

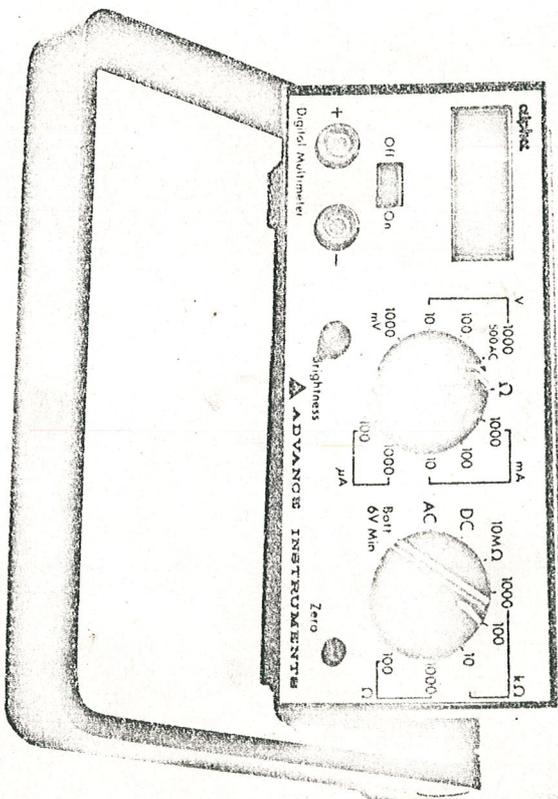
Alpscombe

01-500-1000

Eq ~~721104~~

F65 + 8% VAT
15.20

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alpha
DIGITAL
MULTIMETER

Introduction

The Alpha is a light and compact dry-battery operated digital multimeter housed in an attractive moulded plastic case. The flicker-free display reads up to 999 with decimal points, and has automatic polarity indication on d.c. ranges. A total of 24 ranges indicate d.c. voltages from 1mV to 1000V, a.c. voltages from 1mV to 500V, d.c. and a.c. current from 0.1 μ A to 1A, and resistance from 0.1 Ω to 10M Ω .

An advanced MOS LSI circuit is used to provide all the digital circuit functions, contributing greatly to the high reliability, compactness, and low power consumption of the instrument.

Accessories available include a.c. mains and re-chargeable power supply units, and a carrying case which allows operation when hanging from the shoulder.

Specification

Section 2

Specification

Section 2

At 23°C ± 1°C

DC Voltage

Range	Accuracy	Input Impedance.	Max. cont. overload
+ - 1000mV	0.2% ± 1 digit.	10M	350V
+ - 10V	0.5% ± 1 digit.	11M	1kV
+ - 100V	"	10M	"
+ - 1000V	"	10M	"

AC Voltage mean sensing r.m.s. indicating

Range	Accuracy	Input Impedance.	Freq. Range.	Max. cont. overload.
1000mV		10M 75pF	40-20KHz	350V to 2KHz
10V	1%	11M	"	500V
100V	± 2 digits.	10M	"	"
500V	"	10M	40-1KHz	"

DC Current

Range	Accuracy	Approx. Volt. drop	Max. cont. overload.
+ - 100µA	0.5% ± 1 digit.	1.0V	1A (fused)
+ - 1mA	"	"	"
+ - 10mA	"	"	"
+ - 100mA	"	"	"
+ - 1000mA	"	1.2V	"

AC Current

Range	Frequency	Accuracy	Approx. volt drop.	overload
100µA	40Hz-2KHz		1.0V	1A (fused)
1mA	40Hz-20KHz		"	"
10mA	"	1.5%	"	"
100mA	"	± 2 digits	"	"
1000mA	"	"	1.2V	"

Resistance

Range	Accuracy	Measuring Current	Protection
100Ω	1% ± 1 digit	10mA	10 volts, above which a 100mA fuse operates.
1000Ω	"	1mA	Open circuit voltage 12v
10kΩ	"	100µA	
100kΩ	"	10µA	
1000kΩ	"	1µA	
10MΩ	2% ± 1 digit	0.1µA	

Temperature Coefficients

All D.C. ranges 0.02%°C
 All A.C. ranges 0.05%°C
 Resistance ranges 0.05%°C
 except 10mΩ range 0.15%°C

Over-range is usable up to 1200 (i.e. 200 flashing), except on the 100µA ac range.

Quoted accuracies are for 30 days.

Accuracy on d.c. voltage and current ranges will be within 1% for 1 year, 10-30°C.

Series Mode Rejection of 50Hz on d.c. ranges greater than 30dB
 Common Mode Rejection: essentially infinite when battery operated.
 Operating Temperature Range: -10°C to +50°C
 Power Consumption: 6.2 to 9V d.c., 10 to 45mA
 Size: Height 6 cm. width 14 cm depth 18 cm (2.4 x 5.5 x 7.1 ins) excluding knobs, feet and handle
 Weight: Instrument 570 gm (1¼ lb) Battery 430 gm (1 lb) Total 1 Kg (2¼ lb)
 Accessories supplied: Test leads, Red. P. No. 33317, Black 33318 Handbook, Battery 9V.

Operation

Section 3

ON/OFF Switch off the instrument when not in use to conserve the battery.

BRIGHTNESS Battery life will be extended by adjusting the control for the lowest usable brightness.

ZERO Select 1V d.c. range and join the input leads. Adjust zero control for a reading of 000 or -000

RESISTANCE MEASUREMENT Test lead resistance may affect the 100Ω range readings. It can be allowed for by connecting the leads together, and subtracting the readings obtained from subsequent readings. Alternatively, use the zero control to eliminate test lead resistance, remembering to reset this for other ranges. Power consumption of the instrument increases when used on the 100Ω range. This range may function incorrectly when used with an almost exhausted battery.

INPUT TERMINALS The + input is the low potential terminal with respect to ground

BATTERY CHECK Replace the battery if the reading is less than 600, disregard the decimal point. The reading does not indicate actual battery voltage. The table indicates the approx. life remaining in the battery for different readings. Battery life is up to 300 hours when used 8 hours per day, dependent on brightness setting. Do not attempt to measure the battery voltage via the input sockets. Note: that with a new battery a flashing overrange reading can be obtained.

BATTERY Press and slide out the rear panel for access to the battery.

Remove the battery when exhausted or for storage.

The following 9 volt batteries are suitable types: IEC-6F 100,NEDA-1603. U.K.-PP9, VT9, RR9, M1603, 439. Germany-439, 339, 495. Australia-276. Scandinavia-480, 780, LP5M9, 439, 9T1. France-6NX, R0617, Texas. Italy-592, 995, A23. Japan-N572, 306. S. Africa-PM9, FM9, EF/EM. Spain-PT673. USA-D6, 276, M1603, VS306.

RANGE SELECTION A flashing display indicates overload. Observe maximum ratings on each range. The 1A range must be selected BEFORE currents greater than 100mA are applied. Do not operate the range selectors when the instrument is connected to an inductive circuit.

Operation

Section 3

AC POWER SUPPLY UNIT - Type PU8 This unit fits in place of the battery. An internal adjustment must be set for 100-125V or 200-250V, 45-65Hz operation. Note that the instrument ON/OFF switch does not switch off the a.c. supply. Do not apply more than 1000V d.c. or 600V a.c. between either of the Alpha input terminals and supply ground.

RECHARGEABLE BATTERY UNIT -Type BP8. See separate operating instructions.

CURRENT RANGES. Resistors R34-38 are the shunts. The input is applied to the tap selected by the switch.

RESISTANCE MEASUREMENT. A constant current generator TR13 passes a known current through the resistor under test, the voltage developed being measured. Ranging is achieved by switched resistors at TR13 emitter.

The above paragraphs headed 'CURRENT RANGES' and 'RESISTANCE MEASUREMENT' are part of the Circuit Description and should follow 'VOLTAGE RANGES' in Section 5.

CASE REMOVAL. Slide out the back panel and withdraw the battery and grommet. Unscrew both front panel retaining screws and remove the instrument from its case.

FUSE REPLACEMENT. The ohms protection fuse 100mA is located on the master board; the current protection fuse 1A, is on the switch board.

RE-CALIBRATION. Zero should be checked on each range by connecting together the input leads. If after setting zero on the 1V dc range, the 10V d.c. range does not read zero due to IC1a base current, link p or q as necessary. On the 100 Ω range zero can be adjusted to offset any test lead resistance.

Adjustments must be in the sequence shown by the table.

Inputs should be of better accuracy, e.g. 5 times better, than the Alpha specification.

SWITCH	SWITCH	INPUT	ADJUST OR CHECK	INST. READING	NOTES
1000mV	DC	1V dc	R102	1000 0.2% \pm 1 digit	Reverse Input
10V	DC	10V dc	CHECK	1000 0.5%	Polarity and
100V	DC	100V dc	CHECK	1000 \pm 1 digit	check reading
1000V	DC	1000V dc	CHECK	1000	
1000mV	AC	1V ac 1kHz	R94	1000	When measuring
1000mV	AC	1V ac 20 kHz	CHECK	1000	ac voltage the
100V	AC	100V ac 1kHz	C24	1000 1%	instrument must
10V	AC	10V ac 20kHz	C33	1000 \pm 2 digits	be in its case
500V	AC	500V ac 1kHz	CHECK	1000	
100 μ A	DC/AC	100 μ A dc	CHECK	1000 dc 0.5%	When measuring
1000 μ A	DC/AC	1mA and	CHECK	1000 \pm 1 digit	ac current the
10mA	DC/AC	10mA ac	CHECK	1000 ac 1.5%	instrument must
100mA	DC/AC	100mA 1kHz	CHECK	1000 \pm 2 digits.	be in its case.
1000mA	DC/AC	1A	R103	1000	Adjust R103 on d.c.
1000 Ω	Ω	1000 Ω	R112	1000	
10M Ω	Ω	10M Ω	R97	1000	
100 Ω	Ω	100 Ω	CHECK	1000 1%	
10k Ω	Ω	10k Ω	CHECK	1000 \pm 1 digit.	Lead resistance is
100k Ω	Ω	100k Ω	R96	1000	significant on 100
1000k Ω	Ω	1M Ω	R95	1000	range, check zero

Fault Finding

All voltages measured with respect to '0' volt line, with 10M Ω input impedance voltmeter or oscilloscope. Voltages measured with 8.5V battery.

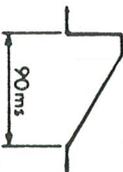
NO DISPLAY ON ONE OR MORE DIGITS. Check:-

- (1) Battery voltage with a separate meter, 6.2 to 9V
- (2) Power supply rails: 14V between 13.6 and 25.1V
10V between 9.6 and 17.3V
5V between 5.2 and 9.1V

- (3) Pulse output at TR35 collector. 5V pk-pk, duration 0.1 - 0.8ms, dependent on brightness control.
- (4) TR42 collector for approximately 200kHz square wave drive to IC2. Voltage pk-pk approximately same as 0-10V supply rail.
- (5) TR19-27 and TR28-34 collectors are switching.
- (6) IC2 outputs.
- (7) VZ 7.0V approximately.
- (8) VR 4.5V approximately.

NO MEASUREMENT ON 1V DC Range. Apply 1V and check:-

- (1) Input wiring and switching path on 1V dc range.
- (2) Reset pulse every 300 ms approximately at TR17 base. 0.6V pk-pk Ramp at TR17 collector.
- (3) Ramp at TR17 collector.
- (4) Comparator output at TR37 collector. 9.5V pk-pk approximately.
- (5) VX relative to 10V. 1.5V
- (6) VX comparator output at TR36 collector. 9.5V pk-pk approximately.
- (7) Check (4) and (6) are present on pins 24 and 23 of IC2.



NO MEASUREMENT ON AC VOLTAGE RANGES. Select 1V range ac and with the input leads connected together, measure the dc level at TR12 collector (6 to 7.5V). Apply 1V ac at 1kHz to the input and check:-

- (1) Input signal at switch side of C10.
 - (2) Signal at TR12 collector.
 - (3) DC voltage proportional to input signal at R111, C15 junction.
 - (4) Switch path between ac/dc converter output and the input comparator.
- NO MEASUREMENT ON 10V, 100V, 500/1000V AC or DC RANGES.** Check the input switching and ac/dc voltage attenuator.

NO MEASUREMENT ON AC/DC CURRENT RANGES Check:-

- (1) FS2
 - (2) Input switching
 - (3) R34-37
- NO MEASUREMENT ON OHMS RANGES** Check:-
- (1) FS1
 - (2) Input switching
 - (3) TR14 base 3.2V approximately.
 - (4) TR13-14
 - (5) TR13 emitter ranging resistors and switching.

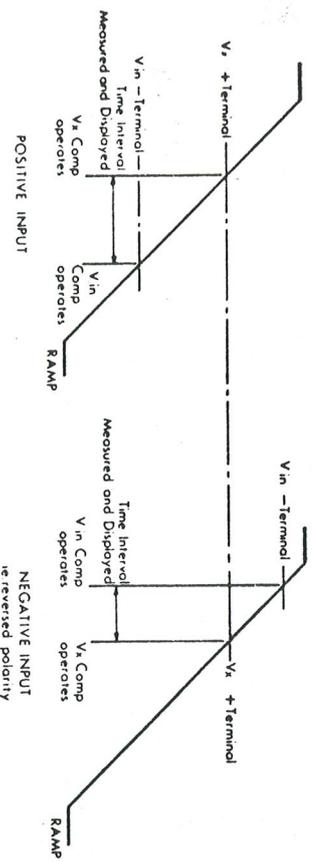
POWER SUPPLY. The battery is connected between the 5V and 10V rails, and powers a multivibrator TR1, 2 which produces the 0V rail by transferring charge from C6 to C7. Similarly C2 and C8 produce the 14 volt rail. TR6 supplies a constant current to TR8 which operates as a zener diode providing a stable reference voltage.

DISPLAY. Digits are sequentially switched on by TR19-27, one for each segment, and switches TR28-34. This sequential switching is controlled by the power supply multivibrator fed via TR35 to the multiplex input of the LS1, IC2. The multiplexed output duty cycle is varied by R98 and TR35 to control the display brightness.

IC2 contains 4 counting and storage decades together with decoding to give multiplexed 7 segment outputs, and 4 digit select outputs identifying the correct digit to be illuminated.

The decimal point anode switch is operated by the instrument range switches.

ANALOGUE TO DIGITAL CONVERSION. The instrument uses a single ramp generated by C29 and TR18, reset approximately every 300ms by TR17 and applied to both comparator amplifiers. The VX comparator provides a reference, the input comparator the d.c. input information. The two diagrams show the sequence of operation of the comparators which feed IC2. Input current flowing to the input comparator is reduced by the clamping action of TR40.



AC TO DC CONVERTER. This is a high gain differential input amplifier TR9-12 with diode rectification at the output forming an a.c. feedback path. R18 provides d.c. feedback.

OSCILLATOR. This is a Colpitts oscillator L1, TR16 followed by a squaring stage TR15 to feed IC2.

VOLTAGE RANGES. The sensitivity at IC1 pin 4 is 0.979 V for a reading of 1.000V, the input being attenuated by R87 and R19. For other ranges the input is attenuated by R84-86 and switched resistors R89, R91 and R90 plus the current shunts. For a.c. voltage measurement the attenuator is capacitively compensated.

Ref.	Description	Pt. No.	Ref.	Description	Part No.
R1	27k C.F. ±5% 1/8W	21813	R40	27k MF ±1%	34321
R2	10k C.F. ±5% 1/8W	21809	R41	475k MF ±1%	33691
R3	390k C.F. ±5% 1/8W	32358	R42	34k MF ±1%	34653
R4	560k C.F. ±5% 1/8W	32359	R43	47k C.F. ±5% 1/8W	21815
R5	68k C.F. ±5% 1/8W	21816	R44	10k C.F. ±5% 1/8W	21819
R6	10k C.F. ±5% 1/8W	21809	R45	C.F. ±5% 1/8W	21807
R7	10k C.F. ±5% 1/8W	21809	R46	4.7k Cracked Carbon ±5% 1/8W	21805
R8	82k C.F. ±5% 1/8W	21818	R47	10k C.F. ±5% 1/8W	21809
R9	47k MO ±2%	32938	R48	10k C.F. ±5% 1/8W	21809
R10	47k MO ±2%	32938	R49	10k C.F. ±5% 1/8W	21809
R11	33k MF ±1%	32945	R50	10k C.F. ±5% 1/8W	21809
R12	43k MF ±1%	34933	R51	10k C.F. ±5% 1/8W	21809
R13	9M53 MF ±1%	33678	R52	10k C.F. ±5% 1/8W	21809
R14	1.8M C.F. ±10%	34316	R53	10k C.F. ±5% 1/8W	21809
R15	10k C.F. ±5% 1/8W	21809	R54	10k C.F. ±5% 1/8W	21809
R16	100k C.F. ±5% 1/8W	21819	R55	180k C.F. ±5% 1/8W	21822
R17	15k C.F. ±5% 1/8W	28787	R56	390 C.F. ±5% 1/8W	28722
R18	10M C.F. ±10% 1/8W	32661	R57	390 C.F. ±5% 1/8W	28722
R19	10M M.F. ±1%	32944	R58	220 C.F. ±5% 1/8W	21796
R20	560 C.F. ±5% 1/8W	21798	R59	220 C.F. ±5% 1/8W	21796
R21	15k MO ±2%	32939	R60	220 C.F. ±5% 1/8W	21796
R22	6k8 MO ±2%	32940	R61	220 C.F. ±5% 1/8W	21796
R23	10M CC ±10% 1/8W	32661	R62	220 C.F. ±5% 1/8W	21796
R24	10M CC ±10% 1/8W	32661	R63	220 C.F. ±5% 1/8W	21796
R25	10M CC ±10% 1/8W	32661	R64	220 C.F. ±5% 1/8W	21796
R26	3M44 MF ±1%	32943	R65	220 C.F. ±5% 1/8W	21796
R27	315k MO ±2%	32947	R66	10k C.F. ±5% 1/8W	21809
R28	33k MF ±.25% 1/8W	32948	R67	27k C.F. ±5% 1/8W	21813
R29	3k26 MF ±.25% 1/8W	32949	R68	27k C.F. ±5% 1/8W	21813
R30	318 MF ±.25% 1/8W	32941	R69	27k C.F. ±5% 1/8W	21813
R31	2M7 C.F. ±5% 1/8W	30758	R70	68k C.F. ±5% 1/8W	21816
R32	56k C.F. ±5% 1/8W	28729	R71	150Ω Cracked Carbon ±5% 1/8W	21719
R33	C.F. ±5% 1W	3309			
	Alternative Pt. No.	34320			
R34	8k82 MF ±.25% 1/8W	32950	R72	56k C.F. ±5% 1/8W	28729
R35	882 MF ±.25% 1/8W	32951	R73	180k C.F. ±5% 1/8W	21822
R36	88R2 MF ±.25% 1/8W	32952	R74	68k C.F. ±5% 1/8W	21816
R37	9R8 MF ±.25% 1W	34327	R75	22k C.F. ±5% 1/8W	21812
R38	1 WW + 5% 2.5W	A3/34230	R76	27k C.F. ±5% 1/8W	21813
	-2%		R77	27k C.F. ±5% 1/8W	21813
R39	1k C.F. ±5% 1/8W	21799	R78	22k C.F. ±5% 1/8W	21812

Component List

Section 6

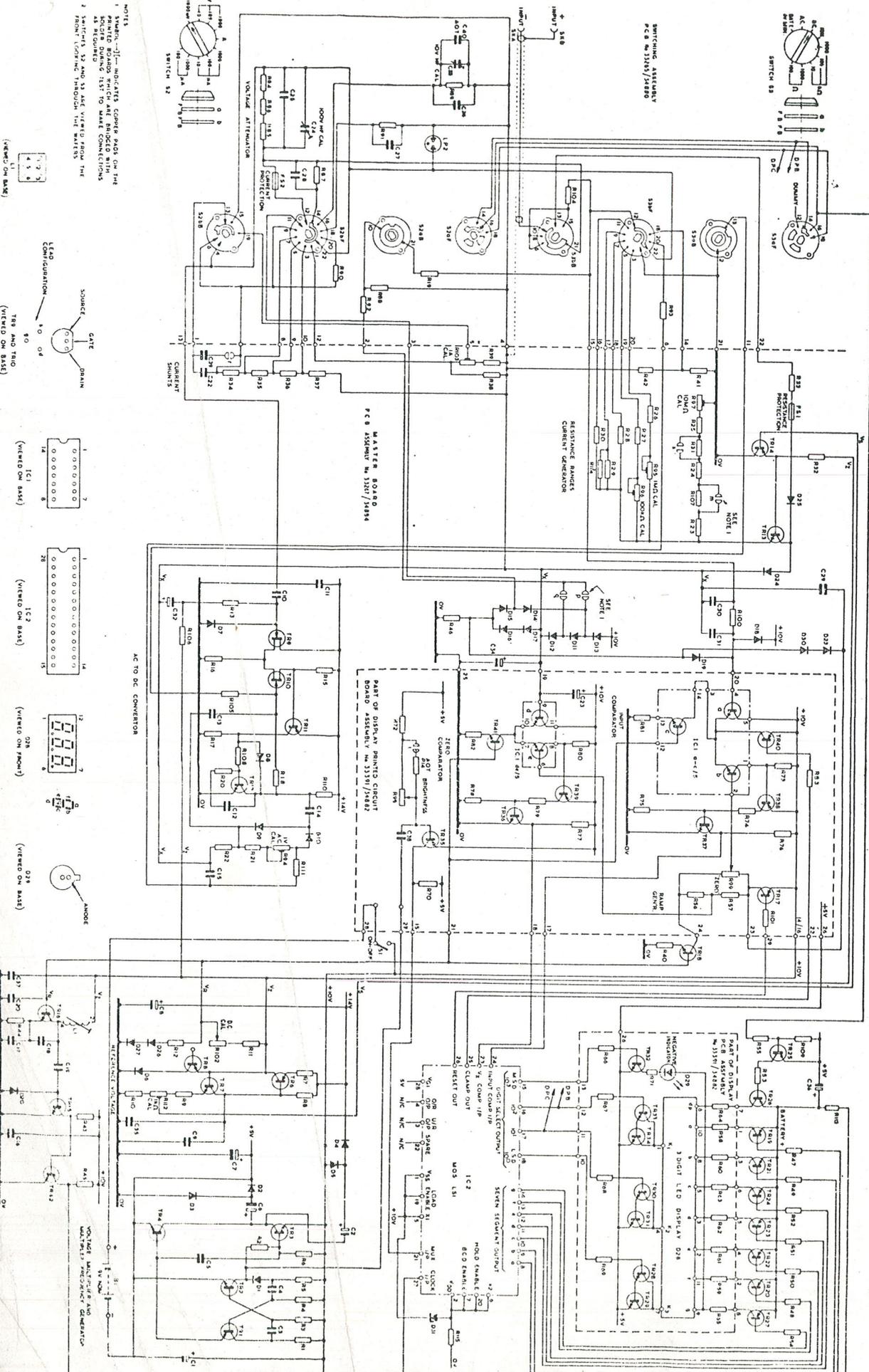
Components List

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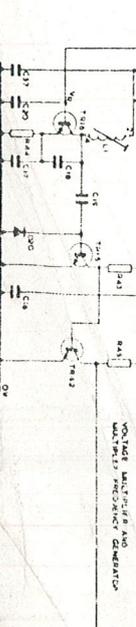
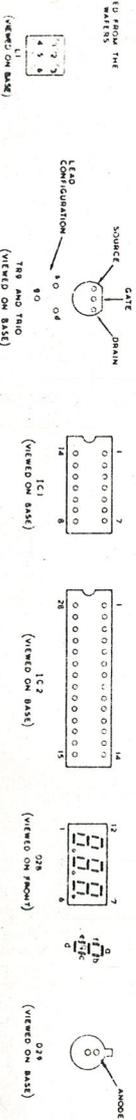
Ref.	Description	Pt. No.	Ref.	Description	Part No.	Ref.	Description	Pt. No.	Ref.	Description	Pt. No.	Ref.	Description	Part No.
R79	68k C.F. ±5% 1/8W	21816	C1	32µF E +50% 10V	21212	C32	12.5µF E +50% 25V	20775	TR24	2N3906	21533	TR24	2N3906	21533
R80	180k C.F. ±5% 1/8W	21822	C2	200µF E +50% 10V	32169	C33	2/10pF Trimmer	32669	TR25	BC2088	33329	TR25	BC2088	33329
R81	390k C.F. ±5% 1/8W	32358	C3	3300pF PF 160V	33420	C34	150µF Electrolytic +50%	32175	TR26	2N3906	21533	TR26	2N3906	21533
R82	390k C.F. ±5% 1/8W	32358	C4	3300pF PF 160V	33420	C35	150µF Electrolytic -10%	32175	TR27	2N3906	21533	TR27	2N3906	21533
R83	68k C.F. ±5% 1/8W	21816	C5	.022µF CE(1) +80% 30V	2663	C36	100µF Electrolytic +50%	19647	TR28	BC2088	33329	TR28	BC2088	33329
R84	Three resistors		C6	.022µF CE(1) -20%	2663	C37	10V	32168	TR29	BSX20	23307	TR29	BSX20	23307
R85	Selected to		C7	200µF E +50% 10V	32169	C38	1500pF CE(2) ±20%	22388	TR30	BC2088	33329	TR30	BC2088	33329
R86	Required Value		C8	100µF E +50% 25V	32183	C39	560pF CE(2) ±10%	22384	TR31	BC2088	33329	TR31	BC2088	33329
R87	10M2 MF ±0.1%	A/33825	C9	.1µF CE(1) +80% 30V	19647	C40	5.6pF Silver Mica ±1pF	29362	TR32	BC2088	33329	TR32	BC2088	33329
R88	2.2k MO ±2%	28830	C10	3300pF PF 160V	33420	TR1	BC2088	33329	TR33	BC2088	33329	TR33	BC2088	33329
R89	6.8k C.F. ±5% 1/8W	21807	C11	.01µF CE(2) ±25% 250V	22395	TR2	BC2088	33329	TR34	BSX20	23307	TR34	BSX20	23307
R90	1M245 MF ±25%	32963	C12	56pF CE(2) ±10% 500V	22373	TR3	BC204	33330	TR35	BC204	33330	TR35	BC204	33330
R91	200 MO ±2%	28786	C13	.047µF CE(1) +80% 30V	2793	TR4	BC2088	33329	TR36	BC2088	33329	TR36	BC2088	33329
R92	101k85 MF ±25%	32964	C14	.1µF PE ±10% 160V	31383	TR5	BC2088	33329	TR37	BC2088	33329	TR37	BC2088	33329
R93	220k C.F. ±5% 1/8W	21823	C15	.33µF PE ±10% 160V	31380	TR6	BC204	33330	TR38	BSX20 Selected	23802	TR38	BSX20 Selected	23802
R94	2k5 CP	28969	C16	.01µF CE(2) ±25% 250V	22395	TR7	BC2088	33329	TR9	2N3819 Selected Pair	33438	TR9	2N3819 Selected Pair	33438
R95	500k PCP	33369	C17	.022µF PE ±10% 250V	31373	TR8	BSX20 Selected	32956	TR10	BC204	33330	TR10	BC204	33330
R96	50k PCP	33368	C18	470pF SM ±5%	4781	TR9	BSX20 Selected	32956	TR11	BC204	33329	TR11	BC204	33329
R97	5M PCP	33370	C19	.27pF CE(2) ±10% 500V	22369	TR10	2N3819 Selected Pair	33438	TR12	BC2088	33329	TR12	BC2088	33329
R98	500k PCP	32959	C20	.01µF CE(2) ±25% 250V	22395	TR11	BC204	33330	TR13	BC209C	33331	TR13	BC209C	33331
R99	2k5 PCP	32960	C21	10.000pF Polystyrene	33851	TR12	BC2088	33329	TR14	BC204	33330	TR14	BC204	33330
R100	330k C.F. ±5% 1/8W	32357	C22	±1% 100V	33851	TR13	BC209C	33331	TR15	2N3904	24146	TR15	2N3904	24146
R101	68k C.F. ±5% 1/8W	21816	C23	150µF E +50% 6V3	32163	TR14	BC204	33330	TR16	BC2088	33329	TR16	BC2088	33329
R102	5k MO ±2%	34934	C24	6pF Trimmer	29421	TR15	2N3904	24146	TR17	BC204	33330	TR17	BC204	33330
R103	100 CP	29915	C25	5pF 2kV	34360	TR16	BC2088	33329	TR18	BC2088	33329	TR18	BC2088	33329
R104	220k C.F. ±5% 1/8W	21823	C26	47pF SM ±½pF	685	TR17	BC204	33330	TR19	2N3906	21533	TR19	2N3906	21533
R105	1M C.F. ±5% 1/8W	31840	C27	1000pF CE(2) ±1%	5013	TR18	BC2088	33329	TR20	2N3906	21533	TR20	2N3906	21533
R106	330k C.F. ±5% 1/8W	32357	C28	1200pF PC ±5%	34397	TR19	2N3906	21533	TR21	2N3906	21533	TR21	2N3906	21533
R107	4M7 C.F. ±5% 1/8W	30759	C29	1.5µF PE	34322	TR20	2N3906	21533	TR22	2N3906	21533	TR22	2N3906	21533
R108	100 C.F. ±5% 1/8W	21794	C30	.1µF PE ±10% 160V	31377	TR21	2N3906	21533	TR23	2N3906	21533	TR23	2N3906	21533
R109	33k C.F. ±5% 1/8W	21814	C31	.1µF PE ±10% 160V	31377	TR22	2N3906	21533						
R110	10k C.F. ±5% 1/8W	21809				TR23	2N3906	21533						
R111	470k C.F. ±5% 1/8W	32330												
R112	10k CP	29574												
R113	4.7Ω Cracked Carbon	29433												
R114	470k Cracked Carbon	32330												
R115	100Ω C.F. ±5% 1/8W	21794												

Not Used

Circuit Diagram



- NOTES
- 1 SYMBOLS IN CIRCLES INDICATE COMPONENTS MADE ON THE BOARD DURING TEST TO MAKE CONNECTIONS AS REQUIRED
 - 2 SWITCHES S1 AND S2 ARE VIEWED FROM THE FRONT (LOOKING THROUGH THE SWITCH)



LEAD CONFIGURATION TO OF (VIEWED ON BASE)

Components List

Section 6

Ref.	Description.	Part No.
D22	Not Used	
D23	IN4148	23802
D24	IN3595	29330
D25	IN4007	52337
D26	IN4148	23802
D27	IN4148	23802
D28	DL33 LED	A3/33328
D29	LED	33421
D30	IN4148	23802
D31	Zener Diode 16v	33940
IC1	CA3046 Selected	34324
IC2		32755
ILP1	Neon 16L	29201
L1		A3/33315
FS1	20mm x 5mm 100mA	32958
FS2	20mm x 5mm 1.5A	33865

Key to abbreviations

Resistors

- CC } Carbon Film 1/4W 5%
- CF } Metal Oxide 1/4W 2%
- MO } Metal Film
- MF } Control Potentiometer
- CP } Pre-set Potentiometer
- PCP }

Capacitors

- CE (1) Ceramic +80%
 - CE (2) Ceramic other tolerance
 - SM Silver Mica
 - PF Plastic Film
 - PE Polyester
 - PC Poly carbonate
 - E Electrolytic (aluminium)
- NB: D29 Add to description Reditt 4 - Sign
 R33 Add value 100 Ω
 R43 Add value 6.8K
 C27 Amend description to read polystyrene ±1%
 C28 Amend description to read polystyrene ±1%
 not CE(2)
 not PC