RADIO & ELECTRONICS CONSTRUCTOR

FEBRUARY 1979
Volume 32 No. 6

Published Monthly
(3rd of preceding Month)
First Published 1947

Incorporating The Radio Amateur

Editorial and Advertising Offices
57 MAIDA VALE LONDON W9 1SN

Telephone 01-286 6141
Telegrams Databux, London

Annual Subscription: £7.50, Overseas £8.50 (U.S.A. and Canada $15.00) including postage. Remittances should be made payable to "Data Publications Ltd". Overseas readers, please pay by cheque or International Money Order.

Technical Queries. We regret that we are unable to answer queries other than those arising from articles appearing in this magazine nor can we advise on modifications to equipment described. We regret that queries cannot be answered over the telephone; they must be submitted in writing and accompanied by a stamped addressed envelope for reply.

Correspondence should be addressed to the Editor, Advertising Manager, Subscription Manager or the Publishers as appropriate.

Opinions expressed by contributors are not necessarily those of the Editor or proprietors.

Production.—Web Offset.

Published in Great Britain by the Proprietors and Publishers, Data Publications Ltd, 57 Maida Vale, London W9 1SN

The ***Radio & Electronics Constructor*** is printed by Swale Press Ltd.

THE MARCH ISSUE WILL BE PUBLISHED ON 9th FEBRUARY

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SPECIAL OFFER!

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Order No.	Quantity	
1616B	5 pieces Assorted Ferrite rods	40p
16169	2 pieces Tuning gangs MW/LW	40p
16170	50 metres Single strand wire assorted wire	40p
16171	10 Reed switches	40p
16172	3 Micro switches	40p
16176	20 Assorted electrolytics Trans types	40p
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16179	20 Assorted tag strips and panels	40p
16180	15 Assorted control knobs	40p
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16188	60½W resistors mixed values	40p
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S100	120 ¼watt resistors. Pre-formed. 1978 Prod. Our mix	60p*
S101	120 ½watt resistors. Pre-formed. 1978 Prod. Mixed values	60p*
S102	250 ¼watt resistors. Range 100ohms — 10 meg	£2.00*
S103	220 ½watt resistors. Range 100ohms — 10 meg	£2.00*
S104	60 Low ohms ¼ watts res. 10 - 100ohms	60p*
S105	40 Low ohms ½watt resistors 10-1000hms	60p*
S106	25 Mixed wirebound resistors	60p*
S107	20 Tantalum bead caps .22 — 100mF Our mix	£1.00*
S108	High quality electrolitics 10mF — 500mF voltage range 15-50v. Our mix	40 for £1.00*
16204	C280 Pak. Contains 50 metal foil caps	£1.00*

POTENTIOMETERS

SLIDER 40mm TRAVEL

Order No			Price
16191	6 x 470ohm	LIN Single	40p*
S24	6 x 1 K	LIN Single	40p*
S25	6 x 5 K	LIN Single	40p*
16193	6 x 22 K	LIN Single	40p*
16195	6 x 47 K	LOG Single	40p*
16194	6 x 47 K	LIN Single	40p*
S27	6 x 100 K	LIN Single	40p*
S28	6 x 100 K	LOG Single	40p*
S29	6 x 500 K	LOG Single	40p*

SLIDER 60mm TRAVEL

S30	6 x 2.5 K	LOG Single	40p*
S32	6 x 50 K	LIN Single	40p*
S34	4 x 5 K	LOG Dual	40p*
S36	4 x 100 K	LOG Dual	40p*
S37	4 x 1.3 MEG	LOG Dual	40p*
S94	6 x 220K	LIN Single	40p*
S95	6 x 100 K	LOG Single	40p*
S96	6 x 500 K	LIN Single	40p*

S38 Mixed slider pots various values and sizes our mix £1.00*
S39 6 x Chrome slider knobs 40p*

WIREWOUND

S90 Wirewound Pots. Linear 1W rating Mixed useful values — 5 for £1.00*

CARBON TYPES

S91 Car Radio type. Dual Switched Pot PC mounting. 100K LIN Switched 2.5 K LIN — 60p each*

DUAL POTS PC MOUNTING

6mm Shaft

S92	4 x 100 K LIN	£1.00*
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No. S56 20 mixed values 400mW Zener diodes 11-33V	£1.00
No. S57 10 mixed values 1W Zener diodes 3-10V	£1.00
No. S58 10 mixed values 1W Zener diodes 11-33V	£1.00

SILICON POWER TRANS N.P.N.

S97 BD371 2amp 1.2w. 60Vceo Hfe 40-400. Case TO92 with heat tab 5 for 60p*
S98 2N5293 R.C.A. 36w 4amps 75Vceo Hfe 30-120 — 5 for £1.00*

CRYSTAL EAR PIECES

S126 Less plug — £0.20

PLUGS FOR ABOVE

No. 16106 2.5 plastic — £0.09
No. 1697 3.5 plastic — £0.11

Mono Crystal Cartridge

S127 GP91/1SC — Special Offer £1.00

Nickel Cadmium Rechargeable Batteries 1.25v

S128	3500D Cell size = U2	£2.50
S129	900C Cell size = ½U11	£0.90
S130	Complete kit of parts to build nickel cadmium charger	£3.50

SUPER SAVE PAK

S124 6 x 741P — £1.00
S125 5 x 555 — £1.00

S138 Surplus/End of Manufacturers Line/Pre-amp, with Base, Treble, Volume Control and circuit diagram supplied. ONCE ONLY OFFER — £1.25

S137 20 Assorted Slider Knobs Chrome/Black — £1.00

S131	2 x 12v Relays plastic case	£0.70
S132	2 x 24v Relays plastic case	£0.60
S133	1 switch bank 5 way incl. silver knob	£0.75
S134	2 x Magnets suitable for reed switches	£0.10
S135	.1 Veroboard pak 2 pcs 45 sq. ins. appx.	£0.80
S136	.15 Veroboard pak 2 pcs 60 sq. ins. appx.	£1.10
16199	.1 Veroboard pak 30 sq. ins. appx.	£0.50
16200	.15 Veroboard pak 30 sq. ins. appx.	£0.50

TOOLS

No. 2011 5 in. wire cutters — £1.55
No. 2012 5 in. long wire plyer — £1.45

Super Duper Component Box

Min. 3 lbs in weight consisting of a fantastic assortment of Electronic Components — Pots. Resistors. Condensers. Switches. Relays. Board-Semiconductors, wire, hardware, Etc., etc., etc.

* This is a large box and is sent separate to your order *

S140 £2.50 including p&p

TRANSFORMERS

SALE OFFER

S141 0235 240v primary 0-55v at 2Amp secondary £4.50* + £1.00 p&p
S142 0349 240v primary 0-20v at 2Amp secondary £3.50* + £0.86 p&p

Complete Amplifier Kits

STA15 15 watts per channel amplifier kit. Consists: 2 x AL60, 1 x PA100 1 x SPM80, 1 x 2034 transformer 2 x coupling capacitors
£37.70 inc. VAT + 85p p&p

STA25 25 watts per channel amplifier kit. Consists: 2 x AL60, 1 x PA100 1 x SPM120/45, 1 x 2040 transformer, 1 x reservoir cap, 2 x coupling capacitors
£41.45 inc. VAT + £1.16p p&p

STA35 35 watts per channel amplifier kit. Consists: 2 x AL80, 1 x PA100 1 x SPM120, 1 x 2041 transformer, 1 reservoir capacitor, 2 x coupling capacitors
£48.45 inc. VAT + £1.16 p&p

STA50 50 watts per channel amplifier kit. Consists: 2 x AL120, 1 x PA200, 1 x SPM120/65, 1 x 2041 transformer 1 reservoir capacitor 2 x coupling capacitors
£58.20 inc. VAT + £1.16 p&p

STA125 125 watts per channel amplifier kit. Consists: 2 x AL250 1 x PA200, 2 x SPM120/65, 2 x 2041 Transformers, 1 x reservoir capacitors 2 x coupling capacitors
£72.85 inc. VAT + £1.25 p&p

TRANSISTORS

BRAND NEW — FULLY GUARANTEED

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AC107	25p	BC177	12p	BF194	*9p	TIP32C	36p	2N1613	15p
AC126	14p	BC178	12p	BF195	*9p	TIP41A	34p	2N1711	15p
AC127	16p	BC179	12p	BF196	*12p	TIP41B	35p	2N1893	28p
AC128	16p	BC182	*9p	BF197	*12p	TIP41C	36p	2N2218	15p
AC128K	24p	BC182L	*9p	BF200	25p	TIP42A	36p	2N2218A	18p
AC176	16p	BC183	*9p	BFX29	22p	TIP42B	37p	2N2219	15p
AC176K	24p	BC183L	*9p	BFX84	18p	TIP42C	38p	2N2219A	18p
AC187	16p	BC184	*9p	BFY50	12p	TIP2955	65p	2N2221	15p
AC187K	26p	BC184L	*9p	BFY51	12p	TIP3055	42p	2N2221A	16p
AC188	16p	BC212	*10p	BFY52	12p			2N2222	15p
AC188K	26p	BC212L	*10p	MPSA05	*22p	ZTX107	*6p	2N2222A	16p
AD161		BC213	*10p	MPSA06	*22p	ZTX108	*6p	2N2369	10p
162MP	80p	BC213L	*10p	MPSA55	*22p	ZTX109	*7p	2N2904	14p
AF139	30p	BC214	*10p	MPSA56	*22p	ZTX300	*7p	2N2904A	15p
AF239	30p	BC214L	*10p	OC44	12p	ZTX301	*7p	2N2905	14p
BC107	6p	BC251	*10p	OC45	12p	ZTX302	*9p	2N2905A	15p
BC108	6p	BCY70	12p	OC71	9p	ZTX500	*8p	2N2906	12p
BC109	6p	BCY71	12p	OC72	12p	ZTX501	*10p	2N2906A	14p
BC118	*10p	BCY72	12p	OC75	10p	ZTX502	*12p	2N2907	12p
BC147	*8p	BD115	40p	OC81	14p			2N2907A	13p
BC148	*8p	BD131	*35p	TIP29A	35p	2N696	10p	2N2926G	*8p
BC149	*8p	BD132	*37p	TIP29B	36p	2N697	10p	2N2926Y	*7p
BC154	*16p	BF115	17p	TIP29C	38p	2N706	7p	2N3053	12p
BC157	*9p	BF167	19p	TIP30A	36p	2N706A	8p		
BC158	*9p	BF173	20p	TIP30B	37p	2N708	8p	2N3702	*7p
BC159	*9p	BF180	25p	TIP30C	38p	2N1302	12p	2N3703	*7p
BC169C	*10p	BF181	25p	TIP31A	32p	2N1303	15p	2N3704	*6p
BC170	6p	BF182	25p	TIP31B	33p	2N1304	15p	2N3903	*11p
BC171	*6p	BF183	25p	TIP31C	34p	2M1307	18p	2N3904	*11p
BC172	*6p	BF184	25p	TIP32A	34p	2N1308	22p	2N3905	*11p
BC173	7p	BF185	25p	TIP32B	35p	2N1309	22p	2N3906	*11p

DIODES

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AA119	5p	BAX16/		BYZ16	30p	OA85	7p	IS44	3p
AAZ13	4p	OA202	5p	BYZ17	28p	OA90	6p		
BA100	6p			BYZ18	28p	OA91	7p	IN5400	10p
BA115	5p	BY100	15p	BYZ19	28p	OA95	7p	IN5401	11p
BA144	5p	BY127	*10p					IN5402	12p
BA148	10p	BYZ10	32p	OA47	5p	IN34	5p	IN5404	13p
BA173	10p	BYZ11	32p	OA70	5p	IN60	6p	IN5406	16p
BAX13/		BYZ12	32p	OA79	7p	IN914	4p	IN5407	17p
OA200	5p	BYZ13	30p	OA81	7p	IN4148	4p	IN5408	19p

LINEAR I.C.'s

Type	Price	Type	Price	Type	Price
TBA800	*£0.75	uA711	£0.25	uA748	£0.28
TBA810	*£0.85	uA703	£0.20	72558	£0.45
TBA820	*£0.65	741P	£0.18	MC1310P	£1.25
LM380	*£0.80	72741	£0.20	76115	£1.25
LM381	*£1.25	uA741C	£0.20	NE555	£0.22
72709	£0.20	72747	£0.55	SL414A	£1.80
uA709	£0.20	748P	£0.28		

ZN 414 RADIO CHIP — 75p*

OPTOELECTRONICS

Displays

No. 1510	707 LED Display	£0.70
No. 1511	747 LED Display	£1.50
No. 1512	727 Dual LED Display	£1.55

LED's

No. S120	.125 Bright Red	£0.09
No. S121	.2 Bright Red	£0.09
No. 1502	.125 Green	£0.12
No. 1505	.2 Green	£0.12
No. 1503	.125 Yellow	£0.12
No. 1506	.2 Yellow	£0.12
No. S82	Clear .2 illuminating Red	£0.10

2nd Quality LED Paks

No. 1507	10 Assorted Colours and Size	£0.75
No. S122	10 x .125 Red	£0.60
No. S123	10 x .2 Red	£0.60

LED Clips

No. 1508/.125	.125	5 for £0.12
No. 1508/.2	.2	5 for £0.15

No S139 Infra Red Emitter Fairchild FP100 — £0.50

SPECIAL REDUCTIONS

No. 1514	NORP 12	45p each
No. S76	OCP71	5 for £1.00
No. S83 5.	NIXIE Tubes ITT 5870 ST (including Data)	£2.00
No. S77	Neon Indicator Lamps 230V A.C. state Colour (Red, Amber and Green)	25p each

P.O. RELAYS

S85 - 2 Off Post Office relays — 40p

BATTERY HOLDERS

to take 6 x HP7's
Order No. 202 — 10p each

MAMMORTH I.C. PAK

Approx 200 Pieces. Assorted fall-out integrated circuits, including: Logic, 74 series, Linear, Audio and D.T.L. Many coded devices, but some unmarked — you identify.
Order No. 16223 — £1.00

EX. G.P.O. MICROSWITCHES

Order No. S51 — 4 for 50p

POWER SUPPLY STABILIZER BOARD

Unused ex-equipment stabilizer board. Input 30V D.C. Output 20V. Complete with circuit diagram.
Order No. S81 — £1.25

CABLE CLIPS

S84 - 50 2 in. round single pin fixing — 30p

ORDERING

Minimum postage and packing for Sale Orders £0.50 PLUS any further postage as stated as per this Sale Advertisement.

Overseas Orders — ADD extra for Airmail.

V.A.T. — Please ADD V.A.T. as follows:
12½% to items marked *
8% to unmarked Items
NO V.A.T. on Books

I.C. INSERTION EXTRACTION TOOL

O/D 2015
30p each

BI-PAK

DEPT. R.C.2, P.O. Box 6, Ware, Herts
COMPONENTS SHOP:
18 BALDOCK STREET, WARE, HERTS.

ambit international ®

Production of the new catalogue has been held up for a few weeks - since we have just been appointed as distributors for two of the most exciting ranges of radio components products yet : The Micrometals range of iron dust torroids cores and formers, and the OKI range of VLSI for digital frequency displays for receivers. We apologize for any inconvenience, but these two ranges are really worth the wait, and include some products you will find hard to believe, like the MSM5523 IC, an IC with less than ten external components that gives AM frequency readout to 1kHz from LW to 39.999MHz, FM frequency readout in 100kHz steps - (all usual IF offsets programmable by diodes), a 24 hour format clock with 12 hour display, independent on and off timers, time signals on the hours, stopwatch facility and a sleep timer. This costs £14 with its timebase crystal, and makes all that has gone before an expensive and time wasting excercise. Rather like the way the Intersil ICM7216 has revolutionized the instrument counter market. (See the OSTS ad.) And those of you familiar with Amidon and IG dust torroids, favoured in many new RF designs, will be pleased to know Ambit will be stocking a broad range of the Micrometals types for applications from EMI filters to RF PA stages.

OKI frequency counter ICs: details in cat2

MSM5523	for CA LEDs with RHDP such as FND507	£14 inc xtal
MSM5525	for 3½ digit LCD AM/FM with direct segment drive. no clock or timers	£11 inc xtal

Other types for fluorescent displays etc OA

Other new semiconductor additions:

KB4437	pilot cancel mpx decoder	4.35
KB4438	muting stereo preamp	2.22
HA1370	supercedes TDA2020	2.99
TDA1090	HiFi AM/FM	3.35
TDA1220	low cost AM/FM	1.45

PRICES DOWN ON VMOS: as expected, this new technology in power transistorsis getting cheaper. 120v comp pairs /100W for £10.00

Price reduction on CA3189E ....now £2.20

New varicaps: to add to the biggest range.....

KV1211 2:9v bias to tune MW, like the KV1210, but a double diode £1.75

New pilot tone filters from TOKO...............

208BLR series, individual per channel with a 26/38kHz version for pilot cancel decoder applications. Flat to 1. Hz £0.90

New crystal filter for amateur NBFM...........

TOYO 10M4B1 with over 90dB adjacent ch. rejection for 2m NBFM. 10.7MHz £14

New ceramic IF filters for 455kHz..............

CFM455H 6kHz/6dB, 15kHz max /60dB - ideal for MC3357 etc. £10

A brief summary of some of our range of ICs:

TDA1062/1.95; TDA1083/1.95; HA1197/£1.40; CA3123E/£1.40; TBA651/£1.81; CA3089/1.94 HA1137/£2.20; MC1310/£2.20; HA1196/£3.95 KB4424/£2.75; KB4423/£2.53;SD6000/£3.75 KB4412/£2.55; KB4413/£2.75; KB4417/£2.55 MC1495L/£6.86*; MC1496P/£1.25 LM381N/£1.81; LM1303/£0.99; ULN2283B/ £1.00; LM380N/£1; TBA810AS/£1.09 TCA940E/£1.80; TDA2002/£1.95; ICL8038CC/£4.50*; NE566/£2.50*; NE567/ £2.50*; NE560B/£3.50; NE561B/£3.50; NE562B/£3.50*; NE565A/£2.50*

SEE THE OSTS ADVERT FOR CMOS/TTL REGULATORS, OPTO DISPLAYS, and other types of linear devices.

Some transistors for RF specifically:

BF256LB/0.34; 40822/0.43*; 40823/0.51 * 40673/0.55* ; BF900/961/0.80*; BF960/1.60* BF224/0.22; BF274/0.18; BF195/0.18; BF240/0.22; BF241/0.22; BF362/0.70; BF479/0.86; BF679S/0.70; BFY90/0.90*

PIN and other Varicap diodes:

BA102/0.30; BA121/0.30; ITT210/0.30 BB104B/0.40; MVAM2/£1.48; MVAM115/ £1.05; MVAM125/1.05; KV1210/£2.75 BA479/0.35; TDA1061/0.95; BA182/0.21

METER MADE low cost panel meters : 3 x 930 series with blanks and dry transfer sheet of scales and ledgends for £12.5 *

TERMS etc: CWO please, VAT on Ambit Items is generally 12½%, except where marked (*). Catalogue part 1:45p, part 2 50p all inclusive. Postage 25p per order, carriage on tuner kits £3. Phone Brentwood (0277) 216029/227050 9am-7pm. Callers welcome inc. Saturdays.

At last, DIY HiFi which looks as if it isn't.

That's not to say it doesn't look like HiFi - just that it doesn't look like the usual sort of thing you have come to associate with DIY HiFi. The Mk3 outstrips and outperforms all British made HiFi tuners, and most imported ones too. Certainly at the price, there isn't one near it. But more than that, it looks superb . A small pic here would be an insult, so send an SAE for details on the kit that looks as if isn't. It's something else.............

- ★ Exceptionally high performance - exceptionally straightforward assembly
- ★ Baseboard and plug-in construction. Future circuit developments will readily plug in, to keep the MkIII at the forefront of technical achievement
- ★ Various options and module line-ups possible to enable an installment approach to the system

and now previewing the matching 60W/channel VMOS amplifier:

- ★ Matching both the style and design concepts of the MkIII HiFi FM tuner
- ★ Hitachi VMOS power fets - characterized especially for HiFi applications
- ★ Power output readily multiplied by the addition of further MOSFETs
- ★ VU meters on the preamp - not simply dancing according to vol level
- ★ Backed with the usual Ambit expertise and technical capacity in audio

The PW Dorchester·LW,MW,SW,& FM stereo tuner

In much the same way as we have swept away the 'old technology' in frequency/timer counters - with the OKI and Intersil single IC counters, we now offer a single IC "All Band" radio tuner. Don't confuse this one chip radio with things like the ZN414 - for this is a genuine superhet receiver with a mechanical AM IF filter, and ceramic IF filters for FM. The AM section employs a balanced input mixer section, covering all broadcast bands - plus a BFO and MOSFET product decetor for SSB/CW - though at this price, the tuner is not intended as a "communications receiver" - although we know of many lesser designs that make that claim. The AM sensitivity is nevertheless better than 5uV, and FM sensitivity is 1.2uV for 30dB S/N. As a multiband broadcast superhet receiver, it is a unique constructor project that fulfills the requests we very frequently get for a general coverage circuit that isn't over complicated. The set has CA3089E FM performance, with mute etc., and a PLL stereo decoder with full pilot tone filtering.

The tuner board - with "on board" PCB mounted switching, all components etc : £33.00
The case/cabinet with PSU, meter and mechanics etc £25.00
An SAE for full details please. See the feature article in Practical Wireless (Dec/Jan)

2 Gresham Road, Brentwood, Essex.

CHESTER ELECTRONICS

HI VOLTAGE TUBULAR CERAMIC CAPACITORS

1.1pf. 1.5pf. 1.8pf. 2.0pf. 2.25pf. 2.7pf. 3.9pf. 4.2pf, 4.7pf. 5pf, 5.6pf. 6.8pf. 9.1pf. 10pf. 12pf, 15pf. 16pf. 17.5pf. 18pf. 18.5pf, 20pf, 22pf, 22.6pf, 39pf. 60pf. 68pf, 70pf, 700pf, 820pf, 1200pf. 1300pf. 1800pf. 2000pf. 2200pf, 2500pf, 2800pf, 3300pf. All at 5p each, 50 for £2.00.

POLYESTER CAPACITORS

0.01u. 0.015u, 0.033u, 0.068u, 0.1u, all 250V @ 5p each
0.15u, 0.22u, 0.33u. all at 250V @ 7p each
1.0u, 2.2u. at 250V @ 15p each

MYLAR CAPACITORS

0.0015u/50V. 0.0068u/50V. 0.005u/100V, 0.02u/100V all at 5p each

SPECIAL OFFER: Hunts 300pf 600V, 0.0015u/400V at 5p each
Silver mica 39pf 2% only 8p each

Reversable Capacitors: 6.8u 40V, 5p each, 400u, 40V only 10p each

0.25W Pre-Sets available at 7p each. 50 for £3, 100 for £5
Vertical: 100 ●. 220 ●. 470 ●. 500 ●. 2K2, 4K7. 22K, 47K, 220K, 1M.
Horizontal: 100 ●, 1K. 4K7. 10K. 15K. 470K. 1M, 3M3,
(Values of both styles may be mixed to obtain price breaks)

AC154	15p	BC125	10p	BD132	34p	BT106	£1.25
AC187K	25p	BC147	7p	BD135	32p	BU20B	£2.00
AD142	65p	BC148	7p	BD136	32p	BFY50	15p
AD149	50p	BC153	10p	BD232	65p	BFY51	15p
AD161	35p	BC184C	7p	BD234	50p	BFY52	15p
AD162	35p	BC184LC	8p	BD238	45p	TIP32C	45p
AU110	£1.00	BC212	10p	BF262	30p	2N3055	35p
BC107	8p	BC213	10p	BF271	15p	2N3703	8p
BC108	8p	BC214	10p	BFXB9	20p	2N29260	10p
BC109	8p	BD131	34p	BRY39	26p	2N3503	18p

(All the above transistors are fully branded, full spec devices)

Small slow motors (Smiths clocks) 50 ● 2W. New only £1 each

ROTARY POTS (Brand New)

LOG (Less Switch)
4K7. 10K. 22K. 47K. 100K. 470K. 1M 2Ms. 28p each

LIN (Less Switch)

470 ●. 1K. 2K2. 4K7. 10K, 22K. 47K. 100K. 220K. 470K. 1M. 2M2. 28p each

PANEL METERS 2⅜" x 1⅞" x 1⅜" (Brand New)

0–50UA	0–50MA	0–50Volts	500–0–500UA
0–100UA	0–100MA	0–300Volts	0–30VDC
0–500UA	0–500MA	"S" Strength Meter	
0–1MA	0–1Amp	V.U. Meter	
0–5MA	0–2Amp	50–0–50UA	ALL METERS ONLY
0–10MA	0–25Volts	100–0–100UA	£5.00 each

MINIATURE TOGGLE SWITCHES

Single Pole Single throw 75p each
Single Pole Double throw 77p each
Double Pole Double throw 83p each

SLIDE SWITCHES

Standard Double Pole Double Throw 15p each
Standard Double Pole Double Throw (Centre Off) 17p each

Banana Plugs Banana Sockets

Red 15p each
Black 15p each
Chassis type Red 15p each
Chassis type Black 15p each

SPECIAL OFFER: 741 8 pin DIL Brand New full spec etc.
1 off 18p each, 50 for £8.100 for £15.00

RUBBER FEET 10 for 50p

MULTITESTERS

All of the multitesters listed below are brand new.

Type	Specification	Price Each
LT101	Economy 1000 OPV	£9.00
T1	Standard 1000 OPV	£12.00
PROE	20.000 OPV	£46.00
TMK500	20.000 OPV (Incl. case)	£31.00

SOLDERING IRONS (Brand New)

Antex CCN £5.00
Antex C £4.75
Antex SK1 Kit £8.00
Antex CX £4.75
Antex X25 £4.75
Antex SK3 Kit £7.50

LEADS FOR THE ABOVE

Standard test leads £1.50 each
Curly lead with Banana Plug £2.10 each
Test Lead Kit £2.50 each (ideal for the beginner)
PROBE: 25KV High Voltage 1000 Meg. Ohms probe only £15.00
SPECIAL OFFER: VERO-BOARD 0.1" 18" long x 3¾" wide only £1.75 each

JACK PLUGS

¼" Mono Plastic Unscreened 15p each
¼" Mono Metal Screened 30p each
¼" Stereo Plastic Unscreened 28p each
¼" Stereo Metal Screened 38p each

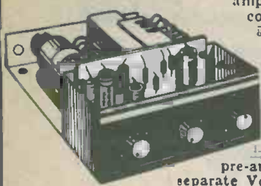
JACK SOCKETS

¼" Jack Line Mono Plastic 20p each
¼" Jack Line Mono Metal 35p each
¼" Jack Chassis Mono Plastic Closed 20p each
¼" Jack Chassis Stereo Plastic Closed 30p each

Do not add VAT to the above prices. Only add 20p Post & Packing. No callers please as we have no retail facilities.

SEND YOUR ORDERS TO: **CHESTER ELECTRONICS**
6 Hunter Street Chester CH1 2 AU

SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 Silicon transistors plus 2 power out-put transistors in push-pull. Full wave rectification. Output approx. 13 watts r.m.s. into 8 ohms. Frequency response 12Hz. 30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8-15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3" high × 6" wide × 7½" deep. AC 200/250V. PRICE £18.00. P. & P. £1.20.

HARVERSONIC MODEL P.A. TWO ZERO

An advanced solid state general purpose mono amplifier suitable for Public Address system, Disco, Guitar, Gram., etc. Features 3 individually controlled inputs (each input has a separate 2 stage pre-amp). Input 1, 15mv into 47k. Input 2, 15mv into 47k. (suitable for use with mic. or guitar etc.) Input 3 200mv into 1 meg. suitable for gram, tuner, or tape etc. Full mixing facilities with full range bass & treble controls. All inputs plug into standard jack sockets on front panel. Output socket on rear of chassis for an 8 ohm or 16 ohm speaker. Output in excess of 20 watts R.M.S. Very attractively finished purpose built cabinet made from black vinyl covered steel, with a brushed anodised aluminium front escutcheon. For ac mains operation 200/240v. Size approx. 12¼"w. x 5" h. x 7¼" d.

Special introductory price £28.00 + £2.50 carr & pkg.

HARVERSONIC STEREO 44

A solid state stereo amplifier chassis, with an output of 3-4 watts per channel into 8 ohm speakers. Using the latest high technology integrated circuit amplifiers with built in short term thermal overload protection. All components including rectifier smoothing capacitor, fuse, tone control, volume controls, 2 pin din speaker sockets and 5 pin din tape rec./play socket are mounted on the printed circuit panel, size approx. 9¼" × 2¾" × 1" max. depth. Supplied brand new and tested, with knobs, brushed anodised aluminium 2 way escutcheon (to allow the amplifier to be mounted horizontally or vertically), at only £10.00 plus 50p P. & P. Mains transformer with an output of 17V a/c at 500 m/a can be supplied at £2.00 plus 40p P. & P. if required. Full connection details supplied.

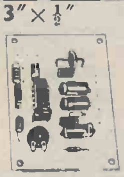
BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240v. Secondary combinations 0-5-10-15-20-25-30-35-40-60v. half wave at 1 amp. or 10-0-10, 20-0-20, 30-0-30v. at 2 amps full wave. Size 3in. long × 3½in. wide × 3in. deep. Price £3.20 P. & P. £1.20.

MAINS TRANSFORMER. For power supplies.
Pri. 200/240v. Sec. 9-0-9 at 500 mA. £1.80 P. & P. 65p.
Pri. 200/240v. Sec. 12-0-12 at 1 amp. £2.00 P. & P. 65p.
Pri. 200/240v. Sec. 10-0-10 at 2 amp. £2.70 P. & P. 90p.
Pri. 200/240v. Sec. 23v. at 1.5 amp, 6v at ·6 amp, 8v. at 50 mA. £2.25 + 65p P. & P.

MAINS TRANSFORMER. Pri, 0.110 and 240 Sec. 28V at 1.8 amps. Also tapped at 12V ·3 amp. Size 2¾in hx 3¼in w x 2¾ in d. £2.50 + £1 P. & P.

ALL PURPOSE POWER SUPPLY UNIT 200/240v. A.C. input. Four switched fully smoothed D.C. outputs giving 6v. and 7½v. and 9v. and 12v. at 1 amp on load. Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case overall size 6" × 3¼" × 2¾". Ready built and tested. Price £6.75. P. & P. 95p

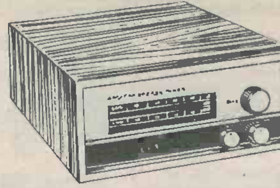
STEREO-DECODER SIZE 2" × 3" × ½"



Ready built. Pre-aligned and tested. Sens. 20-560mV for 9-16V neg. earth operation. Can be fitted to almost any FM VHF radio or tuner. Stereo beacon light can be fitted if required. Full details and instructions (inclusive of hints and tips) supplied. £6.00 plus 20p P. & P.
Stereo beacon light if required 40p extra.

QUALITY RECORD PLAYER AMPLIFIER MK. II A top quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in wide × 3in deep × 6in high. Ready built and tested. PRICE £7·00. P. & P. £1.25
ALSO AVAILABLE mounted on board with output transformer and speaker. PRICE £8·00. P. & P. £1.30.

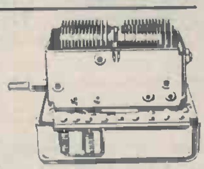
MAINS OPERATED SOLID STATE AM/FM STEREO TUNER



200/240V Mains operated Solid State A/M F/M Stereo Tuner. Covering M.W. A.M. 540-1605 KHZ, VHF/FM 88-108 MHZ. Built-in Ferrite rod aerial for M.W. Full AFC and AGC on AM and FM. Stereo Beacon Lamp Indicator. Built-in Pre-amps with variable output voltage adjustable by pre-set control. Max o/p Voltage 600 mV RMS into 20K. Simulated teak finish cabinet. Will match almost any amplifier. Size 8½" w. 4" h. × 9¼" d. approx. LIMITED NUMBER ONLY at £28.00 + £1.50 P. & P.

SPECIAL OFFERS

Mullard LP1159 RF-IF Double Tuned Amplifier Module for nominal 470kHz. Size approx. 2¾" × 1¼" × ¾" 7·6V + earth. Brand new pre-aligned. Full specification and connection details supplied. £2·25 + P. & P. 20p.



Pye VHF/FM Tuner Head covering 88-108MHz. 10·7M/Hz IF output 7·8V + earth. Supplied pre-aligned, with full circuit diagram. Connection details supplied. Beautifully made with precision-geared FM Gang and 323 Pf + 323 Pf AM Tuning Gang only £3·15 + P. & P. 35p.

PRECISION MADE
Push Button Switch bank. 8 Buttons giving 16 8/P C/O interlocked switches plus 1 Cancel Button Plus 3 d/p c/o. Overall size 5" × 2½" × 1". Supplied complete with chrome finished switch buttons 2 for £1.80 + 20p, P. & P.

SPECIAL OFFER
Limited number only!

New but very slightly shop soiled transistor radios by well known manufacturer. Very smart and attractive, vinyl covered with carrying handle.
Two models available:
AC mains or battery operated and covering VHF/FM and MW bands. **£10.00 + £1.30 p&p**

Similar to above but battery operation only. Five wavebands, MW, FM, SW and two VHF bands for reception of aircraft and some public service systems. **£11.00 + £1.30 p&p**

Size (either model), 7in.H x 9¼in.W x 4in. D approx. Both types have telescopic aerials for VHF/FM reception and internal ferrite aerials for AM bands, also earphone socket for personal listening. Either model uses four HP11 or SP11 batteries (not supplied).

LOUDSPEAKER BARGAINS
5in. 3 ohm £2.20, P. & P. 35p. 7 x 4in. 3 ohm £2.80, P. & P. 48p. 10 x 6in. 3 or 15 ohm £3.85, P. & P. 75p. 8 x 5in. 3 ohm with high flux magnet £3.60. P. & P 60p. Tweeter. Approx. 3½". Available 3 or 8 or 15 ohms. £2.20. 30p P. & P.

2" PLASTIC CONE HF TWEETER 4 ohm, £3·50 per matched pair + 50p P. & P.

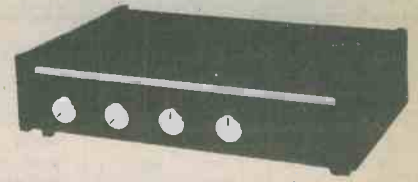
HIGH POWER HI-FI 8 ohm Dome Tweeter. 1" voice coil. Magnet size 3" dia. Suitable for use in up to 50 watt systems. £4·50 each + 60p P. & P.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Our price £2.00 yd. length. P. & P. 50p per yd. (min. 1 yd.). S.A.E. for samples.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size 11¾" × 14¾" × 1¼" deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz–20kHz. Can be mounted on ceilings, walls, etc. and used with or without baffle. Send S.A.E. for details. Only £8·40 each. P. & P. 90p for one, £1.10 for two.
Now available in either 8" round version or 4½" x 8½" rectangular. 10 watts R.M.S. 60Hz-20KHz £6.25 + P. & P. (one 65p, two 75p).

SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus Diamond Stereo LP and Sapphire 78.
ONLY £2.50 P. & P. 20p. Also available fitted with twin Diamond T/O stylus for Stereo LP. £3.00. P. & P. 20p.
LATEST CRYSTAL T/O STEREO/COMPATIBLE CARTRIDGE for EP/LP/Stereo 78. £2.00 P. & P. 20p
LATEST T/O MONO COMPATIBLE CARTRIDGE for playing EP/LP/78 mono or stereo records on mono equipment. Only £2.00 P. & P. 20p
STEREO MAGNETIC PRE-AMP sens. 3mVin for 100m Vout 15 to 35V neg earth. Equ. ± 1db. From 20 Hz to 20 KHz. Input impedance 47k. Size 1½in x 2½in x 5¼in H. £2.60 + 20p P. & P.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



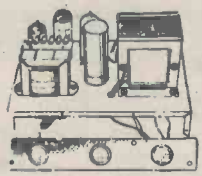
A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. Very simple to modify to suit magnetic cartridge—instructions included. Output stage for any speakers from 8 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board with component identification clearly marked, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specifications: Power output: 14 watts r.m.s. per channel into 5 ohms. Frequency response ± 3dB 12-30,000 Hz Sensitivity: better than 80mV into 1MΩ. Full power bandwidth: ± 3dB 12-15,000 Hz. Bass, boost approx. to ± 12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35v. at 1·0 amp.
Overall Size 12"w. × 8"d. × 2¾"h.
Fully detailed 7 page construction manual and parts list free with kit or send 25p plus large S.A.E.

AMPLIFIER KIT	£14.50	P. & P. 80p
(Magnetic input components 33p extra)		
POWER PACK KIT	£6.00	P. & P. 95p
CABINET	£6.00	P. & P. 95p

Special offer — only £25.00 if all 3 units ordered at one time plus £1.25 P. & P.

Full after sales service
Also available ready built and tested £31·25. P. & P. £1.50.

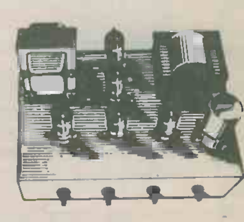
3-VALVE AUDIO AMPLIFIER HA34 MK II.



Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½"w. × 4"d. × 4¾"h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £8.50. P. & P. £1.40.

HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. £8.00. P. & P. £1.40.

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15 Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 25p × SAE (Free with parts). All parts sold separately. ONLY £15.50. P. & P. £1.40. Also available ready built and tested £20.00. P. & P. £1.40.

SPECIAL LINES
OFFERED SUBJECT TO STOCK AVAILABILITY

Limited number of British Manufacturer's Surplus professional 100 watt RMS Slave amplifiers. Special features: 2 separate power modules, 1 for Bass response, and 1 for mid. range/tweeter. 5 stage LED display for power o/p indication. A/c mains i/p switchable for 110 or 240V. Can easily be converted to stereo.

AVAILABLE TO PERSONAL CALLERS ONLY—PLEASE PHONE TO CONFIRM AVAILABILITY.
Brand new and tested only £33·75.

OUR PRICES INCLUDE VAT AT CURRENT RATES

Open 9.30-5.30 Monday to Friday. 9.30-5 Saturday
Closed Wednesday.
Prices and specifications correct at time of press. Subject to alteration without notice

HARVERSON SURPLUS CO. LTD.

(Dept. REC) 170 MERTON HIGH ST., MERTON, LONDON, SW.19. Tel: 01-540 3985

A few minutes from South Wimbledon Tube Station

SEND SAE WITH ALL ENQUIRIES. FOR PERSONAL CALLERS ONLY: WE CAN NOW OFFER A FULL REPAIR SERVICE ON ALL HI-FI EQUIPMENT, DISCO, CASSETTES, CAR RADIO, ETC.

(Please write clearly)

PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

NEW YEAR SPECIAL OFFERS ON CERTAIN COMPONENTS (PRICES VALID UNTIL 1.3.79)

POTS
Carbon Rotary Modern Types

680ohm lin
2K7 lin
4K lin
10K lin
250K lin
50K lin
100K lin
200K lin
500K lin
Dual 100K lin
Dual 250K lin
500K lin
Slider 1K8

★ **STAR OFFER** All pots only 12p each

I.C's

'326' and '335' both are 16 pin dil packages, dual two input dual three input, 12v rail, full spec with data 7p
'370' is a quad flip flop, 16 pin dil package, 12v rail full spec, with data 7p
'332' dual two input with four invertors, 16 pin dil package, 12v rail full spec, with data 7p

HEATSINKS

Single TO3 black anodised aluminium finned & ready drilled 2" x 1¾" x 1¾"	44p
Double TO3 black anodised aluminium finned, ready drilled, 3½" x 1¾" x 1¾"	62p
TO3 transistor insulation covers, black nylon up to 30Kv	5p
TO3 Power Skts	18p
TO3 melinex/mica ins. washers	3p
TO3 ins. bushes	2p

TOROIDAL CORES
all round

21mm **10p**, 25mm **12p**, 27mm **13p**, 29mm **14p**, 33mm **16p**, 39mm **21p**, 48mm **28p**, 52mm **28p**, 58mm **29p**, 68mm **30p**, 78mm **30p**.

EXTRA SPECIAL OFFER

By demand we present a transistor inverter 12v dc input – 200/240v ac output 50Hz at 40 watts uncased but ready wired and assembled, transistors mounted on aluminium folded sheet, square wave output **£4.80** plus **50p** postage or alternative smoothed/filtered output waveform **£5.80** plus **50p** postage.

BOLTS

6BA plated ½" pk six	7p
½" pk of six	10p
Nylon 6BA ½" six	14p
4BA plated ¼" pk five	8p
¾" five	12p
Nuts 6BA or 4BA	ten 8p

Dryfit sealed non-spillable lead acid rechargeable batteries. All types are ex-equipment but tested and in good condition. 6v 900ma **£1.80** plus p/p **35p**. 6v 2.6AH **£3.50** plus p/p **45p**. 6v 6AH **£4.60** plus p/p **55p**. 6v 7.5AH **£6.75 plus p/p 55p.**

DISPLAYS

0.3" economy seven segment displays, common anode, left hand decimal point. 14 pin dil package.

Red	65p
Yellow	70p
Green	75p

HP7750 display C.A. seven seg. red, 14 pin package, plus one displayed at full 0.3" 98p

I.C. SKTS

Low profile dil 8 pin	9p
14 pin	12p
16 pin	13p

TESTED PAKS

Ten mixed marked values electrolytics at	17p
Eighteen mixed small resistors at	12p
Fifteen assorted capacitors could be mylar, ceramic polyester etc. at	12p
Twenty mixed transistors at	35p
Ten mixed wirewound resistors at	★ Star offer 18p
Eighteen mixed values ceramic capacitors at	12p
Ten mixed 400mw zener diodes	18p
Ten mixed 2w zener diodes at	24p
Six mixed value pots rotary at	★ Star offer 40p
Three mixed sizes of toroidal cores at	54p
Three mixed sizes of transistor audio transformers	46p
Twelve 7400 series IC's unmarked/untested at	24p
Twenty silicon diodes mixed signal and power types at	10p
Six FETs at	50p
Six photo type transistors at	★ Star offer 40p
Twenty mixed BC107/8/9 transistors at	★ Star offer 50p
Twelve C280 capacitors asstd	10p

AUDIO TRANSFORMERS

Miniature transistor output types,

3-pin Pri-types	20p
4-pin Pri-types	20p
Interstage types	18p

400mw **Zener Diodes (new)** 3.6v, 6.8v, 10v, 11v, 12v, 13v, 16v, 24v, 30v, 33v, all **3p each**

AC128	5p	2N3866	40p
BC107	4p	2N3553	55p
BC108	4p	ASY51	12p
BC109	4p	ASY66	12p
2N456	25p	OC702	10p
E5398	4p	2S302	15p
T1P31B	20p	2SA49	5p
T1P29	26p	2SB156A	5p
T1P33	31p	AC169	6p
2N3054	34p	OC57	7p
2N3055	34p	OC140	25p
SA496	8p	2N527	20p
2G304	10p	2N215	8p
2SA52	5p	U14708	6p
MM2613	4p	2SA53	5p

FET's

P/channel	11p
N/channel	12p
Photo transistor	12p

Rubber connecting block 2-way mains type	5p
Coil formers 3/16" with core	7p
Solder-in tubular trimmers, 3 pf	7p
6 pf	7p
8 pf	8p
12 pf	8p
TBA120S FM I.C's untested but with data	12p
Wideband Amplifier I.C's untested with data	12p
Vari-Cap Diodes tested at two	6p

ELECTROLYTIC CAPACITORS

Radial		Axial	
6.8uf/25v	4p	16uf/30v	3p
33uf/160v	6p	25uf/12v	3p
47uf/25v	4p	40uf/16v	3p
64uf/70v	4p	400uf/10v	4p
2mfd/40v	3p	64uf/10v	3p
100uf/40v	3p	68uf/6.3v	3p
140uf/100v	7p	68uf/16v	3p
150uf/16v	4p	470uf/6.3v	5p
150uf/18v	4p	125uf/10v	3p
.22/25v	2p	150uf/6.3v	3p
320uf/18v	5p	250uf/16v	4p
330uf/25v	4p	1000uf/10v	8p
400uf/25v	5p		
470uf/16v	6p		
1500uf/3v	7p		

NEW RANGE TRANSISTORISED INVERTER UNITS

Designed to operate reliably in continuous or intermittent use, low standing current drain, proportional current consumption with regard to the connected load, assembled in vinyl covered instrument cases with grade one silicon power transistors — Guaranteed 2 years — DC input fused.

12 volt dc inputs — 200/240V AC outputs regulated at 50HZ square wave or optional smoothed and filtered wave form circuitry for sensitive equipment:

22/25 watts, cased 4 in x 3 in x 2 in **£6.80** postage **85p** extra; **38/40 watts**, cased 4 in x 3 in x 2 in **£9.40** postage **85p** extra; **120/140 watts**, cased 8 in x 7 in x 3 in **£18.70** postage **£1.40** extra; **180/200 watts**, cased 8 in x 7 in x 3 in **£24.60** postage **£1.40** extra; **240/250 watts**, cased 9 in x 8 in x 3 in **£28.80** postage **£1.80** extra; **350/360 watts**, cased 10 in x 8 in x 3½ in **£34.50** postage **£2.00** extra; **420/440 watts**, cased 10 in x 8 in x 3½ in **£40.00** postage **£2.00** extra; **480/500 watts**, cased 10 in x 8 in x 3½ in **£48.20** postage **£2.00** extra.

OPTIONAL EXTRAS

Smoothed and filtered waveform circuitry **£2.50**; Additional 13 amp mains output socket fitted **£1.20**; Panel fuse/holder 20mm for mains protection fitted **£1.00**. All inverters are ready assembled, DC input via heavy duty cables with attached battery clips, AC mains output via a 13 amp socket.

DO NOT ADD ANY EXTRAS UNLESS INDICATED

Some of the advertised components are offered below normal prices due to their being unmarked but identified and tested new and workable by ourselves, any unsatisfied customer may return goods purchased within 8 days for full refund as long as the goods are undamaged.

Overseas orders (including Ireland) add extra 10% towards postage.

ORDER DETAILS

It is helpful if you send a S.A.E. with all orders or enquiries, lists free on request.

ELECTROVANCE **Tel: 01-736 0685**
MAIL ORDER ONLY

P.O. Box 191, London, SW6 2LS

SEMICONDUCTORS. ALL FULL SPEC. BC212, BC182, BC237, BF197, BC159, all 8p each. RCA 2015, TO3 POWER TRANSISTORS (SIM. 2N3055), 35p. MRD3051 PHOTO TRANSISTORS 35p. FET's SIMILAR TO 2N3819 17p. MOSFET SIMILAR 40673 35p. 3N140 MOSFETS 50p. M203 DUAL MATCHED PAIR MOSFETS, SINGLE GATE PER FET 40p. MIN. E.H.T. SIL. RECS. 15K.V.. 2.5mA. 30p. INTEL C1103 1024 BIT MOS RAMS 95p.. BB 113 TRIPLE VARICAP DIODE 35p MC1310 STEREO DECODER IC £1.20. CD4051 IC's 50p. 741 8 PIN IC's 23p. DIODES: IN4002 4p. IN4005 7p. RED LED's 0.2" or 0.125" 12p. NIXIES: ITT 5870ST 85p. GN9A 65p. MAN3A 3/mm 7 SEC. DISPLAYS 60p.

MICROPHONES: GRUNDIG ELECTRET MICROPHONE INSERTS WITH FET PREAMP £1.50. CRYSTAL MIKE INSERTS 37mm 45p. ELECTRET CONDENSER MIKES. IK IMP. WITH STANDARD JACK PLUG £2.85. EM506 CONDENSER MIKES UNI DIRECTIONAL. FET AMP DUAL IMPEDANCE 50K/600 OHMS ON OFF SWITCH 30-18KHz £11.00. EM104 MIN. TIE CLIP CONDENSER MIKES. OMNI. 1K IMP. USES DEAF AID BATTERY (SUPPLIED) £4.95.

MORSE KEYS: ALL METAL HI-SPEED TYPE £2.25 PLASTIC TYPE 95p.

HEADPHONES: 8 OHM STEREO PHONES PADDED EARPIECES AND HEADBAND, CURLY CORD, 30-18KHz ONLY £3.00.

OPTO-ISOLATORS, TYPE BX504. INFRA RED LED TO PHOTO CELL 4 LEAD 25p.

AEROSOL 'TOUCH UP' PAINT. 1 COLOUR. YELLOW/GREY. 35p 6oz can.

POT CORE UNIT. HAS 6 POT CORES INCLUDING FX2243 (45mm) x 1, FX2242 (35 mm) x 2, 3 SILICON TO3 POWER TRANSISTORS ON HEAT SINK, 3 20mm PANEL FUSEHOLDERS, 5 amp PLASTIC S.C.R. AND PANEL WITH VARIOUS TRANSISTORS AND DIODES NEW. £1.75 (75p p&p).

SOLDER SUCKERS: PLUNGER TYPE. REPLACEABLE NOZZLE. EYE PROTECTION SHIELD. HIGH SUCTION £4.95.

CRYSTALS. 300KHz 40p.

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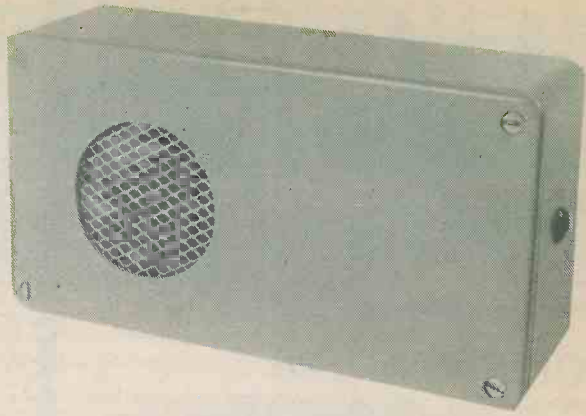
2-TONE DOOR BUZZER



By A. P. Roberts

A DISTINCTIVE REPLACEMENT FOR THE OLD FASHIONED DOORBELL

This door buzzer circuit was designed to replace a 2-tone electric bell of the type which produces a single chime when the bell-push is pressed, and a second, lower, chime when the bell-push is released. It was decided to retain the same 2-tone approach in the electronic replacement unit, but in this case the bell-push would only trigger the circuit. Thus, when the bell-push has been pressed the circuit generates a high tone for about a second and then a low tone for a further second. This happens regardless of whether the push button is operated only momentarily or is depressed for several seconds.

METHOD OF OPERATION

The general arrangement of the unit is shown in block diagram form in Fig. 1. Two monostable multivibrators have their inputs normally tied to earth via resistor R, the inputs being taken to the positive supply rail potential whenever the bell-push is operated. This causes both monostable circuits to be triggered.

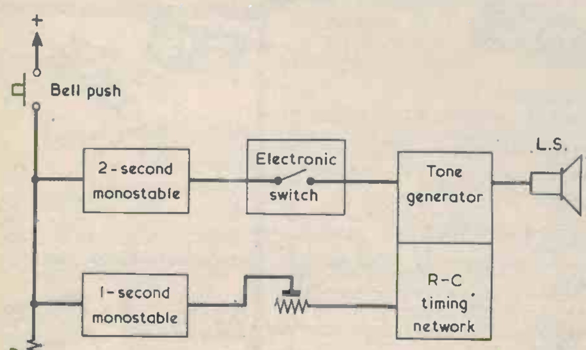


Fig. 1. The basic stages in the 2-tone door buzzer. Pressing the bell-push triggers both monostables. The upper monostable applies power to the tone generator for 2 seconds; after 1 second the pulse from the lower monostable ceases and the tone generator output frequency falls

Once triggered, a monostable of the type employed here gives an output pulse of fixed duration, and further operations of the push button during the output pulse have no effect. Neither does continuously pressing the bell-push, since the pulse will still finish at the end of the appropriate period of time. The circuit will not be retriggered until the bell-push is released and then pressed once again.

One of the monostable circuits produces an output pulse of about 2 seconds duration, and this pulse is used to turn on the tone generator by way of an electronic switch. The other monostable has an output pulse of approximately 1 second, and this pulse is coupled to the R-C timing network of the tone generator through a pre-set variable resistor. There is little effect on the tone generator while the pulse lasts, but when it ends the tone generator frequency is pulled lower. Therefore, a high tone is produced by the circuit for about 1 second, followed by a lower tone for about the same length of time.

The frequency of the lower tone can be adjusted by means of the variable resistor, and this feature is necessary since two tones of random frequency can sometimes produce rather discordant results. The variable resistor enables the unit to be adjusted to give a pleasant sounding output.

THE CIRCUIT

The circuit is shown in Fig. 2 and, as will be apparent from this, the unit incorporates just two integrated circuits and a single transistor.

Each monostable is made up of two of the gates contained in a CMOS CD4001 quad 2 input NOR gate i.c. The 2 second monostable employs gates 1 and 2, and has C2 and R3 as the timing components. Gates 3 and 4 are in the 1 second monostable, with C3 and R4 acting as the timing components. The inputs of the monostables are

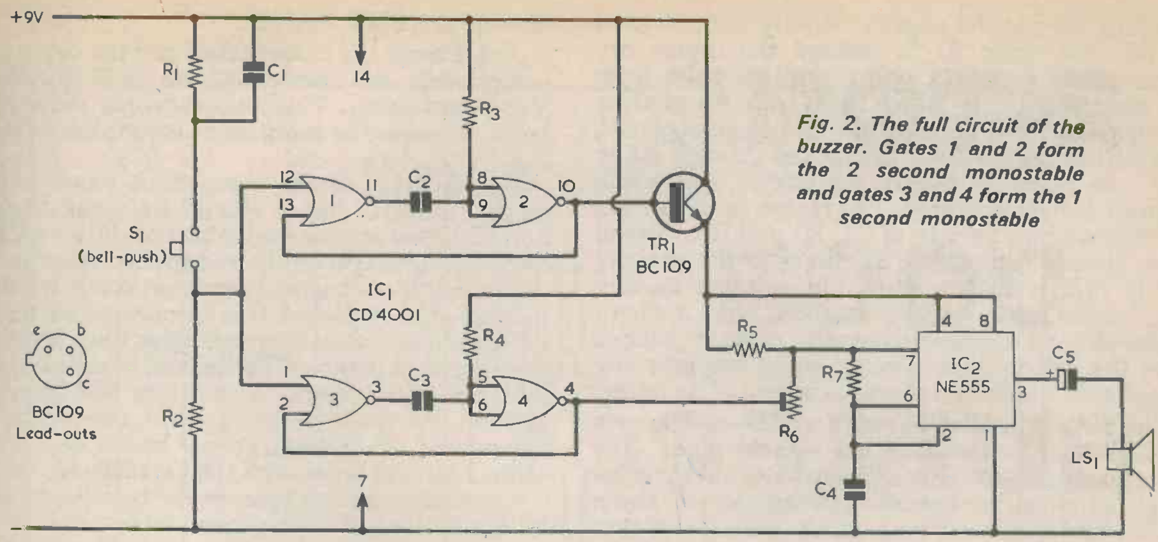


Fig. 2. The full circuit of the buzzer. Gates 1 and 2 form the 2 second monostable and gates 3 and 4 form the 1 second monostable

COMPONENTS

Resistors
(All fixed values ¼ watt 10% unless otherwise stated)
- R1 10MΩ
- R2 2.2kΩ 5%
- R3 8.2MΩ
- R4 3.9MΩ
- R5 1kΩ 5%
- R6 22kΩ pre-set potentiometer, 0.1 watt, horizontal
- R7 4.7kΩ 5%

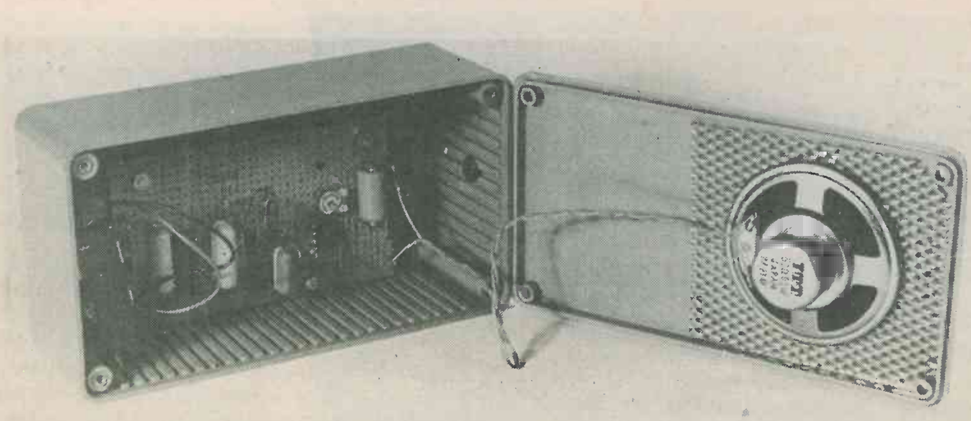
Capacitors
- C1 0.1μF type C280
- C2 0.33μF type C280
- C3 0.33μF type C280
- C4 0.22μF type C280
- C5 100μF electrolytic, 10 V. Wkg.

Semiconductors
- IC1 CD4001
- IC2 NE555
- TR1 BC109

Switch
- S1 bell-push

Speaker
- LS1 miniature speaker, 40Ω-80Ω

Miscellaneous
- Plastic case (see text)
- Veroboard, 0.1in. matrix
- Veropins (see text)
- 9 volt battery type PP3 (Ever Ready)
- Battery connector
- Speaker fabric or fret
- Wire, bolts, nuts, etc.



The plastic case which houses the buzzer components can be screwed to a convenient wall normally held at the negative supply rail potential by R2, but when S1 is pressed the inputs are momentarily supplied with a positive pulse from the discharged C1, which then rapidly charges through R2. Both monostables are then triggered. When S1 is released, C1 discharges through R1 so that it is ready to trigger the circuit once again when S1 is next operated. The reason for triggering the monostables by way of C1, R1 and R2, instead of by simply connecting S1 direct to the positive supply rail, is that push-button switches usually suffer from heavy contact bounce. With a direct connection to the positive rail, contact bounce when the bell-push is released could retrigger any monostable which had come to the end of its pulse.

The tone generator is based on the well-known NE555 timer i.c. used in the astable mode. The timing components R5, R7 and C4 have values which produce an operating frequency of about 640Hz, and the lower tone, given when the output of gate 4 goes low, can be varied from fractionally less than this frequency to lower than half of it. The frequency of the lower tone is adjusted by means of R6. The output from the tone generator is coupled to the loudspeaker by d.c. blocking capacitor C5. The loudspeaker is a miniature type and can have any impedance between 40Ω and 80Ω.

Power for the tone generator is obtained via the emitter follower transistor, TR1. When the output from the 2 second monostable is low, TR1 is cut off and no power is supplied to the tone generator. During the period of the 2 second pulse, when the output of the monostable is virtually at the positive supply rail potential, TR1 is turned on and the tone generator receives the full supply voltage less about 0.7 volt dropped in TR1.

The circuit can be economically run from a small 9 volt battery such as a PP3, as the stand-by current is only a fraction of a microamp. In fact the quiescent current consumption is so low that it is difficult to measure it accurately with normal test equipment. This is partially because CMOS i.c.'s such as IC1 have extremely low static state current consumptions, and because under quiescent conditions only a very small leakage current flows through TR1 into the tone generator.

When operating, the current consumption of the circuit is approximately 35mA.

COMPONENT PANEL

Apart from the loudspeaker and the battery, the components are assembled on a 0.1in. matrix Veroboard panel. This has 20 copper strips by 38 holes and uses the component layout shown in Fig. 3.

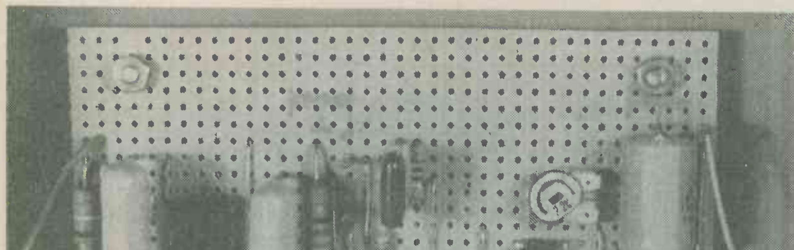
Construction of the component panel is quite straightforward, but it should be noted that IC1 and IC2 have opposite orientations. IC1 is a CMOS device and will probably be supplied in some form of protective packaging to prevent possible damage by high static voltages. It is recommended that the i.c. should be left in this packaging until it is fitted, and also that it should be the last component to be soldered to the board. A soldering iron having an earthed bit must be used when connecting this component. If desired, an i.c. holder can first be soldered to the board and the i.c. plugged into this.

The two mounting holes in the panel are 3.2mm. in diameter and will accept either M3 or 6BA mounting screws. Veropins suitable for 0.1in. Veroboard are fitted at the points where connections will be made to S1 and the loudspeaker.

HOUSING

The project may be housed in any plastic case capable of taking the component panel and the battery and loudspeaker, and that used by the author had outside dimensions of approximately 150 by 80 by 50mm. The lid is used as the front panel and a cut-out for the speaker is made in this. Some speaker fabric or fret is glued over the rear of the cut-out and the speaker is, in turn, glued to this. Care should be taken to ensure that no glue gets onto the speaker cone or surround. The component panel is mounted at the centre of the rear panel of the case by means of short M3 or 6BA countersunk screws. Spacing washers are required on the screws between the panel and the case to prevent strain on the panel when the screws and nuts are tightened up.

There should be small spaces on either side of the component panel which can accommodate mounting screws to fix the unit to a wall. A small hole is drilled in one side of the case and is fitted with a grommet. The wire from the bell-push is passed through this hole, and it connects to the component panel at the points indicated in Fig. 3.



The Veroboard layout. Due to i.c. interconnections this requires a number of tinned copper wire links

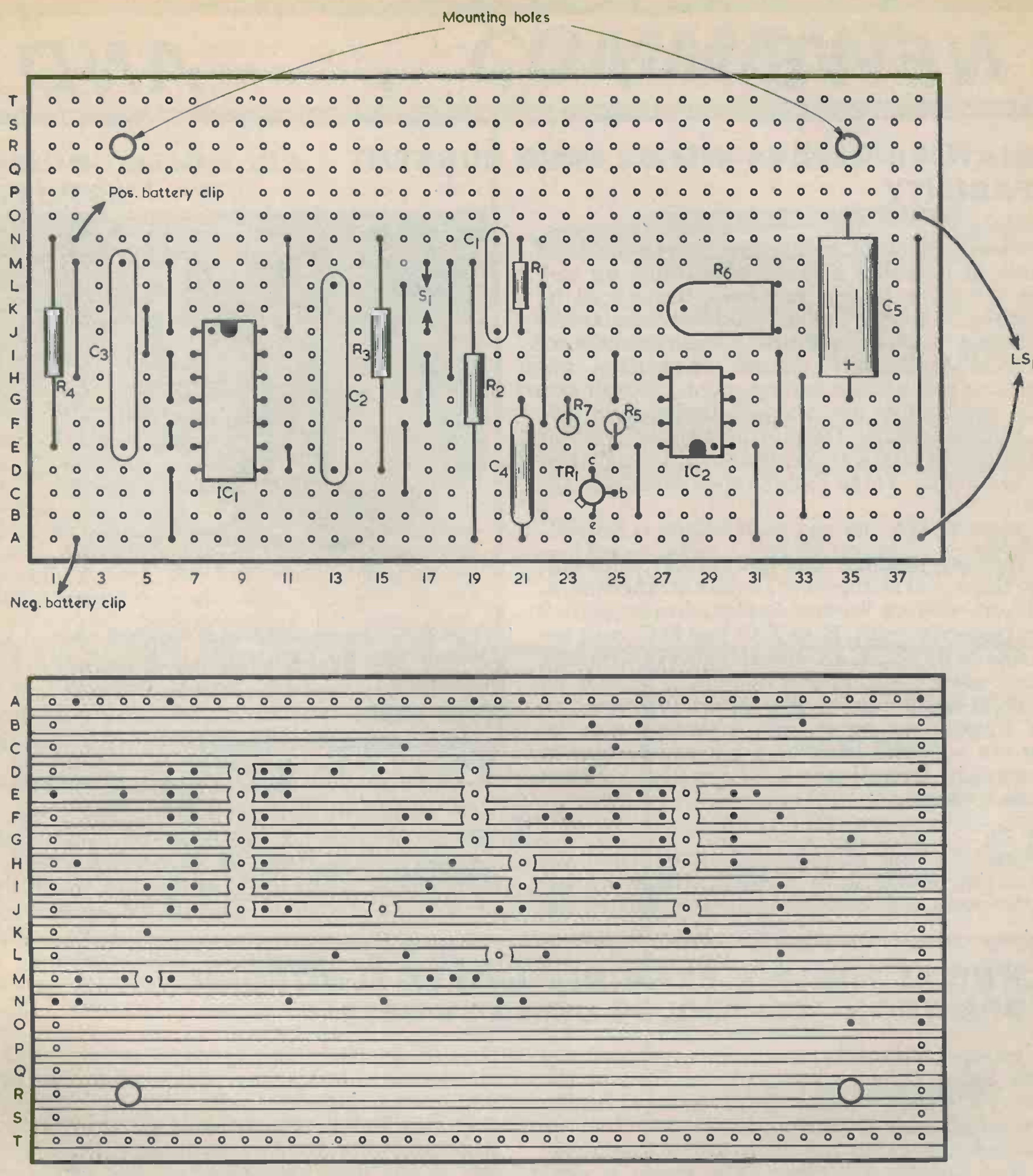


Fig. 3. All the small components are wired up on a Veroboard panel. The component and copper sides of this are shown here

Finally, two flexible wires connect the speaker to the component panel. The interior of the case is not cramped and there are plenty of suitable spaces for the battery. The general layout can be seen in the photographs.

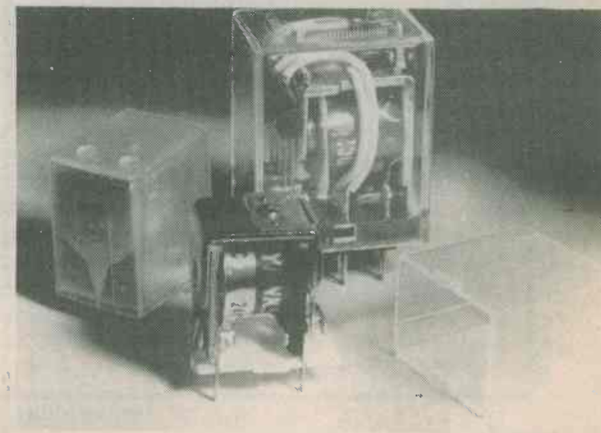
ADJUSTMENT

R6 should be set so that its slider is at about the middle of its track, and the unit checked. Pressing the bell-push should cause the 2-tone output to be given. R6 is then adjusted to produce a lower tone frequency which relates pleasantly to the first, higher, tone. Suitable lower output tones will be found at several settings of R6 and the final selection then becomes a matter of personal preference.

The lower tone decreases in frequency as R6 is adjusted in a clockwise direction. The potentiometer must not be advanced to an extreme clockwise setting as this will block the operation of the tone generator and prevent an audio output from being obtained.

It is advisable to check that the stand-by current drawn from the 9 volt battery is, in fact, negligibly low. The test will confirm that a wiring error or a poor quality component is not causing the appearance of a significantly large quiescent current. The insulation of the wiring to the bell-push and at the bell-push itself should be of a high order to prevent unnecessary current drain. ■

MINIATURE RELAYS WITH LARGE CURRENT CAPABILITY



A new family of miniature low-cost relays, capable of handling a range of currents up to 9 Amps (resistive loads), has been introduced by Impectron Limited. The LYNNKS Series as the new family is called, features a wide selection of A.C. and D.C. coil voltages, mounting configurations and contact arrangements, as well as a sturdy mechanical construction designed to give long, trouble-free life. Despite their power handling capability, the relays are compact, light-weight and easy to handle. Three major types constitute the series:

Type P:
This type is a medium load power relay, with one, two or three pole changeover contact arrangements. Maximum current for the single pole version is 9 Amps (resistive load). Both A.C. and D.C. coils are available in 6, 12, 24, 48, 100 and 200 Volt ratings, and coil power consumption is about 1½ Volts in all cases. The coil and contacts are normally protected by a transparent cover, and mounting may be either via an Octal base, or 8 pin square plug-in arrangement. Overall size is 33.5 x 27.5 x 51mm (square socket).

Type S:
Featuring a lighter and smaller construction, the Type S can handle up to 6 Amps (resistive load) with the same coil and contact variations as the Type P. Coil consumption is however about 1 Watt. Overall size for both types is 40 x 27.5 x 21mm maximum.

Type 103P:
This very light, low cost relay has an integral dust cover and is designed for PCB mounting. It is available in coil voltages of 6, 12, and 24V D.C. and 100V A.C., all below 500mW. Maximum load through the single pole changeover contacts is 3A (resistive load). Weighing only a few grams, this type measures 26 x 22 x 15.5mm overall and has 5 pins on a standard PCB mounting pattern.

TECHNICAL MISSION EXAMINES LATEST ELECTRONIC INFORMATION TECHNIQUES USING TV SETS

A teletext/viewdata teach-in organised by British Relay (Electronics) Ltd was held at the company's Crawley head office for the Esselte Technical Mission from Sweden.

The mission comprised nine senior executives from the Esselte AB group. The group is considering diversifying from publishing magazines to publishing electronic pages and the object of the visit was to examine the progress being made by the information industry in the UK.

Viewdata being demonstrated during the Esselte Technical Mission visit to the Crawley headquarters of British Relay (Electronics) Ltd

British Relay demonstrated some of the latest electronic information techniques using television sets as the users' means of reading information. The company's demonstration included an on-line access of the Prestel database using a GEC viewdata television incorporating an autodialler and user identifier similar to the sets being supplied to the Post Office Prestel test service which has just commenced.

ITT also demonstrated its new development in multilingual viewdata to produce character variations suitable for more than 20 foreign languages. This will bridge the gap with those countries faced with only a British character set.

Finally the latest teletext add-on adaptor was demonstrated by connection to a normal domestic off-air television receiver. This unit will be available in early 1979 and the selling price will be considerably less than an existing add-on unit. The latest teletext adaptor is priced at less than £200, which will make it more acceptable to the domestic market. The unit is produced by Radofin and is expected to be available through British Relay shops and many other audio and photographic outlets.

COMMUNICATION VIA SATELLITES

As a magazine we have taken considerable interest in the use of satellites for radio communication particularly in the field of amateur radio, indeed we have a short article on the Russian amateur radio satellites in this issue.

We were therefore interested, but not surprised, to learn that the special subject chosen for the Marconi International Fellowship 1979 is: "Outstanding advances in satellite and space technologies — relevant to improving world communications".

The Fellowship — a $25,000 grant — commemorates Guglielmo Marconi's creative contributions to scientific discovery, engineering and technology. Established in 1974 on the centenary of the inventor's birth, the Fellowship commissions significant creative works that will add to the knowledge and understanding of how communications, science and technology can be applied to the improvement of human life.

The first four Fellowships have been awarded in the fields of communication and electronics.

LONG LIFE SOLDERING BIT

S. & R. Brewster Limited of 86-88 Union Street, Plymouth, announce the introduction of their No. 1920L long life bit for the SRB type 1 Soldering Iron.

Designed for prolonged use in the workshop or production line, it gives considerably longer usage than the standard bit and therefore improves cost efficiency.

The bit is available in just one size because the coned tip gives you a very fine point for small joints and the side can be used for the larger joints.

It is available packed loose or carded.

CHANGE IN SOURCES OF SUPPLY

As many readers will be aware, Doram Electronics Limited are leaving the component area of the electronics market, and are concentrating in future on the production of kits. These are now listed in the attractively produced Doram 1978/79 Electronic Hobbies & Equipment Catalogue.

To give assistance to potential users, the kits are designated One Star, Two Star and Three Star. A One Star kit is for beginners and the instructions explain the circuit operation so that the constructor learns as he builds. Two Star kits are for the more experienced and Three Star kits are for the accomplished constructor who has already successfully built a stereo amplifier or similarly advanced project. Yet a further category are N.S. Kits. These are No Soldering Kits which require no soldering at all.

The numerous kits cover a wide field ranging from a One Star darkroom exposure meter or a One Star bench amplifier to Three Star digital test equipment. Many of the kits are for use by the motorist. An Autumn Special Supplement to the catalogue describes further kits which are made up on perforated board without housings. The catalogue also includes audio equipment, technical books, tools and test gear, and is available from Doram Electronics Limited, P.O. Box TR8, Wellington Road Industrial Estate, Wellington Bridge, Leeds LS12 2UF.

Many of the projects featured in *R.&E.C.* employ parts which are produced by R.S. Components but these components, as explained above, are no longer obtainable direct from Doram Electronics Ltd. They are now only available through retailers including, of course, mail order houses which stock the parts. We are informed by Ace Mailtronix Limited, Tootal Street, Wakefield, West Yorkshire, WF1 5JR, that they will undertake to obtain for individual constructors any current R.S. Component item subject to a minimum order of £2. Price will be the current R.S. Component price plus 50% including VAT, postage and packing.

21 YEARS' TRADING — FREE GIFT

Messrs. Brian J. Reed of 161 St. John's Hill, Battersea, London SW11 1TQ., will, on 23rd, March next, not only celebrate the personal birthday of Brian J. Reed but also the completion of 21 years of business serving the electrical and electronics world.

To mark this occasion, whoever includes a birthday card with their order will receive a surprise packet of components to the approximate value of 20% of their original order.

Radio 4 Converter

An almost identical design to that featured in our article above, featured last month, is being marketed by Ambit International Ltd., of 2 Gresham Road, Brentwood, Essex. As Ambit have filed a patent in respect of their converter it could be an infringement of it if Radio 4 converters based on our design were built and sold commercially. As has so often happened in the realms of radio and electronics two people working independently have come up with virtually the same answer.

The Ambit Radio 4 Converter, known as the 'Ambitune', has been approved by the BBC and was recently featured in the TV programme 'Tomorrow's World', readers can therefore build the design we published with their usual confidence. For those who missed our January issue we can still supply copies at 58p inclusive of postage.

SUGGESTED CIRCUIT

SURE-FIRE CMOS LATCHES

By G. A. French

CMOS logic gates offer many interesting applications to the constructor and the experimenter, and have the major advantages of drawing virtually zero current from the supply when they are set to a quiescent state.

TWO INVERTERS

A typical example is given by the 2-way CMOS latch shown in Fig. 1(a). Here, there are two inverters with the output of one coupling to the input of the other by way of a 100k Ω current limiting resistor. If the output of the upper inverter is high it causes the output of the lower inverter to be low. This low output, applied to the input of the upper inverter, makes the output of this inverter high, thus holding the latch firmly in the condition where the output of the upper inverter is high and the output of the lower inverter is low. The other stable state for the latch is given when the upper inverter output is low and the lower inverter output is high.

The latch can be tripped from one state to the other by momentarily touching the flying lead from the negative rail to either point X or point Y. If the output of the upper inverter is low, a momentary connection to point X will trip the latch to the state where the upper inverter output is high. Touching the flying lead to point Y will have the opposite effect. The two 100k Ω resistors allow only a very low current to flow from the appropriate inverter output at the instant of making the connection to point X or point Y.

One of the 100k Ω resistors is omitted in the latch circuit of Fig. 1(b). If, in this case, the output from the upper inverter is low it can be made to latch to the high state by touching the flying lead from the negative rail to point X. The opposite state is selected by applying the flying lead from the positive rail to point X.

In practice, the two inverters can be true inverters in, say, the CD4007. They can just as conveniently be two NAND gates or two NOR gates with their inputs connected together. Again, the current limiting resistors shown as 100k Ω can have any value from 10k Ω to 10M Ω . In practical applications also, the latches are not triggered by flying lead connections but by an external logic circuit. A typical instance of a 2-way CMOS latch being employed in this manner was given in the "Door Bell Monitor" described in "In Your Workshop" in the September 1978 issue, and there is little doubt that the latch will appear again in future articles to be published in this magazine.

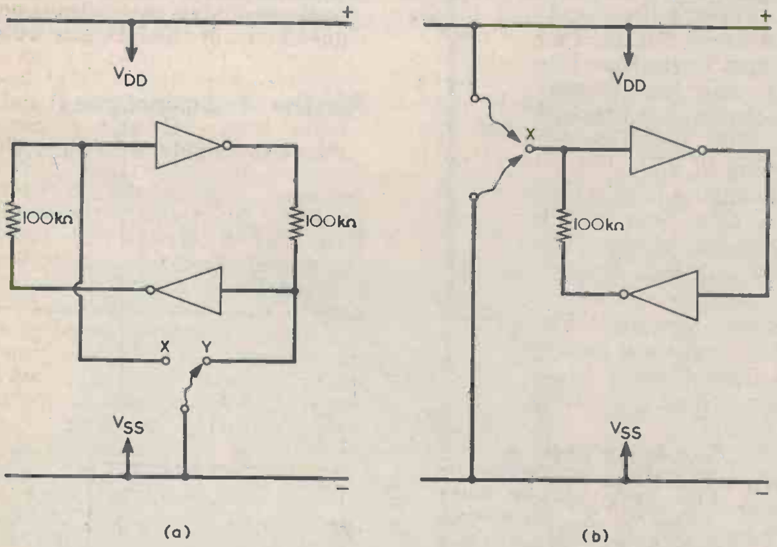


Fig. 1(a). A simple 2-way CMOS latch. It can be changed from one state to the other by a momentary application of the flying lead to point X or point Y, as applicable.

(b). An alternative version of the latch. In practical applications, the latch states are changed by external circuits and not by flying lead connections.

SWITCH-ON STATE

A shortcoming of the 2-way latch is that it can theoretically take up one of its two states in random fashion when power is initially switched on. However, it is usually found that due to dissimilarities in characteristics between the two inverters the latch will favour one state at switch-on, but this point cannot be guaranteed and it certainly cannot be designed into the circuit without the provision of extra components. A very simple additional circuit which always ensures that the latch will take up a particular state at switch-on will now be described.

The additional circuitry is shown in Fig. 2, and it consists of R1, C1 and D1. At the instant of switch-on, C1 is discharged, whereupon pins 1 and 2 of the upper NAND gate are held low via diode D1. The latch then assumes the state where the input of the upper gate is low and remains in this condition until it is changed by whatever voltages are applied to that input. After having carried out its task of setting the latch, C1 charges very rapidly to the full supply voltage, whereupon D1 becomes reverse biased for all voltages applied to the input of the upper gate, and the added circuitry has no further effect upon the operation of the latch.

The author has checked out the circuit of Fig. 2, using a CD4011 quad NAND gate and the pin connections shown. It was found that C1 was still effective in setting the latch when it had a value of 1,000pF, and that R1 could have any value between 10kΩ and 1MΩ. The values of C1 and R1 are, therefore, not at all critical, and 0.01μF and 100kΩ merely represent values which are quite satisfactory in practice. With a time constant of 0.001 second, it is obvious that C1 will charge to the full supply voltage very soon after switch-on.

The component values in Fig. 2 assume that the supply is applied abruptly by closure of the on-off switch S1. Should the supply voltage rise relatively slowly at switch-on, as can occur with a mains power supply having the on-off switch in the mains input, it is desirable to select a value for C1 from a range of somewhat higher capacitances, and it could be given a value between 0.01μF and 0.2μF. A little experiment will determine a suitable value here, the minimum value required depending upon the switch-on characteristics of the particular mains power supply employed.

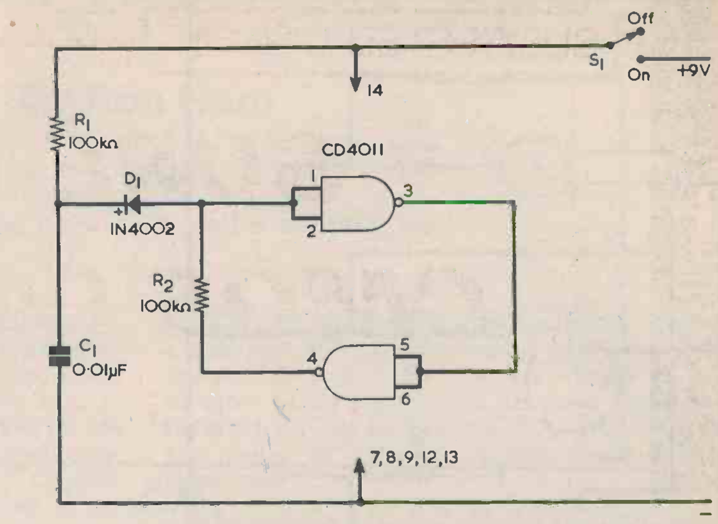


Fig. 2. Adding the components R1, C1 and D1 causes the latch to always take up the same state after switch-on

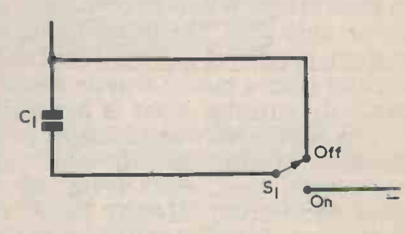
CAPACITOR DISCHARGE

It is necessary for C1 to discharge after switching off, so that it is ready to set the latch at the next switch-on. If there are any current consuming networks across the supply rails, such as bias potential dividers and the like, the capacitor will automatically discharge via R1 and these components after switching off, although the rate of discharge could be significantly slower than the rate of charge at switch-on. In Fig. 2 it was found that, on nearly every occasion, the capacitor discharged sufficiently after switching off, via its own leakage resistance and the CD4011 gates themselves (whose outputs were coupled to the negative rail by monitoring voltmeters). To make quite certain that the capacitor is discharged the on-off switching circuit could be modified to that shown in Fig. 3, where switch S1 is transferred from the positive to the negative rail. In most practical instances, however, it should be adequate to simply allow C1 to discharge through the circuitry between the positive and negative rails.

3-WAY LATCH

A 3-way CMOS latch is illustrated in Fig. 4, and this formed the basis of the author's article "3-Way Touch Buttons" in the July 1978 issue. Ignoring D1, R1 and C1 for the moment, it may be seen that this circuit has three stable states with two NAND gate outputs being high and one NAND gate output being low. If, for instance, the output of gate A is low, that low is taken to an input of gate B and an input of gate C, thereby causing their two outputs to be high. These

Fig. 3. Normally, C1 will discharge automatically after switch-off. To make certain that it is discharged, it can be short-circuited by a contact on the on-off switch in the manner illustrated here



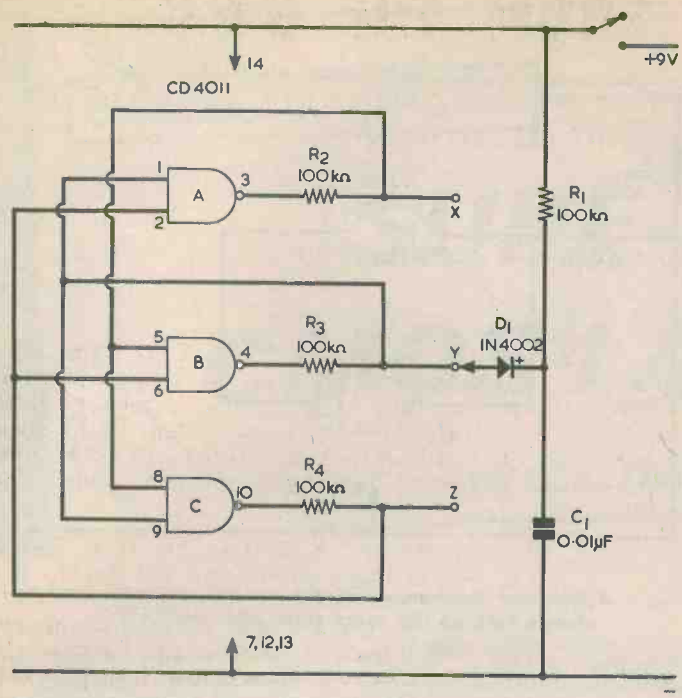


Fig. 4. A 3-way CMOS latch in which the outputs of two gates are high and the output of one gate is low. C1 and D1 ensure that it is the output of gate B which is always low after switch-on

high outputs are taken to the inputs of gate A, reinforcing the low at its output. The latch can be changed by a momentary connection between the negative rail and one of the points, X, Y or Z, as applicable. Taking the connection to point Z trips the latch so that the output of gate C is low and the outputs of the other two gates are high.

As with the 2-way latch, the current limiting resistors, R2, R3 and R4, can have any value between 10kΩ and 1MΩ. Also as with the 2-way latch (and without D1, R1 and C1 in circuit) the state taken up by the latch at switch-on cannot be guaranteed.

The situation is changed by the inclusion of D1, R1 and C1. If the anode of D1 is connected to point Y, as shown, the output of gate B will always be low after switch-on. The diode may alternatively be connected to point X, whereupon it is the output of gate A which will be low, or to point Z, causing the output of gate C to be low after switch-on.

The same comments concerning the values of R1 and C1 and the discharge after switching off of C1, which were given concerning the 2-way latch are equally applicable to the circuit of Fig. 4.

RUSSIAN AMATEUR RADIO SATELLITES LAUNCHED

Great excitement was raised at the beginning of November when it was realised that the long awaited Russian Amateur Radio Satellites had been launched.

Accurate news about these satellites has been difficult to obtain, but for months their launching has been anticipated. When at last, came the news that they were in fact in orbit, a great flurry of excitement spread around the satellite enthusiasts, not only in this country but throughout the world.

It is confidently assumed that there are two satellites. One signs itself "R.S." after its telemetry run and the other is thought to sign "R.S. R.S." They are thought to be quite close to each other. Whether both have been turned on or only one, the other being a 'back-up' system, is not yet known. Until definite information comes out of Russia about them, one can only surmise what is happening.

The parameters are thought to be:— 120.6 minutes orbital period. 30.05 degrees advancement west, each orbit. 82 degrees orbital inclination. Height 1050 miles. "Up" frequency 145.88 to 145.92 MHz. "Down" frequency 29.360 to 29.400 MHz. Telemetry is on 29.400 MHz. Unfortunately the telemetry is on the same frequency as a ten metre Radio Moscow broadcast station, or its harmonic, and a commercial teleprinter station, so, as the ten metre band has been 'open' recently due to the current sunspot activity, it is at times badly jammed during the day. By evening, when the ten metre band has 'closed' down, it is in the clear and of good signal strength.

It is reported that the transponder is so constructed that if excessively strong signals are directed at the satellite, it closes down. It is designed to accept signals up to 5 watts e.r.p. only, as this is said to be the power limit for two metre transmissions in the amateur radio service in the USSR. If this is exceeded, the transponder cuts out. This may account for the few occasions on which the transponder has been heard to be on. Those amateurs who have already worked into it, report that QSO's can be maintained with very little transmitter power indeed — in the order of 5 watts e.r.p.

The telemetry is very different from that sent by earlier amateur radio satellites. It consists of a letter, followed by two numerals, followed by a letter. Until definite information comes from Russia, it has not been possible to decypher it yet.

A.C.G.

OLD TIMERS FROM THE G.E.C.

By Ron Ham

Two veterans from over half a century ago.

Two pleasant surprises for any collector!

The first came from Mr. Burtenshaw, a member of the Brighton and District Radio Society, when he donated a GECoPHONE Crystal Set No. 1, which had been in his family since 1922, to the writer for his collection. And — what a coincidence — a Mr. Wildey left a GECoPHONE Crystal Detector Set No. 2 on the writer's doorstep in the hope that it would be of use in his museum.

55 YEARS OLD

Both sets, now more than 55 years old, are in remarkably good condition. Their cabinets, components and the comprehensive instructions inside each lid are undamaged. Also surviving the passage of time are the maker's GECoPHONE trade mark, the registration numbers, 102 and 103 respectively, and the BBC labels surrounded by the words "Type approved by the Post Master General".

Basically, these are medium wave receivers but they could be made to tune to lower frequencies. Under the heading "Tuning for Wavelengths above 550 metres" the instructions state: "Remove the U-shaped link marked 'loading coil' and replace it by a loading coil for the particular range to which it is desired to tune." By another stroke of luck a member of the Mid-Sussex Amateur Radio Society donated, still in its box, a G.E.C. BC 1347, one of the range of genuine loading coils for these receivers.

The Set No. 1, G.E.C. Model BC 1001, Inst. No. 16112, is tuned by a variometer. The Set No. 2, BC 1501, Inst. No. 4556, has a variometer, labelled "Coupling" on the left and a variable capacitor, labelled "Condenser", on the right. Between these controls is a 7-way stud switch with the aerial terminal connected to its arm; six of the stud contacts are connected to tappings on the stationary coil of the variometer and the seventh, marked "Long", is coupled to the loading coil link.

Two crystal receivers dating from the early 1920's. The set on the left is the G.E.C. Crystal Detector Set No. 1, and that on the right is the Crystal Detector Set No. 2. Basically intended for medium waves, they could tune to longer wavelengths by fitting additional loading coils

These two sets use the same type of crystal detector unit and are designed to drive two pairs of headphones. Underneath their ebonite top panels are pencilled initials, which no doubt belong to the persons whose loving care assembled them. ■

EXCLUSIVE NEW SERIES...

TUNE-IN TO PROGRAMS

Part 1

By Ian Sinclair

GET TO GRIPS WITH PROGRAMMING THE EASY WAY.

This 9-part series will guide you through programming using nothing more complicated than a readily available programmable calculator.

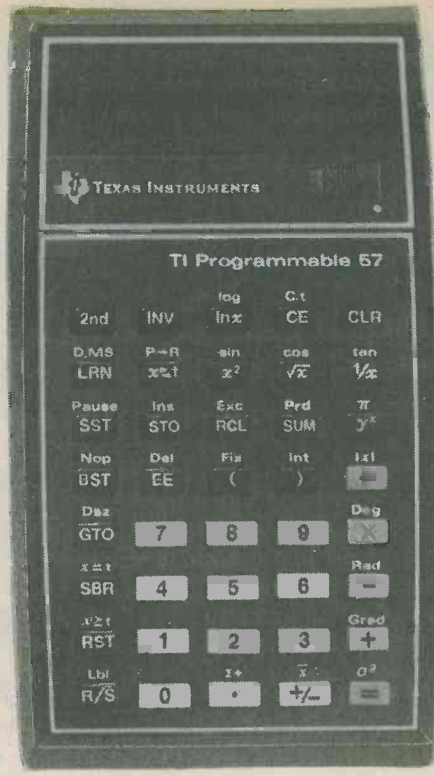
Not so very long ago, it first became possible to buy a pocket electronic calculator. In those days, calculators were four-function machines, meaning that they were able to add, subtract, divide and multiply the numbers that were keyed into the display. As we were recovering from this miracle, improved versions appeared offering memory in addition to the standard four functions, so that an intermediate answer could be held until we were ready to use it, instead of having to write such an answer down.

Soon afterwards, scientific calculators started to appear, and the big price slide started. At first, a "scientific" calculator meant a square and a square-root key and little else at a price tag of around £40, but within a few months calculators with logarithims and trigonometrical functions (sine, cosine and tangent) came on the scene, and prices suddenly dropped again. A few more functions appeared with each new model, but the days of big improvements, either in functions or in price have passed. At the moment, the situation seems to have stabilised as far as the scientific calculator is concerned.

PROGRAMMABLES

The new push forward, as far as pocket calculators are concerned, is in programmable calculators. Now, there's one snag here. Most people who could make use of a scientific calculator had a pretty good idea of what they could use it for, and could learn to use it pretty quickly. The programmable calculator is a more useful device in many ways, but few potential users realise quite how useful it is or, more important, what is involved in its use. The purpose of this series of articles is to show how a calculator can be used, and what is involved in writing and using programs. The examples are taken as far as possible from electronics calculations on the reasonable assumption that anyone reading this magazine will have a keen interest in electronics, and the programs used to illustrate the series have been written for the TEXAS TI-57 but apply with little modification to similar machines, including the CBM PRO-100.

Another point worth mentioning, incidentally, is that with microprocessors rearing their heads all over the place these days, the skills of programming are now a necessary part of the electronic engineer's equipment. Programming languages vary, of course, but it's true to say that when you have learned how to program one device you can very quickly adapt to another. The skills of programming can be learned using microprocessors for a few hundred pounds, or by taking a course at a local Technical College for a few dozen pounds and a night each week, or you can do it the R&EC way. There's little doubt that you learn faster, and get much more out of it with your own programmable.



The keyboard of the Texas Instruments TI-57 programmable calculator. Most keys have a second function, whereupon facilities are nearly double the number of keys provided

WHAT DOES IT DO?

Suppose that we want to calculate the reactance of capacitors at various frequencies. Looking up the books (or remembering it), we use the formula:

$$X_c = \frac{1}{2\pi fC}$$

where f means frequency in hertz and C is capacitance in farads.

On a scientific calculator, the procedure for a 0.1μF capacitor and a 15kHz signal would be something like this. We key in the value of C, remembering that microfarads are millionths of farads, so that 0.1μF is 0.1×10^{-6} farads (10^{-6} is one-millionth). This is entered as

[·] [1] [EE] [+/–] [6],

five key strokes. We then press [x] to multiply, and enter the frequency value, f. Here once again we have to remember that the formula calls for frequency in Hz, so that if the frequency is given in kHz we need to multiply by 1,000, which is 10^3. This is keyed in as

[1] [5] [EE] [3],

another four key-strokes. Now we have to multiply by 2π, so that we enter

[X] [2] [π] [=]

The last "equals" gives the total value of $2\pi fC$. Now we have to invert this quantity, by pressing [1/X]. The number in the display is now the value of reactance that we need. The total number of key-strokes is sixteen for each calcualation of reactance.

Now doing this once is no problem but, if we want to find the reactance of a couple of dozen capacitors at various frequencies, sixteen key-strokes each time is a lot of key pressing, and it gets tedious. This is where a programmable can come in. A program is a set of instructions to the calculator showing what is to be done with each number that is keyed in. After all, we go through exactly the same routine for each calculation of reactance, so there's nothing that really needs any thought. Once the program has been entered into the calculator (the calculator is ***programmed***), the values of capacitance and frequency are entered into memories, and the program carries out the steps of multiplication and inversion that are needed, then displays the final result.

SCRATCHING THE SURFACE

This is, of course, very convenient, and it greatly speeds up the business of making routine calculations, but it is only scratching the surface of what can be done with a programmable calculator. Most ordinary scientific calculators have one, possibly two, memories in which numbers can be stored until they are needed. More memories could easily be provided but they are awkward to use, because you need some reminder of what is stored in each memory. A programmable, on the other hand, can use a large number of memories efficiently, because the program fixes which memories are used and, provided that the program is correct, a number that is stored in memory No. 7 early in the program will be taken out of memory No. 7 later when it is needed.

A programmable can therefore juggle with more stored numbers than an ordinary scientific calculator, and with no risk of making mistakes. This comes in useful in electronics work, for example, if we want to calculate the impedance of a circuit containing capacitance, inductance and resistance. We can store the values of C, L, R and f in the memories, then leave the program to select the items as they are needed to calculate the impedance.

One of the most important features of a programmable, however, is its ability to repeat an action until instructed to stop. This action is so important that we shall devote one complete part of the series to it. Let's take a simple example. Suppose we have a 38kHz oscillator, and a set of dividers which divide by 3 in each stage. How many divider stages do we need to get a frequency which is just under 100Hz? It's easy to do on paper: simply divide repeatedly by 3 and keep going until what is left is just less than 100Hz. The program can be arranged to do this, dividing the number in the display by 3, comparing the result with 100, and dividing again if the result is greater than 100. The programmable can be instructed to keep going through this routine (called a loop) until the answer is just less than 100, and also to count each step. The number of steps is then displayed. It's a simple example, of course, but a good illustration of how a repetitive operation can be carried out automatically and arranged so that it stops when the right number of steps has been carried out. One valuable application of this sort of routine is to get the calculator working out the voltages at intervals along a sine wave, then adding in as many odd or even harmonics as you want and showing the final voltage. In this way, the waveshape of a wave rich in harmonics can be produced in a fraction of the time it would take with an ordinary scientific calculator. A program for this will be given later in the series.

MACHINES

At the moment of writing several programmable calculators are available. Some are considerably easier to use than others, some have instructions which are not particularly easy to follow, some have ready-made programs which cost as much as the calculator. In this series we shall ignore the more expensive type of programmable which uses magnetic cards to store programs, or which prints out answers. Our type of programmable is the key-programmable in which the steps of the program have to be entered before the calculator can begin. Typical of these are the Texas TI-57 and the CBM PRO-100, and it is around these machines, retailing at around the £30 mark in the discount shops and in some High Street retail outlets that these articles are written. You don't have to have a programmable calculator to follow the articles, however, only a large amount of paper. Writing programs is a paper exercise, and the programs can be tried out on paper as easily (but more slowly) as on the calculator. We hope, though, that by the time you have read to part 9 of this series the itch will have struck you and you will have decided to tune-in to programs.

FACILITIES

A good programmable calculator should be a good scientific calculator. Not all programmables have a wide range of scientific functions, and some cannot incorporate many scientific functions into a program. The illustration shows the keyboard of the Texas Instruments TI-57 to indicate the range of functions that can be included. To save keys, many functions are "upper functions", meaning that the key labelled [2nd] must be used first. The Texas TI-57 is, of course, rechargeable. By their nature programmables are left switched on for much longer times than ordinary calculators, so that dry battery use is very expensive and only mains or rechargeable batteries should be considered.

Just to whet your appetite now, how about a program to convert any 8-bit binary number into decimal? Or a decimal number into 8-bit binary? Or a decimal into BCD? Tune-in next month, and stay tuned.

(To be continued)

3 BAND SHORT WAVE PRESELECTOR

By John Baker

Single f.e.t. design covering 1.6 to 30MHz increases receiver sensitivity and reduces image interference.

A simple short wave preselector such as the one described in this article will substantially improve the performance of most short wave receivers. A preselector is really just a tuned r.f. amplifier inserted between the aerial and the aerial input of the receiver with which it is used. Apart from giving increased sensitivity to the whole receiver installation it also reduces image, or second channel, interference when employed in conjunction with a superhet receiver.

The preselector has been designed for use with the 3 Band Short Wave Superhet which was featured in the September to December 1978 issues of this magazine, but is suitable for use with most other sets. However, it is necessary for the set to have an aerial coupling coil connecting directly to its aerial and earth terminals since this coil then provides the output load for the preselector f.e.t., and also provides a d.c. path for the f.e.t. supply. Fortunately, most short wave sets have a coupling coil of this nature at their inputs. In the 3 Band Short Wave Superhet the aerial and earth terminals connect to a a 1kΩ potentiometer and thence to the input coupling coil, whereupon the potentiometer track maintains the requisite d.c. path. (The circuit of the r.f. mixer and i.f. stages of the superhet was published in the September 1978 issue.)

Reception of the whole short wave frequency spectrum is provided in three switched ranges, the approximate coverage of each being: Range 3, 1.6 to 5.0MHz; Range 4, 5.0 to 14MHz; Range 5, 10 to 30MHz. The range numbers 3, 4 and 5 correspond to the manufacturer's range numbers for the three coils employed.

The gain of the preselector is quite high, and on the lower frequency bands it boosts signals by about four "S" points on the meter. In common with most equipment of this type the level of gain falls off slightly at higher frequencies, but even in the 20 to 30MHz region the unit still provides a considerable increase in sensitivity. The circuit incorporates a dual gate metal-oxide f.e.t. which provides a low noise level and good cross modulation performance.

THE CIRCUIT

The complete circuit of the preselector is shown in Fig. 1. S1(a)(b) is the wavechange switch, and S1(a) connects the aerial to the primary winding of whichever coil is in use. S1(b) connects the tuned secondary winding to the tuning capacitor, VC1, and to the gate 1 of TR1. The extremely high impedance at this gate permits direct connection to the tuned circuit. Each of the coils specified has a third winding which is intended to provide a low impedance coupling to the base of a bipolar transistor, but in the present circuit this winding is not required and no connection is made to it. Capacitor C3 across the tuning capacitor slightly reduces the high frequency coverage of each range and allows the ranges to correspond roughly with those switched in on the 3 Band Short Wave Superhet.

R2 is the source bias resistor for TR1, with C1 as its bypass capacitor. The tuned winding of whichever coil is switched into circuit provides a d.c. bias path to the negative rail for the transistor gate 1.

VR1 in company with R1 forms a potential divider across the supply rails, and the potentiometer slider connects to the gate 2 of TR1. The gate 2 voltage can be varied from zero to about 1.5 volts by means of VR1, and this permits the gain of TR1 to be varied. Gain increases with increasing gate 2 voltage, allowing VR1 to act as a simple r.f. gain control. C4 bypasses the gate 2 to the negative rail and thereby prevents pick-up of r.f. signal at this gate as well as possible instability.

The drain of TR1 couples via a coaxial socket SK3 to the input coupling coil of the receiver (or to the input potentiometer of the 3 Band Short Wave Superhet) which thereby allows drain current to flow from the positive supply rail. The preselector cannot be used with a receiver which has a capacitor in series with its aerial input circuit, since the capacitor would block the flow of drain current.

An unusual feature of the preselector circuit is that the input circuitry is negative earth while the output circuitry is positive earth. This does not

COMPONENTS

Resistors
(all fixed values ¼ watt 10%)
R1 27kΩ
R2 470Ω
VR1 5kΩ potentiometer, log, with switch S2

Capacitors
C1 0.015μF type C280 (Mullard)
C2 0.1μF type C280 (Mullard)
C3 15pF polystyrene
C4 0.1μF type C280 (Mullard)
VC1 365pF air-spaced variable, type 01 (Jackson)

Inductors
L1 Miniature Dual-Purpose Coil, Blue, Transistor usage, Range 3T (Denco)
L2 Miniature Dual-Purpose Coil, Blue, Transistor usage, Range 4T (Denco)
L3 Miniature Dual-Purpose Coil, Blue, Transistor usage, Range 5T (Denco)

Semiconductor
TR1 40673

Switches
S1(a)(b) 4-pole 3-way miniature rotary, (see text)
S2 s.p.s.t. toggle, part of VR1

Sockets
SK1 Insulated wander plug socket
SK2 Insulated wander plug socket
SK3 Coaxial socket, flush mounting

Miscellaneous
Verobox type 75-1238-D
Large control knob
2 small control knobs
9-volt battery type PP3 (Ever Ready)
Battery connector
Nuts, bolts, wire, etc.

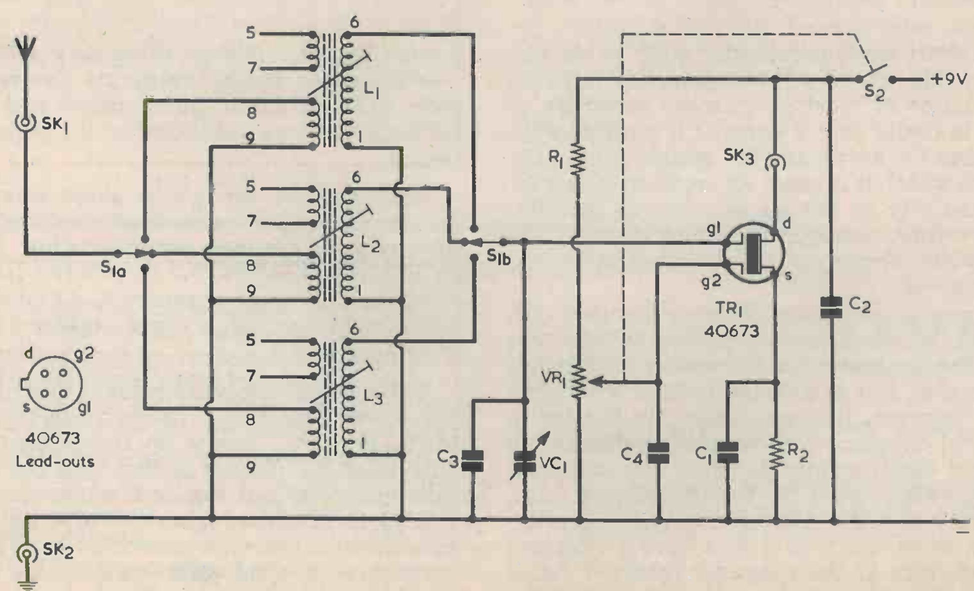
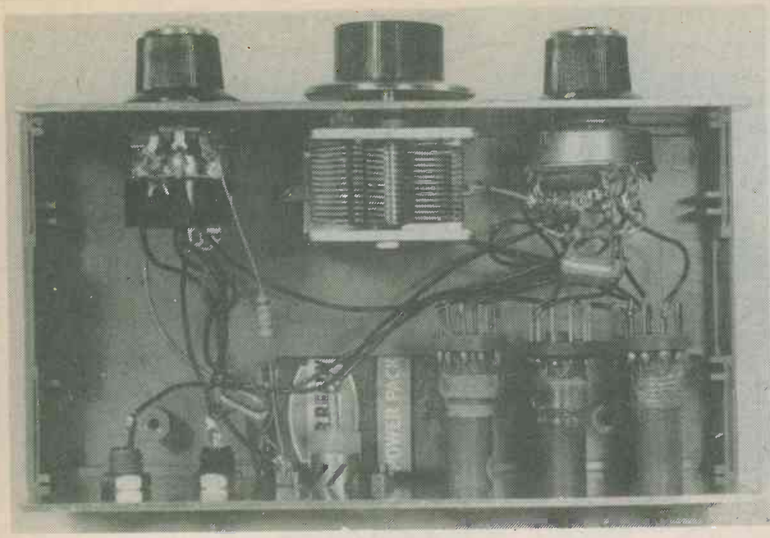


Fig. 1. The circuit diagram of the 3 band preselector. R.F. gain is controlled by VR1



The component layout inside the ready-made case. Normally, the battery is positioned upright behind the r.f. gain control

alter performance because the two supply rails are coupled together at r.f. by the low impedance path given by C2. In practice the arrangement works extremely well provided that the polarity difference is borne in mind when making an earth connection to the combination of preselector and receiver. This point is discussed more fully later.

The on-off switch is S2, and this is ganged with VR1.

PRESELECTOR CASE

The preselector is housed in a Verobox type 75-1238-D which measures approximately 152 by 60 by 84mm. This is of plastic construction with aluminium front and rear panels. The front panel is common with the negative supply rail by way of the mounting bolts of VC1, and the rear panel is common with the positive rail by way of the output socket mounting, and so it is obviously not possible to use an all-metal case.

Drilling details for the front and rear panels are given in Fig. 2, and matters here are mostly quite straightforward. VC1 is mounted by means of three short 4BA bolts passing into tapped holes in its front plate, and it is essential that the bolt ends do not pass more than fractionally past the front plate or they may damage the fixed or moving vanes. Spacing washers can be passed over the 4BA bolts, between the front panel and the capacitor front plate, to provide a satisfactory mounting and to reduce the penetration of the bolts to an acceptable amount.

SK1 and SK2 are insulated wander plug sockets. SK3 is a flush mounting coaxial socket and is secured by two short 6BA or M3 bolts, with nuts. A solder tag is fitted under the nut nearer SK2. The three coils are mounted using the 0BA plastic nuts with which they are supplied, and their pins should take up the orientation shown in the wiring diagram of Fig. 3. Be careful not to overtighten the plastic nuts as the threaded sections of the coils can easily be sheared off.

WIRING

Wiring is carried out as illustrated in Fig. 3. Note that S1(a)(b) consists of 2 poles of a 4-pole 3-way miniature rotary switch. Some of the outer tags of the unused poles are employed as anchor tags for TR1 and the associated components. Before making connections to the switch, ascertain with the aid of a continuity tester or ohmmeter the three outer tags corresponding to the inner tag of one of the sections to be used as a switch. With some switches the relative positioning of the inner and outer tags may vary from that shown in Fig. 3.

All connections are by point-to-point wiring, and all wires should be kept as short and direct as is reasonably possible. In the diagram some wires are shown spaced out for reasons of clarity. It is strongly recommended that the general layout be exactly as shown in Fig. 3. Altering this, or using excessively long wiring, could easily lead to instability due to the fairly high levels of gain and frequency that are involved.

Connections are made directly to the pins of the coils, and the soldering iron must be applied and removed rapidly at each pin as the plastic material

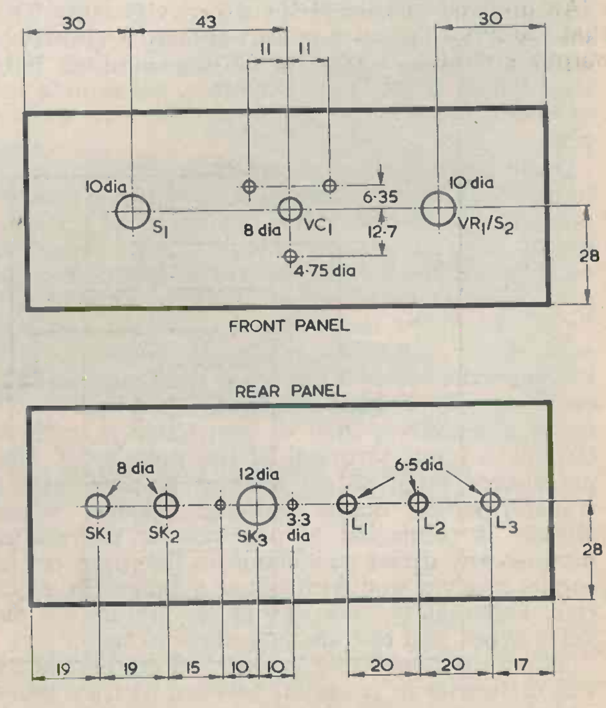


Fig. 2. Drilling details for the front and rear panels of the preselector

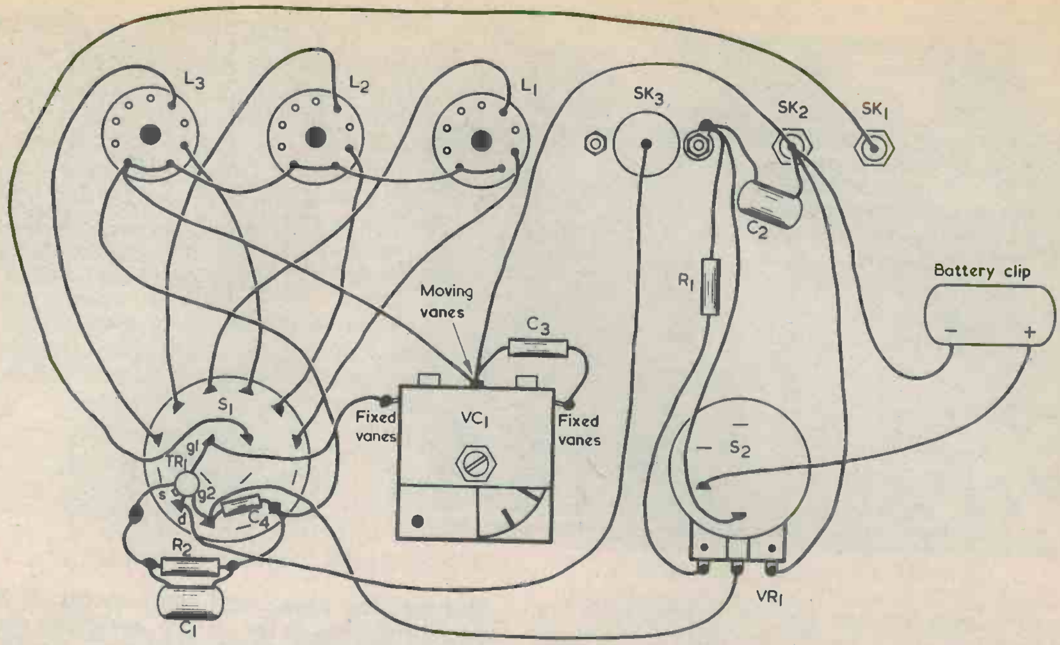


Fig. 3. The wiring of the preselector is not complicated, but it is necessary for all connections to be short and direct

in which the pins are mounted melts readily with heat. It helps to have the wire ends tinned initially with solder.

There is a space for the battery to stand vertically behind VR1/S1. It will be held firmly in position when the lid of the case is clipped into place.

NOTES ON USE

The preselector is coupled to the receiver aerial and earth input terminals via a coaxial cable. This should be no longer than is absolutely necessary in order that losses in the cable are minimised. With the 3 Band Short Wave Superhet, the remote end of the cable will be terminated in two wander plugs.

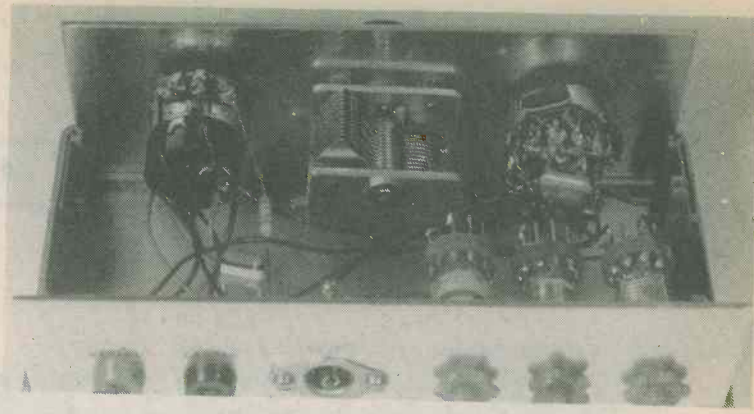
If an earth connection, which is not essential, is to be used, it may either be applied to the receiver or to the preselector. If it is applied to the preselector all the chassis metalwork of the associated receiver will be 9 volts positive of earth when the preselector is switched on. This presents no difficulty when the receiver and any other ancillary equipment is free of any earth connection. If, however, the receiver chassis is itself connected to earth, as is advisable for instance when the receiver is mains powered, then no connection is made to the earth input terminal of the preselector. The preselector must on no account be used with a transformerless mains powered receiver whose chassis is connected to one side of the mains, because any direct connection to the input coil of such a receiver would introduce a dangerous shock risk. Fortunately, receivers of this nature are old valve types and few are nowadays in use.

When the preselector is switched on there is a 9 volt difference in potential between its front panel and the chassis of the receiver to which it is coupled. Loose wires connected to the receiver chassis should not be allowed to accidentally contact the preselector front panel since the preselector battery would then be short-circuited.

As supplied, the three preselector coils have their cores almost fully screwed in, so that virtually no metal screw thread protrudes beyond the end of the plastic former. For the preselector application the coil cores are left in this position.

Operation of the controls is very straightforward. The extreme anti-clockwise setting of S1 selects Range 3, its centre setting switches in Range 4, and its extreme clockwise setting selects Range 5. VC1 is the tuning control and this is adjusted to peak received signals. It will be necessary to re-peak VC1 each time the receiver tuning control is altered to any significant extent. When using the preselector with a superhet it will probably be found, particularly at the higher frequencies, that there are two settings of VC1 which produce peaks in output from the receiver, with different signals being given at each peak. The lower frequency peak (with VC1 vanes more fully enmeshed) is the correct one and corresponds with signal frequency being below oscillator frequency in the superhet. The other peak is the unwanted image channel. Indeed, one of the principal benefits of using a preselector with a superhet is that it enables the

The rear panel. This accommodates the input and output sockets and provides mounting for the three coils



Another look into the case. TR1 and some of the components directly connected to it are wired to unused tags of the rotary switch

desired response to be boosted and the image response to be attenuated. The tuning is quite sharp and the preselector provides a useful increase in front-end selectivity. There is, however, no need to fit a slow motion drive to VC1 provided that a control knob of adequate size is used.

VR1 is the r.f. gain control, but this should not simply be set for maximum gain and then left permanently at that setting. It might be thought that a continual maximum gain setting would always give maximum sensitivity and therefore optimum results, but such is not in fact the case. Even if a fairly modest aerial is used it is quite possible for the receiver to be overloaded for much of the time if VR1 is left at its maximum setting.

In the case of a superhet it is the mixer which is most prone to overloading, with a high level of cross modulation being produced in consequence. The result is a high background noise level which tends to drown weak signals. When this happens it is often possible to bring weak signals above the noise level by turning back the r.f. gain control. Although such an adjustment results in a loss of sensitivity, the noise is reduced by a far greater amount than is the desired signal, and so better reception results.

The 3 Band Short Wave Superhet has its own effective r.f. gain control, this being the potentiometer in its aerial input circuit. Depending largely upon the aerial to be used it will probably be found that this potentiometer can be given a setting which allows most of the r.f. gain control to be provided by VR1 in the preselector. However, the superhet aerial potentiometer may also be adjusted, if required, when receiving any strong signals or when resolving very weak signals surrounded by signals of considerably greater strength. Some experience with the two controls will enable optimum settings in both to be provided.

The preselector can also, of course, be used with a t.r.f. short wave receiver, provided that the receiver meets the aerial input coupling coil requirement. In this case it is the detector which is most easily overloaded, the effect resulting in an unusually high background noise level. The overloading normally results also in an apparent loss of selectivity, with several stations being received simultaneously and having a rather distorted output.

An impressive short wave receiving installation. Here are the 3 Band Short wave Superhet, the Eliminator-Speaker Unit which was described last month and this, and the 3 Band Preselector

With all receivers, therefore, VR1 in the preselector should be kept well backed off in most instances, being advanced only when propagation conditions are poor or when a very inefficient aerial is being used. ■

ULTRA SENSITIVE REMOTE CONTROL

A HIGHLY SENSITIVE SIMPLE TO BUILD DESIGN

By R. A. Penfold

This fairly simple design together with unit to be described next month forms a Doppler intruder alarm.

Ultrasonic remote control systems are suitable for many applications where a remote control link over only a fairly short distance (usually up to about 10 metres or so) is required. They are commonly employed in TV remote control systems, simple control systems for small models and for more mundane uses such as the control of house lighting.

One problem with this type of system is the highly directional properties of the ultrasonic transducers, and it is normally necessary to aim the output from the transmitter at the receiving transducer in order to obtain correct operation. However, ultrasonic sound waves are readily reflected by walls, ceilings and many other surfaces so that, by producing a highly sensitive system, it is possible to completely overcome this problem. The set-up then relies upon these reflected signals to provide the link between transmitter and receiver when there is no direct signal path.

The subject of this article is a fairly simple ultrasonic remote control system which is extremely sensitive indeed. It is found to operate perfectly well even in a large room, almost regardless of where the receiving and transmitting transducers are positioned and aimed within the room. The transmitter is of quite conventional design and the high sensitivity of the system is provided by the receiver, which incorporates a phase locked loop tone decoder.

In next month's issue we shall describe an add-on unit which enables the transmitter and receiver to be employed in a Doppler shift proximity detector or intruder alarm.

TRANSMITTER

Fig. 1 shows the circuit diagram of the transmitter, and this is little more than a conventional two transistor astable multivibrator. It differs from a straightforward astable circuit only in that the biasing for TR2 is obtained from the slider of R5 rather than direct from the positive supply rail. This enables the operating frequency

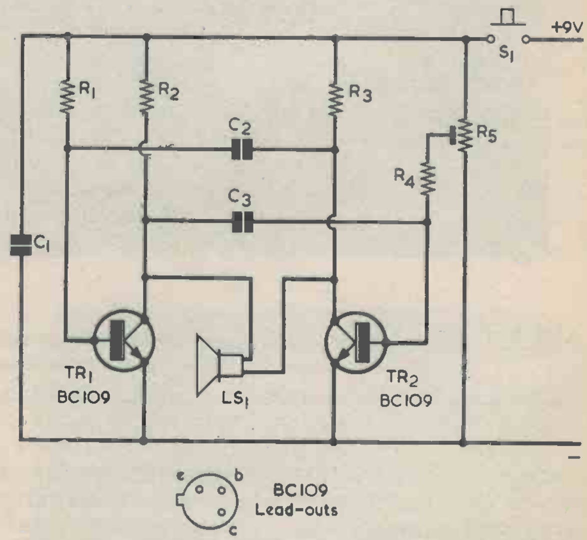
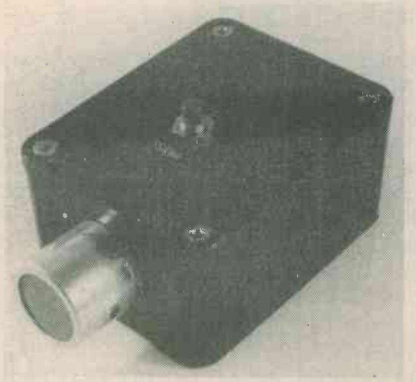


Fig. 1. The ultrasonic transmitter consists of an astable multivibrator with the transducer connected to the two transistor collectors

ULTRASONIC



The transmitter unit. The 40kHz transducer is mounted at the front and is activated by pressing the push-button on the top of the case

of the astable to be varied to a certain extent, so that the required nominal operating frequency of 40kHz can be obtained.

The ultrasonic transducer, LS1, is not an ordinary moving coil loudspeaker but is a piezoelectric device, rather similar to a crystal earphone and some types of tweeter. It is not very efficient at audio frequencies but reaches a sharp peak in efficiency at its nominal resonant frequency of 40kHz. It is for this reason that the astable is adjusted to operate at a frequency of 40kHz.

A form of push-pull drive is provided for LS1 since it is fed from the collectors of TR1 and TR2, rather than from one collector and the negative supply rail. The signals at TR1 and TR2 collectors are in anti-phase and thus when TR1 collector is positive TR2 collector is negative, and vice versa. The peak-to-peak voltage swing across LS1 is then double that which would be given by coupling it to a single collector.

The push-button, S1, is merely an on-off switch, and it is pressed to cause an ultrasonic signal to be emitted by the unit. C1 is a supply decoupling capacitor. The current consumption of the circuit is approximately 15mA. Where gain selected transistors are available, TR1 and TR2 may be A, B or C types.

CONSTRUCTION

The small components are assembled on a 0.1 in. matrix Veroboard panel having 16 copper strips by 15 holes, and the component layout of this panel is shown in Fig. 2. The two mounting holes are drilled 6BA or M3 clearance, and there are no breaks in any of the copper strips.

The prototype unit employs a PP3 battery, but a larger 9 volt battery may be used, if desired. A small plastic case having approximate outside dimensions of 80 by 60 by 40mm. is used as a hous-

COMPONENTS

TRANSMITTER

Resistors
(All fixed values ¼ watt 5%)
R1 33kΩ
R2 1kΩ
R3 1kΩ
R4 27kΩ
R5 10kΩ pre-set potentiometer, 0.1 watt, horizontal

Capacitors
C1 0.22μF mylar or Type C280
C2 470pF ceramic plate
C3 470pF ceramic plate

Semiconductors
TR1 BC109
TR2 BC109

Transducer
LS1 40kHz ultrasonic transducer (see text)

Switch
S1 push-button, press to make

Miscellaneous
Veroboard, 0.1in. matrix
Plastic case (see text)
Phono plug
9 volt battery type PP3 (Ever Ready)
Battery connector
Wire, solder, etc.

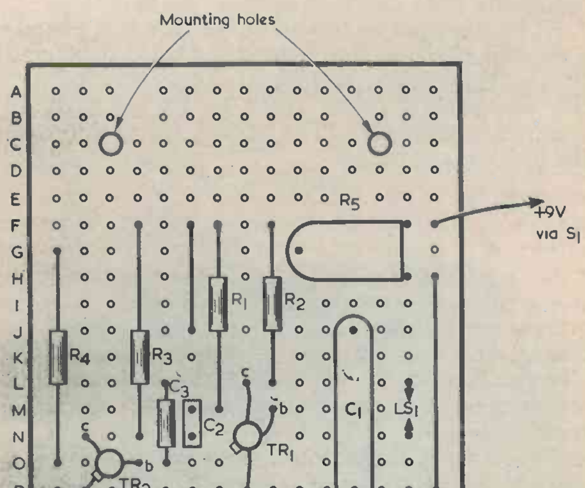
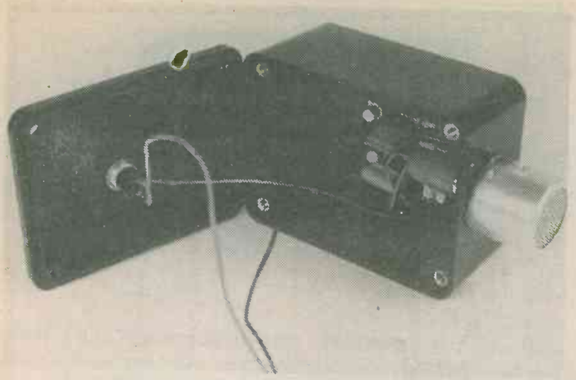


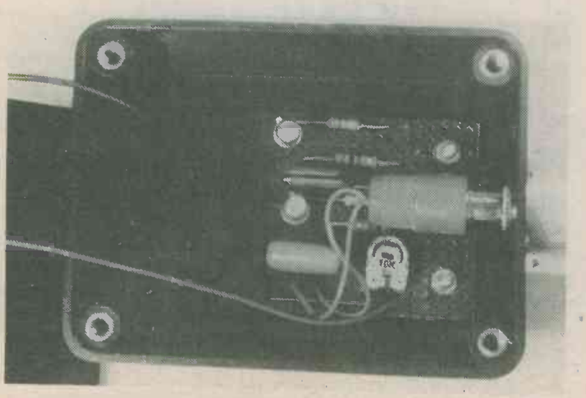
Fig. 2. Veroboard layout for the transmitter components. There are no breaks in the copper strips



Removing the case lid shows the layout of the Veroboard assembly and the push-button switch.

ing for the author's unit but any other small plastic case capable of accommodating the components and the battery to be used can be employed instead. (In the Doppler shift application the transmitter is turned on continually and a larger battery than the PP3 will almost certainly be required.) The general layout can be seen from the accompanying photographs. A 10mm. diameter hole for the transducer is drilled at one end of the case, and the transducer is then glued in position using a good quality general purpose adhesive. The transducer has an integral phone socket in a projection at its rear which fits through the hole in the case. The component panel is then connected to the transducer via two short unscreened flexible wires terminated in a phono plug. The panel is mounted on the bottom of the case close to the transducer by means of two short 6BA or M3 screws and nuts. Short spacing washers are used to hold the panel underside clear of the inside surface of the case, as the panel would otherwise be damaged when the mounting nuts are tightened.

S1 is mounted on the lid of the case just ahead of a central position (i.e. nearer the transducer end). S1 and the battery connector must be wired up to the component panel prior to its being finally screwed into position. The battery fits at the rear of the component panel.



Connection between the transmitter Veroboard panel and the transducer is made by way of two unscreened leads and a phono plug

TRANSDUCERS

The 40kHz transducers are a pair of type 7505 units, available from Ace Mailtronix Limited, Tootal Street, Wakefield, West Yorkshire, WF1 5JR. The units are identical and it does not matter which transducer is used in the transmitter and which is used in the receiver.

RECEIVER CIRCUIT

The circuit of the ultrasonic receiver appears in Fig. 3. MIC1 is the receiving transducer and this acts as a form of crystal microphone with poor sensitivity to audio frequencies and a response reaching a pronounced peak at the nominal resonant frequency of 40kHz. The microphone is therefore very sensitive to the signal from the transmitter but produces little output from even quite loud audio frequency signals.

The output from MIC1 is directly coupled to the base of a common emitter amplifier, TR1. Base bias is provided by R1, and a section of L1 forms the collector load for TR1. Only part of L1 is connected into the collector circuit in order to minimise loading effects so that the coil provides reasonably good selectivity. In conjunction with C4 it forms a parallel tuned circuit resonant at 40kHz. The main reason for using a tuned circuit here is to boost the 40kHz signal as opposed to any audio frequency output from MIC1. A high degree of amplification is required in the TR1 stage and, without the tuned circuit and despite the low a.f. sensitivity of MIC1, audio signals could still be raised to a sufficiently high level to cause spurious operation in the receiver. The coil employed for L1 is available from Ambit International.

C2 couples the output from TR1 collector to the pre-set gain control R2. This control is necessary as it may not normally be possible to utilise the full gain of the receiver without the circuit latching in the triggered state. The latching occurs due to the phase locked loop oscilator signal being picked up at the input of the circuit. The feedback could be avoided by careful screening of the pre-amplifier stage, but in practice this is unnecessary as more than adequate sensitivity can be obtained simply by backing off the gain to the point where latching does not occur.

A straightforward common emitter amplifier, TR2, amplifies the output from R2 and feeds it to the input of the phase locked loop tone detector circuit. C5 attenuates the very high frequency response of TR2 and assists in giving good stability.

The phase locked loop used in the system is the NE567. Phase locked loop circuits incorporating the NE567 have been dealt with before in this magazine and so it will not be considered in great detail here. R6, R7 and C6 are the p.1.1. oscillator frequency determining components, and R6 can be adjusted to produce a centre frequency of 40kHz. If an input voltage of 20mV r.m.s. or more which is within plus or minus 14% of the centre frequency is present at the p.1.1. input, an internal transistor in the device will switch on. The output from the transmitter normally produces such an input signal, and so the internal transistor of the p.1.1. will be switched on when the transmitter circuit is activated.

The internal transistor is connected in the common emitter mode and its collector terminal is

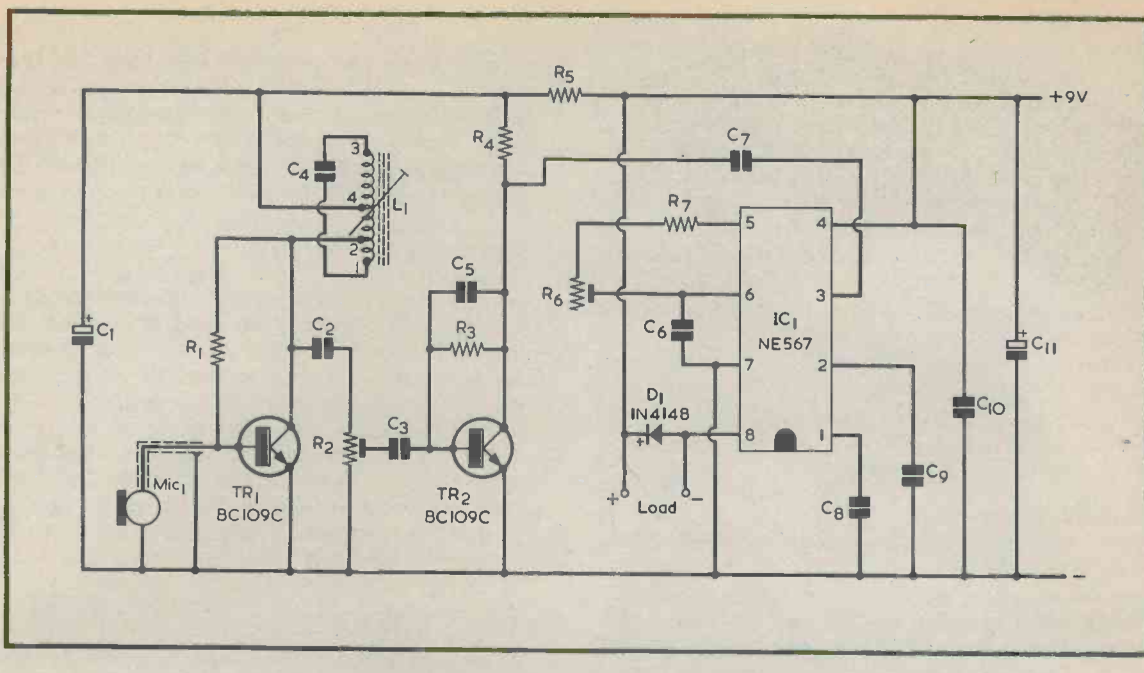


Fig. 3. Circuit of the ultrasonic receiver. MIC1 is the second 40kHz transducer

COMPONENTS

RECEIVER

Resistors
(All fixed values ¼ watt 5%)
R1 5.6MΩ
R2 4.7kΩ pre-set potentiometer, 0.1 watt, horizontal
R3 4.7MΩ
R4 4.7kΩ
R5 1kΩ
R6 4.7kΩ pre-set potentiometer, 0.1 watt, horizontal
R7 2.7kΩ

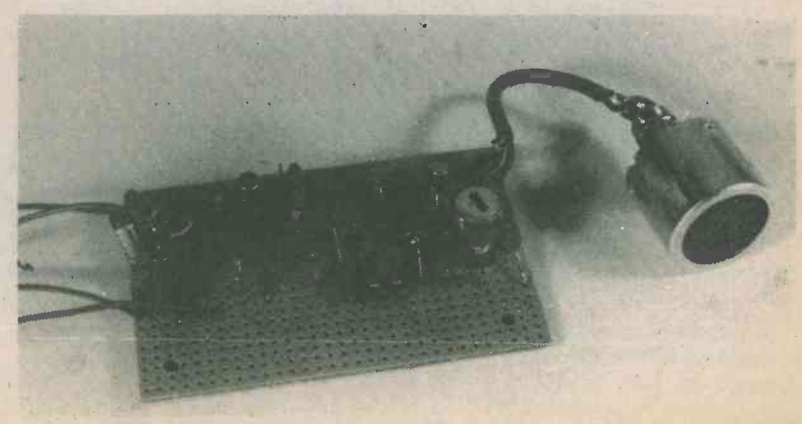
Capacitors
C1 10μF electrolytic, 10V. Wkg.
C2 1,500pF ceramic plate
C3 4,700pF ceramic plate
C4 2,200pF mylar
C5 33pF ceramic plate
C6 5,600pF polystyrene
C7 4,700pF ceramic plate
C8 0.022μF ceramic plate
C9 3,300pF ceramic plate
C10 0.022μF ceramic plate
C11 100μF electrolytic, 10V. Wkg.

Inductor
L1 7mH coil type CAN198OBX (see text)

Semiconductors
TR1 BC109C
TR2 BC109C
IC1 NE567
D1 1N4148 (see text)

Transducer
MIC1 40kHz ultrasonic transducer (see text)

Miscellaneous
Veroboard 0.1in. matrix
Phono plug
Screened cable
Wire, solder, etc.



The receiver board. The receiving transducer connects to this via a short length of screened cable available at pin 8 of the NE567. Loads of up to 100mA can be operated direct from the output at pin 8. For many applications, the output load will be the coil of a relay, and any type capable of energising reliably at slightly less than 9 volts and having a coil resistance of 100 Ω or more will be suitable. A good choice would be an "Open Relay" with 410 Ω coil, available from Maplin Electronic Supplies. Diode D1 protects the output transistor in the NE567 from high back-e.m.f. voltages when the transistor turns off and the relay releases. The relay contacts control the circuit to be switched by the ultrasonic system.

C8 and C9 are low pass filter components. C1, R5, C10 and C11 provide supply decoupling. The quiescent current consumption of the receiver in the untriggered state is only about 9mA, this increasing by the load current on triggering. No on-off switch is shown in Fig. 3 as it is possible that the receiver may be incorporated in existing equipment having a 9 volt supply. If a switch is required it may be inserted at the positive supply input.

Before concluding on circuit details it should be pointed out that if the load switched on by the receiver is not inductive (i.e. is not a relay coil or, say, a motor) diode D1 is not required and may be omitted from the circuit.

CONSTRUCTION

The ultrasonic receiver is constructed on a 0.1in. pitch Veroboard panel which has 19 copper strips by 31 holes. Details of this panel are provided in Fig. 4.

Commence by cutting out a panel of the correct size with a hacksaw, and then drill the two mounting holes 6BA or M3 clearance. Next, the 12 breaks in the copper strips are made and the components and link wires are soldered into position on the board. L1 has two mountings lugs which are either bent out of the way or are simply cut off with a pair of wire snips. The coil has 0.15in. pin spacing, but it will fit into the 0.1in. matrix board if it is positioned diagonally, as shown in the diagram.

A short screened lead is employed for the connection to MIC1, its braiding connecting to the negative rail. The remote end is terminated in a phono plug which is wired such that the screened wire braiding will be common with the metal case of MIC1 when the plug is inserted.

The Veroboard assembly is fitted to any equipment with which it is to be used. Because of this it will probably not require its own case, and it is left to the constructor to carry out his own design here to suit the particular application for which the receiver is required.

ADJUSTMENT

The first adjustment that must be made is to set R5 of the transmitter circuit for maximum output. Transmitter output can be monitored by connecting a multimeter set to its lowest a.c. volts range between TR1 collector in the receiver and the receiver negative supply rail. Many multimeters do not incorporate a d.c. blocking capacitor and will need a capacitor of about 0.1μF to be connected in series with the test lead connecting to the collector, as otherwise the meter will respond to the d.c. level at that collector. An a.c. millivoltmeter set to read several hundred millivolts f.s.d. can be

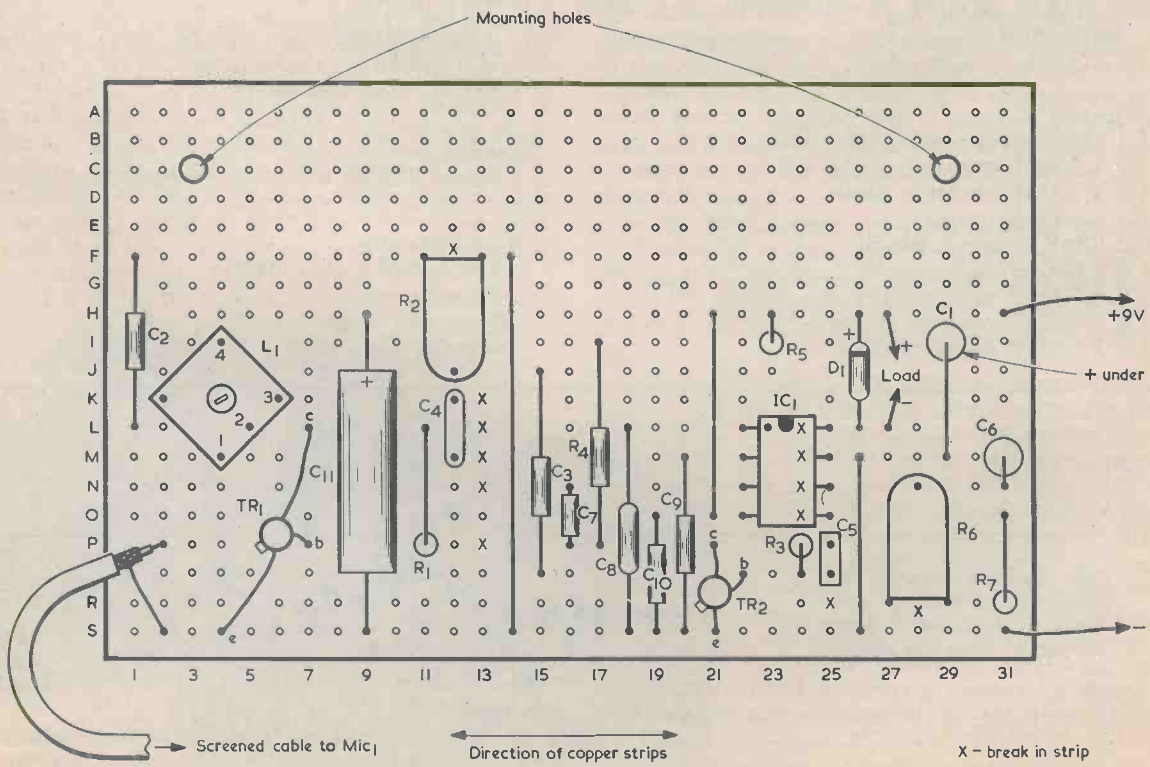
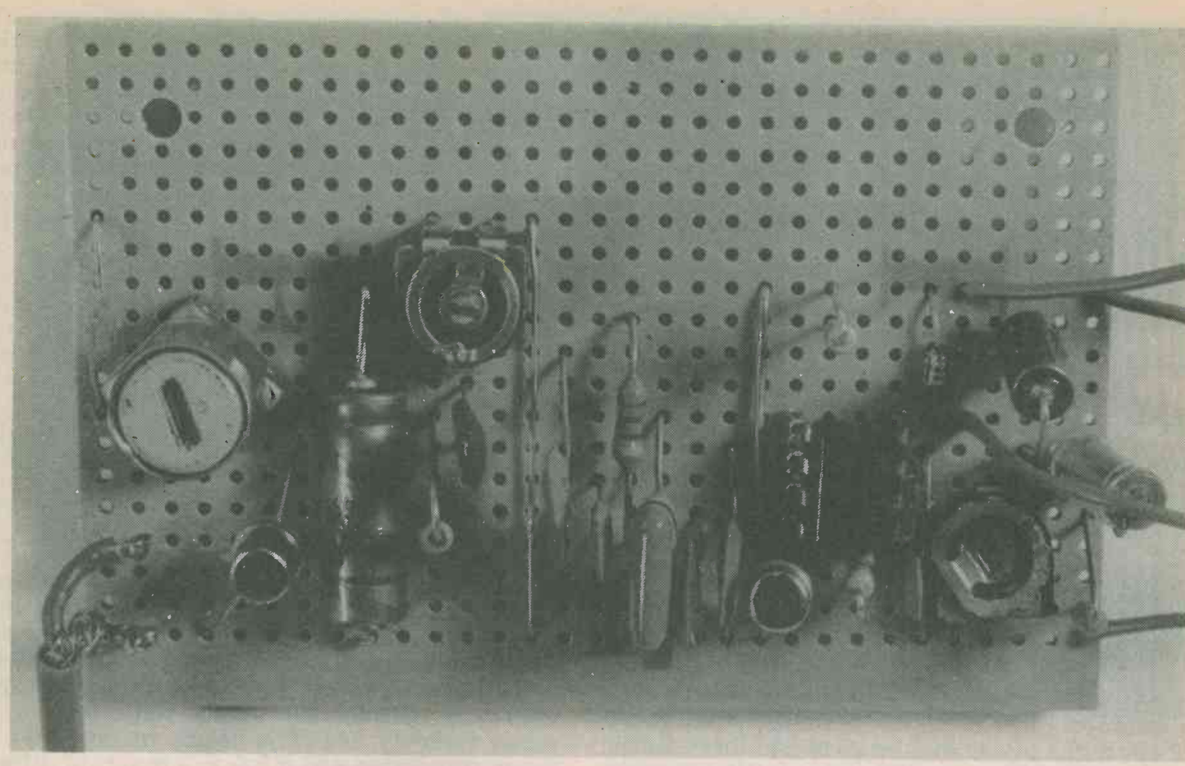


Fig. 4. Another Veroboard panel is employed for the receiver components



A closer look at the receiver panel. This has two pre-set potentiometers, one of which controls gain whilst the other controls oscillator frequency in the phase locked loop

used as an alternative to a multimeter.

With both the transmitter and the receiver switched on, and the two transducers placed close to one another, a small reading should be obtained in the meter. R5 is adjusted to peak the meter reading and then the core of L1 in the receiver is similarly adjusted. If the meter reading rises above 1 volt r.m.s., move the two transducers further apart, as otherwise the signal might clip at TR1 collector in the receiver and make it impossible to obtain a sharp peak with either adjustment.

It should be found that the output transistor in the NE567 will switch on over a small range of settings of R6 in the receiver (with the transmitter still switched on). R6 is merely adjusted to roughly the centre of this range of settings.

It is advisable to keep R2 in the receiver well backed off in the anti-clockwise direction when making these adjustments. When the alignment has been completed, R2 can be advanced clockwise to increase the sensitivity of the receiver. If the circuit malfunctions, for the reason described earlier, back off R2 to a point where proper operation is obtained.

The completed system should be extremely sensitive and, with the transmitter and receiver in the same room, it should be difficult or even impossible to position the transducers in such a way that the link is broken. The receiver is not prone to spurious operation by audio signals due to its tuned pre-amplifier and phase locked loop tone detector, the latter having good immunity to noise and out-of-band signals. Blowing into MIC1 or tapping it will probably operate the receiver output circuit, but this is something which occurs with even comparatively low sensitivity ultrasonic receivers.

A feature of the system is that, with the aid of an auxiliary unit, it can be employed in a Doppler movement detector. This add-on unit will be described in next month's issue. ■

LATE PUBLICATION

We regret that, due to an industrial dispute affecting our printers, this issue of the magazine is published late.

We expect next month's issue to be available by about February 9th and for subsequent numbers to be on sale by the third of each month.

It is very frustrating for our readers to have their favourite electronics magazine delayed, no doubt the excellent list of contents will be some compensation.

DOUBLE DECCERS

A SPECIAL NEW SERIES FEATURING S-DeCs

No. 4

By Ian Sinclair

AUDIO MIXER

Efficient mixer unit for two audio inputs

An audio mixer is a useful circuit for anyone interested in tape recording, particularly if tape recording is carried out as a creative hobby in itself, taking in such activities as the making of sound impressions of events or amateur theatricals. A recorded play may, for example, need sound effects, and a mixer enables us to add these during the recording from another tape or (if copyright permission is available) from a special effects record.

Since an audio mixer of the type to be described here incorporates pre-amplifier stages it can be useful as a pre-amplifier for low-output microphones, and it also enables a long cable to be used between the mixer and the recorder, with short microphone cables. The long cable can be employed because the output impedance of the mixer is fairly low. The design incorporates five n.p.n. transistors and it has two inputs of differing impedance, each with its own volume control. The output is from an emitter follower to ensure that the low output impedance just mentioned is provided.

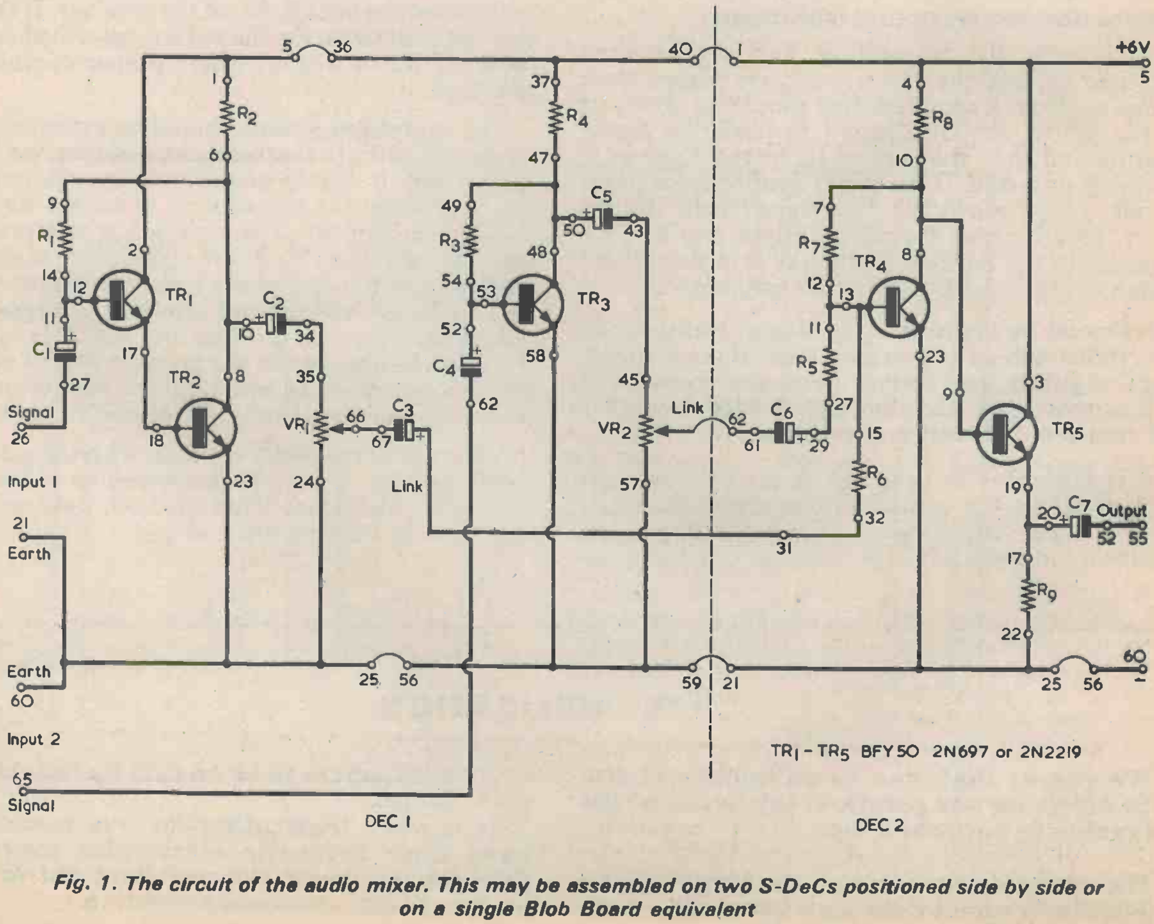
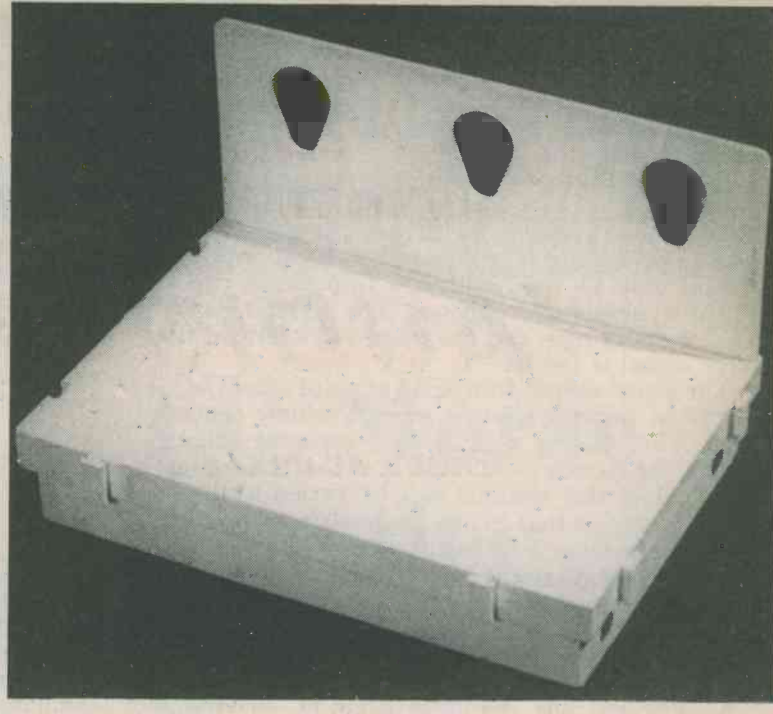


Fig. 1. The circuit of the audio mixer. This may be assembled on two S-DeCs positioned side by side or on a single Blob Board equivalent

A single S-DeC. Two of these, mounted side by side to form a single long DeC, can be used for all the projects in this series



CIRCUIT OPERATION

The circuit of the mixer is shown in Fig. 1. Input 1 couples to the base of TR1, which is an emitter follower biased by R1 and which has its emitter connected directly to the base of TR2. The input impedance of this stage is higher than that of Input 2, and is suitable for medium impedance microphones although not, in its present form, for the old-fashioned crystal microphones. TR2 acts as a voltage amplifier, with R2 as its collector load. The gain given by the two transistors is not fixed; due to the negative feedback given by R1 it depends on the impedance of the microphone that is used and will be greater for low impedance microphones than for high impedance microphones. This is a useful effect because low impedance microphones generally have low outputs which need greater gain. Incidentally, crystal microphones can give reasonable results if the circuit is modified by adding a capacitor between the collector of TR2 and the base of TR1. A value of around 0.001μF will usually be suitable, and the capacitor leads may be fitted to circuit points 7 and 13 of DeC 1.

The output signal from TR2 at point 10 of DeC 1 is coupled via C2, a 10μF electrolytic capacitor, to the volume control, VR1. This acts as the volume control for Input 1 and is inserted in circuit after TR2 rather than at the input itself to ensure that it does not affect signal-to-noise ratio too noticeably. Volume controls are noisy components, and should be used only where a fairly large signal level is present.

If the signal applied to Input 1 is already large, as it might be if taken from another recorder, some attenuation may be needed before C1. This could be provided by a fixed voltage divider, as shown in Fig. 2. Alternatively, the large signal could be taken direct to the volume control by removing C2, so that the stage incorporating TR1 and TR2 is out of

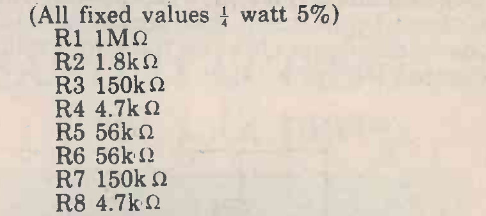
COMPONENTS

Resistors
(All fixed values ¼ watt 5%)
R1 1MΩ
R2 1.8kΩ
R3 150kΩ
R4 4.7kΩ
R5 56kΩ
R6 56kΩ
R7 150kΩ
R8 4.7kΩ
R9 4.7kΩ
VR1 10kΩ potentiometer, log
VR2 10kΩ potentiometer, log

Capacitors
C1-C7 10μF electrolytic, 16V. Wkg.

Semiconductors
TR1-TR5 BFY50 or 2N697 or 2N2219

Miscellaneous
2-off S-DeC
6V battery
2 control knobs



$R_A + R_B \approx$ 10kΩ to 20kΩ

Fig. 2. A simple attenuator circuit to reduce high level signals applied to Input 1

action. The input may then be applied to point 31 of DeC 1.

Signals from VR1 slider are passed through C3 and R6 to the mixer stage transistor, TR4. Note that the leads of C3 link the signal from point 67 of DeC 1 to point 31 of DeC 2.

Input 2 passes to the single voltage amplifier, TR3, which has base bias provided by R3. A higher value of load resistor, R4, is used compared to the load of TR2. The input has a low impedance and should only be used with low impedance (up to 100Ω) dynamic microphones. The voltage gain of TR3 is fairly high and the stage will overload if a large signal is fed in.

The signal output from TR3 at point 50 of DeC 1 is passed through C5 to a second volume control, VR2. This acts as a completely separate volume control for signals from Input 2, so that the volume of signal in this channel can be varied quite independently of that in the channel from Input 1. The output from VR2 is taken through capacitor C6 to resistor R5 in the mixer stage. The lead from VR2 slider is used as a link between the DeCs, plugging into point 62 of DeC 2.

The mixer stage itself is a simple but effective type. TR4 is connected as a common emitter amplifier and the low impedance at its base is further reduced by the feedback from its collector through R7. If the two signals are fed to this base via relatively high value resistors they have practically no effect on each other. In Fig. 1 these resistors are R5 and R6, and their presence ensures that adjustments to VR1 have virtually no effect on signals from Input 2 and that, similarly, adjusting VR2 has virtually no effect on the signal volume in the channel following Input 1.

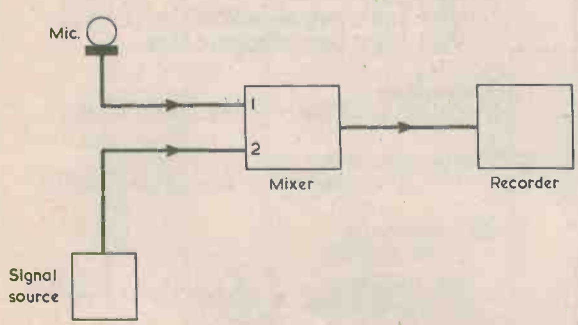


Fig. 3. Testing set-up, as described in the text

R8 is the collector load of TR4, and the mixed signals at this collector are directly coupled to the base of TR5, an emitter follower with the 4.7kΩ resistor, R9, acting as its load. C7 provides d.c. blocking, and the output is taken from point 55 of DeC 2. The output impedance here is sufficiently low to permit even the use of unscreened cables to the following amplifier or tape recorder input, provided that such cables are not run very close to unscreened mains wiring.

S-DEC CONSTRUCTION

Join the two S-DeCs, end to end, to make one long DeC and insert the six wire links. Mount VR1 and VR2 on a front panel, which can be slotted into either DeC. Solder single-strand insulated leads to the potentiometer tags, and plug their other ends into the appropriate S-DeC points. Do not forget that VR2 has its end leads plugged into DeC 1 and its central lead plugged into DeC 2. Capacitor C3 also bridges the DeCs and should be inserted next. Make certain that its positive lead connects to point 31 of DeC 2. Now plug in the transistors, following the lead-out diagram for these transistors (which are used in all the Double-Deccer projects) given in Fig. 4. Check that the transistors are correctly inserted before proceeding further. Next add the remaining capacitors. Because these are all electrolytic, care is needed to ensure that they are connected the correct way round. Different manufacturers use varying methods of marking electrolytic capacitor polarity and these are normally quite obvious. When one lead can be seen to be attached to the metal case of the capacitor this is always the negative lead. With all the capacitors in place and checked, the resistors can be inserted and the mixer unit is then ready for testing.

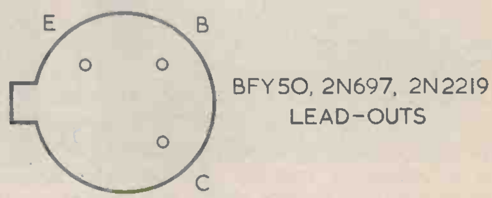


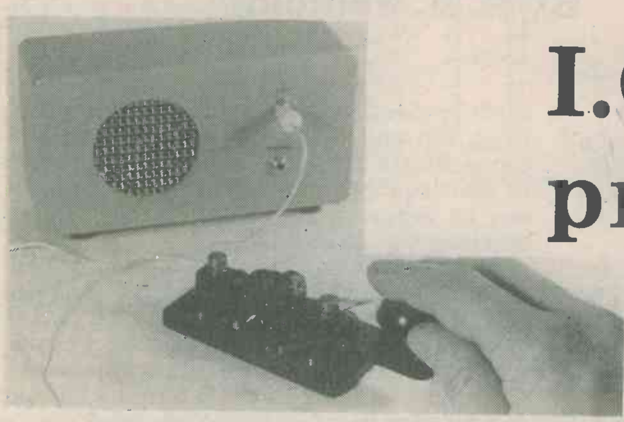
Fig. 4. The transistors specified for the mixer unit all have their lead-outs positioned as here. The leads are pointing towards you

TESTING

Connect the output at 55 (live) and 60 (earth) of DeC 2 to an amplifier or tape recorder input, using an input which will not be overloaded by the signal from the mixer. This will generally be the input marked as "line' or large-signal input. Connect the 6 volt battery to the mixer, positive to point 5 of DeC 2 and negative to point 60 of DeC 2. Now connect a microphone to Input 1 and another signal source (signal generator, detector stage of a transistor radio, etc.) to Input 2. Turn down both volume controls. Switch on the amplifier or tape recorder and advance volume control VR1, speaking into the microphone. Find the level for VR1 at which a reasonable output is obtained. Next turn down VR1 again and advance the setting of VR2 so that a reasonable output is obtained from the second signal. Now turn up VR1 to its previous setting so that the two signals can be mixed. If the volume is too great, both controls can be turned down slightly. Have fun! ■

RADIO & ELECTRONICS CONSTRUCTOR

IN OUR NEXT ISSUE —



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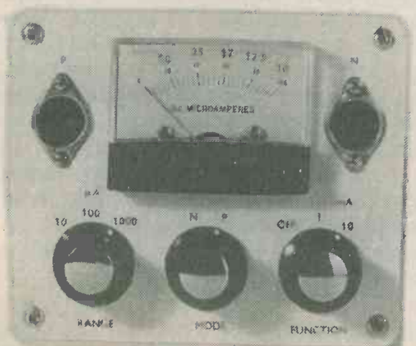

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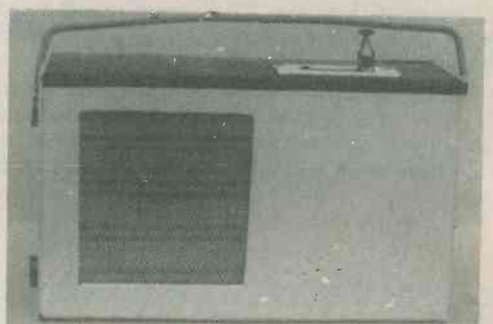

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9v ELIMINATOR SPEAKER UNIT

Part 2

By R. A. Penfold

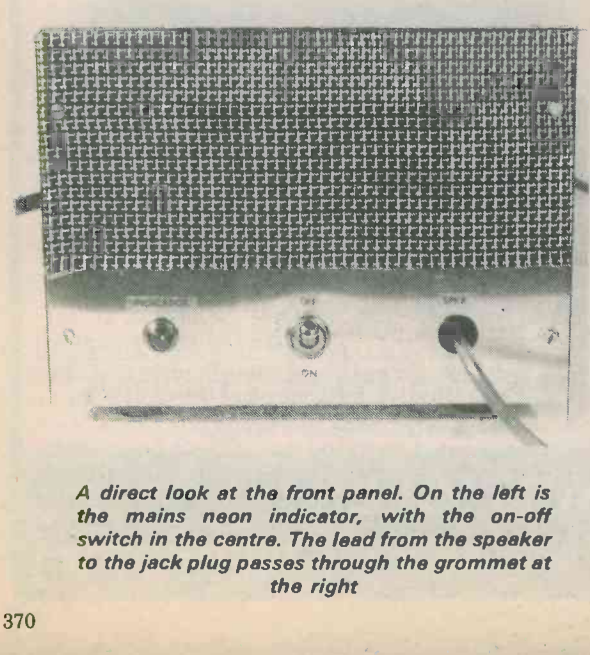
CONSTRUCTION

Most of the small components are wired up on a plain perforated s.r.b.p. panel of 0.1in. matrix having 24 by 25 holes. Details of this panel are shown in Fig. 3, which also shows the other wiring of the power supply circuitry.

First cut out the s.r.b.p. panel and then drill out the two mounting holes 6BA or M3 clear. The various components are then fitted to the panel, their lead-outs being bent flat against the underside. The lead-outs are next wired together as shown in the diagram.

T1 is mounted on the base of the cabinet immediately behind S1. The component panel is mounted behind the transformer with the edge at which D1 is fitted being closest to the transformer. There must be adequate clearance between the tags of T1 (if this is fitted with tags rather than flying leads) and the speaker frame. The component panel is secured to the cabinet base by 6BA or M3 screws and nuts as applicable, with 10mm. spacing washers over the screws to keep the panel underside well clear of the base. The panel is not finally mounted until it has been wired up to the remainder of the circuit.

For reasons of safety, a 3-core mains lead must be used, with the earth wire connecting to a solder tag under one of the securing nuts for T1. An insulated flexible wire from this tag then carries the earth connection to the solder tags mounted on the front, top and rear aluminium panels. The wires connecting to the solder tag on the top panel should be a little longer than is required so that this panel can be removed and taken to one side without breaking the connection.



A direct look at the front panel. On the left is the mains neon indicator, with the on-off switch in the centre. The lead from the speaker to the jack plug passes through the grommet at the right

The speaker is connected to a twin lead about 250mm. long which is terminated in a ¼in. jack plug. This plug is, of course, inserted into the output socket of the receiver. The output of the power supply is taken to the receiver via another twin lead about 350mm. long which is terminated in one red wander plug for positive and one black wander plug for negative. Both the speaker and the output leads can be a little longer, if desired. Matching red and black wander plug sockets are mounted on the rear panel of the receiver in the positions shown in the photograph which was published in Part 1 of the receiver articles. These sockets are connected to the appropriate supply rails of the receiver. The battery connectors inside the receiver can be left wired into circuit if it is possible that portable operation will be required at a future date, but it will be necessary to cover the positive connector with insulating tape so that the supply rails will not be short-circuited if it should happen to come into contact with the receiver chassis.

C3 is most effective if it is mounted inside the receiver. It is wired across the two wander plug sockets in the receiver. TR1 should be fitted with a TO5 size clip-on heatsink.

In the photograph of the interior of the unit, the transformer visible is a type having a 9-0-9 volt secondary. This was employed initially, but it was found possible to slightly overload the supply unit at high volume levels in the receiver. The overloading resulted in the "S" meter readings being reduced and also created difficulties with s.s.b. reception. The transformer was changed to the 12-0-12 volt type specified, which completely eradicated the problem. The earthing wire links to the front, top and rear panels were also added after the photograph was taken.

TESTING

Before connecting the power supply to the receiver, make quite sure that both the wander plugs and sockets are connected with the correct polarity. The set could easily be damaged if the supply were to be connected with the wrong polarity.

The current limiting circuitry can be checked by connecting across the output a multimeter set to give a full-scale deflection of 250mA or more in series with a 47Ω resistor. The resistor should

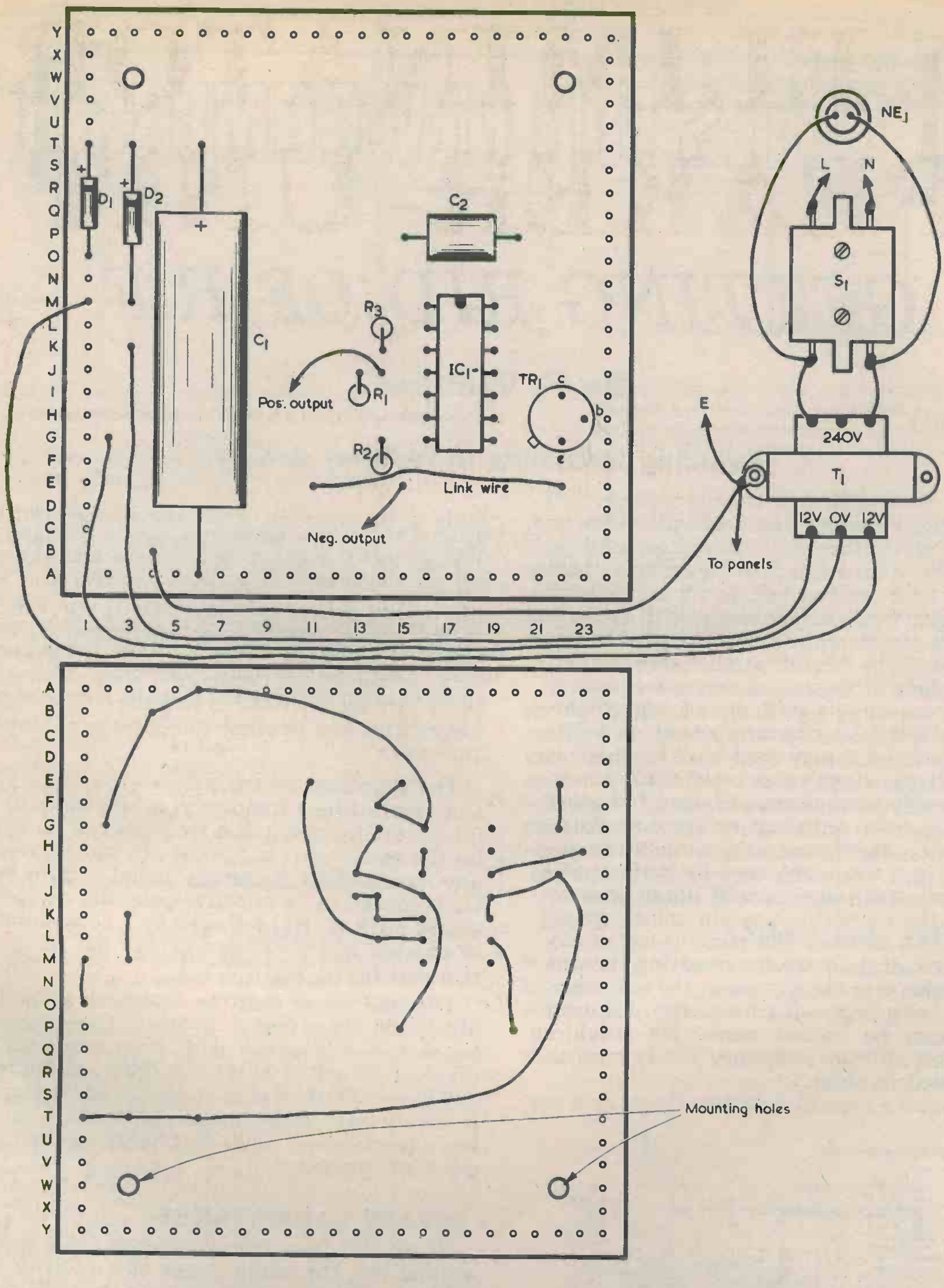


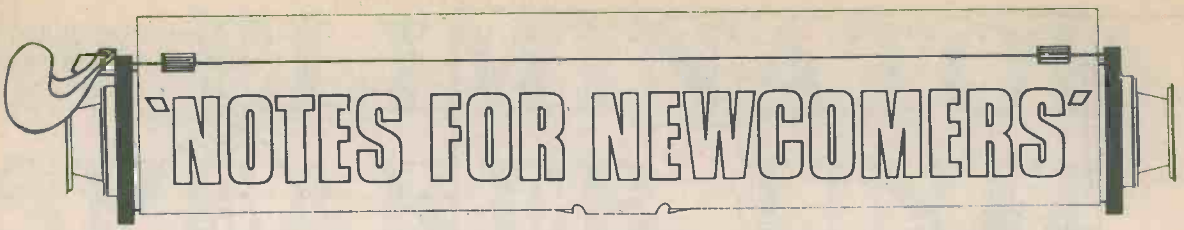
Fig. 3. Details of the wiring of the power supply section of the unit. The speaker simply connects to a jack plug which is inserted in the receiver output socket

preferably be a ½ watt or 1 watt component. If the current limiting circuit is operating correctly, the meter will give a reading of approximately 100mA. Should the current limiting circuit not be operating properly, the 47Ω resistor will limit the current to a level which will prevent damage provided that the meter circuit is not connected for more than a few seconds.

After completion of the current test a multimeter switched to a suitable voltage range can be used to check that the output voltage is not excessive.

If all is well, the unit can be connected to the receiver and tried out. The power supply circuit provides a very well smoothed output, and no problems with mains hum should be given even with headphone reception.

The prototype was able to withstand a continuous output short-circuit, although TR1 did get rather hot under this condition. Thus, whilst output short-circuits can be handled, it is advisable to avoid these if at all possible. ■



GETTING RID OF R.F.

By R. Webber

Avoiding instability in receiver design

The normal radio receiver provides r.f. amplification before the detector and a.f. amplification afterwards. In a simple home-constructed t.r.f. receiver, all the r.f. amplification will be at signal frequency, whereas with a superhet there may be some amplification at signal frequency with most of the amplification before the detector taking place at the intermediate frequency.

We don't want any significant r.f. amplification after the detector, because any r.f. which appears in the audio section may feed back to the stages before the detector and cause instability. When we use modern silicon transistors in the a.f. stages the situation becomes quite acute since transistors nominally intended for operation at audio frequencies can, in practice, offer meaningful amplification at tens or even hundreds of megahertz.

CAPACITIVE REACTANCE

The most useful device for removing unwanted radio frequencies is the capacitor, the reactance of which falls with increasing frequency. Capacitive reactance can be looked upon, for rough approximations, as "a.c. resistance". Like resistance it is expressed in ohms.

Fig. 1 shows a typical detector circuit in a portable a.m. superhet. After the germanium diode detector there is a 0.01μF capacitor to chassis, C1, a 1kΩ series resistor, R1, and a second 0.01μF capacitor, C2. The volume control follows. The circuit is very similar to that following the rectifier in an a.c. mains supply unit, whereupon C1 can be looked upon rather as a "reservoir capacitor" and C2 as a "smoothing capacitor". Here, however, the capacitors are intended to stop the passage of radio frequencies and to allow the passage of audio frequencies.

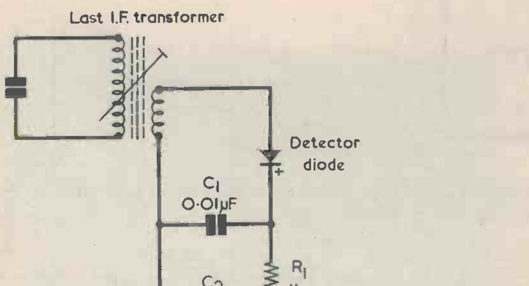


Fig. 1. Typical detector circuit in an a.m. radio. C1, R1 and C2 remove most of the intermediate frequency signal appearing after the detector

The reactance of 0.01μF at 470kHz (a typical a.m. intermediate frequency) is 34Ω, whilst at 5kHz (about the highest audio frequency to be handled by the receiver) it is 3,200Ω. It can be seen that any intermediate frequency signal content leaving C1 is passed to an effective potential divider consisting of 1kΩ (R1) followed by a 34Ω shunt (C2) to chassis. Much of the i.f. (but not all of it) is removed by R1 and C2.

Did you notice that the reactance at 5kHz was about 100 times that at 470kHz? Capacitive reactance varies inversely with frequency: the reactance of 0.01μF at 5kHz is 3,200Ω, at 50kHz it is 320Ω, at 500kHz it is 32Ω, and so on. It also varies inversely with capacitance. An 0.02μF capacitor has a reactance of 1,600Ω at 5kHz, i.e. half that of a 0.01μF capacitor.

BYPASS CAPACITANCE

If we still have trouble due to radio frequency getting into the audio stages of a receiver we can add a further capacitor at some strategic point. In Fig. 2(a) the capacitor, designated "C", is between the collector of an a.f. transistor and chassis, and it has a bypassing effect on any r.f. that may be present at that collector. Values vary according to particular requirements but a typical figure would be of the order of 0.01μF. Or we can connect the capacitor between the collector and the base, as in Fig. 2(b). This time the capacitor is actively giving negative feedback of r.f. and it can have a lower value, say about 1,000pF.

The inductive reactance offered by an r.f. choke increases with frequency, within the range over which it is intended to work, whereupon an r.f. choke may be used to provide series opposition to radio frequency signals. But take care with the circuit shown in Fig. 3. At the frequency at which the

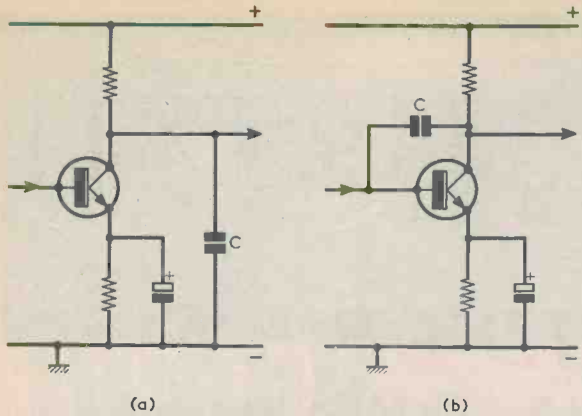


Fig. 2(a). An r.f. bypass capacitor connected between the collector of an a.f. transistor and chassis
(b). Here the capacitor is connected between the collector and base of the transistor

inductive and capacitive reactances are equal the choke and capacitor act as a series tuned circuit, and a *boosted* r.f. signal can appear across the capacitor!

Unwanted couplings between the audio frequency and radio frequency stages can occur along the supply rails, and these are bypassed by a large value capacitor. Since it is desirable that the supp-

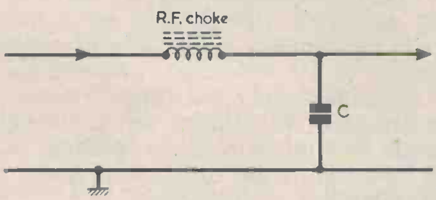


Fig. 3. This apparently innocuous r.f. suppression circuit can be troublesome at the frequency at which it is resonant

ly rails are bypassed at audio frequencies, it is usual to find a large value electrolytic capacitor of 200μF or more used here. An electrolytic capacitor does not always provide a very good bypass at radio frequencies and you may occasionally find connected across it a polyester, or similarly non-electrolytic, capacitor of around 0.1μF. See Fig. 4(a). The 0.1μF capacitor gives a better r.f. bypass. A typical supply rail decoupling circuit, using a series resistor, appears in Fig. 4(b).

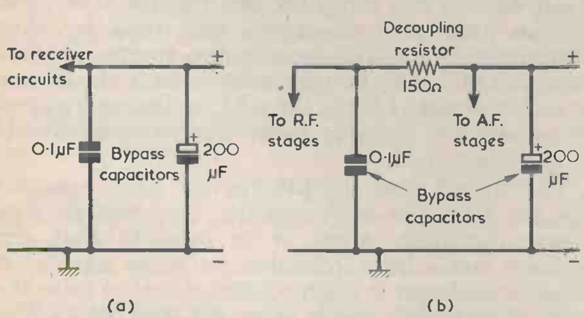


Fig. 4(a). Sometimes a non-polarised capacitor is connected across an electrolytic bypass capacitor to improve performance at r.f.
(b). A supply rail decoupling circuit with typical component values

GRID STOPPER

In the old valve days a common and quite respectable dodge for getting rid of r.f. was to insert a resistor of around 20kΩ in series with the control grid of an a.f. valve. The idea is shown in Fig. 5.

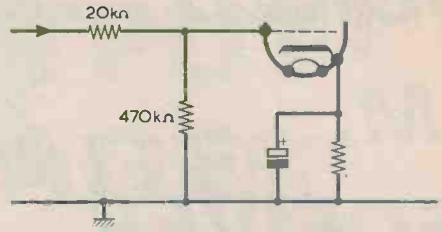


Fig. 5. The old valve grid stopper can be brought back into use again with f.e.t.'s. The 470kΩ resistor in the diagram is a bias component

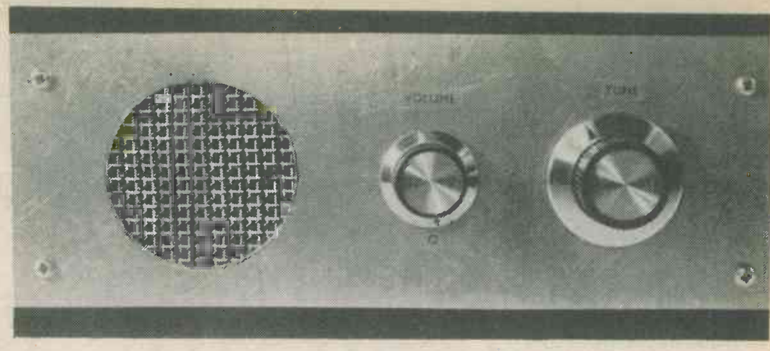
The resistor formed a resistance — capacitance potential divider in company with the stray capacitance between the grid and cathode, which would typically be of the order of 2 to 6pF. The resistor had virtually no effect on audio frequencies. An r.f. stopper resistor cannot be used very successfully with bipolar transistors, which are virtually current driven, but it is well worth while trying one in series with the gate of a field-effect transistor.

Finally, there are ferrite beads. If a ferrite bead is simply strung on a piece of wire carrying unwanted radio frequency signals, it increases the inductance of the wire and reduces the radio frequency current which flows. It also offers a small measure of screening, since the r.f. field around the wire tends to concentrate in the ferrite material of the bead. It is difficult to predict the usefulness of a ferrite bead in any particular circumstance and its effect normally has to be checked out in practice. It is quite in order to string two beads along a piece of wire to get a greater effect.

Fig. 6. Ferrite beads are occasionally fitted over the lead from a receiver output stage connecting to the earphone socket and loudspeaker

In commercially made radios, ferrite beads are most commonly encountered in the a.f. output stage, usually on the lead to the speaker and earphone socket, as in Fig. 6. They prevent feedback to the r.f. stages via the speaker wiring, or via the earphone lead when an earphone is plugged in ■

PHASE LOCKED A.M. RECEIVER



Part 2 By M. V. Hastings

Alignment instructions for this unusual and ingenious receiver design

In last month's issue we described the circuit operation and construction of this unusual receiver design. We now carry on to details of its alignment.

ALIGNMENT

The cores of L2 and IFT1 are set up at the factory for correct operation in terms of frequency, and they do not need any adjustment at all in the present receiver.

The set should be switched on and the volume control advanced slightly. At first it will probably not be possible to tune in any stations properly. By trying R7 at various settings it should be possible to produce a heterodyne (a whistling sound from the speaker) with the p.l.l. oscillator beating with received signals. The aerial coil is then slid along the ferrite rod until received signals can be peaked to a level which enables the p.l.l. to lock on and produce an audio output. R7 is then adjusted by trial and error to the setting which gives best results (i.e. the setting which causes received signals to most readily bring the p.l.l. into lock).

Alignment of the mixer and oscillator circuits is then quite conventional. As already stated, the core of the oscillator coil will not require any adjustment and should be left alone. If the frequency coverage of the set seems to be incorrect, with either a lack of coverage at the high frequency end of the band (tuning capacitor vanes almost fully enmeshed) or an excess of coverage at this end with short wave maritime signals being received, then adjustment of TC2 should enable this to be corrected. It is important to have the high frequency coverage of the set reasonably correct as otherwise the aerial tuned circuit will not track well with the oscillator tuning.

In order to align the aerial tuned circuit first tune to a station at the low frequency end of the medium wave band and then slide the aerial coil along the ferrite rod to locate the position which produces the strongest signal. Next tune to a station at the high frequency end of the band and adjust TC1 for strongest possible signal. Re-tune to the station at the low frequency end of the band and once more adjust the position of the aerial coil on the ferrite rod for maximum signal strength. This procedure should be repeated a few times until the set has good sensitivity over the entire band.

When peaking the aerial circuit it can be rather difficult to determine when exactly the peak setting has been achieved. One way of overcoming this problem is to connect a multimeter switched to read about 5 or 10 volts f.s.d. between IC2 pin 1 and the negative supply rail (negative test prod to the negative rail). Maximum signal strength then corresponds to minimum meter reading, but there will only be a significant drop in the meter reading on strong signals.

An alternative method is to use a weak signal which will not readily cause the p.l.l. to lock onto its carrier wave. With the tuning adjusted for a fairly low beat note between the station's carrier and the oscillator of the p.l.l., variations in signal strength will cause changes in the beat note. Minimum beat frequency corresponds to maximum signal strength.

The prototype receiver picks up all the normal medium wave stations well and the p.l.l. readily achieves lock. However, it is worth noting that although the p.l.l. may well lock onto the received carrier over a fairly wide range of settings of the tuning control, the set should be adjusted to about the middle of this range for best results. Distortion on the audio output signal will then be at a minimum. On weak stations the tuning is more critical and it may be necessary to tune the station to within about 1kHz of the p.l.l. oscillator frequency in order to achieve lock. Good results should then be obtained.

The circuit does not incorporate a.g.c. and this was not found to be necessary. However, in very strong reception areas it is possible that the receiver could be overloaded on some signals. If this should occur it might be beneficial to raise the value of R4 slightly, say to about 47k Ω ro 56k Ω. This will reduce the sensitivity of the receiver, but it will still be capable of receiving numerous stations. In severe cases the directivity of the ferrite aerial could be used to reduce the strength of a received signal which produced overloading. ■

In your workshop

VIDEO OUTPUT STAGE FAULT

Looking for a lost picture

"Happy New Year, Smithy!"

"And the same to you, Dick," replied the Serviceman, as he took off his raincoat and hung it up behind the door.

He surveyed the brightly lit Workshop.

"Blimey, you're in early," he remarked. "Normally, I'm half-way through my first job for the day before you come stumbling in."

"Today's different," stated Dick. "This is the first working day of 1979 and I'm dead keen to get started. Especially now that I've got my new servicing aid with me."

"Oh, what's that?"

Proudly, Dick pointed to a corner of his workbench. Unlike the rest of its surface this was completely uncluttered, and in the centre of the cleared space was a brand-new shining multi-button electric calculator.

VIDEO AMPLIFIER FAULT

"That," continued Dick, "is my Christmas present from my Auntie Eff. It's a Laboratory Model, Super-Memory, Multi-Function, Scientific Calculator!"

"Humph," sniffed Smithy, as he glanced suspiciously at the machine. "Personally, I'm against the use of calculators. People with calculators end up by using them to add 2 and 2 together."

"2 and 2?" repeated Dick eagerly, turning to the calculator. "I'll try that out. Here we go! I first press '2', then 'plus', then '2', and then 'equals'."

He looked down at the little readout window of the calculator.

"The answer," he announced gravely, "is 4."

"You steaming great buffoon," snorted Smithy, "of course the answer is 4. What on earth did you expect it to be?"

"Now, don't get like that, Smithy. I'm only trying it out."

"And that's another thing. Now that we're starting a new year, it seems a good time for you to stop calling me 'Smithy'. It's most disrespectful for my assistant to refer to me by a familiar name like that."

"Okay, Chief!"

Smithy grunted.

"That sounds a bit better," he conceded, "Well, if you've come in all keyed up to do a lot of work today you're going to be disappointed. So far as I can see, there's only one job to do and that's the black and white TV you've already got on your bench."

"That's true," agreed Dick. "We cleared out everything before the holiday started, except for this set."

"What's wrong with it?"

"No picture, apparently. Sound, but no picture."

Smithy walked over and switched on the receiver. At once the sound channel of one of the local transmitters became audible, and he waited for the picture tube cathode to warm up. After some moments the screen came to life, showing a blank white raster with no picture information on it whatsoever. Smithy adjusted the brightness control and noted that this varied the brightness of the raster in a perfectly normal manner. He put his hand to the contrast control, to find that someone had already turned it fully clockwise. The control had no effect on the raster and he left it at a central setting.

"This shouldn't be too difficult a snag," he said. "The vision i.f. signal must be getting past the vision detector, because we're getting intercarrier sound. And the line and frame timebases must also be working because we're getting a raster, which means in turn that e.h.t. is present as well. It looks as though we've got a nice easy fault in the video amplifier section."

"Fair enough," stated Dick, leaning forward and switching off the receiver. "I'll take the back off and get the board out, if you like."

"Yes, do that."

"Okay, Chief!"

As Dick busied himself with the receiver, Smithy wandered over to the filing cabinet and leafed through the service manuals. Locating the manual for the particular set on Dick's bench, he returned and commenced to study the circuit around the video amplifier stages. (Fig. 1.)

"This is pretty straightforward," he pronounced cheerfully. "We've got quite a standard line-up here, so far as recent monochrome TV receivers are concerned. The vision detector is connected into circuit with a polarity which causes the detected picture information to be positive-going and sync pulses, which of course are at maximum signal amplitude in the 625 line system, to be negative-going. After a couple of i.f. chokes, together with a 10pF and two 5pF bypass capacitors going down to chassis, the detected signal goes on to a video amplifier transistor with resistive loads in both its emitter and collector circuits. The signal at the

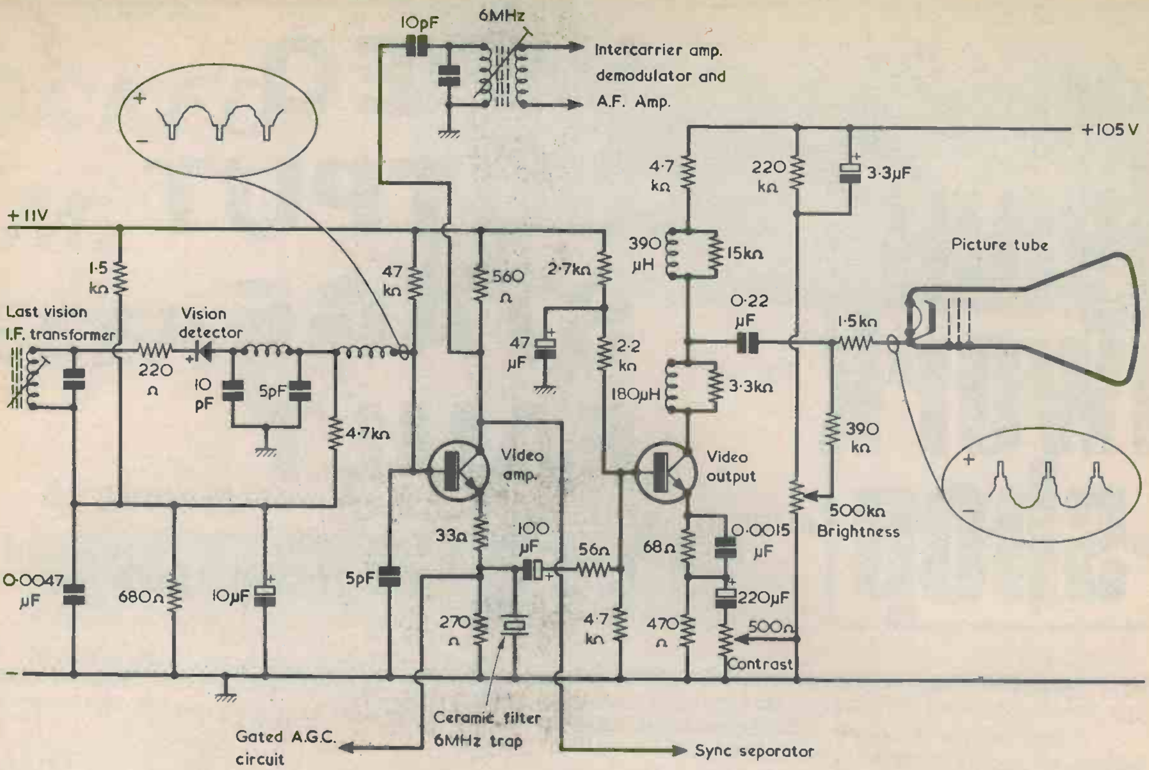


Fig.1. The vision detector and video amplifier stages of the television receiver serviced by Dick and Smithy. This is a slightly simplified version of the circuit employed in the Bush monochrome receiver Model BM6510. Omitted are the line and frame blanking pulse inputs, which are applied to the emitter of the video output transistor. The control grid of the picture tube connects effectively to chassis when the receiver is switched on

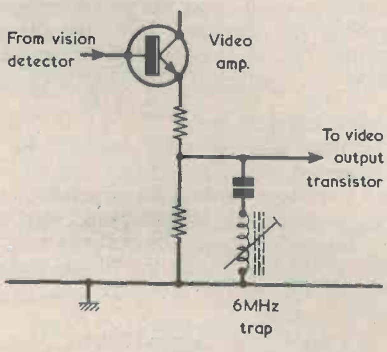
emitter is applied, via a 100μF electrolytic and a 56Ω resistor, to the base of the video output transistor. So the video signal at the output transistor base still has negative-going sync pulses. The output transistor is in the common emitter mode and it inverts the signal so that, when applied to the picture tube cathode, it has positive-going sync pulses and negative-going picture information. Which is just what is required for application to the cathode of the tube."

INTERCARRIER SOUND

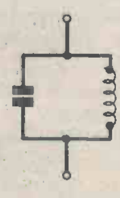
By now, Dick had eased out the circuit board of the receiver and was standing beside Smithy, looking at the service sheet.

"A signal is taken from the collector of the video amplifier transistor," he remarked, pointing at the appropriate place in the circuit. "It goes to a 6MHz tuned circuit."

"You're right," confirmed Smithy. "That's the 6MHz intercarrier sound signal and it's applied to the 6MHz intercarrier amplifier, the sound demodulator and the a.f. amplifier of the set. The fact that we're hearing the sound channel means that the video signal is, at least, getting through to that video amplifier collector. Also taken out



(a)



(b)

Fig. 2(a). In some receivers the 6MHz trap consists of a series tuned circuit resonant at that frequency

(b). When compared with the parallel tuned circuit, shown here, the series tuned circuit is referred to as an 'acceptor' circuit. The parallel arrangement is a 'rejector' tuned circuit

from the collector is a signal for the sync separator. And, from the emitter, a further output is taken to the gated a.g.c. circuit."

"That video amplifier transistor does a good bit of signal sorting out, doesn't it?"

"It does, indeed. Now, we don't want the 6MHz sound signal to go to the picture tube at any significant amplitude and so the usual course is to put a 6MHz trap in the emitter circuit of the video amplifier. This set uses a ceramic filter, which will exhibit a low impedance at 6MHz. In other sets you may find, instead, a series tuned circuit resonant at 6MHz to act as the trap." (Fig. 2 (a).)

"I seem to remember," said Dick, "that a series tuned circuit offers minimum impedance at its resonant frequency."

"It does," agreed Smithy, "and because of this it's referred to as an 'acceptor' circuit when compared with a parallel tuned circuit, which gives maximum impedance at resonance. The latter is then known as a 'rejector' circuit. Incidentally, when I was talking to you some months ago about f.m. receivers I referred to a 10.7MHz series tuned circuit trap as a '10.7MHz rejector', and somebody mentioned later that here was an acceptor tuned circuit being referred to as a rejector cir-

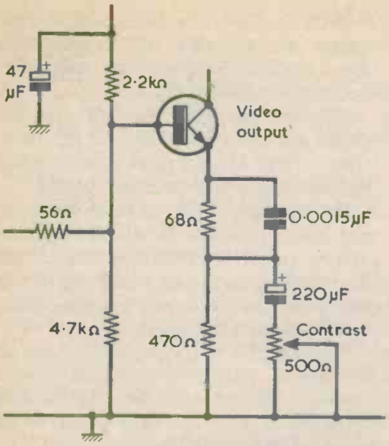


Fig. 3. Detail of the emitter circuit of the video output transistor. This includes both contrast control and frequency compensation components

cuit! So far as terminology is concerned it's safest to refer to these circuits which remove a small band of frequencies as 'traps'." (Fig. 2 (b).)

"I get your point," commented Dick, as he continued to examine the circuit. "I see that the contrast control is in the emitter circuit of the video output transistor." (Fig. 3.)

"Yes," said Smithy. "What the contrast control does is to alter the amplitude of the video signal passed to the picture tube, and in the arrangement used here it varies the amount of negative feedback in the video output emitter circuit. When the slider of the control is at the top of its track the emitter couples almost directly to chassis by way of the 220μF electrolytic capacitor, whereupon there is minimum negative feedback and maximum amplification of the video signal. The negative feedback increases, and the gain reduces, as the slider goes down the track."

"Just a minute, though," objected Dick. "There's a 68 Ω resistor and a 0.0015μF capacitor between the 220μF electrolytic and the emitter of the video output transistor."

"That's to give frequency compensation," explained Smithy. "Due to stray capacitances to chassis in the collector circuit, including in particular the capacitance between the tube cathode and its heater, you have to have a bit of compensation to increase the gain at the higher video frequencies. A really good set can have a video amplifier whose output is only 6dB down at 5MHz, which means that its voltage gain at that frequency drops to a half of that at the lower frequencies. The reactance of that 0.0015μ F capacitor falls with rising frequency and at 5MHz will be, rough check, of the order of 20 Ω. So the negative feedback at the emitter of the video output transistor reduces as video frequency goes up. Okay?"

"Sure thing, Chief!"

"Now we come to the collector circuit. . ."

"Stap me," Dick interrupted him. "There are two more chokes there!" (Figs.4(a) and (b).)

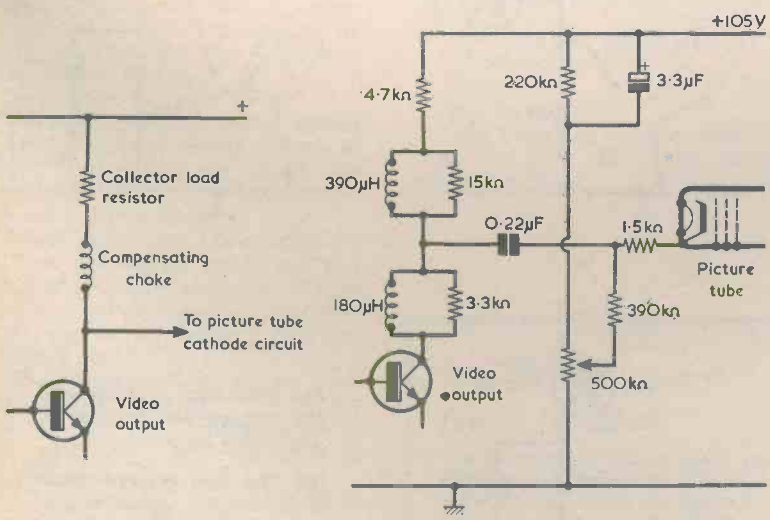


Fig.4(a). A simple frequency compensating circuit. The reactance of the choke increases as the video frequency increases, whereupon the higher frequencies undergo a higher degree of amplification

(b). The more complex frequency compensating network employed in the circuit of Fig. 1

"They're for frequency compensation again," said Smithy. "The usual form in most receivers is to simply have a single choke immediately after the video output collector with a load resistor in series with it. The reactance of the choke increases with frequency and so, once again, there is increasing voltage gain as video frequency increases. In this set, however, there are two chokes which, together, set the frequency response just right. The lower one will actually reduce the higher frequency signal passed to the tube cathode whilst the upper one will increase it."

"The upper choke," said Dick, "has an inductance of 390μH. what will its reactance be at 5MHz?"

"At a guess I'd say somewhere between 10 and 15k Ω."

"Hey, why do we have to make guesses when I've got my calculator here? What's the formula for inductive reactance?"

"In ohms," replied Smithy, "it's equal to 2 times pi times frequency in hertz times inductance in henrys. Or, to save you grief with that calculator of yours, in megahertz and microhenrys."

"Right," said Dick briskly, his finger hovering over the calculator keys. "Here goes then, 5MHz and 390 μH! I'll first select '2', then 'multiply', then 'pi', then 'multiply', then '5', then 'multiply' and finally '390'."

Smithy looked at him wearily.

"What's the answer?"

Dick pressed the "equals" key.

"12252.211 ohms!"

Smithy sighed.

"I don't think we need all that accuracy," he said patiently. "Let's just call it 12k Ω at 5MHz. At very low video frequencies that choke will be nearly a dead short and so you can see that it offers quite a high level of boost at the higher video frequencies."

"I'll do the 5MHz reactance of the 180μH choke now."

"All right," said Smithy resignedly.

Dick punched at the keys on his calculator.

"This one is 5654.8668 ohms!"

Smithy's eyes wandered helplessly towards the ceiling.

"All we really need are the first two significant figures, you know."

"If," pronounced Dick firmly, "my calculator gives an output of eight figures, then eight figures it's going to be!"

"All right, all right," replied Smithy irately. "For myself, I'll just stick with a reactance in that choke of 5.6k Ω at 5MHz. So, the bottom choke actually gives some attenuation at the higher video frequencies whilst the upper choke gives quite a lot more boost. Together, they should doctor the video frequency response so that it's just what's needed."

A.C. COUPLING

"The video signal next goes to the tube cathode through a 0.22 μF capacitor."

"It does, indeed," responded Smithy. "Which gives a pure a.c. coupling. And that's an interesting point so far as our present snag is concerned."

"Why's that?"

"Because, even if the fault causes quite big changes in the d.c. voltage conditions of the video output transistor, those changes will be isolated by the capacitor from the cathode of the tube. I found that the brightness control worked perfectly well; if there had been a d.c. coupling to the tube cathode, a d.c. fault in the video output stage could have prevented that from happening."

Smithy mused for a moment, then suddenly thumped his fist on Dick's bench.

"What's up?"

"What's up," snorted Smithy, "is what's always happening in this place. Here am I spending my time giving you a *theoretical* description of where the fault could be when we should actually be sorting it out in practice! Testmeter to the ready, Dick!"

"Right away, Chiefy!"

Dick pulled his battered multimeter across the bench towards him, and looked up at the Serviceman expectantly.

"Some simple voltage checks would be in order," stated Smithy. "Let's first locate the video output transistor on the printed board."

He studied the service manual and then pointed to the transistor on the printed circuit board. Dick clipped the negative test lead of his meter to the receiver chassis, then switched on the television set.

"Check the voltage on the base of the video output transistor," said Smithy. "It should be somewhere between 4 and 5 volts positive of chassis." (Fig.5(a).)

"Okeydoke, Chiefy!"

"And don't keep calling me 'Chiefy'," said Smithy irritably. "What voltage are you getting?"

Dick glanced down at his meter.

"Just under 5.5 volts."

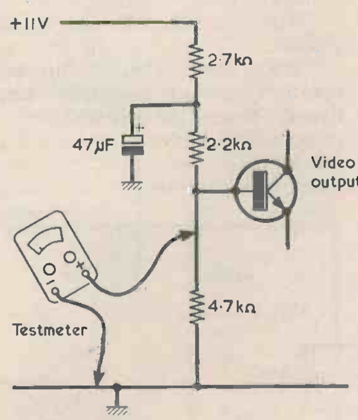
"Humph," grunted Smithy. "That seems to be a bit high. Try the emitter."

"Right-ho, Skip!"

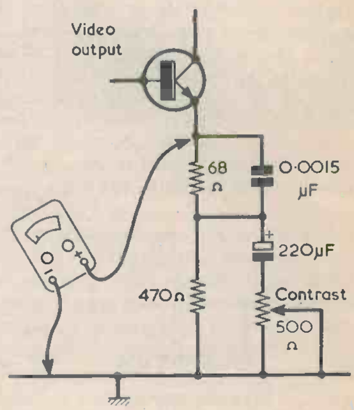
Dick applied the positive test prod to the emitter and checked the voltage reading. (Fig.5(b).)

"Just over 5 volts," he announced.

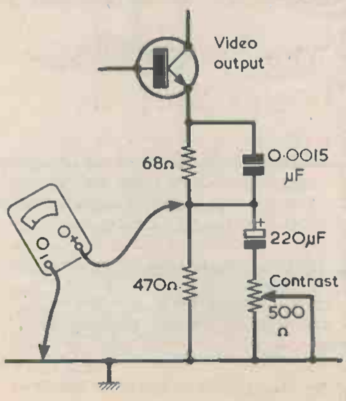
"There's something fishy here," stated Smithy. "That output tran-



(a)



(b)



(c)

Fig. 5(a). Dick first checked the voltage on the base of the video output transistor

(b). The next voltage check was at the video output emitter

(c) The final test, which located the position of the fault

sistor is a silicon type, and if it's passing any significant emitter current there should be at least a good 0.5 volt drop from its its base to its emitter. Try the junction of the 68 Ω resistor and the 470 Ω resistor." (Fig.5(c).)

"I'm doing that right now, Skip!"

"And what reading do you get?"

Dick grinned.

"Precisely zero."

"Ah, then that's the snag," said Smithy happily. "The 68 Ω resistor must have gone open. Just for the fun of it, check the voltage on the video output collector. You'll need to select a higher voltage range on your meter because, if my guess is correct, that collector will be sitting at the same voltage as the positive supply."

And, indeed, when Dick applied his positive test prod to the video output collector he obtained a voltage reading not noticeably different from the 105 on the output on the video output position supply rail.

BACK TO NORMAL

"A very nice easy snag," commented Smithy. "I *thought* that that base voltage was a bit high. Since the emitter circuit of the transistor was open it wasn't drawing any base current, whereupon the base voltage was simply the unloaded voltage given by the potential divider consisting of the 2.7k Ω, 2.2k Ω and 4.7k Ω resistors in series. And, since the transistor wasn't drawing any emitter current it obviously wasn't drawing any collector current either. Just do a simple ohmmeter check on that 68 Ω resistor, Dick, and check that there's nothing silly like an open-circuit solder joint to one of its leads, or anything like that, and then replace it. Okay!"

"Whatever you say, Skip!"

"And for goodness sake," grated Smithy, "stop referring to me as 'Skip'. You make me sound like something left out in the street to put old mattresses in!"

"Well," protested Dick innocently, "you don't want me to call you 'Smithy' because you reckon it's too familiar, and then you get your guts in an uproar whenever I call you anything else."

"That's because you choose such outlandish names," retorted Smithy. "Oh well, anything for a quiet life. You'd better go back to the old ways after all."

"Right you are," responded Dick with alacrity, *"Smithy!"*

As Dick carried out the few remaining checks on the 68 Ω resistor, Smithy failed to observe the fleeting smile which passed over his assistant's face as he bent over the printed board. In any event, Smithy was gloomily preoccupied with the thought that 1979 was promising to turn out much the same as 1978, 1977 and all the preceding years so far as the behaviour of his assistant was concerned.

His spirits rose, however, when Dick returned with a new 68 Ω resistor, soldered it into circuit and switched on the television set again. After the tube cathode had warmed up, this now displayed an impeccable picture.

"Another job done," chortled Dick. "Now let's recap a minute. You were referring to the voltage on that potential divider feeding the base of the video output transistor, weren't you? You said that it was high, at 5.5 volts, when there was no base current."

"Yes," said Smithy unguardedly.

"Let me work out the actual voltage on my calculator."

"As you wish," said Smithy, "although the question of that voltage is pretty academic now. Well, the bottom resistor in the potential divider is 4.7k Ω and the two above it are 2.7k Ω and 2.2k Ω. The supply voltage in that part of the circuit is 11 volts, and so the voltage across the 4.7k Ω resistor when no base current is drawn should be 11 volts multiplied by 4.7 and divided by the sum of 4.7, 2.7 and 2.2."

"Okay Smithy," said Dick confidently. "I'll soon have this little lot worked out."

"Two significant figures will be enough."

"Right-ho, Smithy."

Dick proceeded to tap the keys of his calculator. Despite his earlier comments, Smithy found himself increasingly intrigued by the possibilities offered by a calculator for even such simple computations as the one in which Dick was engaged.

"Here we are, Smithy."

"What's the answer?"

"30 volts!"

Smithy groaned.

1979 was going to be *precisely* the same as 1978, 1977 and all the preceding years. ■

The "6S3T" Short Wave Receiver

In the opening paragraph of this article in the December 1978 issue, reference was made to an earlier receiver project designed by Sir Douglas Hall. Due to an editorial error it was stated that the earlier receiver employed silicon transistors whereas, in fact, it used micro-alloy germanium devices. The construction of the present receiver is not, of course, affected by this matter. The value of C8, omitted from the Components List, is 1,000μF 10 V. Wkg.

SHORT WAVE NEWS
FOR DX LISTENERS

Times = GMT   *Frequencies* = kHz

• BRASIL

Radio Emisora Rural, Santarem, on **4765** at 0130, OM's with a discussion in Portuguese. The schedule is from 0800 to 0400 and the power is 10kW.

Radio Ribamar, Maranhao, on **4785** at 0139, OM with a sports commentary in Portuguese, the schedule of this one being from 1100 through to 0400 and the power is 5kW.

Radio Borborema, Campina Grande, on **5025** at 0147, OM with the same sports commentary as above, in Portuguese of course. The schedule is from 0830 to 0500 and the power is 1kW. If you are listening for this one be careful, the frequency can vary down to **5023** and it sometimes identifies as "A Princesa do Sul". Also, at a slightly later time, this one can get mixed with the Peruvian Radio Quillabamba on the same channel.

Radio Education do Para, Belem, on **5045** at 0149, OM announcer with records of local pop music. The schedule is from 0900 to 0600 and the power is 10kW.

Radio Nacional, Boa Vista, on **4835** at 0310, OM with a political talk in Portuguese. The schedule is from 0900 to 0300 but has been logged here as late as 0400 when closing. The power is 10kW.

Radio Brasil Central, Goiania, on **4985** at 0110, OM with announcements in Portuguese, Latin American type music. This one operates on a 24-hour basis and the power is 5 kW.

Radio Difusora de Macapa, Macapa, on **4915** at 0005, OM with a newcast in Portuguese. The schedule is from 0850 to 0300 and the power is 10kW. Sometimes also identifies as "Aqui Difusora".

Radio Timbira, Sao Luiz, on a measured **4976** at 2120, OM with a political speech in Portuguese. The schedule is from 0700 to 0430 and the power is 2.5kW. This one has been reported closing as late as 0600 on occasions.

• PAKISTAN

Radio Pakistan, Karachi, on a measured **4732.5** at 0027, OM with a talk about local affairs in English. This is the Home Service scheduled from March to August from 1400 to 1810 and 0045 to 0400; November to February from 1400 to 2000 and 2345 to 0415. Foreign Service link to Islamabad from March to October in English from 1815 to 1845 and from 2345 to 0045; in French from 1900 to 2000. The power is 10kW.

• ZAMBIA

Lusaka on a measured **4911** at 1832, OM's with a discussion in vernacular. This is the Home Service which operates in both English and vernaculars from 0345 (Sunday from 0440) to 0530 and from 1400 to 2015 (Saturday until 2115). The power is 50kW.

• KENYA

Mombasa on **4950** at 1839, OM's with a discussion in vernacular. Not often reported, this one transmits from 0330 to 0500 and from 1400 to 1935 on weekdays only. The power is 10kW.

Nairobi on a measured **4934** at 0305, religious service in English after opening of transmission. This is the National Service which operates from 0300 to 0630 and from 1310 to 2115. The power is 100kW.

• CAMEROON

Radio Bertoua on **4750** at 0432, OM song in vernacular with guitar-type instrumental accompaniment. The schedule is from 0430 to 0730, 1630 to 2200. There is a programme in English from 1830 to 1845 and the power is 20kW.

• MALAWI

Blantyre on **3380** at 1948, OM and YL with a discussion in vernacular. The schedule is from 0245 to 0520 (April to October closes at 1110 and reopens at 1300); from 1745 to 2210. The power is 100kW.

• GHANA

Accra on a measured **3366** at 1955, OM with local sports and football results in English in the Domestic Service 2nd Programme (in English) scheduled from 0530 to 0805 (Saturday and Sunday until 0900) and from 1600 to 2305. The power is 10kW.

• LIBERIA

Monrovia (ELWA) on a measured **3226** at 2002, local-type African music and songs in vernacular. This is the Home Service (in vernaculars) scheduled from 0610 to 0800 and from 1805 to 2220. The poweris 10kW and the station is listed on **3227**.

• ANGOLA

Radio Nacional, Luanda, on **3375** at 2357, Portuguese-type music, YL with announcements, identification as "Radio Nacional", National Anthem and off at 2400. The schedule is from 0400 (Sunday from 0430) to 0800 and from 1530 to 2400. The power is 10kW.

● **EGYPT**
Radio Cairo on **12005** at 1830, OM with identification and world news in Arabic in the Domestic Service General Programme, scheduled here from 1800 to 2355.

● **AUSTRALIA**
ABC Brisbane on **4920** at 1940, OM with announcements in English, pops on records. This one operates from 1900 (Sunday from 1930) until 1402 and the power is 10kW.

● **CHINA**
Radio Peking on **7935** at 2000, 'East is Red' on chimes in the opening of the Domestic Service 1st Programme, 5 pips time-check, identification in Chinese by YL, orchestral and choral 'East is Red'. The schedule on this channel is from 2000 to 1735.
Radio Peking on **6790** at 1853, YL in Standard Chinese to Taiwan, scheduled here from 1226 to 1900 and from 2000 to 2314.
PLA Fukien Front on **4330** at 1845, OM in Standard Chinese to Taiwan and Offshore Islands in the Network 1 Programme, scheduled here from 1414 to 2400.
PLA Fukien Front on **4380** at 1845, OM in Amoy to Taiwan and Offshore Islands in the Network 2 Programme, scheduled from 1400 to 1900 and from 0230 to 1512.
Urumchi on **4110** at 0010, YL with songs in Chinese, local classical music in a relay of the Peking Domestic Service. The schedule is from 2300 to 1730.
CPBS Peking on **4800** at 2105, YL in Chinese in the Domestic Service 1st Programme, scheduled here from 2000 to 0100 and from 1100 to 1735.

● **ALBANIA**
Tirana on **11845** at 1820, YL with identification, OM with a talk in the Spanish programme for Europe, scheduled from 1800 to 1830.

● **CZECHOSLOVAKIA**
Radio Prague on **11990** at 1813, OM with pop records in the English programme intended for Africa, scheduled from 1730 to 1830.

● **HUNGARY**
Radio Budapest on **11910** at 1810, OM with a newscast in the Italian programme for Europe, scheduled from 1800 to 1830.

● **ROMANIA**
Radio Bucharest on **11705** at 0410, YL with the news in the English programme to North America, scheduled from 0400 to 0430.

● **USSR**
Radio Moscow on **11710** at 0414, YL with the English programme to North America and the West Coast, scheduled from 0330 to 0730.

● **CUBA**
Radio Havana on **11930** at 0427, OM with identification, YL with announcements in the English programme to the Americas, scheduled from 0330 to 0600.

● **SPAIN**
Madrid on **11920** at 1807, OM with a newscast in the Spanish programme for Europe, scheduled from 1300 to 1900 on this channel.

●**POLAND**
Warsaw on **11840** at 1803, OM with the Spanish programme for Europe, scheduled from 1800 to 1830.
Warsaw on **15120** at 1236, OM and YL with the English programme for Africa, scheduled from 1230 to 1300.

● **IRAN**
Tehran on a measured **15084** at 0315, YL announcer with a programme of European-type music in the Domestic Service, scheduled here from 0200 to 2030.

● **NORTH KOREA**
Pyongyang on a measured **6338** at 1950, OM with the French programme for the Near, Middle East and Africa, scheduled from 1900 to 2100.
Pyongyang on **6400** at 2009, OM with the programme in Korean to South Korea, scheduled from 2000 to 2130.

● **VIETNAM**
Hanoi on a measured **15009** at 1210, YL with the Japanese programme to Japan (where else!), scheduled from 1200 to 1300.

● **VATICAN**
Vatican City on **15120** at 0935, Mass to Europe, a programme which occupies much of the nearly mornings.

● **PORTUGAL**
Lisbon on **21700** at 0950, YL with the programme for Timor, Macao and Australia in Portuguese, scheduled from 0925 to 1055 and in parallel on **21735**.

● **SINGAPORE**
Radio Singapore on **5010** at 1520, YL with announcements in English, pops on records. This is the English Service scheduled from 1030 to 1630 and from 2230 to 2400.

● **CYPRUS**
BBC Limassol on **15420** at 0534, OM announcer with a programme of country and western music, in English, in a transmission presumably for Africa.

● **FINLAND**
Helsinki on **15265** at 1305, OM with the English programme for Europe, North America, the Far East and Australasia, scheduled from 1300 to 1325.

● **NOW HEAR THIS**
Clandestine "Radio Freedom of South Yemen" on a measured **9953** at 1750, Arabic music and songs, at 1800 military music followed by a political harangue against the S. Yemen (Aden) Government. The schedule is from 1130 to 1430 and from 1600 to 1900 and in parallel on **5345**.

NEW L.F. SIGNAL ANALYZER

By Michael Lorant

Hewlett-Packard, of Palo Alto, California, has developed a new dual channel digital signal analyzer, the Model 5420A, to simplify noise and vibration measurements and to make low frequency signal and spectrum analysis faster and easier.

Mechanical applications of the analyzer, when used in conjunction with suitable transducers, include the study of noise and vibration associated with mechanical structures and components. Closed-loop servo systems and process control equipment can also be rapidly examined and their characteristics evaluated.

The new Hewlett-Packard Model 5420A Digital Analyzer in operation. Here it is determining the control system characteristics of a disc memory

Electronic applications include spectrum and network measurements such as transfer functions, modulation index, non-linear distortion, power, phase and signal-to noise ratio. These measurements are valuable in the design and production of audio and telecommunication equipment.

The analyzer has absolute internal calibration in the user's choice of engineering units, digital storage of both data and measurements on a tape cartridge, and a random noise source to provide test stimuli. All information pertaining to measurements is available at one easy-to-read location.

Processing features include operators to convert between mechanical acceleration and velocity or displacement, to measure frequency and damping of a resonance, and to compute power in any band or in the harmonics of a fundamental. A four-function "waveform calculator" provides easy data comparisons as well as more advanced computations such as coherent output power, open-loop gain and signal-to-noise ratio.

Operating over a 25kHz bandwidth the Model 5420A analyzer has a dynamic range of 75dB, and resolution to at least 0.004Hz can be achieved anywhere in the frequency range. Over the lower 250Hz of its range, the device can provide resolution to as fine a level as 20μHz. Closely coupled vibration modes and phase noise close to a fundamental frequency are accurately identified and measured.

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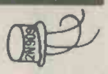

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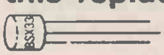

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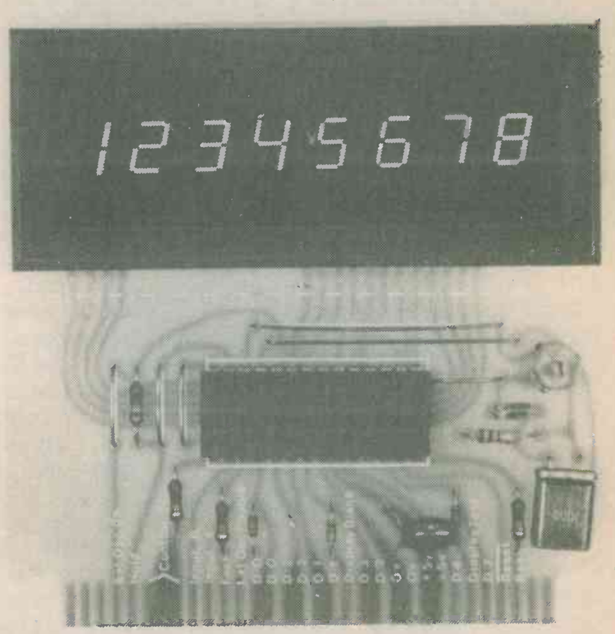
New Products

8 DIGIT UNIVERSAL COUNTER-TIMER



An 8-digit counter/timer introduced by Lascar Electronics of Module House, Billericay, Essex is claimed to perform all the major counting and timing functions. The module can measure frequency from 0-10MHz, period from 0·5 micro-seconds to 10 seconds, frequency ratio between two inputs, time intervals in increments of 0·1 micro-seconds, and can also function as a normal 8-digit totaliser Mode Selection is by a single external switch.

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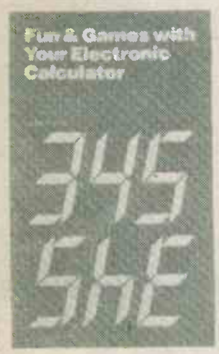

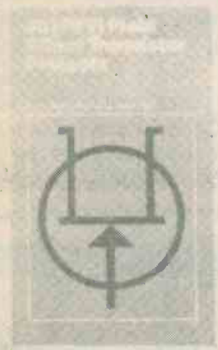

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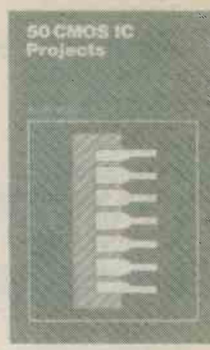

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