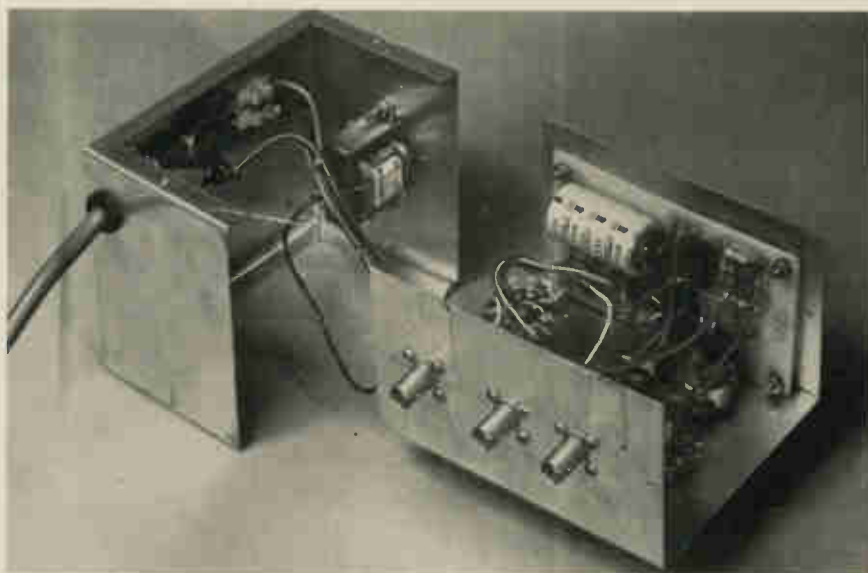




# DUAL BEAM ADAPTOR

Simple unit converts single beam CRO to dual beam operation.



THE oscilloscope, next to the multimeter, is perhaps the most useful test instrument. Indeed, for any serious experimental work an oscilloscope is indispensable. Unfortunately they are expensive beasts, and whilst an experimenter may well afford a simple, low-frequency single-beam type, a dual-beam version (at £100 or more) is usually beyond his means.

Nevertheless a dual-beam facility is most convenient, for it allows comparison of two different signals, for wave-shape or timing, and makes obvious, differences which otherwise would not be discernable.

The simple dual-beam adaptor described here, whilst not providing *all* the capabilities of an expensive dual-beam CRO, will however, cover most experimenter's requirements.

It is a low cost unit which allows two inputs of similar amplitude to be displayed simultaneously on separate traces. Frequency response of the unit is sufficient to allow observation of signals up to about 1 MHz.

## CONSTRUCTION

Most of the components are mounted on a printed circuit board. However, if desired matrix or veroboard may be used.

Be careful to orientate the polarised components correctly, as shown on the component overlay. Wiring to the sockets and switches should be as short as possible. Note that C3 and C4 are mounted on the input switches and C5 is mounted on the output socket.

Our prototype was mounted in a small aluminium minibox as illustrated. As individual requirements will vary, details of front panel layout and metalwork only are supplied.

## USING THE ADAPTOR

Connect the output of the adaptor to the input of the CRO. The two adaptor inputs now become A and B trace inputs to the CRO. A triggering signal should be applied direct to the trigger input of the CRO as otherwise the CRO will tend to synchronize to the chop frequency and not to either input signal.

It is preferable that the two input signals have approximately the same amplitude as there is no input amplifier or range selection provided

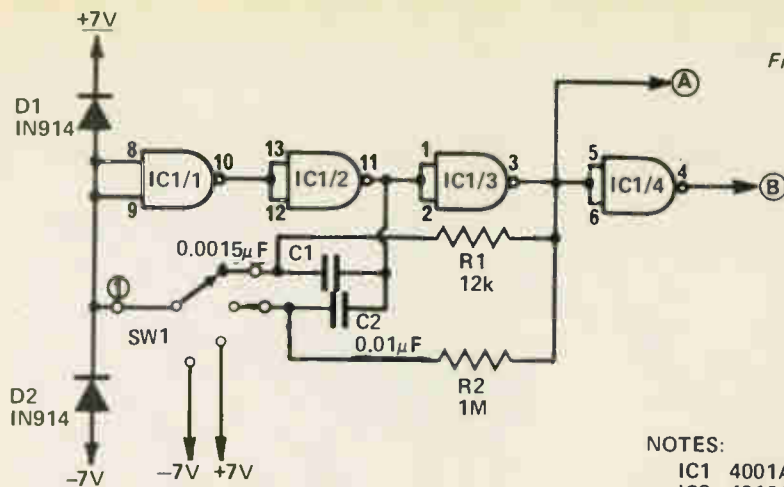
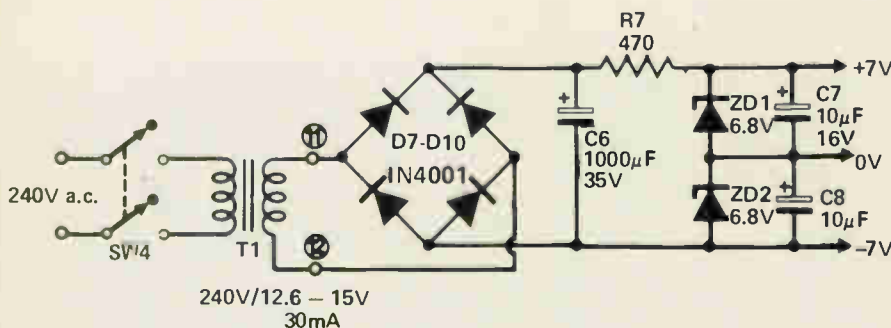
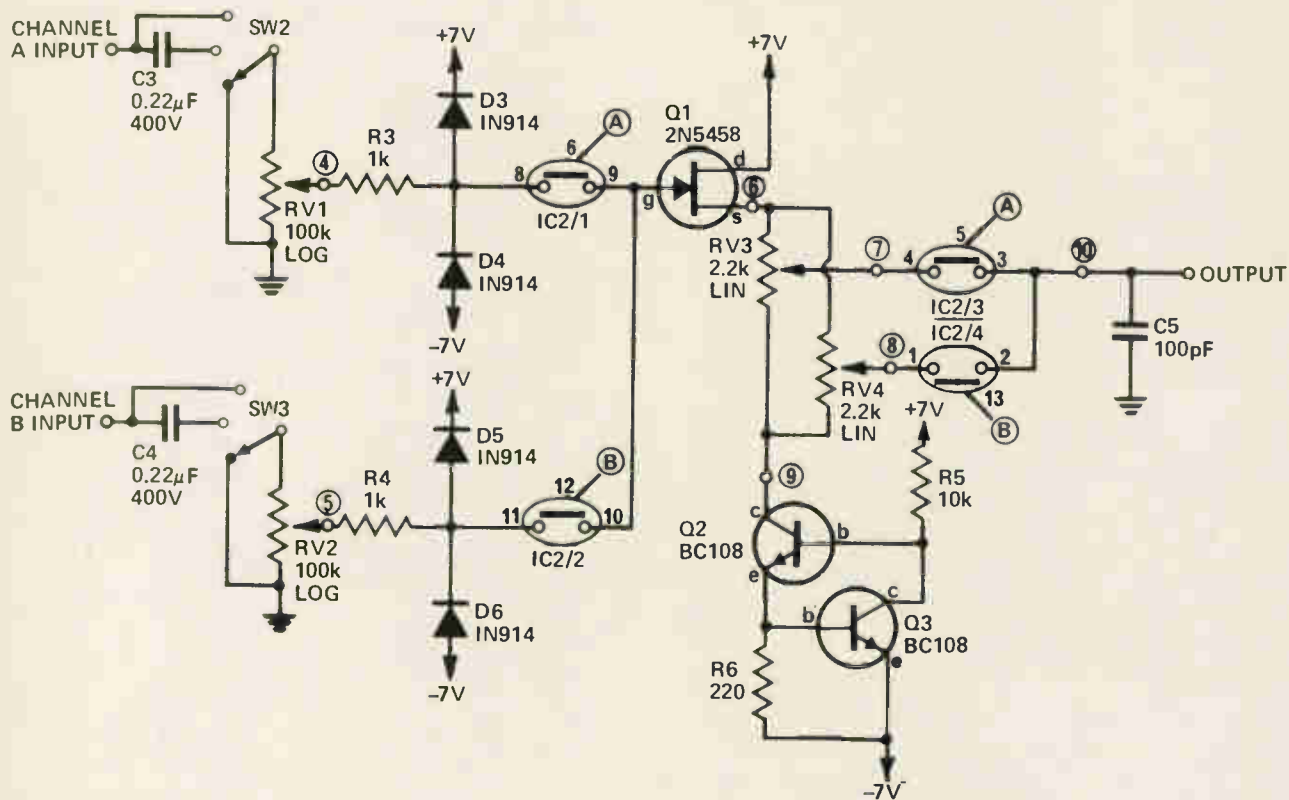


Fig. 1. Circuit diagram of complete unit.

NOTES:

- IC1 4001AE CMOS
- IC2 4016AE CMOS
- C3, C4 ARE MOUNTED ON SW2 AND SW3
- C5 IS MOUNTED ON THE OUTPUT SOCKET



SPECIFICATION

<b>Input Level</b>	
dc	± 4 volts max
ac	2 volts RMS max
<b>dc insulation on ac</b>	
	± 400 volts max
<b>dc level shift</b>	
	± 1.5 volts
<b>Frequency Response</b>	
	- 3dB point > 1 MHz
<b>Chopping Frequencies</b>	
A	60 Hz
B	35 kHz
<b>Input Impedance</b>	
	100 kHz

on the adaptor. However there is an attenuator provided on each input so that some adjustment may be made.

If only one input is to be applied it is best to switch to that input only thus eliminating the second trace and any cross talk which may occur due to the high input impedances.

Two chopping frequencies are used, having widely different frequencies, so

that if the input signal is a harmonic of the chopping frequency, (see Fig. 4) choosing the other chop mode will prevent the chop frequency being visible.

Normally CHOP 1 would be used for high frequency inputs, and CHOP 2 for low frequency inputs. An ALTERNATE mode has not been included (entails obtaining an output

from the CRO of unknown level and availability) as the CHOP 1 mode is similar and almost as effective.

By means of the two shift controls traces A and B may be separated by up to  $\pm 1.5$  volts.

#### HOW IT WORKS - ETI 114

Switches SW2 and SW3 select dc or ac coupling, or input shorted, for channel A and channel B inputs respectively. The signals are applied to the sensitivity potentiometers RV1 and RV2 and then passed to IC2/1 and IC2/2 which select one of the signals as an input to source follower Q1.

Transistor Q1 is supplied with a constant current (approximately 2.7 mA) by transistors Q2 and Q3. Hence, there is about 3 volts across RV3 and RV4, and this is unaffected by changes in input signal level. These potentiometers therefore provide a level-shift facility. When channel A is selected by IC2/1, IC2/3 selects RV3, and when channel B is selected by IC2/2, IC2/4 selects RV4. Thus as each signal has an independent level shift the two traces may be separated when chopped.

The CMOS gates of IC2 are driven by the outputs, A and B, the circuitry associated with IC1. The drive circuit mode of operation is selected by SW1, a four position switch, such that channel A only, channel B only, A and B chopped at 60 Hz or, A and B chopped at 35 kHz may be selected. The operation is as follows.

Integrated circuit IC1 forms a multivibrator which can run at 60 Hz or 35 kHz, or be locked in A-high B-low, or A-low B-high output states. For example, if SW1 selects -7 volts, IC1 pin 10 will be at +7, IC1 pin 11 will be at -7, IC1 pin 3 will be at +7 and IC1 pin 4 will be at -7 volts. The CMOS switches of IC2 will be "on" if the control voltage is at +7 volts and "off" if the control voltage is at -7 volts. Thus when -7 volts is selected by SW1, "A" will be at +7 volts, and IC2/1 and IC2/3 will select channel A. Similarly if +7 volts is selected by SW1, IC2/2 and IC2/4 will select channel B.

If C2 and R2 are selected by SW1 the multivibrator will be free to run at 60 Hz and channels A and B will be alternately selected at this frequency. Similarly if C1 and R1 are selected, channels A and B will be alternately selected at 35 kHz.

The power supply is a simple full-wave bridge type which uses two Zeners to provide the +7 and -7 volt supplies required.

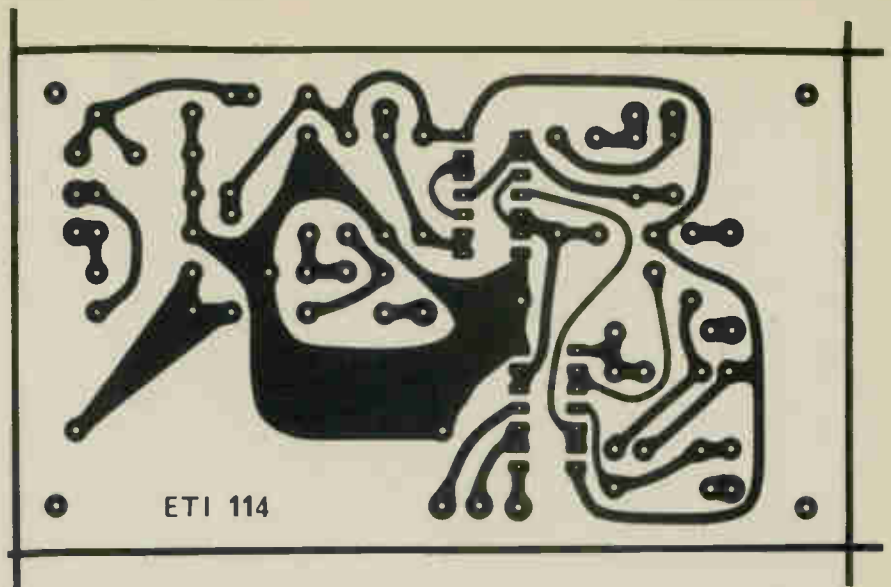


Fig.2. Printed circuit board pattern for the adaptor. (Shown fullsize).

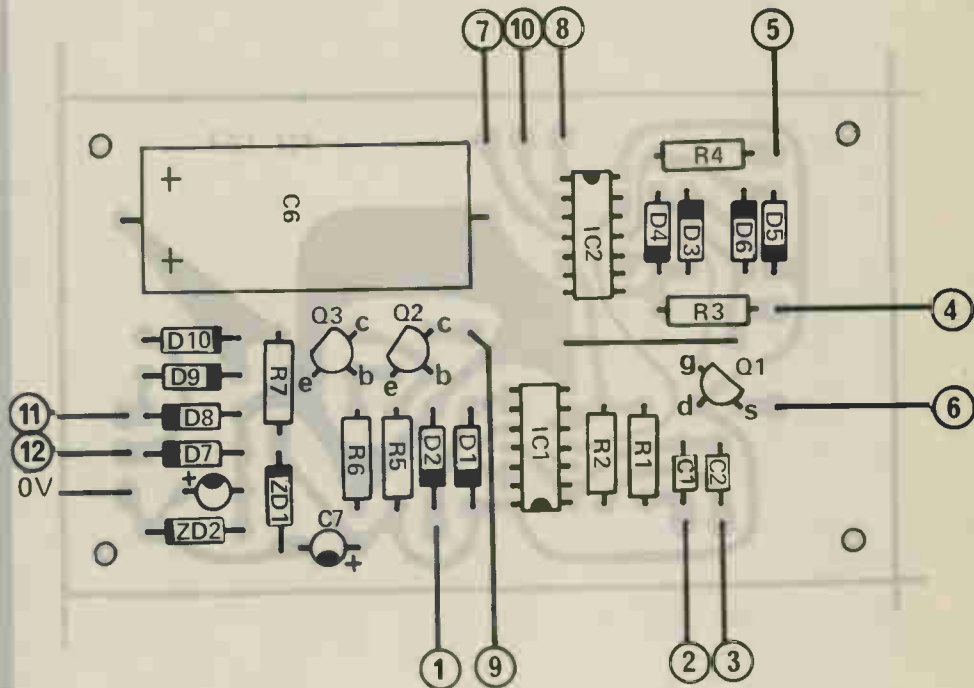


Fig.3. Component overlay.

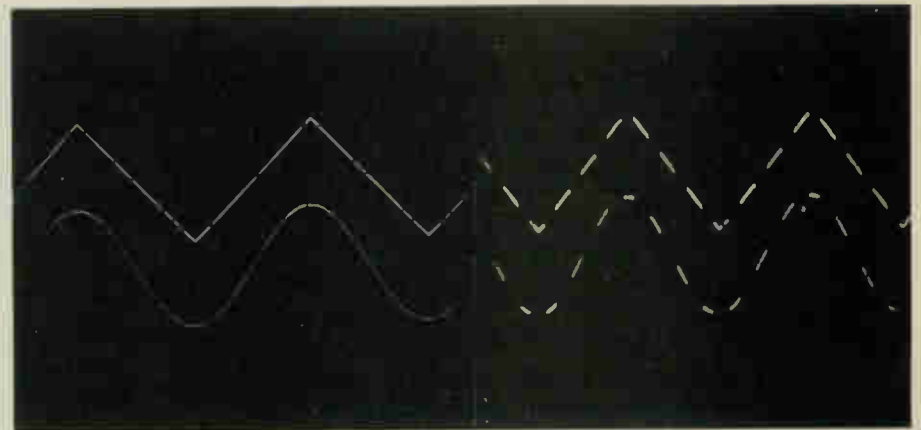
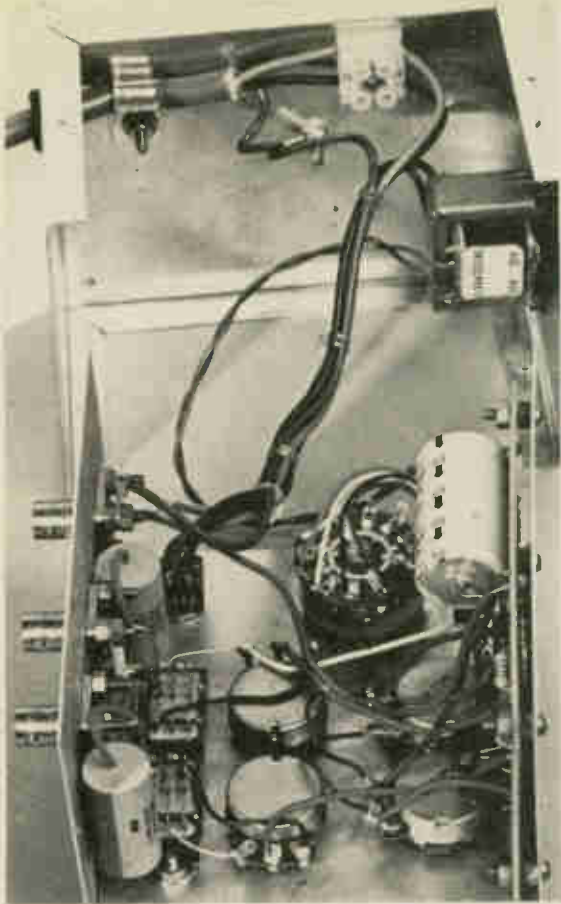


Fig.4a. Two signals, correctly displayed using the dual beam adaptor.

Fig.4b. Use of incorrect chopping frequency for a particular input signal (chop frequency a harmonic of signal) results in above effect. To cure use other chop frequency.



Layouts of components within the unit can be seen from this and accompanying photographs.

#### PARTS LIST—ETI 114

R6	Resistor	220	½W	5%
R7	"	470	½W	5%
R3,4	"	1k	½W	5%
R5	"	10k	½W	5%
R1	"	12k	½W	5%
R2	"	1M	½W	5%
RV1,2	Potentiometer	100k	log	rotary
RV3,4	Potentiometer	2.2k	lin	rotary
C5	Capacitor	100pF	ceramic	
C1	"	0.0015μF	polyester	
C2	"	0.01μF	polyester	
C3,4	"	0.22μF	400V poly.	
C7,8	"	10μF	10V electrolytic	
C6	"	1000μF	35V	"
D1-D6	Diode	1N914	or similar	
D7-D10	"	1N4001	or similar	
ZD1,ZD2	Zener Diode	BZY88CV8		or similar
Q1	Transistor	2N 5458		
Q2,Q3	"	BC108,BC548		or similar
IC1	Integrated circuit	4001AE	CMOS	
IC2	Integrated circuit	4016AE	CMOS	
T1	transformer	12,6V—15V	at 300mA	
PC Board	ETI 114			
SW1	switch	one pole 4 position	rotary	
SW2,3	switch	3-position	slide	
SW4	switch	2-pole on-off	toggle 240V rated	
	Metal box	130mm x 105mm x 80mm		
		3 sockets to suit CRO leads		
		Knobs for front panel.		

**eti** 114

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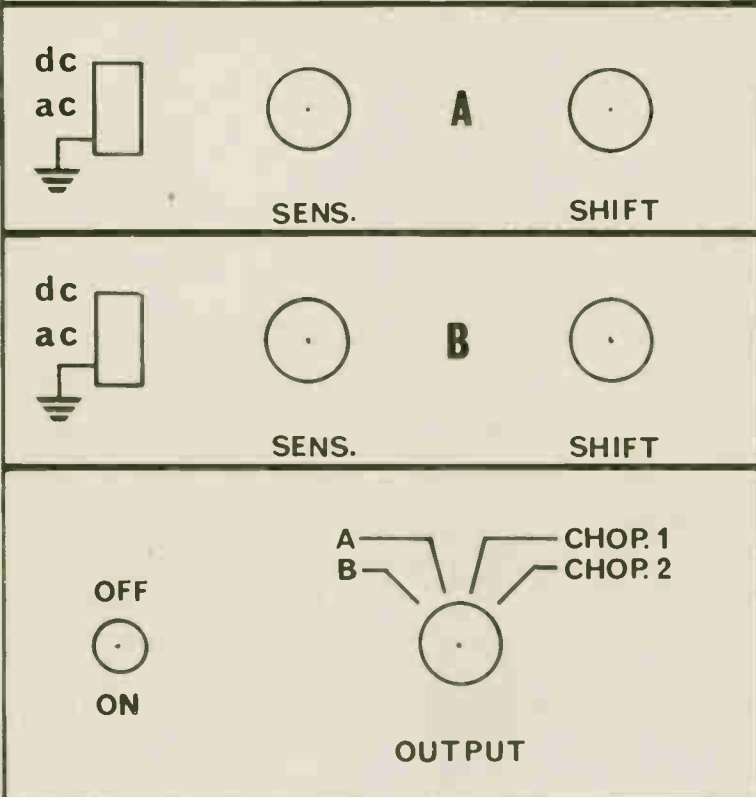


Fig.5. Artwork for front panel of the adaptor.

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