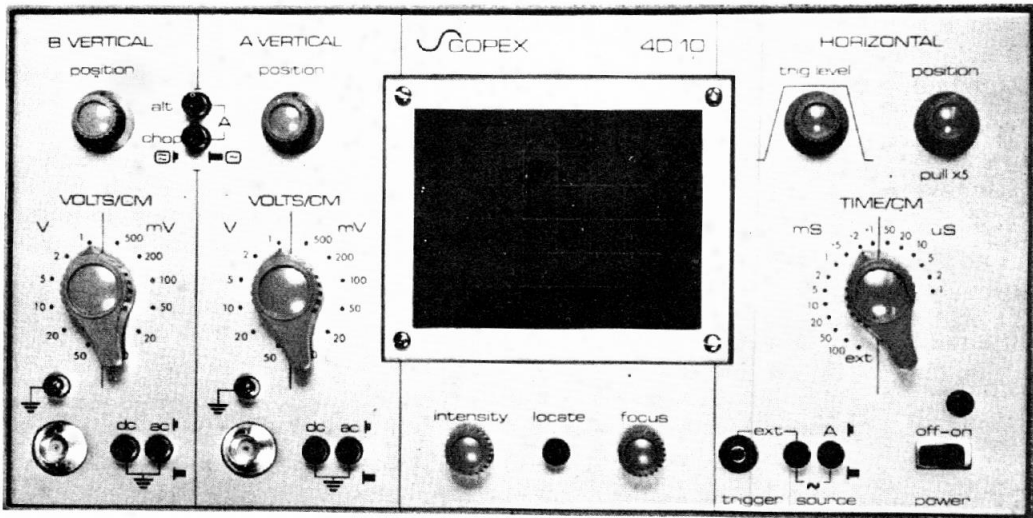


## SCOPEX 4D10

## CONTENTS

Page

2	Specification
3	First time operation
4	Function of controls
6	Circuit description
9	Calibration
	Vertical amplifier circuits
	Horizontal & power supply circuits



'SCOPEX' is the trade mark of:

Scopex Instruments Ltd.,  
 Pixmore Industrial Estate,  
 Pixmore Avenue,  
 Letchworth, Herts. SG6 1JJ  
 Telephone: Letchworth 72771

## A &amp; B Vertical

Sensitivity $\pm$ 5%	10mV/cm - 50V/cm (12 calibrated ranges)
Bandwidth to -3dB points	
DC coupled	DC - >10MHz
AC coupled	<3Hz - >10MHz
Risetime (calculated)	35nS approx.
Overload protection	Max. 400V (DC + peak AC to 3KHz)
Input impedance	1M $\Omega$ $\pm$ 3% and 33pF approx.
Modes	"A" Channel only
	ALT.
	CHOP. (approx. 100KHz)

## Horizontal

Sweep Speeds $\pm$ 5%	1 $\mu$ S/cm - 100mS/cm (16 calibrated ranges)
Magnifier $\pm$ 5%	5 times
External sensitivity	1V/cm approx. (200mV/cm magnified)
External bandwidth	DC - 50KHz
External input impedance	1M $\Omega$ $\pm$ 10% and 20pF approx.
Max. external input	250V (DC + peak AC to 1KHz)

## Trigger Circuit

Sources	External input - "A" Channel - Power line frequency
Sensitivity. Internal	5mm minimum 10Hz - 1MHz rising to 3cm at 5MHz.
External	300mV peak to peak 30Hz - 5MHz 600mV peak to peak 10Hz - 10MHz
Input impedance	220K $\Omega$ approx. and 20pF approx.
Max. input	250V. (DC + peak AC to 1KHz)

## General

Display size	Graticule ruled 6cm x 8 cm
Power requirements	210 - 250VAC. 48 - 60 Hz. 25VA approx.
Dimensions (excluding handle)	H 6". W 12 $\frac{1}{4}$ ". D 14 $\frac{1}{4}$ ".
Weight	17 lbs.
Ambient operating temperature	- +40 $^{\circ}$ C.

We reserve the right to amend the specification without prior notice.

## Dual Trace Operation

Carry out instructions for single trace operation. Then switch ALT-A-CHOP switch to ALT (see later note on the function of this switch). Find and position the second trace, (if necessary using LOCATE switch) using the 'B' VERTICAL POSITION control. Connect the second input signal between 'B' INPUT and ground. Switch corresponding AC-G-DC switch to AC. Adjust VOLTS/cm switch of both channels to give convenient display amplitudes.

## Control Functions

ALT-A-CHOP switch. Use position 'A' for single trace and one of the other positions for dual trace operation. Generally speaking, use CHOP when TIME/cm switch is in the mS SECTOR. (on CHOP the trace is switched between 'A' and 'B' at approx. 100Khz). On ALT the 'A' and 'B' traces are swept alternately.

## 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 position, a capacitor is placed in series with the input signal, so as 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 of the screen.

## Horizontal Position Control

This control simultaneously positions both traces in the horizontal axis. When pulled OUT it increases the horizontal gain by a factor of 5. and in effect provides a trace 40 cms long. When measuring time, this gain of 5 must be corrected by dividing the time by the same amount. (e.g. with TIME/cm SWITCH at  $1\mu$  second & horizontal X5 switch OUT, the true time calibration is  $\frac{1}{5} = .2\mu\text{sec/cm}$ )

## External-A-line Switch

On position 'A' the time base is locked to the signal applied to the 'A' vertical channel. On "External" it is locked to whatever signal is applied to the EXTERNAL TRIGGER source. On "  " it is locked to the frequency of the mains supply, normally 50 Hertz in the U.K.

## 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.

## Sweep Output (on rear of instrument)

This socket provides a negative going sawtooth waveform of 10 volts, and of the same duration as the timebase sweep.

## Auto trigger disable

Linking the two pins to the rear of TR404 disables the auto trigger. This may prove useful on applications involving sweep repetitions of less than 2 per second.

## Circuit Description

The following description applies to both amplifiers.

The signal to be observed is applied to the input socket where it passes to the attenuator. 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 diodes D51 and D52 prevent the amplifier from being damaged by excessively large input signals.

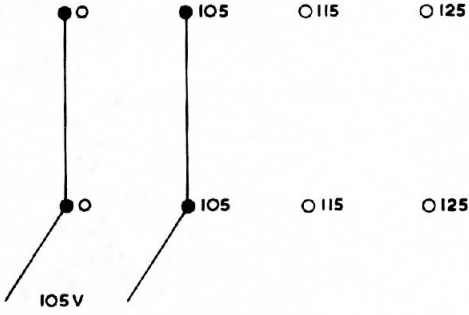
The input amplifier comprises two dual gate M.O.S. field effect transistors TR51 and TR52 in a long tailed pair configuration. The source supply for this stage in 'A' channel is supplied by the internal trigger amplifier. 'B' channel is supplied from a decoupled supply formed by R61B and C53B.

The drain current of TR51A flows through TR202 where the variations produce an amplified signal at TR202 collector without loading the output of the long tailed pair. The signal appearing at TR202 collector is further amplified by TR201 and supplied to the trigger source switch S401. The signals appearing at the drains of the input stage are further amplified by another long tailed pair TR53 and TR54. A variable resistor RV53 between the two sources permits the gain of the amplifier to be adjusted. When the channel is being displayed the shunt diodes D53 and D54 are turned off and the series diodes D55 and D56 conduct connecting the drains to the load resistors R101 & R102 and hence the output stage. To switch the stage off the shunt diodes D53 and D54 are caused to conduct by the switching multivibrator thus elevating the cathodes of the series diodes more positive than their anodes.

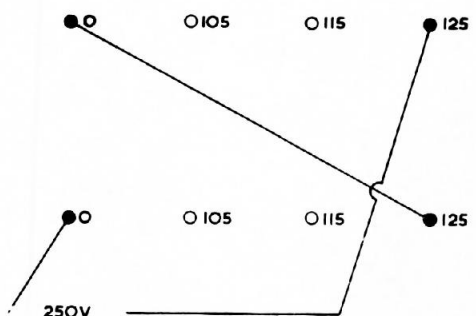
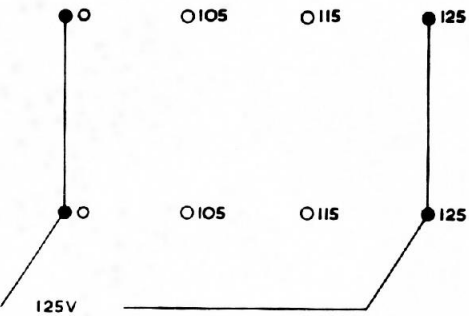
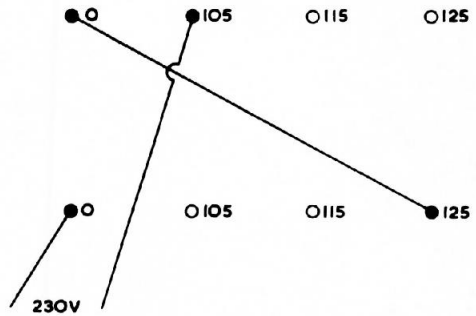
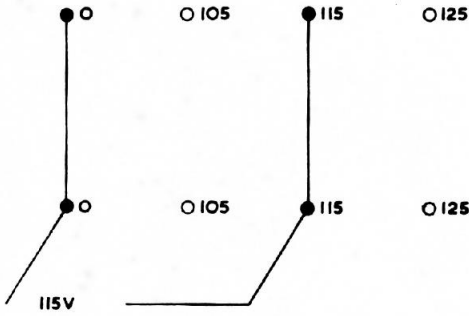
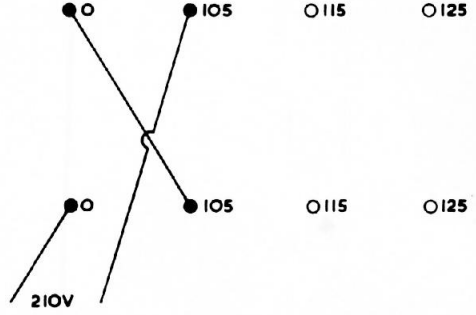
The network D101, D102, R112, R113 and R114 ensures that the output stage can recover quickly from overloads. The filter networks in the collectors of TR101 and TR104 minimise the effects of stray capacitance hence improving the high frequency response.

The beam switch bistable TR302 and TR303 can be placed in three different modes by applying the appropriate bias levels through the mode switch S301.

PARALLEL OPERATION  
105 - 125V



SERIES OPERATION  
210 - 250V



## Sweep Timing

A source of accurate timing signals (i.e. better than  $\pm 1\%$ ) is required to calibrate the time base.

With the TIME/cm switch set to 1 mS/cm and a source of 1mS time marks applied to 'A' channel obtain a locked display.

Adjust RV 502 to give 1 mark every cm. Pull the X5 magnifier and adjust RV503 to give 1 mark every 5 cms.

Switch off the magnifier and select 1 $\mu$ S/cm, apply 1 $\mu$ s time marks and adjust CV501 located behind the TIME/cm switch to give 1 mark per cm. Now return through all the ranges to check that they remain within specification.

## Attenuator compensation

Compensation of the attenuators will require the following equipment. A fast rise (less than 1 $\mu$ s) square pulse generator of approximately 2KHz with an output up to at least 100V and an attenuator probe.

At each step the signal amplitude should be adjusted to give a display height of approximately 4cms where possible.

The capacitors listed below should be adjusted to give a flat top with a good square corner to the displayed waveform.

Volts/cm	Adjust
10mV	CV11 to mid range
20m V	CV8
50mV	CV10
100mV	CV2
200mV	CV7
500mV	CV9
1V	CV4
10V	CV6

Connect divider probe and switching to 10mV/Cm adjust its compensation correctly. With the divider probe still in circuit adjust the following -

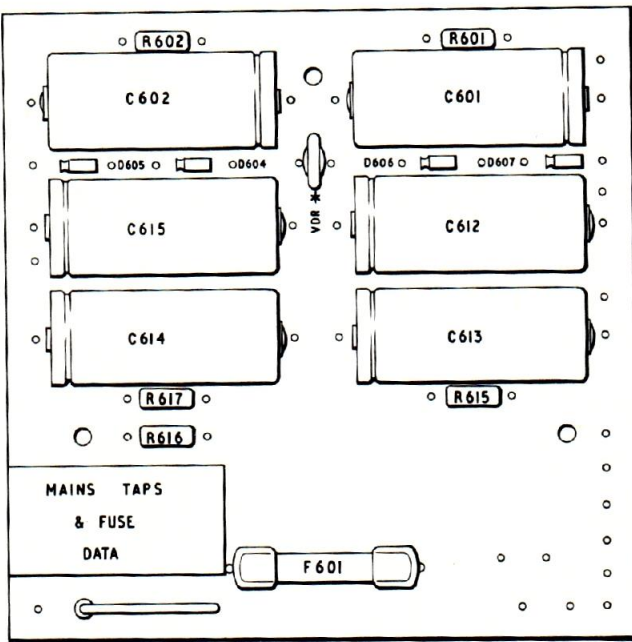
100mV/cm	CV1
1V/cm	CV3
10V/cm	CV5

Without altering the probe compensation adjust the other attenuator but this time with the divider probe in circuit adjust CV11 on 10mV/cm first.



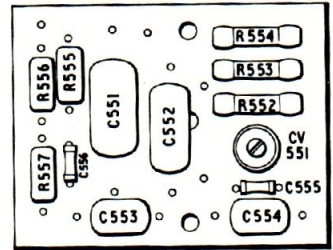




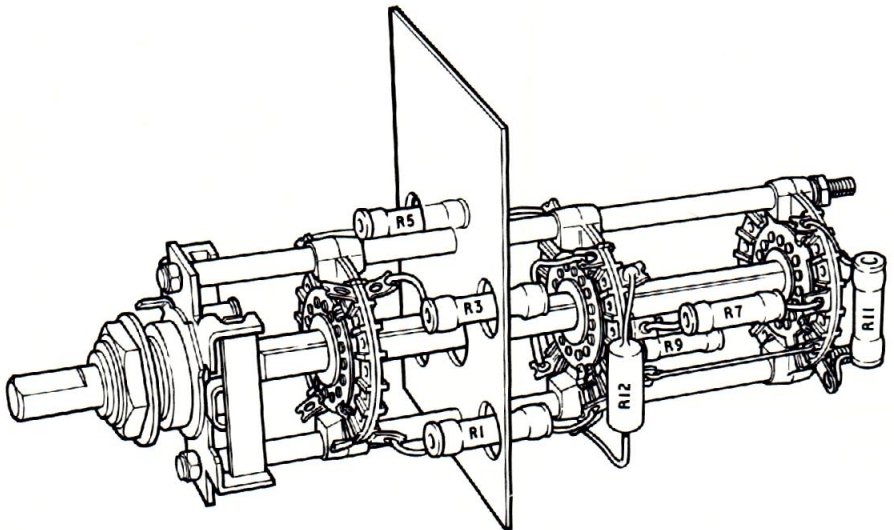


EHT BOARD

\* EARLY INSTRUMENTS ONLY.



TIMING SWITCH BOARD



ATTENUATOR SWITCH