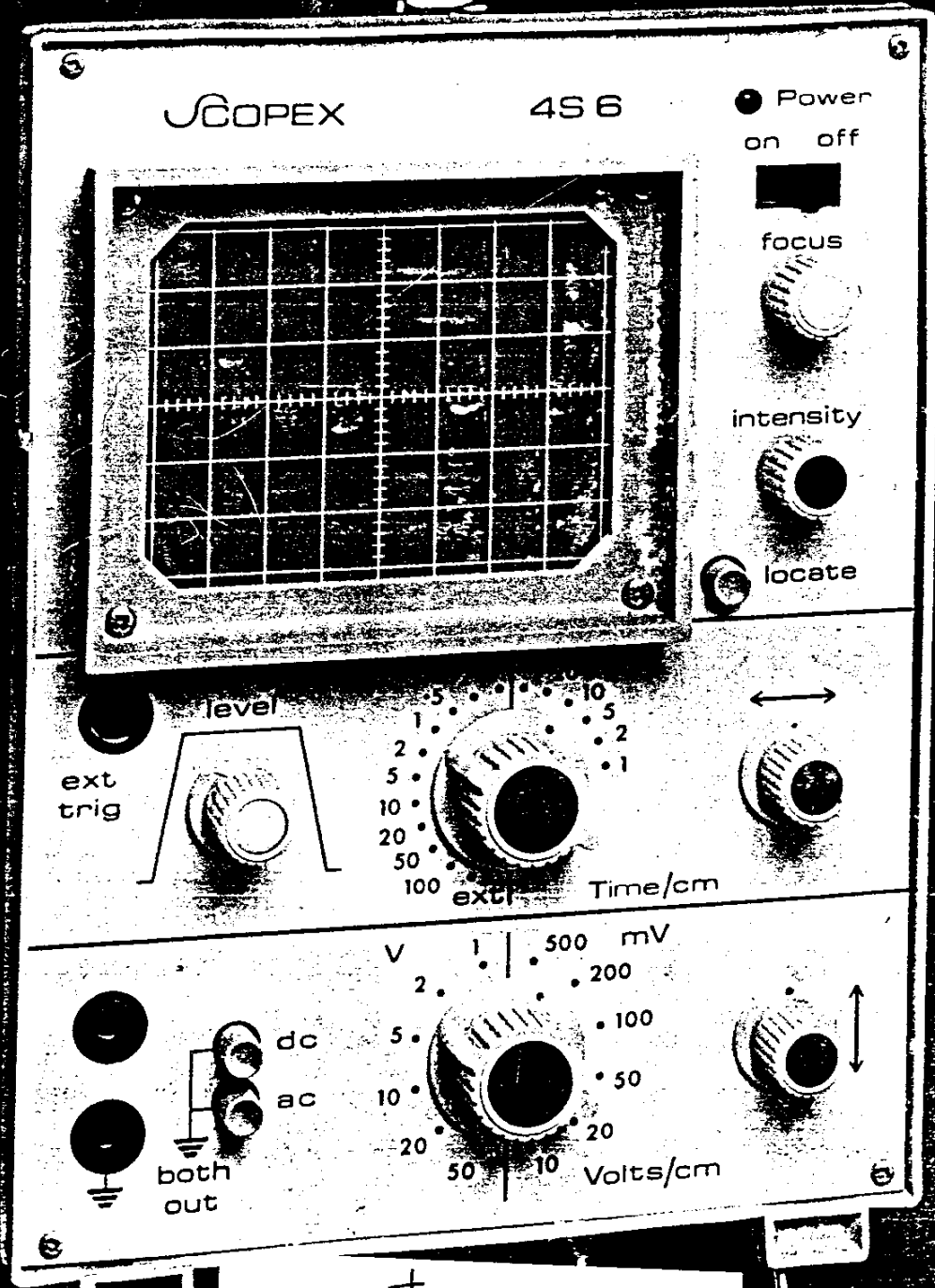
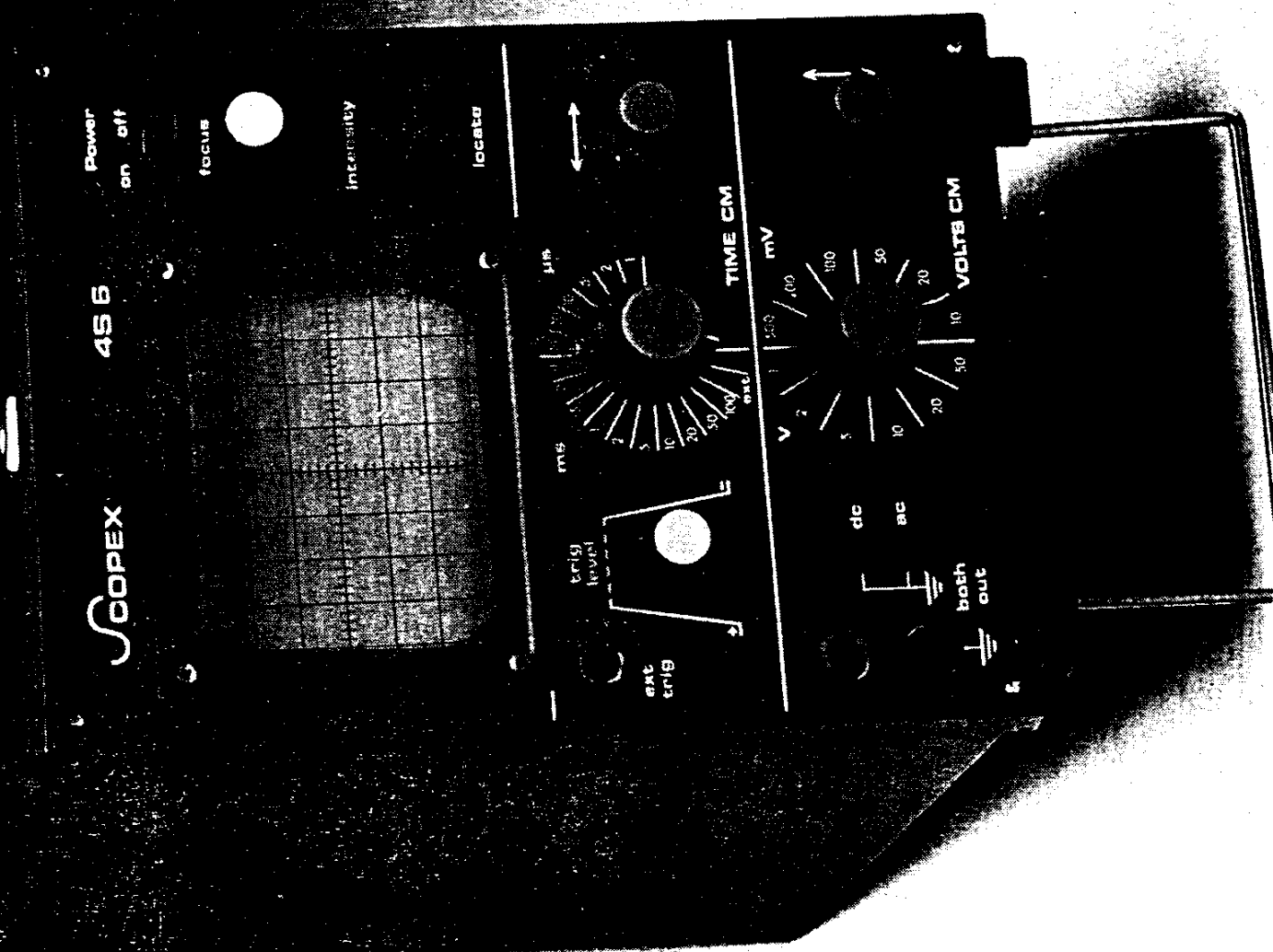


SCOPEX 4S-6 Single Beam Oscilloscopes



+
CALSCOPE SUPER 6
FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554

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



- ★ Full 6MHz operation
- ★ 10mV sensitivity
- ★ Timebase 1 μ s to 100ms/cm
- ★ All solid state circuitry
- ★ "Glarecheq" Graticule★

Scopex 4S-6 is a portable single-beam 6 MHz bandwidth oscilloscope with easy-to-use controls. It is ideally suited for schools, technician training and television servicing. The 4S6-LS has been specially produced for the investigation of low frequency signals beyond the timebase range of the 4S6.

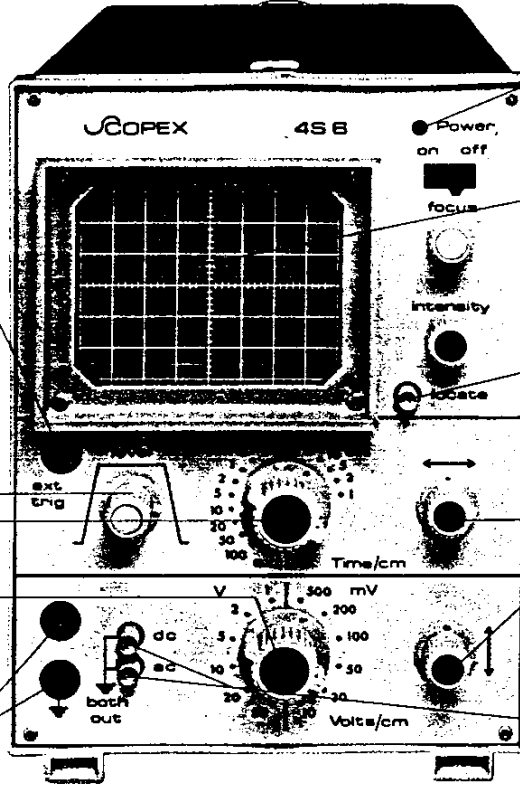
External trigger facility is automatically selected by insertion of standard 4mm plug.

Gives you precise control of the point of triggering.

Wide range timebase with 16 calibrated speeds from 1 μ S/cm to 100mS/cm and external input for Lissajous and phase comparison.

Sensitivities from 10mV/cm to 50V/cm selected from 12 calibrated ranges.

Input, standard 4mm sockets on standard 19mm centres.



Power ON/OFF indicator.

"Glarecheq" non reflective graticule for trouble free and easy measurement.

Trace locate button returns a lost trace to the display area irrespective of the control settings.

X-Y position controls colour coded to match corresponding timebase-sensitivity controls

Instant ground reference on input coupling switch gives accurate d.c. measurements.

4S-6 SPECIFICATION

Vertical Deflection System

Sensitivity: 10mV/cm-50V/cm (12 Calibrated ranges)
 Bandwidth:
 DC coupled; DC - 6MHz (-3 dB)
 AC coupled; 3Hz - 6MHz (-3 dB)
 Input coupling: AC, DC, Ground
 Input Impedance: 1M Ω + 35pF approx
 Input Sockets: 4mm (19mm between centres)
 Risetime: 60nS approx
 Accuracy: \pm 5%
 Maximum Input Voltage:
 400V (DC + AC Peak to 10kHz)
 Controls Colour Coded RED
 Horizontal Deflection System
 Sweep Speeds: 1 μ S/cm-100mS/cm (16 Calibrated ranges)
 Accuracy: \pm 5%
 External Sensitivity: 1V/cm approx
 External Bandwidth: DC - 100 KHz
 Max External Input: 250V (DC + AC Peak to 3kHz)

Controls Colour Coded BLUE

Trigger Circuit
 Sources: Internal, External
 Sensitivity:
 Internal: 5mm, 10Hz-1MHz rising to 1.5cm at 6MHz
 External: 200mV, 10Hz-1MHz rising to 500mV at 6MHz
 Bright Line Auto:
 Trace free runs in absence of trigger signal at all sweep speeds (facility to disable)
 External Selection:
 Automatically selected when 4mm plug is inserted into input socket
 Max External Input:
 250V (DC + AC Peak to 3KHz)
 External Input Socket: 4mm Socket
 Trigger Level and Polarity:
 Both functions selected on one continuously variable control
 Control Colour Coded YELLOW
 General Information
 Display:
 Graticule ruled 6cm x 8cm, Cathode Ray

Tube with P31 medium persistence phosphor supplied as standard.
 Dimensions (excluding handle):
 H, 8 1/2" (217mm) W, 6 1/2" (159mm)
 D, 12" (306mm)
 Weight: 10lb. (4.5kg)
 Power Requirements:
 105-125, 210-250V AC 48-60Hz, 15 VA
 Options (available on request)
 CRT with P7 long persistence phosphor

4S6-LS SPECIFICATION

Specification details are identical to the 4S6, with the following exceptions:
Horizontal Deflection System
 Timebase: 10us/cm to 1 Sec/cm in 16 calibrated ranges.
 Accuracy: \pm 5%
 Trigger: Bright Line Auto Disable switch fitted to trigger level control.
 Sensitivity:
 Internal; 5mm 3Hz - 1MHz rising to 1.5cm at 1Hz and 6MHz.
 External; 200mV 3Hz - 1MHz rising to 500mV at 1Hz and 6MHz.
 Max. external input: 100V. (DC + AC Peak to 1KHz)
C.R.T.:
 P7 long persistence phosphor.
 Accessories
 High Impedance Probe
 Fitted Protectomuff
 Light Hood

SCOPEX is the trade mark of Scopex Instruments Limited

Our policy is one of continuous development and we reserve the right to amend this specification without prior notice.

"Glarecheq" is the registered trade mark of Chequers Engraving Ltd.

Scopex Instruments
 Pixmore Industrial Estate,
 Pixmore Avenue, Letchworth,
 Herts. SG6 1JJ
 Letchworth 72771 (STD 046 26)

4S6 SPECIFICATION

Vertical Deflection System

Sensitivity: 10mV/cm - 50V/cm. (12 Calibrated ranges).
Bandwidth: DC coupled; DC - 6MHz (-3dB), AC coupled; 3Hz - 6MHz (-3dB).
Input coupling: AC, DC, Ground.
Input impedance: $1M\Omega + 35pF$ approx.
Input sockets: 4mm (19mm between centres).
Risetime: 60ns approx.
Accuracy: $\pm 5\%$
Maximum Input Voltage: 400V (DC + AC Peak to 10kHz).
Controls colour coded RED.

Horizontal Deflection System

Sweep speeds: 1 μ s/cm - 100ms/cm (16 calibrated ranges).
Accuracy: $\pm 5\%$.
External sensitivity: 1V/cm approx.
External bandwidth: DC - 100KHz.
Max. external input: 250V (DC + AC Peak to 3kHz).
Controls colour coded BLUE.

Trigger Circuit

Sources: Internal, External.
Sensitivity: Internal; 5mm, 10Hz - 1MHz rising to 1.5 cm at 6MHz.
External; 200mV, 10Hz - 1MHz rising to 500mV at 6MHz.
Bright line auto: Trace free runs in absence of trigger signal at all sweep speeds, (facility to disable).
External selection: Automatically selected when 4mm plug is inserted into input socket.
Max. external input: 250V (DC + AC Peak to 3KHz).
External input socket: 4mm socket.
Trigger level and Polarity: Both functions selected on one continuously variable control.
Control colour coded YELLOW.

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES

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

cont:-

4S6 Specification cont:-

General Information

Display: Graticule ruled 6cm x 8cm.

Cathode ray tube with P31 medium persistence phosphor supplied as standard.

Dimensions (excluding handle):

H. 8½" (216mm) W. 6¼" (159mm) D. 12" (306mm).

Weight: 10lb (4.5kg).

Power requirements: 105 - 125, 210- 250V AC 48-60Hz, 15VA.

Options (available on request)

CRT with P7 long persistence phosphor.

ACCESSORIES

High impedance probe.

Fitted Protectomuff.

Light hood.

FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352654

Operating Instructions

Plug into mains supply

Set controls as shown on the front cover photograph

Switch on the power and check that the red power light comes on.

Allow a one minute warm up period, when a trace should appear.

If not, press locate button, adjust INTENSITY control until a line appears. Use HORIZONTAL POSITION and VERTICAL POSITION controls to place the line on the centre line of the graticule

Connect a signal between red input socket and the black ground socket.

Switch AC-G-DC switch to AC

NB: This type of switch has three positions -

Either of the buttons depressed

or

Both buttons released

Adjust VOLTS/cm switch to obtain a display of convenient amplitude, say 4 cms.

Rotate TRIG LEVEL control until picture "locks" (i.e. gives a stationary picture).

Adjust TIME/cm switch to display as much detail as required.

Adjust FOCUS and INTENSITY to suit.

4S6 - 1

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

Trig Level Control

There are two sectors where the signal will "lock", one on the positive and the other on the negative slope. Within these sectors the control decides the exact point at which triggering starts. In all other positions, the time base "free runs" at an arbitrary frequency, and will not lock.

AC G DC Switch

In the ground position, the amplifier (but not the input signal) is grounded, giving a true ZERO voltage reference. On the AC positions, a capacitor is placed in series with the input signal to exclude its DC component. On DC, this capacitor is short circuited, and the DC component will be seen on the screen as a positive or negative shift of the zero baseline. Too large a DC component may displace the trace right off the screen.

X Input (on rear of instrument)

This permits signal input to the X (horizontal) amplifier providing the time base is switched to EXT. This may be used with an external time base, or for making lissajous figures. When used the horizontal position control functions normally.

Auto Trigger disable

Linking the two pins at the front of TR404 disables the auto trigger. This may prove useful on applications involving sweep repetitions of less than 5 per second.

Circuit Description

Vertical Amplifier

The attenuator comprises five frequency compensated dividers which can be bypassed, used singly or in cascade, thus enabling the signal to be adjusted to a level suitable for application to the input amplifier. The input amplifier TR51A TR51B is a dual field effect transistor. The source current being provided by the TR52, whose action is to cause the gain of TR51 to vary proportional to the mains

input thus counteracting the change of sensitivity of the Cathode Ray Tube with changing E.H.T. The second stage TR53, TR54 amplifies the signal appearing at the drains of TR51A, TR51B. RV53 enables the gain of the stage to be altered so that the sensitivity of the instrument can be set accurately. The virtual earth amplifiers TR55, TR56, provide a low impedance to drive the output transistors and a low input impedance to improve the high frequency response of TR53 and TR54. The internal trigger signal is taken from TR56 collector. The high voltage transistors TR57 TR58 drive the vertical deflector plates of the Cathode Ray Tube.

Horizontal Circuits

The source of signal to the trigger stage is determined by the Ext. trig. input jack SK401. This signal is superimposed on a DC level determined by the setting of the TRIG LEVEL control RV401. This composite signal is applied to the input base of the Schmitt trigger circuit TR402 and TR403 via the emitter follower TR401 which provides a high input impedance to the signal. If the base potential of TR402 is more positive than the base of TR403 the current provided by R409 flows through TR402, any further positive excursions of the base of TR402 will have very little effect on the circuit condition. However on any subsequent negative excursion a point may be reached whereby cumulative action the stage switches rapidly (approx. 30nS). This switching action takes place when the base of TR402 is at approximately +10V. Thus the lower the potential set by RV401 the more positive the input signal must go before the stage switches. Should the potential set by RV401 be more positive than +10V then only when the input signal is negative will switching take place.

The antiphase outputs from the collectors of TR402 and TR403 are taken via the gating diodes D402 and D403 and differentiating capacitors C403 and C404 to the sweep generator. The resistors R413 and R415 ensure that the anodes of the gating diodes are negative with respect to their cathodes and are thus turned off thereby blocking the passage of the signals. Only when a diode is caused to conduct by applying a forward bias from the 170V rail will it allow the signal to pass to the timebase, S402 which is ganged to RV401 determines which diode shall conduct.

A negative going trigger pulse is required to start the timebase. A sample of the signal at the collector of TR403 is peak rectified by D404, D405 and C406 to turn off TR404. If for any reason (i.e. no input signal) the trigger stage is not producing pulses then TR404 conducts, causing the timebase to free run. Immediately trigger pulses are produced, TR404 is turned off and the timebase reverts to the triggered state.

In the quiescent state (i.e. ready to be started) the conditions in the timebase circuit are as follows. The Miller run down circuit formed by the field effect transistor TR503 is biased such that its drain is at approx. +18.5V. Should it attempt to rise higher, the base of TR502 will go positive. The corresponding positive excursion at TR501 collector will allow the gate of TR503 to go positive which will act against the original rise to restore equilibrium.

The sweep gate multivibrator TR504, TR505 is biased such that TR504 takes the current supplied by R515. Under this condition the collector of TR504 is at 0V holding the base of TR505 approximately 1V more positive than the base of TR504. This potential is set by D502. The collector of TR505 is approximately -15V and D503 is turned off. The collector of TR502 is negative with respect to earth and D506 is close to conducting.

A negative going trigger signal applied to the cathode of D506 causes it to conduct taking the collector of TR504 negative. By cumulative action the circuit switches so that TR505 now takes all the current supplied by R515. The collector of TR505 rises turning on D503, this positive going signal is also used to unblank the cathode ray tube. D502 is now reversed biased and the Miller Stage is free to run down at a rate determined by the timing capacitors C551 to C555 and the timing resistors R554 to R556. During the run down period D501 is turned off and TR502 conducts all the current supplied by R505 thus elevating its collector to approximately +8V.

The run down continues until the base of TR504 becomes more negative than the base of TR505 whereupon the sweep gate multivibrator switches back to its quiescent state. The collector of TR505 falls to approximately -15V blanking the cathode ray tube and turning off D503. The current supplied by R504 now flows through D502 to the gate of TR503 causing it to turn off. The current supplied by

R510 flows into the timing capacitor causing the junction with the drain of TR503 to rise. Eventually a potential is reached whereby D501 starts to conduct and TR501 collector rises taking D505 in a positive direction re-establishing the stable quiescent state.

During the run down period and subsequent re-setting action, the collector of TR502 has been at approximately +8V ensuring that D505 is turned off. This action prevents trigger pulses causing the timebase to run before it has completely reset. Only when the timebase has completely reset does the collector of TR502 fall sufficiently negative for D505 to pass a trigger signal. The output from the time base is applied to one input of the long tailed pair TR506 TR507 and the shift voltage from RV503 to the other input. The gain of the stage is set by R522 and RV502 which controls the amount of coupling between the emitters of TR506 and TR507.

The low voltage supplies are obtained by conventional half wave rectification. The E.H.T. is obtained by voltage doubling the output from an overwind on the transformer. The supplies for the cathode ray tube are obtained by a potential divider network which also incorporates the smoothing capacitors.

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

Calibration

The advanced circuit design coupled with solid state reliability will make frequent recalibration unnecessary. Before assuming that a fault condition exists always set up the oscilloscope as outlined in the first time operation; this will eliminate any apparent faults caused by incorrect settings of the controls. Should recalibration become desirable all the necessary highly accurate signals are provided by the SCOPEX SC1 oscilloscope calibrator.

Removal of Covers

The covers can be removed by slipping them backwards after removing the two screws securing the carrying handle and the two matching screws in the underside of the instrument. Having removed the covers, great care should be exercised as the E.H.T. supply takes several minutes to completely discharge after switching off; DO NOT however, discharge the E.H.T. supply by shorting it to earth through any resistor less than 100K Ω .

4S6 - 1

-/-

Astigmatism

Before recalibrating the instrument the ASTIGMATISM should be correctly adjusted as this has a considerable effect on the accuracy.

Apply a 2KHz approx. signal and adjust the level to give 4cms display height. Select 500 μ S/cm and lock the display. Now adjust the FOCUS and ASTIGMATISM controls until the vertical and horizontal portions of the display are equally sharp.

Vertical Amplifier Sensitivity and Position Centre

Using the 50 Ω terminated lead connect the 40mV square wave output from the SC1 calibrator to the input sockets. Select 1mS on the SC1 and 10mV/cm with DC coupling on the 4S6, now adjust RV53 to give exactly 4cms between the top and bottom flat portions of the waveform.

Return the vertical position control to precisely mid range and with the AC-G-DC switch at G, adjust RV52 such that the trace lies along the centre line of the graticule.

Trigger Threshold RV501

The auto free run circuit must firstly be immobilised; this is done by connecting the shorting link between the two pins adjacent to TR404. Connect a voltmeter between TR504 collector and chassis and adjust RV501 for zero volts. Remove the voltmeter but the shorting link should be left connected if the trigger sensitivity is to be adjusted.

Trigger Sensitivity RV402

Apply a sine wave signal of 1 KHz simultaneously to the input socket and ext. trig. socket. With the volts/cm switch set to 100mV adjust the amplitude of the signal to give 4cms and obtain a locked display.

Now adjust RV402 such that by rotating the Trig level control over the + slope sector it is only possible to trigger from the top 2 cms of the displayed waveform.

Sweep Timing

Using the 50 Ω lead, connect the 500mV time marks from the SC1 calibrator to the input sockets. Select 1mS on the SC1 and set the 4S6 controls as follows: DC coupling, 200mV/cm, 1mS/cm and trig level adjusted to give a locked display. Now adjust RV502 to give one mark every cm. Select 1 μ S/cm and apply 1 μ S time marks and adjust CV501 located behind the TIME/cm switch to give 1 mark per cm. Return through all the ranges to check that they remain within specification.

Attenuator Compensation

When adjusting any trimmers listed in this section, they should be set to give a flat top and square corner to the displayed waveform.

Connect the H1 head directly to the "input sockets" of the 4S6. DO NOT USE ANY LEADS. Set the 4S6 controls as follows:- DC, 10mV/cm, 1mS/cm and on the H1 head, 10mV/cm and "set ratio". Now obtain a locked display, and adjust CV10 on the 4S6. Select "set input" and adjust the trimmer on the side of the H1 head.

The following table gives the correct sequence and appropriate control settings. The volts/cm switch on the 4S6 and the Volts/cm range switch on the SC1 should always be set to the same position. The "set ratio" should be adjusted first followed by "set input".

<u>VOLTS/CM SWITCH</u>	<u>HEIGHT OF WAVEFORM</u>	<u>SET RATIO</u>	<u>SET INPUT</u>
10mV	4 divisions	CV10	CV9
20mV	4 divisions	CV8	CV7
50mV	4 divisions	CV6	CV5
100mV	4 divisions	CV4	CV3
1V	4 divisions	CV2	CV1

All other ranges should now be checked to see that they are correct.

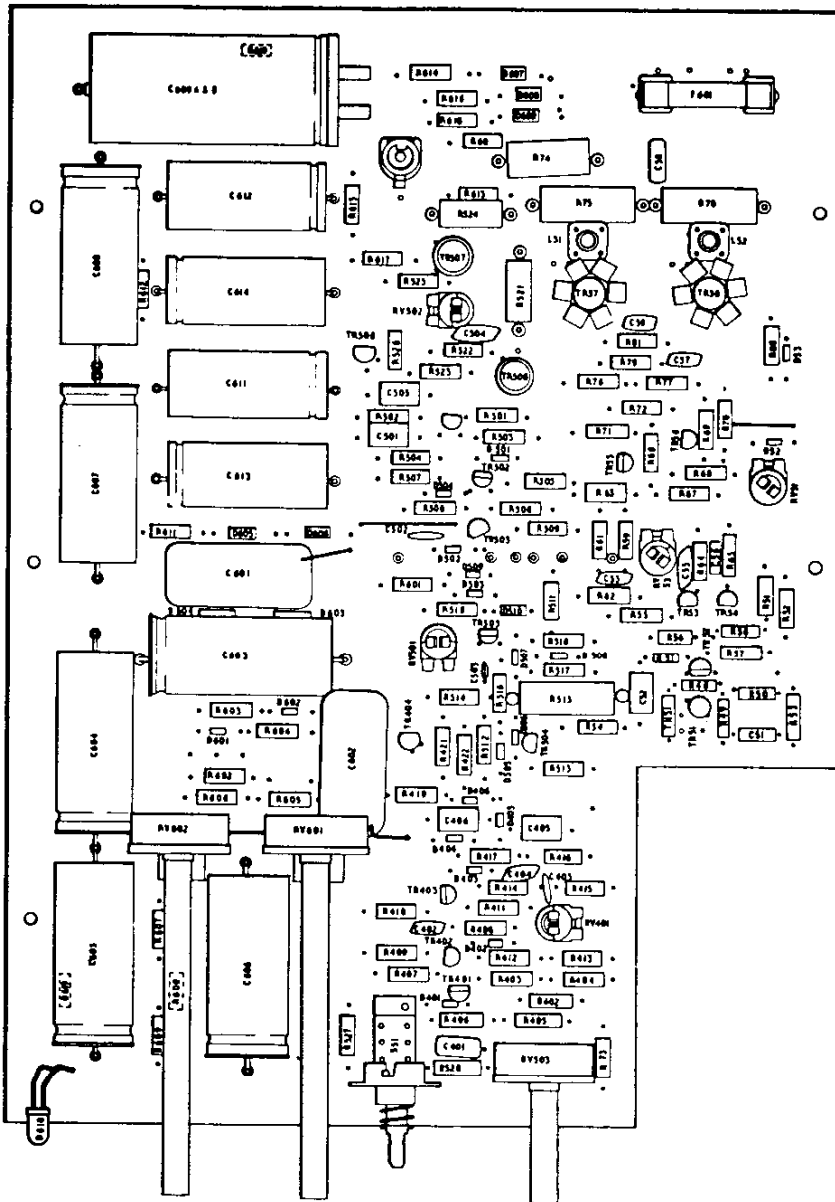
External "X" Input Phase

Select "A" only, 1V/cm and EXT on TIME/cm switch. Feed a sine wave signal of 30KHz and 6 volts pk/pk simultaneously to "A" channel and external "X" input and adjust CV101 to give a straight line at 45°.

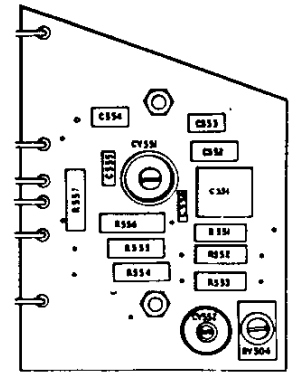
Remove the signal, and where fitted adjust RV551 to give a spot in the middle of the tube when the horizontal position control is centred.

Should you have to return the instrument for service PLEASE DO NOT RETURN ACCESSORIES unless you believe they are faulty.

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

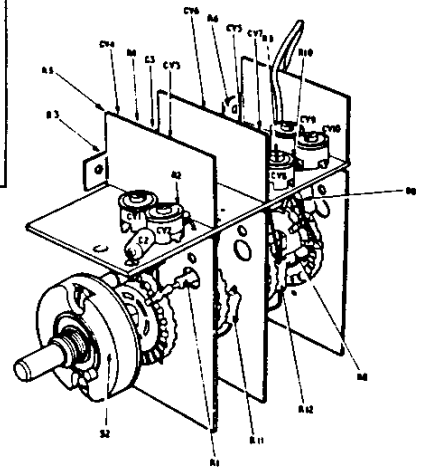


MAIN BOARD



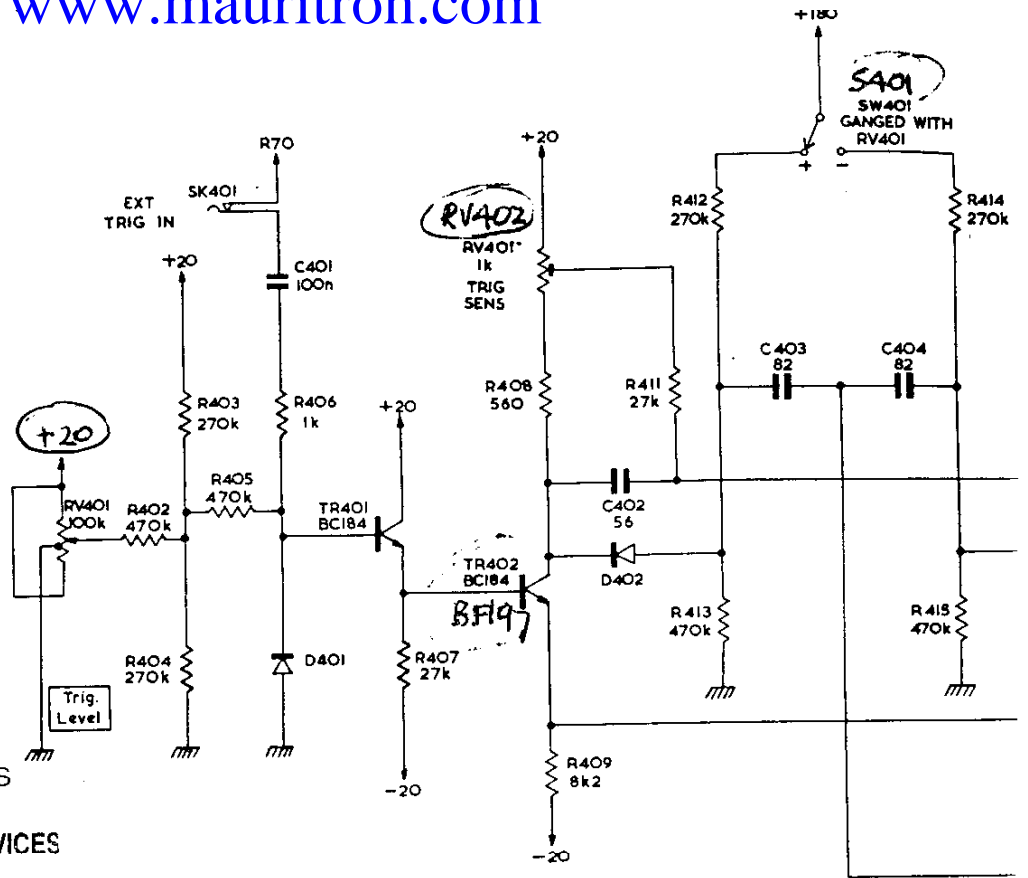
5561 MOUNTED BOARD

TIME/CENTIMETRE SWITCH ASSEMBLY

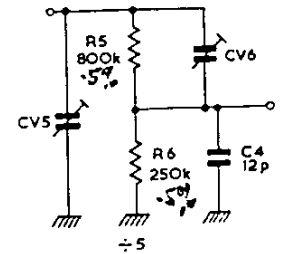
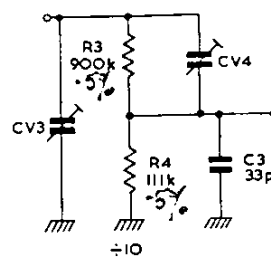
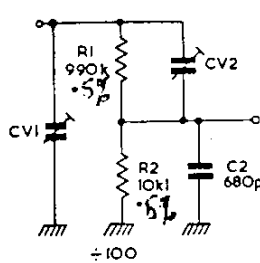
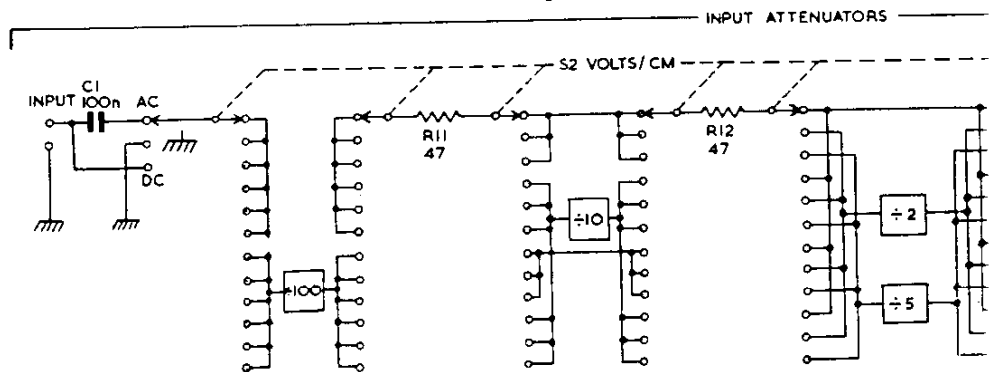


ATTENUATOR

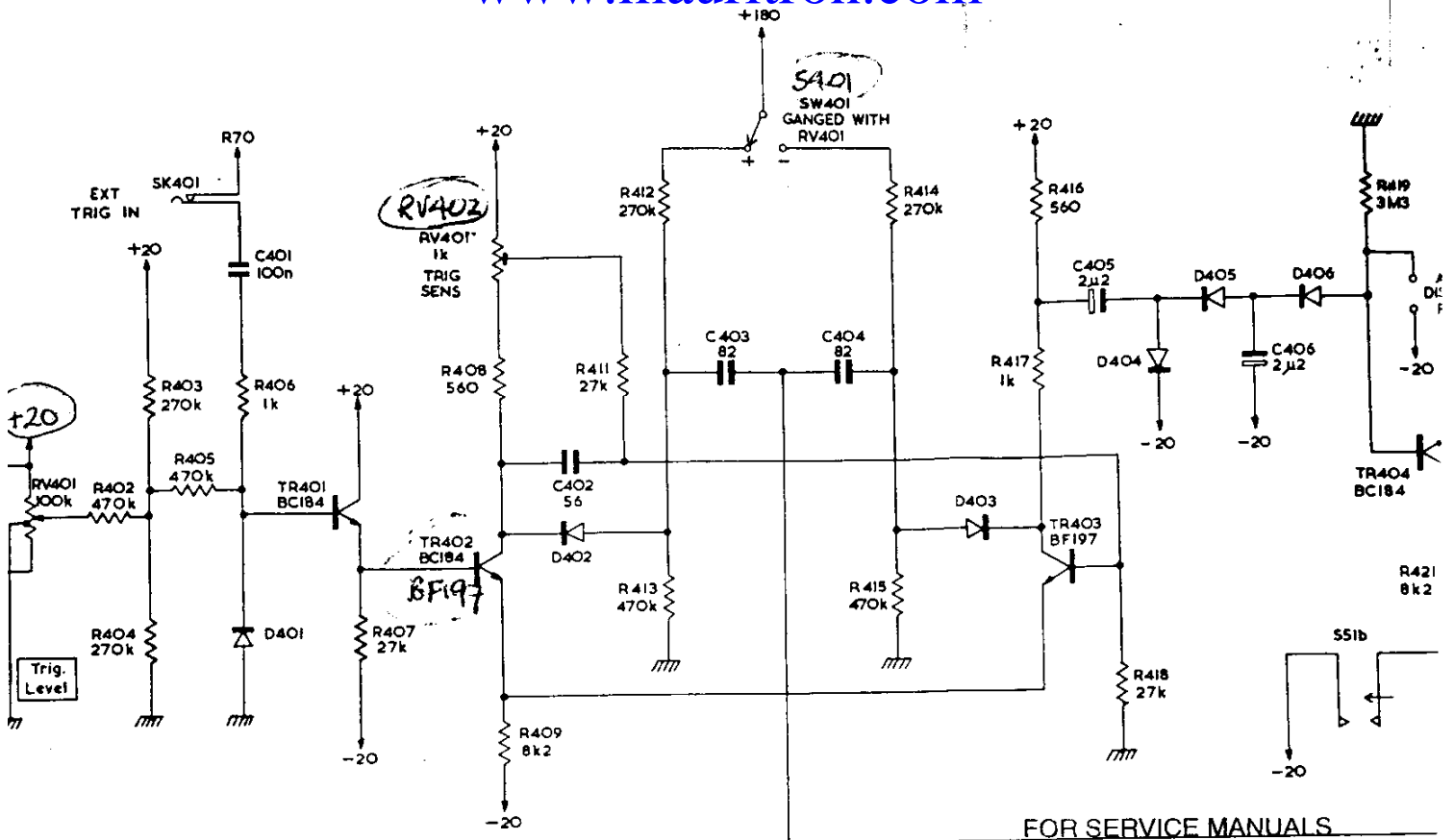
FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554



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



ALL RESISTOR VALUES IN OHMS $\frac{1}{2}$ W 5%
ALL CAPACITOR VALUES IN pF
ALL DIODES IN4148
ALL PRESET POTENTIOMETERS 1W LINEAR
ALL TRIMMER CAPACITORS 6-30pF
UNLESS OTHERWISE ST



FOR SERVICE MANUALS

CONTACT:

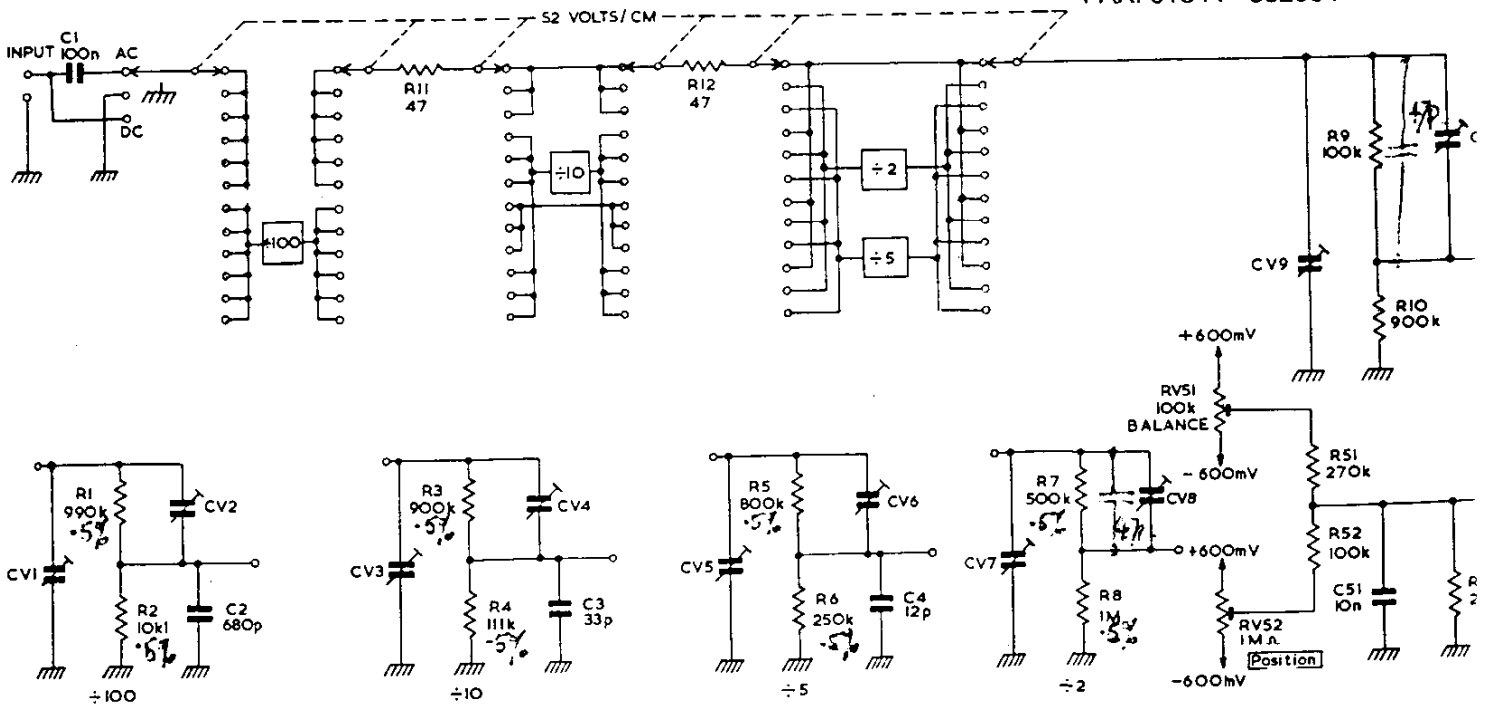
MAURITRON TECHNICAL SERVICES

www.mauritron.co.uk

TEL: 01844 351694

FAX: 01844 - 352554

INPUT ATTENUATORS



ALL RESISTOR VALUES IN OHMS 1/2 W 50%
 ALL CAPACITOR VALUES IN pF
 ALL DIODES IN4148
 ALL PRESET POTENTIOMETERS 1W LINEAR
 ALL TRIMMER CAPACITORS 6-30pF

UNLESS OTHERWISE STATED

