TELEQUIPMENT®

DANGER

It is not possible to screen all high voltages, so care should be taken not to touch high voltage tags. Also where possible the instrument should be unplugged AND switched off during servicing. A BLEEDER PATH FOR THE EHT IS NOT PROVIDED, so after switching off and before touching any internal parts, the EHT should be discharged by temporarily shorting the appropriate points to chassis, (for instance the CRT cathode pin and PDA connector where applicable).

FOR SERVICING AND SPARES ENQUIRIES
SEE THE INFORMATION AT START OF SECTION 5.

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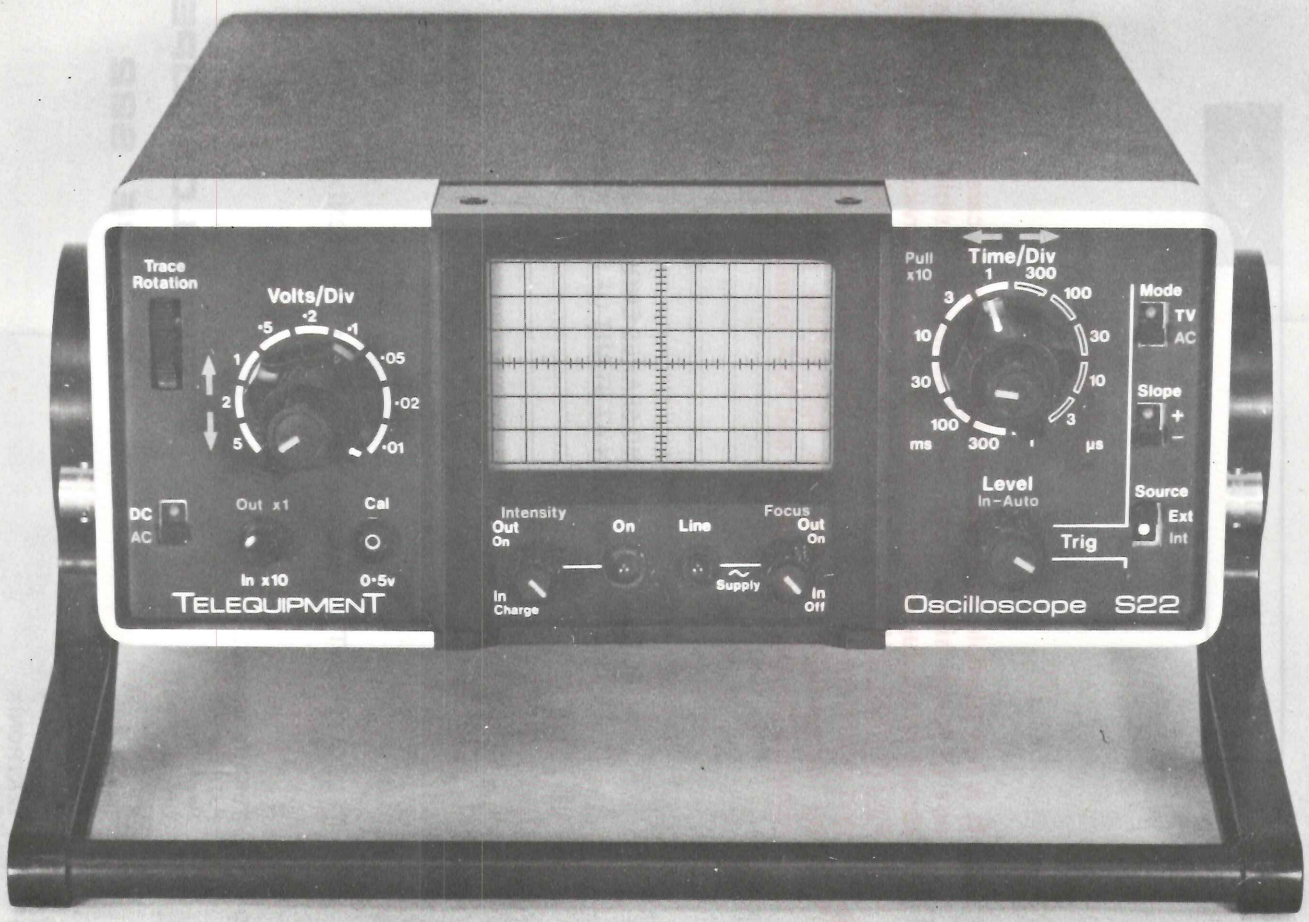
OSCILLOSCOPE
TYPE S22

INSTRUCTION MANUAL

Issue 2 (429247)
July 1977

070-2027-00

Printed in England by D & H NEWMAN LTD, 29 Harcourt Street, London W1. 01-262-6356


Trace Rotation
Volts/Div
·5
·2
·1
1
2
5
·05
·02
·01
DC
AC
Out x1
Cal
In x10
0·5v
TELEQUIPMENT
Intensity
Out
On
On
Line
Focus
Out
On
In
Charge
Supply
In
Off
Pull x10
Time/Div
1
300
3
100
10
30
30
10
100
3
300
ms
µs
Level
In-Auto
Trig
Mode
TV
AC
Slope
+
−
Source
Ext
Int
Oscilloscope S22

INTRODUCTION

The S22 is a single trace portable 'scope' operating either from internal batteries or an external a.c. supply. It incorporates a built-in battery charger and is intended for general servicing and field use.

WARNING

THE ATTENTION OF A USER IS DRAWN TO THE FOLLOWING IMPORTANT POINTS.

1. (a) The instrument should be switched off by pushing the intensity control in until it clicks off. The constant current battery charger will still be on until the focus control is pushed in.

   (b) The battery charger should be switched off by pushing the focus control until it clicks off. This operation also switches the AC supply off.

2. The instrument should have the batteries fitted at all times because additional to being a supply source the batteries act as high value capacitors when operating from an AC supply.

3. Before fault finding or servicing is carried out on this instrument, careful attention should be paid to the notes at the start of section 4.

NOTICE TO OWNER

To obviate the risk of damage during transit and facilitate packaging, the owner is requested to remove the power supply plug and NOT send the following items unless they are suspect, should this instrument be returned to TEKTRONIX for servicing:-

Manual

Probe

Power Supply Lead

Plug Assemblies

CONTENTS

SECTION 1

SPECIFICATION

1.1 CATHODE RAY TUBE (CRT)

Rectangular flat faced C.R.T.

Display Area	10 x 6 divisions (each division = 0.6 cm).
Phosphor	P31.
Overall accelerating potential	1.2 kV approximately (varies with battery voltage).

1.2 VERTICAL AMPLIFIER

1.2.1 BANDWIDTH (-3db)

X1 gain	
DC	DC - 5 MHz.
AC	2 Hz - 5 MHz.
X10 gain	
DC	DC - 1 MHz.
AC	2 Hz - 1 MHz.

1.2.2 VERTICAL DEFLECTION

Calibrated Ranges (X1)	10 mV/div - 5 V/div	) 9 Ranges in)
(X10)	1 mV/div - 500 mV/div	) 1-2-5 sequence.
Accuracy	±5%.	
Input impedance	1 MΩ in parallel with 45 pF approximately.	
Max. Input Voltage	±250 V peak.	

1.3 HORIZONTAL DEFLECTION

Sweep Rates X1	300 ms/div - 1μs/div ±5%	) 12 ranges in) 1-3-10
X10	30 ms/div - 100 ns/div ±10%	) sequence.

1.4 TRIGGER

AC	
Level	Fully variable over 6 divisions on all waveforms.
Auto	Bright line in absence of trigger signal and automatic triggering on symmetrical waveforms over 1 div. with restricted level control.
TV	Triggering on TV field pulses for sweep ranges 0.3 sec/div to 0.1 ms/div and TV line pulses for 30 μs/div to 1 μs/div.
Source	Internal or external. Both positive or negative for ac and TV.
Sensitivity	
Internal	
40 Hz - 2 MHz	0.3 div.
2 MHz - 5 MHz	1 div.
External	
40 Hz - 5 MHz	500 mV approximately.

1.5 CAL OUTPUT SOCKET

Output Voltage	500 mV ±1%.
Output Impedance	1 kΩ approximately
Wave Shape	Vertical edge at about screen centre - positive with respect to earth.

1.6 POWER REQUIREMENTS

Internal rechargeable battery	
Voltage	6 x 1.25 V ('D' CELLS)
Battery life	4 hours approximately with continuous use. Built in charger allows the batteries to be charged in 14 hours with the instrument switched off or trickle charges the batteries if the instrument is switched on.
Mains	
Voltage	100 - 112 V
	112 - 125 V
	200 - 224 V
	225 - 250 V
Frequency	50 - 400 Hz
Consumption	14 VA

1.7 SIZE

Height	77 mm
Width	200 mm
Depth	263 mm

1.8 WEIGHT

4.3 kg

1.9 TEMPERATURE RANGE (AMBIENT)

Operational	0° to 35° C
Storage	−10°C to 40°C

1 .10 ACCESSORIES AVAILABLE AS EXTRAS

ACCESSORY	PART NUMBER (For Ordering)
Calibration Lead	012-0572-00
Carrying Case (attache style)	016-0373-00
Carrying Case (shoulder strap)	016-0372-00
External battery adaptor	119-0766-00
Probe type TP1 (X1 attenuator)	010-0274-00
Probe type TP2 (X10 attenuator)	
Approx. 1.4 metres cable	010-0270-00
Approx. 2.0 metres cable	010-0270-02
Approx. 3.0 metres cable	010-0270-03
Probe type TP5 (X1 - X10 attenuator)	010-0279-00

SECTION 2

OPERATING INSTRUCTIONS

2.1 PRE-OPERATIONAL CHECK

Although this instrument is robust and is subjected to stringent checks before leaving our factory, it should be checked externally for possible damage. In the case of damage contact the carriers and your local Tektronix field office immediately.
Remove the front protection cover by gently pulling off.
Before switching the instrument on it is recommended that this section is read right through. Some time should be spent in becoming familiar with the controls although experienced oscilloscope users may find the instructions in paragraph 2.6.2 rather laborious.
The S22 relies on convection cooling and care should be taken to see that external air circulation is not restricted.

2.2 BATTERY OPERATION

The batteries fitted in this instrument have been charged before despatch. If a considerable time has elapsed between despatch and putting the batteries into use, a self discharge process may result in the batteries either being discharged or in a low state of charge. A battery test facility is provided on the rear socket to allow a check to be made. Using a voltmeter of 20 kΩ/volt connected between + and - a reading of not less than 7.0 V should be obtained. If the reading is under 7.0 V the batteries should be charged as shown below. Operation on batteries is the same as for mains operation (see paragraph 2.6).

2.3 MAINS OPERATION

2.3.1 GENERAL

The mains cable should be plugged into the back of the instrument. Where a standard mains lead is supplied it will be necessary to fit a plug to suit the available supply. The mains cable connections are as follows.

Brown . . . . . Live
Blue . . . . . Neutral
Green/Yellow . . . . . Earth

Two voltage selector switches are provided. The LINE switch is located on the underside of the instrument and a RANGE switch is on the real panel. These switches should be set to the available mains supply according to the table below. If the selector switches have to be moved it may be necessary to change the instrument fuse using the alternative one provided. The correct fuse to be fitted is shown in the table. The fuse is located inside the instrument so it is necessary to remove the case as per paragraph 4.2.1. The mains fuse is situated on the charger transformer printed circuit board.

A.C.LINE VOLTS	LINE	RANGE	INSTRUMENT FUSE
100 – 112	112	LO	500 mA
113 – 125	112	HI	500 mA
200 – 224	225	LO	250 mA
225 – 250	225	HI	250 mA

Having carefully checked the fuse rating and voltage selector switch positions the instrument can be plugged into the mains supply. Pull out the FOCUS knob to switch on the supply. The line indicator should be illuminated. With the instrument switched off, the charger will provide a full charge to the batteries but when the instrument is switched on, (by pulling out the INTENSITY knob) this becomes a trickle charge, to keep the battery voltage topped up.

2.3.2 BATTERY CHARGING

Before carrying out the charge procedure the instructions for mains operation should be followed.
Upon pulling out the FOCUS knob the indicator on the front panel should light.
The instrument should be off. This can be checked by seeing that the INTENSITY control is pushed in and that the ON indicator is not illuminated. After 14 hours the batteries should be charged from a fully discharged condition.

2.3.3 OPERATION FROM AN EXTERNAL DC SUPPLY

The rear socket allows the instrument to be operated from an external dc supply of 11 V. The current consumption is of the order of 1A. If a different voltage operation is required then an external battery adaptor (part number 010-0182-00) will allow operation from 12 - 30 volts. This adaptor is available as an accessory.

2.4 OPERATION OF CONTROLS

2.4.1 CRT

INTENSITY	varies the display intensity. An "instrument ON/OFF switch" is fitted to this control.
FOCUS	controls the display definition. A "mains ON/OFF switch" is fitted to this control.
TRACE ROTATION	This control allows the trace to be aligned with the horizontal graticule lines.

2.4.2 VERTICAL

VOLTS/DIVISION	provides attenuation of the input signal in 9 calibrated steps.
X1 - X10	The vertical deflection is magnified by the factor selected (i.e. 1 or 10 times).
Y POSITION ↑ ↓	marked with a double headed vertical arrow. Moves the trace in a Y or vertical axis.
AC/DC	This selects the input coupling. In the AC position a capacitor is in series with the input, whilst in the DC position the signal is coupled directly to the attenuator.

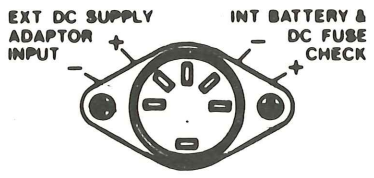
2.4.3 HORIZONTAL

TIME/DIV	Selects the sweep speed having 12 calibrated steps in the range 300 ms/division to 1.0 µs/division.
X10	When the X10 switch is pulled out the sweep speeds are magnified by a factor of 10 and therefore the sweep range becomes 30 ms/division to 100 ns/division.
X POSITION ← →	The X POSITION control uses the same knob as the speed magnifier. When it is rotated it moves the trace in an X or horizontal axis.

TRIG MODE	Triggering operates in an AC or TV mode. When TV is selected, triggering is from a TV frame pulse at sweep speeds of 0.3s/division to 0.1 ms and from a TV line pulse at sweep speeds of 30μs/division to 1 μs/division.
TRIG SOURCE	In the INT position triggering is from the input signal whilst the EXT position allows triggering from an external source connected to the EXT TRIG socket.
TRIG SLOPE	This switch allows triggering on a positive or negative slope of an input waveform.
TRIG LEVEL	The level control selects the voltage level of the input waveform at which the sweep starts. With the knob pushed in, the AUTO position is selected. Auto will start sweep at approximately zero volts of a symmetrical waveform. In the absence of an adequate trigger signal the sweep generator free runs providing a reference trace.

2.5 INPUT AND OUTPUT SOCKETS

INPUT	This socket feeds the input signal to the vertical amplifier.
EXT TRIG	This socket feeds an external signal to the trigger circuit and is used in connection with the trig SOURCE switch.
CAL	A waveform of 0.5 V amplitude is provided at this socket to allow for the checking of the calibration of the vertical amplifier. The CAL waveform can be used to set up a X10 probe connected to the INPUT. With the VOLTS/DIV switch set to 0.1 V and the TIME/DIV switch set to 1ms/DIV, the probe tip should be connected to the CAL. socket. The probe trimmer should be adjusted for the best obtainable square corner.
BATT CHECK AND EXTERNAL DC SUPPLY SOCKET (DIN)	This 5 pin DIN socket has a dual function. Two connections are used to enable the state of charge of the internal batteries to be determined. Two other connections are used to enable the instrument to be operated from an external DC supply via an external battery adaptor (part number 020-0182-00).



SOCKET VIEWED FROM REAR OF INSTRUMENT

2.6 FIRST TIME OPERATION

2.6.1 SETTING THE CONTROLS

Set the front panel controls as follows.

INTENSITY	Central - In
FOCUS	Central - In
VOLTS/DIV	0.1 V
AC/DC	DC
Y POSITION	Central
TIME/DIV	100 μs
X POSITION	In and central
LEVEL	In and central
MODE	AC
SOURCE	INT
SLOPE	+

2.6.2 SWITCH ON

1. Switch the power supply on by pulling out the focus control (the LINE indicator should light).
2. Pull out the intensity control (the ON indicator should light).
3. Allow a short while for the trace to appear.
4. Centralize the trace using the X and Y POSITION controls.
5. Adjust the INTENSITY control so that the trace is at a suitable viewing intensity.
6. Adjust the FOCUS control for the sharpest obtainable trace.
7. Observe that by operation of the Y POSITION control it should be possible to shift the trace over 6 full divisions of the graticule.
8. Align the trace with the horizontal graticule lines by using the TRACE ROTATION control.
9. Connect the CAL 0.5 V socket (2 mm) to the input socket. For this operation a calibration lead is required with a BNC plug at one end and a 2 mm plug at the other (012-0572-00).
10. Adjust the Y POSITION control so the trace is level with one of the two lower graticule lines.
11. Observe that the trace will occupy 5 vertical divisions of the graticule.
12. Switch VOLTS/DIV to 0.2 V and observe that the trace will only occupy 2.5 divisions.
13. By now the user will be conversant with the operation of the Y or vertical controls so now they should turn to the sweep controls.
14. Disconnect the cal signal and connect a sinewave to the input. By turning the TIME/DIV control anticlockwise in steps it should be noticed that the sweep speed decreases.
15. Set the TIME/DIV swtich to 1 ms and observe the display.
16. Set the TIME/DIV switch to 10 ms and note that the sweep should be slower.
17. Pull out the X10 control and observe that the sweep speed should be the same as 15 above.

2.7 USE OF ADDITIONAL FACILITIES

2.7.1 TRIGGER SOURCE

We have been using the control in the INT position but it is possible to trigger from an external signal by plugging the signal into the EXT TRIG socket. The SOURCE switch should then be set to EXT.

2.7.2 SLOPE

The SLOPE switch allows triggering from a positive (+) going or negative (-) going portion of the input signal.

2.7.3 MODE

For the inspection or measurement of most waveforms the MODE control is used in the AC position. For the inspection of TV frame or TV line waveforms the switch should be set to TV. For TV field waveforms sweep ranges of 0.3 s/division to 0.1 ms/division should be used. For TV line waveforms sweep ranges of 30 μs/division to 1 μs/division are required.

2.7.4 LEVEL

There are two modes of level control operation. In the normal (control out) position the triggering point can be varied over the whole of the waveform to a maximum of 6 divisions and with a minimum sensitivity of 0.3 divisions.
In the AUTO position (control in), level control is restricted to approximately 1/8 of the normal variation. In the absence of a triggering waveform or if the waveform does not meet the required minimum amplitude a non triggered sweep is displayed.
When TV is selected the level control is inoperative.

2.8 BASIC APPLICATIONS

The following are typical applications of oscilloscope type S22. Only outline procedures are given to allow the user to adapt the method to individual requirements. Familiarity with the controls of the instrument as outlined in 2.4, 2.5, 2.6 and 2.7 should allow these basic techniques to be applied to a wide variety of uses.

2.8.1 USE AS A MONITOR OR DISPLAY

One of the most frequent uses of an oscilloscope is as a monitor or display. By correct adjustment of the X and Y controls it is possible to display many cycles or a fraction of one cycle of a repetitive waveform. Generally it is desirable to limit the display to the centre 6 divisions vertically and in the case of a repetitive waveform to display 1 to 8 cycles within the centre 8 divisions horizontally. It is possible to use the S22 instrument in this way to inspect a waveform for slope, over or undershoot and ringing.

2.8.2 PEAK TO PEAK VOLTAGE MEASUREMENT

AC - Symmetrical waveform

1. Connect the waveform to be measured to the INPUT.
2. Set the VOTS/DIV switch to display about 5 or 6 divisions of the waveform.
3. Set the AC-DC-switch to AC.
4. Set the TIME/DIV switch to display several cycles of the waveform.
5. Use the Y POSITION control to set the lower edge of the waveform on one of the lower graticule lines so that the top edge of the waveform is in the graticule area.
6. Measure the vertical amplitude (div) of the signal on the screen.
7. Multiply the amplitude in 6 above by the VOLTS/DIV setting and by the attenuation factor of any probe used.

EXAMPLE

Assume a vertical deflection of 5.3 division using a X10 attenuation probe and a VOLTS/DIV setting of 0.05 Volts per division.

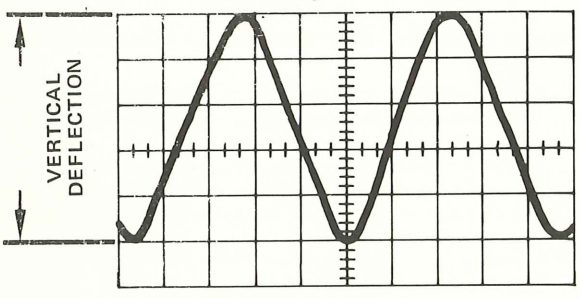
∴ Peak to Peak Voltage =

Vertical deflection X VOLTS/DIV (Setting) X Attenuator factor (probe)

for our example

Peak to Peak voltage = 5.3 x 0.05 x 10

∴ Peak to Peak voltage = 2.65 Volts.



Measuring Peak to Peak Voltage of a Waveform

2.8.3 VOLTAGE MEASUREMENT BETWEEN TWO POINTS ON A WAVEFORM

Proceed as in 2.8.2 above substituting the two measurement points for the peaks and setting the lower point on one of the lower graticule lines.

2.8.4 INSTANTANEOUS VOLTAGE MEASUREMENT WITH REFERENCE TO GROUND

To make a measurement of the DC level at a specified point on a waveform use the following procedure.

1. Set the AC/DC switch to DC.
2. Push the TRIG LEVEL control IN to the AUTO position.
3. Connect the waveform to be measured to the INPUT.
4. Use the TIME/DIV and X POSITION (⟷) controls to display the section of the waveform of interest.
5. Remove the signal from the input.
6. Set the trace to the lowest graticule line or other suitable reference line, using the Y POSITION control, if the point to be measured is positive. Set to highest or other suitable graticule line if the point to be measured is negative. AFTER THIS DO NOT ADJUST THE Y POSITION CONTROL.
7. Reconnect the signal to the INPUT.
8. Measure the distance in divisions from the reference line to the point to be measured.
9. Establish the polarity of the measured voltage. If the measurement point is above the reference line the voltage is positive. If the measurement point is under the reference line it is negative.
10. Multiply the estimate in (8) above by the VOLTS/DIV switch setting and any probe attenuation factor.

EXAMPLE

Assume that the vertical distance measured is +2.7 divisions with a VOLTS/DIV setting of 200 mV and the probe attenuation factor is X1

∴ Instantaneous voltage =

Vertical distance (divisions) X Polarity X VOLTS/DIV (Setting) X Probe Attenuator factor

For the values given

Instantaneous voltage = 2.7 x 1 x 0.2 x 1

∴ Instantaneous voltage = 0.54 volts.

2.8.5 INSTANTANEOUS VOLTAGE MEASUREMENT WITH REFERENCE TO A DC VOLTAGE

Proceed as in 2.8.4 but in step (5) remove the INPUT signal and feed in the reference voltage to the input. Step 7 will be to remove the reference voltage and replace the signal.

2.8.6 TIME DURATION MEASUREMENT

1. Connect the waveform to be measured, to the INPUT.
2. Set the VOLTS/DIV switch to display a suitable vertical amplitude of the waveform.
3. Set the TIME/DIV and Level controls to display the appropriate portion of the waveform to be measured over the maximum number of horizontal graticule divisions possible, keeping well inside the graticule limits.
4. Use the Y POSITION control to move the trace so that the measurement points are on the horizontal centre line.
5. The X POSITION control is used to move the start of the measurement period to a convenient reference point.
6. Measure the distance (divs) between the measurement points.
7. Multiply the measurement in 6 above by the setting of

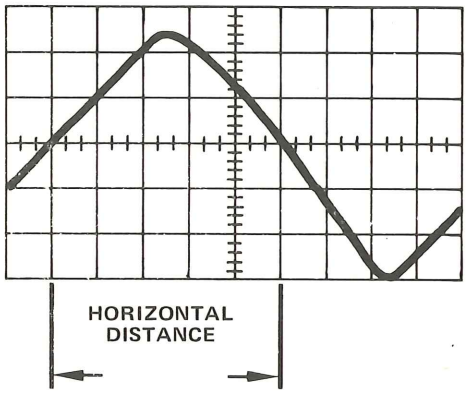
the TIME/DIV switch and if the X10 control is used divide by 10. This gives the time duration

EXAMPLE
If the distance between the points is 2.5 divisions with the TIME/DIV control on 0.3 ms/div and the magnifier is not used.

$$\text{Time duration} = \text{horizontal distance (divisions)} \times \text{TIME/DIV setting}$$

$$\therefore \text{Time duration} = 2.5 \times 0.3 \text{ ms}$$

$$\therefore \text{Time duration} = 0.75 \text{ ms}$$



Measuring the Time Duration between points on a Waveform

2.8.7 FREQUENCY MEASUREMENT

The time duration technique shown in 2.8.6 can be used to establish the frequency of a periodically recurrent waveform. The start of two adjacent cycles is taken as the measurement points and the time duration between these points established. The frequency is the reciprocal of the time duration.

EXAMPLE
If one cycle occupies 5 divisions with the time division control on 0.3 ms/div and the X10 magnifier is used.

$$\text{Time duration} = \frac{\text{Horizontal Distance} \times \text{TIME/DIV (setting)}}{\text{Magnification}}$$

for the example

$$\text{Time duration} = \frac{5 \times 0.3 \text{ ms}}{10}$$

$$= 0.15 \text{ ms}$$

$$\text{Frequency} = \frac{1}{\text{Time duration}}$$

$$= \frac{1}{0.15 \times 10^{-3}}$$

$$= 6.7 \text{ kHz}$$

2.8.8. RISE TIME MEASUREMENTS

Rise time measurements employ the same basic techniques as time duration measurements. Rise time t is the time required by the leading edge of a waveform to rise from 10% to 90% of the waveform amplitude. The procedure is as follows:-

1. Connect the waveform to the input.
2. Set the AC/DC switch to AC.
3. Set the VOLTS/DIV switch to display 4 to 8 divisions amplitude.
4. Centre the display about the centre horizontal line.
5. Set the trigger controls to obtain a stable display.
6. Set the TIME/DIV switch so that the 10% and 90% points of the waveform lie within the centre 8 divisions horizontally.
7. Determine the 10% point of the waveform and use the X and Y position controls to set this point to a convenient graticule point.
8. Determine the 90% point and estimate the horizontal distance in graticule divisions between the 10% and 90% points of the waveform.
9. Multiply the distance obtained in (8) by the setting of the time divisions switch. If the sweep magnifier is used divide the result by 10. If the result is close to the rise time of the instrument it is necessary to apply a correction factor (See below).

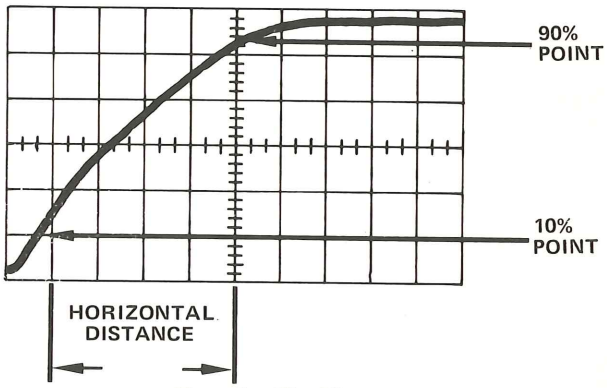
EXAMPLE
Assume that the horizontal distance between the 10% and 90% points is 5 divisions and the TIME/DIV switch is set to 100 μs and the sweep magnifier is used.

$$\text{Rise time} = \frac{\text{Horizontal distance (divs)} \times \text{TIME/DIV setting}}{\text{sweep magnification}}$$

for the example

$$\text{Rise time} = \frac{5 \times 100\mu s}{10}$$

$$\therefore \text{Rise time} = 50\ \mu s$$



Measuring Rise Time

2.8.9 CORRECTION FORMULA FOR FAST RISE TIME WAVEFORMS

When the rise time of the oscilloscope is of the same order as the rise time of the waveform being measured it is necessary to apply a correction formula as follows:-

$$\text{Actual Rise time (tra)} = \sqrt{\left(\text{Measured Rise time(trm)}\right)^2 - \left(\text{Oscilloscope Rise time (tro)}\right)^2}$$

EXAMPLE
Assume the rise time found by the method given in 2.8.8 is 100 ns. The oscilloscope rise time is approximately 70 ns. Applying the formula formula

$$\text{Actual rise time} = \sqrt{(100)^2 - (70)^2}$$

$$= \sqrt{10000 - 4900}$$

$$= \sqrt{5100}$$

$$\cong 71 \text{ns}$$

NOTE
It should not be necessary to apply the correction to waveforms having a rise time greater than 250 ns. Also the quoted rise time is the maximum figure and the actual rise time could be considerably better than this. This would mean that a calculated rise time would be in error. If it is necessary to work to great accuracy it would be necessary to measure the bandwidth of the instrument and calculate the rise time as follows :-

$$\text{Rise time} = \frac{0.350}{\text{Bandwidth (MHz)}} \text{ ns}$$

SECTION 3

CIRCUIT DESCRIPTION

3.1 GENERAL

The S22 uses entirely solid state circuitry to drive a single beam cathode ray tube (CRT). Internal nickel cadmium cells supply a non-regulated invertor power unit. The cells are charged from a.c. lines via a transformer and constant current charger. A dual field effect transistor (F.E.T.) in the first stage of the vertical (Y) amplifier enables a constant, high impedance input to be applied whilst a further F.E.T. in the sawtooth generator ensures a high degree of ramp linearity.
Normal triggering is a.c. coupled with selection of trigger point and polarity but an alternative mode allows triggering from a TV waveform. In both modes an 'AUTO' facility is provided whereby a bright line reference is displayed in the absence of a suitable triggering signal.

3.2 Y AMPLIFIER AND ATTENUATOR (Fig. 1 and 2).

An input signal
An input signal connects via the BNC socket SK701 to the AC-DC switch S701. In the A.C. position of the switch the signal is passed via C701, to S702, the attenuator switch. In the DC position, the capacitor is shorted by S701. The attenuator in addition to the straight through 1 : 1 range has four frequency - compensated resistive dividers, with ratios of 100 : 1, 10 : 1, 5 : 1 and 2 :1.
These are switched singly or in tandem with C704, C705, C712 and C713 serving to standardise the input time constants. C702, C703, C706, C707, C708, C709, C711 and R710, C714, C715, provide compensation for the respective dividers. Basic input impedance is set by a precision 1 MΩ resistor part of R703, shunted by capacity C716 which in addition to the stray capacitance sets the basic channel input capacitance at high frequencies.
R711, C717 and low leakage diode D701 form an input protection circuit for the field effect transistor TR701. This is connected as a long tail amplifier such that the vertical position control is applied to the other half of TR701B and the push pull output at the drains is applied to the next amplifier stage TR703, TR704.
The gain of TR701 is switched from X1 to X10 by switching the drain load resistors R714, R713 and R728, R727. Simultaneously the position voltage at TR701B gate is attenuated ten times by switching in R730.
R721 is the coarse D.C. balance control to centre the shift control and R718 ensures equal D.C. levels at the two drains, when switching to the X10 gain position.
The transistor stage TR703, TR704 have diodes D702, D703 in their emitters to increase the signal carrying capacity. They also provide the close vertical amplifier gain tracking, with D.C. rail variation necessary to compensate for tube sensitivity variations. The tail resistor includes R717 to set the vertical gain and thermistor TH701 to provide gain compensation with temperature.
The collector currents of TR703, TR704 are fed to the bases of shunt feedback stages TR751, TR754. The shunt feedback stage outputs are fed to the bases of TR752, TR753, a long tail pair whose collectors drive the Y plates of the CRT.
CR755, and, R757, in the emitter circuit are adjusted for optimum pulse response.
The trigger signal is taken from the collectors of the shunt stage TR751, TR715 and fed via resistors R753, R760 to the trigger circuit (Fig. 4).

3.3 TRIGGER CIRCUITS Fig. 4

The trigger amplifier accepts either internal or external signals, selection being made by S21. External trigger signals are applied via socket SK21, C21 and R21.
Switch S22 selects the base of TR21 or TR22 to provide correct polarity.
The collector of TR22 is a.c. coupled to the base of TR23. The TR23 collector signal is routed to TR26 base through switching diodes D23 and D24. TR26 and TR27 form the Schmitt Trigger circuit. TR27 collector signal is differentiated by L22, R54. This trigger pulse is taken to the Timebase circuit (gating bistable and Bright line Auto monostable circuits) via C32, R55.
The TV mode of operation prevents TR23 collector signal reaching TR26 base through D23 and D24 by reverse biasing these diodes and connecting the signal to TR24 base. At the collector of TR24 the waveform appears as a re-shaped square waveform. This signal is integrated by R39 and C30 for 300 ms/div to 100 μsec/div positions of the Time/div switch as R42 is disconnected from any supply voltage rails. For Time/div positions of 30 μsec/div to 1 μsec/div, 75 volts is applied to R42 causing D21 to reverse bias and thus reducing the integration time constant. This reduction in time constant allows the line pulses of a TV waveform to increase in amplitude and satisfy the Schmitt switch-over voltage levels. With the longer time constant, only frame pulses can initiate the Schmitt trigger. Trigger level control is completely switched out of circuit during the TV mode of operation so making this mode fully automatic.
In the AC mode and AUTO position, S24 switches in R40 to reduce the effect of the level potentiometer, permitting CRT displays greater than 1 div to be automatically triggered.

3.4 TIMEBASE, UNBLANKING AND BRIGHT LINE AUTO CIRCUIT Fig. 5

The differentiated positive pulse from the trigger circuit is fed via D101 to the base of TR102 which together with TR104 forms a bistable. The positive pulse turns on TR102 which in turn cuts off the clamping transistor TR101. The timebase, TR103 a F.E.T. Miller circuit, then runs up linearly charging up the timing capacitor. The hold off capacitor also charges up via R110 and D106 and resets the bistable via R112. When TR102 switches off, TR101 conducts and discharges the timing capacitor until D103 conducts and reduces the current in TR101 to the value required by the timing resistor. At this point the flyback stops. During the flyback the hold-off capacitor discharges through R112 until D108 conducts. The circuit then "clamps" in a quiescent state and remains so until the arrival of the next triggering pulse.
If the Trig level control is in the Auto position and no trigger pulses are present, TR105 and D109 conduct and reduce the potential at the anode of D108. This allows the hold-off capacitor to discharge further and re-trigger the bistable. The timebase then free-runs. If trigger pulses are applied at the anode of D113 to TR106 base, TR106 then conducts during the period of the pulse, switching off TR105, via C106. TR105 collector potential then rises, back biasing D109 thus inhibiting the free run timebase sweep which is then dependant upon the trigger pulses.
The collector current of TR104 which is cut off during the sweep, is fed to the input of TR107. The collector of TR107 goes negative at the beginning of the sweep driving TR108 on, and providing the unblanking pulse. At the end of the sweep, TR104 turns on, turning off TR107, TR108 and returning the trace to the blanked condition.

3.5 HORIZONTAL AMPLIFIER Fig.4

TR111, TR112, TR113 and TR114 form a balanced symmetrical amplifier system to drive the CRT X plates.
Shunt feedback amplifier TR111 accepts the sweep generator current via R138 and a current from the horizontal position potentiometer R137 via R139. An output voltage propor-

tional to the input currents is then applied to TR112 base. TR113 is longtailed with TR112 to form the output stage with X1 and X10 gain adjustment located between the emitters. Balance for TR113 is obtained from TR114, a similar stage to TR111, but with an effectively grounded input.

3.6 CATHODE RAY TUBE Fig. 3

V301 is a mono accelerator C.R.T. The grid cathode potential is stabilised by zener diode D303, with R313 as a current limit. R308 is the intensity control with R312 as a pre-set intensity level.
The unblanking pulse is A.C. coupled via C303 to the C.R.T. grid and D.C. restored by D305.
A resistive divider R305, R304, R307 allows focus control range and the Astig voltage is supplied by R302.
The trace rotation circuits are shown in Fig. 2. TR731, TR732 act as a compound emitter follower to provide current into the rotation coil L301. R733 the front panel control is connected between positive and negative stabilised supplies which also supply the voltage rails for the vertical amplifier input stages.

3.7 CALIBRATOR Fig.2

Transistors TR741 and TR742 form a bistable switch, compensated against ambient temperature variations by D741 and D742, and supply stabilised by zener diode D743. Switch over is controlled by the sweep voltage applied via R120 to TR741. In the absence of the sweep voltage, TR741 conducts and TR742 is switched off and the DC voltage at SK741 is therefore zero. An increasing voltage applied to TR741 base reaches a level equal to TR742 base voltage, and switch over then occurs. TR741 switches off and TR742 switches on.
Collector current of TR742, determined by R741 and R743, then flows through the precision resistor R748, providing a 500 mV DC output level to SK741. Switch over of TR741 and TR742 is arranged to occur at approximately half sweep, so that the CAL signal when applied to the Y amplifier, provides a zero volt datum level for the first half of the sweep and a calibrated +500 mV level during the second half of the sweep.
R741 enables accurate setting of the CAL voltage.

3.8 BATTERY CHARGER Fig. 3

Mains transformer T401 supplies current via a fullwave rectifier D401 - D404, to TR401 and TR402. The transistors provide a constant current charge to the batteries with the instrument switched off, or a trickle charge with the instrument on. Line voltage switching of 100-125V AC or 200 - 250V AC is set by S401 located under the instrument via a small access hole, and connected to T401 primary. Range switching, selecting the lower or upper 10% of each line voltage is set by S402 located at the rear of the instrument and is connected to T401 secondary. C402 smooths the rectified output. D405 and D406 stabilise TR401 base emitter voltage, bias current being provided by R401. TR401 with R402 in its emitter provides a constant current to the negative rail via D407 the "ON" panel LED and part of R404. Forward bias voltage developed between R404 wiper and the negative rail causes TR402 to conduct and draw current from the positive rail via D408 and hence form the charge current for the battery pack. R404 therefore controls the charge current rate.
S403a and S403b form the 'ON' switch and are ganged together. Current demand in the 'ON' condition is over twice that in the 'OFF' condition, and increased current is obtained from TR402 by switching in an additional parallel resistor R403. TR401 current is therefore increased, thereby increasing TR402 current. Battery charge rate in the 'OFF' condition is 400 mA and varies between zero and 100 mA in the 'ON' condition dependent upon actual line input voltage. D408 prevents battery discharge when instrument is stored.

3.9 CONVERTOR POWER SUPPLY UNIT Fig.3

All supply rails, with the exception of the battery charger are derived from a push-pull, C.R. timed, DC to DC convertor. TR411 and TR412 with protection diodes D411 and D412 drive a ferrite cored transformer T411 at approximately 14 kHz, feedback being obtained from a single winding in series with C412 the timing capacitance. R411 and R412 are forward bias resistors decoupled by L411 and C411. C413 decouples the supply lines from voltage spikes generated by the switching action. +13 and -13 volt supplies are obtained from the two 14.5 volt windings on T411, rectified by D413, D414, D415 and D416 and smoothing is provided by R418, C418, L412 and C423 for +13 V and C421, L413 and C424 for -13 V.
An additional 23 volts winding added serially to a 14.5 V winding, rectified by D421 and smoothed by C422, L414 and C425 supplies +36 V. Additional +80 V is obtained from the same windings by a voltage doubler C417, D418, D419 and C419.
CRT negative supplies for the gun are voltage trebled from the 523 volt winding, by D420, D417, D422, C415, C420, C414, and smoothed by C416 and C410 in parallel.

SECTION 4
MAINTENANCE AND RE-CALIBRATION

It is not possible to screen all high voltages, so care should be taken not to touch high voltage tags. Also where possible the instrument should be unplugged AND switched off during servicing. It is advisable when replacing any component, or carrying out internal work to disconnect the battery cell to prevent an accidental short circuit from damaging the instrument. This can be done by disconnecting the plug and socket on the left hand sub assembly..

4.1 INTRODUCTION

4.1.1 GENERAL

The solid state deisgn of the instrument makes frequent adjustment of the internal preset components unnecessary. The appropriate part of the calibration procedure should be performed whenever the instrument fails to meet its specification, or whenever a defective component is replaced. The Circuit Description, section 3, will assist in deciding which part of the circuit requires adjustment.

4.1.2 CALIBRATOR

The internal 500 mV calibrator allows the accuracy of the vertical amplifiers to be checked. Timing accuracy should be checked against an external sinewave or marker pulse source.

4.1.3 TOOLS AND EQUIPMENT

To carry out the whole calibration procedure, the following tools and equipment are required:-

Small screwdriver (for access).

Trimming tool, low capicitance (for preset capacitors and potentiometers).

Amplitude Calibrator, approximately 10 kHz squarewave providing outputs of 50 mV to 50 V. To an accuracy of ±0.25%.

Time calibrator, providing markers of 1 μ sec to 0.3 sec., timing accuracy ± 0.1%.

Squarewave generator, providing a terminated 1 MHz signal of approximately 50 mV variable with rise time less than 10 n sec.

Sinewave generator, providing 50 kHz, to 10 MHz signal of amplitude up to 25 volts.

Monitor oscilloscope with X10 passive probe.

Digital voltmeter D.C. with input impedance of 1 MΩ or greater.

Meter for voltage measurement with resistance of 20 kΩ per volt or better.

Ammeter 0 - 1 A DC accuracy ± 3%.

Co-axial connecting leads and terminating load suitable for matching to co-ax impedance (Z_0 = 50Ω)

4.2 MECHANICAL

4.2.1 ACCESS TO INTERIOR

(a) Remove all external leads and cables, switch unit off.
(b) Remove 2 screws visible on underside of instrument case.
(c) Holding case firmly, push rear panel, withdraw chassis through the front of the case.

4.2.2 OPENING OUT SIDE AND LOWER FLAPS

(a) Remove case as in 4.2.1 above.
(b) To open right hand panel undo the screws at the top and bottom of the instrument just behind the TIME/DIV switch.
(c) To open the left hand panel undo the screws at the top and bottom of the instrument just behind the attenuator.
(d) To open the bottom flap undo the screw under the attenuator and the screw under the level potentiometer.

4.2.3 CRT REMOVAL

(a) Remove instrument from case as in 4.2.1 above.
(b) Stand chassis on rear panel, slacken both, side sub assembly screws as in 4.2.2.
(c) Open all three sub assemblies.
(d) Unsolder trace rotation leads from eyelets 13 and 49 on PC200, the vertical amplifier circuit board.
(e) Remove CRT shield securing screws located on top of centre box and at the two sides of the centre box (total of 4 screws).
(f) Withdraw the tube assembly through the lower sub assembly opening, removing the tube base at the same time.
(g) Slide Mu-metal screen off tube neck.

4.2.4 CRT FITTING

To be able to get to the tube base it is necessary to remove the rear voltage warning label. Reverse the order in paragraph 4.2.3 above. Make sure tube is pressed forward in housing to locate against bezel rear, before tightening CRT shield securing screws.

4.3 CALIBRATION PROCEDURE

4.3.1 BATTERY CHARGE RATE AND INITIAL SETTING

(a) Ascertain actual A.C. line voltage available, and set ac line switch S401, located underneath and Hi-Lo switch S402 on rear panel as follows:-

AC LINE VOLTS	LINE SWITCH (S401)	HI-LO SWITCH (S402)
100-112	112 V	LO
113-125	112 V	HI
200-225	225 V	LO
226-250	225 V	HI

(b) 1. Remove instrument from case as in 4.2.1 above.
2. Disconnect plug and socket to open circuit the batteries on the left hand sub assembly.
3. Using an Ohmmeter check the resistance of the voltage rails to chassis as follows:-

VOLTAGE RAIL	TEST POINT	RESISTANCE
+ 13 V	Top of L412	1.5 kΩ approx.
−13 V	Top of L413	1.0 kΩ approx.
+ 36 V	Top of L414	1.0 kΩ approx.
+ 75 V	Top of D419	4.0 kΩ approx.
−1.2 kV	Top tag of INTENSITY Pot	2.4 MΩ approx.

4. Check that FOCUS and INTENSITY knobs are pushed in.
5. Connect D.C. ammeter between the plug and socket disconnected in 2. above.
6. Connect instrument to AC line.

7. Switch ON line by pulling out the FOCUS control.
8. Observe that the right hand side LED is lit.
9. Adjust R404 on PC199 for a current reading of about 400 mA.
10. Switch OFF line
11. Disconnect ac line, remove ammeter, reconnect the battery plug and socket.
12. Connect the monitor oscilloscope probe to the metal surface (collector) of TR411 or TR412, on PC 199.
13. Switch on unit by pulling out the FOCUS and INTENSITY controls.
14. Check to see that there is approximately a 15 V pp squarewave on the monitor oscilloscope at a frequency about 14 kHz.
15. Disconnect monitor.

(c) Set front panel controls as follows:-
1. AC/DC switch to AC.
2. VOLTS/DIV switch to 5 V/DIV.
3. Y POSITION - central.
4. INTENSITY - central in.
5. FOCUS - central in.
6. TIME/DIV to 1 ms.
7. LEVEL central, in for AUTO.
8. MODE, SOURCE and SLOPE set to AC, int and + respectively.

4.3.2. SUPPLY LINE VOLTAGES

With the controls as in para 4.3.1, switch unit ON using intensity control.
No adjustments exist for supply lines. The voltages shown in the table below are those which should be obtained for a nominal 7.8 volts battery pack voltage, (measured at the rear DIN socket).
The Voltage measurements should be made at the test points given in the table below. Allowance should be made for pack voltages differing from above. The under sub-assembly may be lowered to facilitate these voltage measurements.

NOMINAL RAIL VOLTAGE	TEST POINT
+ 13 V	Top of L412
− 13 V	Top of L413
+ 36 V	Top of L414
+ 75 V	Top of D419
−1.2 kV	Top tag of INTENSITY Pot

4.3.3 ASTIGMATISM AND GEOMETRY

Note: To carry out these adjustments the batteries should be fully charged or the instrument connected to an A.C. line.
(a) Set TIME/DIV to 30 μ sec.
(b) Apply 50 kHz sinewave signal to INPUT and set VOLTS/DIV for a 2 div p-p display adjusting the Y POSITION control if necessary to bring the trace on the screen. If a trace is not obtainable centre Y POSITION control and adjust stability (R116) until trace is obtained.
(c) Adjust FOCUS and R302 (Astigmatism) on PC199 for best trace definition.
(d) Disconnect 50 kHz signal.
(e) Trace should free run. If no trace re-adjust R116..
(f) Set trace at centre graticule line, adjust trace rotate control if necessary for best alignment.
(g) Pull out trig LEVEL control.
(h) Turn INTENSITY fully anti-clockwise and adjust R312 until spot just disappears.

4.3.4 Y GAIN

(a) Set the controls as 4.3.1 (c) except that the VOLTS/DIV switch should be set to 0.01 V and TIME/DIV switch to 1 m sec.
(b) Connect a 1 kHz squarewave of 50 mV amplitude to the INPUT.
(c) If the signal can not be triggered adjust R116 on PC201 until trigger can be achieved.
(d) Adjust R717 until the display occupies 5 vertical divisions.
(e) Disconnect the input signal.

4.3.5 X1-X10 BALANCE

(a) Set INT/EXT to EXT.
(b) Connect a voltmeter between test point 29 on PC200 (vertical amp PC board) and chassis.
(c) Adjust Y POSITION until the reading on the voltmeter is zero.
(d) Bring trace to centre graticule line by adjusting R721..
(e) Re-set X1-X10 gain switch to X10.
(f) Adjust R718 to bring trace back to centre of graticule.
(g) Re-set X1-X10 gain switch to X1.
(h) Repeat steps d to g until there is no trace movement when the X1-X10 switch is operated. Leave switch in X1 position.

4.3.6 ATTENUATOR

(a) Set the controls as 4.3.1 (c) except VOLTS/DIV should be set to 0.01 V and TIME/DIV to 0.1 m sec.
(b) Connect a 1 kHz squarewave of 50 mV amplitude to the INPUT.
(c) Observe the shape of the display waveform especially the corners.
(d) Increase the signal amplitude to 500 mV and feed the signal to the INPUT via a 10 : 1 probe.
(e) Adjust the probe trimmer for best waveform corner which should be similar to (c) above.
(f) Reduce the signal amplitude to 50 mV.
(g) Switch X1/X10 to X10 and adjust C719 for best corner of the waveform.
(h) Repeat steps (b) to (g) until upon switching from X1 to X10 there is no appreciable change in wave shape.
(j) Remove probe.
(k) Operate the VOLTS/DIV switch setting it to each of the positions as shown in the table below. For each of the settings in the first column input a 1 kHz wave of amplitude as shown in the second column. Adjust the trimmer shown in the third column for the best corner of waveform.

VOLTS/DIV SETTING	INPUT SIGNAL (1kHz) AMPLITUDE (VOLTS)	TRIMMER TO ADJUST
0.01 V	0.1	C711
0.05 V	0.25	C715
0.1 V	0.5	C703
0.2 V	1.0	C712
0.5 V	2.5	C713
1.0 V	5.0	C708

(l) Switch the VOLTS/DIV switch to 1V and adjust C708 for best corner on display. The trimmer C708 may not have enough range to compensate to obtain a best corner. To overcome this twist or untwist the pair of wires on the attenuator front wafer, readjusting C708.
(m) Remove the input signal and reconnect via a 10 : 1 probe.
(n) Switch VOLTS/DIV switch to 0.01V.
(p) Adjust the probe compensation trimmer for best corner on display.
(q) Repeat stage k, substituting the table below:-

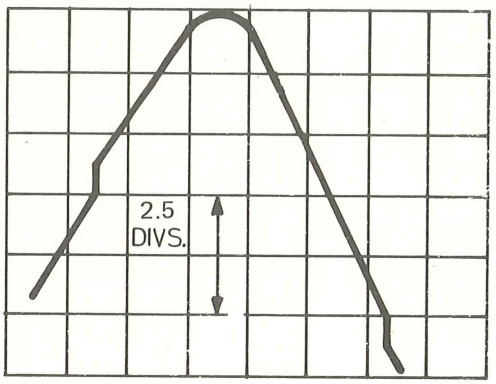
VOLTS/DIV SETTING	INPUT SIGNAL (1kHz) AMPLITUDE (VOLTS)	TRIMMER TO ADJUST
0.1 V	5	C704
1.0 V	50 V	C705

(r) Remove probe signal and reconnect the signal directly to the INPUT.

4.3.7 TRIGGER SENSITIVITY

(a) Set controls as in para 4.3.1 but with TIME/DIV set to 10 μ sec.
(b) Apply 50 kHz sinewave signal to INPUT.
(c) Connect the X10 probe of the monitor oscilloscope to the junction of D22 and D23 on PC 201.
(d) Set monitor scope sensitivity to 10 mV/div and adjust the 50 kHz input to display approximately 6 div. on monitor.
(e) Adjust the LEVEL control until switching transients appear on the monitor display. See waveform below.

(f) Adjust R36 (backlash) on PC 201 until the transients are separated by 2.5 div vertically (or 250 mV at probe tip).
(g) Remove probe.
(h) Centralize the trig LEVEL control (in auto mode).
(j) Reduce signal amplitude to give a display of 0..3 div.
(k) Adjust R50 to give a triggered display.
(l) Check that when adjusting the LEVEL control triggering can be achieved with the control in a central position. At the extremes of the control setting the display will not be triggered.



4.3.8 SWEEP ACCURACY

(a) Set controls as in para 4.3.1.
(b) Apply 1 m sec. time marker to the INPUT.
(c) Adjust the trigger LEVEL control for stable display.
(d) Adjust R152 (X1 gain) PC 201, in conjunction with horizontal position control for an accurate marker graticule alignment 1 : 1.
(e) Change marker input to 0.1 m sec.
(f) Pull horizontal POSITION control for X10 gain and adjust R151 (X10 gain) on PC201, and horizontal POSITION control for an accurate marker/graticule alignment of 1 : 1.
(g) Set TIME/DIV to 1 μ sec. Set horizontal position to X1 gain and apply 1 μsec. markers. Adjust C2, the trimmer capacitor mounted on the TIME/DIV switch, and the horizontal position control for an accurate marker/graticule alignment of 1 : 1.

4.3.9 SWEEP STABILITY AND LENGTH

(a) Set controls as in para 4.3.1 but with LEVEL control in the 'OUT' position and fully clockwise.
(b) Apply 50 kHz sinewave signal to INPUT.
(c) Set TIME/DIV to 10 μs.
(d) Adjust R116 (stability) anticlockwise on PC201 until trace appears then back off R116 until the trace just ceases.
(e) Note position of R116 rotor.
(f) Adjust the LEVEL control for a stable display of approx 3 div vertically.
(g) Back off R116 until trace disappears and note R116 rotor position.
(h) Set R116 mid way between two noted positions.
(j) Adjust R107 (sweep length) on PC201 for a trace length of 10.3 divisions.

4.3.10 INTERNAL CALIBRATOR

(a) Set controls as in para 4.3.1 but with TIME/DIV set to 0.3 sec.
(b) Set the VOLTS/DIV switch to 0.1 V.
(c) Set AC-DC to DC.
(d) Connect CAL output to CH1 input and to digital voltmeter.
(e) Connect ground of digital voltmeter to ground via BNC outer on R.H. side.
(f) Note that trace steps upwards, approximately half way across screen.
(g) Note the digital volt meter reading after step has taken place, and adjust R316 on PC200 for a reading of 500 mV $\pm$1mV.

4.3.11 TV TRIGGER

(a) Select DC, TV, INT and +ve polarity.
(b) Apply composite T.V. video signal to INPUT and switch the VOLTS/DIV switch for a 2 division p-p display.
(c) TV line synchronisation should occur on the four fastest sweep ranges, and TV field on the rest of the ranges. There are no internal adjustments for T.V. and failure to lock would indicate a need for servicing.

4.3.12 HF PULSE RESPONSE

(a) Set controls as in para 4.3.1 but with VOLTS/DIV switches set to 0.01 V.
(b) Apply a 1 MHz squarewave signal of 30 - 40 mV via terminated cable of 50Ω.
(c) Set TIME/DIV switch to 1 μsec.
(d) Adjust R757 and C755 on PC200, the vertical amplifier printed circuit board, for squarest leading top edge of display. (X10 horizontal gain may be used to facilitate this).
(e) The bandwidth may now be checked from a 50 kHz, 5 division datum point at all settings of VOLTS/DIV switch. The response should be $<$ -3db at 5 MHz.

SECTION 5

COMPONENT LIST

All requests for repairs or replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service.

In the U.K. enquiries should be made to Harpenden (see below).

Values of resistors are stated in ohms or multiples of ohms; ratings at 70°C are in watts or sub-multiples of watts. Values of capacitors are stated in sub-multiples of farads; ratings at 70°C are in volts or kilovolts.

Whenever possible, exact replacements for components should be used, although locally available alternative may be satisfactory for standard components.

Any order for replacement parts should include:

1. Instrument type
2. Instrument serial number
3. Component circuit reference
4. Component part number
5. Component value

CIRCUIT REFERENCE BLOCKS

The table below gives the blocks of circuit references, so that the reader can relate the items listed in this chapter and their location in the circuitry in Section 6.

Circuit Reference		Circuit	Figure
From	To		
1	300	Sweep Generator, Unblanking & X Amp. Time/Div Switch Trigger	5 6 4
401	600	Battery Charger CRT Power Supply	3
701	800	CAL and Vertical Amplifier Vertical Amplifier	2 1

ABBREVIATIONS

BM	Button mica
C	Carbon
CP	Carbon preset
CV	Carbon variable
CER	Ceramic
CT	Ceramic Trimmer
CM	Cermet thick film
CMP	Cermet preset
E	Electrolytic
Ge	Germanium
MF	Metal Film
MO	Metal oxide
PC	Polycarbonate
PE	Polyester
PP	Polypropylene
PS	Polystyrene
Se	Selenium
Si	Silicon
SM	Silver mica
WW	Wire-wound
WWP	Wire-wound preset
WWV	Wire-wound variable

TEKTRONIX U.K. LIMITED

36 - 38 Coldharbour Lane, Harpenden, Hertfordshire, England

Telephone: Harpenden 63141 Telex: 25559

CIR REF	PART NUMBER	VALUE	DESCRIPTION TYPE	TOL %	RATING Volts	Eff. Ser.No.
B401-6	146-0027-00	1.25	Cell Ni Cad. D Size			
C1	285-0855-00	91 p	PS	2 p	350	429751
C2	281-0732-00	3 - 12 p	PP		350	429751
C3	285-1110-00	1.0μ	PC	1	40	
C4	285-1146-00	10 n	PS	1	63	429751
C6	285-0906-00	15 n	PE	20	250	
C7	285-1078-00	1.5 μ	PE	20	63	
C21	285-0796-00	100 n	PE	20	250	
C22	285-0745-00	4.7p	CER	0.5p	500	
C24	281-0710-00	10n	CER		250	
C25	290-0546-00	15 μ	ELEC		16	
C26	281-0731-00	5.6p	CER	0.5p	750	
C27	285-0915-00	100 n	PE	20	100	
C28	290-0756-00	100 μ	ELEC		16	
C29	290-0756-00	100 μ	ELEC		16	
C30	285-1054-00	270 p	PS	1p	350	
C31	285-0869-00	47 p	PS	2p	350	
C32	285-0845-00	68 p	PS	2p	350	
C33	281-0710-00	10 n	CER		250	
C36	290-0707-00	22 μ	ELEC		25	
C100	285-0871-00	150p	PS	5	350	
C101	285-0776-00	27p	PS	1p	350	
C102	290-0661-00	100 μ	ELEC		16	
C103	281-0710-00	10 n	CER		250	
C104	285-0762-00	450 p	PS	1	125	
C105	285-0869-00	47 p	PS	2p	350	
C106	285-0779-00	470 n	PE	20	100	
C107	290-0623-00	4.7 μ	ELEC		25	429151
C109	281-0705-00	1.0 p	CER	0.1p	500	
C110	285-0915-00	100 n	PE	20	100	
C112	290-0627-00	22 μ	ELEC		40	
C114	285-0676-00	2.2 p	CER	0.1p	500	
C115	285-0867-00	20 p	PS	1p	350	
C301	281-0710-00	10 n	CER		250	
C303	281-0793-00	4.7 n	CER		2k	
C305	285-0796-00	100 n	PE	20	250	
C401	285-0915-00	100 n	PE	20	100	

CIR REF	PART NUMBER	VALUE	DESCRIPTION TYPE	TOL %	RATING Volts	Eff. Ser.No.
C402	290-0675-01	4.7 m	ELEC		16	
C403	285-0915-00	100 n	PE	20	100	
C410	281-0706-00	30 n	CER		1.5 kV	
C411	290-0676-00	1.0 μ	ELEC		100	
C412	285-0836-00	47 n	PE	20	250	
C413	290-0679-00	1.0 m	ELEC		10	
C414	281-0706-00	30 n	CER		1.5k	
C415	281-0748-00	1.0 n	CER	20	1.25k	
C416	281-0706-00	30 n	CER		1.5k	
C417	290-0688-00	22 μ	ELEC		63	
C418	290-0678-00	47 μ	ELEC		25	
C419	290-0688-00	22 μ	ELEC		160	429351
C420	281-0748-00	1.0 n	CER	20	1.25k	
C421	290-0678-00	47 μ	ELEC		25	
C422	290-0678-00	47 μ	ELEC		63	
C423	290-0678-00	47 μ	ELEC		25	
C424	290-0678-00	47 μ	ELEC		25	
C425	290-0678-00	47 μ	ELEC		63	
C701	285-0796-00	100 n	PE	20	250	
C702	281-0678-00	3.0 p	CER	0.1p	500	
C703	281-0155-00	2-22p	PP		500	
C704	281-0157-00	5.5p-65.5p	PP		500	
C705	281-0157-00	5.5p-65.5p	PP		500	
C706	Twisted Wires					
C707	285-1080-00	220 p	PS	5	350	
C708	281-0157-00	5.5p-65.5p	PP		500	
C709	285-0844-00	39 p	PS	2p	350	
C710	285-0266-00	10 p	PS	1 p	350	429151
C711	281-0154-00	2-12 p	PP		500	
C712	281-0155-00	2.2p	PP		500	
C713	281-0155-00	2-22p	PP		500	
C714	283-0662-00	7.5 p	CER	0.5p	350	
C715	281-0155-00	2-22 p	PP		500	
C716	281-0731-00	5.6 p	CER	0.5p	750	
C717	281-0710-00	10 n	CER		250	
C718	281-0710-00	10 n	CER		250	
C719	281-0156-00	1p4-6p4	PP		500	
C720	290-0661-00	100 μ	ELEC		16	
C721	290-0661-00	100 μ	ELEC		16	
C722	285-0760-00	330 p	PS	5	125	
C751	281-0710-00	10 n	CER		250	
C753	281-0676-00	2.2 p	CER	0.1p	500	
C754	281-0676-00	2.2 p	CER	0.1p	500	
C755	281-0157-00	5.5p-65.5p	PP		500	
C756	285-1063-00	390 p	PS	5	160	429401
C757	281-0710-00	10 n	CER		250	
C758	290-0623-00	4.7 μ	ELEC		25	429151
C759	285-0707-00	22 μ	ELEC		25	

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING	Eff. Ser.No.
D21	152-0062-01	75 V	1N914	Si		50 mA	
D22	152-0062-01	75 V	1N914	Si		50 mA	
D23	152-0062-01	75 V	1N914	Si		50 mA	
D24	152-0062-01	75 V	1N914	Si		50 mA	

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TYPE	TOL %	RATING	Eff. Ser.No.
D101	152-0062-01	75 V	1N914	Si		50 mA	
D102	152-0062-01	75 V	1N914	Si		50 mA	
D103	152-0062-01	75 V	1N914	Si		50 mA	
D104	152-0062-01	75 V	1N914	Si		50 mA	
D105	152-0062-01	75 V	1N914	Si		50 mA	
D106	152-0062-01	75 V	1N914	Si		50 mA	
D107	152-0062-01	75 V	1N914	Si		50 mA	
D108	152-0062-01	75 V	1N914	Si		50 mA	
D109	152-0062-01	75 V	1N914	Si		50 mA	
D111	152-0062-01	75 V	1N914	Si		50 mA	
D112	152-0062-01	75 V	1N914	Si		50 mA	
D113	152-0062-01	75 V	1N914	Si		50 mA	
D114	152-0062-01	75 V	1N914	Si		50 mA	
D115	152-0062-01	75 V	1N914	Si		50 mA	
D116	152-0062-01	75 V	1N914	Si		50 mA	
D117	152-0062-01	75 V	1N914	Si		50 mA	
D303	152-0511-00	51 V	Zener	Si		1 W	
D305	152-0468-00		BAX16	Si		150 V	
D401	152-0339-00		1N4001	Si		50 V	
D402	152-0339-00		1N4001	Si		50 V	
D403	152-0339-00		1N4001	Si		50 V	
D404	152-0339-00		1N4001	Si		50 V	
D405	152-0421-00	3.3 V	Zener	Si		330 mW	
D406	152-0062-01	75 V	1N914	Si		50 mW	
D407	152-0625-01		L.E.D.	Ga Asp		50 mA	
D408	152-0467-00		1N5400	Si		50 V	
D411	152-0062-01	75 V	1N914	Si		50 mA	
D412	152-0062-01	75 V	1N914	Si		50 mA	
D413	152-0468-00		BAX16	Si		150 V	
D414	152-0468-00		BAX16	Si		150 V	
D415	152-0468-00		BAX16	Si		150 V	
D416	152-0468-00		BAX16	Si		150 V	
D417	152-0515-00		SCM60	Si		6 kV	
D418	152-0468-00		BAX16	Si		150 V	
D419	152-0468-00		BAX16	Si		150 V	
D420	152-0515-00		SCM60	Si		6 kV	
D421	152-0468-00		BAX16	Si		150 V	
D422	152-0515-00		SCM60	Si		6 kV	
D423	152-0625-01		L.E.D.	Ga Asp		50 mA	
D701	152-0483-00	10 V	CE1004	Si			
D702	152-0062-02	75 V	IN4148T	Si		50 mA	
D703	152-0062-02	75 V	IN4148T	Si		50 mA	
D731	152-0347-00	7.5 V	Zener	Si			
D732	152-0347-00	7.5 V	Zener	Si			
D741	152-0062-01	75 V	1N914	Si		50 mA	
D742	152-0062-01	75 V	1N914	Si		50 mA	
D743	152-0347-00	7.5 V	Zener	Si			

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TOL %	Eff. Ser.No.
FS401	159-0077-00	250 mA	Fuse Link 1.25"lg slow (for 225V)		
FS402	159-0076-00	3 A	Fuse Link 1.25"lg slow (battery)		

CIR REF	PART NUMBER	VALUE	DESCRIPTION	TOL %	Eff. Ser.No.
L21	108-0780-00	53 µH	Inductor fixed iron dust cored		
L22	108-0483-00	16 µH	Inductor fixed		
L402	108-0780-00	53 µH	Inductor fixed Iron dust cored	10	
L4111	108-0482-00	160 µH	Inductor fixed Iron dust cored		
L412	108-0482-00	160 µH	Inductor fixed Iron dust cored		
L413	108-0482-00	160 µH	Inductor fixed Iron dust cored		
L414	108-0482-00	160 µH	Inductor fixed Iron dust cored		
L733	108-0482-00	160 µH	Inductor fixed iron dust cored		
L734	108-0482-00	160 µH	Inductor fixed iron dust cored		
PL401	134-0154-00		Plug Mains		
PL402	134-0125-00		Battery Disconnection		

CIR REF	PART NUMBER	VALUE ohms	TYPE	TOL %	RATING WATTS	Eff. Ser.No.
R1	321-0396-48	130 k	MF	1	125 m	
R2	325-0211-00	260 k	MF	1	250 m	
R3	321-0888-48	910 k	MF	1	125 m	
R4	323-0813-40	2.6 M	MF	1	500 m	
R20	317-0152-01	1.5 k	C	5	125 m	
R21	317-0513-01	5.1 k	C	5	125 m	429151
R22	317-0393-01	39 k	C	5	125 m	
R23	317-0682-01	6.8 k	C	5	125 m	
R24	317-0472-01	4.7 k	C	5	125 m	
R25	317-0682-01	6.8 k	C	5	125 m	
R26	317-0393-01	39 k	C	5	125 m	
R27	311-1708-00	47 k	CV	20	250 m	
R28	317-0203-01	20 k	C	5	125 m	
R29	317-0103-01	10 k	C	5	125 m	
R30	317-0152-01	1.5 k	C	5	125 m	
R31	317-0332-01	3.3 k	C	5	125 m	
R32	317-0332-01	3.3 k	C	5	125 m	
R33	317-0392-01	3.9 k	C	5	125 m	
R34	317-0101-01	100	C	5	125 m	
R35	317-0203-01	20 k	C	5	125 m	
R36	315-0335-02	3.3 M	C	10	250 m	429151
R37	317-0822-01	8.2 k	C	5	125 m	
R38	317-0121-01	120	C	5	125 m	
R39	317-0104-01	100 k	C	5	125 m	
R40	317-0334-01	330 k	C	5	125 m	
R41	317-0154-01	150 k	C	5	125 m	
R42	317-0334-01	330 k	C	5	125 m	
R43	317-0822-01	8.2 k	C	5	125 m	
R44	317-0123-01	12 k	C	5	125 m	
R45	317-0332-01	3.3 k	C	5	125 m	
R46	311-1655-00	100	CP	20	50 m	
R47	317-0608-01	68	C	5	125 m	
R48	317-0163-01	1.6 k	C	5	125 m	
R49	317-0392-01	3.9 k	C	5	125 m	
R50	311-1692-00	22 k	CP	20	50 m	
R51	317-0561-01	560	C	5	125 m	
R52	317-0470-01	47	C	5	125 m	
R53	317-0103-01	10 k	C	5	125 m	
R54	317-0561-01	560	C	5	125 mm	
R55	317-0821-01	820	C	5	125 m	
R56	317-0363-01	36 k	C	5	125 m	
R101	317-0203-01	20 k	C	5	125 m	
R102	317-0332-01	3.3 k	C	5	125 m	
R103	317-0332-01	3.3 k	C	5	125 m	
R104	317-0104-01	100 k	C	5	125 m	
R105	317-0103-01	10 k	C	5	125 m	
R106	317-0682-01	6.8 k	C	5	125 m	
R107	311-1692-00	22 k	CP	20	50 m	
R108	317-0471-01	470	C	5	125 m	
R109	317-0471-01	470	C	5	125 m	
R110	317-0621-01	620	C	5	125 m	
R111	315-0622-02	6.2 k	C	5	250 m	
R112	317-0303-01	30 k	C	5	125 m	
R113	317-0913-01	91 k	C	5	125 m	
R114	317-0123-01	12 k	C	5	125 m	
R115	317-0183-01	18 k	C	5	125 m	
R116	311-1654-00	10 k	CP	20	50 m	
R117	317-0103-01	10 k	C	5	125 m	
R118	317-0223-01	22 k	C	5	125 m	
R119	317-0391-01	390	C	5	125 m	
R120	317-0104-01	100 k	C	5	125 m	
R121	317-0123-01	12 k	C	5	125 m	
R122	317-0564-01	560 k	C	5	125 m	
R123	317-0753-01	75 k	C	5	125 m	
R124	317-0822-01	8.2 k	C	5	125 m	
R125	317-0432-01	4.3 k	C	5	125 m	
R126	317-0123-01	12 k	C	5	125 m	
R127	317-0331-01	330	C	5	125 m	
R128	317-0123-01	12 k	C	5	125 m	

CIR REF	PART NUMBER	VALUE ohms	TYPE	TOL %	RATING WATTS	Eff. Ser.No.
R132	317-0103-01	10 k	C	5	125 m	
R133	317-0334-01	330 k	C	5	125 m	
R134	317-0220-01	22	C	5	125 m	
R135	317-0103-01	10 k	C	5	125 m	
R137	311-1648-00	22 k	CV	20	250 m	
R138	317-0333-01	33 k	C	5	125 m	
R139	317-0273-01	27 k	C	5	125 m	
R142	317-0104-01	100 k	C	5	125 m	
R143	317-0203-01	20 k	C	5	125 m	
R144	317-0622-01	6.2 k	C	5	125 m	
R145	317-0330-01	33	C	5	125 m	
R146	301-0822-01	8.2 k	C	5	500 m	
R147	317-0182-01	1.8 k	C	5	125 m	
R149	317-0102-01	1 k	C	5	125 m	
R151	311-1655-00	100	CP	20	50 m	
R152	311-1657-00	1 k	CP	20	50 m	
R153	301-0113-02	11 k	C	5	500 m	
R154	317-0272-01	2.7 k	C	5	125 m	
R155	317-0330-01	33	C	5	125 m	
R156	317-0622-01	6.2 k	C	5	125 m	
R157	317-0103-01	10 k	C	5	125 m	
R158	317-0473-01	47 k	C	5	125 m	
R159	317-0510-01	51	C	5	125 m	
R302	311-1869-00	100 k	CP	20	50 m	
R304	311-1849-00	2.2 M	CV	20	250 m	
R305	317-0474-01	470 k	C	5	125 m	
R306	317-0105-01	1.0 M	C	5	125 m	
R307	307-0543-00*	5.6 M		5	500 m	
R308	311-1849-00	2.2 M	CV	20	250 m	
R309	317-0105-01	1.0 M	C	5	125 m	
R310	316-0476-01	47 M	C	10	250 m	429151
R311	317-0105-01	1.0 M	C	5	125 m	
R312	311-1651-00	1.0 M	CP	20	50 m	
R313	317-0222-01	2.2 k	C	5	125 m	
R314	317-0225-01	2.2M	C	5	125 m	
R400	315-0201-03	200	C	5	125 m	429151
R401	317-0152-01	1.5 k	C	5	125 m	
R402	317-0181-01	180	C	5	125 m	
R403	315-0101-02	100	C	5	250 m	
R404	311-1653-00	220	CP	20	50 m	
R405	308-0725-00	2.7	WW	10	1	
R406	317-0104-01	100 k	C	5	125 m	
R407	308-0725-00	2.7	WW	10	1	
R411	317-0102-01	1.0 k	C	5	125 m	
R412	317-0102-01	1.0 k	C	5	125 m	
R413	317-0241-01	240	C	5	125 m	
R414	317-0241-01	240	C	5	125 m	
R415	317-0102-01	1.0 k	C	5	125 m	
R416	317-0102-01	1.0 k	C	5	125 m	
R417	317-0393-01	39 k	C	5	125 m	429151
R418	307-0382-00	7.5	C	5	125 m	
R419	307-0543-00	5.6 M	CM	5	500 m	429151 429097
R423	317-0221-01	220	C	5	125 m	429097 429097

CIR REF	PART NUMBER	VALUE ohms	TYPE	TOL %	RATING WATTS	Eff. Ser.No.
R422	317-0103-01	10 k	C	5	125 m	
R701)	310-0679-00	900 k		1	250 m	
) *		111 k		1	250 m	
R702)	310-0678-00	990 k		1	250 m	
) *		10.1 k		1	250 m	
R703)	310-0683-00	500 k		1	250 m	
) *		1.0 M		1	250 m	
)		800 k		1	250 m	
)		250 k		1	250 m	
)		1.0 M		1	250 m	
R710	317-0100-01	10	C	5	125 m	
R711	315-0104-01	100 k	C	5	250 m	
R712	317-0101-01	100	C	5	125 m	
R713	321-0192-42	976	MF	0.5	125 m	
R714	321-0097-48	100	MF	1	125 m	
R715	321-0097-48	100	MF	1	125 m	429151
R716	317-0472-01	4.7 k	C	5	125 m	429151
R717	311-1656-00	4.7 k	CP	20	50 m	429151
R718	311-1893-00	100	CMP	20	500 m	
R719	317-0102-01	1.0 k	C	5	125 m	
R721	311-1764-00	47 k	CER	20	500 m	
R722	317-0203-01	20 k	C	5	125 m	
R723	311-1658-00	47 k	CV	20	250 m	
R724	317-0124-01	120 k	C	5	125 m	
R725	317-0302-01	3.0 k	C	5	125 m	
R726	317-0162-01	1.6 k	C	5	125 m	429151
R727	321-0192-42	976	MF	0.5	125 m	
R728	321-0097-48	100	MF	1	125 m	
R729	321-0097-48	100	MF	1	125 m	429151
R730	317-0105-01	1.0 M	C	5	125 m	
R731	317-0431-01	430	C	5	125 m	
R733	311-0756-01	47 k	CP	20	50 m	
R734	317-0431-01	430	C	5	125 m	
R735	317-0471-01	470	C	5	125 m	
R736	315-0560-01	56	C	5	125 m	
R737	315-0560-01	56	C	5	125 m	
R741	311-1652-00	2.2 k	CP	20	50 m	
R742	317-0104-01	100 k	C	5	125 m	
R743	317-0682-01	6.8 k	C	5	125 m	
R744	317-0222-01	2.2 k	C	5	125 m	
R746	317-0333-01	33 k	C	5	125 m	
R747	317-0433-01	43 k	C	5	125 m	
R748	321-0193-48	1.0 k	MF	1	125 m	
R749	317-0222-01	2.2 k	C	5	125 m	
R751	317-0272-01	2.7 k	C	5	125 m	
R752	317-0752-01	7.5 k	C	5	125 m	
R753	317-0102-01	1.0 k	C	5	125 m	
R754	317-0332-01	3.3 k	C	5	125 m	
R755	307-0320-00	3.3 k	MO	5	1.5	
R756	317-0112-01	1.1 k	C	5	125 m	429151
R757	311-1653-00	220	CP	20	50 m	
R758	317-0102-01	1.0 k	C	5	125 m	
R759	317-0201-01	200	CF	5	125 m	
R760	317-0102-01	1.0 k	C	5	125 m	
R761	307-0320-00	3.3 k	MO	5	1.5	
R762	317-0112-01	1.1 k	C	5	125 m	429151
R763	317-0332-01	3.3 k	C	5	125 m	
R765	317-0752-01	7.5 k	C	5	125 m	
R767	317-0220-01	22	C	5	125 m	
R768	317-0272-01	2.7 k	C	5	125 m	

*thick film cermet resistor.

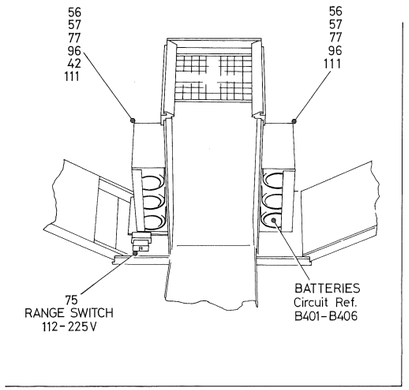
CIR REF	PART NUMBER	DESCRIPTION	Eff. Ser.No.
S1	260-1807-00	Time/Div	
S21	260-1429-00		
S22	260-1429-00		
S23	260-1429-00	AC-TV	
S24	With R27	Auto	
S102	With R137	X10 Gain	
S401	260-1429-00	125/250 V	
S402	260-1307-00	HI-LO Line	
S403	With R308	Power ON/OFF	
S701	260-1429-00	AC-DC	
S702	260-1690-00	Volts/Div	
S703	260-1808-00	X10	

CIR REF	PART NUMBER	DESCRIPTION	Eff. Ser.No.
SK21	131-1654-00	BNC 50Ω EXT TRIG	
SK401	131-1733-00	5 Pin Din	
SK402	136-0389-00	Battery Disconnection	
SK701	131-1733-00	B.N.C. 50 Ω input	
SK741	131-1268-00	2mm Probe test CAL 0.5 V	
T401	120-0885-00	Transformer (Mains)	
T411	120-1036-00	Transformer invertor	

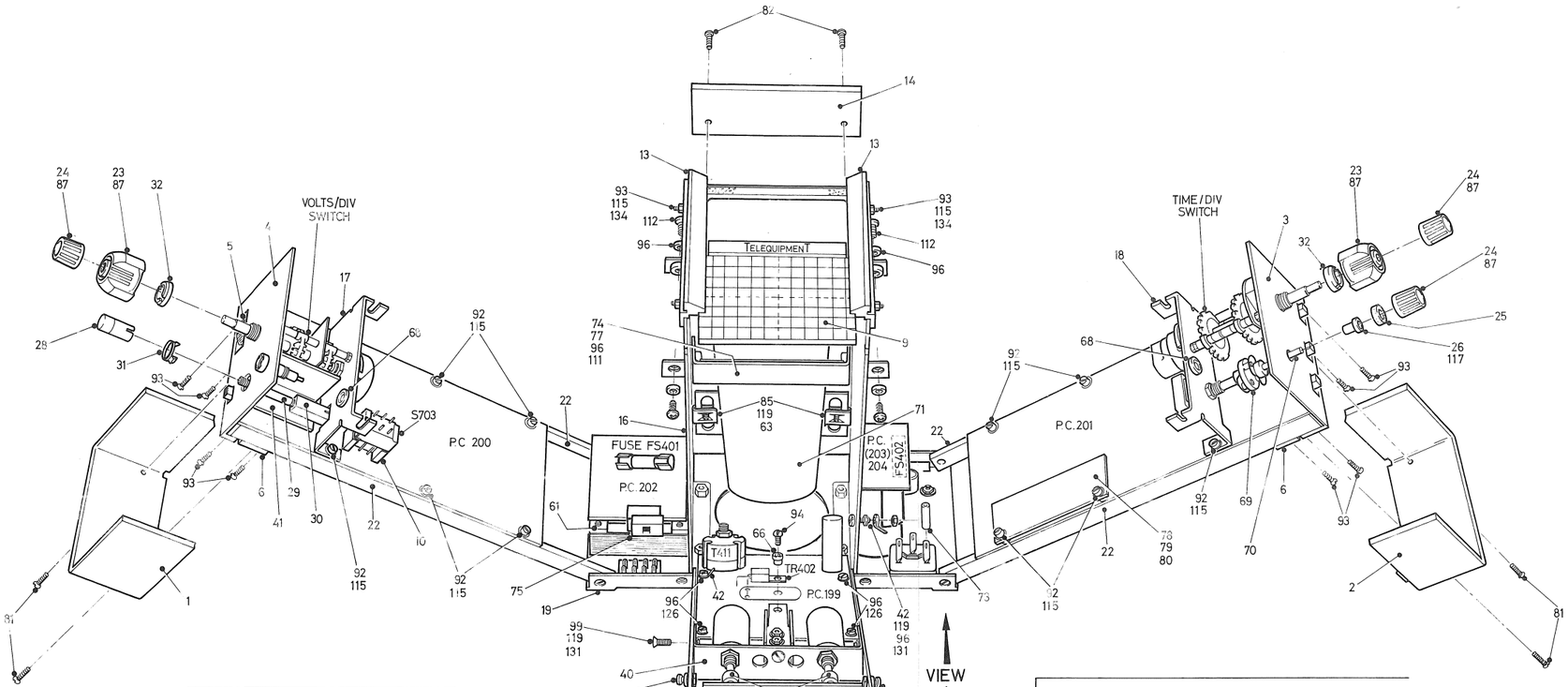
CIR REF	PART NUMBER	VALUE	DESCRIPTION	TOL	RATING	Eff. Ser.No.
TH701	307-0288-00	1.3 k	N.T.C. VA 1038	20	0.5	

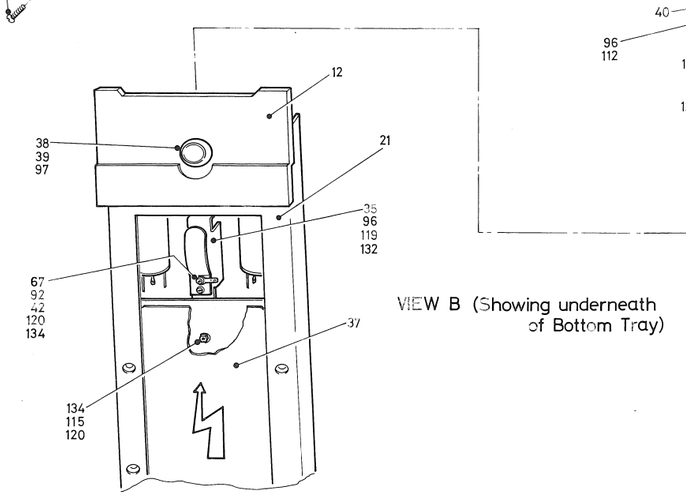
CIR REF	PART NUMBER	DESCRIPTION		TYPE	Eff. Ser.No.
TR21	151-0326-00	BC107	Si	NPN	
TR22	151-0326-00	BC107	Si	NPN	
TR23	151-0326-00	BC107	Si	NPN	
TR24	151-0320-01	MPS6518	Si	PNP	
TR25	151-0317-00	BC109C	Si	NPN	
TR26	151-0320-01	MPS6518	Si	PNP	
TR27	151-0320-01	MPS6518	Si	PNP	
TR101	151-0320-01	MPS6518	Si	PNP	
TR102	151-0127-02	BSX20	Si	NPN	
TR103	151-1076-00	WN537	Si	N.Channel	
TR104	151-0326-00	BC107	Si	NPN	
TR105	151-0326-00	BC107	Si	NPN	
TR106	151-0326-00	BC107	Si	NPN	
TR107	151-0242-00	2N3904	Si	NPN	
TR108	151-0320-01	MPS6518	Si	PNP	
TR111	151-0320-01	MPS6518	Si	PNP	
TR112	151-0257-03	FRB749	Si	NPN	
TR113	151-0257-03	FRB749	Si	NPN	
TR114	151-0320-01	MPS6518	Si	PNP	
TR401	151-0320-01	MPS6518	Si	PNP	
TR402	151-0480-00	2SC1173	Si	NPN	

CIR REF	PART NUMBER	DESCRIPTION		TYPE	Eff. Ser.No.
TR411	151-0479-01	BDX36	Si	NPN	
TR412	151-0479-01	BDX36	Si	NPN	
TR701	151-1036-00	Dual FET	Si	N.Channel	
TR703	151-0326-00	BC107	Si	NPN	
TR704	151-0326-00	BC107	Si	NPN	
TR731	151-0326-00	BC107	Si	NPN	
TR732	151-0320-01	MPS6518	Si	PNP	
TR741	151-0320-01	MPS6518	Si	PNP	
TR742	151-0320-01	MPS6518	Si	PNP	
TR751	151-0320-01	MPS6518	Si	PNP	
TR752	151-0257-03	FRB749	Si	NPN	
TR753	151-0257-03	FRB749	Si	NPN	
TR754	151-0320-01	MPS6518	Si	PNP	
V301	154-0741-00	C.R.T.Type 17D 7GH/L			

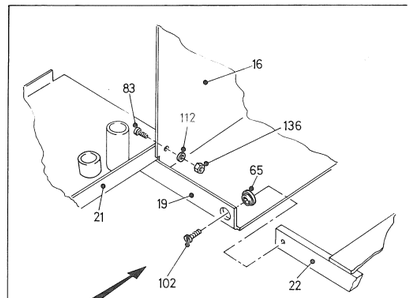


MECHANICAL ASSEMBLY 1
S22





VIEW B (Showing underneath of Bottom Tray)



VIEW A (Showing Tray, Typical hinge for Volts/Div and Time/Div Assy's)

MECHANICAL ASSEMBLY 2
S22

MECHANICAL

For positions of the mechanical parts see the exploded drawings which follow.

DRAWING	PART NUMBER	DESCRIPTION
1	101-0032-01	Front Trim (LH)
2	101-0033-01	Front Trim (RH)
3	333-2128-00	Front Panel (Time/Div)
4	333-2129-00	Front Panel (Volts/Div)
5	366-1406-00	Knob
6	333-2130-00	Side Panel
9	331-0415-00	Graticule Assembly
10	361-0777-00	Block – Switch Spacer
11	333-2127-02	Front Panel (Control)
12	200-1939-00	Front Bezel (Lower)
13	200-1940-00	Front Bezel (Side)
14	101-0034-00	Front Trim (Upper)
15	343-0207-00	Cable Cleat
16	441-1318-00	Centre Chassis
17	407-1778-00	Bracket
18	407-1779-00	Bracket
19	333-2126-00	Rear Panel
20	016-0360-00	Rear Protection Cover Assembly
21	441-1317-01	Bottom Tray
22	381-0351-01	Bar
23	366-1654-00	Knob Assembly
24	366-1657-01	Knob Assembly
25	310-1247-00	Felt Washer
26	358-0460-00	Bush
27	366-1656-01	Knob Assembly
28	366-1414-15	Knob – Push Button Assembly
29	384-1141-07	Shaft Extension
30	376-0132-00	Coupling
31	200-1885-00	Bezel
32	220-0527-00	Nut Ring
33	376-0137-01	Coupling
34	384-1381-00	Extension Rod
35	407-1776-00	Bracket – Heat Sink
36	253-0194-00	Insulating Tape (330 mm)
37	200-1938-01	Cover Warning
38	348-0167-01	Foot
39	200-0882-01	Foot Cap
40	407-1777-00	Bracket
41	407-1780-00	Screen (Electrical)
42	210-0297-00	Solder Tag – 6BA
43	437-0201-00	Cabinet – Cover
44	367-0208-02	Handle (LH)
45	367-0208-03	Handle (RH)
46	214-2286-00	Ring Index (LH)
47	214-2286-01	Ring Index (RH)
48	210-1235-00	Washer (Handle)
49	105-0680-00	Catch (Handle)
50	200-1830-01	Cap (Handle)
51	214-2287-00	Spring (Handle)
52	367-0207-02	Grip (Handle)
53	210-3061-00	Tubular Eyelet
54	101-0027-02	Handle Trim (LH)
55	101-0027-03	Handle Trim (RH)
56	352-0447-00	Battery Holder
57	352-0448-00	Battery Holder Insulator
58	343-0500-01	Capacitor Clamp
59	334-2711-00	Label (Fuse)
60	334-2752-00	Label (Mandatory Mod)
61	343-0512-00	Transformer Clamp
62	200-1937-01	Transformer Cover
63	220-0727-00	'U' Nut
64	334-2712-01	Plate – Name
65	361-0670-01	Spacer – Pivot
66	361-0275-00	Spacer Bush
67	131-1259-00	Earthing Contact
68	348-0161-00	Grommet
69	376-0148-01	Flexible Coupling
70	384-1381-00	Shaft Extension
71	337-2285-00	CRT Shield
72	200-2126-00	Cover Fuse Insul.
73	166-0502-00	Insulating Sleeve
74	407-1781-00	Bracket (CRT)
75	391-0128-01	Voltage Indicator
76	334-2710-01	Label – Rear
77	252-0614-00	Foam Strip
78	337-2321-00	Shield (Electrical)

DRAWING	PART NUMBER	DESCRIPTION
79	361-0784-00	Spacer
80	124-0330-00	Insulator
81	213-0699-00	Screw 8 BA R/CSK X 3/8"
82	213-0639-02	Screw 6 BA R/CSK X 3/16"
83	213-0280-00	Screw 6 BA CH HD X 1/4" (Nylon)
85	213-0727-00	Screw S/T No.4 PAN HD X 3/8"
87	213-0248-00	Screw Set M3 x 3 mm
91	213-0458-00	Screw 8 BA CH HD X 3/16"
92	213-0460-00	Screw 8 BA CH HD X 1/4"
93	213-0454-00	Screw 8 BA CSK HD X 1/4"
94	213-0746-00	Screw 8 BA RD HD X 5/16"
95	213-0392-00	Screw 6 BA PAN HD X 3/16"
96	213-0393-00	Screw 6 BA PAN HD X 1/4"
97	213-0406-00	Screw 6 BA PAN HD X 3/8"
98	213-0395-00	Screw 6 BA PAN HD X 1"
99	213-0391-00	Screw 6 BA CSK HD X 1/4"
100	213-0404-00	Screw 6 BA CSK HD X 5/16"
102	213-0321-00	Screw 6 BA CH HD X 1/4"
105	213-0665-01	Screw 6 BA MUSH HD X 1/2"
107	213-0482-00	Screw 4 BA PAN HD X 1/4"
108	213-0475-00	Screw 4 BA CSK HD X 3/8"
109	213-0403-00	Screw 4 BA CSK HD X 1/2"
110	213-0515-00	Screw 2 BA PAN HD X 1/2"
111	210-1204-00	Washer 6 BA Small
112	210-1207-00	Washer 6 BA Large
115	210-1213-00	Washer 8 BA Small
117	210-1203-00	Washer 2 BA Shakeproof
118	210-1215-00	Washer 4 BA Shakeproof
119	210-1210-00	Washer 6 BA Shakeproof
120	210-1214-00	Washer 8 BA Shakeproof
121	200-1202-00	Transistor cover for T018
126	213-1159-00	Washer 6 BA SRBP
130	220-0714-00	Nut 4 BA (Full)
131	220-0716-06	Nut 6 BA (Full)
132	220-0717-00	Nut 6 BA (Half)
134	220-0718-00	Nut 8 BA (Full)
136	220-0720-00	Nut 6 BA Nylon

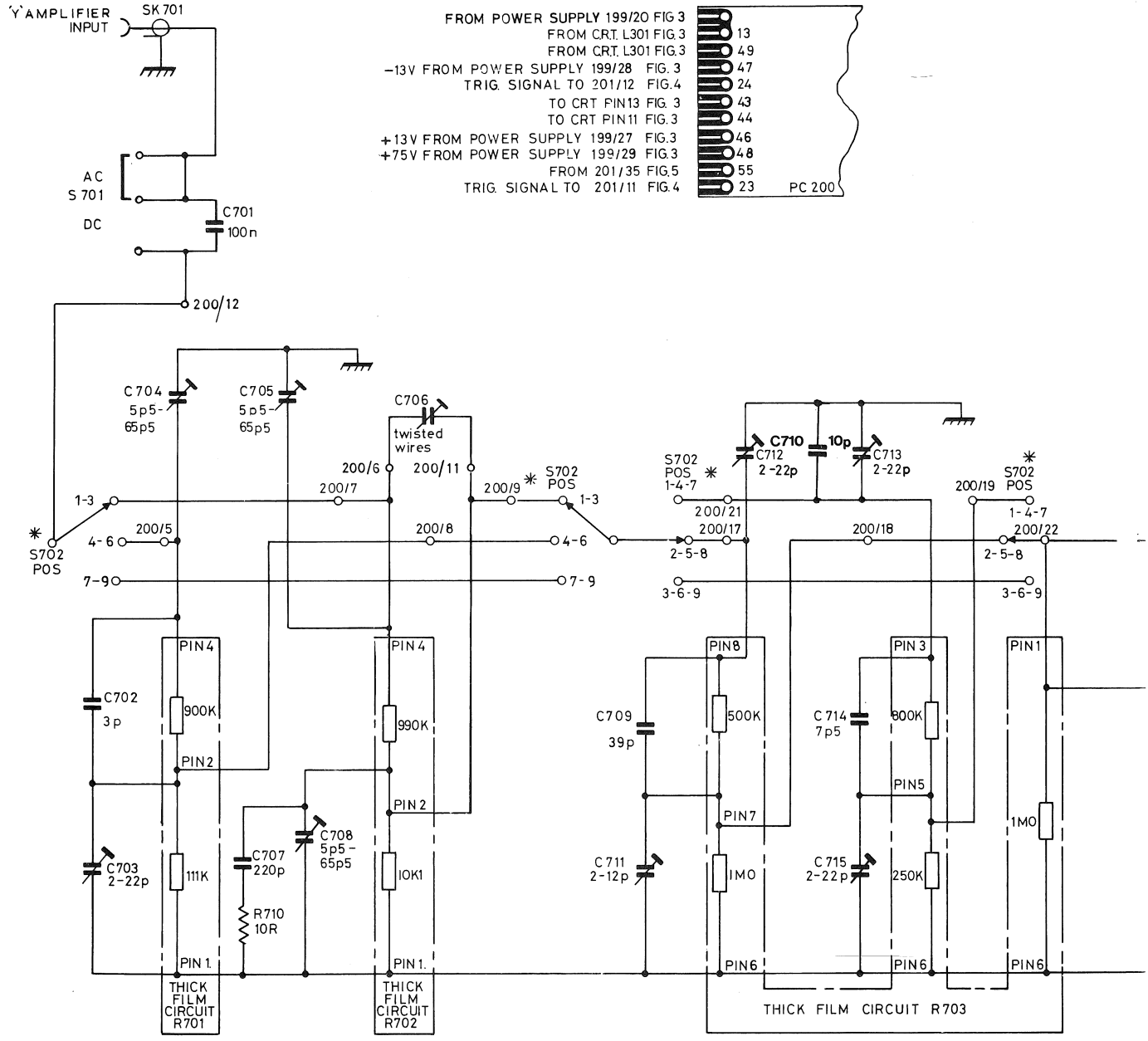
SECTION 6

CIRCUIT DIAGRAMS

To minimise the risk of misinterpretation of component values on circuit diagrams, the decimal point has been replaced by the multiplier or sub-multiplier of the basic unit. For instance, 2.2 megohms is shown as 2M2 and 1.8 picofarads is shown as 1p8.

To aid the reader further, in addition to the block Circuit Reference Table in Section 5.1, to locate a component in the circuit diagram, a table is provided at the top of each circuit diagram, in which the circuit reference will appear, where practicable, directly above the component being sought.

RESISTORS	701 710 702 703
CAPACITORS	704 707 705 708 706 711 712 713 701 714 702 709 715 703 710
MISC.	SK701
	S702 S701



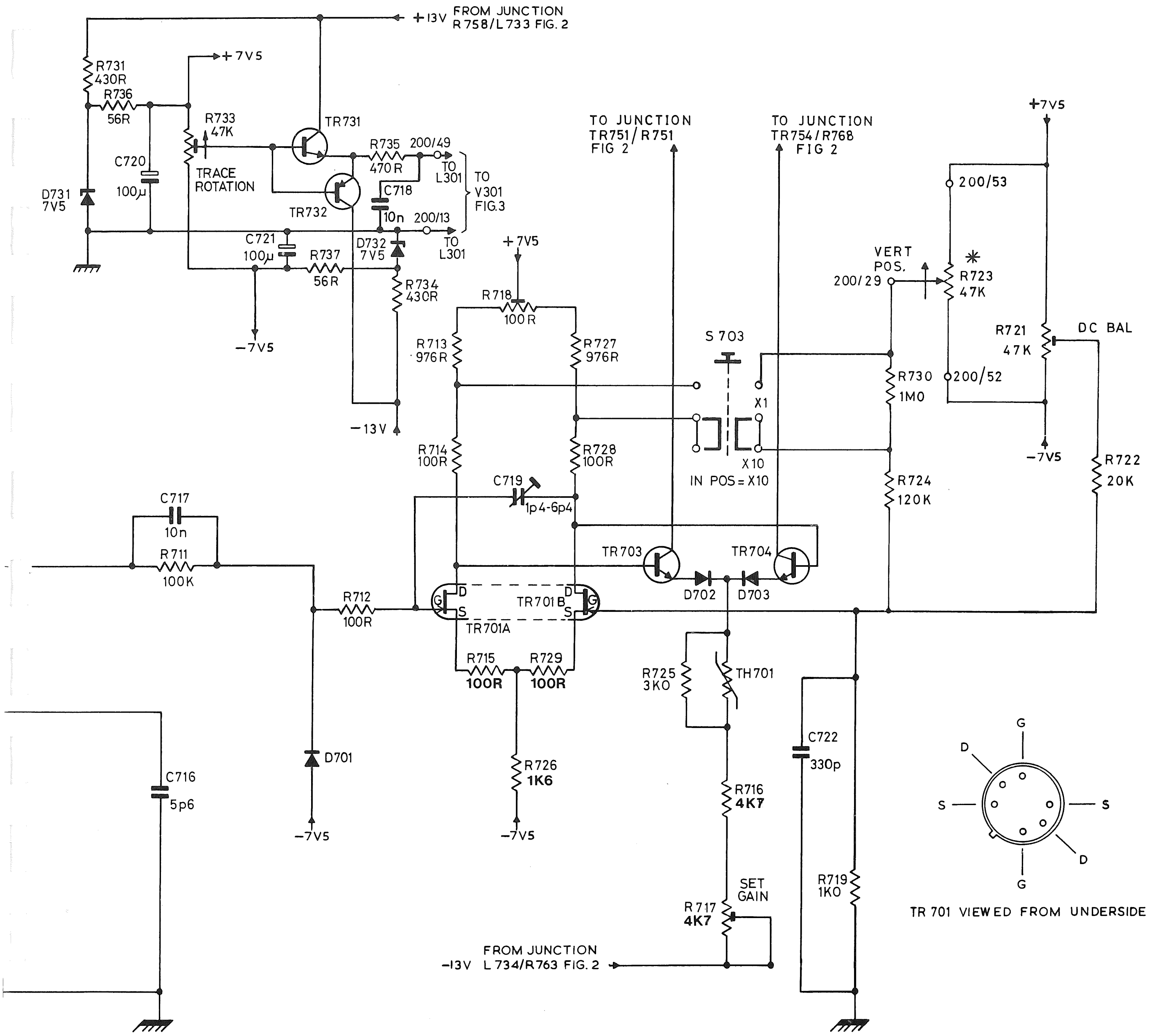
NOTE

1. * DENOTES COMPONENTS NOT MOUNTED ON P.C. BOARD
2. 200/7 DENOTES PC BOARD EYELET OR TERMINAL Nº. CONNECTION.
3. ALL SLIDER SWITCHES ORIENTATED IN THE DOWN POSITION.
4. SWITCHES SHOWN IN FULLY ANTI-CLOCKWISE POSITION

731 711 733 712 734 713 718 727 725 716 719 721 722 723 724
736 737 735 714 726 728 717 730
715 729

717 716 718 719 722

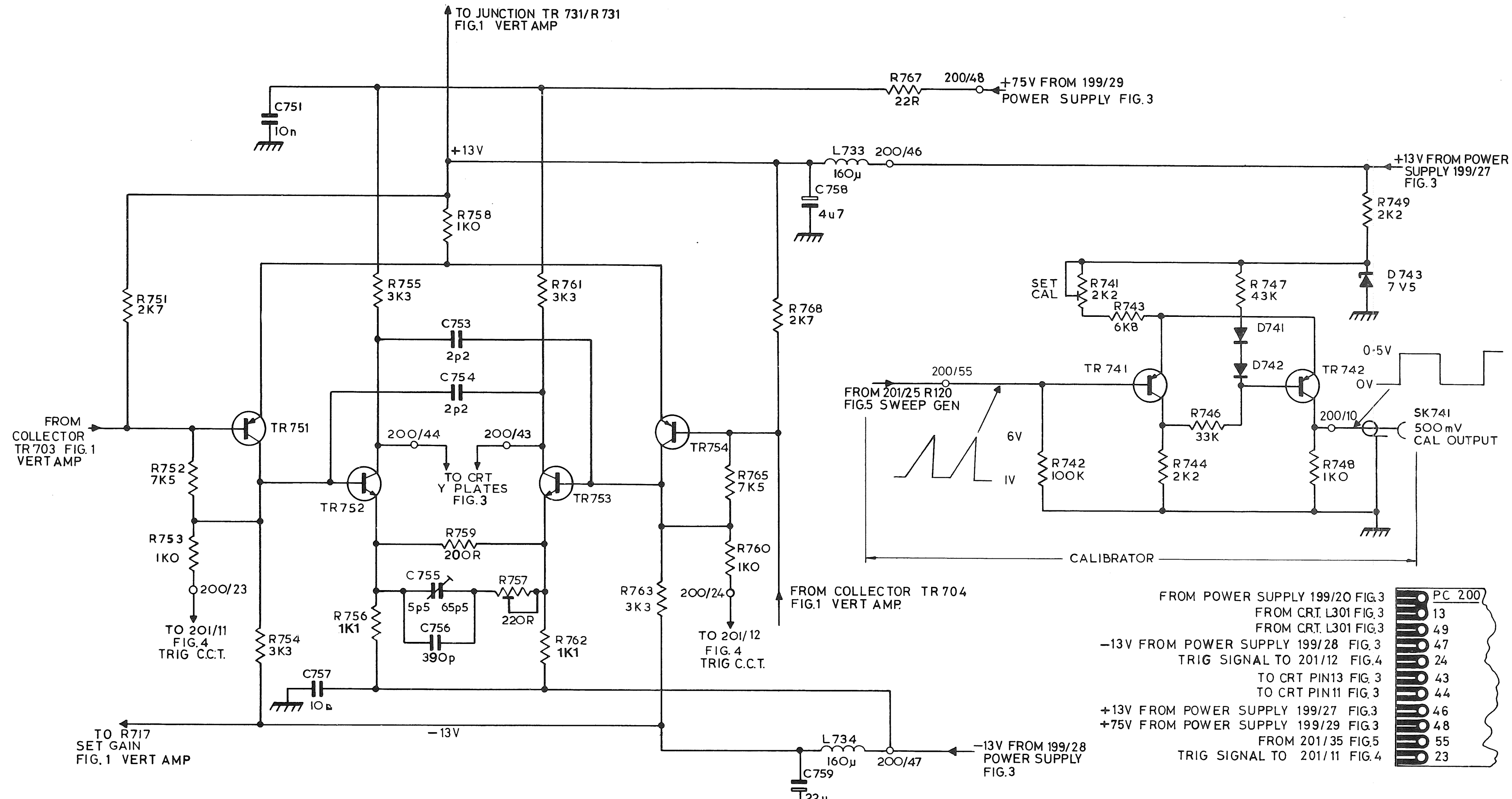
D731 D701 TR731 D732 TR701A TR703 S703 TR704 D702 D703
TR732 TR701B TH701 S703



VERTICAL AMPLIFIER S22

PC200 FIG. 1

RESISTORS	751	752 753	754		755 756	758 759	757	761 762	763	765 760	768	767	742	741	744	746	747	748	749
CAPACITORS			751	757		755 756	753 754				758 759								
MISC.			TR751		TR752			TR753	TR754			L733 L734			TR741		D741 D742	TR742	D743 SK741



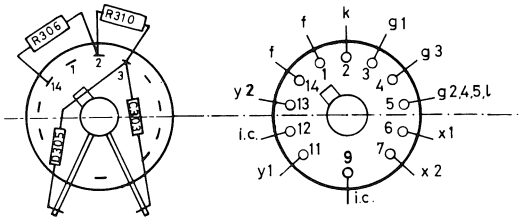
NOTE
200/35 DENOTES P.C. BOARD EYELET OR TERMINAL No. CONNECTION.

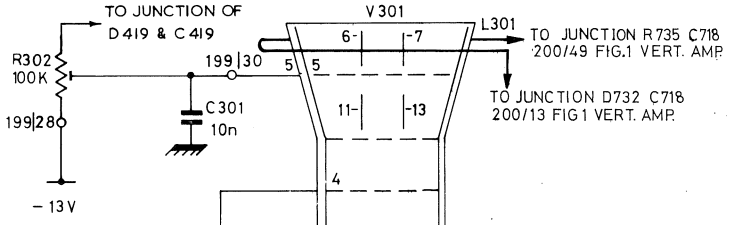
CALIBRATOR & VERTICAL AMPLIFIER S22
PC200 FIG. 2

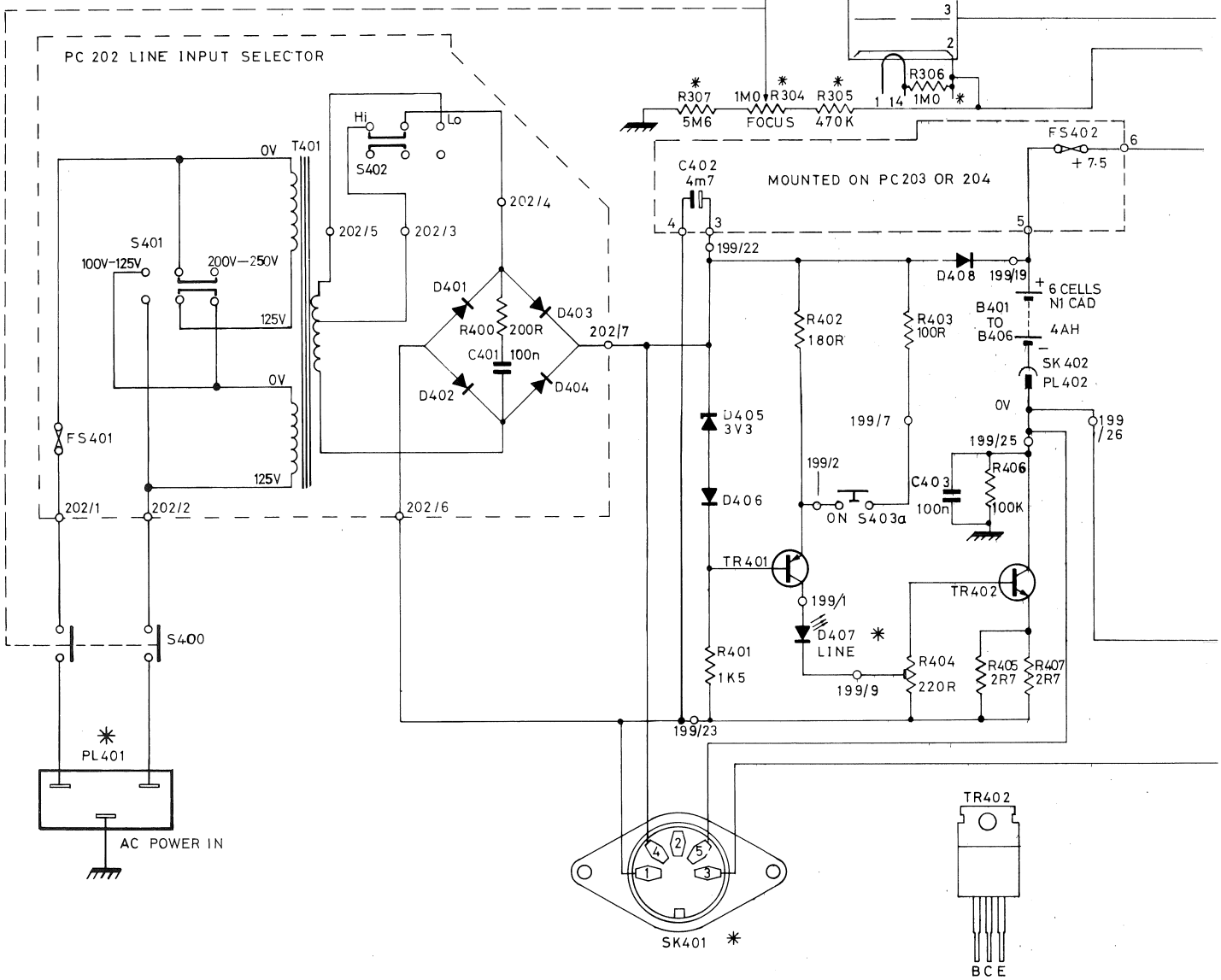
7/77.

RESISTORS	400 302 307 304 305 306 406 407 401 402 403 404 405
CAPACITORS	401 402 301 403
MISC.	S400 D401 D403 SK401 D405 TR401 S403a V301 TR402 FS402 FS401 PL401 S401 T401 S402 D402 D404 D406 D407 D408 B401-406 L301

CRT BASE CONNECTIONS





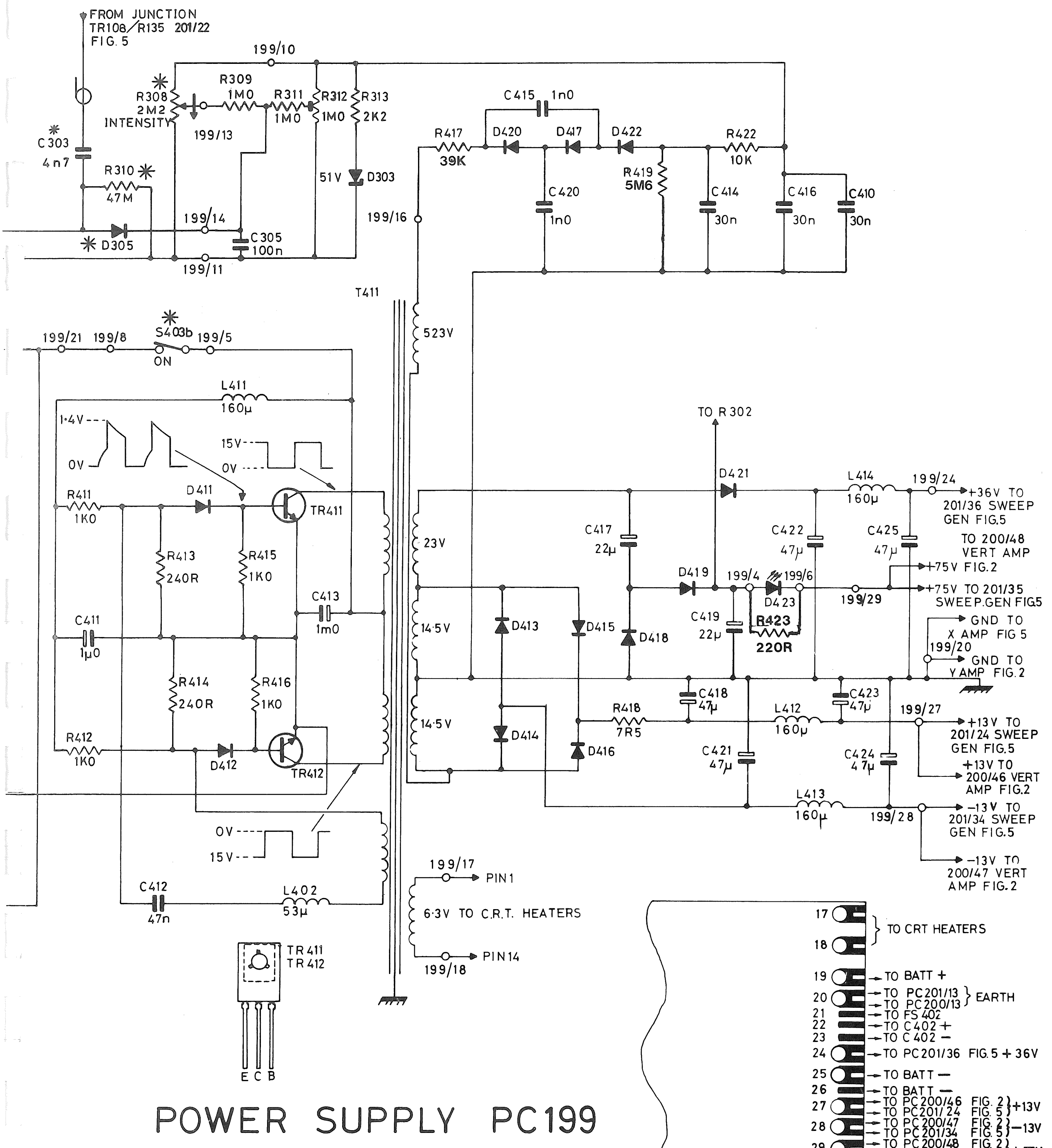


BATTERY CHARGER

NOTES.

1. * DENOTES COMPONENTS NOT MOUNTED ON PC BOARDS
2. 199/31 DENOTES PC BOARD EYELET OR TERMINAL No CONNECTION
3. ALL SLIDER SWITCHES ORIENTATED IN THE DOWN POSITION

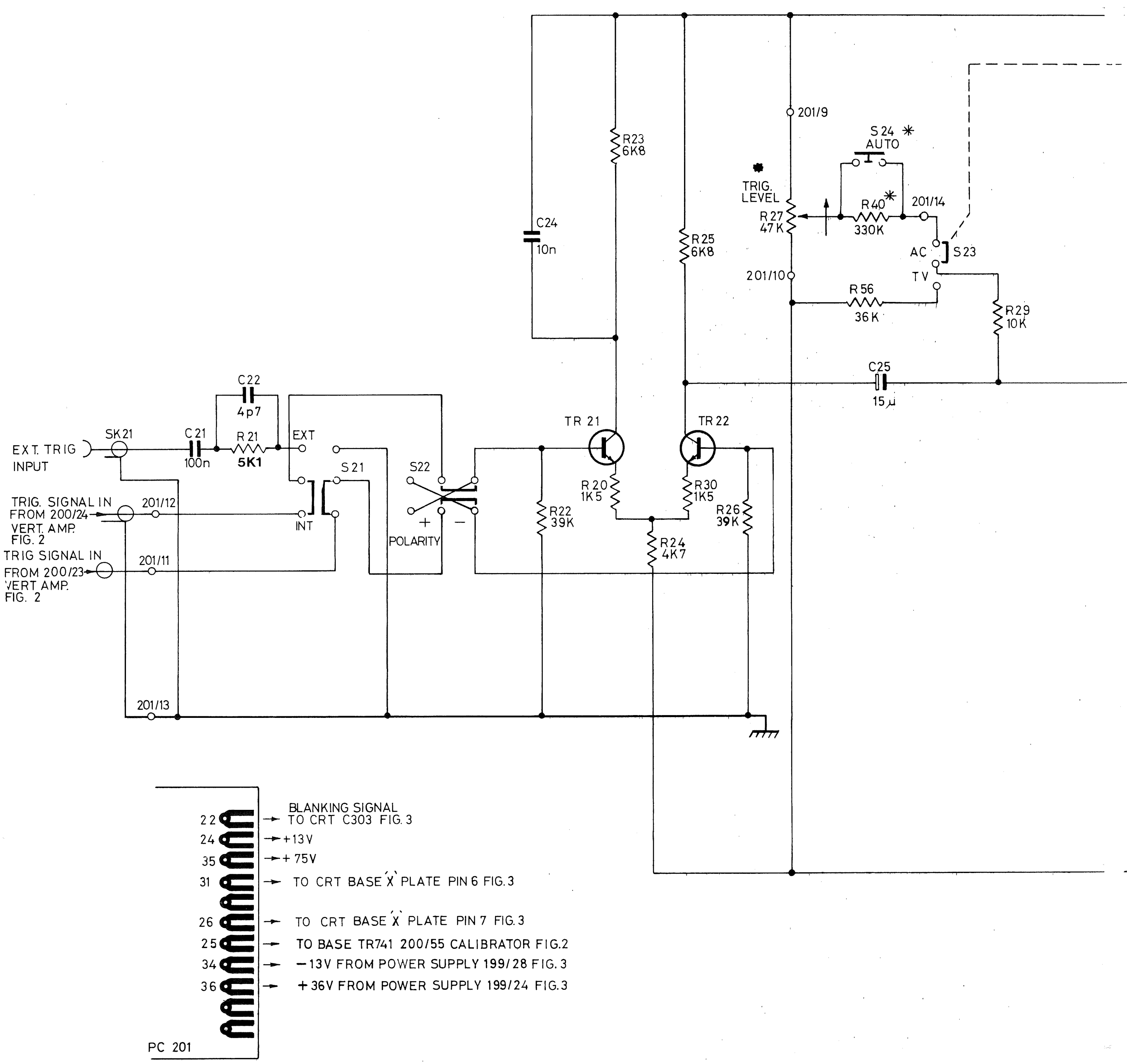
412 310 411	308 413	309 414	311 415	312 416	313	417		418	419	422	423			
411 303	412	305	413			415 420	417	418	419 414	421 416	422	423 410	424	425
D305	S403b	D411 D412 L411	TR411 TR412 L402	D303 T411		D413 D414 D420	D415 D416 D417	D422 D418	D419 D421	D423 L412 L413	L414			



POWER SUPPLY PC199

FIG. 3 S 22

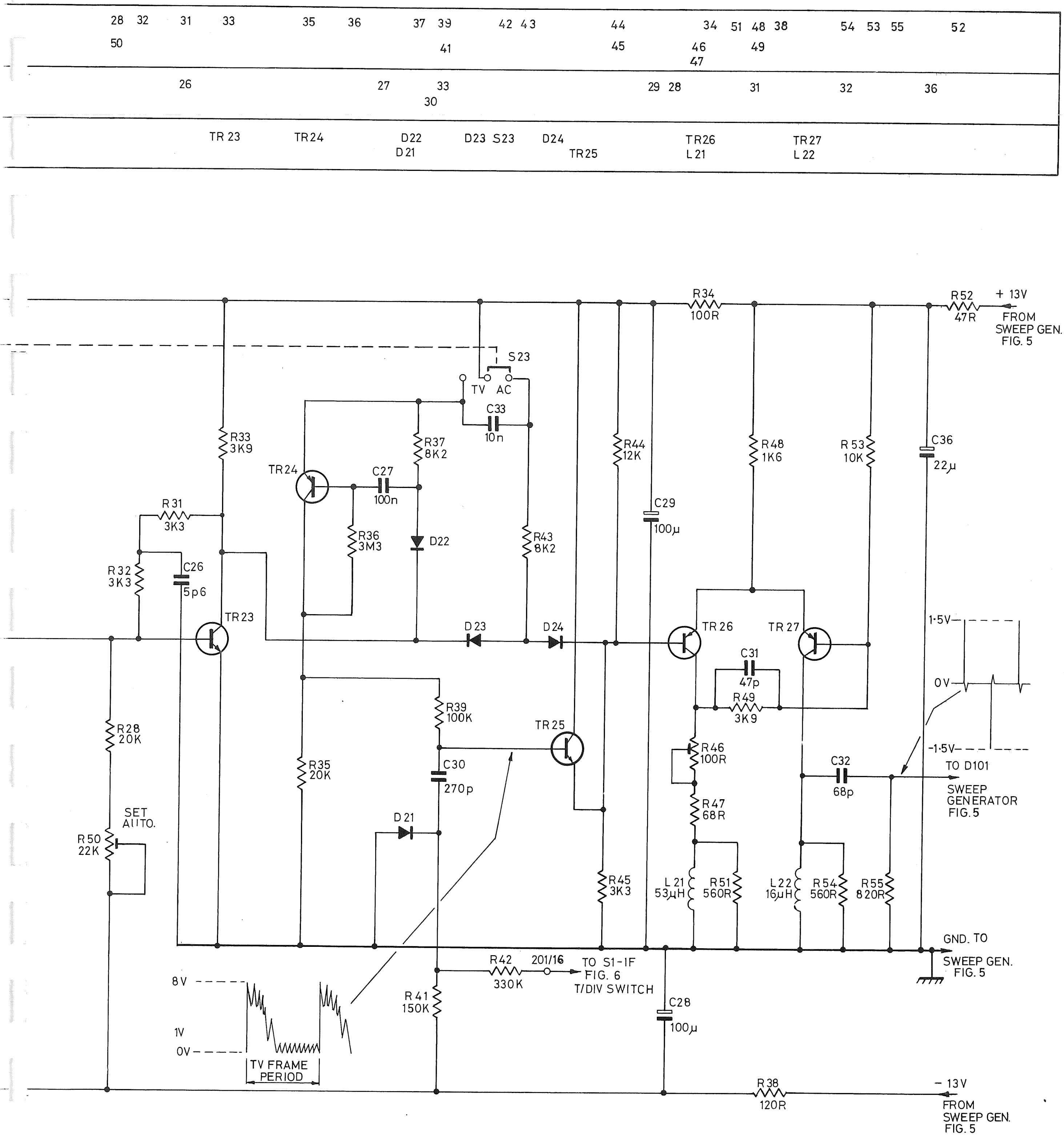
RESISTORS			21			22	23 20	24	25 30	26	27	40 56		29
CAPACITORS		21	22			24						25		
MISC.	SK 21			S 21	S22		TR21		TR22			S24	S23	



VIEWED FROM COMPONENT SIDE

NOTES
1 ✱ DENOTES COMPONENTS NOT MOUNTED ON PC BOARD.
2 201/4 DENOTES P.C. BOARD EYELET OR TERMINAL No. CONNECTION
3 ALL SLIDER SWITCHES ORIENTATED IN THE DOWN POSITION.

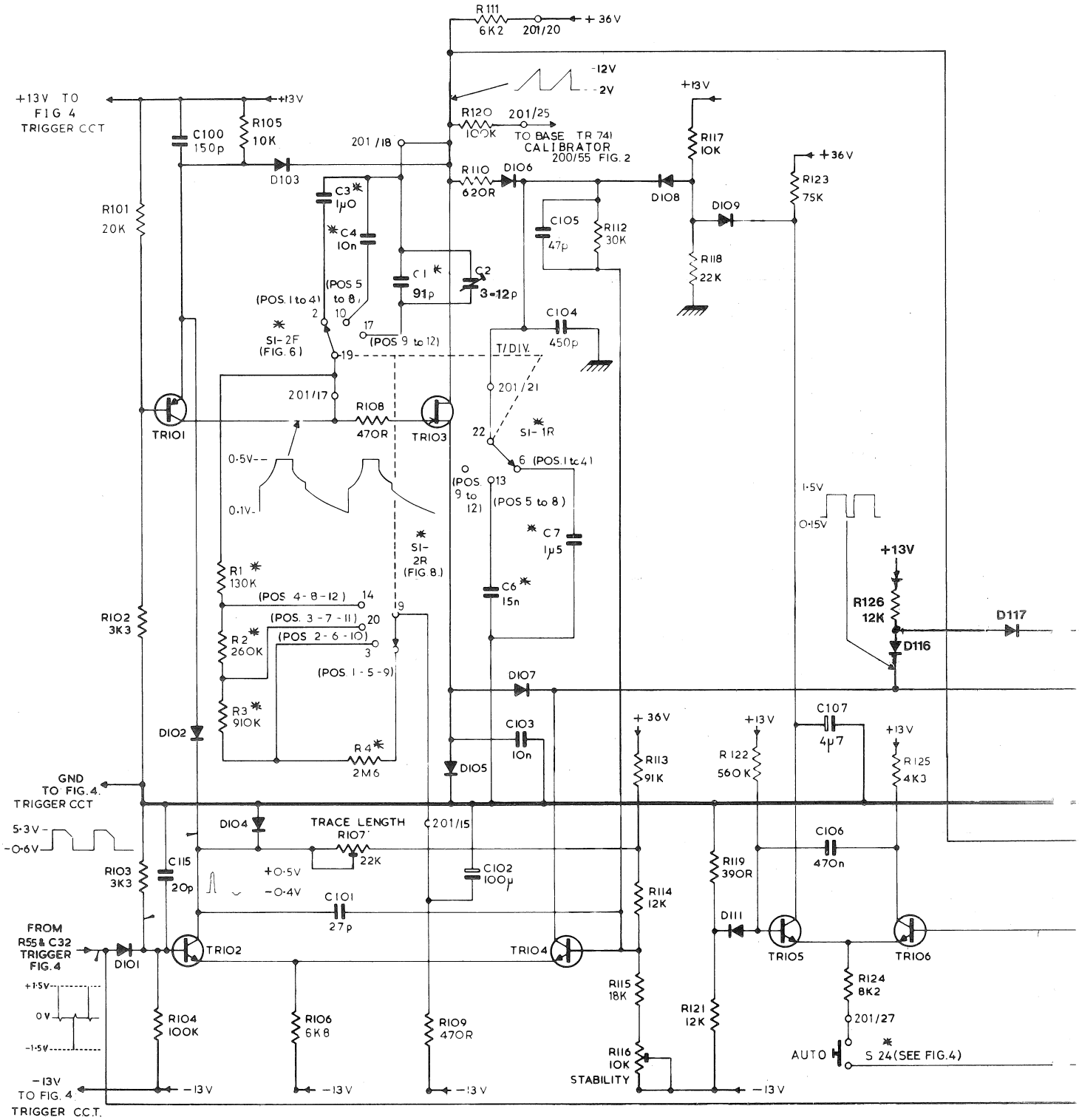
4L
7/77



S22 TRIGGER CIRCUIT - PC. 201

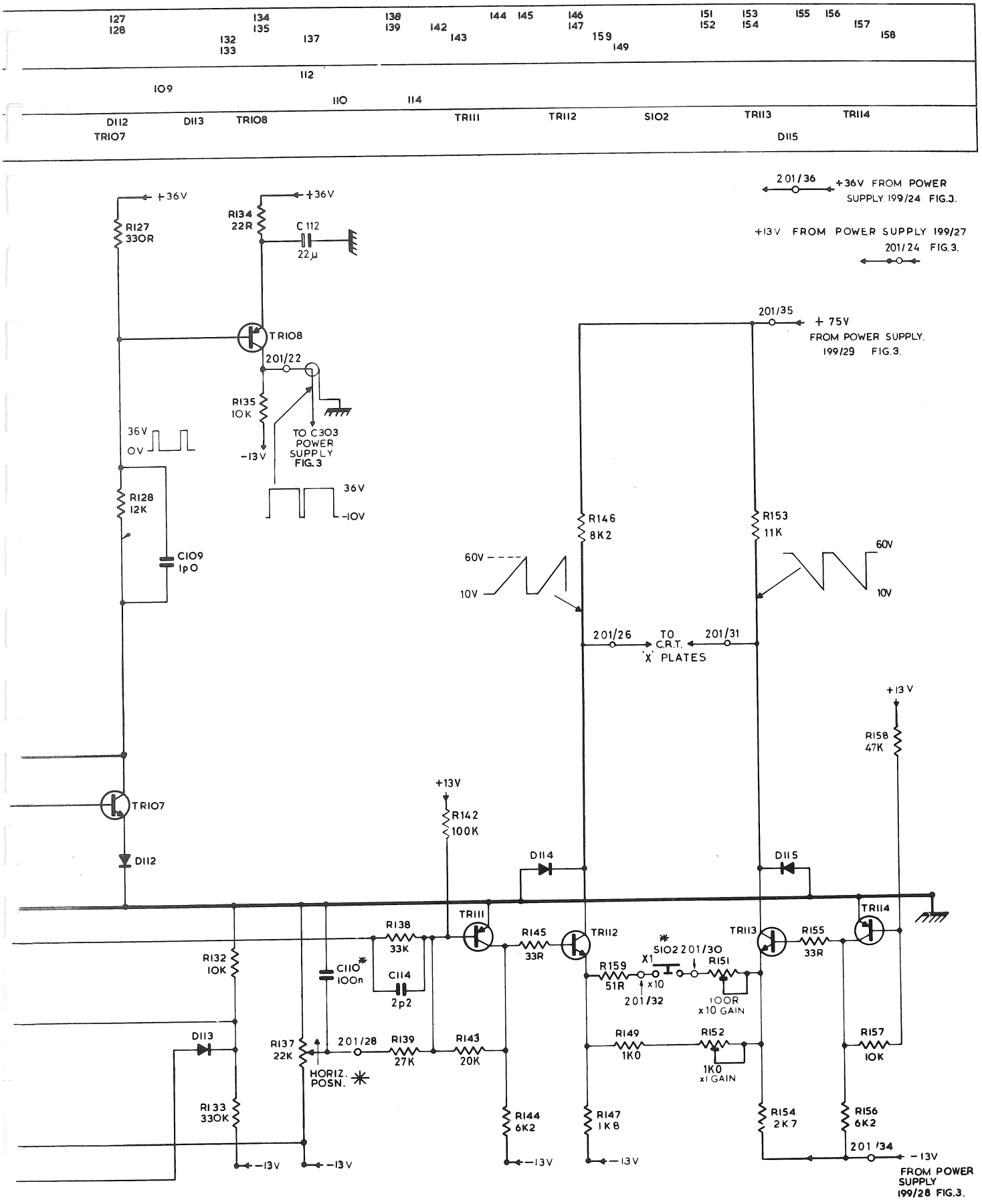
FIG. 4

RESISTORS	101 1 106 107 5 109 112 113 117 123 124 125 126 102 2 108 111 114 118 103 3 115 119 104 110 116 121 122 105 120
CAPACITORS	101 102 103 106 3 4 1 2 6 104 7 107 100 115 105
MISC.	D101 D102 D104 SI 2F SI-2R D105 D107 D108 D109 S24 D117 D103 D106 TRI04 D111 TRI06 TRI01 TRI02 TRI03 SI-1R TRI05 D116



NOTES

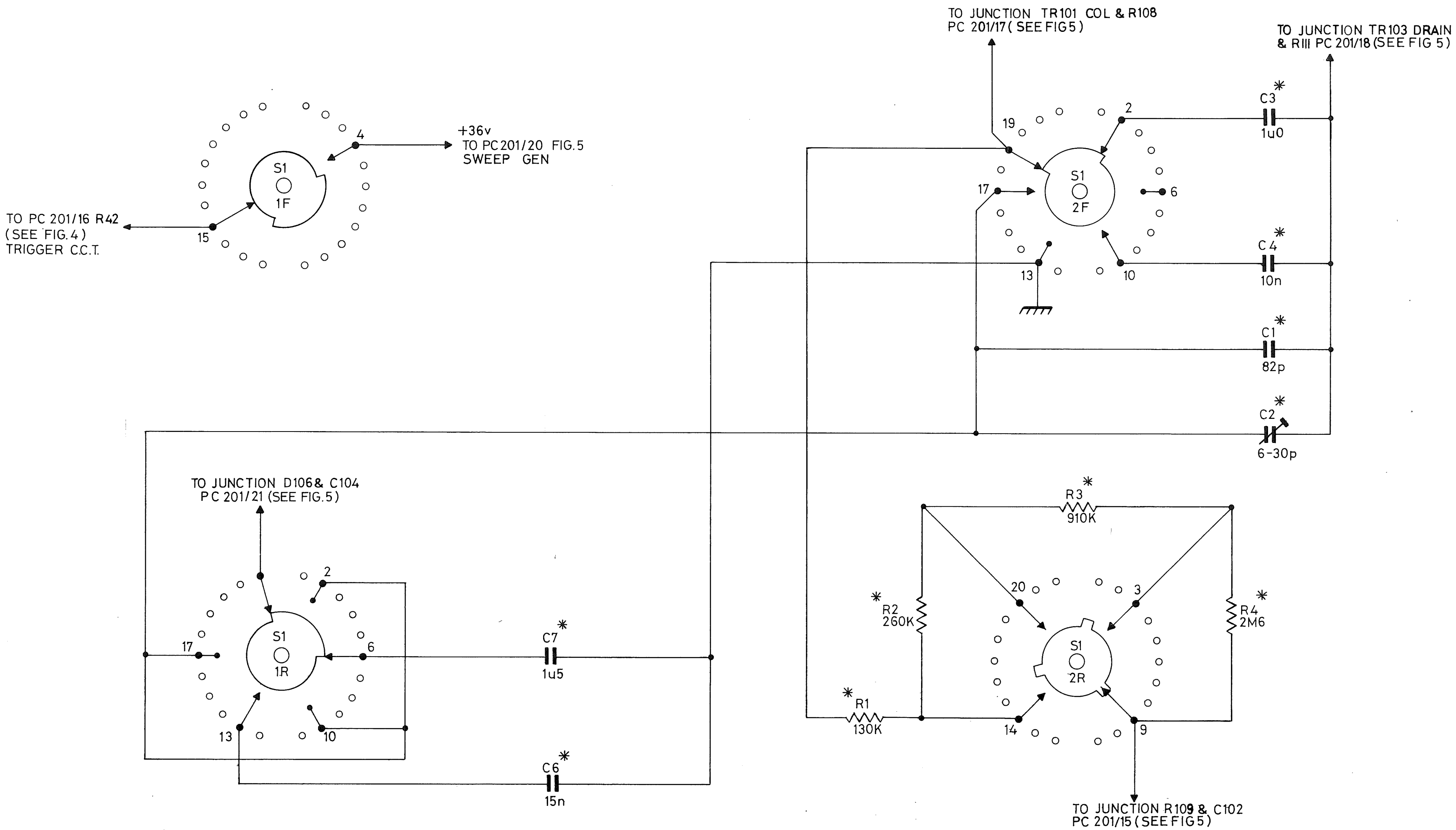
1. * DENOTES COMPONENTS NOT MOUNTED ON PC BOARD.
2. 201/15 DENOTES PC BOARD EYELET OR TERMINAL No CONNECTION.
3. SEE FIG 4 FOR EDGE CONNECTIONS.
4. ALL SLIDER SWITCHES ORIENTATED IN THE DOWN POSITION.



S22 SWEEP GENERATOR. UNBLANKING & 'X' AMP — P.C. 201

FIG. 5.

RESISTORS			1	2	3	4
CAPACITORS		7 6				3 4 1 2
MISC.	S1-1F S1-1R				S1-2F S1-2R	



NOTES
1. SWITCH IS SHOWN IN 300ms/DIV. POSITION
2 * DENOTES THAT COMPONENTS ARE NOT MOUNTED ON A PC BOARD

TIME/DIV. SWITCH
S22 FIG. 6