
D711		IN4148		23802
D712				
D713		IS923		3560
D714		IS923		3560
D715		IS923		3560
D716		IS923		3560
D717		IN4148		23802
D718		IN4148		23802
D719		IN4148		23802
D901		HS2–4		39325
D902		HS2–4		39325
D903		HS2–4		39325
D904		HS2–4		39325
D905		IN4937		43306
D906		IN4148		23802
D907		IN4148		23802
D908	9V1	ZENER		33934
INTEGRATED CIRCUITS				
IC701		LM317		40731
IC702		MC7908CT		37561
IC901		NE555		36813
IC902		MC78L12CP		40714
MISCELLANEOUS				
BR701		WO2		19725
BR702		WO4		29367






EHT MULTIPLIER BOARD
EHT OSCILLATOR BOARD
HEATER
TRACE ROTATE
TWIST COIL
FOCUS
SET EHT.
AOT
PRESET BRILL
GEOM.
ASTIG
CHOP
BRIGHT UP
X-Y CONTROL
INTENS
+4.5kV
-15kV
+230V
+120V
+12V
-12V
-3V
+18V
-18V
0V

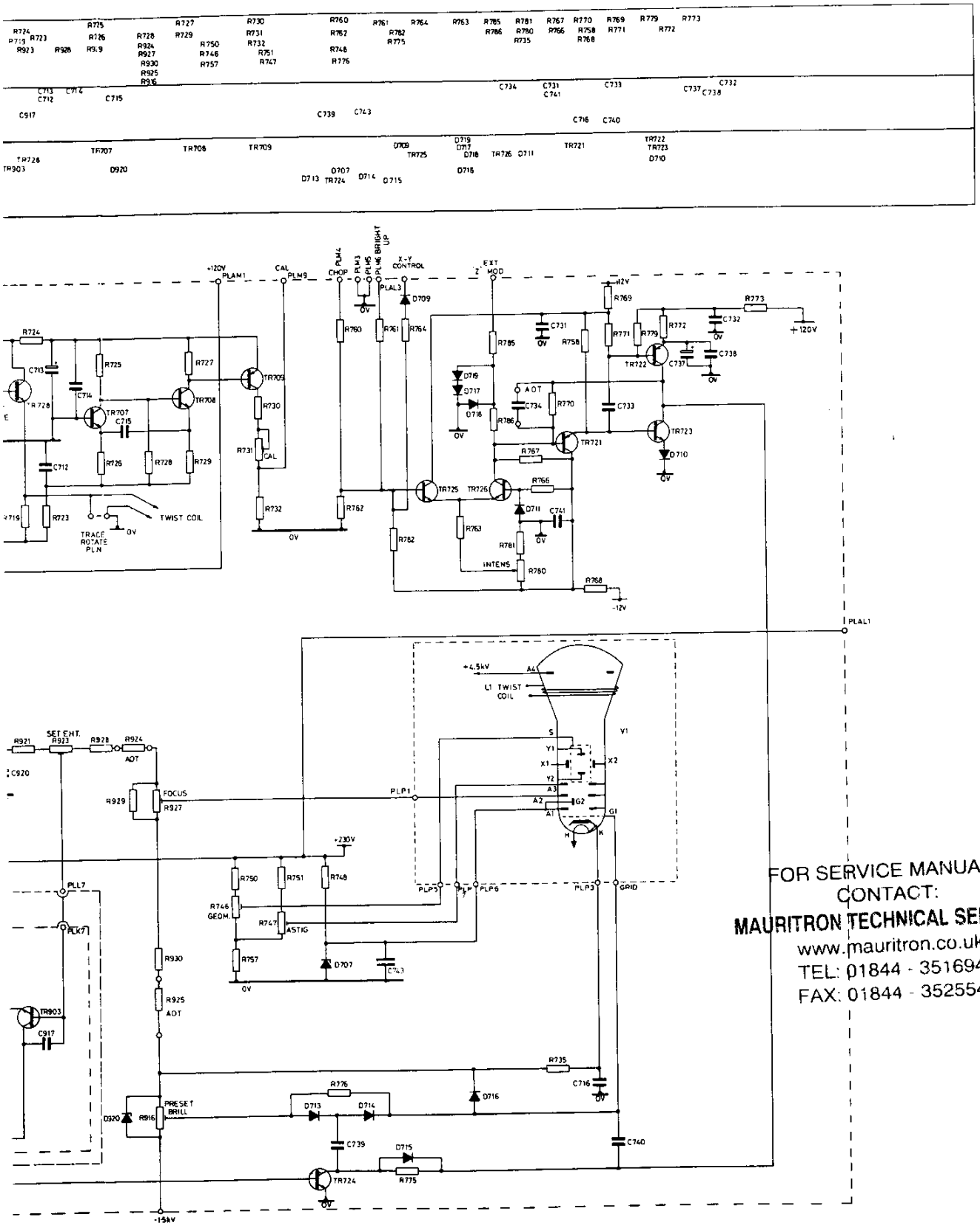
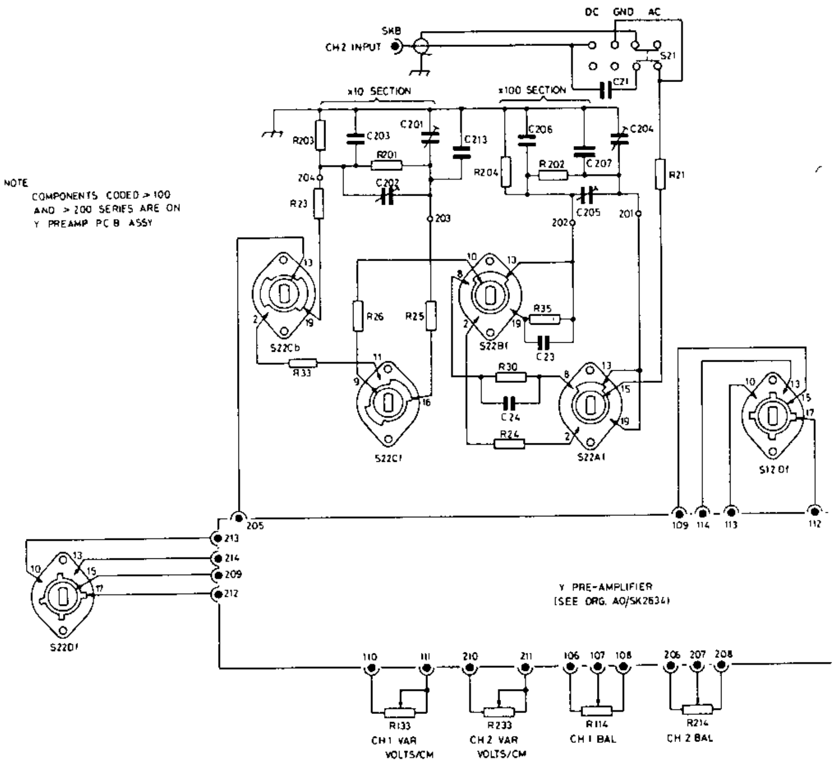


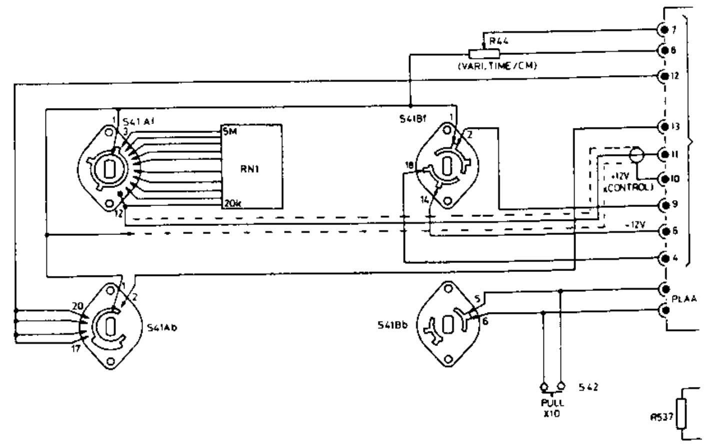
Fig. 5 Power Supply & E.H.T. Generator Circuit

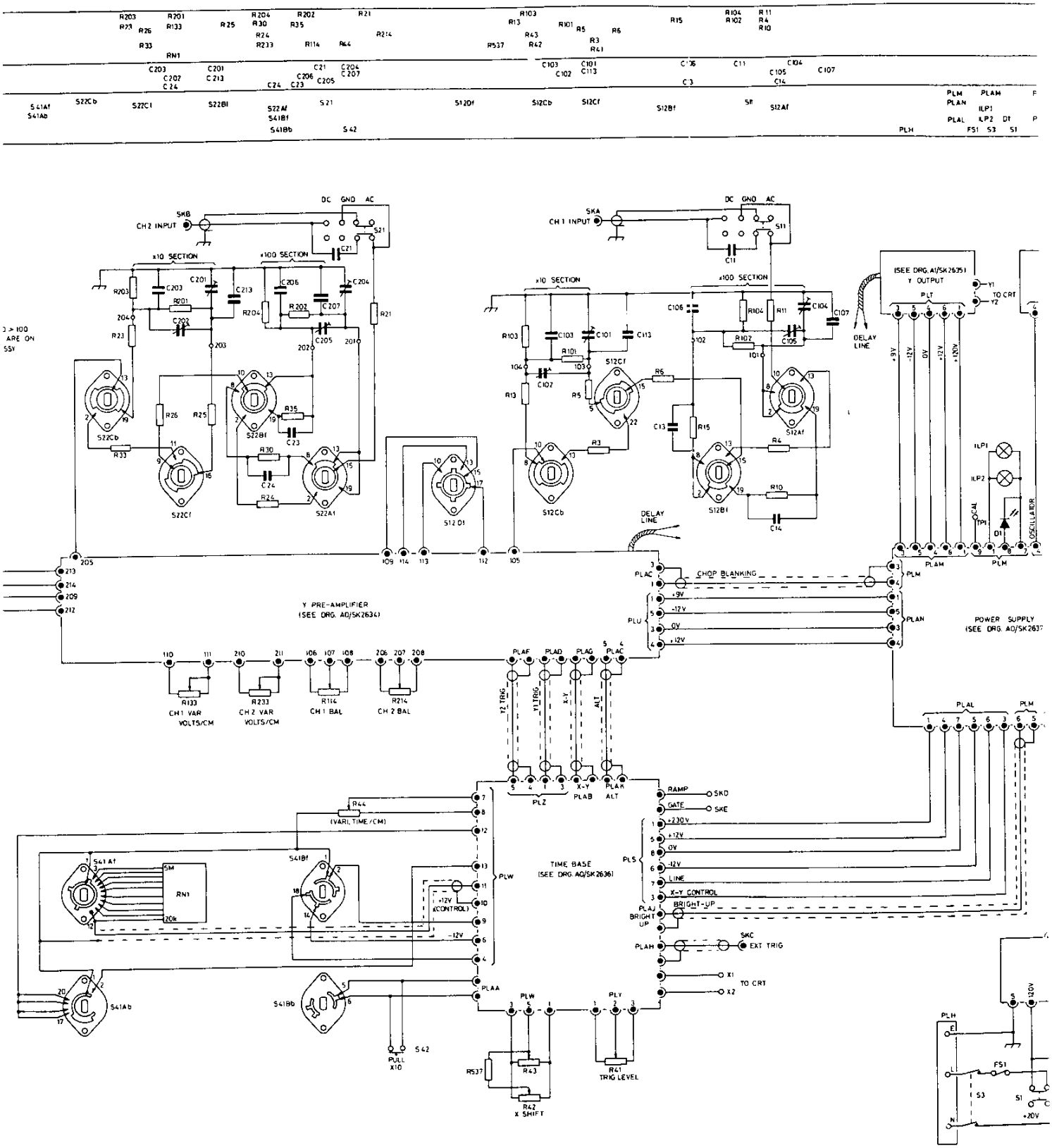
OS1200 TIMEBASE (Cont)

Ref	Value	Description	Tol % ±	Part No
MISCELLANEOUS (Cont)				
PLV				37878
PLW				39387
PLY				54181
PLZ				41610
PLAA				41391
PLAB				42499
PLAE				37878
PLAH				41391
PLAJ				41391
PLAK				41391

RESIS	R203 R23 R26 R33 R201 R133 RN1 R25 R204 R30 R24 R233 R202 R35 R114 R44 R21 R214
CAP	C203 C202 C24 C201 C213 C206 C24 C23 C21 C205 C204 C207
MISC	S22Df S41Af S41Ab S22Cb S22Cf S22Bf S22Af S41Bf S41Bb S21 S42 S12Df






SKB
CH 2 INPUT
DC GND AC
S21
C21
x10 SECTION
x100 SECTION
C201
C213
C206
C204
C207
R203
R201
R204
R202
R21
C203
C205
R23
R26
R25
R35
R33
R30
C23
C24
R24
S22Cb
S22Bf
S22Af
S22C1
S22A1
SKA
CH 1 INPUT
S11
C11
C106
C104
C107
R104
R11
R103
C103
C101
C113
R101
C102
R5
R6
R13
R3
R15
R4
R10
C14
R102
C105
S12Cf
S12Af
S12Bf
S12Cb
S12D1
DELAY LINE
(SEE DRG. A1/SK2635)
Y OUTPUT
PLT
Y1
Y2
TO CRT
+9V
-12V
0V
+12V
+120V
ILP1
ILP2
CAL
TPI
D1
OSCILLATOR
PLAM
PLM
205
213
214
209
212
109
114
113
112
105
Y PRE-AMPLIFIER
(SEE DRG. A0/SK2634)
CHOP BLANKING
PLAC
PLU
PLAN
POWER SUPPLY
(SEE DRG. A0/SK2637)
110
111
210
211
106
107
108
206
207
208
R133
CH 1 VAR VOLTS/CM
R233
CH 2 VAR VOLTS/CM
R114
CH 1 BAL
R214
CH 2 BAL
PLAF
PLAD
PLAG
PLAC
PLZ
X-Y
PLAB
ALT
PLAK
PLAL
PLM
RAMP
SKD
GATE
SKE
+230V
+12V
0V
-12V
LINE
X-Y CONTROL
BRIGHT-UP
PLAJ
PLS
SKC
EXT TRIG
X1
X2
TO CRT
R44
(VARI. TIME/CM)
S41Af
S41Bf
S41Ab
S41Bb
RN1
5M
20k
+12V (CONTROL)
-12V
PLW
PLAA
TIME BASE
(SEE DRG. A0/SK2636)
PLY
PULL X10
S42
R537
R43
R42
X SHIFT
R41
TRIG LEVEL
PLH
E
L
N
FS1
S3
S1
+20V

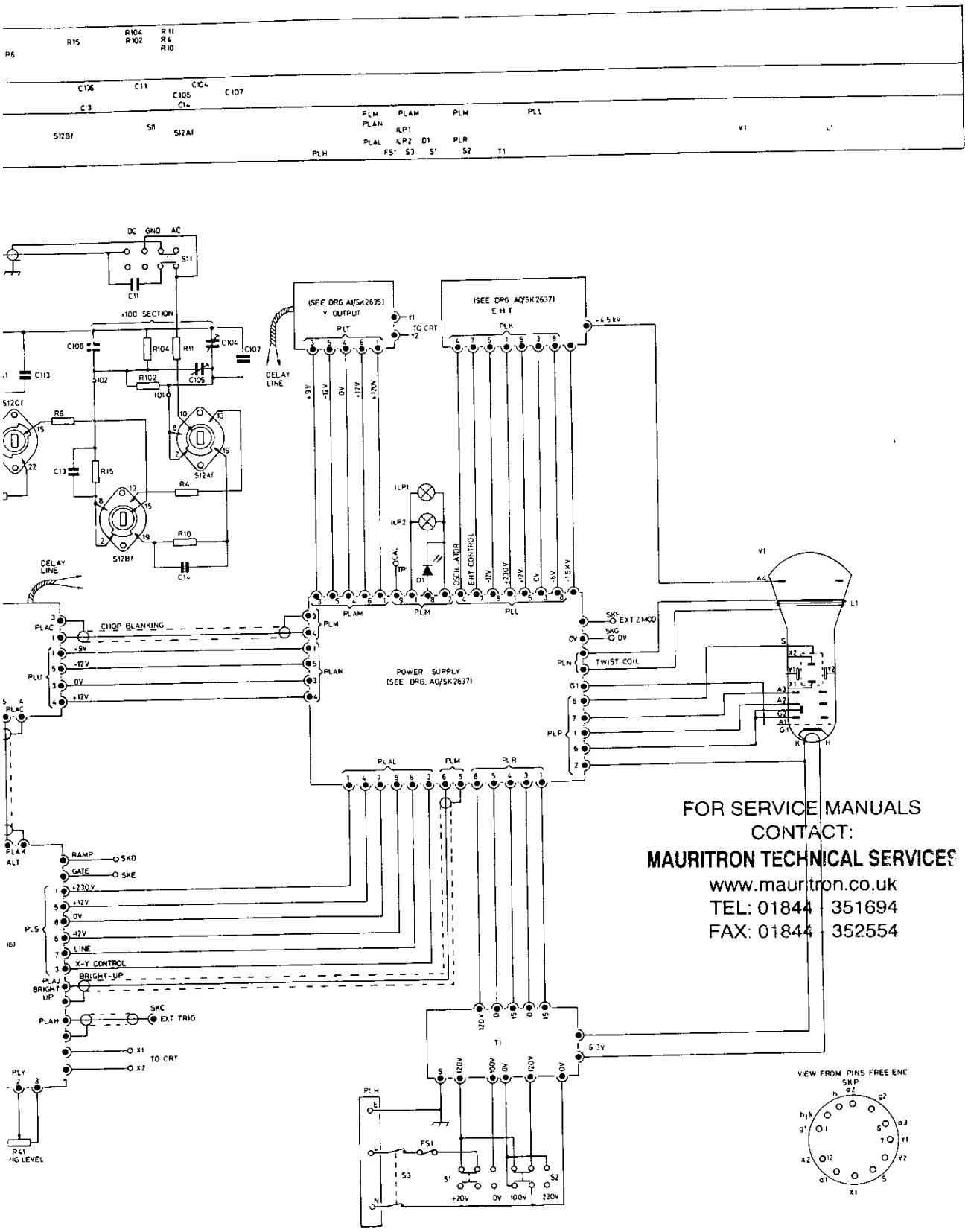


Fig. 6 Interconnections Diagram

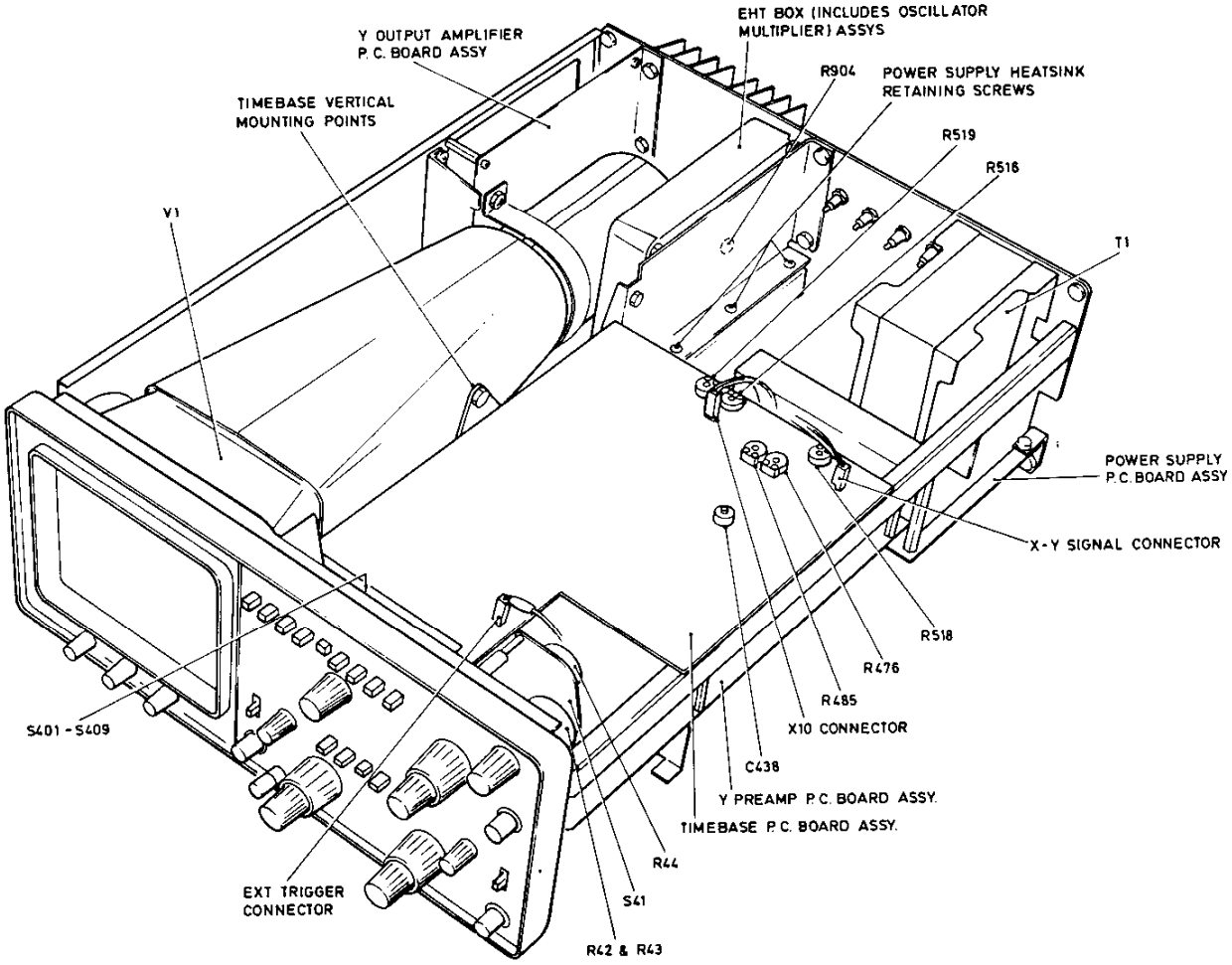


Fig. 7 Internal View (Timebase)

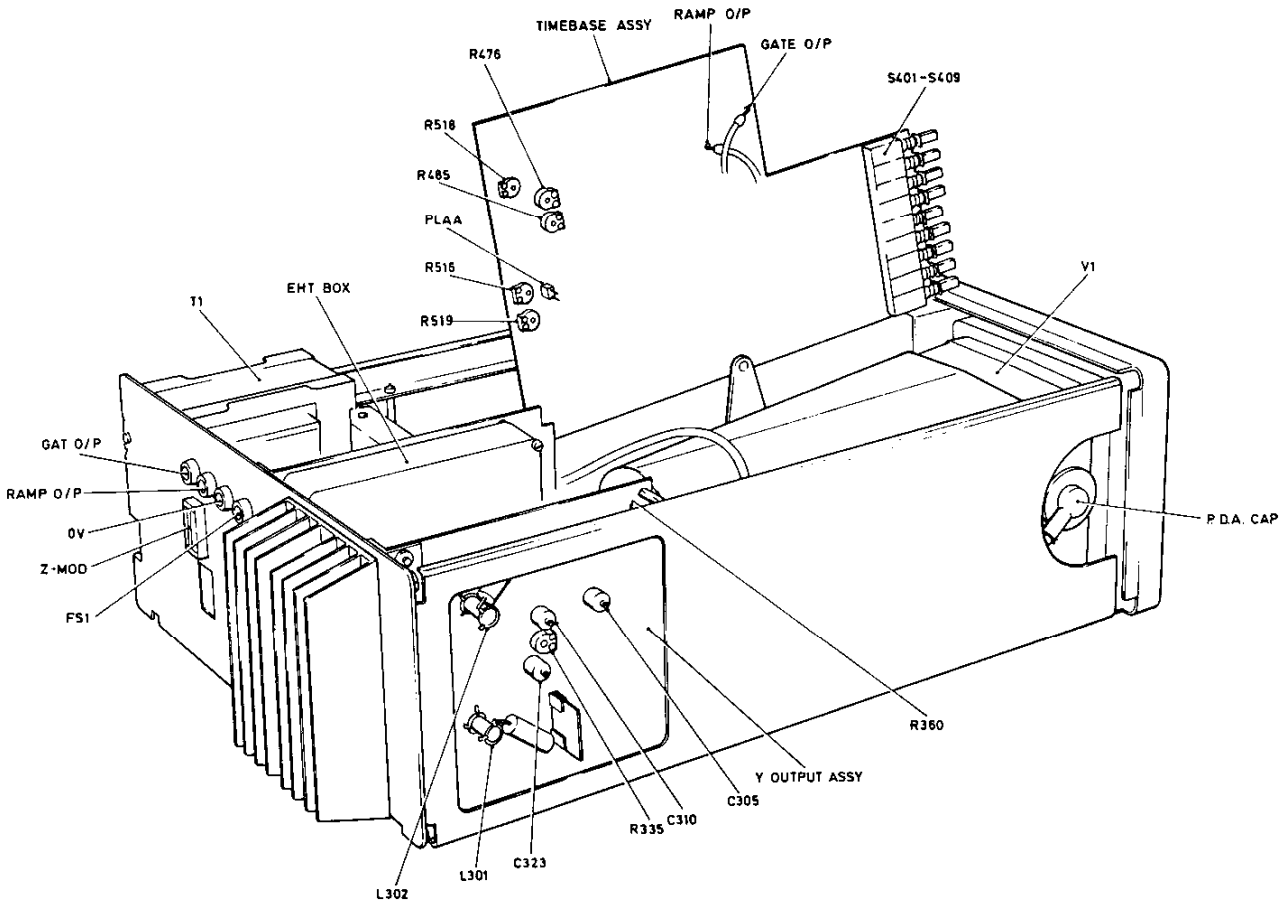


Fig. 8 Internal View (Y Output Amp & Timebase mounted for maintenance)

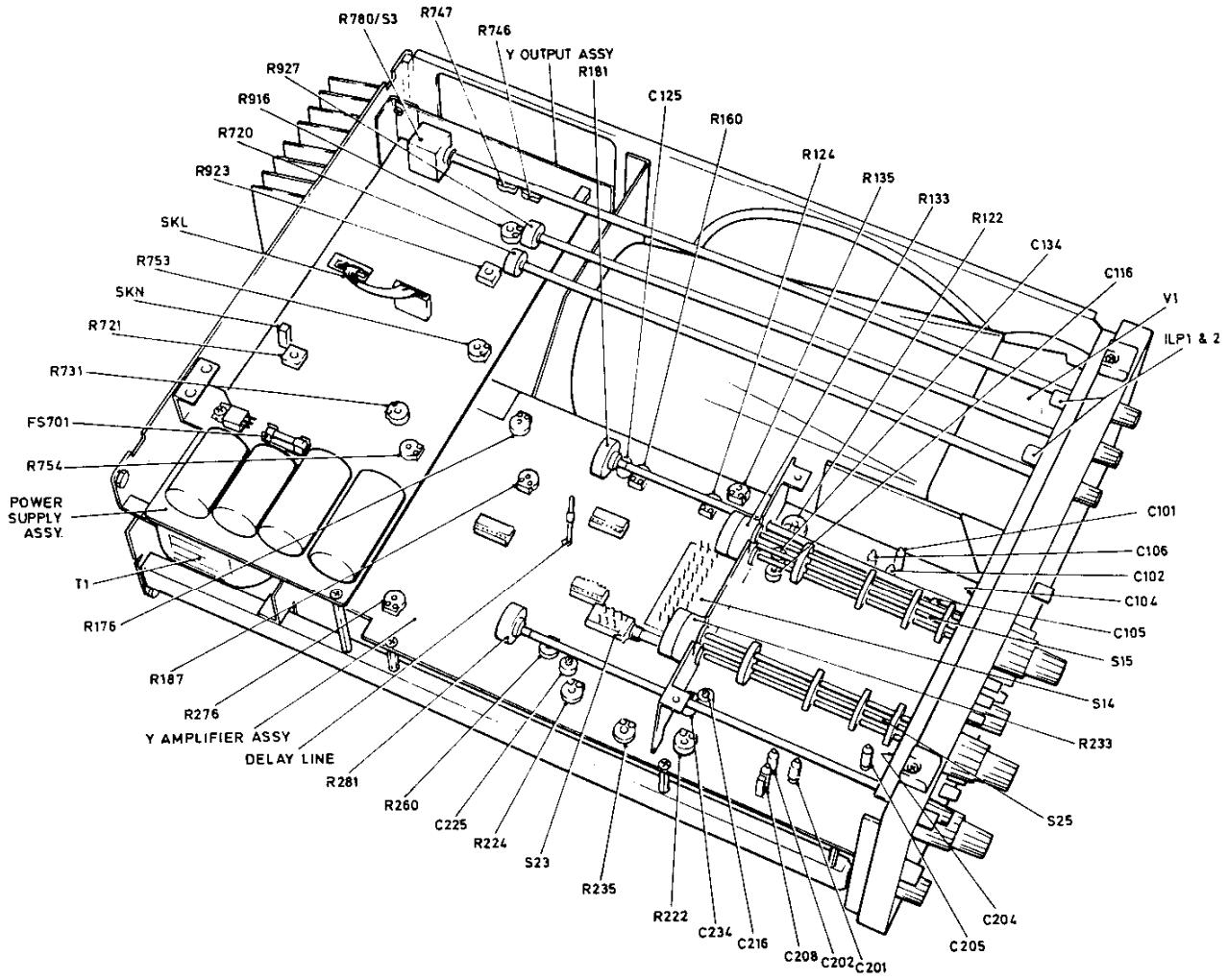


Fig. 9 Internal View (Y Preamp & Power Supply)

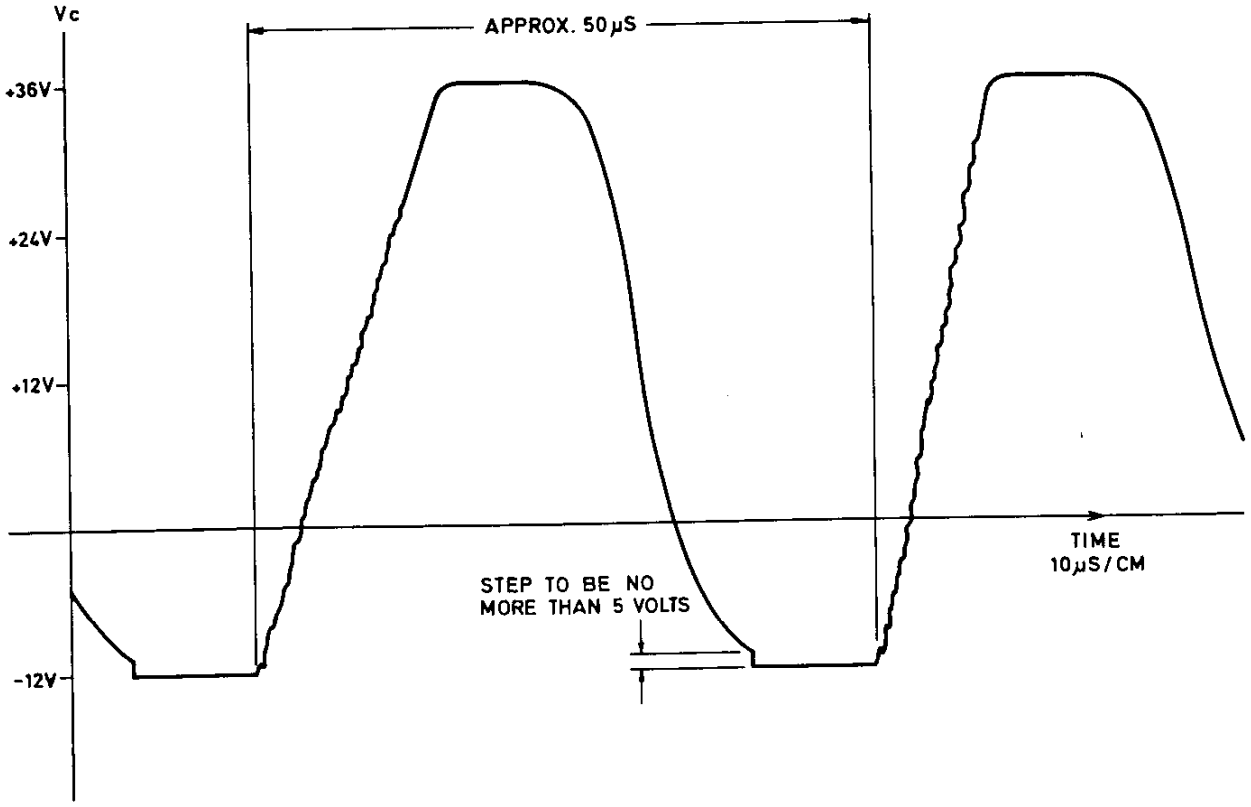
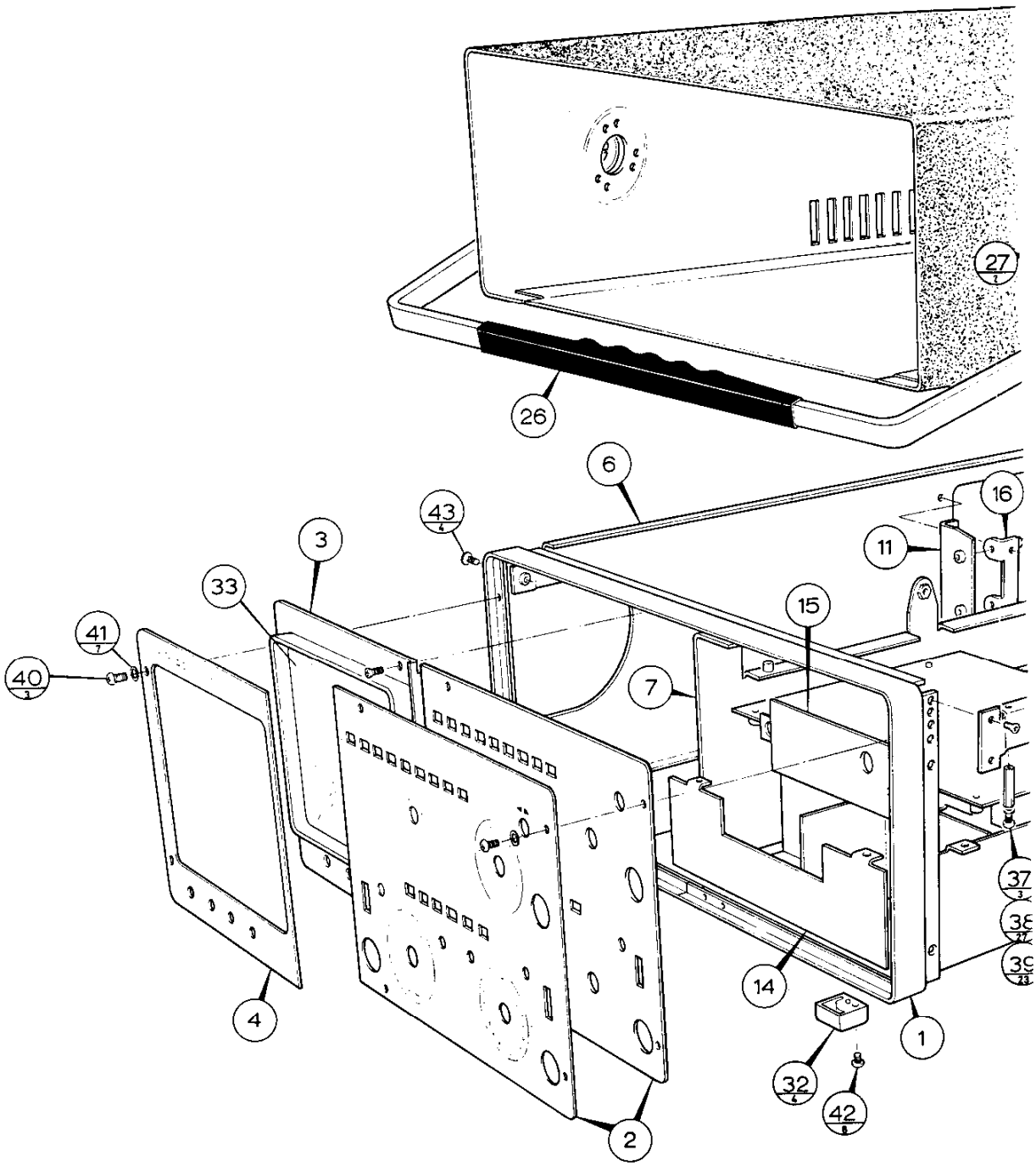


Fig. 10 Waveform on Collector of TR901 for E.H.T. oscillator adjustment.

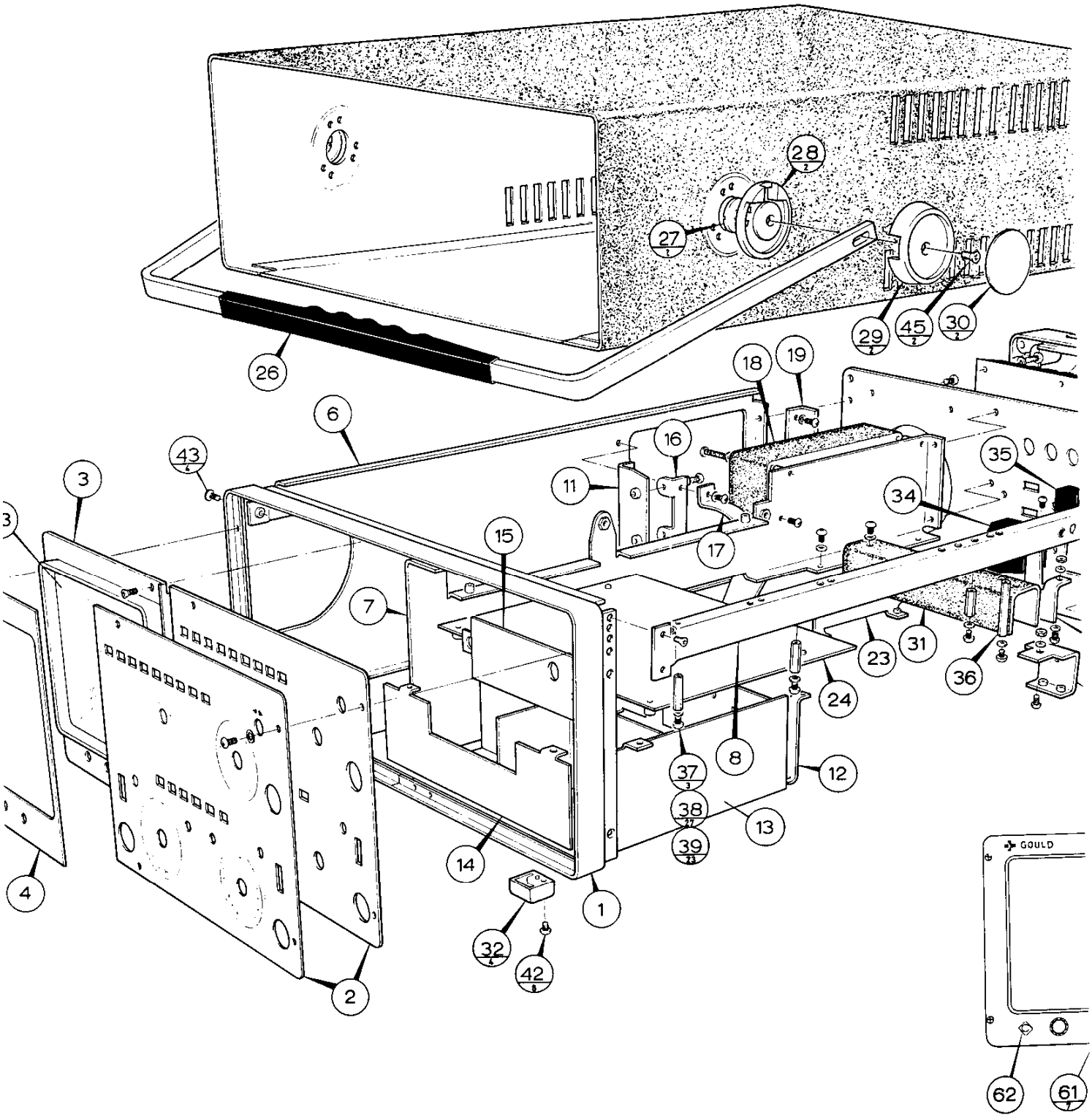
OS1200 MECHANICAL PARTS LIST

Item No.	Part No.	Description	Qty.
1	42053	Frame	1
2	43059	Front Panel Coverlay	1
3	38399	Escutcheon	1
4	43041	Escutcheon Coverlay	1
5	41654	Panel Rear	1
6	41676	Side Plate	1
7	41653	Centre Plate	1
8	41765	Side Support	1
9	41652	Heatsink	1
10	41680	Rear Cover	1
11	41661	C.R.T. Support	1
12	41883	Pot. Mounting Bracket	1
13	42096	Screen Atten.	1
14	41670	Atten. Panel	1
15	41657	Timebase Panel	1
16	42488	C.R.T. Support	1
17	41663	C.R.T. Clamp	1
18	42901	E.H.T. Housing	1
19	41660	Heatsink – 'Y' Output	1
20	41655	Support Transformer	1
21	42057	Heatsink –Power	1
22	41382	Transformer Clamp	2
23	41658	Heatsink – Power	1
24	41656	Screen X and Y	1
25	41763	Cover	1
26	41693	Handle Assy.	1
27	42190	Spindle – Handle	2
28	42189	Handle Base Moulding	2
29	42191	Handle Cover Mounting	2
30	36681	Button Handle	2
31	42201	Delay Line Cover	1
32	36329	Foot – Moulded	4
33	42112 OR 42510	Filter Blue Pt.No. 42112 OR Amber Pt.No. 42510	1 OR 1
34	33787	Plug Supply	1
35	40068	Fuse Holder	1
36	41667	Spacer	1
37	416666	Spacer	3
38	33015	M2.5 Wavey Washer	27
39	33032	Screw M2.5 x 6 Pan Hd.	23
40	33033	Screw M2.5 x 8 Pan Hd.	3
41	33002	M2.5 Plain Washer	7
42	33038	Screw M3 x 8 Pan Hd.	8
43	33068	Screw M3 x 6 C'sk Hd.	4
44	33044	Screw M4 x 8 Pan Hd.	4
45	33077	Screw M4 x 12 C'sk Hd.	2
50	38408	Bezel Pushbutton	15
51	38407	Knob Pushbutton	15
52	40408	Knob 10 x 4 R2–324	4
53	37614	Slider Switch	2
54	40410	Knob 21 x 1/4 R4–454	3
55	40922	Knob 15 x 1/8 R2–324	3
56	40927	Cap W1–303	3
57	41679	Bush 4mm	4
58	40833	Earth Terminal	1
59	1222	B.N.C. Socket	3
60	40580	Knob 10 x 1/8 R2–224	3
61	40411	Cap 10 W1 208	7
62	39884	L.E.D.	1
63	24159	Terminal Lead Thro'	1



FOR SERVICE MANUALS
CONTACT:

MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554


28
27
26
29
45
30
18
19
6
16
43
35
3
11
34
15
17
7
23
31
36
24
37
8
12
38
13
39
14
1
32
42
2
4
GOULD
62
61

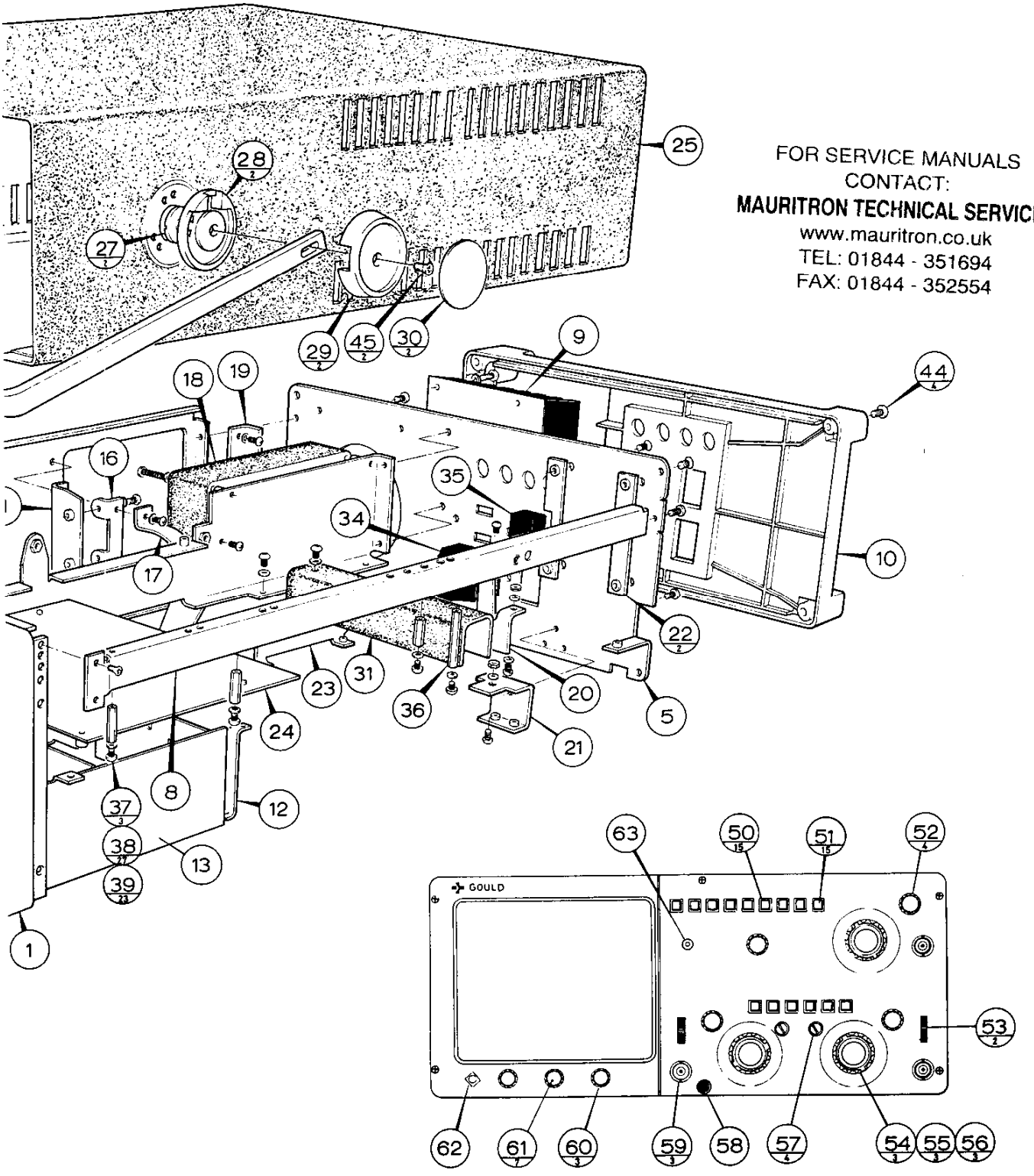


Fig. 11 Mechanical Views

Guarantee and Service Facilities

Section 7

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 and ensure that any 13 Amp mains plugs fitted are removed. To prevent possible transit damage, we regret that mains plugs cannot be returned.

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

Tel: 01-500 1000
Telex: 263785
Telegrams: Attenuate Ilford

WL 300 3 80

Manual Part Number 42475