OCTOBER 1982

ISSN 0262—2572

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RADIO & ELECTRONICS WORLD

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1ST BIRTHDAY ISSUE

GaAs FET PRE-AMPS

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DNR FOR VIDEO RECORDERS

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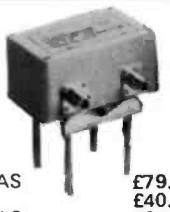

GASFET MASTHEAD PREAMPS

D70c 70cm	£500	D200:300 FM 600W PEP	£495	VV700GAAS	£79.00
D200C 125W FM 190W PEP	£295	D200S 400 + FM 1kW PEP	£600	VV2GAAS	£40.00
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These are high power 240V linears using 4C x 150 or 4C x 250 or 4C x 350 Eimac Tubes NOT using the grounded Grid system.
Fully protected, no thermal damage to PA finals possible.

171

Powered by the linear or with separate interface.
0.7 - 0.9dB signal to noise
0.2dB insertion loss
3SK97 GASFET **Available separately £4.50**

ICOM 173

HF TRANSCEIVERS

IC730 200W	£586.00
IC2KL 500W linear	£839.00
IC2KLPS Power Supply	£211.00
IC AT100 100W auto A.T.U.	£249.00
IC AT500 500W auto A.T.U.	£299.00

ACCESSORIES

BP5 IIV Pack	£30.15
BP4 Empty case for 6XAA	£5.80
BP3 STO Pack	£15.50
BP2 6V Pack	£22.00
DC1 12V adaptor	£8.40
WM9 Mic speaker	£12.00
CP1 Mobile Charging load	£3.20
LC1/2/3 cases	£3.50
BC30 base charger	£39.00
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YAESU 176

FT1	P.O.A.
FT902	P.O.A.
FT101ZD/F/A	P.O.A.
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FT708 70CMS Portable	£200.00
FT290 2MTR Portable	P.O.A.
FT480 10W 2MTR	£325.00
FT230 25W 2MTR	£210.00

Accessories avail. for all above.
Sommerkamp available.

TRIO/KENWOOD 174

TS930S	POA
TS830S HF Transceiver	£680.00
TS130S HF Transceiver	£530.00
TR8400 UHF mobile	£320.00
TR9500 UHF Multimodal	£440.00
TR7800 VHF mobile	£250.00
TR7850 HP FM 2m	£295.00
TR7730 2m FM	£230.00
TR9130	£380.00
TS530S HF Transceiver	£520.00
TR2500 2m Portable	£200.00

Many Trio/Kenwood accessories avail.

FULL RANGE OF TET AVAIL. 184

SQ22 16dB 144MHz	£55.00
SQ22DX4 19dB 144MHz	£99.00

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HB34D	£200.00
HB35T	P.O.A.
HB33SP	£185.00

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MMA 144V 2m Preamp	£34.90
MML 144/25 RF AMP	£59.00
MML 144/40	£77.00
MML 144/100S New with Preamp	£129.95
MMT 432/144 2-70 Transverter	£184.00
MMT 28/144 10m Transverter	£99.00
MMS1 Morse Talker	£115.00

MM4000 RTTY – See it working at our shop; inc.keyboard:– £299.00
Full range stocked

STANDARD 178

CPB 58	£79.50
CPB 78	£67.50
C78 70cm Portable	£219.00
C58 2mtr. Port ssb/FM	£239.00
CM88 Mounting tray	£19.95
CL8 Carry case	£6.95
Battery charger	£7.95
Set Nicads.	£11.00

ROTATORS ETC 182

DIAWA

DR7600X	£135.00
DR7600R	£144.00
DR7500R	£105.00

KENPRO

KR250	£44.00
KR400	£90.00
HAM IV	£189.00
CHANNEL MASTER 9502	£50.00
CN620 1.8–150MHz Pwr/swr	£52.00
CN2002 2.5 KW PEP auto ATU	£190.00

OATONG 183

PCI G/C converter HF on 2mtr	£120.75
VLF very low frequency converter	£ 25.30
FL1 frequency agile audio filter	£ 67.85
FL2 multimode audio filter	£ 89.70
ASP/B auto RF speech processor (Trio)	£ 79.35
ASP/A auto RF speech processor (Yaesu)	£ 79.35
D75 manually controlled RF Sp/Processor	£ 56.35
RFC/M RF speech clipper module	£ 26.45
D70 Morse tutor	£ 49.45
AD270 indoor active antenna	£ 37.95
AD370 outdoor active antenna	£ 51.75
MPU1 PSU for above	£ 6.90

+ Full range stocked

CUSHCRAFT ANTENNA 179

HF,A3 20/15/10 3 ele beam 8bD	£170.00
AV3 20.15.10 Trapped vertical	£39.95
AV5 10.15.20.40.80 Trapped vertical	£84.95
214B 14 ele boomer 05.2dB	£59.95
ARX 2B Ring Ranger 6dB vertical	£32.00
CS100 Speaker	£13.50
A144.44 ele Yagi	£18.25
A144.11 11 ele Yagi	£29.95
ARX2K Conversion Kit	
RINGO Mk I to RINGO MkII	£14.18
144 - 10T Yagi	£38.95
144 - 20T Yagi	£55.00
147 - 20T	
144 - 146 Yagi	£55.00

TONNA ANTENNAS

144MHz	
4 ELE	£13.00
9 ELE X	£30.00
9 ELE Portable	£30.00
9 ELE Fixed	£16.00
13 ELE Portable	£29.00
16 ELE Fixed	£33.00
435MHz	
19 ELE	£19.00
19 ELE	£30.00
21 ELE	£27.00
21 ELE ATV	£27.00
144/435 OSCAR	£31.00
1296 23 ELE	£27.00
Power Divider 4 x 23	
Stacking Frame	£160.00

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R1000	Trio/Kenwood
FRG7	Yaesu
FRG7700	Yaesu
FRG7700	Memory
FRA7700	Active Antenna
FRT7700	Tuner
FRV7700	A/B/C/D/E Convertors
C2001	inc. M/Adaptor £148.00
Sony ICF2001	£140.00
Mickey/Maximal Scanning Receiver	185

POA PHONE HOT LINE 01-556 1415

£89.95 avail.Oct.

ICOM PORTABLES 175

IC2E FM 2m	£159.00
IC202 SSB	£169.00
IC402 70cm	£242.00
IC4E FM 70cm	£199.00

All accessories available – see below

ICOM MULTIMODES 180

IC251 2m	£495.00
IC451 70cm	£630.00
IC290 2m	£366.00

ICOM FM MOBILES 181

IC24G	£165.00
IC25E	£235.00

ICOM 720A G/C 186

IC720A 200W	£883.00
PS15 Power Supply	£99.00
PS20P/S with speaker	£130.00
IC730 200W	£586.00

ALL ACCESSORIES AVAILABLE – PLUGS SKTS CO-AX 2MTR COLINEAR £31.50, 70CM COLINEAR £31.50

Access

PRICES INCLUDE VAT AT THE PRESENT RATE OF 15%
OPEN MON–FRIDAY 9:00–5.30. SATURDAY 10:00–3:00. INSTANT HP FACILITY AVAILABLE
EASY ACCESS M2–M11–M1 NORTH CIRCULAR ROAD–EASY PARKING

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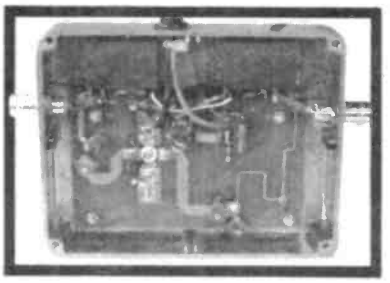
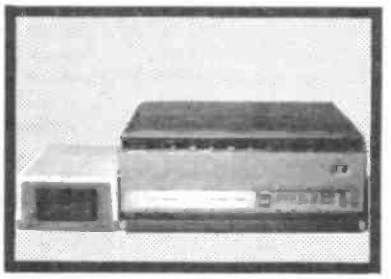
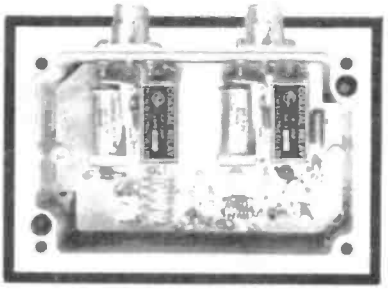
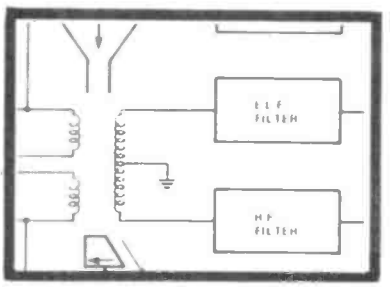
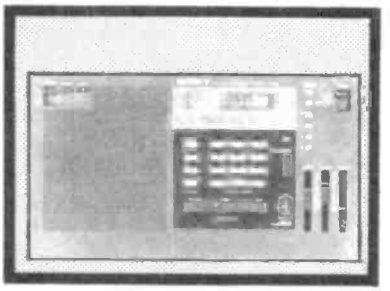
247 for further details











R&EW

OCTOBER 1982

Volume 2 No. 1

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The professional

IC-Rx70. The very latest from Icom!

The New Rx 70 receiver from Icom is designed to provide a really stunning performance at a price not much greater than its inferior competitors.

It covers all modes (when the FM option is included), uses 2 CPU – driven VFO's for split frequency working, has 3 IF frequencies – 70MHz, 9MHz and 455KHz and a dynamic range of 100dB.

Other features are:-
Input switchable through a pre-amplifier, direct or via an attenuator.
Selectable tuning steps of 1KHz, 100Hz or 10Hz.
Adjustable IF bandwidth in 3 steps (455KHz)
Noise limiter. Switchable AGC. Tunable notch filter.
Squelch on all modes. RIT. Tone control.
Tuning LED for FM (discriminator centre indicator)
Recorder output. Dimmer control.
Separate antenna sockets for LW-MW with automatic switching.
Large front mounted loudspeaker - 5.8W output.
Frequency stability 1st hour ± 250Hz, thereafter ± 50Hz, sensitivity -SSB/CW/RTTY better than 0.32 µv for 12 dB $\frac{S+N}{N}$.
Am – 0.5 µv, FM better than 0.32 for 12 dB Sinad.
Built in mains supply – DC optional.
Size 286mm x 110mm x 276mm – weight 7.4Kg.

IC-25E, The Tiny Tiger £239.inc.

Amazingly small, yet very sensitive. Two VFO's, five memories, priority channel, full duplex and reverse, LED S-meter, 25KHz or 5KHz step tuning. Same multi-scanning functions as the 290 from mic or front panel. All in all the best 2M FM mobile ICOM have ever made.

Remember we also stock Yaesu, Jaybeam, Datong, Welz G-Whip, Western, TAL, Bearcat, RSGB Publications.

Agents (phone first – all evenings and weekends only, except Scotland).
Scotland – Jack GM8 GEC (031 665 2420)
Midlands – Tony G8AVH (021 32 - 2305)
North West – Gordon G3LEQ (0565 4040 Ansafone available)

Introducing the NEW IC-740. £699.

This latest transceiver contains all the most asked-for features, in the most advanced solidstate HF base station on the amateur market...performing to the delight of the most discerning operator.

Study the front panel controls of the ICOM IC-740. You will see that it has all of the functions to give maximum versatility to tailor the receiver and transmitter performance to each individual operator's requirements.

Features of the IC-740 receiver include a very effective variable width and continuously adjustable noise blanker, continuously adjustable speed AGC, adjustable IF shift and variable passband tuning built in. In addition, an adjustable notch filter for maximum receiver performance, along with switchable receiver preamp, and a selection of SSB and CW filters. Squelch on SSB Receive and all mode capability, including optional FM mode. Split frequency operation with two built-in VFO's for the serious DX'er.

The IC-740 allows maximum transmit flexibility with front panel adjustment of VOX gain and VOX delay along with ICOM's unique synthesized three speed tuning system and rock solid stability with electronic frequency lock. Maximum versatility with 2 VFO's built in as standard, plus 9 memories of frequency selection, one per band, including the new WARC bands.

With 10 independent receiver and 6 transmitter front panel adjustments, the IC-740 operator has full control of his station's operating requirements.

See and operate the versatile and full featured IC-740 at your authorized ICOM dealer.

Options include:
- FM Module
- Marker Module
- Electronic Keyer
- 2 - 9MHz IF Filters for CW
- 3 - 455MHz Filters for CW
- Internal AC Power Supply

Accessories.
- SM5 Desk Microphone
- UP/DWN Microphone
- Linear Amplifer
- Autobandswitching Moblie Antenna
- Headphones
- External Speaker
- Memory Backup Supply
- Automatic Antenna Tuner

Ask about the new range of CUE DEE antennas, the winners in recent tests!

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double act

Thanet ICOM Thanet ICOM

The World's most popular portables IC-2E £159. IC4E £199.inc. and now the marine version IC-M12 £199+VAT.

Nearly everybody has an IC-2E, the most popular amateur transceiver in the world, now there is the 70cm version which is every bit as good and takes the same accessories.

Fully synthesized – Covering 144-145.995 in 400 5KHz steps. (430-439.99 4E). **Power output** – 1.5W. **BNC antenna** output socket. **Send/Battery indicator. Frequency selection** – by thumbwheel switches, indicating the frequency. 5KHz switch-adds 5KHz to the indicated frequency. **Duplex Simplex switch** – gives simplex or plus 600KHz or minus 600KHz transmit (1.6MHz and listen input on 4E). **Hi-Low switch** – 1.5W or 150mW. **External microphone jack. External speaker jack.**

The IC-4E is revolutionising 70cm!

Multimode Mobiles IC-290E £366. IC-490E £445.inc.

290E-144-146 MHz/490E-430-440 MHz. 10 W RF output on SSB, CW and FM. Standard and non-standard repeater shifts. 5 memories and priority channel.

Memory scan and band scan, controlled at front panel or microphone. Two VFO's. LED S-meter. 25KHz and 1KHz on FM – 1KHz and 100KHz tuning steps on SSB. Instant listen for repeaters.

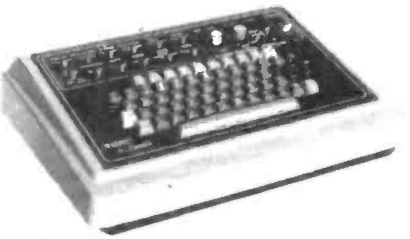
IC-720A Possibly the best choice in HF. £883.inc.

One way of keeping up with rapidly advancing technology is to look at what the IC-720A offers in it's BASIC form. How many of it's competitors have two VFO's as standard, or a memory which can be recalled, even when on a different band to the one in use, and result in instant retuning AND BANDCHANGING of the transceiver? How many include really excellent general coverage receiver covering all the way from 100KHz to 30MHz? How many need no tuning or loading whatsoever? and take care of your PA, should you have a rotten antenna. How many have an automatic RIT which cancels itself when the main tuning dial is moved? How many will run full power out for long periods without overheating? How many have band data output to automatically change bands on a solid state linear AND an automatic antenna tuner unit?

The IC-720A may be just a little more expensive than some, but it's better than most! Make your choice an IC-720A.

IC-PS15 Mains PSU £99.

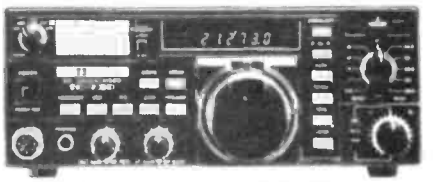
Tono RTTY and CW computers 7000E £500. 9000E £650.inc.



The TONO range of communication computers take a lot of beating when it comes to trying to read RTTY and CW in the noise. Others don't always quite make it!

Check the many facilities offered before you buy – especially look at the 9000E which also throws in a Word Processor. Previous ads have told you quite a lot about these products – but why not call us for further information and a brochure?

IC-730 The best for mobile or economy base station £586.inc.



ICOM's answer to your HF mobile problems – the IC-730. This new 80m–10m, 8 band transceiver offers 100W output on SSB, AM and CW. Outstanding receiver performance is achieved by an up-conversion system using a high IF of 39MHz offering excellent image and IF interference rejection, high sensitivity and above all, wide dynamic range. Built in Pass Band Shift allows you to continuously adjust the centre frequency of the IF pass band virtually eliminating close channel interference. Dual VFO's with 10Hz, 100Hz and 1kHz steps allows effortless tuning and what's more a memory is provided for one channel per hand. Further convenience circuits are provided such as Noise Blanker, Vox, CW Monitor APC and SWR Detector to name a few. A built in Speech Processor boosts talk power on transmit and a switchable RF Pre-Amp is a boon on today's crowded bands.

Great base stations IC-251 £499. IC-451 £569.inc.

ICOM produce a perfect trio in the UHF base station range, ranging from 6 Meters through 2 Meters to 70 cms. Unfortunately you are not able to benefit from the 6m product in this country, but you CAN own the IC-251E for your 2 Meter station and the 451E for 70 cms.
Mains or 12 volt supply.
SSB, CW and FM.

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143 Reculver Road, Herne Bay, Kent.
Tel: 02273 63859

BARCLAYCARD VISA

Trade enquiries welcome.

229 for further details

DATONG
NEW PRODUCT

MODEL FL3·A NEW AUDIO FILTER WITH AUTO-NOTCH

A NEW AUDIO FILTER FROM DATONG MODEL FL3

Model FL3 gets it all together! It combines all the power of the FL2 which continues in production with a remarkable new automatic notch filter - a concept which we pioneered with our FL1.
In one stylish case Model FL3 offers the complete solution to receiver audio processing. We believe that such a powerful combination of filtering capabilities has never been offered before in one package.

NOTCH FILTER SCANS CONTINUOUSLY

User of our FL1 will confirm the practical advantages of an automatic notch filter. With absolutely no help from you the operator the automatic notch tirelessly scans the receiver's audio output until a continuous audio tone is received. When it is the notch filter locks on and removes it. If the tone changes in frequency the auto-notch follows.

SHOOTS DOWN TUNE-UP WHISTLES AND HETERODYNES

Imagine the benefits. A tune-up whistle no longer causes any problem; after a second or two it simply drops out of ear shot. Those tiresome whistles that occasionally descend on a QSO become a thing of the past. Only the "LOCK" lamp on the FL3's panel reminds you of what you are thankfully missing.

PLUS LOW PASS, HIGH PASS AND MANUAL NOTCH

While all this is happening you still have three other independent filters at your disposal. Imagine, for example that another SSB station starts up 2 kHz high. Instead of trying to copy through all that high-pitched monkey chatter simply wind down the low-pass filter (the right hand knob) and wipe it out.
Then perhaps a teleprinter starts up 300 Hz above your carrier frequency; a touch on the high-pass filter knob (the middle one) cures that.
Finally maybe a second whistle appears. Since the auto-notch is busy, just bring in the manual notch as well and tune it out (left hand knob).

PHENOMENAL SKIRTS WINKLE OUT CW

For CW and RTTY the low-pass, high-pass and manual notch filters combine to give a 12 pole fully variable filter with remarkable skirt selectivity. Compared with lesser filters you can use a much wider bandwidth for a given interference suppression - this makes tuning easier and reduces ringing effects.

ATTENTION FL2 OWNERS!

At Datong we don't believe in "planned obsolescence". There's no need to throw away your FL2 to get an FL3. Instead you can convert it to an FL3 using our conversion unit, Model FL2/A.
This is a fully assembled PCB module with its own board-mounted "IN/OUT" switch and "LOCK" lamp. Installation involves four soldered connections to the existing FL2 PCB and one track cut.
Model FL2/A is also suitable for building into other equipment where an automatic notch function is required.

FREE HARDWARE KIT

As an introductory offer Model FL2/A will be supplied complete with a punched and printed FL3 front panel to replace the FL2 panel, plus PCB mounting hardware.

TECHNICAL REPRINT OFFER

The filtering in Model FL2 and now in Model FL3 has been carefully conceived to give maximum possible benefit in real life reception conditions. The thinking behind the product design has been described in depth by the designer, Dr D A Tong in "Ham Radio", November 1981. A limited number of reprints of the article are available free on request.

PRICES

All prices include delivery in U.K. basic prices in £ are shown with VAT inclusive prices in brackets

FL3	112.50	(129.37)	AD370	56.00	(64.40)	RFA	29.50	(33.92)
FL2/A	34.50	(39.67)	AD270 + MPU	45.00	(51.75)	Codecall (Linked)	28.00	(32.20)
FL1	69.00	(79.35)	AD370 + MPU	60.00	(69.00)	Codecall (Switched)	29.50	(33.92)
FL2	78.00	(89.70)	MPU	6.00	(6.90)	Basic DF System	149.00	(171.35)
PC1	119.50	(137.42)	DC144/28	34.50	(39.67)	DF System	159.00	(182.85)
ASP	72.00	(82.80)	DC144/28 Module	28.00	(32.20)	Complete Mobile DF System	214.00	(246.10)
VLF	26.00	(29.90)	Keyboard Morse Sender	119.50	(137.42)			
D70	49.00	(56.35)						
D75	49.00	(56.35)						
RFC/M	26.00	(29.90)						
AD270	41.00	(47.15)						

See previous advertisement or price list for further details.

DATONG ELECTRONICS LIMITED

ALL DATONG PRODUCTS ARE DESIGNED AND BUILT IN THE U.K.

Data sheets on any products available free on request – write to Dept S.W.

DATONG ELECTRONICS LIMITED

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LSG Printers, Lincoln

Photosetting by
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INFORMATION

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Back Issues: £1 each inclusive of postage from Subscription Dept, or send reply paid card with cheque or PO.

Comment

ONE FOR ALL

We have been rather surprised to see just how many readers have accepted our coverage of video with interest and enthusiasm. It has always been our aim to cover the entire gamut of the electronics scene - and whilst the VCR is invading British homes faster than those of any other land, we thought we had better take a closer look.

The availability of good, full-feature VHS and Beta machines for under £300 is clouding the once reasonably clear-cut issue of rent versus buy, so perhaps it is more pertinent to have a technician's view of the available machinery.

We hope that the content of each issue is providing roughly the sort of balance of topics and information that *you* want. Watch this page in future for the 'overall' rating numbers.

ALL FOR ONE

Despite our protestations, we *still* get to hear comments to the effect that **R&EW** is strictly written and devised 'in house', implying that we are not actually interested in external submissions.

Well, this really isn't so, and we are delighted to report that we have received a number of excellent external submissions recently that owe their very being to our sponsorship and assistance schemes.

Nevertheless, we can always use more - and we would remind you that we are still paying the best rates in the business for features and projects, as well as providing the best support for the development of basic ideas.

HAPPY BIRTHDAY TO US

After a year of **R&EW**, we think we all deserve a first birthday present. We've actually managed to negotiate the finest possible present for all of us - a substantial commercial investment that will permit us to consolidate and develop all aspects of **Radio & Electronics World**.

One of the first aspects to get the treatment is REWTEL, which goes firmly 'on-line' this Autumn and provides the backbone of the entire operation. You may not *yet* have the means of access to external REWTEL, but you will soon be able to feel the benefits of one of the most comprehensive and carefully considered implementation of the art....or at least one of the **R&EW** staff had better practise unblocking the drains.

Brideshead revisited ....

Some features from the past issues have been presented with rather scant explanation sections for the *non-cognoscenti*, and it is apparent from correspondance that there are many readers out there who would be grateful if we covered these in more detail. So, we shall be presenting a selection of the most asked-for items; but not merely re-runs with the spolling mistekes removed, and the polarity protection diodes drawn the correct way round, but colouring in more of the background, and bringing you up to date with all the latest developments and thoughts on the subject.

One of the first features to get the treatment includes the *real* CB set described early in the year, which has now been refitted with all the worthwhile corners cut off when it was considered expedient to try and compete with £35 rigs. Keith Mitchell's magnificent Airband receiver is being revisited with a much more comprehensive background description, and the Automatic modulation meter is being fitted into a neat case, and attired with a few more features.

If you have any special requests, please let us know, and we will take a vote on the choices.

Your reactions to the entire issue please circle:

Generally useful and informative 5
Interesting with some useful features 6
Pretty average 7
I was going to pick up Mayfair, but lost my nerve at the last minute, and bought this instead 8

NEW PRODUCTS

Mistaken Identity

The photograph of Hitachi's L-70 caused quite a stir when it reached the R&EW offices as, at first glance, we thought the VHD video disc player had made a sooner than expected appearance on the UK market. Not the case however for the L-70 is just a Hi-Fi turntable although a fairly stylish, linear tracking, computer controlled representative of the genre.

Nearly every operation on this turntable is automated and a microcomputer and opto electronic sensing device are used to control the wide range of functions that the turntable offers.

A linear tonearm eliminates two of the significant drawbacks of conventional offset tracking tonearms - 'tracking error' which can cause harmonic distortion and 'centripetal force' causing the stylus to be pulled towards the centre of the record, resulting in uneven wear on the stylus and record along with intermodulation distortion.

The HTL 70 linear tracking arm maintains an idea relationship between the arm support stylus and record surface - that is in effect tracking the groove exactly as it was originally cut. Tracking error is a negligible + or -0.1% and there is no need for clumsy anti skate device since inside force is non existent.

The HTL 70 uses a Hitachi quartz lock direct drive 'Unitorque' motor which ensures precise turntable rotation and high stability for genuine HiFi reproduction.

One of the many features of the HTL 70 is the digitally controlled track selection. Without having to handle the tonearm, any track on the record can be selected by simply pushing a button on the front panel. An opto electronic sensing system locates the gap between selections on the record and the tonearm is positioned and lowered into the right position automatically. A digital readout on the front panel shows which track has been selected and the turntable can be set to repeat a track midway through the disc or replay the entire side. The same opto electronic sensing and microcomputer control network also controls operation during normal playback of an entire record. The electronic control first assesses the record size and then sets the correct turntable speed automatically, followed by the tonearm leading in and lowering onto the record. At the end of the record the arm returns and the turntable motor is stopped automatically. Manual operation is also posssible.

The recommended retail price of the HTL 70 is £199 and will be available from Hitachi's network of dealers.

Low Cost Keyboard

Recently introduced by SMK is a new, ultra low cost, keyboard which utilises a 'rubber mat switch action' design and is capable of being produced to almost any customer specification.

Being currently incorporated within the new French Telecommunications directory system, this low profile style keyboard sits only 7m above the base plate and incorporates 2mm stroke keys requiring low operating forces, yet still providing tactile feedback.

Having a minimum life of 1 x 10^6 operations, maximum bounce of 5msec, and contact resistance of only 150ohms, the switching capabilities are 1mA at 5Vdc over an operating range of -10°C to +60°C.

Further details from:
SMK
14 Malcolm Road,
London SW19

Action Stations

Hand-held computer games still represent a bouyant market and various manufacturers are expanding their ranges in order to cash in on the Christmas market.

Actronics is a new name in this field and their range will initially be comprised of six models.

Monster Maze is Actronic's answer to the popular eat/energise type of game that goes further than the rest with joy stick control, four colour display, five skill levels and scoring up to 9,999. An optional extra is the main adaptor facility.

Featuring three skill levels, demonstration function and scoring up to 999 the TwinVader 3 is going to be another popular item in the Actronics range. Other Actronics games are: Cupid's Arrow, Fighting Climber (RSP both £15.00 - £16.00), Challenge Racer (RSP from £27.00), and Astro Attack (RSP from £30.00).

Already there are various new items being planned for launch at the end of this year, and future long-term plans will also include TV video games.

For further details of samples, stockists write to:
Barbara Riddell
Sadler, Little & Associates
18 Exeter Street
Covent Garden
London WC2

PMR Addition

Frank Cody Electronics Limited have introduced the Stentor FM 2-way Mobile Radio and Base Station to their growing range of PMR equipment.

The Stentor is a VHF mobile radio telephone suitable for industrial, commercial and public service applications. Compact and easy to use this new land mobile R/T has been constructed using corrosion resistant materials and the lastest modern circuitry technology. Two models are currently available - the FC1500 which operates on 150-174MHz and the FC720 which operates on 66-88MHz. Both units have an RF Power output of 25 watts and 6 channel capacity.

The Stentor can also be used as a Base Station when attached to an optional Base Station Power Supply Unit.

A number of important and unique features have been incorporated in the Stentor including a large LED channel display which lights automatically when additional channels are installed and only indicates those channels for which crystals have been fitted. There is an LED Channel Busy Indicator and an LED Transmit Power Indicator which will not function if there is a fault in the system.

Large recessed control switches are well spaced for easy control of volume squelch and channel functions the Stentor operates from a standard vehicle electrical system and is supplied complete with test crystals, first microphone, mounting bracket, hardware and users manual.

Frank Cody Electronics
Star House
Gresham Road
Staines
Middlesex TW18 2AN

NEW PRODUCTS

Distortion Meter

A valuable recent addition to the Philips range of audio servicing equipment is the PM 6309 - a distortion meter which produces fast automatic measurements to DIN specifications.

The instrument takes either third harmonic or total harmonic distortion readings, displaying them on an integral 3.5-digit LED display or on a simple analogue trend meter. The test signal is generated by a built-in oscillator with very low distortion.

Four fixed DIN-standard test frequencies are produced - 4, 333, 1000 and 5000Hz - all that is required for service applications. Output is on a front-panel connector with continuously adjustable output voltage from 1mV to 1V. The connector can be either BNC or DIN type (the latter particularly for use with recorders.

Input range can be selected from 200mV to 20V; input LEDs indicate the need to change range. With the DIN input, DIN levels 0.2 to 2V are selectable and it is possible to check either right or left channels.

The incoming signal is filtered to remove the first harmonic - the original signal - and distortion is indicated as a percentage of this harmonic. The measurement can indicate either the total harmonic distortion (normally at 40, 1000 or 5000Hz) or only the third harmonic distortion (particularly at 333Hz when used for cassette and tape recorder testing).

Resolution with the LED display is 0.01 per cent up to 19.9 percent distortion. The separate analogue meter allows adjustments such as setting minimum levels. The LED display can also function as an RMS voltage meter, which is very useful when setting, for example the gain of an amplifier to a required value.

A separate output on the rear of the instrument provides the distortion signal, i.e. the incoming signal minus the first harmonic, for any further analysis

The PM 6309 is almost entirely automated and thus particularly easy to use. It is virtually impossible to make operating mistakes. The meter can be used almost anywhere in the service field, but particularly in audio servicing for testing hi-fi equipment. Cassette and tape recorders, amplifiers and record players can all be checked quickly and easily, and the trend meter simplifies alignment of FM stages in stereo tuners. The PM 6309, together with the whole range of Philips audio, TV and radio test equipment, is marketed in the UK by Pye Unicam of Cambridge.

Further information from: *Pye Unicam Ltd., York Street, Cambridge CB1 2PX*

Getting a Grip

A set of four easi-grip miniature hand tools are currently available mail order from Electronic Hobbies Ltd.

The tools weigh approximately 40gms and are manufactured with ergonomically designed self-opening handles. Intended for fine modelling applications and for the electronics and telecommunications industries the tools are ideal for both industrial and hobby markets. The set includes a fine tweezer/plier, a miniature side cutter, a scissor (plain blade) and a serrated scissor shear - ideal for cutting fine wires, foil and card. Each tool costs £3.25 plus p&p at 45p VAT must be added to both the cost of the tools and p&p.

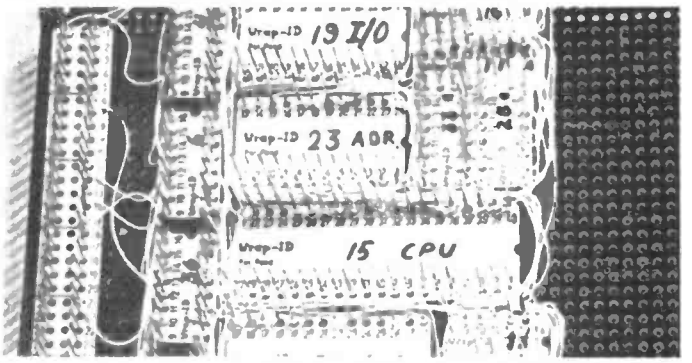
Electronic Hobbies Ltd
17 Roxwell Road
Chelmsford
Essex CM1 2LY

Identification Parade

OK have extended their popular Wrap -ID terminal identification system to cover virtually all standard pin configurations from 8 to 40.

Wrap -ID tags are plastic identification labels which can be slipped over DIP socket wire-wrapping terminals at the rear of the PCB. They have printed numbering corresponding to the DIP terminations as seen from the wiring side, and friction between holes in the labels and the terminals lock the DIP sockets in position until the first wrap is made. Component identification can be written on the labels. OK can also supply the DIP sockets with 8, 14, 16, 18, 20, 24, 28, 36, 40 pin configurations suitable for virtually all SSI MSI and LSI devices.

OK Machine & Tool (UK) Ltd
Dutton Lane
Eastleigh
Hants SO5 4AA



60MHz Scope

The new Kikusui COS 5060 scope has 60MHz bandwidth on each of its 3 vertical input channels, and dual timebase with a delay sweep function. Vertical input channels 1 and 2 offer sensitivity ranges from 5mV to 5V/DIV at full bandwidth and the "x 5 MAG" pre-amplifier gives 1mV/DIV sensitivity at 20MHz bandwidth.

Channel 3, which doubles as trigger view, has a sensitivity of 0.1V/DIV or 1V/DIV at 60MHz bandwidth. Channels, 1, 2 and 3 and the sum of channels 1 and 2 (ADD) can be displayed simultaneously, giving 4 traces or when used in a dual timebase alternate mode, 8 traces can be displayed.

Trigger may be selected from channel 1 or 2, or in the "VERT MODE" from channels 1 and 2 alternately, providing stable triggering even when the channel 1 and 2 input signals have no synchronous relationship.

Among other trigger characteristics are a new TV synch circuit to give precise observation of field and line TV signals. Variable trigger hold-off means that digital signals with complex repeat period relationships can be triggered stably, by a simple adjustment of the hold-off control. Level lock and HF REJ are also features of the 5060.

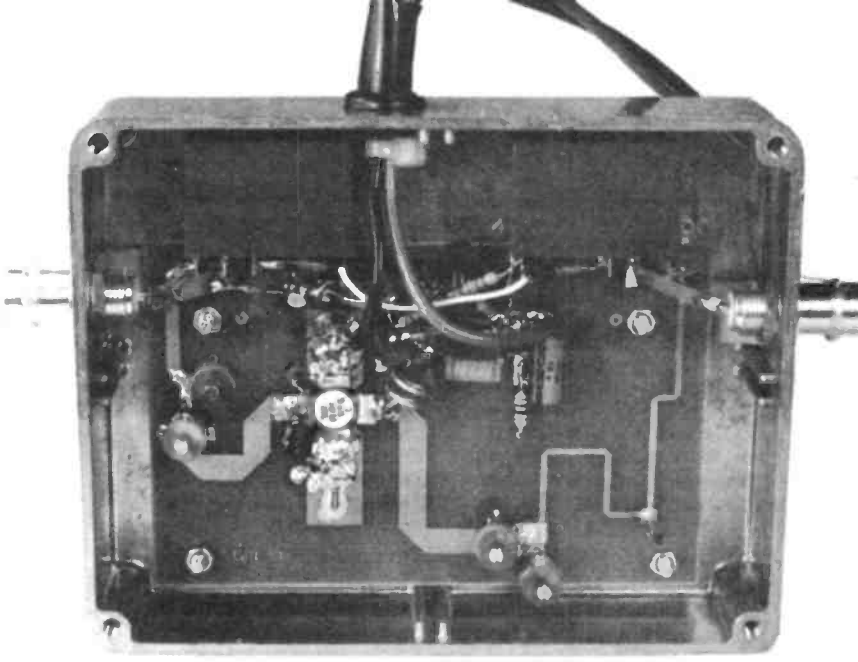
Separate A and B timebases cover sweep ranges from 0.05uS to 0.5S/DIV, and there is also a x 10 horizontal amplifier for a fastest sweep speed of 5 nanoseconds. Delay time is 0.5uS to 5S/DIV. The 5060 can be used in an XY format, either with channel 1 as X input and channel 2 as Y input or as a 2 channel XY display, with channels 1 and 2 as vertical inputs, and channel 3 as the horizontal input.

The 5060's CRT has a 12kV accelerating potential for high intensity display, and a new linear focus circuit ensures optimum trace sharpness. The CRT has an internal graticule for parallax- free operation.

The Kikusui 6060 oscilloscope is for use in general purpose applications like research and development, production test, and computer servicing. The instrument costs £735 plus VAT and including probes.

for further information contact:
Telonic Instruments
2 Castle Hill Terrace
Maidenhead
Berkshire

70CM 10W PA



A compact design for use with handheld transceivers.

Design by Graham Leighton.

THE CURRENT GENERATION of UHF handheld synthesised transceivers have almost all the facilities found in mobile/base tranceivers, the only major limitation being their output power.

For handheld operation 1 watt or so is adequate, but for mobile to mobile and for use with higher power repeaters,the additional power provided by the **R&EW** amplifier increases the range considerably. This is especially noticeable, as is to be expected, at the limits of the service area.

DESIGN CONSIDERATIONS

Given the 1-2W output of 70cm handheld tranceivers, the device that seemed most suited for use in the amplifier was a PT8811 from TRW. This is particularly so in view of its reasonable cost. Early tests with just the amplifier (no switching or filtering) showed that this transistor was capable of in excess of 10dB gain at 15W output at 13V8. The PT8811 is not specified as being DC safe. An attempt was made to linearise the amplifer, but it was found that unless the supply voltage,bias current and drive power are very carefully controlled thermal runaway followed by destruction of the device results. (It blows up).

In the final design the transistor is operated in class C. This has resulted in very stable operation despite the severe mistreatment meted out by **R&EW** personnel.

The harmonic output from class C transistor amplifiers is fairly high (The 2nd harmonic without a filter was -40dB relative to the fundamental). A two stage low pass filter reduces the harmonic content to below - 65dB relative to the carrier.

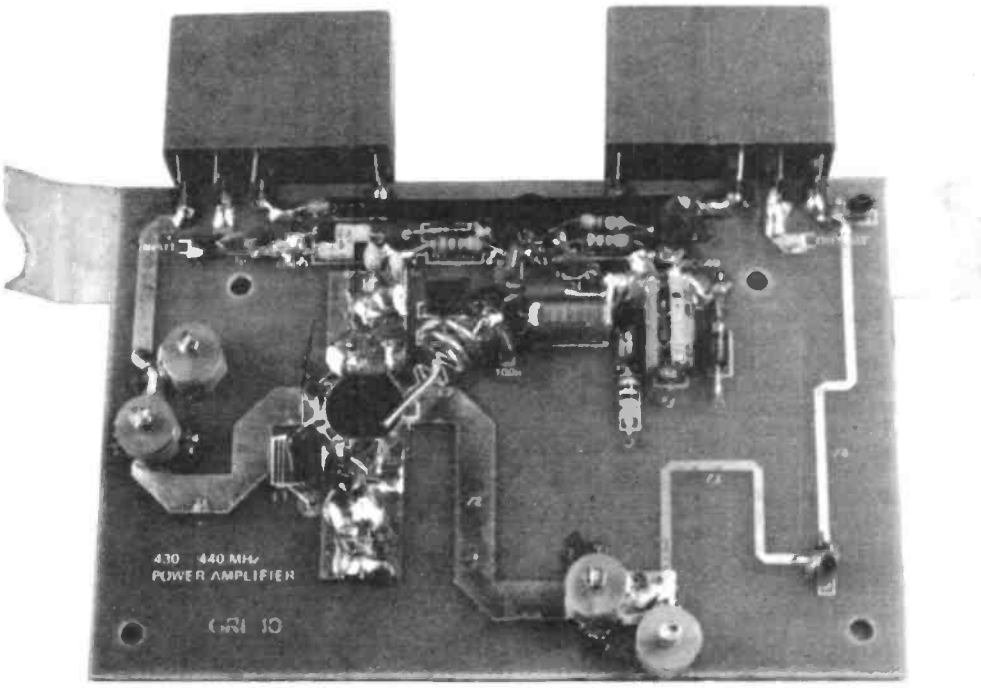


Photo 1: The PCB prior to final assembly into the case.

In order to reduce the number of possible errors during construction, all the critical inductors/transmission lines are printed on the PCB. There is some power loss in the PCB dielectric material but this does not present any problems in practice.

Several relays were tried. The best value for money turned out to be an OM1. The loss through the amplifier on receive is about 0.6dB, which under most circumstances, is not noticeable. The size and shape of the relay contacts is such that they seem to approximate to a 50R line. It was not thought to be worthwhile to include a receive preamplifier since the sensitivity of most modern tranceivers is adequate.

Very few problems occurred during the development of the RF stages. The switching, however, was a different matter.

Initially, using just a single transistor (even a Darlington), the change in the RF voltage sensed during the switching time of the relays was sufficient to cause the transistor to turn off. The result of this was that the relays 'chattered'. This was cured by the use of an extra stage of switching. The resulting circuit works well, its only drawback being experienced in the presence of very strong signals e.g., it will try to switch when the 70cm aerial is within three feet of a 100 watts ERP on 2m. It is unlikely that this will be a nuisance in practice.

CONSTRUCTION

WARNING: The PT8811 PA transistor contains berillium oxide, the dust of which is toxic.

Using the PCB as a template, drill the four fixing holes (3mm dia.). Make sure that there is enough room to mount the relays on the edge of the PCB. Reference to the photographs should make the required position clear. Bolt the PCB into the box and drill a 4.2mm hole for the pa transistor. This should be in the exact centre of the PCB hole. Drill the holes for the sockets and the power lead.

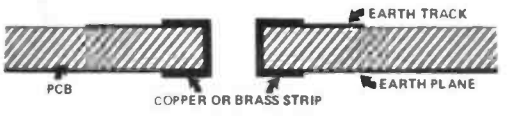


Figure 1: Method of earthing the PA transistor.

Fit and solder the through board links around the emitter leads. Form two pieces of copper or brass strip to connect the earth around the PCB inside the transistor hole. (See *Fig. 1.*) Solder these to the PCB making certain that they are not likely to raise the emitter leads.

Fit all the components to the PCB with the exception of the PT8811, the relays, C3,C4 and the coax link.

Components that require an earth connection and are not connected to the emmiter pads are soldered to the earth plane through the board. Components that are connected to the track have their leads soldered directly to the top of the PCB.

All components must have the shortest possible lead lengths this is especially important in the case of C3 and C4.

Solder the relays in position and connect the top connections of the coils to earth (see photos). Cut the coax to the dimensions shown in *Photo 2* and fit to the PCB.

Solder two pieces of copper or brass strip to the underside of the board (see *photo 1*) locate the PCB assembly in the case, forming the two pieces of strip to the shape of the case. Scribe the shape of the socket holes onto the strip and, using tin shears, cut the strips to form tags.

Bolt the PCB into the box leaving the board free to move slightly. (see *Fig. 2*). Trim the leads of the PT8811 to about 1/4 inch long. Smear some heat sink compound onto the face of the stud and bolt the transistor into position. Do not apply any stress to the leads. Solder the transistor leads. Tighten up the fixing screws and the transistor nut. Solder C3 & C4 in position. Fit the BNC sockets making sure that the earth strips make a good connection. Solder two pieces of 0.15 inch strip to form the input and output connections. Solder the power leads and include an in-line fuseholder in the positive line.

Some silicone rubber compound between the relays and the case will provide extra mechanical stablity.

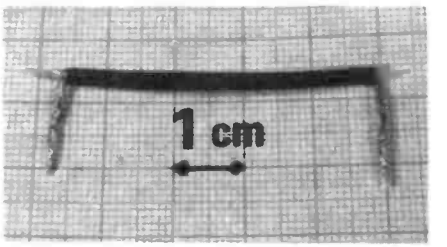


Photo 2: Cutting details for the coax link.

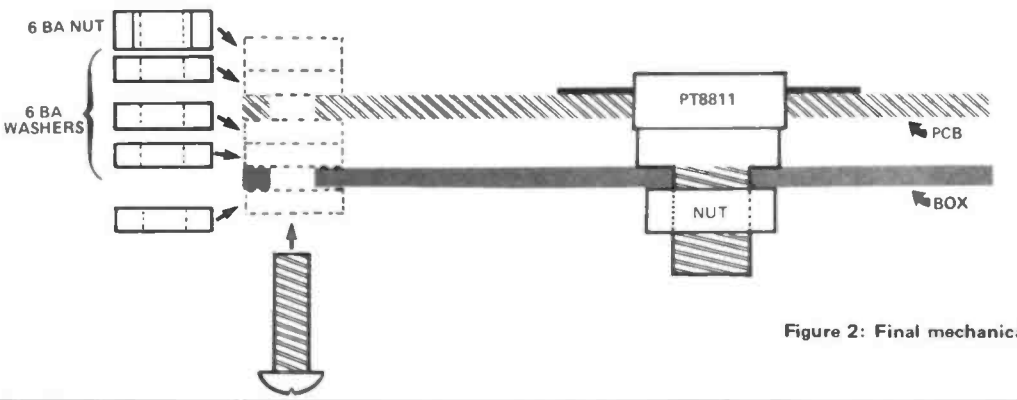
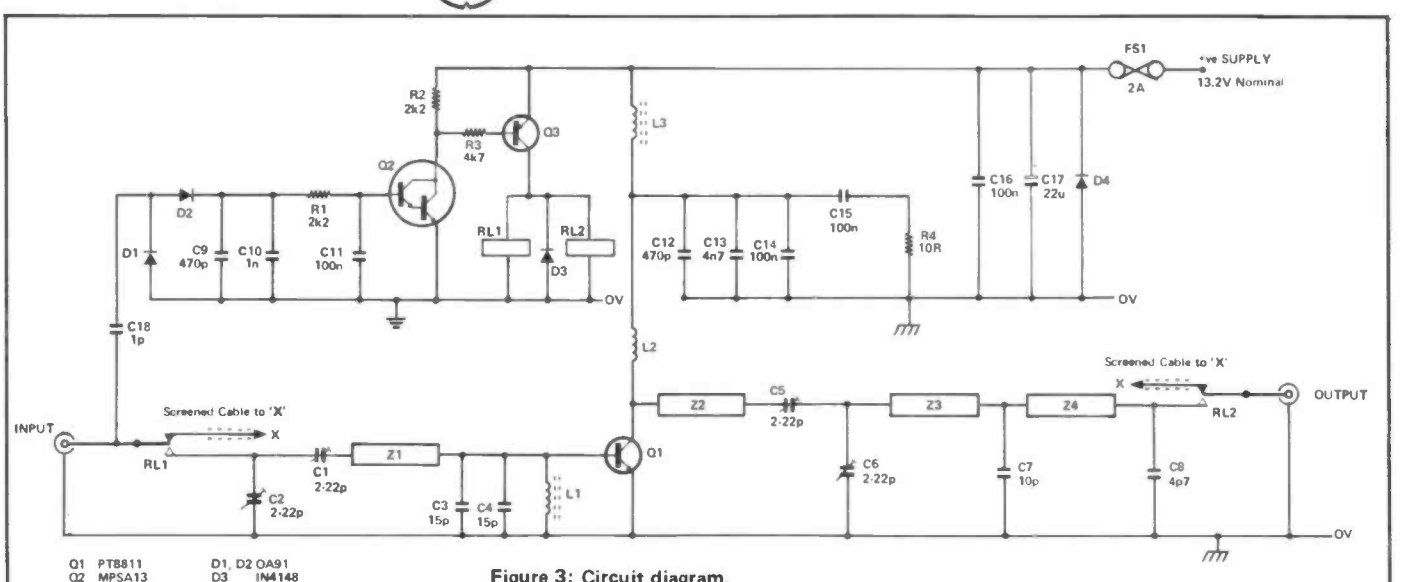


Figure 2: Final mechanical assembly details.



Q1 PT8811
Q2 MPSA13
Q3 BC640
D1, D2 OA91
D3 IN4148
D4 IN5404

Figure 3: Circuit diagram.

CIRCUIT DESCRIPTION

The input to the amplifier is matched to the transistor by the network comprising C1,C2,Z1,C3,C4.

The output from the collector is matched to 50R by Z2,C5 and C6. DC power is supplied via the collector choke, L2. This is decoupled by C12-14 and the network, comprising C15 and R4. L3 is present for further supply filtering. A two section low pass filter is formed by C6,C7,C8,Z3 and Z4. The cut off frequency of this filter is about 490MHz.

Switching Circuit. Some RF is applied to the voltage doubler, R1,D2,C9,C10, via C18. The base current to Q2 is limited by R1 which, in conjunction with C11, smooths the transients which are present during switching. The relay current is switched by Q3. D4 provides some reverse polarity protection.

PARTS LIST

Resistors - all ¼W 5%

R1,2	2k2
R3	4k7
R4	10R

Capacitors

C1,2,5,6	2-22pF 7mm dia. foil trimmer
C3,4	15p
C7	10p
C8	4p7
C9,12	470p
C10	1n
C11,14,16	100n
C13	4n7
	0.1" spacing min. ceramic
C15	100n Polycarbonate
C17	22u 16V axial electrolytic
C18	1p min. ceramic

Inductors

L1	2t on FX1242 ferrite bead 0.25mm dia. enamelled wire
L2	2t 5mm id 1mm dia. wire spaced wire dia.
L3	1mm wire through FX1242 bead

Semiconductors

Q1	PT8811
Q2	MPSA13
Q3	BC640
D1,2	OA91
D3	1N4148
D4	1N5404

Miscellaneous

RL1,2 OM1 Relay

10mm RG95 coax., 2 single hole fixing BNC sockets, 2A fuse & in-line fuseholder, 5 thou thick copper or brass strip, diecast box, PCB, wire for supply leads, 6BA screws, nuts and washers.

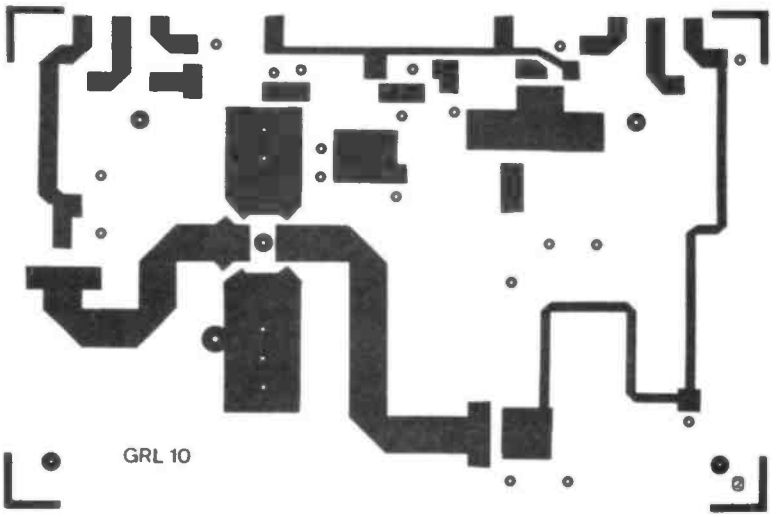


Figure 4: PCB Foil Pattern.
(Note PCB is double-sided. The other side is earth plane).

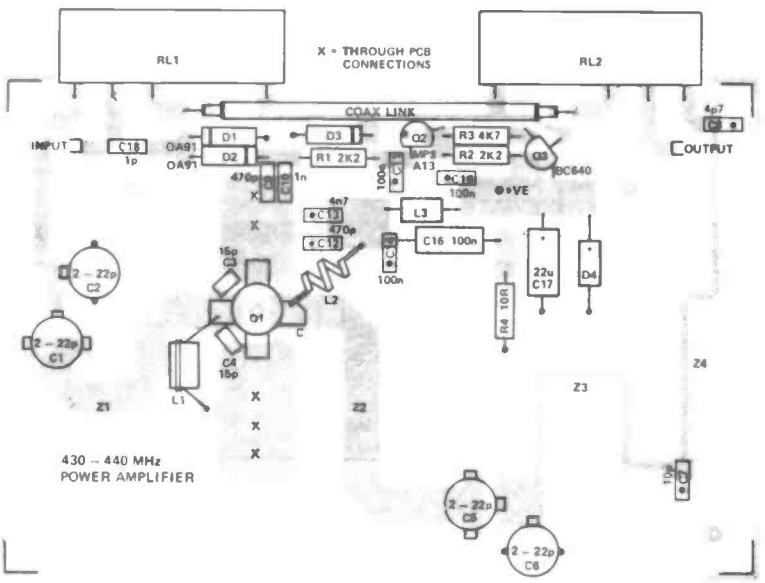


Figure 5: Component Overlay.

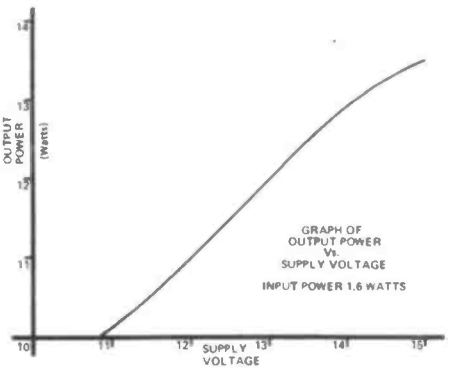
TESTING

Check the amplifier for solder bridges, incorrect components etc.

With no DC power applied check that the RF power loss through the amplifier is not more than 1dB (it should be less than 200 mW in 1 watt). Connect a DC power supply and a dummy load. Monitor the output power and the DC input current. Initially, set the power supply to 12V. The current drawn at this stage should be negligible. Set the trimmer capacitors to mid position. Energise the transmitter. The relays should operate and the current drawn increase. Adjust C1 and C2 for about 1 Amp of supply current. Peak C5 and C6 for maximum output power. Increase the supply voltage to 13V5. Adjust C1,C2,C5 and C6 for maximum output power. Keep the transmit time as short as possible during tune up. Ensure that the stud of the PT8811 does not get extremely hot relative to the case. This is indicative of inadequate mechanical connection between the transistor and the case. If the stud does get hot (greater than 70°C) check the assembly.

IN USE

Two of these amplifiers have been run continuously at 12 watts output for periods in excess of 2 hours. The temperature rise is approximately 40°C. This feels hot, but is perfectly safe under most conditions. If the amplifier is to be used in a very confined space with little ventilation, a heat sink may be bolted to the box to improve the dissipation.



The input power should not be greater than 2.5 watts and the output power must not be allowed to be above 14 watts for more than a short period.

The RF switching operates from a input level of about 0.5watts upwards - so if your transceiver has a low power position it probably won't switch the amplifier.

■ R & EW

Your Reactions.....	Circle No.
Excellent - will make one	44
Interesting - might make one	45
Seen Better	46
Comments	47

LEADER

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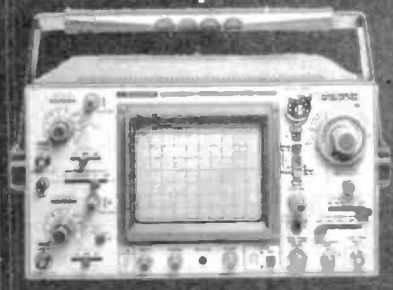
thandar
ELECTRONICS LIMITED

Oscilloscopes



- 4 to 50mHz
- Single, Dual and Quad trace
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- Wide bandwidth
- High sensitivity
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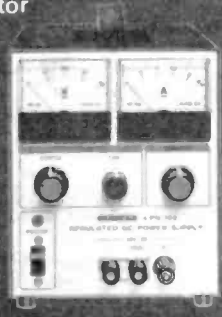
- Battery operated

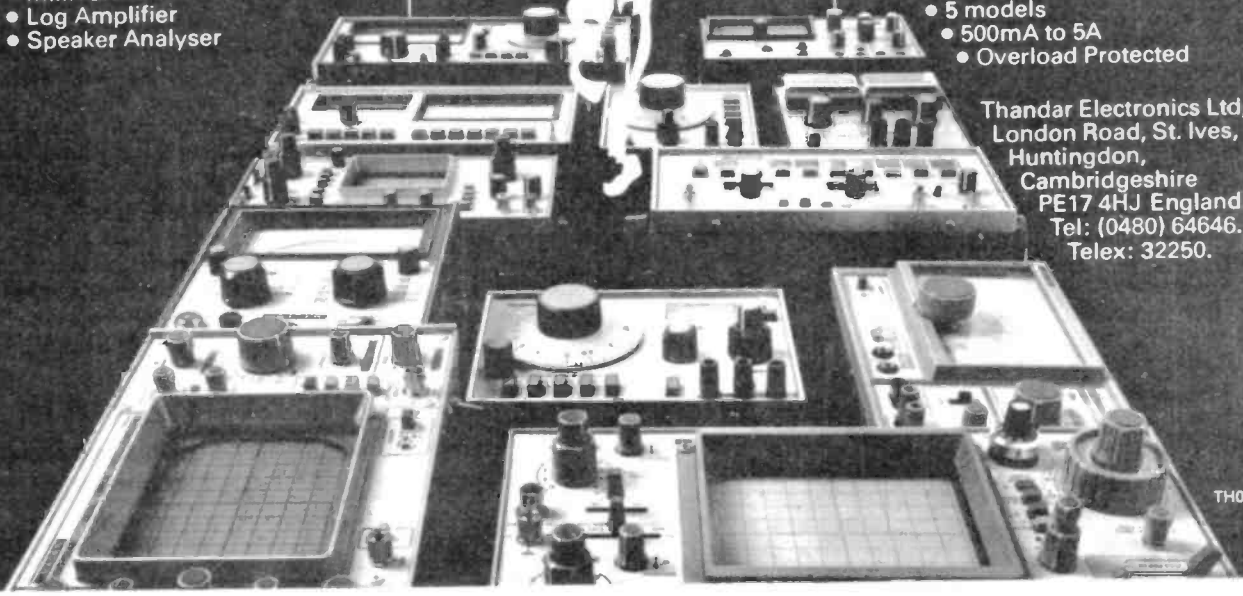
General Test

- LCR Bridge
- Semiconductor Curve Tracer
- Transistor Testers
- Logic Probe



Power Supplies

- Laboratory bench type
- 5 models
- 500mA to 5A
- Overload Protected



Thandar Electronics Ltd,
London Road, St. Ives,
Huntingdon,
Cambridgeshire
PE17 4HJ England.
Tel: (0480) 64646.
Telex: 32250.

TH02

R&EW Data Brief

TDA 1220

An AM-FM radio receiver subsystem

Look inside many portable radios from the far east (and one or two from the not-so-far East), and you may find SGS's versatile TDA1220. We have noticed it inside a couple of the "Walkman" style hip-fi radios, as well as more conventional types of equipment.

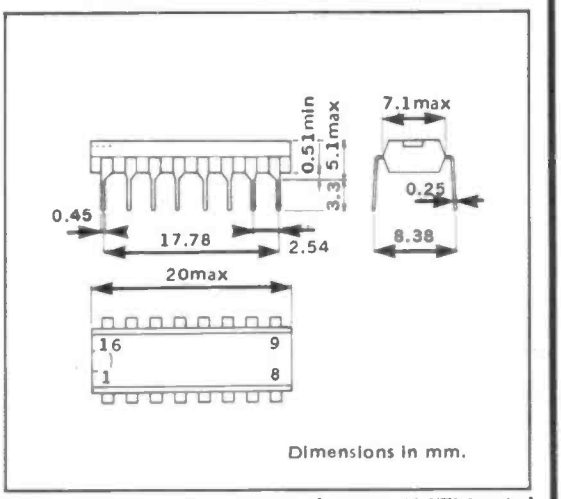
The device combines low voltage and low power with high sensitivity, except that unlike the TDA1083 series, the TDA1220 provides an entirely separate signal processing channel for the AM and the FM signals. In fact, the signals only ever combine after the detector stage. Notwithstanding that, you will see from the internal circuit diagram (Figure one) that many of the familiar elements of radio IC design are present.

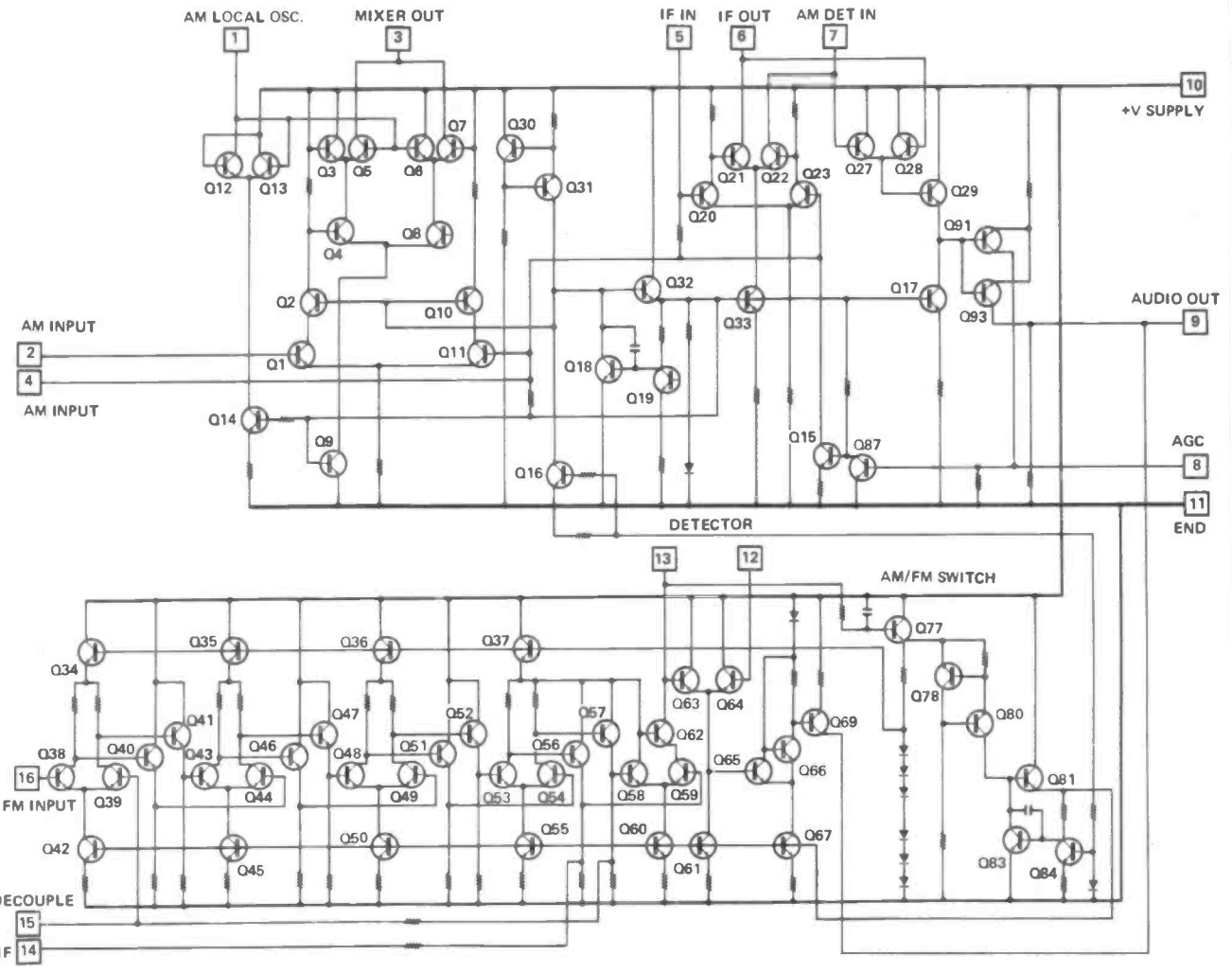
Following the AM input (on pins 2 and 4) into the depths of the device, you will see that the input stage is a differential pair, at the base of a familiar transistor tree mixer. The local oscillator stage is formed by Q12 and Q13, with AM/FM switching control provided by Q14. The output of the mixer is filtered at pin 3 using any one of a variety of AM ceramic or LC filters, bearing in mind the output impedance of 50k may need to be dropped with a parallel resistor to the 2k0 approx. required by most ceramic ladder filters.

If using a coil to match the filter, substantial damping is necessary to prevent instability, so the 50k impedance tends to become rather acedemic in practical applications. The AM IF input stage at pin 5 is a conventional differential amplifier formed by Q20-Q23, whose output at pin 6 ad 7 feeds a low level differential peak detector: an AM version of the widely used quadrature detector seen in FM and PM detectors. The IF outputs and detector inputs are common, with the tuned circuit used to invert the phase of the IF signal applied to the base of Q28. Full wave detection at the emitter junctions of Q27 and Q28. The junction capacity is used to integrate the output waveform.

A DC voltage proportional to the carrier level also develops at this points, and while Q33 buffers the AM audio output on its way to the next stage via pin 9, Q91 drives the base of the AGC amplifier Q87/Q15 (with the necessary time constant on pin 8), which then controls the current in the IF and mixer stages. Q16 operates the main AM/FM switchover function, the entire process being initiated by putting the supply on pin 13.

A chain of events is then set in motion: Q77 turns on, Q78 turns off, Q80 turns on, Q81 turns on, finally switching Q16. This seems rather a long way round, but maybe it has something to do with chip topography.../



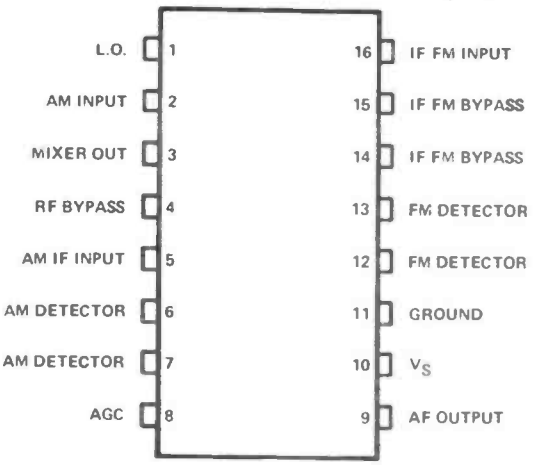


Onto FM:

The FM input on pin 16 follows the familiar pattern set in everything from uA753s to CA3089s - lots of differential limiters followed by quadrature detector at Q64/64. Not much to be added, except that the switching arrangement turns on the transistors controlling the emitters, and enables the audio output via Q65 through to pin 9.

This means that the device cannot readily configured with the AM section feeding the FM detector stage. Apart from the all-in-one NBFM tuneable IF, such setups lend themselves to limiting SSB receivers as well. Various attempts to confuse the device into leaving the AM front-tend running whilst the FM detector also operates have proved only partially successful. Anyone else want to try and let us know how they get on?

The ICF2001 review scheduled in the contents page has been held over until November, due to shortage of space.



Connection Diagram for TDA1200.

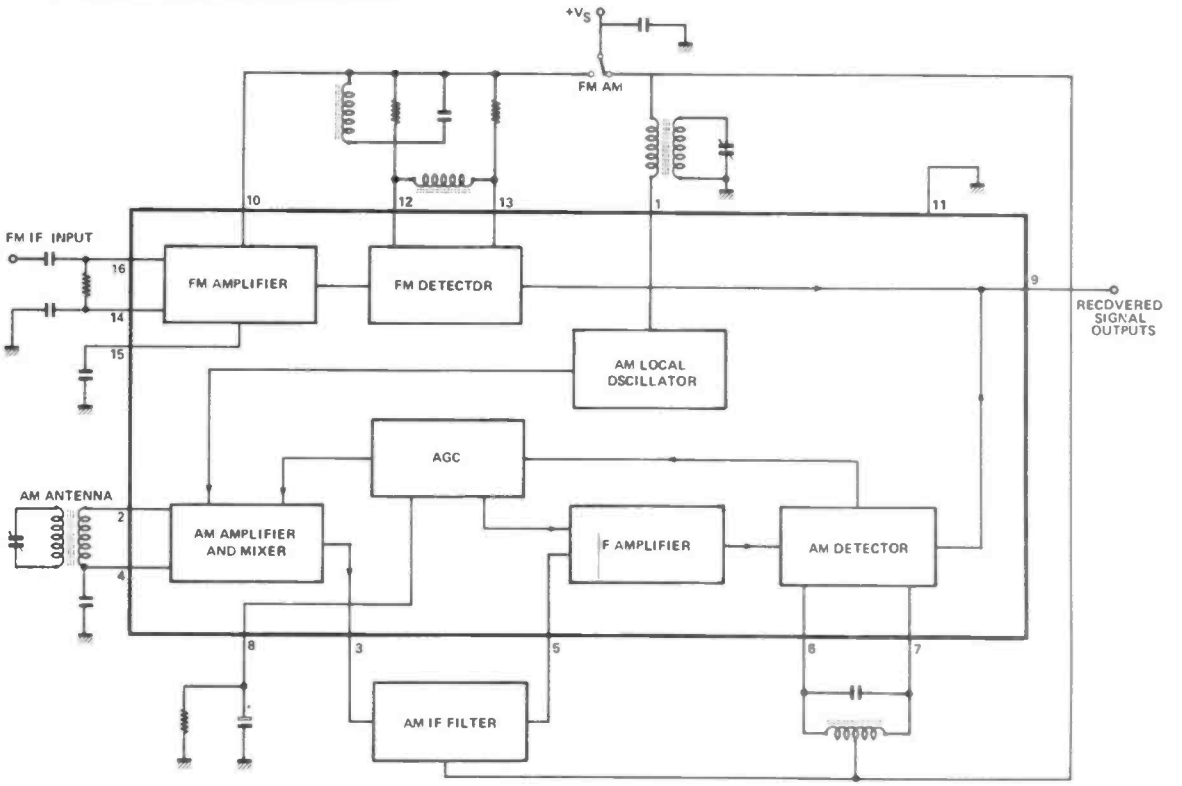
Parameter	Test conditions	min	typ	max	Unit
Supply voltage			4 to 18		V
Quiescent current	9v supply AM		15		mA
	9v supply FM		20		mA
AM Section:					
Sensitivity	26dB S/N AM 30% mod 1MHz		10		uV
Signal/noise	10mV in, 1MHz		56		dB
AGC range	3dB AF change		75		dB
AF output	1mV in, 1MHz, 80% mod, 1kHz		200		mV
Distortion	1mV in, 1MHz, 30% mod, 1kHz		0.5		%
Max input	10% distortion, 80% mod		2		V
Min supply	For LO operation		2		V
FM section					
Sensitivity	10.7MHz, limiting		25		uV
AM rejection	10.7MHz, 1kHz, 75kHz dev., AM 30% mod.		45		dB
S/N	10mV in, 75kHz dev		65		dB
Distortion	75kHz dev., 1kHz mod		1		%
Audio output	1mV in, 10.7MHz, 75kHz dev., 1kHz mod		220		mV

STATIC ELECTRICAL CHARACTERISTICS

Pin	Port	Typical values
Pin 1	Oscillator	5k/5pF
Pin 2	RF amp./mixer in	5k/10pF
Pin 3	Mixer IF output	50k/3pF
Pin 5	IF amp input	2k/5pF
Pin 6,7	AM detector	20k/5pF
Pin 12,13	FM detector	5k/5pF

The resistance between pins 14/16 is chosen to suit the FM filter impedance (usually 330R).

DYNAMIC ELECTRICAL CHARACTERISTICS



R&EW Data Brief

U264/266

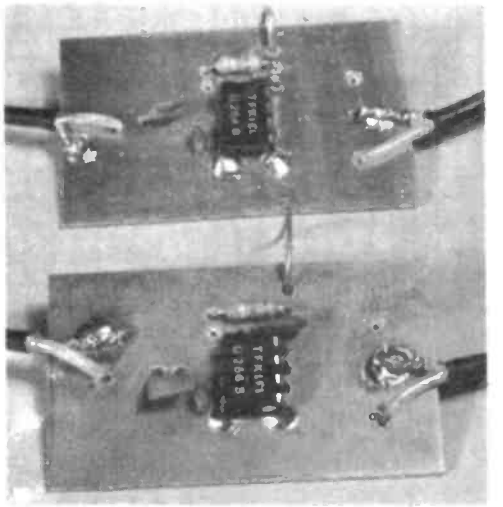
÷64/÷256 PRESCALER ICs

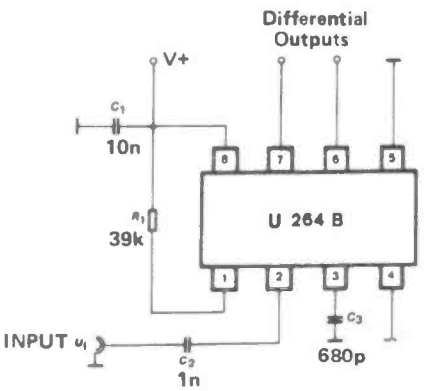
Notes:

To avoid oscillation of the frequency divider without input signal, the wide band preamplifier is adjusted to a slight unbalanced bias (resistor between Pin 1 and U_S).

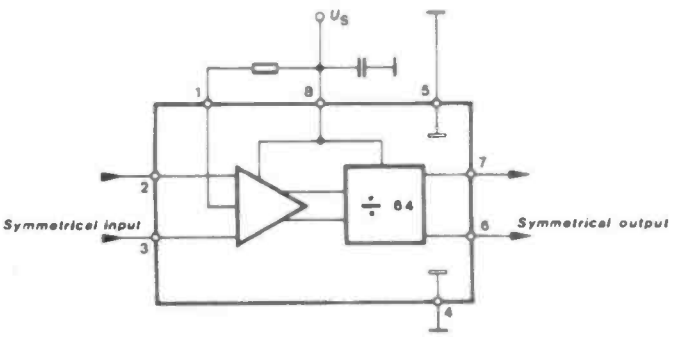
The IC is optimised for supply voltage of U_S = 5 V. The sensitivity changes slightly throughout the supply voltage range.

It may be useful in case of $U_S \leq 4.5$ V to reduce resistor R_1.

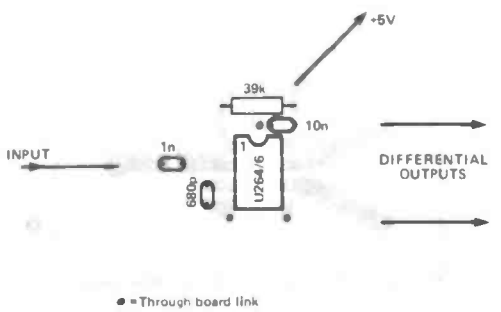




Circuit diagram of the prescaler circuit

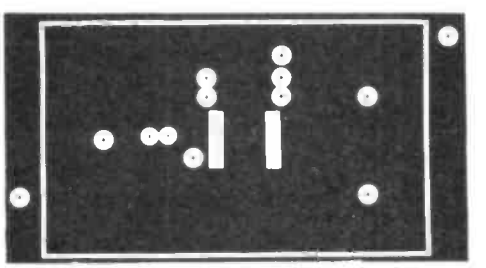


Internal schematic of the U264

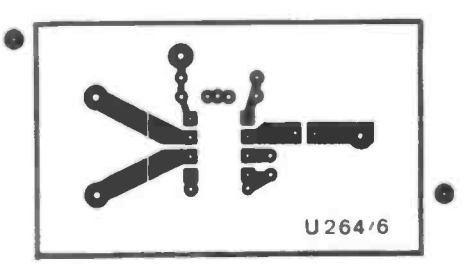


● = Through board link

The overlay for the U264 and U266 is the same.



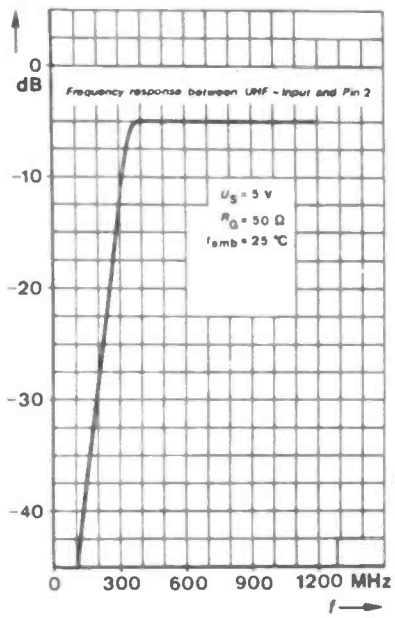
PCB Foil Pattern (Top Side)

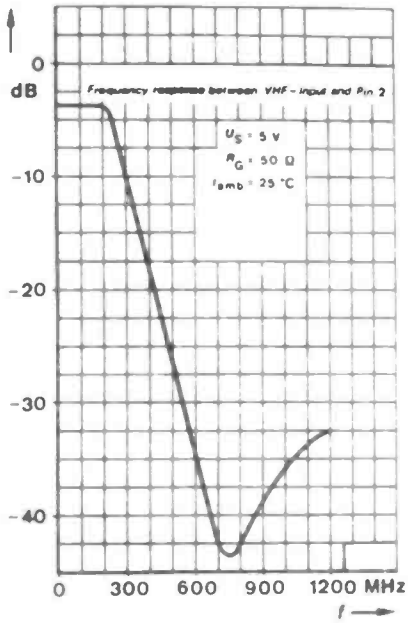


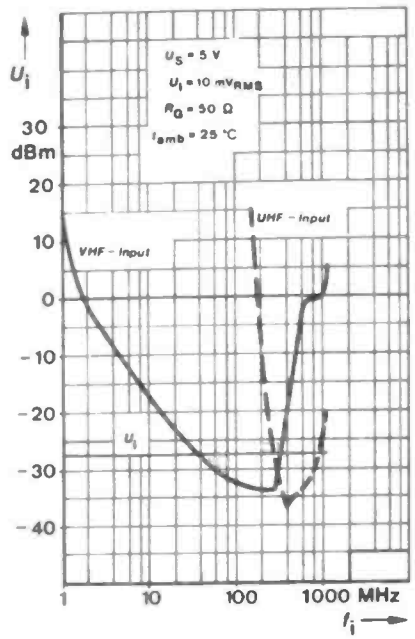
PCB Foil (Track Side)

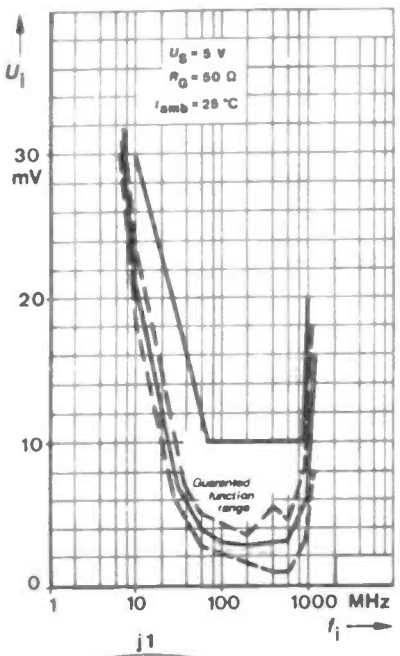
Features:

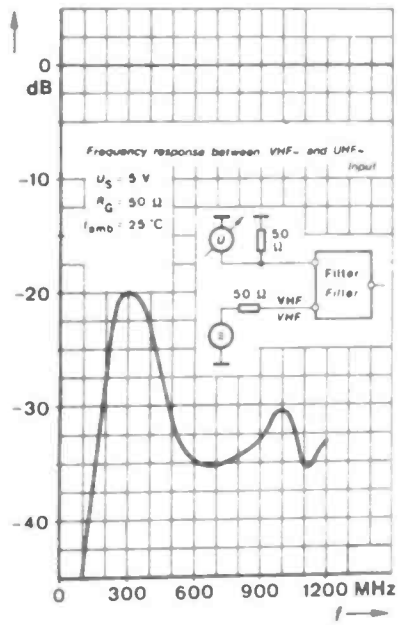
- *High input sensitivity*
- *Large operation frequency range*
- *Large signal compatibility*
- *High dynamic stability*
- *Low power dissipation*
- *Wide supply voltage range*
- *Few external components*

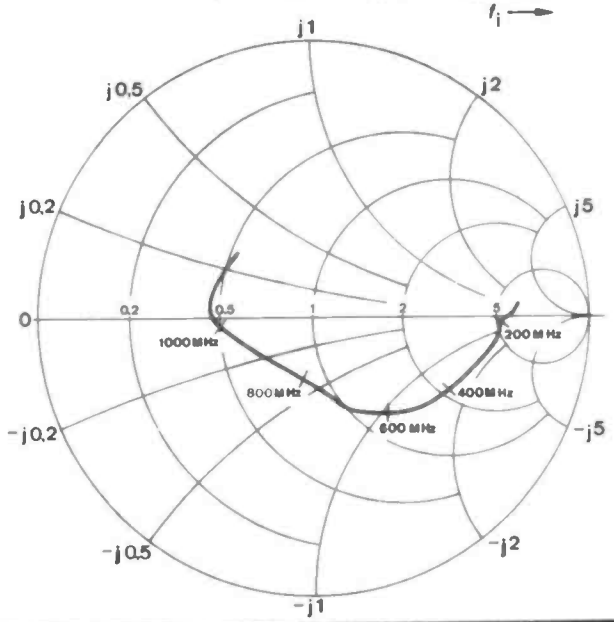












U_S = 5 V
Z_L = 50 Ω
f = 200...1000 MHz
t_{amb} = 25 °C

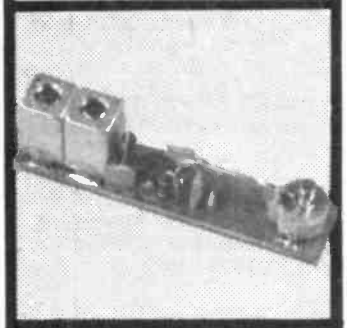
For details of Data Brief PCB prices please see the Project Packs page.

R&EW PROJECT PACKS

2m PRE-AMP

Very compact low-noise MOSFET 2m pre-amp. Gain, 22dB; noise figure less than1.5dB; I/P and O/P impedance; 50R size; 34 x 9 x 15mm. Featured in April '82.

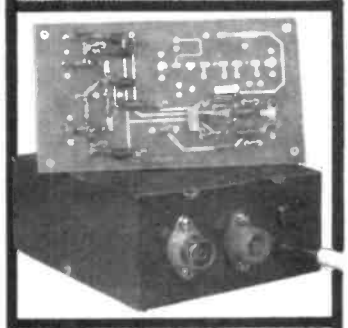
Stock No.		Price
40-14400	Kit	£2.94



70cm PRE-AMP

Compact low-noise pre-amp. Gain at 470MHz; 13dB. I/P and O/P impedance 50R. Size: 50 x 10 x 17mm Featured in March '82.

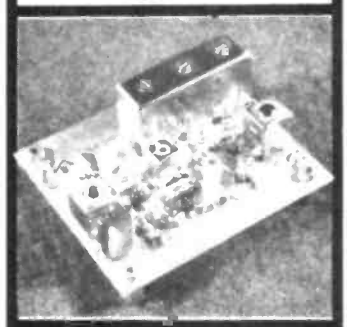
Stock No.		Price
40-07000	Kit	£4.49



MASTHEAD TV PRE-AMP

'ngeniously designed UHF TV Masthead pre-amp. Power fed up centre core of co-ax from base PSU. Complete kit of parts including two case (PSU case punched) mains transformer etc. Featured in January '82.

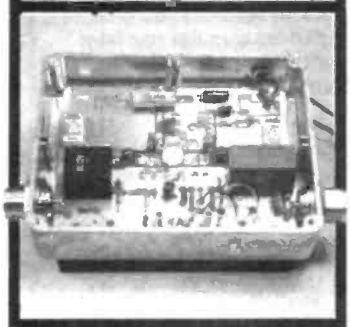
Stock No.		Price
40-06200	Kit	£10.47



2m CONVERTER

Low noise 144/5 to 28/9MHz converter Latest design with low noise MOSFET and 3 chamber helical filter. Complete kit of parts: PCB, all components, xtal, pre-drilled case and sockets. Featured in October '81.

Stock No.	Price
40-01030	£16.67



2m POWER AMP

An updated version of our popular design from December'81; the kit is available with or without pre-amp (published in June '82). Stock No.

Stock No.		Price
40-14421	Less Preamp	£32.77
40-14422	With Preamp	£34.96

REWBICHRON - MSF CLOCK

The ultimate timepiecel 12 or 24 hour display, microprocessor based, continues running if MSF fails or is lost. Featured in April '82.

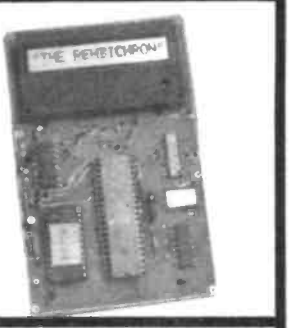
Logic Display Board - PCB and all components including pre-built display module and pre-programmed EPROM.

Stock No.		Price
40-06000	Kit	£73.18

Receiver Board

PCB and all components.

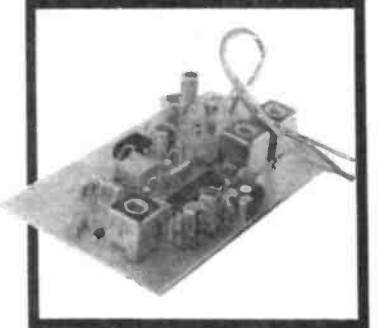
Stock No.		Price
40-06002	Kit	£10.08



27MHz DEVIATION METER

Will read deviation levels of FM transmission within the 27.6 - 28MHz band. Based around TDA4421 Kit includes PCB, all components and meter. Featured in October '81.

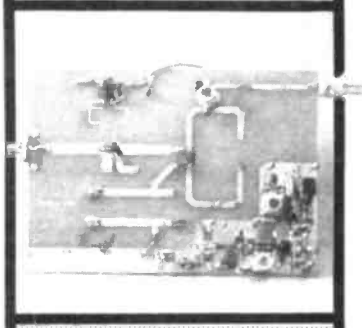
Stock No.		Price
40-01040	Kit	£8.62



23cm CONVERTER

Low noise Microwave Converter with 2m or 10m output. PCB and all components (no connectors). Xtal for 2 or 10m output. Featured in March '82.

Stock No.		Price
40-23144	2m	£19.45
40-23028	10m	£19.45



2m MONITOR RX

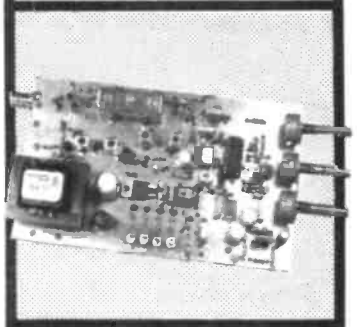
Complete 2m/UOSAT receiver system. 6ch xtal controlled with AFC facility on 2ch for tracking the doppler shift of UOSAT signals. High performance front end with 3 chamber Helical filter. Sensitivity 0.15uV for 12dB SINAD. PSU, AF amp, IF and RF sections all on one PCB (160 x 100mm). Kit only. Featured in May '82.

Less PSU components:

Stock No	Filter	Price
40-14404	SLF-D12	£33.12
40-14405	LHF12S	£27.94

With Mains PSU

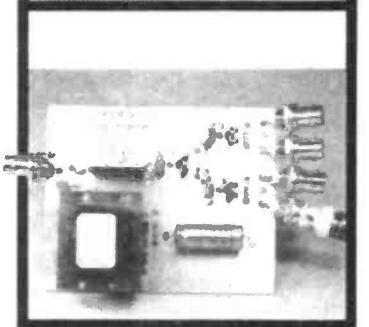
40-14406	SLF-D12	£37.07
40-14407	LHF12S	£34.20



TV DISTRIBUTION AMPLIFIER

4 way, wide band, 5 - 900MHz, broad band distribution. Kit includes, double-sided PCB all components, mains transformer and undrilled case. Featured in May '82.

Stock No.	Price
40-59004	£23.45

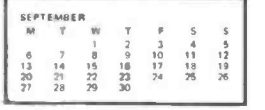


TOP 10

Project Packs from earlier issues of R&EW are still available.
Above are some of the most popular R&EW projects.
Back numbers of R&EW are also available — see page 5 for details.
ALL PRICES INCLUDE VAT @ 15%.
PLEASE ALLOW 21 DAYS FOR DELIVERY.
POSTAGE & PACKING 50p per order.
Send orders to 200, North Service Road, Brentwood, Essex CM14 4SG

TOP 10

SEPTEMBER '82 EVENTS: MOBILE RALLYS



Sept 12	Telford Mobile Rally	Telford New Town Centre Mall, Telford, Shropshire	G8DIR Shrewsbury 64273
Sept 12	Vange ARS Mobile Rally	Nicholas School, Basildon, Essex	Albert Smith G4FMK
Sept 19	Peterborough R&ES Mobile Rally	Wirrina Sports Stadium, Bishops Road, Peterborough	D. T. Wilson, G4KSW, 4 Conway Ave., Peterborough, Peterborough 76238.
Sept 26	Harlow Mobile Rally	Harlow Sportscentre, Hammarskjold Way, Harlow, Essex.	Phil, G8FRG, QTHR
Oct 3	Great Lumley ARCS Rally	Community Centre, Great Lumley, Nr. Chester-le-Street, Co. Durham.	Max Hanaghan, G8HPW, QTHR Tel 078324 3946

NB: Would Rally organisers please send details of forthcoming events to the Editor – and please also include a list of exhibitors.

METAL DETECTORS IN SECURITY

Richard Turner reveals more interesting facts about metal detection.

THE RECENT SECURITY EXHIBITION at London's Olympia has shown that with the aid of electronic devices, security is very big business indeed. A variety of devices were on show with, photo-electrics, gas detectors, RF- debugging, CC TV, Ultrasonic and microwave technologies well represented. This article will however, confine itself to a subject seldom written about, but one which contributes a great deal to security - metal detectors.

In recent years metal detectors have increasingly been coming into prominence as a very useful security device. Weapon detection is perhaps the most widely used application, but metal detectors are also used for checking letters and packages for explosive devices as these will require at least a battery and connecting wires - metallic items readily detected.

Several years ago readers may recall there was a scare of oranges being injected with mercury. No member of the public suffered ill effects however, as all suspect oranges, before being offered for sale were passed through highly sensitive metal detectors. These were of a type widely used in food and pharmaceutical industries and can detect liquid mercury with the greatest of ease. Thus terrorists were defeated and the health of the nation remained secure!

The more sophisticated vending machines have been using metal detection technology for many years with coin recognition systems to dispense goods only when the correct value coins have been inserted.

Paper bank notes can also be rapidly checked for possible forgeries. The metallic strip in notes renders a metal detector a very useful device.

There were many cases in recent years of car assembly workers systematically stealing parts straight off the production line and reselling them - one or two have even built complete cars with stolen parts! Now this is rather surprising as walk-through metal detectors for prevention of pilfering metal parts from factories have been patented as early as 1925.

STATISTICS

Police forces use metal detectors for locating murder weapons and stolen jewellery which may have been hastily thrown away into rivers, or from moving cars into the roadside when the 'law' is in pursuit. It is also quite a common method of disposing of jewellery 'too hot to handle', and police searches at Frensham Ponds and London Bridge with underwater metal detectors have been well publicised.

The army uses metal detectors to recover deadly wartime relics such as unexploded bombs, mines and ammunition still lurking in the depths of the soil, and indeed while the latest bomb and mine detectors were being exhibited at Olympia, bomb disposal squads were busy just a few miles away at Potters Bar carrying out clearance of 28 land mines. Just a few days later a 'Mudlark' found a bomb on the Thames foreshore right in the heart of London. These are by no means isolated incidents - EOD (Explosive Ordnance Disposal) units of the British Army dealt with 36000 finds of UXO's (Unexploded Explosive Ordnance) during 1981!

In the United States the Federal Aviation Authority has carried out a study of airline hi-jacking and the effectiveness of metal detectors for weapon detection. Their figures show that the large

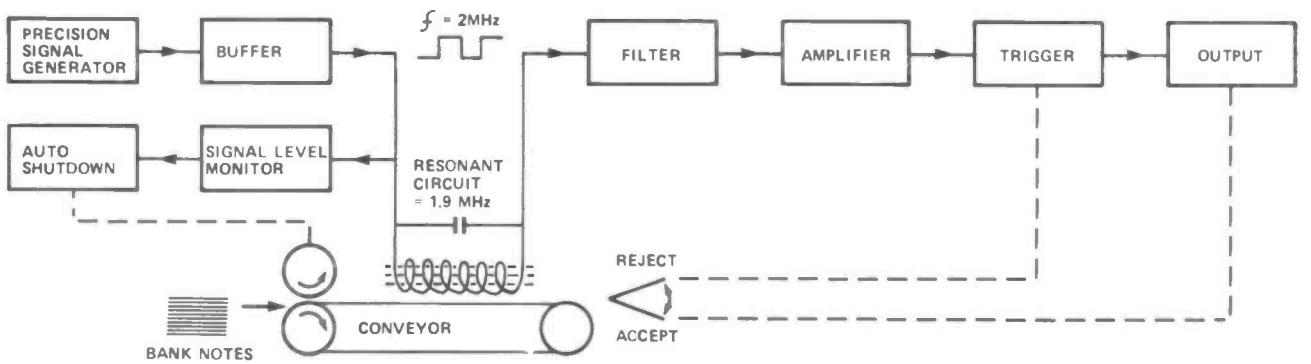


Figure 1: 'Off Resonance' bank note checker. The sensing tranducer is driven by a signal which is higher than its natural resonant frequency, giving an amplitude rise when a metallic strip is detected, passing the note to the acceptor bin.

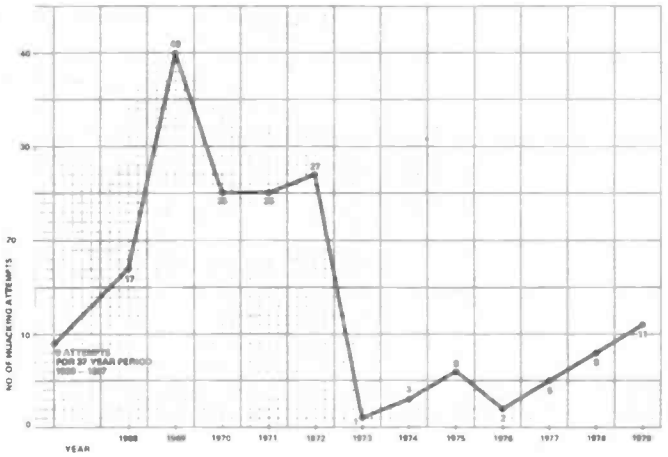


Figure 2: United States hi-jacking attempts (figures issued by the Federal Aviation Authority - 1980). The graph shows a dramatic decrease in hi-jacks when metal detectors were introduced at US airports during 1973.

scale installation of metal detectors during 1972 has dramatically reduced this terrorist activity. At US airports in the years between 1973-1979 screening of 2.5 billion people and 4 billion pieces of luggage resulted in the detection of 19000 weapons. In 1973 attemped hi-jackings were reduced down to one, compared with twenty-seven the previous year!

PRINCIPLES OF DETECTION

Simple magnetometers have been known and used for many years, but using the naturally generated magnetic fields of the earth, can detect ferrous metals only. The ferrous metal is magnetized and readily disturbs the known magnetic force thus giving an indication on a read-out instrument. Magnetometers suitable for this purpose can be all mechanical (Torsion spring or Wire sensor), electromechanical (Torroid coil) or all electronic using a Neuclonic sensor. The requirements in security are, however, to detect Non Ferrous metals as well, thus electronic detectors operating on continuous wave (AC) or pulsed fields (PI) are used. Both methods use one or more induction coils to generate a magnetic field independent of the earth's natural fields as the basis for detection of Non and Ferrous metals. The intermittent magnetic fields induce eddy currents in wires of letter bombs and masses of metal such as knives and guns. These eddy currents are readily used to alter the operating characteristics of the induction coils by means of phase shift, amplitude or frequency change and decaying pulse, thus enabling detection to be made. Other high technology detectors use a combination of microwave and laser techniques to provide an image of metal objects detected, but are used only in special

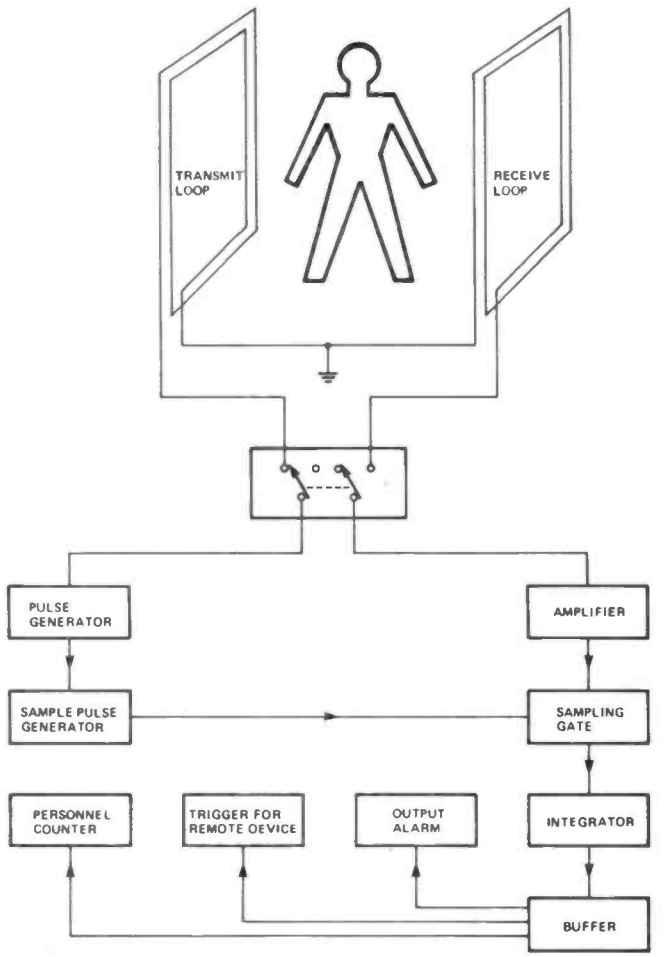
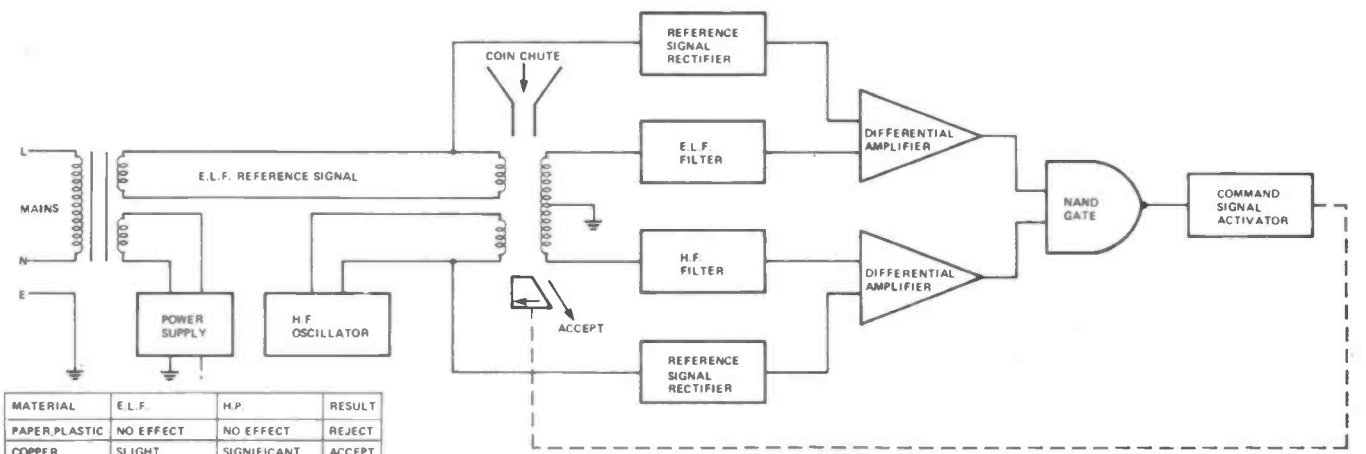


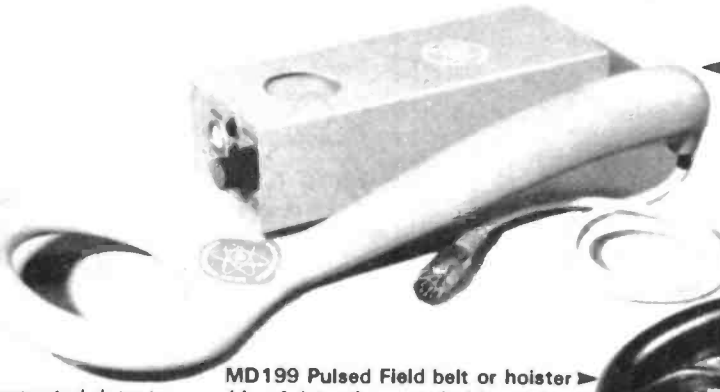
Figure 3: A 'pulsed field' walk-through weapons detector injects a high amplitude, short duration, pulse into a transmit loop. An eddy current is induced in any metallic object between loops and this causes a decaying pulse in the receive loop.

applications due to slow response and possible health hazards, for instance to people fitted with heart pacemakers. An American University has recently been engaged in R & D using multifrequency methods for detection and identification of weapons, and that project has produced some startling results in as much that weapons can be very accurately distinguished from any other metal objects such as bunches of keys, lighters and even cigarette cases. In fact different makes of pistols can even be distinguished from one another.



MATERIAL	E.L.F.	H.F.	RESULT
PAPER,PLASTIC	NO EFFECT	NO EFFECT	REJECT
COPPER	SLIGHT DAMPING	SIGNIFICANT DAMPING	ACCEPT
CUPRO NICKEL	NO EFFECT	SIGNIFICANT DAMPING	ACCEPT
IRON,STEEL	SIGNIFICANT DAMPING	HEAVY DAMPING	REJECT

Figure 4: A dual frequency coin recognition system typical of those found in vending machines.



MD199 Pulsed Field belt or holster mounted detector capable of detecting metal objects down to 1.5mm in size. the electronics are contained in a moulded plug-in module enabling instant replacement. Weight is 730 grammes, current consumption 50mA giving a minimum life of 30 hours on continuous operation. A ground search probe is available as an optional extra.

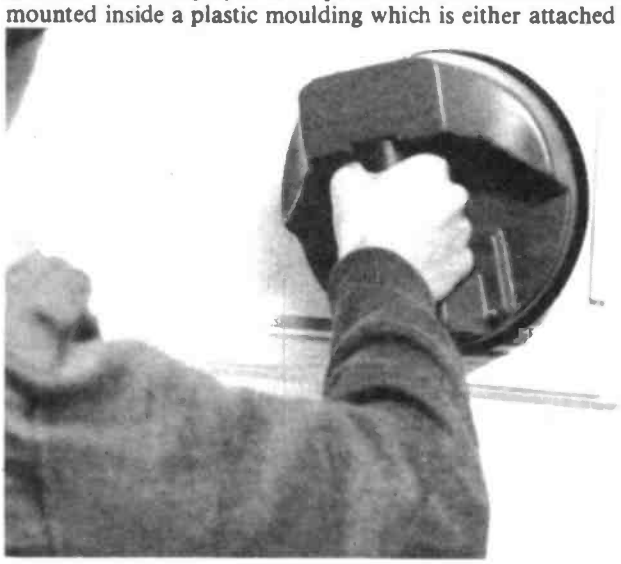
A closer look at IPD4. It is of all ABS construction weighing only 350 grammes and requiring current of only 5mA, while a metallic magnetic reed sounder makes it an all weather instrument.

Frisker MK45 Pulsed Field detector. The 100mm search coil is capable of detecting a pistol at 200mm. Its high sensitivity renders it useful for scanning mail for explosive devices. Maximum current consumption is 130 mA giving 10 hours of continuous life from a PP9 battery. Total weight is 1.25 kilogrammes.

British manufacturers are also active in R & D using Pulse Induction technology. S-DEC letter bomb and PIM-DEC mine detectors are known the world over, while the recently developed RAPIDEX 1500 weapons detector is certain to cause quite a stir in security circles. Its search coils can be concealed behind plaster, bricks or concrete, thus the subjects are not aware of being screened, but persons carrying weapons can be discreetly apprehended or photographed for later identification. By concealing the sensor coils this type of detector is harder to sabotage and can be installed out of doors, for instance in walls or gate ways. An added benefit is the ability to count persons, thus giving an instant indication of the number of people at the location protected by this unit. Induction Balance and Transmit- Receive techniques have also been well exploited in detectors designed for security use.

SPIN-OFFS

Metal detection technology has produced some useful spin-offs for security use, article antithief systems are a familiar sight in many of the High Street shops and in libraries. There are two basic methods used, for protection of books or such-like articles. A magnetized metallic strip may be concealed inside an item to be protected. This will cause an alarm to go off if unauthorized removal from premises is attempted. When the article has been paid for or the book lent, the magnetic signal is wiped off by a pen or a concealed sensor in the desk. For larger articles, or those containing metal, such as radios, domestic appliances or musical instruments, a tag system is preferable. A resonant circuit is mounted inside a plastic moulding which is either attached to or concealed inside the article and has to be manually removed when a sale has taken place. The big advantage of the tag system, which was developed in Britain with the assistance of the National Research Development Corporation, is that metal articles have no effect on the sensors placed at exits - these are only energized by the specific frequency of the resonant circuit in the tag. The detectors for these systems can be in the form of free standing pillars or a box construction attached to doorframes etc.



B100 'Induction Balance' hand detector in service with the British and other armies. It is pictured in Northern Ireland during a search for weapons which are suspected to be concealed behind panelling.

As already stated last year there were 36,000 finds of UXO's and a worthy mention should be made of people who in pursuance of their hobby with metal detectors have reported many of those finds, and indeed in many cases have taken part in organized searches for those deadly items. One of the best examples of this was when the wreck of the 'Aeolian' spilled its deadly cargo of cyanide canisters. Metal detector enthusiasts assisted the coast guard and police in the search for these canisters. Even now, several years after the wrecking, the search goes on for canisters which may have been brought up by winter storms.

The annual Brighton beach clearance on Mayday holiday is always well attended. This year some three hundred enthusiasts turned up, and indeed it was reported later that some live ammunition was found. Thus it can be seen that even simple metal detectors of the 'Treasure Hunting' variety are a very useful security tool.

However technology marches on and new ideas and applications are always being devised. A recent British Patent suggests that a metal detector which is completely concealed on a person could be used for discreet frisking should there be any suspicion of a terrorist or criminal by-passing the usual security checks. The sensor would be of a flexible nature concealed in a flesh coloured glove, the electronics and output transducer of a vibratory or bone conducting nature being hidden in clothing but in contact with the body. The metal detector in its various shapes and forms is thus a powerful countermeasure in the 'war' against terrorism and continuing development will continue to make it a valuable tool in security forces the world over.

Photographs courtesy of Add-On Electronics Ltd and Avimo Ltd.

■ R&EW

COMPUTING NEWS

The 5th Personal Computer World Show

Gary Evans gathers together this month's micro news.

A MIXED BAG OF news this month starting with price cuts and marketing policy changes for the Sinclair ZX81.

The early part of August saw the cost of this machine, in ready built form, fall from £69.95 to £49.95 inclusive of VAT, of course, do it yourselfers have been able to pick machines up at this price since the start but it appears that Sinclair are starting to abandon the kit market in favour of ready built machines. This is evidenced by the fact that the Spectrum is only available as a finished unit with no plans to offer it in a knocked down form.

Sinclair are also to market the ZX81 through branches of Boots and Greens in addition to the established distribution via W.H. Smith. Prism Microproducts are also to act as a wholesaler from whom other computer stores will be able to purchase the ZX81.

Total sales of the ZX81 to date are 450,000 with 60,000 units per month being produced. The new price and increased availability should mean that sales of the ZX81 remain buoyant over the later end of the year and sales of 3/4 of a million units before the end of the 81's life do not seem too fanciful.

PERSONALLY SPEAKING

The 5th Personal Computer World Show takes place this year between Thursday 9th and Sunday 12th of September. The venue for this year's show is the Barbican Centre which provided a home for the extremely successful AES event earlier this year.

R&EW has a personal interest in the gathering as we have booked a stand on which we intend to demonstrate much of the computer orientated projects published in recent issues of **R&EW**.

The two star attractions on the stand will be our Z8 Tiny Basic Development System and our new REWTEL service.

Exact plans for our stand have not yet been formulated but the Z8 will be seen in action, with the possibility that a prototype of the minimum chip, dedicated system, will be on display. Our REWTEL service will be officially launched on the show's opening day (we're working on a computer generated fanfare of trumpets) with, it's hoped, hourly demonstrations throughout the four days.

We've been keeping fairly quiet about REWTEL although an announcement about initial trials was made in our July issue. These have been proceeding quite smoothly and the service has had any initial bugs ironed out of it and is now ready for mass exposure.

R&EW has started work on a low-cost Modem which will mean that any computer capable of talking RS232 will, at negligible expense, have access to REWTEL's Data Base.

Do come along and see us at the show, one thing we can promise is that our stand will have something going on all the time.

SOFT SELL

Interest in PRESTEL among the Business and Consumer markets in general may not be as high as British Telecom had envisaged after a couple of years of operation but the computing fraternity has certainly taken the system to its heart. The availability of down loaders for various machines means that users of many of the popular micros have access to the range of educational, games and utility software now becoming available via Prestel and other viewdata services, including of course, REWTEL.

Owl Micro-Communications Ltd., have just launched a down loader program to operate in conjunction with their existing Owltel package. Designed for use with Apple computers, the complete package provides a direct interface between the computer and Prestel.

The downloading operation is a two stage operation; the first stage enters the program selected into a data file, while the second stage converts the stored data to a working program. The downloader requires a minimum of user input, and is fast and easy to run.

Full details of Owltel and their new downloader are available from
Owl Micro-Communications
The Maltings
Station Road
Sawbridgeworth
Herts CM21 9LY

The Tantel Prestel adaptor is the most successful device in the UK with some 70% of the market. A new product from Tandata Marketing is their Briefcase Viewdata System.

This portable system combines the Alpha Tantel adaptor with an acoustic modem, both units being moulded into a briefcase.

This self-contained unit enables anyone with access to a standard TV set and a phone to make use of Prestel or any like system.

The potential sales for the system should be very healthy with one area of use being in conjunction with sales forces. A company's sales personnel could use Tantel's system to keep in touch with their Head Office, to place orders and to keep up with General Administration, meaning more time on the road, doing their prime job. The increase in productivity that could be realised by the intelligent use of this system would more than pay for its initial cost in a short period of time.

The Briefcase Viewdata costs £449 plus the dreaded VAT and details of it, and other products in the Tandata range can be obtained from
Tandata Marketing Ltd.,
Clydehouse Reform Road,
Maidenhead
Berks SL6 8BU

DYNAMIC NOISE REDUCTION SYSTEM

Peter Luke describes a DNR system for video recorders.

* Dolby is a registered trademark of Dolby Labs. Inc.

THE FILM INDUSTRY is often pointing out that the enjoyment derived from watching a video recording of a major film is not as great as seeing it on the big screen. No doubt there's something in this, but until we can all afford projection TV systems, if its big you want, to the cinema you'll have to go.

Watching video software has another drawback, in that the sound quality of most TV sets, although much improved over the past few years, leaves a lot to be desired. This problem is easier, and cheaper, to overcome however, as nearly every video recorder has an audio output socket. This provides a signal that is suitable for feeding the auxiliary input of an audio amplifier.

The improvement in sound quality, in particular bass notes and upper trebles, is quite dramatic. The added richness of the sound track goes some way to making up for the inadequacies of the small screen.

HISSING VID

There is a price to pay for the increased fidelity of sound when the recorder's output is played back through a high quality amplifier and that is that the 'hiss' which is present on any video recorder's audio track will, in all probability, become far more objectionable. This 'hiss' is present when tapes are played back via the TV's speaker, but because of the limited frequency response of such speakers, is less likely to be objectionable.

All audio record/playback chains produce 'hiss' on played back material and, to a gross simplification, the level of hiss is inversly proportional to linear tape speed- the slower the speed, the greater the noise.

Noise is a problem in audio cassette decks and no self respecting audio recorder does without some form of noise reduction system, Dolby, dBx etc. As the tape moves past the record/playback head of a video recorder at a slower speed than the tape in an audio recorder, it is no surprise that without some form of noise reduction system, there are going to be noise problems.

The Dolby noise reduction system is starting to feature on the top price machines and does make a considerable improvement in the audio track's quality. There is however a disadvantage in that the Dolby system is what's known as a complementary system-: that is signal processing must take place both during record and playback. Thus, if a tape has not been recorded with a Dolby sound track, and few prerecorded tapes to date have been so recorded, the Dolby system is of little use.

In addition, the Dolby system can only reduce noise that is introduced by virtue of the record/playback process-it cannot remove any noise that is present in the signal to be recorded. As many older films have very noisy sound tracks, some method of reducing the inherent noise of the source to be recorded would be a very useful feature.

ITS DYNAMIC

The dynamic noise reduction system described here overcomes these problems inherent in the Dolby system. Not only does the **R&EW** noise reduction system offer a greater reduction in the level of HF noise passed to the amplifier (some 18dB of noise reduction as opposed to the Dolby's 10dB) but it can reduce by a similar amount any noise that is inherent in the material to be recorded.

CIRCUIT DESCRIPTION

Figure 2 shows the final circuit diagram of the DNR system. The two variable bandwidth filters are built around the two halves of the OTA IC, IC1. A portion of the input signal is fed via R2 to the high pass filter and peak detector formed by IC2 and Q1.

CONTROL CIRCUIT

The signal bled off from the main signal path has any signals above 16 KHz attenuated by the combination of C7 and R2. R15 and C11 together with R19 and C12 attenuate signals below 4.8 kHz while C2 and RV1 provide an additional roll-off below 1.6kHz. These components result in the frequency response shown in *Fig. 1*.

The voltage gain of the first section of the amplifier (IC 2a) is set by R18/R15 + 1 and by R23/R20 for IC2b. The total gain is about 60dB.

IC2b is configured as a quasi-closed-loop peak detector with D1, Q1 performing the peak rectification with C15 acting as the storage capacitor, D1 prevents zenering the Q1 base-emitter junction if, with a positive charge of C15, IC2b's output swings low. D2 prevents any charge being transferred from C15 to C12.

CURRENT CONTROLLED FILTERS

Two identical OTA filters are formed by IC1a and IC1b.

Resistor R3, 4 and 9,10 are included to linearise the performance of the OTA's in accordance with the 13600 data sheet.

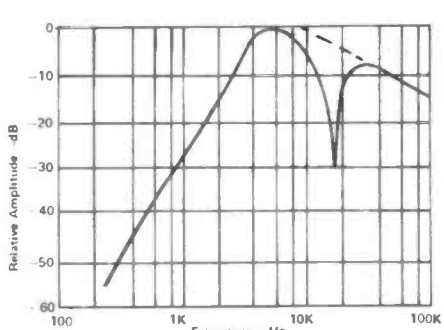


Figure 1: Frequency response of the DNR circuit's control path.

The cut-off frequency is dependent on the amount of current flowing into the amplifiers control pins (16&1)-this is provided by the control circuit described above.

R1 and R7 (R11 & R12) are made equal in value to provide a unity gain in the filter's pass band.

R8(R13) is chosen to provide the maximum output voltage swing.

LED DISPLAY

The LED display provides an indication of the instantaneous bandwidth of the filters, it is driven from the smoothed output of the control path filter/amplifier.

A full description on the bar graph driver IC appears in Data File elsewhere in this issue.

POWER SUPPLY

The power supply is a straightforward circuit based on the three terminal voltage regulator IC4.

See the principles of operation section for a full description of the theory behind the DNR system.

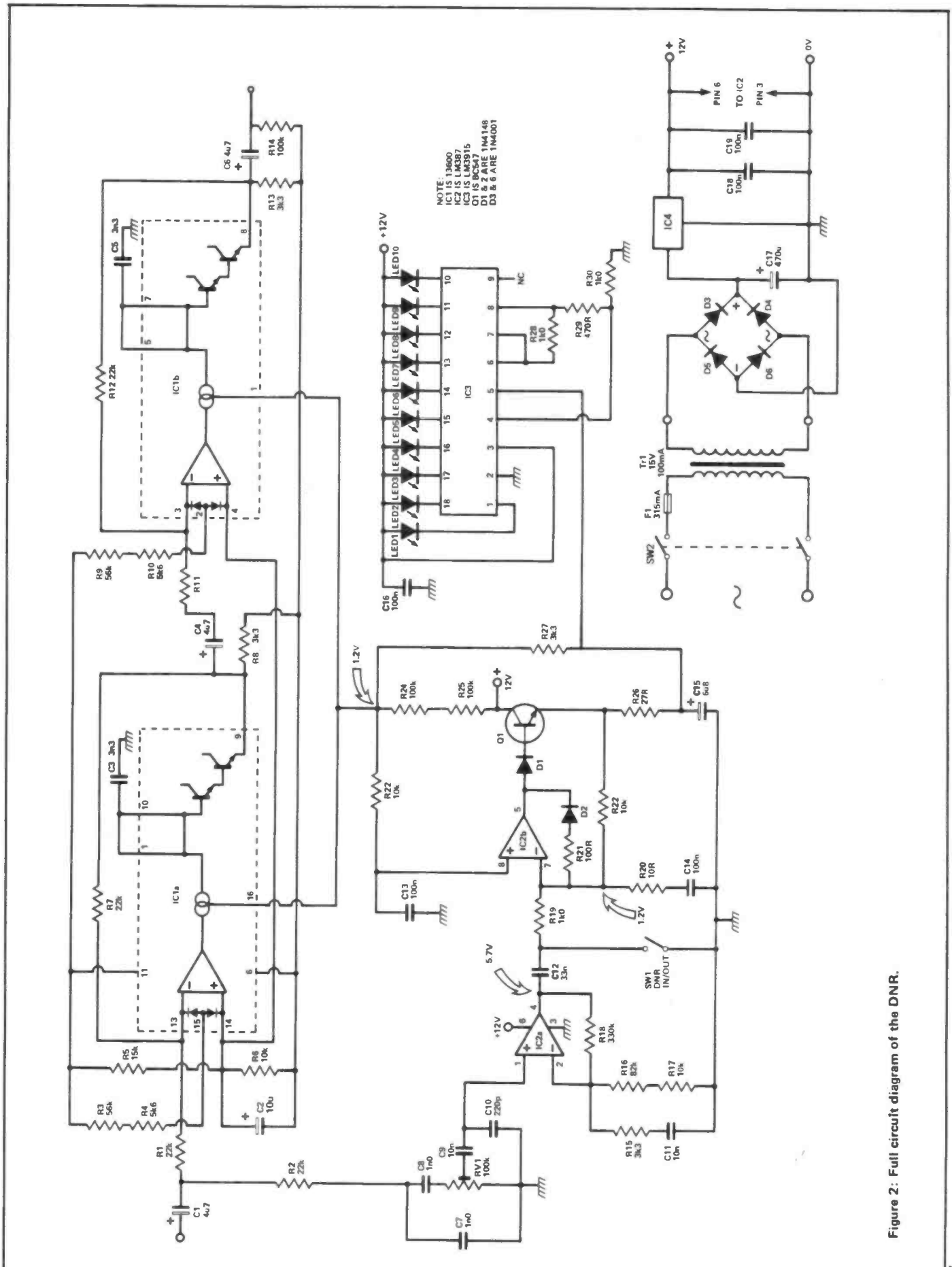


Figure 2: Full circuit diagram of the DNR.

DYNAMIC NOISE REDUCTION SYSTEM

The principles on which the **R&EW** system operates are the same as those behind National's new LM1894 single chip noise reduction system. National will only provide this IC to manufacturers (Grundig are using it in their next generation of TVs) which is a shame as *Fig. 3* shows just how straightforward a system based on the 1894 can be.

At **R&EW** we managed to get hold of an LM1894 and comparing its performance to that of our circuit, and let's face it we've only used two ICs to do most of the work, there was not a lot to choose between the two.

CONSTRUCTION

Insert all the components, with the exception of ICs 1 to 3, according to the overlay of *Fig. 5*. Pay particular attention to the orientation of any polarity conscious devices as Luke's law, with acknowledgement to Murphy, states that if it is possible to insert a component a right way and a wrong way, said device will show an unhealthy desire to end up the wrong way round. If the device has more than two possible ways of being mounted the odds against you become even greater.

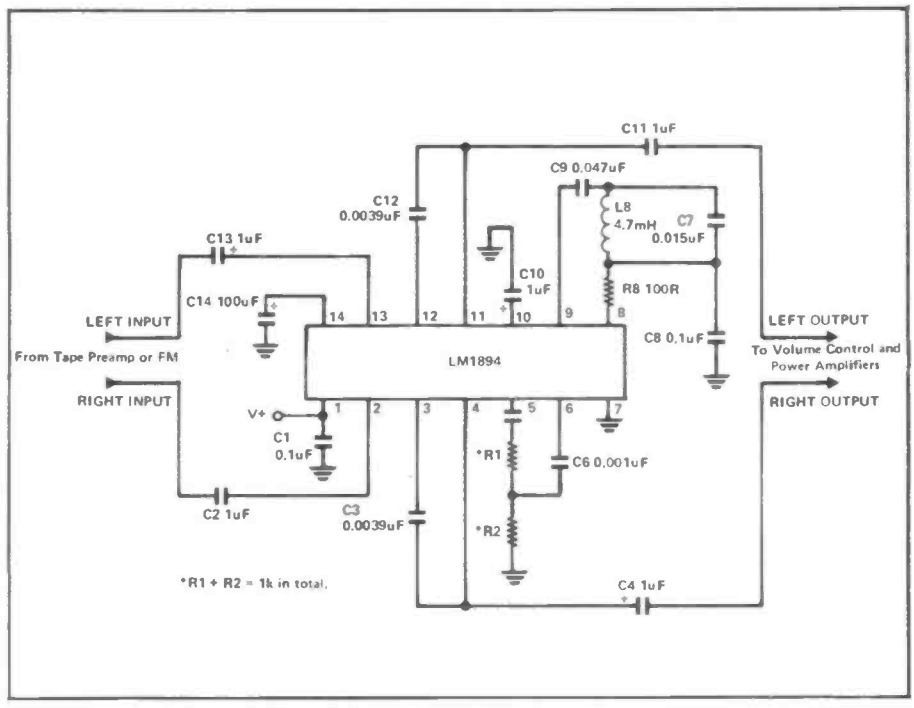


Figure 3: National's LM1894 single chip DNR IC offers a straightforward design, it is only available to GEMs however.

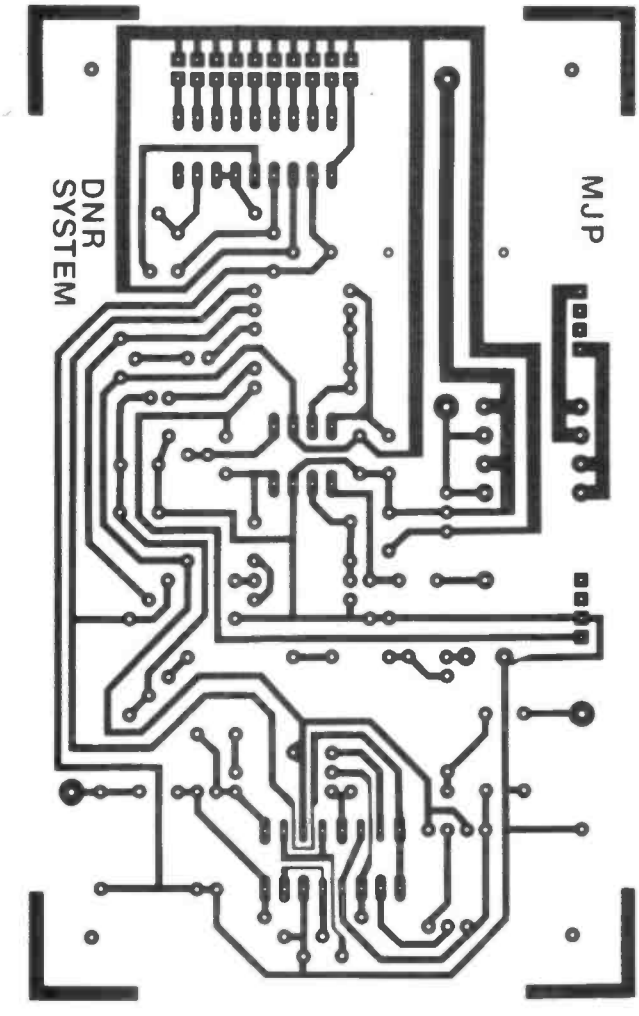


Figure 4: The DNR's foil pattern.

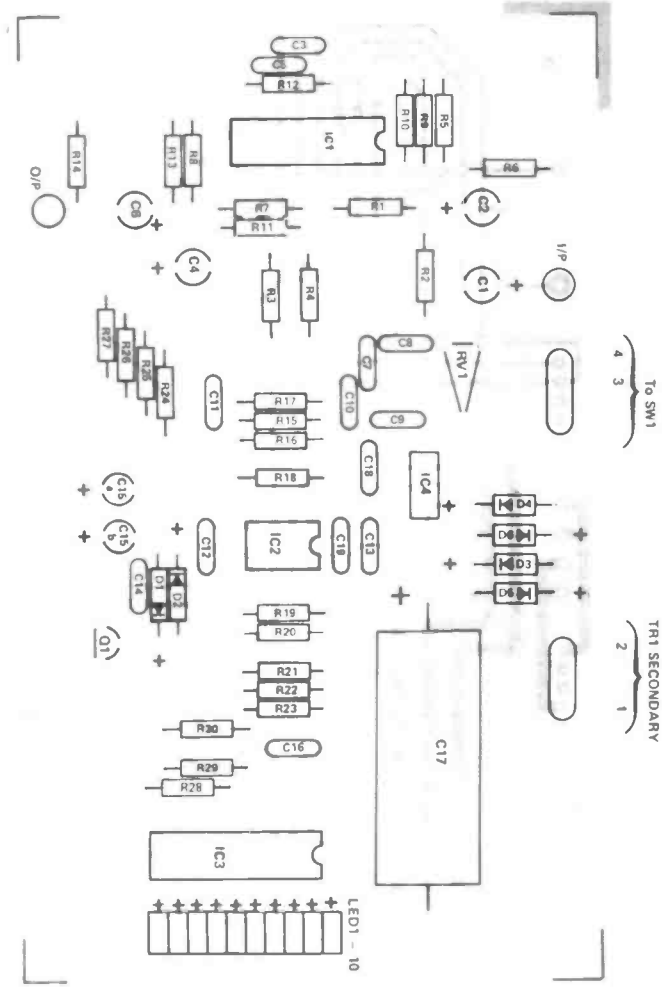


Figure 5: The DNR's overlay.

There is one wire link to be made — easy to overlook but its position is clearly marked on the board.

The prototype was mounted in a two-tune vero case with a rectangular slot cut in the front to allow the LEDs to be viewed through a translucent panel.

The photos show clearly the way in which the LEDs were mounted and how the finished board was mounted in its case.

With everything in its place, switch on the power and check that 12V is present at the appropriate pins of the vacant IC sockets. If all is well insert the remaining three ICs and move on to the setting up procedure.

SETTING UP

Setting up the noise reduction unit is quite straightforward and involves adjusting RV1 until the filters are just starting to open with no signal present.

To accomplish this, first set RV1 fully anti-clockwise. Now connect the video recorders audio out socket to the input of the DNR circuit.

It is now necessary to playback a period of about 30 seconds 'silence'. As broadcasting authorities seldom allow periods of silence when on air, except last thing at night, the easiest way to provide the peace and quiet is to use the audio dub function found on most video recorders to erase some unimportant piece of the sound track.

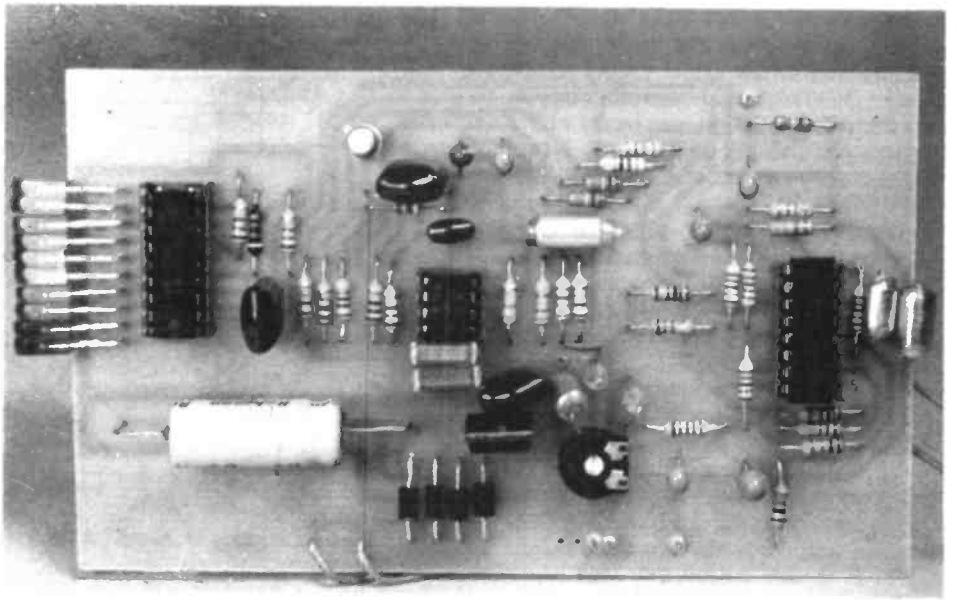
With the 'silence' applied to the DNR unit, adjust RV1 until LEDs 1 and 2 just light. That's the setting up over.

Put the lid on the box, connect to your amplifier, and listen to the vast improvement in the noise figure of the system.

IN USE

After initial calibration, the unit should require no further adjustment. It is placed between the video recorder's output and the input of a power amplifier. This can either be an amplifier dedicated to the task or the aux input of a hi-fi set up. Of course it may be that the hi-fi's position is not exactly suited to reproducing the TV's sound but many hi-fi amplifiers have main and remote speaker selectors. In which case, an additional speaker on one set of the remote terminals, situated near the TV could prove a better solution than reorganising the whole front room.

The front panel LEDs do not act as a conventional level meter but rather give an indication of the instantaneous bandwidth of the noise reduction system. Operating the DNR's defeat switch will cause the top LED to remain lit. In practice, the DNR can be left in operation at all times, providing noise reduction for off-air TV programs as well as pre-recorded tapes.



The DNR PCB.

The **R&EW** prototype has been in use for some time now, and the improvement it provides in terms of perceived audio quality has been commented upon by many people. It should certainly be part of any video system that uses something other than a poor quality TV speaker to reproduce a video recorder's sound track.

PRINCIPLES OF OPERATION

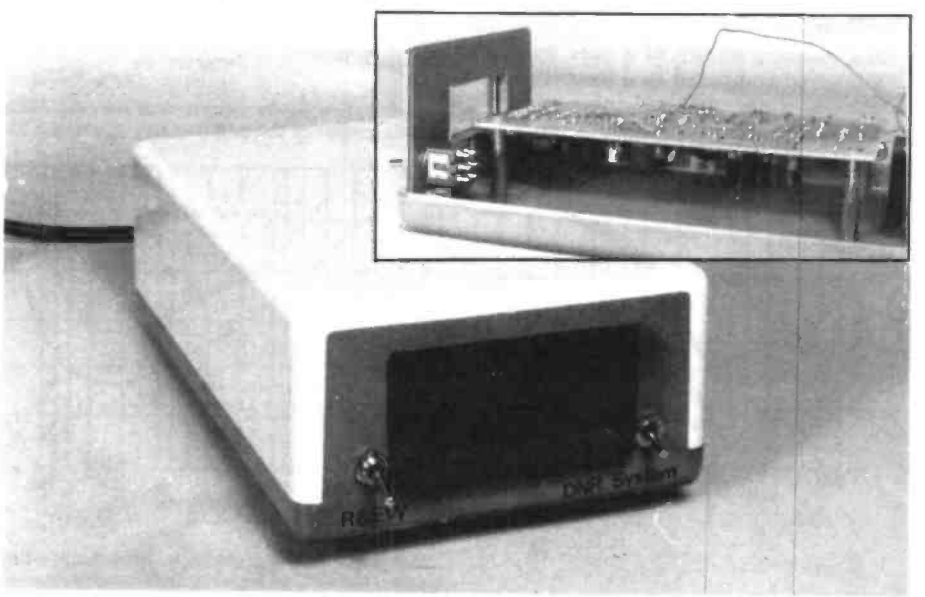
There are many methods used to achieve noise reduction in audio systems, but the different approaches may be divided into two distinct groups depending on whether they are complementary (companding) types, or non-complementary (single-ended) circuits.

The best known exponent of the complementary approach to noise reduction is the Dolby system. A complementary system is characterised by the fact that the signal is processed both during record (or at the transmitter in the case of an FM radio broadcast) and during playback (or at the receiver).

One reason for the wide popularity of the Dolby system is that to a certain extent Dolby encodes tapes are compatible with unmodified playback equipment. Dolby encoded material played back without a decoder will provide acceptable results, particularly if an amplifier's tone controls are adjusted.

Dolby B (the system most commonly found in domestic equipment) provides about 10dB of noise reduction which, while an improvement over an unencoded tape, does not render tape hiss inaudible.

More recently developed complementary systems can offer a greater amount of noise reduction. Dolby C (which cascades two Dolby B circuits and adds some additional refinements) offers some 20dB while dBx can provide a 35dB improvement. These increased amounts of noise reduction are, however, at the expense of compatibility. ▶



The DNR and inset and internal view of the project during construction. Note the PCB is mounted upside down in order that the LED's read from left to right.

All these complementary systems work along broadly the same lines. They involve compression of the signal during record (across the whole audio frequency range or in selected areas of the spectrum) with a reciprocal expansion on playback. Hence the term compander-COMpresser/-exPANDER.

Alternative forms of noise reduction have made appearances over the years — the Philips DNL is one example — and many of these have been based on the Dynamic Noise Filter developed by Burwen.

One of the major advantages of a non-complementary system is its ability to reduce noise that is inherent to the signal being recorded-something which a complementary system is not capable of doing. In addition it can provide greater levels of noise reduction than a standard Dolby B circuit.

The operation of the DNR system described here depends on two basic principles. The first of these states that the noise output of a system is proportional to its bandwidth and the second states that the presence of a single tone will decrease the ear's ability to perceive other sounds.

The first of these points, suggests that if the bandwidth of a system is reduced, the noise output of the system will also be reduced. As ever, things are not quite that simple as the ear's sensitivity to sound varies depending upon the frequency of the sound. *Figure 8* shows that the ear is most sensitive to sound in the 600Hz-6KHz frequency range-this is the reason for weighting the noise figure quoted for an amplifier in order that such a figure will accurately reflect the perceived noise output of the system.

Figure 9 shows that when a low pass filter (one or two pole) is included in a 'noisy' signal path, a 14 to 18dB improvement in the noise figure for the system can result.

The masking principle referred to above can be further explained by reference to *Fig. 10*, which shows a passing similarity to *Fig. 8*. This time however, the graph shows the effect of a white noise source on the ear's ability to detect a single tone. The general trend shows that the ear is most readily able to detect tones at around 1kHz but that at higher frequencies, the white noise's masking effect becomes greater and a relatively higher SPL (Sound Pressure Level) is required before the ear can detect a tone.

White noise contains all frequencies at an equal amplitude and from fact and the graph of *Fig. 10* it can be deduced that for any single tone, there will be a range of frequencies capable of masking the note.

To be applicable to the DNR system, the above principle needs to be 'turned on its Head', if we require that a single tone masks broadband (white) noise. Experiments show that relatively high levels of a single tone (even at the most effective frequencies between 700 & 1KHz) are required to mask noise. Luckily, most natural sounds (music, speech etc.) do not consist of single tones but are made up of a broad spectrum of frequencies with, in most cases, the largest energy content centred around the 600Hz- 1KHz band. Such 'natural' sounds can improve the noise masking ability of a note by some 30dB when compared to a pure tone.

By now the general principle behind the DNR system should be clear. Combine a variable bandwidth low pass filter the bandwidth of which is controlled by the high frequency content of the audio signal and the DNR will utilise both of the fundamental principles to achieve its noise reduction.

The system will pass only as much noise as the audio signal is capable of masking.

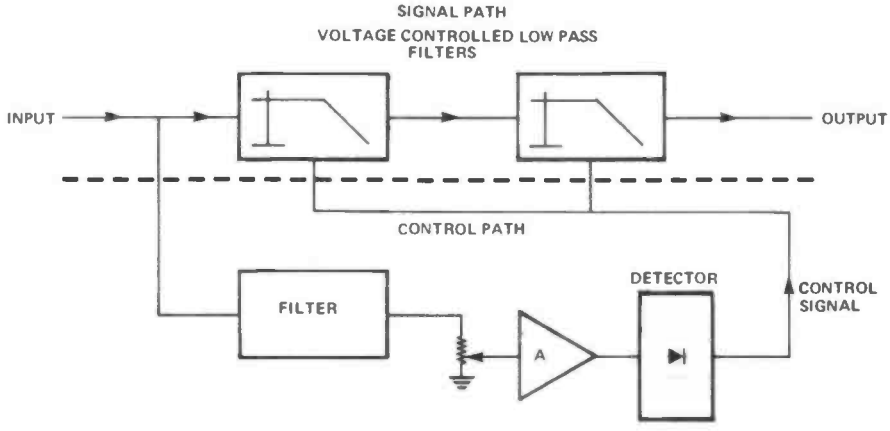


Figure 6: A block diagram of the R&EW DNR system.

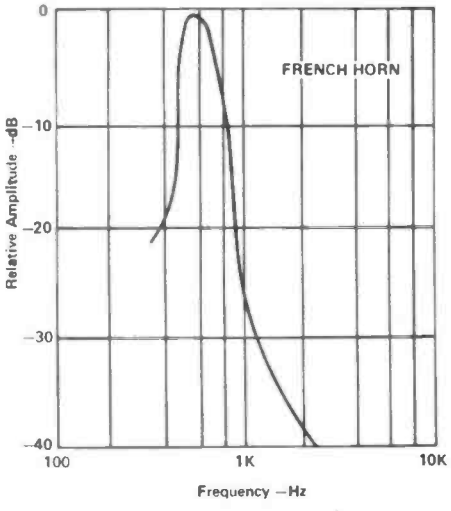


Figure 7: Frequency spectrum of a french horn showing most of the audio energy at around 700Hz.

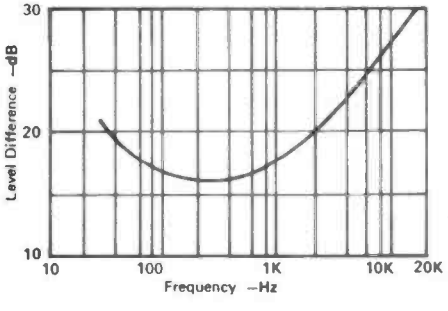


Figure 8: The ear is most sensitive to sounds in the 600 - 1kHz band.

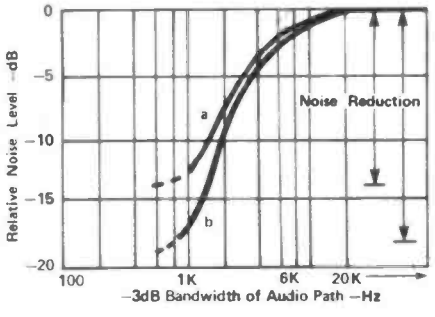


Figure 9: Between 14 and 18dB improvement in S/N ratio can be acheived with a DNR unit.

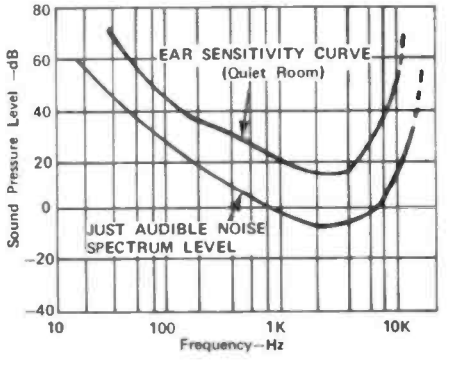


Figure 10: In the presence of broadband white noise, the SPL of a particular frequency required before the sound can be distinguished varies as shown in this graph.

PARTS LIST

Resistors (All ¼W 5%)		C3,5	3n3
R1, 2,7,11,12	22R	C7,8	1n0
R3,9	56k	C9,11	10n
R4, 10	5k6	C10	220p
R5	15k	C12	33n
R6,17,22,23	10k	C13,14,16,18,19	100n
R8,13,15,27	3k3	C15	4u7//2u2 16V Tantalum
R14,24,15	100k	C17	470u 25V Electrolytic
R16	82k	**Semiconductors**	
R18	330k	IC1	LM13600
R19,28,30	1k0	IC2	LM387
R20	10R	IC3	LM3915
R21	100R	IC4	7812
R26	27R	Q1	BC547
R29	470R	D1,2	1N4148
RV1	100k preset	D3 - 6	1N4001
Capacitors		LED's 1-10	Red Stackable
C1,4,6	4u7 16V Tantalum	**Miscellaneous**	
C2	10u	PCB, Case, sockets, wire, etc.	

A block diagram of the system is shown in *Fig. 6*.

Two variable bandwidth, low pass filters are cascaded to provide a 12dB/octave roll off for the overall system. *Fig. 9* shows the response of one filter for various levels of control voltage.

The control path frequency response shown in *Fig. 7* shows that the bandwidth of the system is increased in the presence of high frequency signals capable of masking the system noise. The high frequency roll off is to compensate for the rapidly decreasing energy content of high frequency signals.

The notch shown represents a filter which may be included to filter out any strong line frequency content at 15,625 KHz. The **R&EW** prototype has been used with a wide range of recorders at different price levels and line frequency break through was not a problem. We have therefore not included this filter in our design.

The peak detector prevents the system responding to instantaneous clicks or noise spikes. This would result in highly objectionable noise bursts being reproduced. The attack time is chosen to be a compromise between rejecting noise spikes while not inhibiting high frequency transients.

The delay time is again a compromise. To slow a time would allow the system to remain 'wide open' for some period after a transient's decay,while too fast a decay would result in a loss of ambience due to harmonics occurring after a transient has been suppressed.

■ **R & EW**

Your Reactions.....	Circle No.
Excellent - will make one	143
Interesting - might make one	144
Seen Better	145
Comments	146

VIDEO NEWS

Peter Luke looks at a new recorder and has some heady thoughts.

MOST VIDEO RECORDER manufacturers appear to be expanding their range of machines to include four models. A 'basic' no-frill machine, a middle of the range model with a multi-event timer and some of the more popular trick video effects and a 'top of the tree' recorder with the darlings of the spec. sheet at the moment - Dolby noise reduction and stereo capability. The range is often rounded off with a portable system.

Panasonic have just fallen into this sort of plan with the launch of their NV333 recorder. This is a low cost, well £445.00, model that joins the existing range that is made up of the NV7200 (the 'middle man'), the NV7800 (flagship model with stereo) and the NV3000B (portable system).

The NV333 offers the familiar specification of a low-cost machine, one event 14 day timer, wired remote control (an optional extra at £8) etc. It also provides a solenoid operated tape transport and visual search which, while not present on the budget machines of two years ago, are to be expected on every video recorder today.

The timer features, what Panasonic choose to call, 'one-touch time recording' or OTR. This simplifies setting of the timer by providing record duration buttons for 30, 60, 90 or 120 minutes. Thus it is not necessary to set both start and stop times but only the start time and length of programme.

An additional feature, found on some but by no means all recorders, is a picture sharpness control. This allows the played back picture to be 'crisped up' when any inadequacies in the VHS standard (lack of definition and chroma noise) will be more pronounced, or to be 'softened' for a more subtle effect.

The NV333 nicely completes the Panasonic range and should be on display at the Company's numerous UK dealers.

DISCOUNT 82

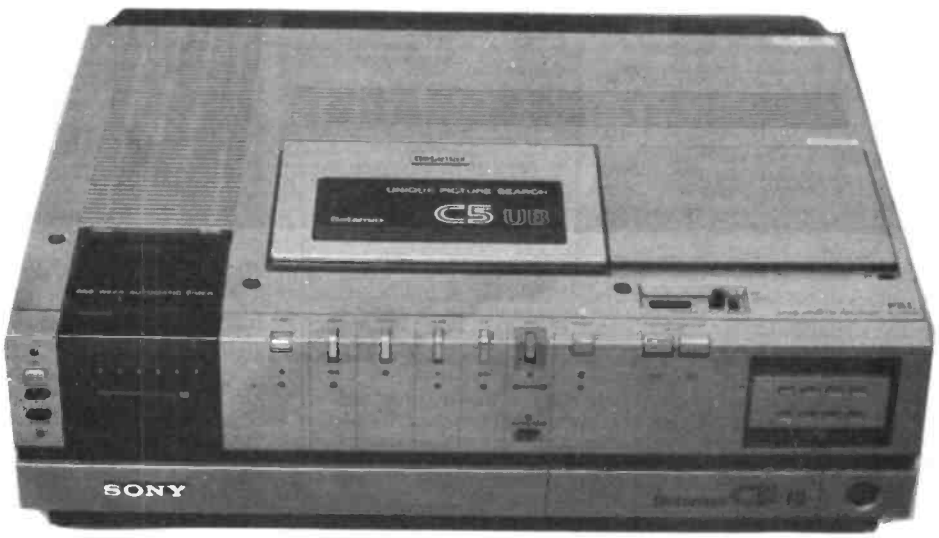
New recorders have been slightly thin on the ground this month so this is a good opportunity to put forward some general points about the video market, in particular about pricing policies and service contracts.

The early summer saw Sony C5 recorders available at less than £300, a price level that reflected Sony's desire to 'shift' the stock of C5s in order to make way for the C6 machine which replaces the earlier model.

At this sort of price, the recorders were almost being given away and anyone buying a C5 at this price certainly got a bargain. On the principle that you can't please all of the people, all of the time, this price cutting exercise left some people displeased. In this case, the 'we are not amused' comments were coming from some of Sony's dealers.

The reaction was probably rather more emotional than financial, however, as Sony had taken great pains to be as fair to their dealers as possible. A typical deal would have meant that an outlet with say five C5s, bought at the old price would have been sold a further five machines at a very low price such that the average price would have enabled the dealer to sell his stock at the £300 and still retain his margins. Sony allocated all their stock in this orderly fashion and maintained that in this way, the dealers could sell their stock faster, maintain their margins and should be pleased with the arrangement.

The grumblings of some dealers reflected a general dislike of price cutting however. Many is the high street shop that has found its stock of washing machines, hoovers etc., can become overpriced, overnight when some large multiple has obtained the same machine, at the end of its manufacturing life, at rock bottom prices and can retail it for less than the dealer paid, trade.



While in this instance Sony were as fair as possible (they could have sold the entire stock to just one large multiple and saved themselves a lot of administrative costs) the fear is that this will not always be the case.

Such an exercise also destroys the dealers beloved orderly pricing policy as other manufacturers followed Sony's price down. The result seemed like a VHS vs. Beta price war with Beta machines costing £100-£150 less than equivalent VHS models. All good for the customer, but good for the trade in the long run?

HEAD WEAR

The subject of video heads, and how long they can be expected to last is often a point of consideration when deciding whether or not to take out a service contract.

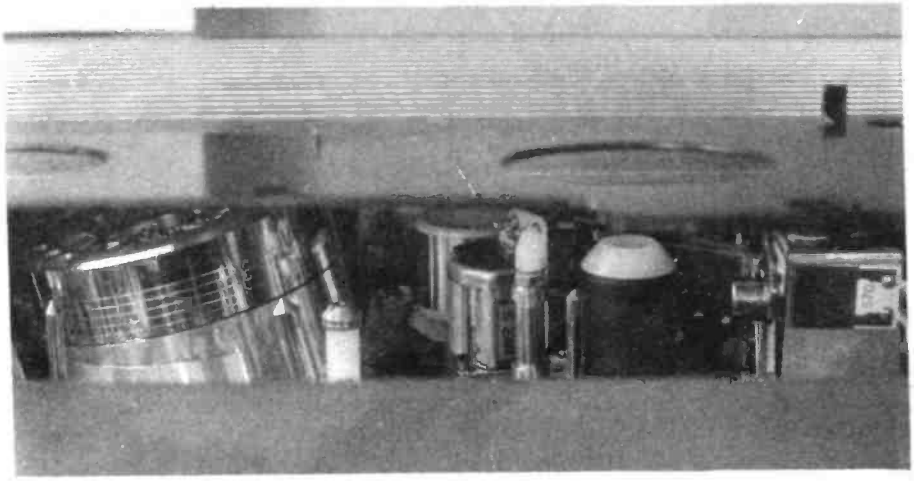
A video recorder's heads are often guaranteed for 500 hours of use, although will probably give a useful performance for far longer. Thus if one purchases a video recorder and after nine months of heavy use (in excess of 500 hours record/playback time - just over 1 hour a day) the heads need replacing, it would seem that the manufacturer is under no obligation to replace them. After all, the Sale of Goods Acts which form the basis of most Consumer protection rights state that goods purchased must be of merchandisable quality

Fair wear and tear would, presumably, be excluded from any such obligation, and thus the expense of replacing heads borne by the purchaser.

The small print of service contracts should also be examined, for while in the case of a TV set that malfunctions, the failure will generally be just that and not due to wear, for a video recorder the case is different.

The situation has some parallel to cars and a 'super cover' scheme. Thus if a car is so insured, while any failures would be dealt with under the scheme - the routine servicing costs of the vehicle would have to be met by the owner. The replacing of video heads is more akin to routine servicing than any failure.

It would therefore seem wise to ensure exactly what is covered by any service contract and, if possible get video heads explicitly included. Over a five year period, it could well be that heads will need replacing once or twice and that, if paid for by the scheme, would make such a service deal a very good idea.



Video heads — will you be responsible for their replacement.

If any of you have had to change heads under a service arrangement perhaps you would like to write to me at the **R&EW** offices and detail your experiences.

VIDEO WORLD SHOW

With the recent lifting of consumer credit restrictions, the video and Hi-Fi trade are looking to an extremely healthy end of year sales period. This likely upturn in trade should provide an additional boost to sales of video recorders, which although keeping a healthy profile during the summer, have done so by virtue of some of the exceptionally good deals referred to above.

These good sales prospects for the winter months should in turn lead to a healthy attendance level at London's latest Hi-Fi and Video exhibition, Hi-Fi and Video World, to be held at the Westmoreland Hotel (near Lords Cricket Ground) from October 8th to 10th.

The exhibition is to be sponsored by Bartletts Hi-Fi and Video Centre of 175 Holloway Road, London N7. The list of companies already booked to appear at the show reads the like the Who's Who of the video world or alternatively like an entry in a Japanese trade directory (they amount to the same thing).

Aiwa, Hitachi, JVC, Panasonic, San Sui and Sony have all planned displays and demonstrations. The driving force behind the event, George Bartlett, expressed surprise at the level of support received so far, saying that he would not have been surprised if some areas of the Hi-Fi trade had held back support from yet another audio/video show.

As far as we, the paying public are concerned, one of the most attractive features of the show will be that we do not have to pay. Admission will be free and with ample parking available at Lords Cricket Ground, the day should be easy on both pocket and nerves.

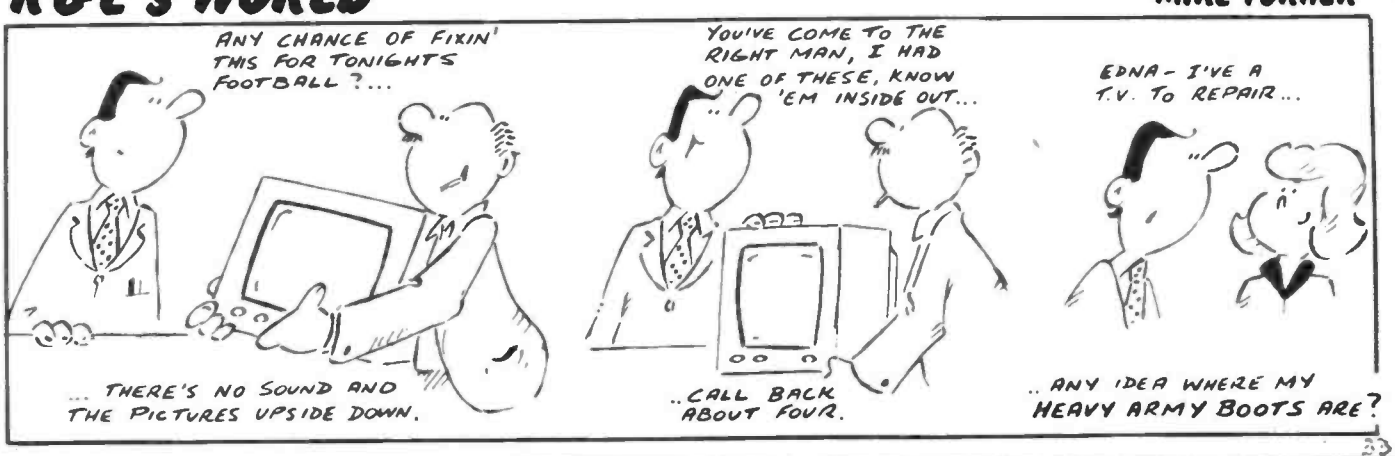
The exhibition opens at 15:00 on October the 8th closing at 20:00 that day, while on the Saturday and Sunday doors will open at 10:00 and close at 20:00.

Further information can be obtained from George Bartlett, Hi-Fi and Video World, Bartlett's Hi-Fi Centre, 175 Holloway Road, London N7. The telephone number there is 01-607 2296.

Your Reactions.....	Circle No.
Immediately Interesting	104
Possible application	105
Not interested in this topic	106
Bad feature/space waster	107

R&E's WORLD

MIKE TURNER



DESIGNERS UPDATE

Sophisticated linear ICs offer complete analogue subsystems within one or two ICs. Michael Graham looks at some of National Semiconductor's building blocks.

THE CONTINUOUS ADVANCES in integrated circuit technology have, in addition to making possible todays powerful MPUs and large capacity memories, spawned a range of sophisticated analogue subsystems based around one, or perhaps, two ICs. While some manufacturers tend to concentrate on digital devices, Zilog and AMD for example, others are involved with these analogue systems to a far greater extent. National fall into the latter camp and their *Linear Data Book* offers a cornucopia of device data and applications information ranging from basic op-amp configurations to details of a complete music centre based around some of the more adventurous of National's IC subsystems.

The quality of circuits presented in manufacturer's data books varies considerably, some presenting circuits which, if built as specified, work to spec. first time while others produce circuits which require a considerable amount of 'engineering' if they are to work at all (the saga of GI and their application note for a touch sensitive piano chip set still brings tears to many peoples eyes).

National fall midway between these two extremes, and while the majority of circuits presented in the Data Book will work, to extract the best performance from some, a certain amount of fine tuning may be necessary.

We've selectd a few of the more interesting devices featured in National's *Linear Data Book* in the hope they might provoke some of you into a little experimentation. We must stress that we have not built all of the circuits and, as mentioned above, can not guarantee that they will perform satisfactorily. Having said that, those that we have tried, have at least formed the basis of a workable system.

The devices shown here should be available from National Semiconductor franchised outlets.

Additional device information can be found in National's 1982 Linear Data Book.

LM1818 - ELECTRONICALLY SWITCHED AUDIO TAPE SYSTEM

The LM1818 contains all of the active electronics necessary for building a tape recorder deck (excluding the bias oscillator). The electronic functions on the chip include: a microphone and playback preamplifier, record and playback amplifiers, a meter driving circuit, and an automatic input level control circuit. The IC features complete internal electronic switching between the record and playback modes of operation. The multipole switch used in previous systems to switch between record and playback modes is replaced by a single pole switch thereby allowing for more flexibility and reliability in the recorder design.

PREAMPLIFIERS

There are 2 identical preamplifiers with 1 common output pin on the IC. One amplifies low level inputs such as a microphone in the record mode and another amplifies the signal from the playback head in the playback mode. The amplifiers use a common capacitor, C6, to set the low frequency pole of the closed loop responses. On the playback amplifier, the collector of the input device is made available so that an external low noise device can be connected in critical applications. When using an external low noise transistor, pins 17 and 18 of the IC are shorted together to ensure that the internal input transistor is turned OFF and the external transistor's collector is tied to pin 19. The input and feedback connections are now made to the external input transistor. The amplifiers are stable for all gains above 5 and have a typical open loop gain of 100dB. R8 and R9 enable C6 to be quickly charged and set the DC gain.

MONITOR AND RECORD AMPLIFIERS

The monitor and record amplifiers share common input and feedback connections but have separate outputs. During playback, the input signal is amplified and appears only at the playback monitor output. Because the outputs are separate different feedback components can be used and, as a result, totally different responses can be set. The amplifiers are stable for all closed loop gains above 3 and have an open loop gain of typically 80dB. The outputs are capable of supplying a minimum of 400uA into a load and swing within 500mV of either Vcc or ground. If more than 400uA is needed to drive a load, an external pull-up resistor on the output of these amplifiers can increase the load driving capability.

AUTOMATIC LEVEL CONTROL - ALC

The automatic level control provides a constant output level for a wide range of record source input levels. The ALC works on the varying impedance characteristic of a saturated transistor.

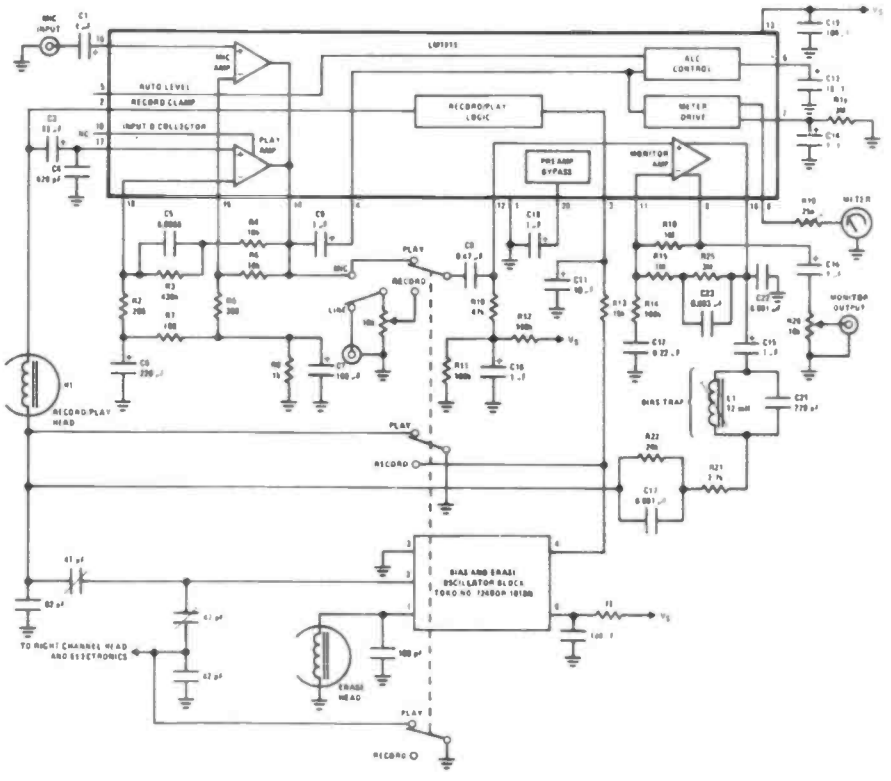
The gain of the ALC loop is such that a preamp input signal increase of 10dB will result in a 2dB increase on the AC output of the preamplifier. If greater than 25mVrms is desired at the output of the preamp, a series resistor can be added between the preamp output coupling capacitor and the ALC input (pin 4).

The ALC memory capacitor connected to pin 6 has the additional function of amplifier anti-pop control; for this reason, it is necessary that a capacitor be connected to pin 6 even if ALC is not used.

METER DRIVING — MOTIONAL PEAK LEVEL RESPONSE

The meter drive output (pin 8) is capable of supplying 1-2mA at a filtered DC voltage that is typicaly equal to 10 times the RMS value of the signal applied to the ALC-meter drive input pin (pin 4). The RC network connected to pin 7 of the IC determines the memory constant of the meter circuit. It is therefore possible to store the peak input signal by giving this RC network a long time constant, or read the instantaneous signal level by giving this RC network a very short time constant (i.e., no capacitor).

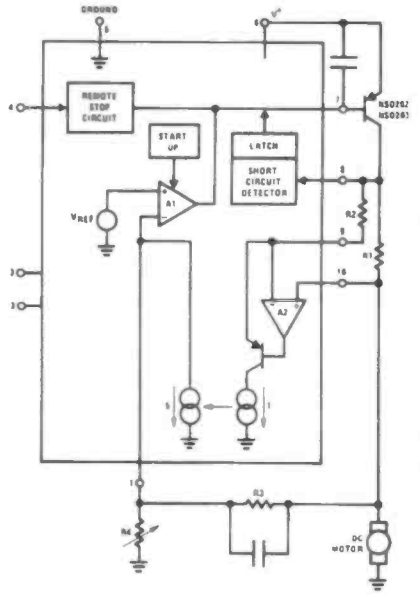
Different discharge rates allow the meter



circuit to display fast, accurate responses on the lower portion of the meter display, slow responses in the higher portion of the meter display, and rapid discharge when the voltage is above the maximum reading the meter can display. The resistor in series with the meter can be adjusted such that the previously mentioned responses coincide with the proper points (0 VU and +3 VU) on the meter scale.

RECORD PLAYBACK SWITCH

When the voltage on pin 3 of the IC is greater than 0.5 Vcc, the internal record playback switch switches into the playback mode. During playback the record preamplifier remains partially biased but the input signal to this preamp does not appear at the preamplifier output. In addition, during the playback mode, the record monitor output (pin 9) is disabled and the ALC circuit operates to minimize the signal into the record preamp input. The meter circuit is operational in the playback as well as the record mode. Similarly, during the record mode, the playback preamp input is ignored and the playback monitor output is disabled. In addition, a pin is available to hold one side of the record head at ground potential while sinking up to 500uA of AC bias and record current.



LM1014 - MOTOR SPEED REGULATOR

The LM1014 is designed for controlling low voltage DC motors. It features a 5V to 20V operating range, short circuit protection, torque compensation and a remote pause control.

TYPICAL PERFORMANCE CHARACTERISTICS

1. The output voltage V_M is given by:

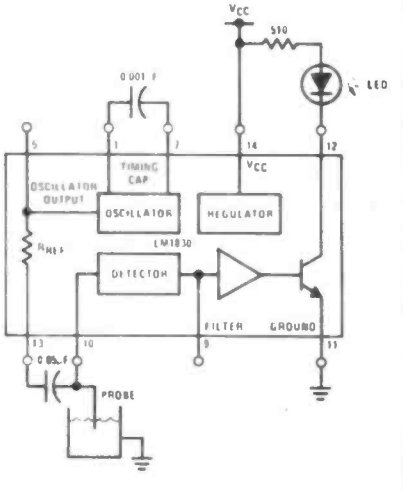
$$V_M = V_{REF}(1 + \frac{R3}{R4}) + 1_M \frac{R1\ R3}{5R2}$$

2. R1 R3/5R2 must be equal to dynamic motor winding resistance R_M in order to keep the speed constant during load torque variations.
3. Four selectable temperature coefficients by grounding pin 2 and/or pin 3 for temperature compensation of motor characteristic.
4. Parameter of the motor used for the test results shown below: R_M = 16.3Ω and back e.m.f. = 3.25V @ 2000 r.p.m.; torque constant 5.9 mA/mNm; External components: R1 = 1Ω Cu, R2 =

LM1830 FLUID DETECTOR

The LM1830 is a monolithic bipolar integrated circuit designed for use in fluid detection systems. The circuit is ideal for detecting the presence, absence, or level of water, or other polar liquids. An ac signal is passed through two probes within the fluid. A detector determines the presence or absence of the fluid by comparing the resistance of the fluid between the probes with the resistance internal to the integrated circuit. An ac signal is used to overcome plating problems incurred by using a dc source. A pin is available for connecting an external resistance in cases where the fluid impedance is of a different magnitude than that of the internal resistor. When the probe resistance increases above the preset value, the oscillator signal is coupled to the base of the open-collector output transistor. In a typical application, the output could be used to drive a LED, loudspeaker or a low current relay.

In a typical application where the device is employed for sensing low water level in a tank, a simple steel probe may be inserted in the top of the tank with the tank grounded. Then when the water level drops below the tip of the probe, the resistance will rise between the probe and the tank and the alarm will be operated. This is illustrated in The Circuit. In situations where a non-conductive container is used, the probe may be designed in a number of ways. In some cases a simple phono plug can be employed. Other probe designs include conductive parallel strips on printed circuit boards.



200Ω and R3 = 16kΩ; V_{REF} = 1.13V (pin 2 grounded); C_{BE} = 2.2uF and C3 = 0.47uF.

LM1886 AND LM1889 - COLOUR TV ENCODER AND MODULATOR

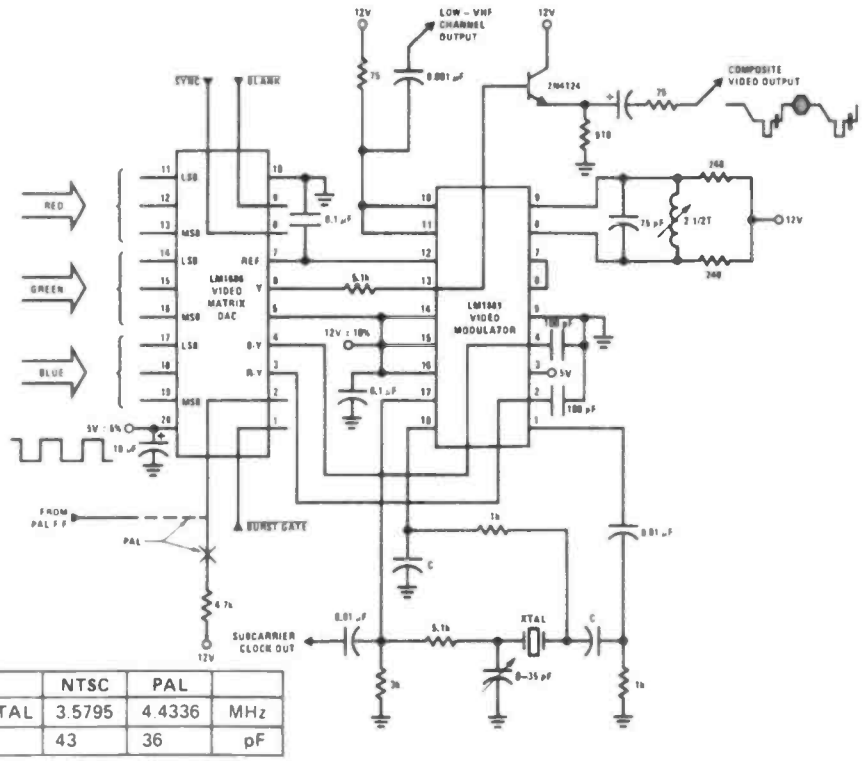
The LM1886 is a TV video matrix D to A converter which encodes luminance and colour difference signals from 3-bit red, green and blue inputs. The luminance output is encoded from the NTSC equation Y = 0.3R + 0.59G + 0.11B and the R-Y and B-Y outputs are weighted to prevent over-modulation. A built-in R-Y and burst gate polarity switch allow PAL compatible signals to be encoded.

When used in combination with the LM1889 and a suitable sync generator, 3-bit R, G and B information may be encoded to both composite video and RF channel carrier.

CIRCUIT DESCRIPTION

The 3-bit red, green, and blue inputs go to identical 3-bit current-mode digital-to-analog converters (DACs). Each DAC consists of three binary-weighted current sources controlled by diff-amp current switches. The DAC output currents are arbitrarily given a weighting factor of 0.59, which is the green coefficient in the luminance equation. Portions of the red and blue currents are split off, so that the remaining currents combined with the green current form the luminance current I_Y = 0.3 I_R + 0.59 I_G + 0.11 I_B. I_Y develops the luminance voltage V_Y across R_O in a summing amplifier referenced to the + 5V supply. A current switch operated by pin 8 adds (-) sync pulses to the Y output at pin 6.

The portions of red and blue currents previously split off flow through resistors R_O/0.29 and R_O/0.48, which are weighted to form the red and blue voltages respectively. Since the opposite ends of the 2 resistors are connected to V_Y, the red and blue voltages across the resistors subtract from V_Y to develop the colour difference voltages V_{Y-R} and V_{Y-B}. V_{Y-B} is coupled through a X.56 gain, 5V-referenced inverting amplifier to the B-Y output at pin 4. V_{Y-R} feeds parallel inverting and non-inverting unity gain amplifiers which allow either polarity to be coupled to the R-Y output pin 3. Switching between the 2 amplifiers is controlled by a current switch activated by the H/2 pin 2. A (-) burst gate pulse on pin 1 controls current switches which add the burst pulse components to the B-Y and R-Y outputs.



	NTSC	PAL	
XTAL	3.5795	4.4336	MHz
C	43	36	pF

The requirements for PAL and NTSC encoding differ in the areas of burst gate operation and R-Y polarity, both of which are controlled via pin 2 as follows:

PAL, pin 2 fed by a half-line frequency TTL square wave - in this mode a PNP switch between pin 2 and + 5V is held off continuously, which results in equal burst pulse components on the B-Y and R-Y outputs. In addition, the H/2 square wave causes the R-Y output polarity to reverse every line. (When fed to the LM1889 chroma modulator this causes the phase of the R-Y subcarrier to change 180° as required in PAL.)

NTSC, pin 2 tied through an external resistor to + 12V - this turns on the PNP switch continuously, which eliminates the burst pulse on the R-Y output and increases the amplitude of the B-Y pulse. Since pin 2 is being held high, the R-Y output is locked in the positive polarity.

Blanking is activated by a low on pin 9, which de-biases the left side of the DAC diff-amps, so that I_R = I_G = I_B = 0 independent of the input states. When blanked, the Y, B-Y and R-Y outputs all go to + 5V. An additional amplifier produces a 0 carrier reference voltage at pin 7 which is 25% above the peak white voltage on the Y output, relative to + 5V.

LM1812 - ULTRASONIC TRANSCEIVER

The LM1812 is a general purpose ultrasonic transceiver designed for use in a variety of ranging, sensing, and communications applications. The chip contains a pulse-modulated class C transmitter, a high gain receiver, a pulse modulation detector, and noise rejection circuitry.

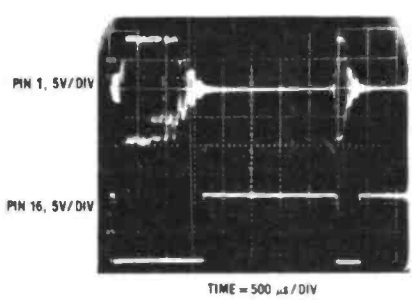
A single LC network defines the operating frequency for both the transmitter and receiver. The class C transmitter output drives up to 1A (12W) peak at frequencies up to 325kHz. The externally programmed receiver gain provides a detection sensitivity of 200uVp-p. Detection circuitry included on-chip is capable of rejecting impulse noise with external programming. The detector output sinks up to 1A.

Applications include sonar systems, non-contact ranging and acoustical data links, in both liquid and gas ambients.

TRANSMITTER

The transmitter consists of an oscillator, a 1uS one-shot, and a power amplifier.

When the transmitter is keyed ON at pin 8, the L1-C1 tank is switched to the oscillator mode. An on-chip 1uS one-shot is triggered with each cycle of the oscillator and, in turn, drives a power amplifier. This one-shot has a reset time of 2uS, limiting the maximum operating frequency to about



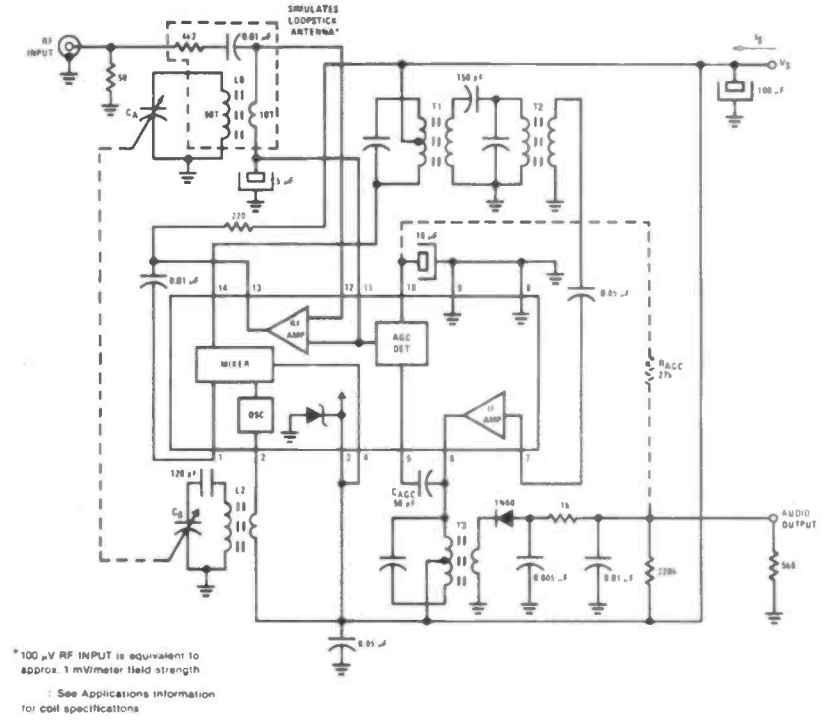
LM3820 AM RADIO SYSTEM

The LM3820 is a 3-stage AM radio IC consisting of an RF amplifier, oscillator, mixer, IF amplifier, AGC detector, and zener regulator.

The device was originally designed for use in slug-tuned auto radio applications, but is also suitable for capacitor-tuned portable radios.

APPLICATIONS INFORMATION

The circuit shown is recommended as a starting point for portable radio designs. Loopstick antenna L1 is used in place of L0, and the RF amplifier is used with a resistor load to drive the mixer. A double tuned circuit at the output of the mixer provides selectivity, while the remainder of the gain is provided by the IF section, which is matched to the diode through a unity turns ratio transformer. RAGC may be used in place of CAGC to bypass the internal AGC detector and provide more recovered audio.



325kHz. A transformer couples the transducer to the output stage.

The oscillator frequency is set by L1-C1 and can be calculated from

$$f_0 = \frac{1}{2\pi\sqrt{L1C1}}$$

RECEIVER

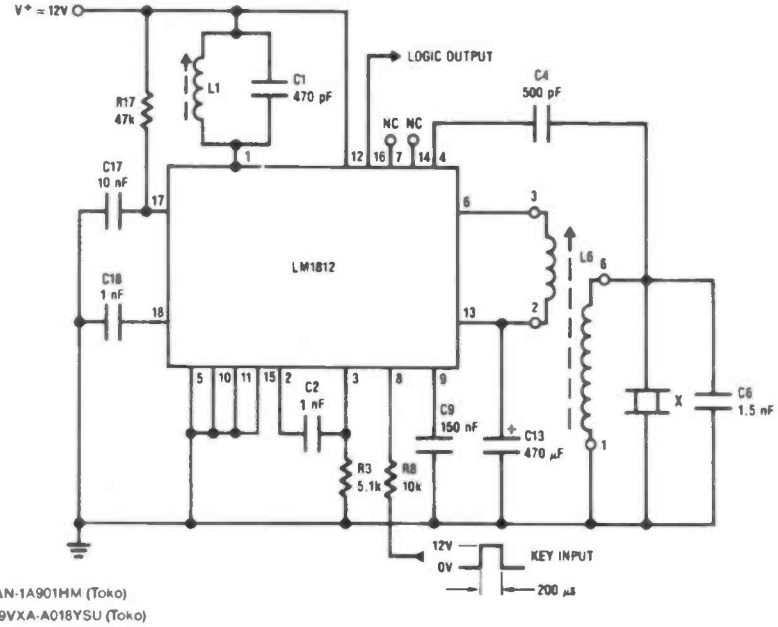
The receiver section contains two separate gain stages.

In some applications large voltages are applied across the transducer during transmit. Since the receiver input is coupled to the transducer, some protection is necessary to limit the input current spikes to less than 50mA. Where the voltage across the transducer is less than 200 Vp-p, a C4 reactance of 5kΩ at the operating frequency is adequate protection. Above 200 Vp-p, a 5kΩ resistor should be inserted in series with C4.

PULSE DETECTOR

The pulse detector circuitry consists of five distinct stages: 1) threshold detector, 2) pulse integrator reset, 3) pulse integrator, 4) output driver, 5) power output stage.

The detector (Q1,Q2) switches on all pin 1 signals that exceed 1.4 Vp-p. Since noise pulses are also detected, filtering is done by an integrator stage, C17 and R17 whose time constant is typically 10% to 50% of the transmit time. Integration starts when Q3 turns OFF, which occurs at the same moment Q1 and Q2 detect a signal. Pins 16 and 14 go low after the integration delay.



L1 = CAN-1A901HM (Toko)
L6 = 719VXA-A018YSU (Toko)
X = R283E (Massa Products)

CIRCUIT DESCRIPTION

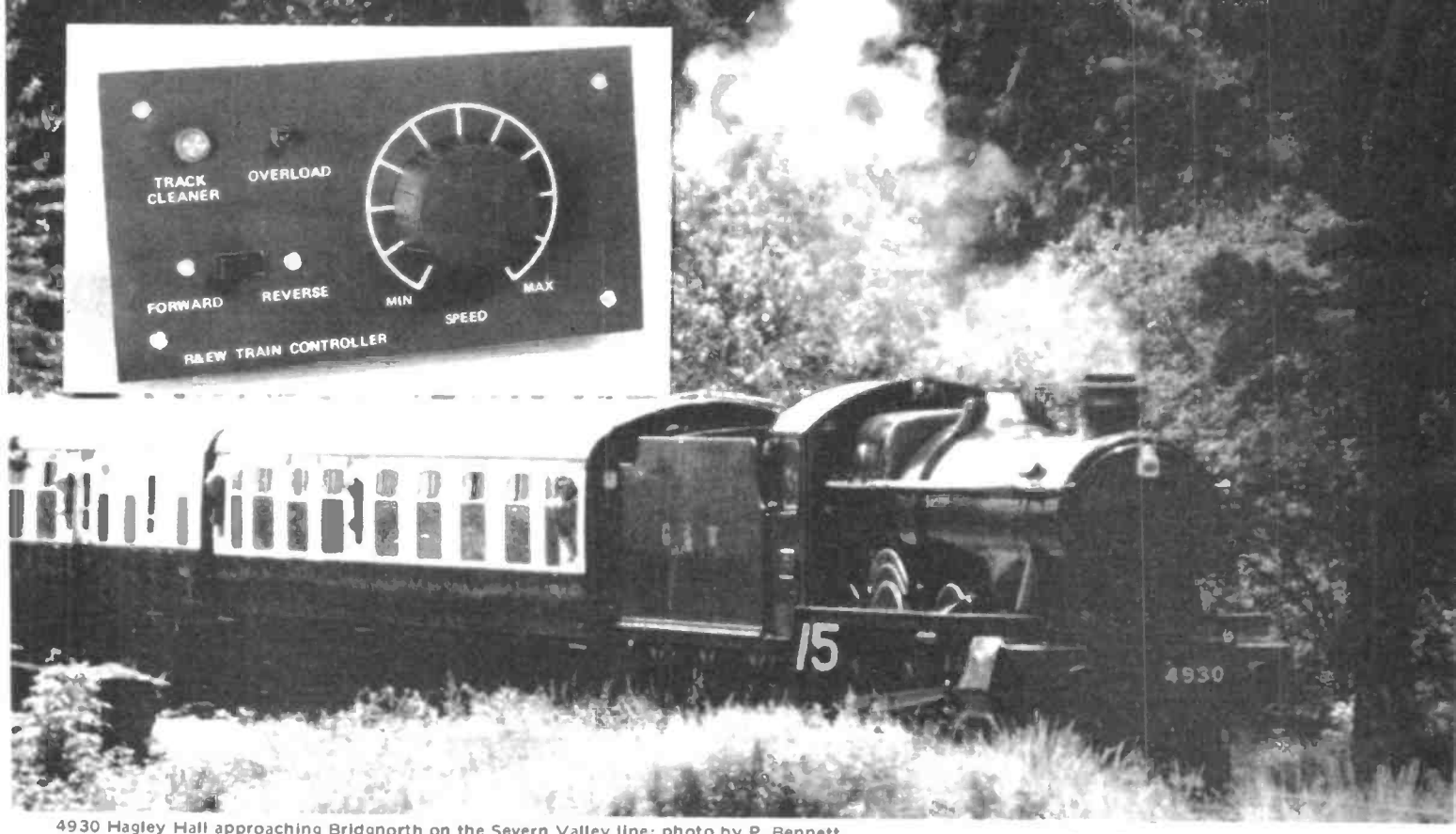
The Circuit provides a CMOS compatible logic output. For driving high-intensity displays, pin 14 will sink up to 1A When driving a transformer such as T14 in *Fig. 1*, it is possible for the primary current to integrate up to destructive levels under conditions of multiple echo reception. Pin 11 is employed to protect the power output (pin 14) C11 integrates an internal current source while pin 14 is low. When V11 reaches a 0.7V threshold, the second gain stage is turned OFF. With the receiver OFF, no signal will be applied to the detector and pin 14 will turn OFF. After another delay C11 is discharged and the receiver is then again activated. With C11 = 680nF and a continuous echo return, the receiver will cycle ON and OFF every 6ms. This function can be defeated by grounding pin 11.

TYPICAL OPERATION

The 'scope trace shows typical waveforms at pins 1 and 16 for 200kHz operation, with pin 9 left open. The pin 1 oscillator signal (5 Vp-p) lasts for 200uS. The next 900uS show a ring signal so strong that it is clipped by the receiver. The exponential nature of the decaying ring is seen for the next 500uS. An echo return appears at 3.9mS. Note that the detector is held low during the transmit period and for the duration of the ring.

■ R&EW

Your Reactions.....	Circle No.
Immediately Interesting	16
Possible application	17
Not interested in this topic	18
Bad feature/space waster	19



4930 Hagley Hall approaching Bridgnorth on the Severn Valley line: photo by P. Bennett.

traincontroller

Ray Marston describes another practical application for his SMVF circuit.

THE VERY SOPHISTICATED model-locomotive controller/regulator described here uses the brand new 'amplified-feedback Switched-Mode Voltage Follower' principle described in August and September "Data File", and gives degrees of speed control and regulation that are vastly superior to those available from any commercial unit or from any previously published designs.

Our controller can smoothly vary loco' speeds all the way from an 'imperceptible' (1cm/minute) up to the maximum '12V' value, irrespective of whether the loco' is unloaded or hauling a heavy load. The unit can drive up to three locos simultaneously and is ideal for double- or triple-headed operations. Most important of all, the unit incorporates fully automatic speed regulation circuitry, which continuously monitors the speed of the loco's motor via its 'dynamo effect' voltage and thence adjusts the power feed to hold the speed constant at the desired value, irrespective of loading conditions or the state of the track.

Thus, if the loco' is running around a track, hauling a load at a particular speed, and then starts to run down an incline, the circuit automatically reduces the power drive to hold the motor (and thus the drive-wheel) speed constant. If the loco' starts to climb an incline, the unit automatically increases the power drive, to maintain the speed. If the incline is so steep that the loco' cannot climb it, the power drive simply increases to such a level that the drive wheels spin at the same speed as they would if the loco' were running on the level or down hill. The 'regulation' circuitry is fully effective, all the way from low speeds up to maximum.

Our controller/regulator has lots of other attractive features. It incorporates fully automatic output protection circuitry, with audio/visual FAULT indication. If output loading is excessive (greater than 1.2 amps mean), the feed to the track and the FAULT indicator pulses on and off once per second. If a short occurs across the track, shut-down circuitry automatically reduces the mean output current to 1.5mA and the FAULT indicator turns fully on, with a LED illuminating and the audio circuit generating a pulsed-tone alarm signal. Full power is automatically restored within 500mS of the short being removed.

HIGH-VOLTAGE TRACK CLEANING

Other pieces of built-in sophistication are a loco' DIRECTION switch and a fully automatic high-voltage 'track cleaner'. This track cleaner continuously monitors the impedance between the tracks. If the loco' is making good contact with the track, a low impedance is registered and the cleaner is inoperative. If the loco' reaches a section of track that is badly oxidised, however, the loco' loses contact with the track and a high impedance is registered. Under this condition, the cleaner applies a high-impedance, high-frequency (up to 40kHz), high- voltage (typically 600V peak-to-peak) signal to the track, thereby breaking through the oxide and restoring contact with the loco'. Since this signal is at a high impedance, it presents no danger to the operator. The output to the track cleaner is continuously monitored by a neon lamp, giving a visual indication of the state of the cleaner and of the track. The cleaner turns off automatically when the loco' drive is reduced to zero.

A final unique feature of our model-locomotive controller/regulator unit is that if two (or more) such circuits are built and

CIRCUIT DESCRIPTION

The major part of the circuit is shown in *Fig. 1* and is simply a practical implementation of the 'amplified-feedback SMVF' circuit given in *Fig. 3* of "Data File No. 10". IC1-IC2-RV1, etc., form the basic circuit, but with slight additional offset biasing given by R2, to compensate for poor-quality RV1 pots that do not quite give zero resistance in the 'low' position. Note, however, that resistor R5 has a lower value than in *Fig 3*, to give a low value of hysteresis voltage and a wider-than-normal range of motor-speed control, and that diodes D1-D2 are wired in series to give a ceiling value of 1V2, to accommodate the very 'dirty' track-derived loco' motor signals. The IC1-IC2 supply is decoupled from the main supply via C2-D3, and the switched-mode output of IC2 is fed to Darlington output transistors Q7-Q8 via the Q6 driver stage.

The unit has comprehensive output protection, via monitor resistor R24. Mean output currents are sensed via Q3 and integrating components C6-R16; Q3 turn on when mean currents exceed 1.2 amps, and thence activates monostable IC3. Peak currents are sensed via the R19 and R22 divider, which feeds the bases of Q4 and Q5. Then peak currents reach 3.6 amps, Q5 starts robbing base drive from Q7-Q8, and Q4 turns on and fires the IC3 monostable. When IC3 fires it activates the FAULT indicator LED via Q1, and also audio alarm IC4, and simultaneously removes all Q6 base drive via Q2, thereby disabling the Q7-Q8 output circuitry for the duration of the 500mS monostable pulse. In the event of a shorted output, this circuitry limits the mean output current to about 1.5mA. Note that C8 reduces the rise times of the monostable trigger signals, enabling the circuit to power slightly capacitive loads without triggering the 'short circuit' protection circuitry, while at the same time rejecting RF pick-up signals from the high-frequency high-voltage track cleaner circuit.

The track cleaner circuit is based on blocking oscillator Q9, in which changes of loading on the secondary of the transformer (T1 in *Fig. 2*) are reflected to the primary and control the action of Q9. When the output is heavily loaded (by impedances less than a few kilohms) the primary impedance is so low that the circuit cannot oscillate. Under this condition, negligible Q9 base-bias is provided by R30-31, and Q9 draws only a few tens of mA from the output of the main circuit. When the output of T1 is unloaded, the primary appears as a high impedance, so the gain between Q9 collector and base is sufficient to cause the circuit to oscillate. The oscillation signals are rectified by the Q9 base-emitter junction, causing Q9 emitter to rise to half-supply volts. Under this condition, Q9 draws roughly 120mA from the output of the main circuit; the primary signals are stepped up at the secondary, where they have typical peak-to-peak amplitudes of 600V, and these signals are added to the output of the main 'amplified-feedback SMVF' circuit. Note that the output current of the main circuit passes through the secondary winding of T1.

Also note that, as far as the Q9 blocking oscillator is concerned, the output of the main circuit appears as a short- circuit, so the signals and impedances on the track are the same as those on the output of T1. Neon lamp N1 thus effectively monitors the output voltage of T1. The oscillation frequency of Q9 is determined by C14 and the capacitance of the track or any track load. With no track connected, the circuit oscillates at about 40kHz. Up to 1n0 of capacitance can be connected across the track without significantly impairing the action of the track cleaner. When a loco' is making contact with the track the oscillator is, of course, disabled.

Also note that, because the track cleaner has an inherently high output impedance, it presents no danger to the operator. Finally, note that, since the track cleaner is powered via the output of the main unit, it is only 'active' during the MARK parts of the SMVF waveform, and is completely disabled when the SMVF circuit is set to give zero output, and during all SPACE parts of the waveform; it thus has no impairing effects on the 'dynamo voltage-sensing' characteristics of the main amplified- feedback SMVF circuit.

are individually powered, and have their outputs shorted together in the same polarity, the unit with the higher mean output voltage automatically causes the other unit to shut down. This feature greatly simplifies model railway control, since to change a loco' from one track to another it is simply necessary to throw the track points and let the controller with the higher setting take over, rather than to go through a complicated procedure of sequentially operating the controllers and points, as in a normal system. If the two outputs are shorted together in opposing polarities, both units simply register short circuits and automatically shut down.

CONSTRUCTION AND USE

The circuit of the main unit is shown in *Fig. 1*. Construction of this part of the unit should present few problems. Note, however, that RV1 is a dual-gang linear pot, and that the two halves are wired to the circuit in anti-phase (as indicated by the 'spots'). R24 is the current-monitor resistor, and needs a rating of 1 watt. Output transistor Q8 dissipates negligible power and does not need a heatsink.

The power supply circuit is shown in *Fig. 2*, and should be connected to the main circuit at the points indicated, with the positive connection to the 'hot' side of R24 and the negative to the negative output terminal.

Figure 2 also shows the output circuitry, comprising the loco' DIRECTION switch and the 'home built' high-voltage track cleaner. Alternatively *Fig. 3* shows the output circuitry based on a commercially available track cleaner unit. If you opt for the home-built track cleaner system, note

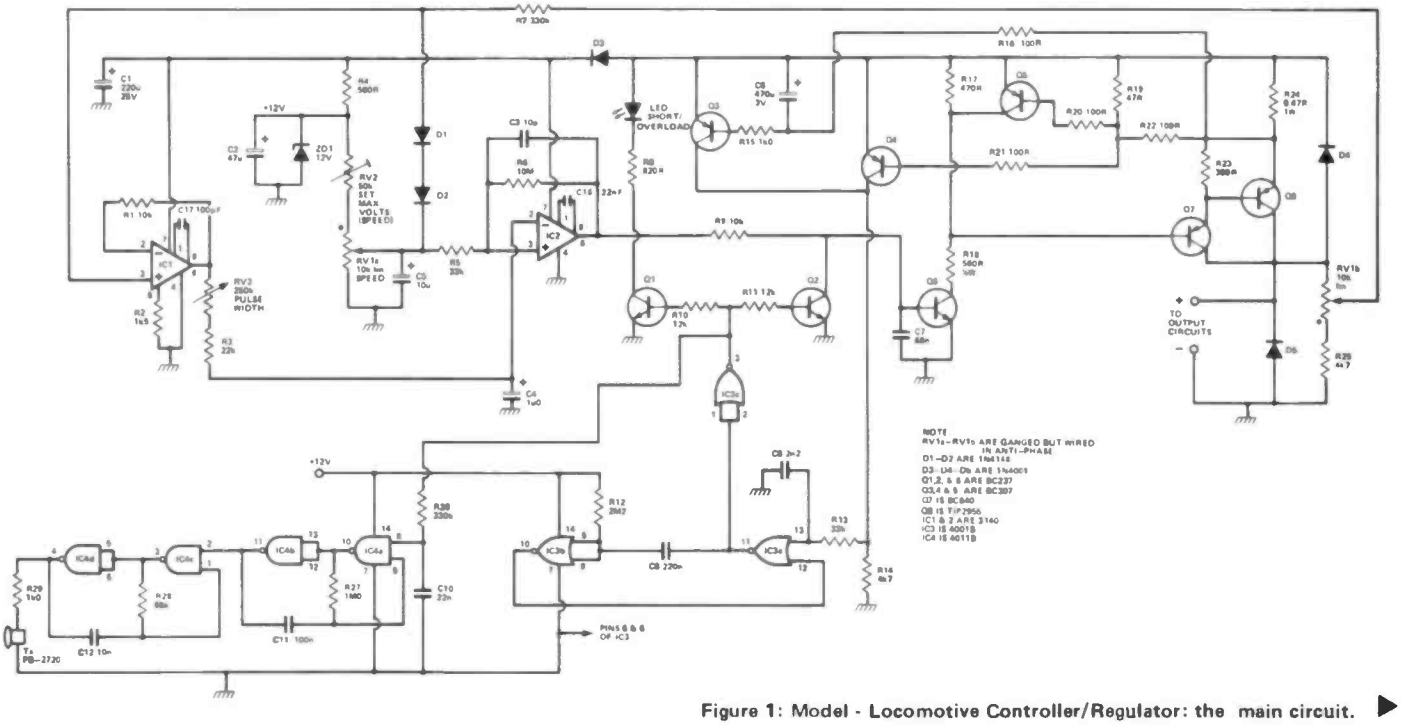
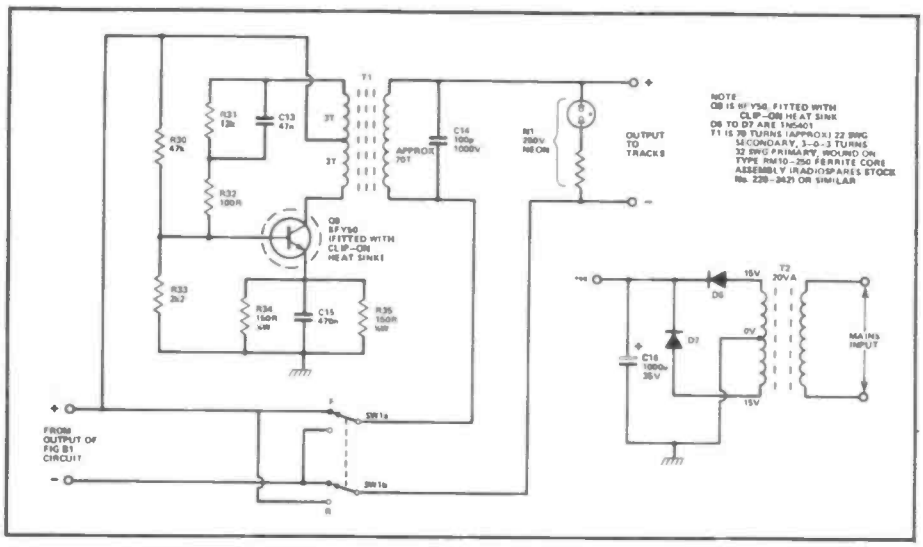


Figure 1: Model - Locomotive Controller/Regulator: the main circuit. ▶



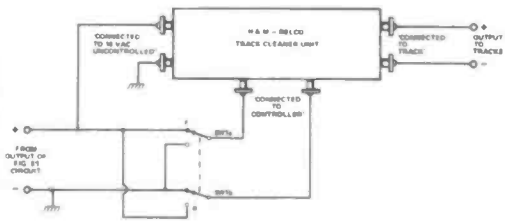
that the track cleaner transformer is a 'special' that you will have to wind for yourself. The ferrite core assembly is a type RM10-250 kit (available from Watford Electronics, or from Radiospares as stock number 228-242) or similar 'large' unit.

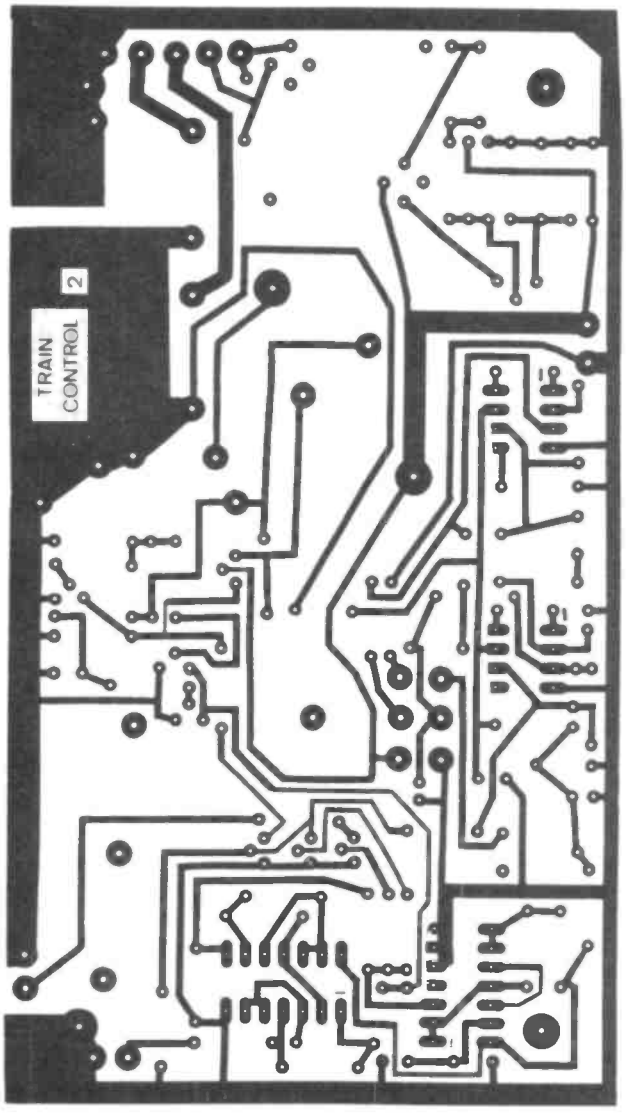
The secondary is wound first, using about 70 turns (or as many as you can comfortably get on the former) of 22swg insulated copper wire. This can then be covered with a thin layer of insulation tape.

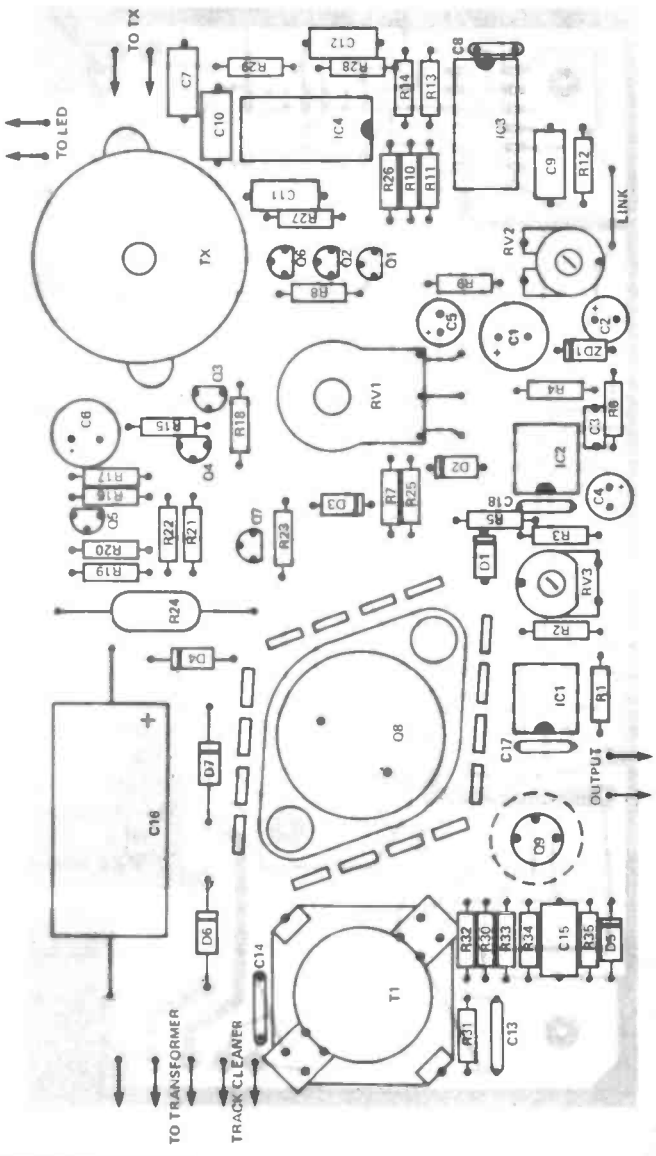
The primary is then wound on, and comprises 6 centre-tapped turns (3-0-3) of 32swg insulated copper wire. The complete transformer is fixed to the PCB 'upside-down', with its connection tabs sticking upwards. Note that track cleaner transistor Q9 needs to be fitted with a clip-on heatsink.

When construction of the entire unit is complete double-check all wiring and then test and adjust the unit as follows.

(1) Switch the circuit on and, with no output connected, wind up RV1 and check that the neon lamp illuminates, indicating that the track cleaner is working. If all is well, connect a 1k2 resistor across the output and check that the neon turns off.
(2) Connect the unit's output to the track, and fit a loco' in place. Turn RV1 slightly above zero until pulses of power can be heard reaching the loco'. Adjust RV3 so that each pulse produces a small but finite movement of the loco' wheels.
(3) Increase the RV1 setting, checking that the loco' speed increases smoothly. Set RV1 to maximum and, with an analogue voltmeter connected across D5 (the output of the basic unit) adjust RV2 for a reading of 12V with the loco' unloaded.
(4) Reduce RV1 to give an output of 4 to







COMPONENTS LIST

Resistors (all ¼W 5% carbon film except where shown)

R1,9	10k
R2	1k5
R3	22k
R4	560R
R5,13	33k
R6	10M
R8	820R
R10,11,31	12k
R12	2M2
R14,25	4k7
R15,29	1k
R16,20,21, 22,32	100R
R17	470R
R18	560R ½W
R19	47R
R23	390k
R24	0.47k 1W
R26	330k
R27	1M
R28	68k
R30	47k
R33	2k2
R34,35	150R ½W
RV1	10k lin dual gang

Capacitors

C1	220u 25V Electrolytic
C2	47u 16V
C3	10p ceramic
C4	1u 50V electrolytic
C5	10u 16V electrolytic
C6	470u 6V3 electrolytic
C7	68u polyester
C8	2u2 ceramic
C9	220u polycarbonate
C10	22u polyester
C11	100u polyester
C12	10u polyester
C13	47u polyester
C14	100p 1kV ceramic
C15	470u polycarbonate
C16	1000u 35V electrolytic
C17	100p ceramic
C18	22u ceramic

Semiconductor

IC1,IC2	CA3140E
IC3	4001B
IC4	4011B
Q1,2,6	BC237
Q3,4,5	BC307
Q7	BC640
Q8	MJ2955
Q9	BFY50
D1,2	IN4148
D3,4,5	IN4001
D6,7	IN5401
ZD1	12V zener
LED	5mm Red LED

Miscellaneous

2 off 8 pin DIL Socket
2 off 14 pin DIL Socket
1 off TO5 Heatsink
1 off TO5 Heatsink
1 off RM10 Core
1 off Neon
1 off PCB
1 off Change-over switch
22swg and 32swg enamelled copper wire, knob.
Mains transformer 15-0-15V 25uA, Front panel, spacers, 6BA nuts, bolts and washers.

5V. Run the loco' on to a finger or buffer and check that the drive wheels keep turning at normal running speed, even though the actual loco' is stopped, and that the output voltage increases. Stall the loco' and check that the output increases further. (5) Place a short across the track and check that the audio/visual FAULT alarm activates. Remove the short and check that the alarm condition ceases. All adjustments/tests are then complete, and the unit is ready for use.

Note that, once the above tests are complete, RV2 needs no further adjustment. RV3 may requiree re-adjustment to suit individual loco's, and is simply set to give a definite but minimal motor movement with each 'pulse' at minimum speed.

■ R & EW

Your Reactions.....	Circle No.
Excellent - will make one	24
Interesting - might make one	25
Seen Better	26
Comments	27

CIRCUIT BLOCKS

Design by Richard Collins.

A versatile fixed period timer with 'delay to on' or 'delay to off' capability

MANY APPLICATIONS EXIST where there is a requirement for a fixed period timer to control the mains supply to a piece of equipment. The basic circuit shown here, based on the Ferranti ZN1034E chip, was originally designed to control an extractor fan, providing a five minute cycle after activation. The circuit is of the "delay to off" type. Simple changes make a "delay to on" type possible and by alteration of the timing resistor/capacitor network (R2/C2) almost any period is possible from one second to in excess of 24 hours.

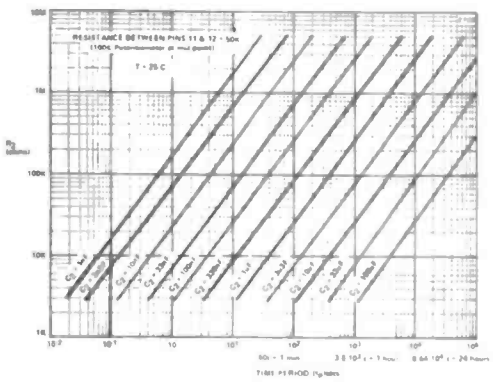


Figure 1: Timing component selection chart.

Suitable components can be selected using the chart shown. Fine adjustment of time periods are possible by means of the 100k trimmer (R3) connected between pins 11, 12 on the ZX1034E. The components R1/C3 are an additional circuit added to ensure the timing period finished at the preset time even in a 'noisy' mains environment. C3 effectively grounds the trigger input on the IC to switch 'on' starting the timed period, but then charges via R1 so that the trigger is then held 'high', making further triggering impossible.

For "delay to on" timer, following changes are required:

(1) Connect R5 to pin 2 on the IC (instead of pin 3).

(2) Wire mains circuit as shown below:

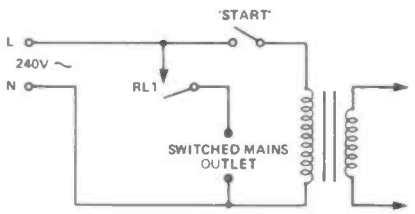


Figure 2: Wiring changes for a "delay to " timer.

BASIC OPERATION

(A) "Delay to off" circuit - mains supply is momentarily connected via the start push button. The timer circuit is activated and pin 3 on the IC goes high, turning on the relay which then holds the mains supply connected, until after the preset time when pin 3 goes low again and the relay drops out, switching 'off' the mains.

(B) "Delay to on" circuit - mains supply is connected via a standard single pole switch activating the timer. Pin 2 stays low until after the preset period when it goes high, activating the relay and connecting power to the outlet.

■ R & EW

Your Reactions.....	Circle No.
Immediately Interesting	28
Possible application	29
Not interested in this topic	30
Bad feature/space waster	31

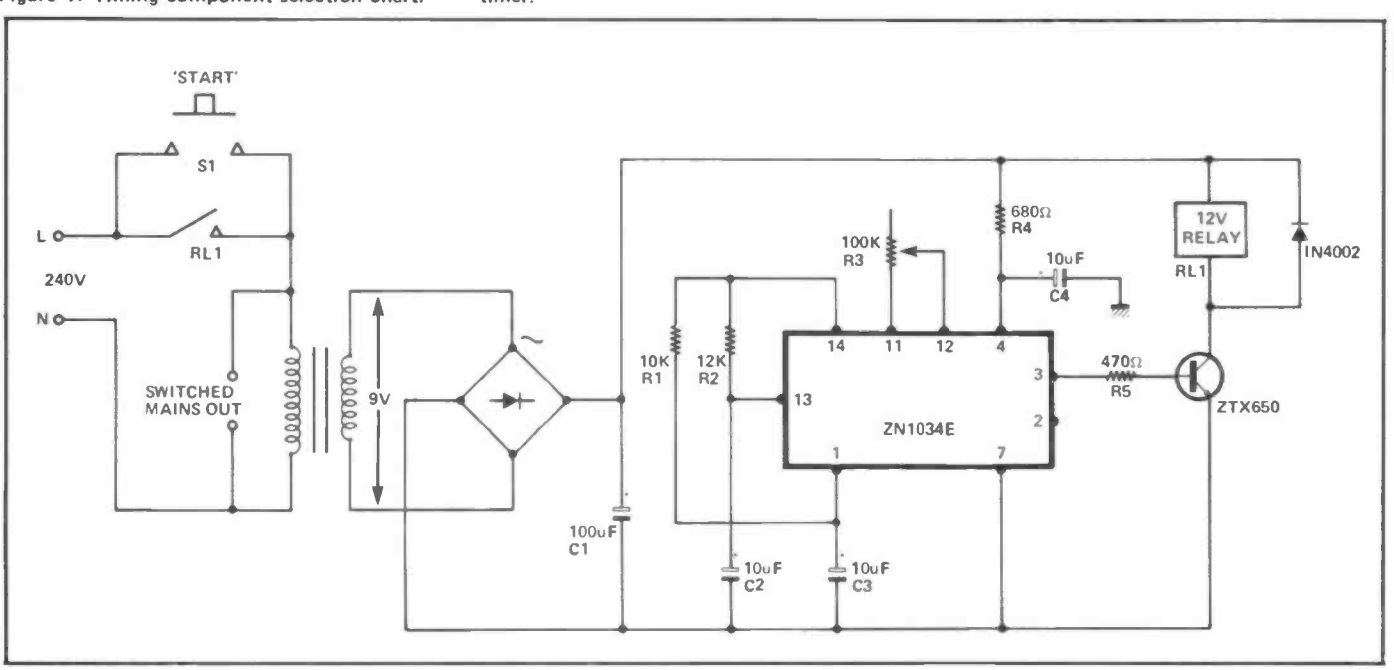


Figure 3: Circuit diagram of the "delay to off" timer.

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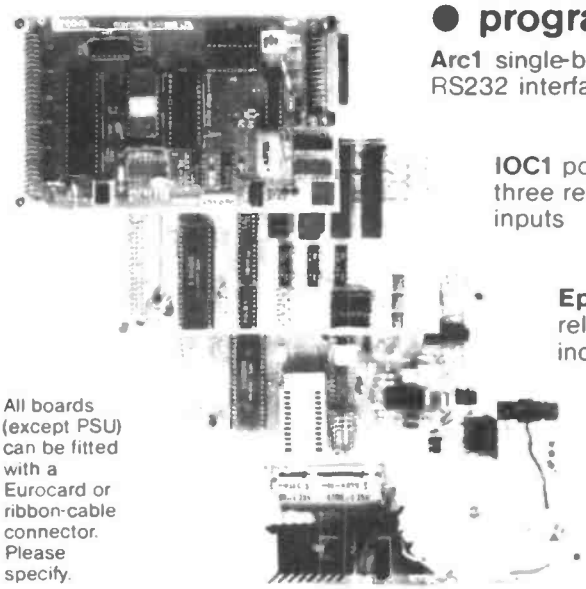

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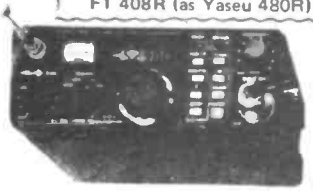

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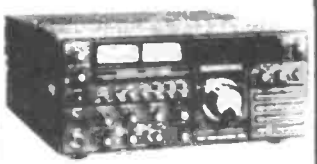

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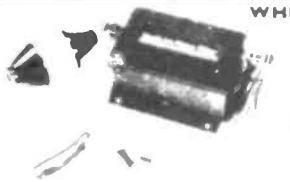

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196 for further details

AMATEUR RADIO WORLD

Compiled by Arthur C Gee. G2UK

The author of this series is a well known radio amateur who has been very actively associated with the promotion of a number of 'advances' in amateur radio. These include the British Amateur Teleprinter Group, BARTG, of which he was founder and AMSAT-UK of which he is Chairman. during the last war, before joining up, he was one of the band of voluntary interceptors who were enrolled in, the Radio Security Service. He was a co-founder of 'Radio & Electronics Constructors' and in 1956 he was awarded the Calcutta Key by the R.S.G.B.

THIS IS THE FIRST of a series of bi-monthly articles that will aim to round up news items of interest to the radio amateur. A pretty formidable assignment this, as it depends so much on 'rapid communications'. It might seem that in this age of almost 'instant' communications, this should be the least of the problems, but the snag is that 'communications' have to be started by someone.

Although I have some private channels of information on 'what's going on' in amateur radio communication up my sleeve, I shall have to rely on you, the reader, to brief me on what is happening in your locality and in your own particular field of interest. With amateur radio covering such a wide field of interests these days, one has to rely on those with special interests to keep one up to date with the specialities, which often are the most newsworthy. So if you have a special interest in a particular facet of the amateur radio scene which you think other readers would like to hear about or about which you would like some publicity, do please write in.

Well most of the excitement has been in the sphere of amateur radio satellites. In the week before Christmas, the Russians launched six amateur satellites! They were designated RS3, RS4, RS5, RS6, RS7 and RS8. The writer heard all six for the first time on 19th December. Beacons were audible on each between 29.322 to 29.464MHz. Their orbital periods were around 120 mins.

Transponders were provided on some, notably RS6 and RS8 and a robot system was also provided on a couple of them in which, on receiving a signal from a ground station, the satellite's receiver accepts it and retransmits back to ground its call-sign and its signal report. After the first week or so the robots have been turned off as they did not seem to be functioning as intended, but the transponders - 2 metres up, 10 metres down - have been working well ever since and the 'DX' hunters have been having a field day.

The Russians provided the amateur world with another excitement in May, when on the 17th, they launched yet another amateur radio satellite designated ISKRA II. There had been an earlier satellite with the designation ISKRA I, but this did not have any amateur radio facilities. ISKRA II had the call-sign RK02 and transmitted telemetry on 29.580MHz. It had a period of 91 minutes and produced a very strong signal. It was supposed to have a transponder using frequencies in the 21 and 28MHz bands, but if this was so, it did not stay on long and no reports of anyone having used it have been received to date. It was in a very low orbit, viz., 344Kms, circular. This would mean that it was not likely to stay up very long and it did in fact enter the earth's atmosphere at about its 840th orbit on the 8th-9th July. Much interest was stimulated by this satellite in reading its telemetry and endeavouring to predict its demise. Harold Meeza, an AMSAT-UK member, in Chatham, Kent, seems to have come very near to getting it right! He recorded the exact time of every sixteenth orbit and thus got a curve of the gradually decreasing period times. As can be seen from the accompanying diagram, this would have given a burn-up date around the 15th July. However, two plots near the end showed a much more rapid fall and suggested its end to be about the 840th orbit - which was about right. Another most interesting feature of this satellite was that it was in fact launched by simply throwing it out of the Russian Spacecraft SALYUT 7 the first time, as far as one knows, that this method of launching a satellite has been tried.

UOSAT, the University of Surrey's Experimental Satellite, having got off to such a successful start, ran into difficulties in April. During the loading of software into the satellite's computer, by a million to one chance, a false command resulted in both data beacon transmitters being switched on at the same time, so that both command channels were blocked! The receivers became desensitized so that no further command signals could be received by the satellite! A solution to the problem has been attempted by using ground stations with sufficient RF power to break into the desensitized receivers. One attempt was made using a high power amateur transmitter in Maine, USA, used for 'moon bounce' experiments. This was unsuccessful and another attempt has been made using equipment at the Stanford University,California, where there is a 150ft. diameter dish antenna and lots and lots of watts of RF. But so far, no success has resulted. This is all very disappointing indeed and our sympathy goes out to Dr. Martin Sweeting and his team at U of S. We wish them ultimate success.

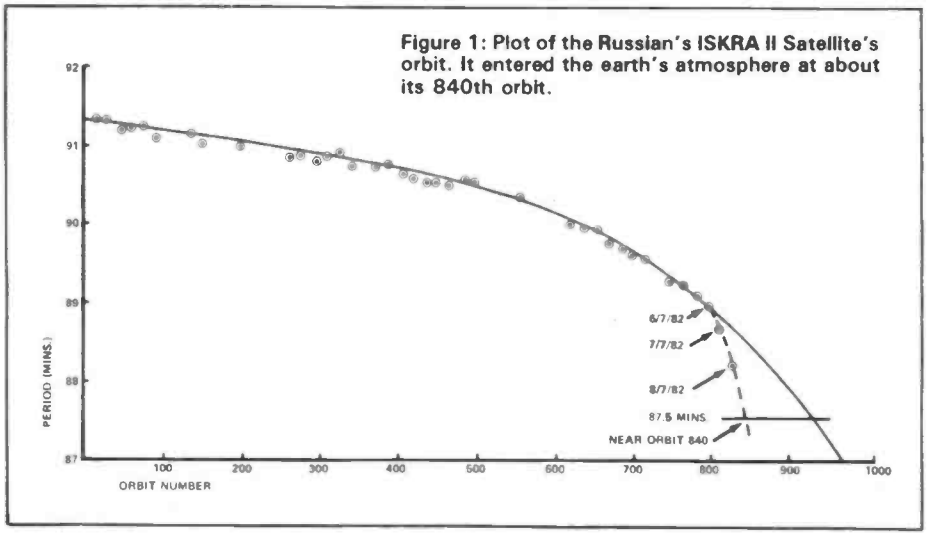


Figure 1: Plot of the Russian's ISKRA II Satellite's orbit. It entered the earth's atmosphere at about its 840th orbit.

Your Reactions.....	Circle No.
Immediately Interesting	36
Possible application	37
Not interested in this topic	38
Bad feature/space waster	39

REWTEL UPDATE

J. Burchell takes a close look at REWTEL which will be officially launched at the PCW Show in September.

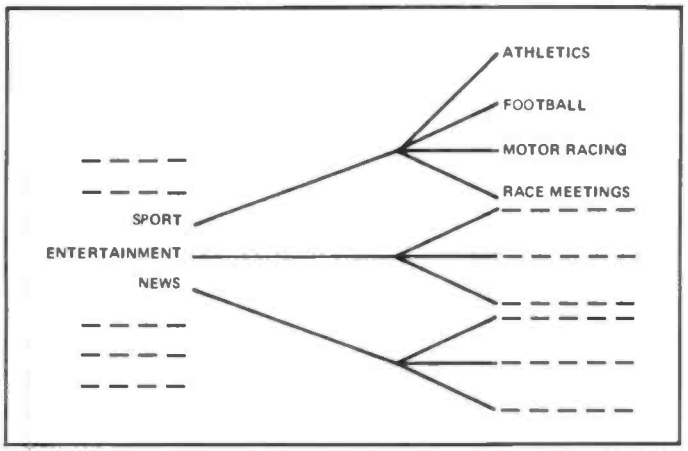


Figure 1: The tree menu system.

REWTEL - in case you havn't heard is a telephone accessible database system run by **R&EW**. We first started trials about two months ago, and since then have developed and crystallised our ideas on the exact nature of the system.

Anybody with an RS232 terminal (really serial ASCII) and a 300 baud CCIT modem can phone up REWTEL and gain access to over 5,000 pages of information and data. The information on REWTEL is all related to electronics, computing etc, some of this acts as an extension to the magazine and allows us to provide further information and support to the monthly issues of **R&EW** on paper.

The information part is largely derived from the mountain of press releases we receive each month. A further feature will allow REWTEL subscribers, (the cost of a subscription will be about £10) to request that further information is sent to them on the items of interest (an electronic BINGO card system).

Further features allow users to leave messages on the system for other users and to order parts from the **World of Radio & Electronics** catalogue. Also planned is a versatile typesetting system *R&EW* authors to directly transfer their text into our Wurlitzer.

For those of you interested REWTEL is being run on a multi-user S100 computer system, where each user has their own processor card with a Z-80 and 64K of RAM, the S100 bus is used as a network to talk to the bus master which deals with features such as disk/file access. We also have 70M-byte in the form of three 8 inch Winchester drives providing the hard storage medium.

Now that we have largely finished the experimental stages of REWTEL we hope that from around 14th of September REWTEL will be on the air 24 hours a day with 1-2 lines available during office hours and 4-5 after hours, the big launch of REWTEL will be at the PCW show 9-11th of September. We have some 50 complimentary tickets available so give us a phone to see if there are any left, strictly first come first served.

DATABASE ACCESS METHODS

The most common method of access for a large database is via a tree menu system, (like PRESTEL) see *Fig. 1*. This method of access has the advantage that it is very easy for the first-time/occasional user to understand what to do, and that the terminal device can have greatly reduced specifications, for instance on PRESTEL each node can have up to 10 branches, indicated by 0-9. Thus the access device only needs to be capable of transmitting the numbers 0-9 plus a few access codes.

Tree structures also allow you to search out a particular page by exploring the branches from each node in an iterative fashion. However the tree structure also means that it can take a long time to access the page you wish to see if it is many nodes up the tree. Further disadvantages are that it is difficult for the implementors to provide the ability to take shortcuts if you know where you want to go, and that the ability to backtrack up the tree or hop from one branch to another are also almost impossible to provide. (Users of menu driven software will also be acutely aware of these limitations.)

A second method of access is available if the users know almost exactly what it is they require further information on, this is the direct access method, see *Fig. 2*. Here the request for information is converted to a code which is assummed to point directly to a page in the system. Thus a database about 7400 series ICs would have as access codes the device number you are interested in e.g., 7490, this would then be converted to a pointer, probabaly by subtracting 7400 from the number inputted to leave 90, the data would then be looked up by retrieving page 90 from the data base. This method of access has the advantage that the access to the information is extremely direct, and needless time is not wasted traversing the branches, on the other hand it is very difficult to use if you are not 100% sure of the item you require information about.

The method used by REWTEL differs from both of these methods and we believe it to be a valuable extension to database technology. The REWTEL database consists of a number of pages of text, each page has a header which consists of up to eight, 16 character KEYWORDS. These keywords are words chosen by the page originator to index it in the most appropriate manner see *Fig. 3*. Thus a page about the Motorola direct memory access device for the M68000 family would be keyed as follows:

MOTOROLA M68000 M68200 DMA MICRO UPDATE

whilst a page on the Motorola smoke detector may well be keyed as follows:

MOTOROLA MXXXX SMOKE DETECTOR TRANSDUCER UPDATE

and a page on the Mostek ethernet controller would be

MOSTEK LANCE MxxXXX ETHERNET CONTROLLER UPDATE

The keyword UPDATE implies that the information in the pages was gained from a press release sent to **R&EW**.

To understand how this keying works we now need to look at how the REWTEL system works from the point of view of a user at REWTEL.

To use REWTEL you must connect your micro or terminal up to a MODEM and dial the REWTEL phone number currently (0277 230959) the phone will ring, unless it's engaged. After the phone has rung a few times it will be answered by the REWTEL computer, you then have about 30 seconds to connect your MODEM to the telphone line. REWTEL will then send a sign on message and ask you to enter your name and account number (for subscription holders) Non subscription users are still welcome to use the system but they will not be able to ask for further information on items of interest to be sent to them.

The rewtel prompt of

12:00 REWTEL >

will then appear, the first four digits indicate the time of day the > indicates that REWTEL is waiting for you to type something. To gain access to information you type keywords at the system until you have uniquely defined a page of information, which will

then be recalled and sent to you. If the keywords you have entered do not uniquely define a page then REWTEL will list all the headers of the pages which contain the keywords you have so far defined, thus if you were interested in finding out about the M68000 DMA device you might proceed as follows

12:00 REWTEL >> MOTOROLA UPDATE

this implies you wish to know about all of the Motorola press releases REWTEL would reply with the following:

MOTOROLA M6800 M68200 DMA MICRO UPDATE
MOTOROLA M68200 SMOKE DETECTOR TRANSDUCER UPDATE

telling you that there are two pages of MOTOROLA press releases to specify that you wish to see the page on the DMA unit you could then type

12:00 REWTEL >> MOTOROLA M68200 DMA this would then uniquely define a page and REWTEL would transmit the data to you.

Note that the beauty of the system is that initially typing any of the words MOTOROLA M68000 M68200 DMA MICRO UPDATE would have caused REWTEL to inform you about the page on the DMA device, thus there are many almost direct routes to the pages.

To aid you in building up the keywords to define the page a number of operators are provided by the REWTEL system, the aim is to save you having to retype the whole KEYWORD definition line each time you wish to change it the + operator adds the keyword you type to the current list thus if you type

12:00 REWTEL >> MOTOROLA UPDATE

and next time type

12:00 REWTEL >> +M68000

REWTEL will respond with

[MOTOROLA UPDATE M68000]

showing that it has added the keyword M68000 to the search list to initiate a search to take place you must use the / operator at the next prompt e.g.

12:00 REWTEL >> /

would cause the response

MOTOROLA M68000 M68200 MICRO UPDATE DMA
MOTOROLA M68000 M68400 MICRO UPDATE BAM

showing that there are two pages with those keywords in the header, in order to select one you could obviously type +BAM or +DMA, however to then access another page you would have to either retype the line or use the - operator which has the reverse effect of the + operator; one sequence might then be

12:00 REWETEL >> +BAM
[MOTOROLA M68000 BAM]
12:00 REWTEL >> /
BAM PAGE IS SENT
12:00 REWTEL >> -BAM
MOTOROLA M68000
EG BAM HAS BEEN REMOVED
12:00 REWTEL >> +DMA
[MOTOROLA M68000 DMA]
ADD DMA
12:00 REWTEL >> /
FETCH THE DMA PAGE.

However in order to speed things up it is possible to add keywords to the search list on a purely temporary basis, this is used by typing them after the / operator

thus working from the start of

12:00 REWTEL >> MOTOROLA M68000 UPDATE
MOTOROLA M68000 M68200 MICRO DMA UPDATE
MOTOROLA M68000 M68400 BAM MICRO UPDATE

WE COULD type

12:00 REWTEL >> /DMA

which adds the keyword DMA to the search list for one search only and because the searchlist now uniquely defines a page causes the page on the DMA device to be transmitted.

Having read this page and because the root of MOTOROlA M6800 UPDATE is unchanged we can simply type

12:00 RETWEL >> /BAM

to gain access to the page on the bus arbitration module, this technique works particularly well where there are multiple pages on the same subject which differ only in the header info by the inclusion of page 1/page 2 etc, as appropriate.

Finally the special keyword/ONLY is provided, sometimes the header of one page might be a subset of the header of another page, this causes a problem as REWTEL believes that there are two pages or more which contain all or part of the current search list. To solve this problem the special keyword

12:00 REWTEL >> /ONLY

can be used to tell REWTEL that you wish to see the page which contains ONLY the current search list as it's header.

To leave messages on the system type CHALK at the prompt, you will then be asked to type up to 16 lines of 64 characters, and then up to 7 keywords under which you would like to see the page stored, all messages automatically have the keyword BULLETIN appended to them. The message will then be edited by the system operator, the consistency of the proposed keywords checked and placed onto the database within a few hours, or first thing next morning if the entry is made outside office hours.

Further details of REWTEL services will be published in later articles and on REWTEl itself.

MOTOROLA M68000 DMA MICRO UPDATE

This is an example of the type of information page offered by the REWTEL service. Each page is designed to be universally acceptable, being 24 lines of 64 characters each. In the fullness of time, we hope that we will also be able to install a full graphic capability, and we invite our readers to let us know which of the various popular standards they would prefer.
REWTEL users should leave a message on the bulletin facility to advise of the type of equipment they are using, and details of any problems they encounter in the interface.

Figure 3: REWTEL uses a KEYWORD System.

ON MODEMS AND THINGS

There are many suitable modems on the market at the moment, two sources of which are MODULAR TECHNOLOGY on (01-421 0626) who make a very suitable acoustically coupled modem for around £150 and DISPLAY electronics who have some second hand GPO Model 2A for around £60 these are direct connect modems but are easily converted to acoustically-coupled if you're worried about Busby and friends.

The **R&EW** modem will be based on an amazing device called the AM7910 which is an entirely digital multistandard modem part, we will let you know more, as soon as we do, as the device is still at the sampling stage at the moment.

In the meantime, why not give REWTEL a try; here are a list of suitable keywords to get you started:

HELP,MOTOROLA,MOSTEK,BACKGROUND,JOBS,GEC,CHALK,HELP-KEYWORDS,BULLETIN,VIDEO,REW,HELP-KEYWORDS.

Good luck and see you at PCW where we hope to give REWTEL demonstrations on the hour every hour. ■ **R&EW**

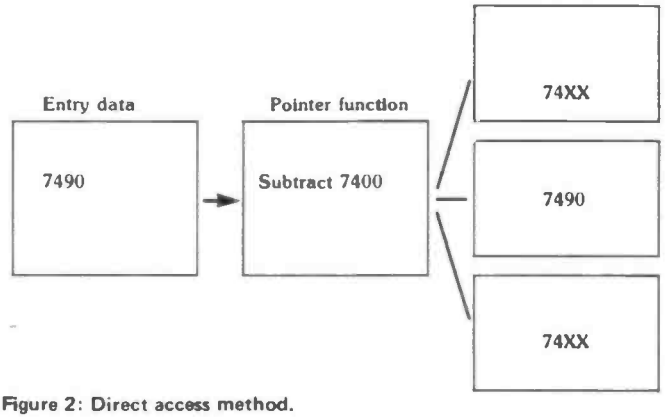
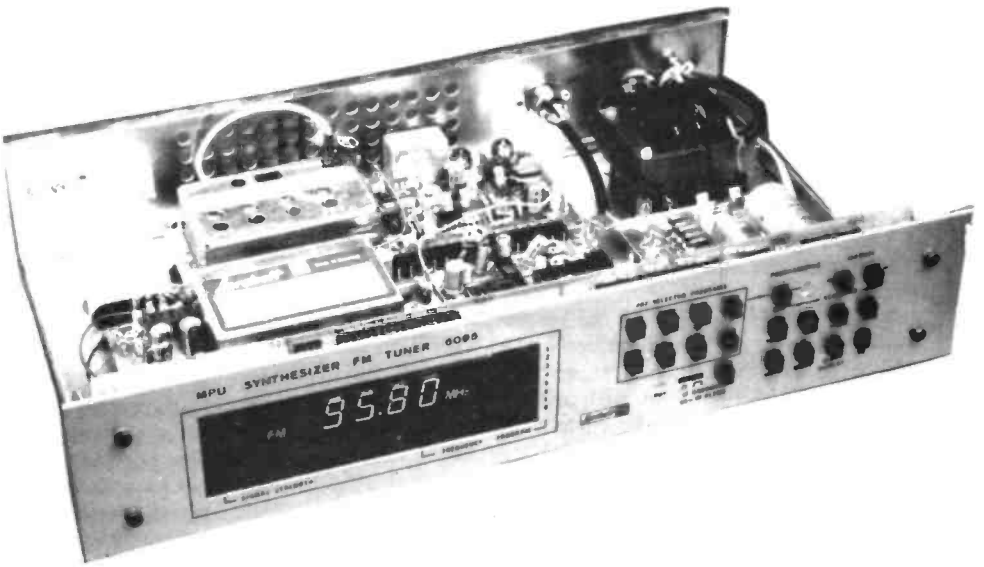


Figure 2: Direct access method.

A SYNTHESISED HI-FI FM TUNER

By Eric Larsen and William Poel

THERE ARE FEW electronics engineers and enthusiasts who have not tackled a piece of 'HiFi' in their time. The term 'HiFi' has achieved a fairly arbitrary status in the past few years, and the term is generally applied very loosely these days. Such is the pace of development that even the most modest pieces of machinery qualify under the DIN standard definition - so let's start by defining the basis of HiFi for the purposes of this publication.



No more, no less

Without wishing to aspire to the status of 'pundit', let's state that true HiFi simply reproduces the signal from the recorded or transmitted medium without adding distortion or noise, and without removing any 'information'.

The acceptable limits of noise, distortion and limitations on the frequency response are what all the fuss is about, since the perception of different individuals varies hugely.

At its most cerebral, the argument dives into such unanswerables as exactly how do *you* know what comprises harmony - or if your perception of, say, red, is the same as the next person's. So we have to stick to measurable fact. And if it's not measurable, then its difficult to justify space in an essentially technical publication. Sorry all you subjectivity freaks.

The tuner described here is capable of reproducing all those background sounds that the broadcasters would rather you didn't hear: like the famous Radio Three hum, the tape hiss on recordings, and the rumbling sounds caused by too much of the infamous BBC coffee. The enthusiastic use of compression by some of the IBA 'locals' is also very apparent.

The detail available with this tuner is reflected in its measured performance. It is not a function of some magical quality, but simply the combination of low IMD, THD and noise. In other words, the means of reproduction achieve standards that are equal to, or better than, those of the broadcast programmes. And that's what HiFi is all about.

So now you know

Notwithstanding all this, you still have to be capable of making and setting up the design. Long gone are the days when magazine projects could be based around the same types of tagstrip that could be found in everything from a 19 set to an early computer. Technology has upped the ante to such an extent that most would-be constructors recoil from the *state-of-the-art* in understandable horror at the impossibility of ever achieving a workable result.

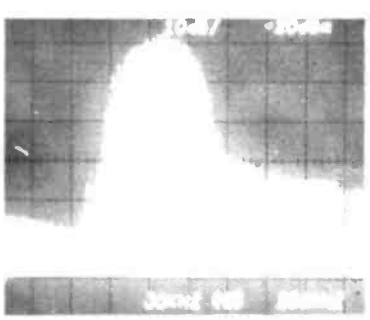
Although some innovations - like the PCB - have been a positive boon, the complexity of the functions achieved has meant that the end product is ever more unattainable. However, in this particular instance, the complex functions have been kept managable through the use of a pre-aligned tuner module. Despite the apparent complexity of the MPU synthesiser system, it really can be set up using a multimeter, and the facilities provided by the prealigned tuner module. The Larsholt 7255 was briefly reviewed in the July '82, including a memorable photograph of the separation characteristics that managed to get printed upside down.

As with some previous constructional features in **R&EW**, this tuner is presented in collaboration with a commercial supplier of the complete kit - but all the component parts are also available separately if you have the nerve. In this particular instance however, we are pleased to say that the **R&EW** design lab has been intimately involved with the project from its inception, and we claim a high degree of influence on the end result.

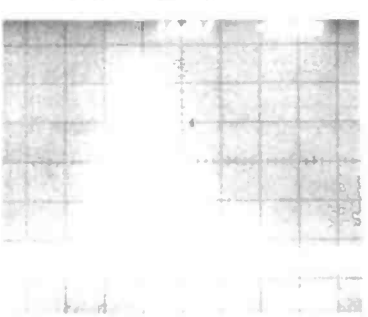
Tracing back the history of the tuner reveals the difference between the concise approach of a manufacturer, versus the problems of the designer trying to decide exactly where to stop the development. The tuner is derived from a rather 'over the top' solution prototyped about a year ago that involved a separate tuner module for each of three AM bands, as well as three module solution to the FM section.

It may have been rather fun to design, and fun to operate, but it was not exactly the

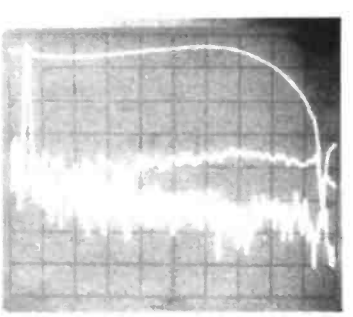
all vertical axes are 10dB/div



'Swept' IF response of wide filters



'Swept' IF response of narrow filter



40% Modulation, 10uV RF, Wide IF 0-20kHz sweep, THD and separation

most makeable design ever produced in-house. Larsholt picked up the basic design and refined it into a concise and manageable object, for which we are all rather grateful. It may not have all the bells and whistles of the original multiband approach - but it *is* makeable.

The block system

The modular approach is clearly defined in the block diagram *(Fig. 1)*. Apart from the complete RF/IF and stereo decoder contained within the 7255 tuner module, the system separates into four other individual PC assemblies:

1. The Synthesiser MPU board.
2. The audio preamp and muting board.
3. The control and display PCB.
4. The PSU.

The PCB assemblies are interconnected using a combination of plug-in and solder connectors to facilitate easier assembly and debugging.

The MPU controller provides a plethora of functions under software control of a reasonably straightforward synthesiser device. The HD44015 synthesiser device is not solely dedicated to this application, and with the application of the appropriate strobed BCD information at the inputs, it can perform a variety of other tasks in communications and consumer equipment. However, the HD44752 CMOS 4 bit MPU certainly is a dedicated controller system, from a family of mask programmable devices that evidence the fact that the Japanese seem to have the 4 bit CMOS controller market well under control.

The HD10551 prescaler *(Fig. 2)* certainly finds a place in other applications, being one of the most versatile VHF prescalers with built-in preamp for sinewave inputs.

The audio filtering and muting board takes the relatively low level audio output from the stereo decoder, and provides both amplification, and filtration of the pilot tone. The KB4438 IC also endows it with the smoothest muting function you are likely to come across, since the transition from silence to signal is totally noiseless and undistorted.

The control panel is mounted at right angles to the MPU board. In view of the number of lines required to run between the two boards, this approach provides a good compromise for what is a veritable PCB draughtsman's nightmare. The display has to match up the driver pins with the display segment pins as neatly as possible - and using a completely static display means that there are a very large number indeed. It's not quite obvious whether Hitachi and Futaba got together on the compatibility of the two parts - but the result is mercifully straightforward.

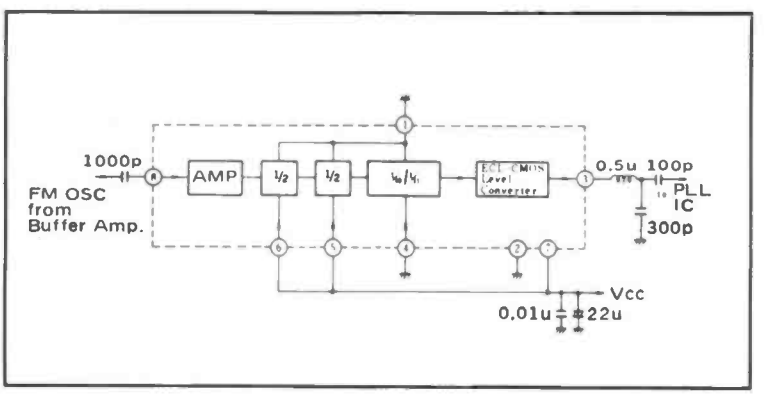
Functions

The tuner takes advantage of most of the available features of the controller programming. Apart from the usual tuning by 50kHz channel increments with slow and fast rates, there is a scan and hold, or scan and sample option. 8 preset stations are held in RAM, backed by a battery inside the case for when the power is switched off.

The display reverts to clock time when the tuner is switched off, and may be forced to display time whilst the tuner is on, if required.

The dual bandwidth IF system provides a means of sorting out the station pile-ups that can occur under good reception conditions in many parts of the country - or for those of you in good sites with a yen for band 2 DXing. Narrowing the IF bandwidth has the further quality of reducing the stereo separation, and thereby inducing a degree of high frequency blend that reduces noise on marginal stereo transmissions.

From a user's point of view, the tuner is a good deal 'friendlier' than some around, and requires little effort to master before you feel sufficiently in control that you can forget the technicalities and enjoy the music.



Internal block diagram of HD10551.

How it works

The tuner module itself *(Fig. 3)* is a single superhet FM receiver, with multiple ceramic filtering at the IF of 10.7MHz. The front end (an 8319-120) design derives from Larsholt's long experience in the necessary blend of sensitivity and selectivity to suit the rather more demanding conditions of mainland Europe than *used* to be found in the UK before the explosion of local radio.

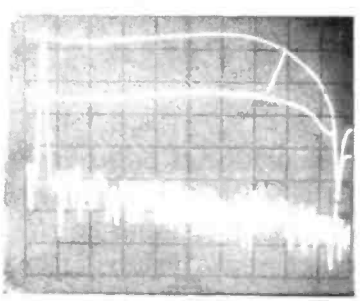
The local oscillator tank circuit is tapped to provide a signal for the prescaler on the control board - fed by buffer transistor stage. As much as amplification, this stages isolates the sensitive signal processing from the raw switching taking place in the synthesiser circuits, and cuts down on the wideband hash that might otherwise find its way in to the front-end. The IF system uses either two wideband linear phase ceramic filters on their own (220/240kHz wide IF mode), or a third narrower filter (180kHz) may be added in series by defeating the electronic bypass switching that acts to short the signal through in the wide mode. It is not beyond the bounds of possibility that this third filter might be automatically switched into circuit under low signal conditions - but as mentioned above, the line has been drawn somewhere....

The main IF system uses the latest generation of CA3089/CA3189 devices. Either the TOKO KB4441 or the Hitachi HA11225 will perform here, offering low noise, deviation muting and adjustable mute onset: all three notable absentees from the first generation of such devices.

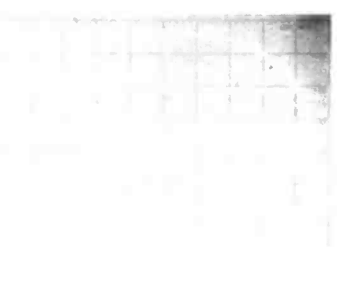
The IF system achieves excellent detection linearity through the use of the TOKO 12HF series coil. The large format construction keeps stray capacity to a minimum, and provides a very repeatable coupling between the two sections of the double tuned detector. The incorporation of the 22uH phase correction choke inside the screened can also helps alleviate one of the bugbears of the *genre*, whereby the 9th harmonic of the squarewave 10.7MHz signals from the output of the limiter at pin 8 of the IF IC have been prone to find their way into the RF stages and make a mess of stations around 95.8MHz.

Down to baseband

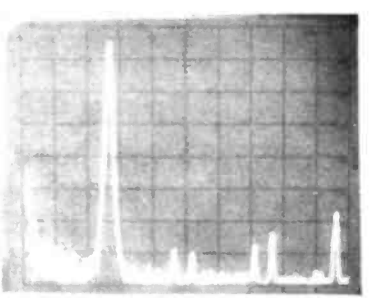
The post detector low pass filter provides bandpass tailoring for the composite multiplex signal, i.e. the roll-off occurs at 55kHz to reduce the effects of signals in alternate channels, since the general



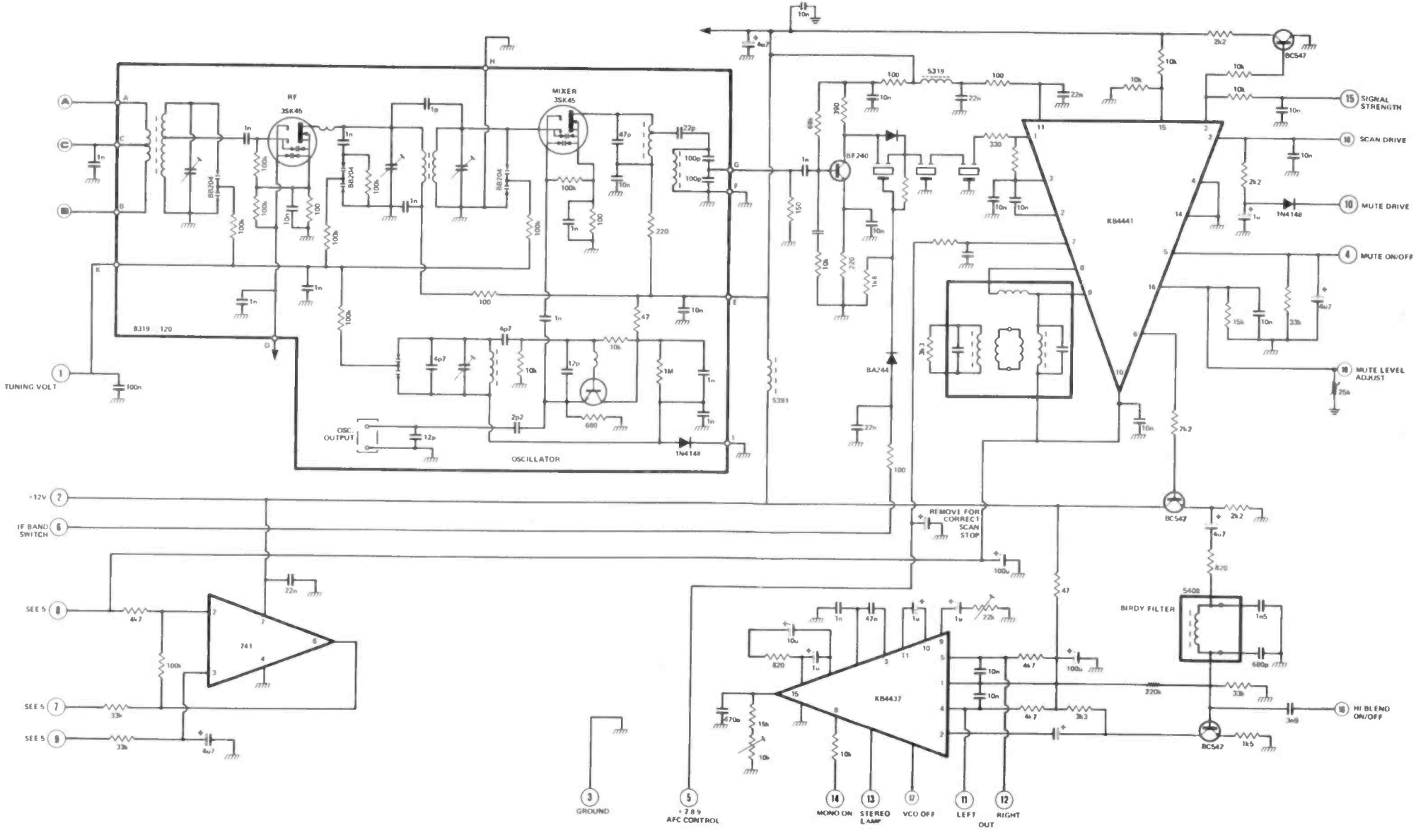
40% Modulation, 10uV RF, narrow IF
0-20kHz sweep, THD and separation



40% Modulation, wide IF, 1mV RF
0-20kHz sweep, THD and separation



60% Modulation, wide IF, 1mV RF
0-20kHz sweep, THD and products



The tuner module is a single superhet FM design.

switching processes involved in stereo transmissions create many harmonics capable of interacting for some distance outside the 'official' baseband.

The stereo decoder device seems to be the major element in determining the sound quality of a tuner. The cleaner sound of tuners using this decoder device is generally attributed to the measurably improved intermodulation performance. An improved separation characteristic reflects the overall advance in the phase linearity of the ceramic IF filters, although very careful setting up of the detector and low pass filter stages is required to make the most of the available performance - and for this reason, the 7255 is not currently offered in kit form.

The use of phase cancellation techniques to null the 19kHz pilot tone signal keeps the overall audio bandwidth flat to beyond the transmission limit of 15kHz. A subsequent preamplification stage with filter poles at 26kHz and 38kHz removes extraneous ultrasonic signals before the KB4438 muting audio preamplifier amplifies the low level output from the decoder by up to 17dB to provide an adjustable level that will drive any subsequent amplifier. The muting function of the preamplifier is derived from a combination of the basic noise and deviation muting signals available from the IF, and the muting signal supplied by the synthesiser controller during frequency changes.

Controlling the whole show: Figure four

The signal from the MPU is a short duration pulse, which is stretched with a 4u7 capacitor, charged via a transistor.

If large frequency hops are made without the muting facility, then you will hear the characteristic 'ring' as the synthesiser loop takes an moment to settle to a steady DC state.

The main synthesis function is performed by the HD44015, which is fed data from the MPU according to the control selection, to set the 'n-counter'. The comparison frequencies are 9kHz for the MW and LW, 5kHz for SW - and 5kHz for FM, which reflects the /10 prescaling function of the HD10551 on the basic 50kHz channel spacing. It's not ideal, as purists will have noted, since the best loop characteristics also derive from the highest possible comparison frequency. The use of 5kHz represents a series of compromises to produce a single chip solution, and in a broadcast application such as this, you might never notice the difference anyway.

By way of example, the /n counter is instructed according to:

(Frf + 10.7)MHz/.05

And now for an example for one of those big-sums we've been threatening for a long time, using the data sheet example...

$$N_0 = \sum_{j=0}^{3} [\, 10^j \sum_{i=0}^{3} (2^i N_{ji})] = (N_{03}$$

...confused? It's just a rather roundabout way of describing the BCD format fed to the n counter.

The output of the phase detector at pin 16 of the PLL IC is cleaned up with an internal active filter stage employing a MOSFET. Remember that any other capacitance on the tuning line (such as that in the tunermodule) will contribute to the loop time constant, and the time will come when the loop refuses to lock as the overshoot become unmanageable.

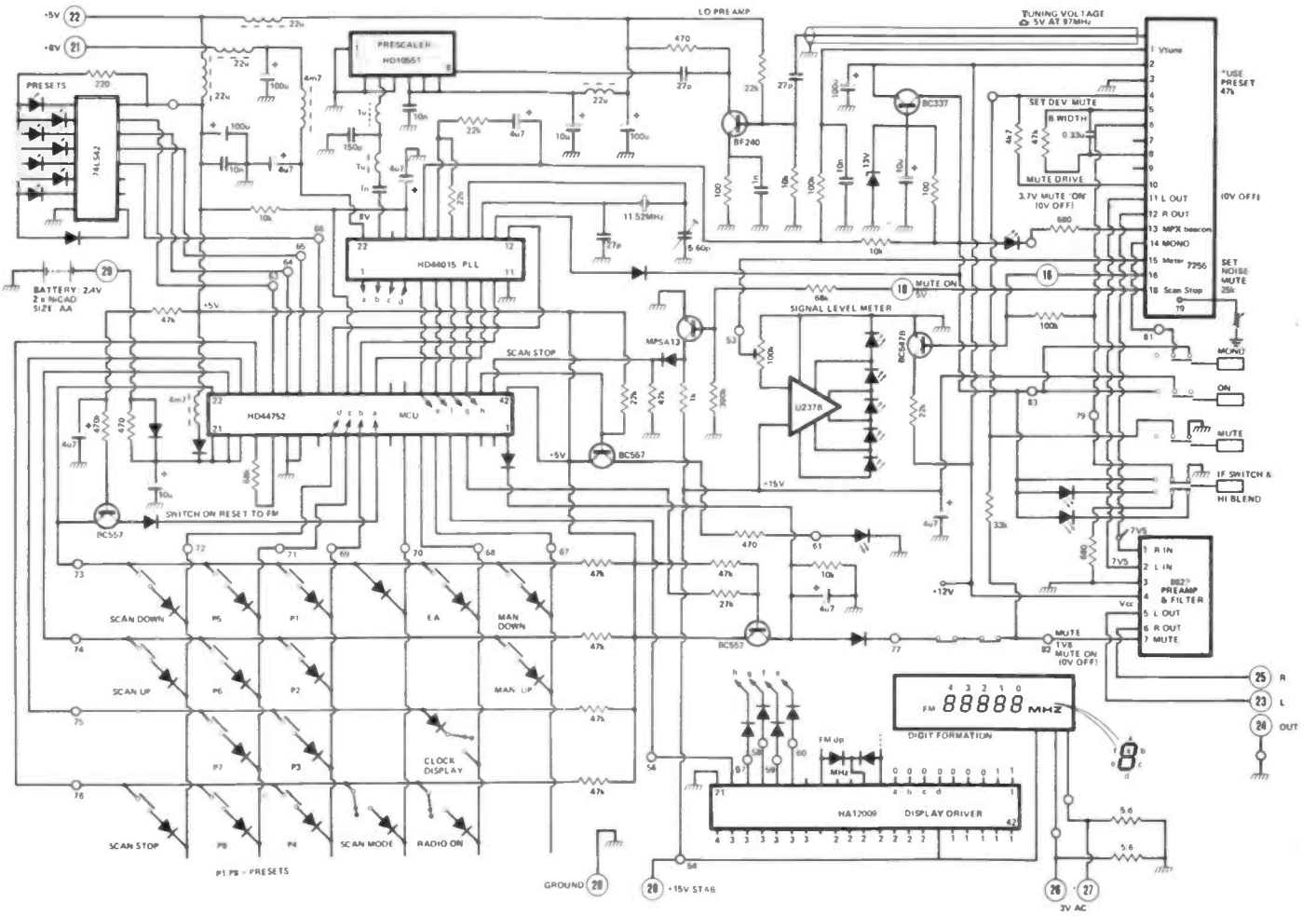
As well as instructing the PLL, the MPU provides outputs to indicate the preset selected, and data for the display driver. Rather than working in some obscure derivative of binary functions, this system takes the less elegant solution of sticking to good old BCD so that a common set of output lines can be used to instruct the PLL, and to load the display data. In fact the HA12009 comes as something of a surprise to many designers, since there aren't many non-multiplexed LED/fluorescent drivers of such versatility available. It seems to have become lost in this particular application, although it might equally well be used in conjunction with an EPROM controlled frequency synthesiser or any number of MPU interfaces requiring 7 segment display outputs. *Figure four* throws some light on the way this device is controlled.

The PLL and the display are obviously sent different BCD instructions, although they use common data lines, through the use of different address lines. The preset programme indicator uses pins 26 to 28 to provide 3 bit data, with pin 29 for the blanking instruction.

Scanning

The MPU controls the scanning function by incrementing the 'n' counter instruction sequentially until it receives a scan stop signal, derived from the deviation muting 'window' of the tunermodule's IF on terminal 18. The speed of this instruction is vital for the scan to stop 'on channel', so all time constants are kept to the level required for RF decoupling only.

The MPU does not issue an increment instruction to the PLL, if the out of lock detector on pin 19 of HD44015 is low. This means that although you can increment the tuning functions manually, the scan function will not operate until the loop is locked. At the end of the scan, the synthesiser rolls over the top of the band and starts again until stopped. The scanning can sample stations for approximately 3 seconds and then move onto the next station, or it can be set to stop dead until told otherwise. In the sample mode, the



The tuner's MPU controlled synthesiser

station sampled can be held indefinitely by pressing the 'stop' function button.

Correct adjustment of the tuning 'window' with the FM discriminator is vital for the correct operation of the scanning system - and a *very* minor tweak of the detector coil in the tunerset may be needed to set the stop point spot on channel.

Although the default condition on switch-on *should* be to select the FM mode, a separate reset is provided on pin 22 of the MPU using a delayed time constant on a transistor stage to provide the unseen finger on the band select function during power up.

A battery backup of the MPU function is provided in case of accidental power failure wiping the memories. Since the clock function is derived from the crystal timebase of the PLL device, the time will not be maintained. The connection to the backup battery provides the facility for trickle charging a NiCad battery. Skinflints using primary cells beware, and remove the 470R resistor in the charge circuit.

All that goes in, stays in

Radio and logic circuits do not mix. In order to ensure that the MPU and associated switching devices keep themselves to themselves, careful isolation through the use of chokes and capacitor decoupling is required.

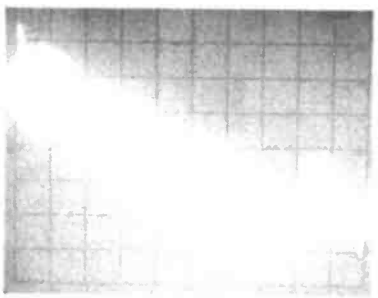
If you have ever been privileged to examine the spectrum from the output of an ECL divider, you will appreciate the relevance of the T-section low pass filter at pin 3 of the HD10551. There is no hard and fast rule about this type of decoupling, and as any engineer engaged in this type of work will testify, you just keep on tacking bits on to prototypes until it goes away. Scientific stuff, eh?

The non-multiplexed display is one blessing, and although the multiplexed control lines still remain, they are at relatively low levels, and do not intrude into the RF workings of the tuner.

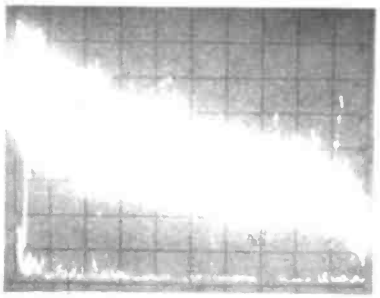
The power supply *(Fig.6)* uses three terminal devices quite fearlessly at this frequency. Applications involving LW/MW need to take care that noise generated in this type of regulator doesn't get around the circuit. The problem of noise in three terminal regulator devices seems to remain largely unattended: another example of the computer fraternity riding roughshod over the sensitivities of the RF engineer.

Next month we continue the circuit description together with details of the tuner's assembly.

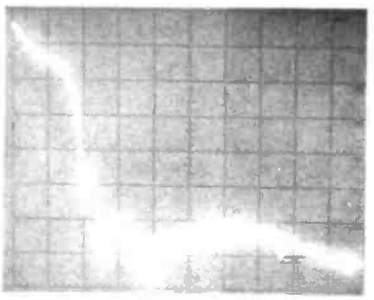
Your Reactions.....	Circle No.
Excellent - will make one	112
Interesting - might make one	113
Seen Better	114
Comments	115



Top screen 40% mod. 0-20kHz sweep gathered over a 30 minute sample.



As left hand trace but showing output of a commecial station, as opposed to Radio 1. The average mod. is higher but still far below 40%.



Audio output after filter stage.0-100kHz sweep.(No preemphasis).

CAPTION COMPETITION

This month's Caption Competition once again follows the theme of our front cover. The entry which in the Editor's opinion is the best of those to reach us by September 30 will win the original cartoon.

Send your entries to:

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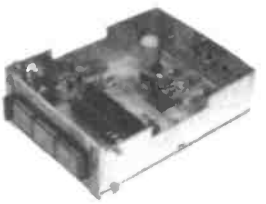

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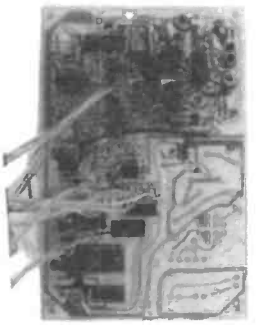

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226 for further details

R&EW TRANSCEIVER PROJECT MIXER & BUFFER MODULES

Design by Simon Ruffle G4EAG

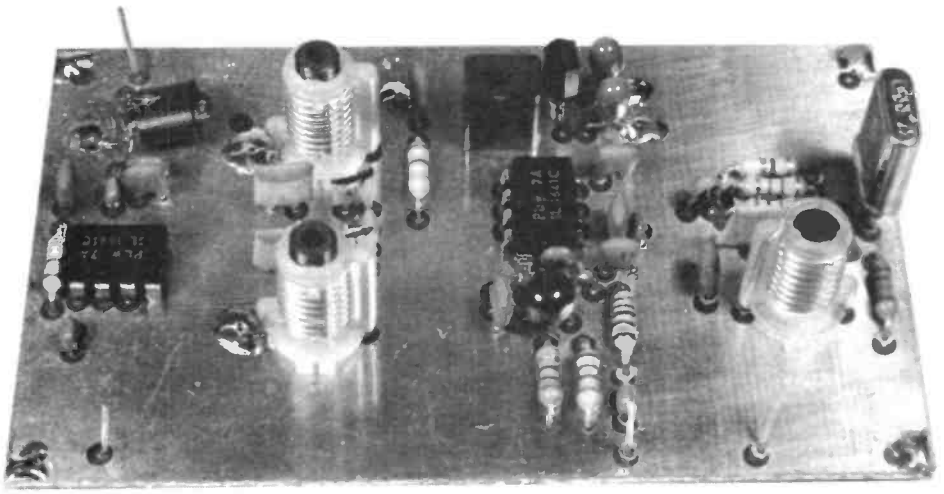


Photo 1: General view of Mixer Board

This module forms the heart of the **R&EW** transceiver project. When linked to the local oscillator of a Trio R1000 or Yaesu FRG7700 general coverage receiver, and fed with a signal at 10.7MHz in the required mode, the circuit will give HF output on the same frequency as the receiver, in other words, transceive operation between 0 and 30MHz.

The Mixer Module circuit board (*Photo 1*) is small enough to fit inside the receiver itself, and some enterprising constructors may like to do this, but in this article we have assumed that the transmitter will be in a box of its own, linked to the receiver local oscillator by 50 ohm coaxial cable. This requires a small buffer board to be located inside the receiver case (*Photo 2*).

PRINICIPLES OF OPERATION

As was explained in the first article in this series (July **R&EW**), the R1000 and FRG7700 both have the same first intermediate frequency (IF) of 48.055MHz and the same synthesised local oscillator range, tuning 48.055MHz to 78.055MHz giving 0 to 30MHz receive coverage. The Mixer Module generates its own IF signal at 48.055MHz which is mixed with the receiver local oscillator to give 0 to 30MHz transmit coverage. A block diagram of the transmitter mixing process is outlined in *Fig. 1*.

The transmitter IF signal is developed by mixing a 10.7MHz 'mode drive' signal, which could be amplitude modulated, frequency modulated, single sideband or a simple carrier wave, with a 37.355 signal from a crystal oscillator. (A 10.7MHz SSB generator was described in the July issue of **R&EW**, and FM and CW generators will be described in forthcoming issues).

After passing through tuned circuits the IF signal is mixed with the receiver local oscillator to produce the transmit signal. This signal can then be passed, given suitable filtering, to broadband, multi-band or single band, linear or class C amplification as is required.

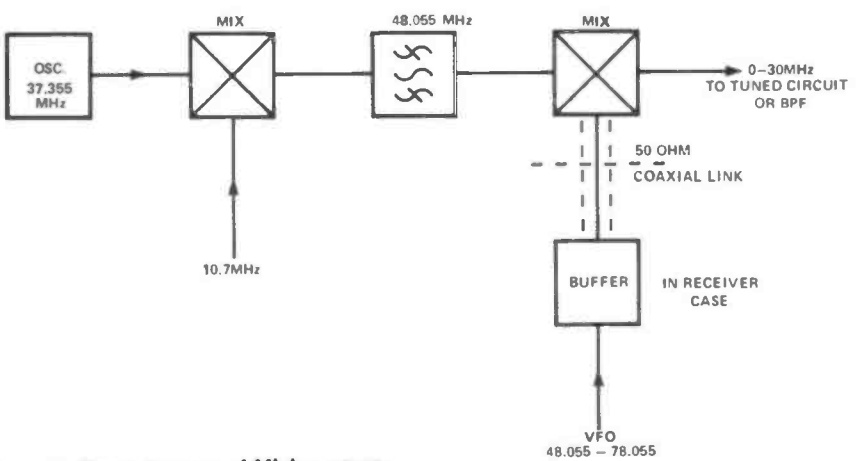


Figure 1: Block diagram of Mixing power

CIRCUIT DESCRIPTION MIXER MODULE

Figure 2 shows the circuit diagram of the Mixer Module. Q1 is a third-overtone crystal oscillator which is the result of much experiment to find an oscillator that is reliable, adjustable and gives enough output to drive the first mixer directly. L1 and C5/C6 tune to 37.355MHz. The output is tapped well down the emitter resistor R3/R4 to minimise loading on the oscillator, to avoid drift or chirp.

Q2 is an emitter-follower that buffers the 10.7MHz mode drive from the first mixer. It has a gain of unity, and protects the mode generator from changes in loading when the mixer is keyed. It also allows for DC-switched mode selection.

IC1 is a double balanced mixer of type SL1641. The 37.355 and 10.7MHz signals are mixed together here to produce the 48.055MHz IF signal. Care must be taken to keep the input leads to the mixer (pins 3 and 7) below 200mV or unwanted products will increase disproportionately to any increase in the required signal.

The ratio R3/R4 controls the output level of the crystal oscillator. The mixer itself has a gain of approximate unity and its output, which should be in the region of 150 to 200mV, is fed to a double-tuned circuit designed to remove unwanted mixer products.

The second mixer, IC2, is another SL1641. This mixes the IF signal with the local oscillator drive from the receiver. The oscillator signal is fed via 50 ohm coaxial cable from the buffer board in the receiver to a 9:1 broadband toroidal transformer T1 which transforms up to 450 ohms which suits the input impedance of IC2.

In the circuit described here the output of the second mixer is developed across a 390 ohm resistor, but other output network configurations may suit certain applications better. For example, if 50 ohm output was required, a 9:1 broadband transformer could be wired between pin 5, which is an open collector, to the supply line. Space has been left on the board for this. A tuned circuit could also be used. Incidentally, pin 5 can be supplied from up to 9 volts for improved performance. As it stands, approximately 150mV should be available on the output pin of the board, at an impedance of approximately 390 ohms.

It is important to note that, whatever circuits follow this board, all unwanted mixer products between 96 and 126MHz, and any residual 48MHz or 37MHz components should be thoroughly filtered out.

There are two + 12 volt supply connections to the board. One powers the crystal oscillator and buffer, and should be 'on' all the time. The other connection supplies the mixers via a voltage regulator, and is used to key the transmitter, in other words it is 'on' during transmit only. Capacitor C22 acts to suppress switch-on clicks and is mainly useful when keying the mixers for CW. More information on this subject will be given in the forthcoming article on the CW generator.

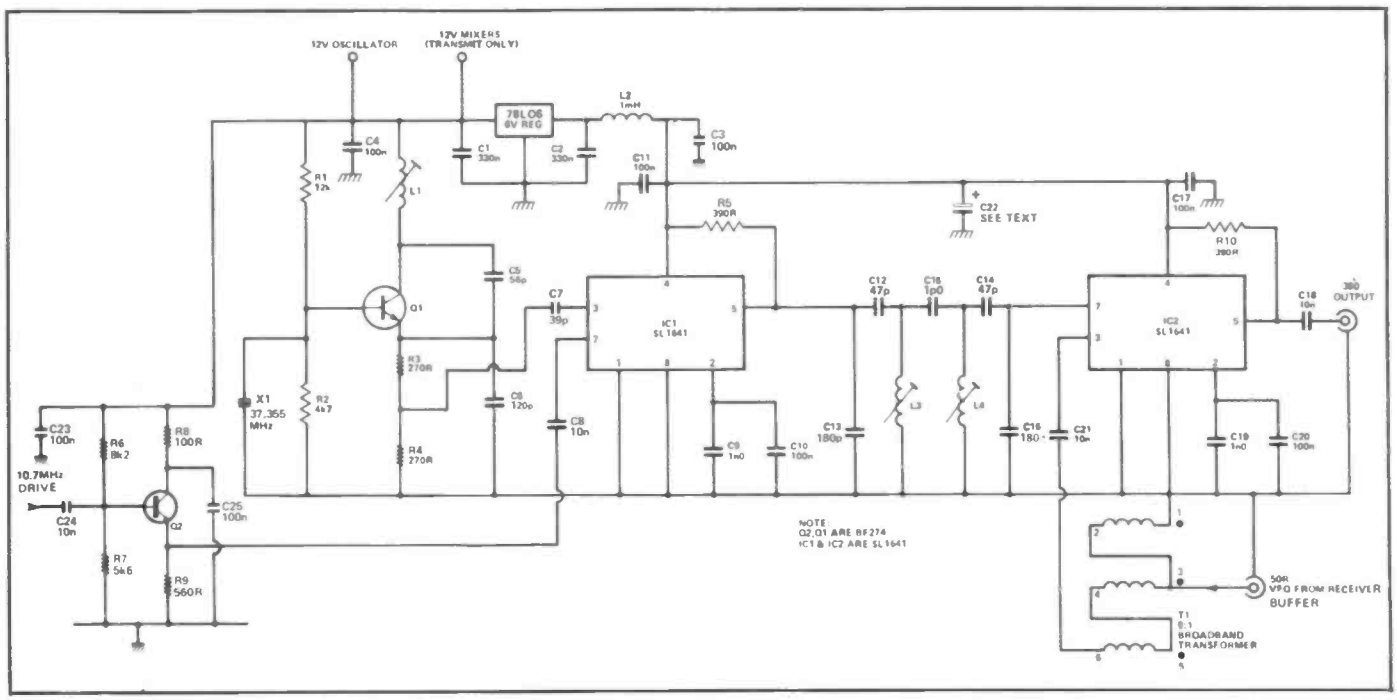


Figure 2: Circuit diagram of mixer board

CIRCUIT DESCRIPTION BUFFER BOARD

In both the R1000 and FRG7700, the output from the frequency synthesiser or 'PLL unit' is made available for the receiver's first mixer via a buffer and bandpass filter at an impedance of 50 ohms.

The Buffer Board circuit diagram is shown in *Fig. 3*. Q1 is a high impedance FET buffer with an input impedance in the region of 100k. This buffer then feeds Q2, a bipolar amplifier which drives a 9:1 step-down transformer. This results in an output impedance of 50 ohms, which is capable of matching the coaxial link between receiver and transmitter.

The Buffer Board needs a supply in the order of 9-12 volts; this is available off the PLL board in both receivers.

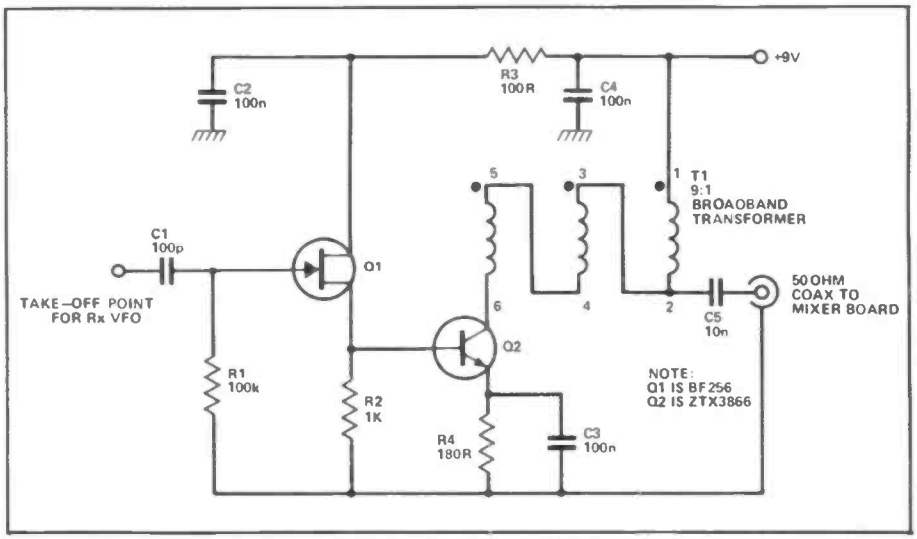


Figure 3: Circuit diagram of buffer board

CONNECTION TO THE RECEIVER

Obtaining the 48.055 to 78.055 VFO drive from the receiver is a significant part of this project, because it involves a certain amount of work inside the receiver case. This should cause no great difficulty if it is undertaken with care and a reasonable degree of expertise. The two receivers are surprisingly similar inside, so I can discuss them together. Refer to *Figs. 4 & 5* which show the approximate positions of the relevant features inside the receivers, and carefully consult your own receiver's circuit diagram.

The 50 ohm output from the PLL board emerges at a small plug and socket arrangement. Remove this plug and ascertain which pin is the local oscillator output, and then wind a short length of fine bare wire around that pin tightly enough to make a good connection. Re-insert the plug, leaving about two inches of the fine wire trailing.

In both receivers, approximately 10 volts DC is available on one pin of a four-pin plug and socket arrangement. Determine

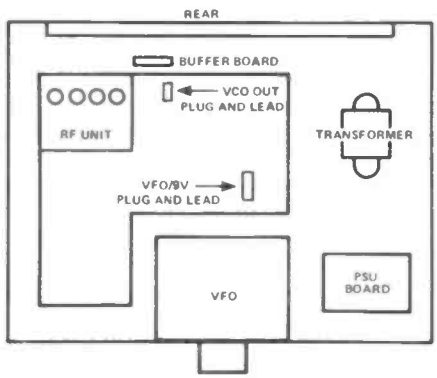


Figure 4: Underside of R1000

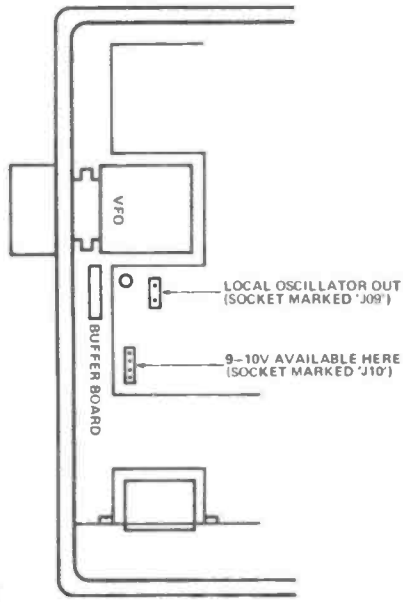


Figure 5: Underside of FRG7700

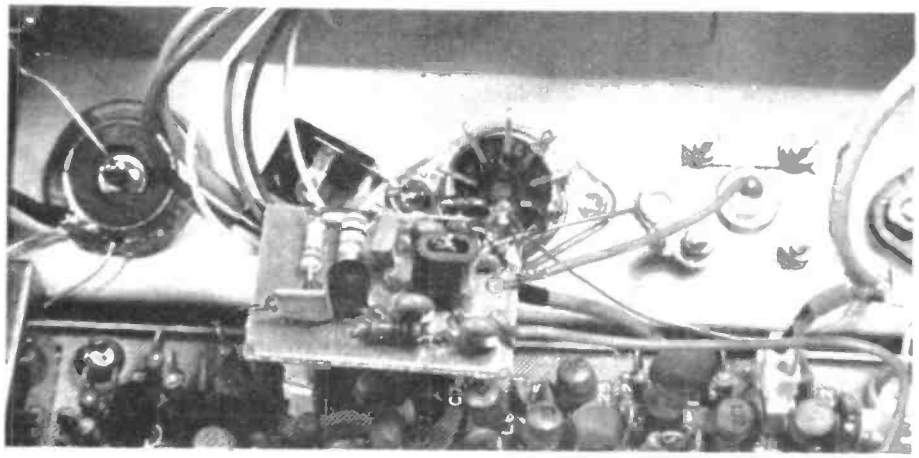


Photo 2: The buffer board inside the R1000 case.

which pin carries the volts, and make connection to it in the 'solderless' manner just described.

The Buffer Board itself is mounted by a single solder tag bent at right angles soldered to the board, and attached to one of the PLL board mounting posts near the oscillator take-off point. See *Photo 2*.

Photo 3: Rear view of FRG7700

A lightweight 50 ohm coaxial lead is run from the buffer board to a BNC socket mounted on the back of the receiver case. Here the FRG7700 owners have a slightly easier time of it. As shown in *Photo 3*, the FRG7700 has a black plastic panel on the rear of the case. It is relatively easy to drill four 8BA sized holes through the plastic and pass the main body of the socket through the rectangular cut-out reserved for the DC supply connector, which is usually covered by a small plastic clip-on cover. It is important to fit a solder tag onto one of the bolts of the BNC socket to take the braid of the coaxial cable.

The R1000 also has a DC connector cut-out that can be revealed by removing the small black cover plate. Four holes must be drilled through the metal case to accept the socket mountings. Take great care to ensure that metal fragments do not get inside the receiver case.

When this work is completed, you have a 50 ohm 'local oscillator out' socket on the back of your receiver. If the job is done competently there is no reason why the resale value of your set should be reduced.

CONSTRUCTION AND SETTING UP

The use of pre-wound coils makes setting up this project relatively easy, but remember that frequencies near 80MHz are involved so good constructional practice is necessary. *Figs 6, 7, 8, 9* show the foil patterns of the two double-sided printed-circuit boards. In general all component leads that connect to the earth plane should be carefully soldered on both sides of the board - though in some cases this may not be possible. *Figs. 10 & 11* show the component overlays.

The only aspect of construction that may be more difficult is the toroidal transformers. For each transformer, cut three six-inch lengths of 38swg enamelled copper wire. Carefully twist the three wires together to form the trifilar lead. Patiently wind this lead through the holes of the ferrite core taking care not to strip off any of the enamel insulation. Do this so there are six turns in all. You probably will not be able to fit seven turns through the holes anyway. Cut off any excess wire and bare the six ends. The dots of the circuit diagram denote the start of each individual winding; you decide which set of three wires is the 'start'. You can then use a multimeter to identify which 'end' is which. The numbering convention should help you keep track of the winding arrangement. See *Fig. 12*.

The rest of the construction is straightforward. If you build the crystal oscillator and first mixer, and apply 10.7MHz drive the unwanted mixer product on 26.655MHz should be audible on the receiver capacitively coupled to pin 5 of IC1. If this is not the case, then the circuit should be thoroughly checked before proceeding any further.

When the Mixer Board is completed, and Buffer Board installed in the receiver, couple the receiver antenna terminals to the output pin of the Mixer Board. It should be possible to hear the mode signal on the receiver, wherever it is tuned, across its whole range. Tweak L3 and L4 for maximum output. It is likely that L1 will need to be adjusted to get the transmit signal properly co-channel; do not adjust the crystal oscillators on the SSB generator if they have been correctly set-up as described in the July article. Ensure that the USB and LSB positions on the receiver and generator coincide, so you don't talk to people on the wrong sideband.

You should now have a transceive signal anywhere in the HF and MF range, in any mode, depending on how you drive the Mixer Board at 10.7MHz. Remember, whatever you do with the output, to filter out unwanted mixer products immediatly after the signal leaves IC2.

CONCLUSION

This module can form a very cost-effective path for the newly-licensed SWL owner of an R1000 or FRG7700 to move into transmitting. Although the mixer board can form the heart of a multi-mode broadband HF rig, we thoroughly recommend that it is viewed as an experimental base, around which a variety of simple low cost transmitters can be built.

Next month's **R&EW** will describe the CW generator. With this, and a simple single-band class C power amplifier, it is possible to get on the air at low cost, and with surprisingly little effort. Then further enhancements can be added as time passes: The SSB generator (July **R&EW**) single and multi- band PAs, broadband PA, VOX, CMOS break-in, FM and RF speech processing, all of which are to be featured in future **R&EW**'s.

We suggest, however, that the R1000 or FRG7700 owner should seriously consider taking advantage now of the potential offered by the synthesised broadband oscillator which is exploited by this project.

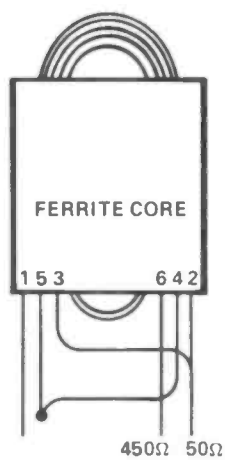


Figure 12: Toroidal transformer

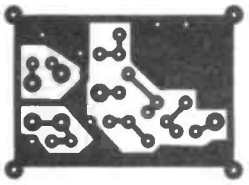


Figure 6

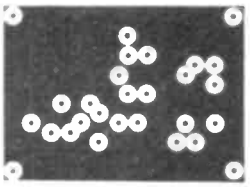


Figure 7

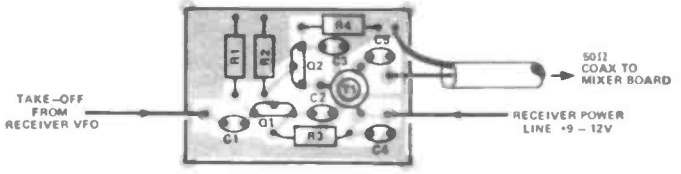


Figure 8: Overlay

BUFFER BOARD COMPONENTS LIST

Resistors	
R1	100k
R2	1k
R3	100
R4	180
Capacitors	
C1	100p
C2, 3, 4	100n
C5	10n
Semiconductors	
Q1	BF256
Q2	ZTX3866 or similar
Inductors	
T1	Toroid transformer on ferrite core (see text)

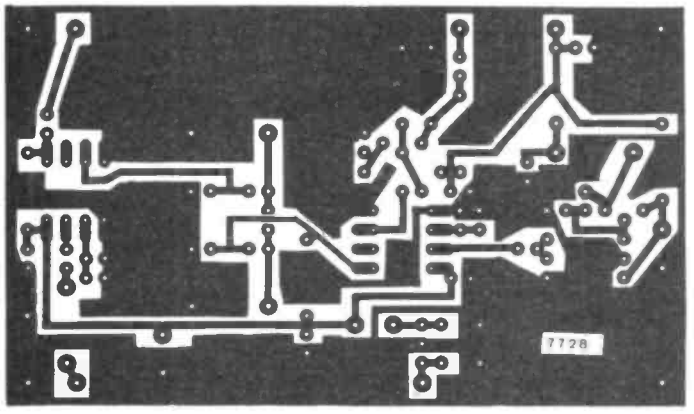


Figure 9

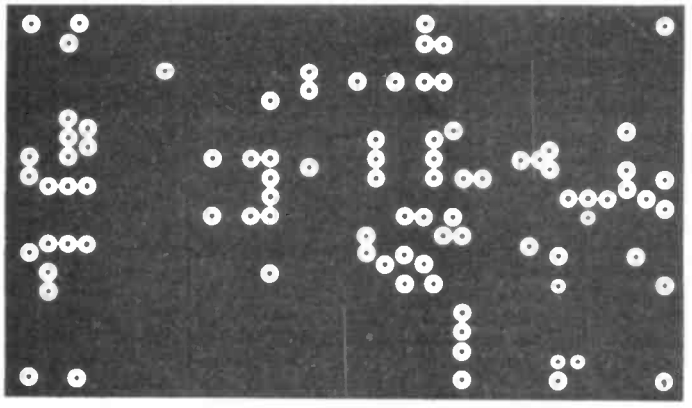


Figure 10

MIXER BOARD COMPONENTS LIST

Resistors	
R1	12k
R2	4k7
R3 R4	270R
R5	390R
R6	8k2
R7	5k6
R8	100R
R9	560R
R10	390R
R11	470R
Capacitors	
C1,2	.33uF 10V min. tantalum
C3,4,10,11,17,20, 23,25 26	100n
C5	56p
C6	120p
C7	39p
C8,18,21,24	.10n
C9,19	1n
C12,14,	47p
C13,15	180p
C16	1p
C22	See text
Semiconductors	
IC1,2	SL1641
Q1,2	BF274 or similar
VR1	78L06
Inductors	
L1	Toko S18 coil, 8.5 turns, (white former)
L2	1mH choke
L3,4	Toko S18 coil, 7.5 turns, (violet former)
T1	9:1 toroidal transformer (see text)
Crystals	
X1	37.355MHz

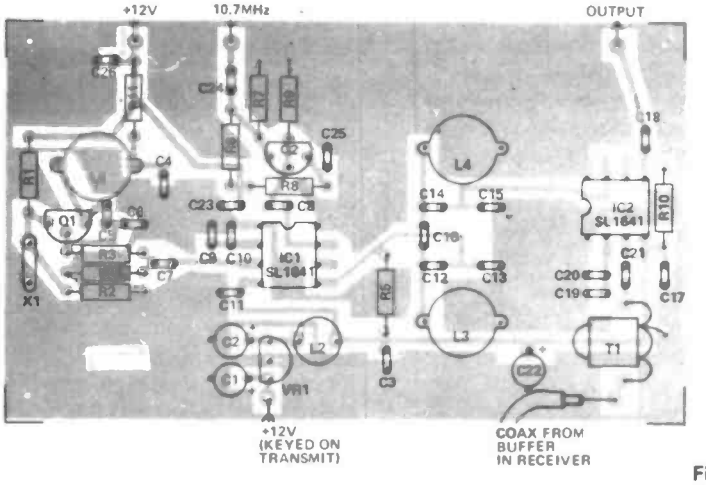


Figure 11: Overlay

Many thanks to Roger Ray and Graham Leighton for help on this project, and thanks to Malcolm Connah for pointing out that the new Trio R600 receiver can also be used in this project.

■ R & EW

Your Reactions.....	Circle No.
Excellent - will make one	12
Interesting - might make one	13
Seen Better	14
Comments	15

Sinclair ZX Spectr

16K or 48K RAM... full-size moving-key keyboard... colour and sound... high-resolution graphics...

From only £125!

First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

Then, the ZX81. With up to 16K RAM available, and the ZX Printer. Giving more power and more flexibility. Together, they've sold over 500,000 so far, to make Sinclair world leaders in personal computing. And the ZX81 remains the ideal low-cost introduction to computing.

Now there's the ZX Spectrum! With up to 48K of RAM. A full-size moving-key keyboard. Vivid colour and sound. High-resolution graphics. And a low price that's unrivalled.

Professional power – personal computer price!

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can uprate later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

There's no need to stop there. The ZX Printer – available now – is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.

Key features of the Sinclair ZX Spectrum

- Full colour – 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound – BEEP command with variable pitch and duration.
- Massive RAM – 16K or 48K.
- Full-size moving-key keyboard – all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution – 256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set – with upper- and lower-case characters.
- Teletext-compatible – user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE – 16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC – incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

um

RS232/network interface board

This interface, available later this year, will enable you to connect your ZX Spectrum to a whole host of printers, terminals and other computers.

The potential is enormous. And the astonishingly low price of only £20 is possible only because the operating systems are already designed into the ROM.

ZX Spectrum

Available only by mail order and only from

sinclair

Sinclair Research Ltd,
Stanhope Road, Camberley,
Surrey, GU15 3PS
Tel. Camberley (0276) 685311

The ZX Printer – available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set – including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.

The ZX Microdrive – coming soon

The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing.

Each Microdrive is capable of holding up to 100K bytes using a single interchangeable microfloppy.

The transfer rate is 16K bytes per second, with average access time of 3.5 seconds. And you'll be able to connect up to 8 ZX Microdrives to your ZX Spectrum.

All the BASIC commands required for the Microdrives are included on the Spectrum.

A remarkable breakthrough at a remarkable price. The Microdrives are available later this year, for around £50.

How to order your ZX Spectrum

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST – use the no-stamp needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item Price £	Total £
	Sinclair ZX Spectrum – 16K RAM version	100	125.00	
	Sinclair ZX Spectrum – 48K RAM version	101	175.00	
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
	orders over £100	29	4.95	
			Total £	

Please tick if you require a VAT receipt ☐

*I enclose a cheque/postal order payable to Sinclair Research Ltd for £

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable

Signature

PLEASE PRINT

Name: Mr/Mrs/Miss

Address

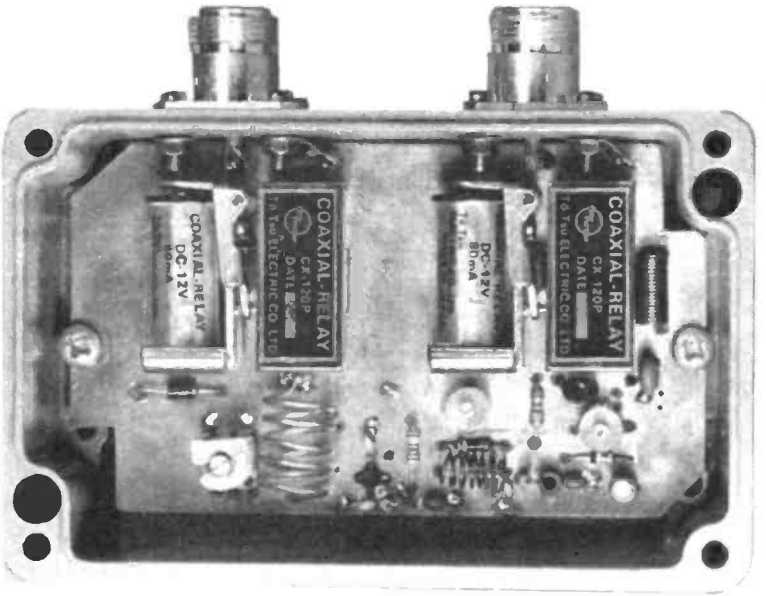
REW 810

FREEPOST – no stamp needed. Prices apply to UK only. Export prices on application.

2m GaAs FET PRE-AMP

This low noise design provides excellent receive performance on 2 metres.

Design by Roger Ray.



PRE-AMPLIFIERS PROVIDING noise figures of 1dB or less offer little improvement to receive performance when placed at the end of a 'lossy' length of feeder. Amateur aerial installations are placed high up in the clear to provide best signal capture! Unfortunately getting the aerials high up also means fairly long feeder runs, which provide typical losses of 1dB or so at 2 metres and worse at 70cm. To realise low system noise figures made possible with the advent of very low noise mosfets, GaAs FET and bipolar devices, it is necessary to mount the first RF amplifier in the system at the aerial itself. Hence changing the position of the feeder loss in the equation for calculating system noise figure, from adding to the first stage noise factor, to slightly reducing the gain before the second stage.

The **R&EW** GaAs FET pre-amplifier uses co-axial relays for low 'straight through' insertion loss and good isolation. A waterproof die-cast box provides protection from the elements while allowing the amplifier to be mounted right at the aerial.

CIRCUIT DESCRIPTION

Relays RLA and RLB provide a straight through path when in their un-energised state, to allow for transmission and reception without pre-amplification. Loss is kept to a minimum by using co-axial relays and 50R track joining them to the RF connectors. A positive voltage of 10-15 volts on the inner of the feeder cable passes through RF chokes L4 and L3 and energies the two coax relays. C1 provides DC isolation to stop the aerial shorting the DC path. The supply voltage is regulated by D1 to give a constant 6.8 volt supply for the pre-amplifier.

Input selectivity is provided by the tuned circuit L1 and C2. The 50R input is tapped onto the coil, the tap position being chosen to give optimum noise match rather than impedance matching. A high Q air spaced coil is used for L1 and an air spaced capacitor for C2 to minimise input circuit losses. The high impedance end of the tuned circuit is connected to gate 1 of the GaAs FET Q1. The required negative bias voltage on gate 1 is obtained by the voltage drop across R2, the value of R2 is chosen to give a drain current of 9-12mA (see **R&EW** Aug '82 page 63) for optimum performance. Gate 2 of Q1 is held at the same potential as the source, through resistors R1 and R3, C5 providing HF decoupling to maintain stability. The drain of the 3SK112 is connected to a low Q tuned circuit further damped by R4 when used on 144MHz. Trimmers C7 and C8 allow output matching to 50R.

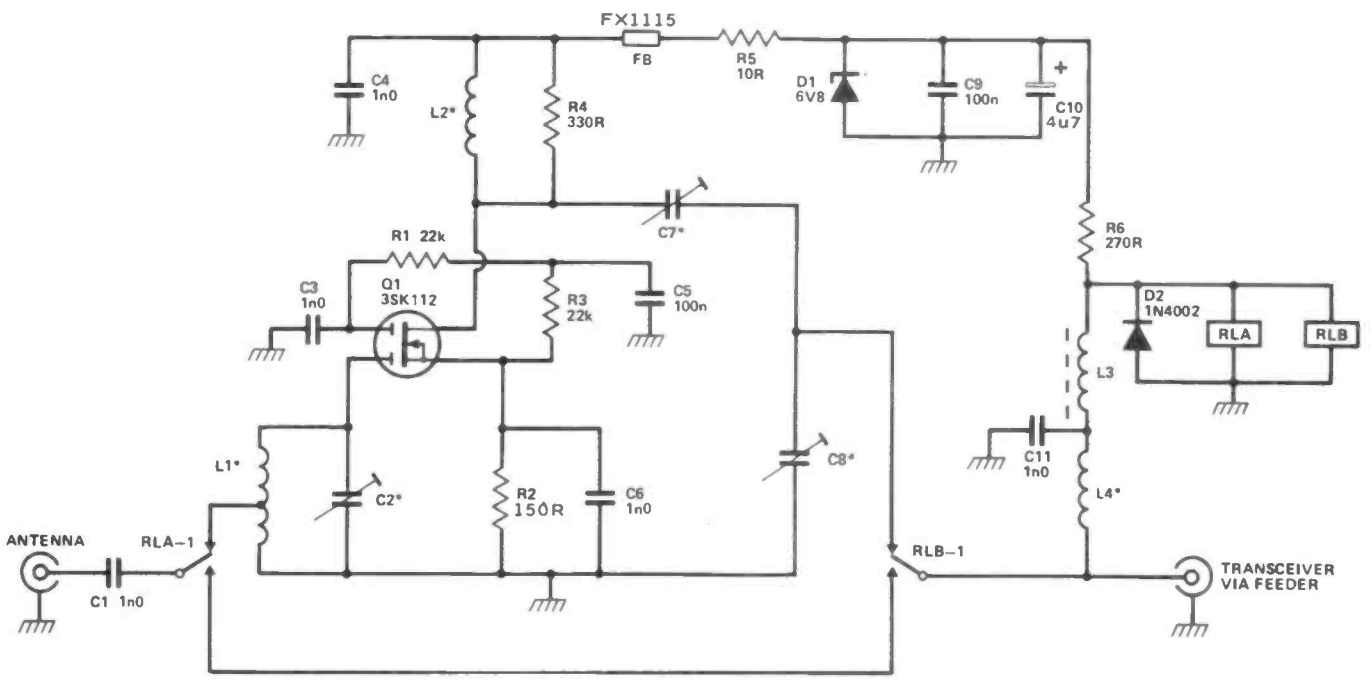
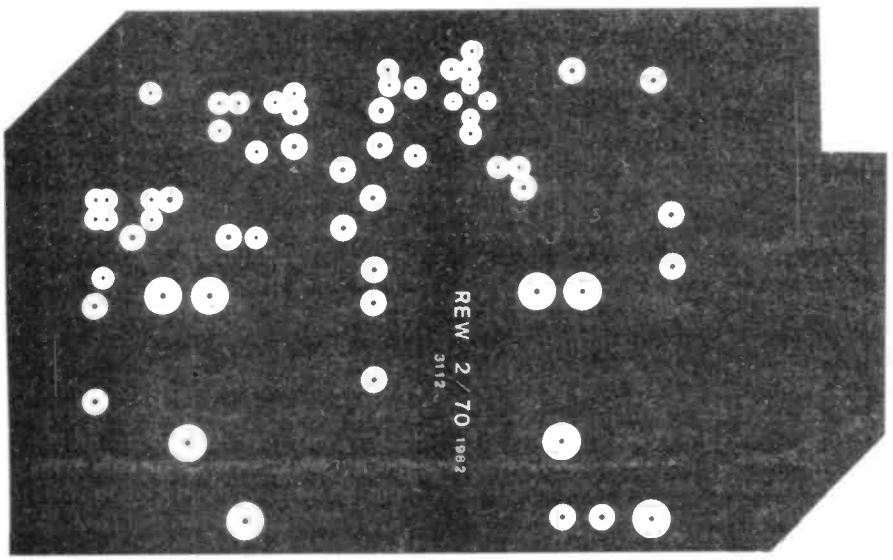
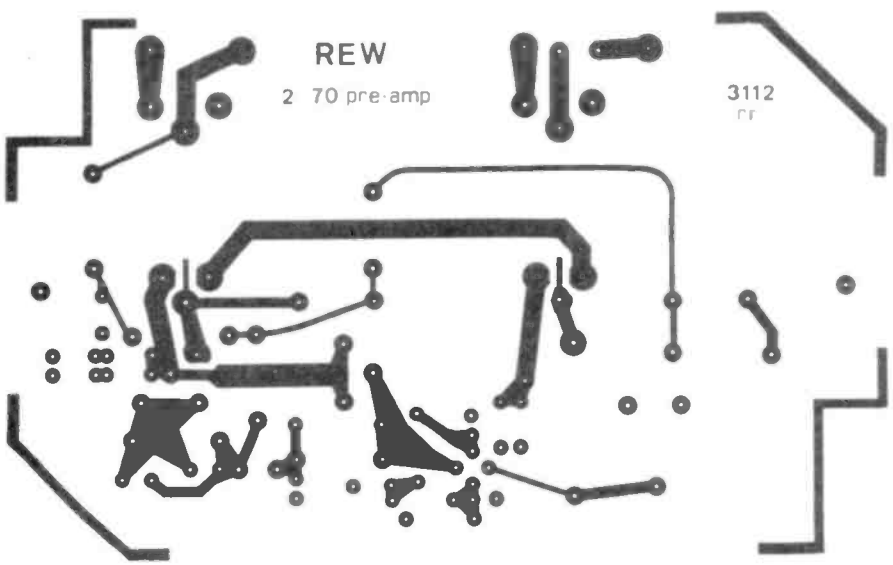


Fig.1: Circuit diagram of masthead 144MHz pre-amplifier.

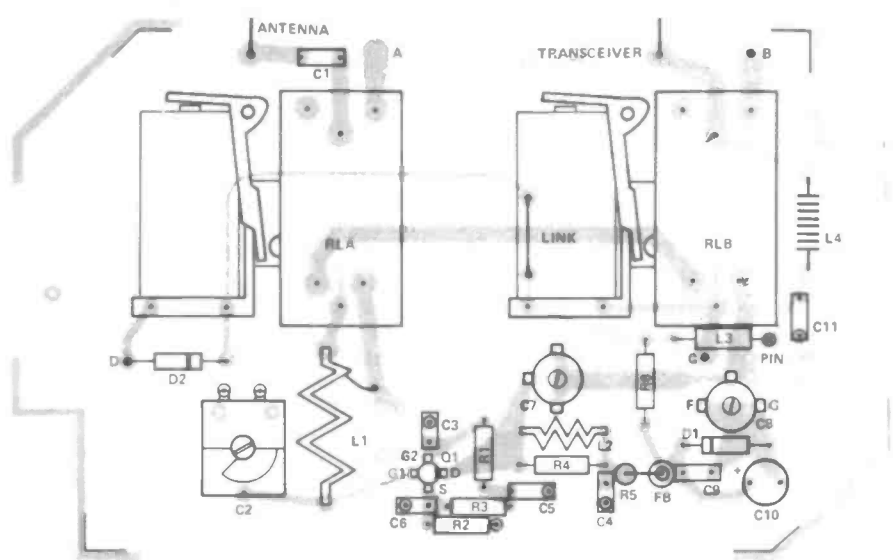
Note: Component values marked thus * depend on whether the pre-amplifier is used for 144 or 432MHz, see parts list for details.



PCB Top Foil



PCB Bottom Track

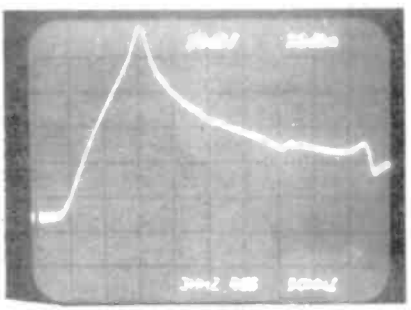


A,B,AND C ARE THROUGH BOARD LINKS

LEADS MARKED D,E,F AND G ARE SOLDERED TOP AND BOTTOM

⊙ SHOWS COMPONENT LEAD SOLDERED TO TOP EARTH PLANE

PCB Overlay



AMPLIFIER RESPONSE
0-500MHz

SPECIFICATION	144MHz
Bandwidth (1dB)	6MHz
Noise Figure	less than 1,0dB
Gain (typ)	17dB
1dB Compression	+5dB
Supply/Voltage Current	12V 180mA
Impedance	50R
Insertion Loss	0,2dB
Size (transmission)	125x80x58mm

COMPONENTS LIST

Resistors (all ¼W 5%)

R1,3	22k
R2	150R
R4	330R
R5	10R
R6	270R

Capacitors

C1,11	1n0 disc ceramic 250V
C2	12pF air spaced trimmer
C3,4,6	1n0 ceramic
C5,9	100n monolithic
C7,8	22pF trimmer
C10	4u7 16V electrolytic

Semiconductors

D1	6V8 zener 400mW
D2	IN4002
Q1	3SK112

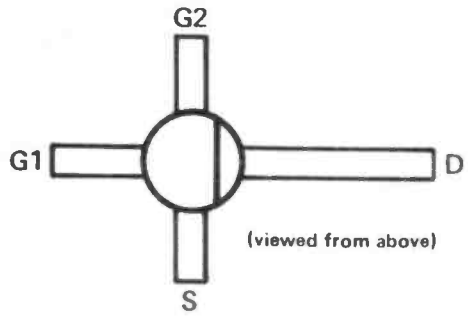
Inductors

L1	5 turns 16swg + c.w. tap 1 turn 9mm dia.
L2	7 turns 0.56mm e.c.w. 4mm dia.
L3	3.5 turns 0.25mm e.c.w. on FX1115 ferrite bead.
L4	19 turns 4mm dia. 0.56mm e.c.w.

Miscellaneous

RLA,B coax relay CX-120P
FB FX1115 ferrite bead.
PCB
Waterproof box
N-type connectors
Screws etc.

3SK112 CONNECTION DETAILS



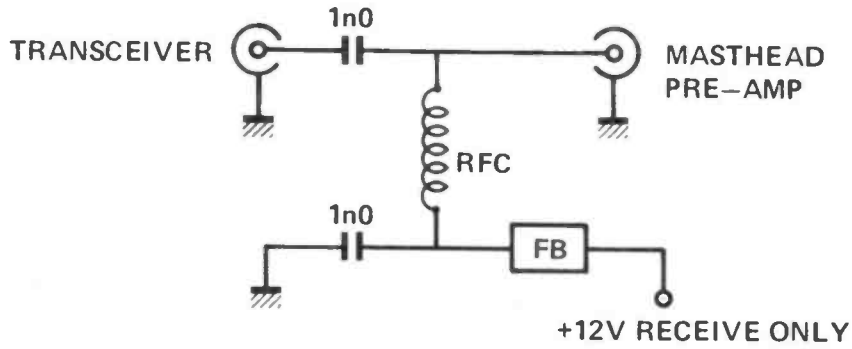


Fig.2: Tranceiver and RF/supply interface capacitors 1n0 250V
RFC RFC as L4 in pre-amp.

CONSTRUCTION

All components are mounted on a double-sided PCB the top being used as an earth plane. Begin construction by fitting the link under RLB, and the through board links A, B and C leaving approximately 30mm of wire above the board on A and B. Links A, B and C should be made using 16swg thick tinned copper wire, soldered both sides of the board. Wind the four coils L1-4 following the details in the components list. These can now be fitted to the board, note that the earthy end of L1 is soldered top and bottom to the PCB.

The rest of the components with the exception of the GaAs FET Q1 can now be fitted. Note that component leads marked D-9 are soldered both sides of the board, and that some components have leads bent and soldered to the top earth plane (C2, 3, 4, 5, 6 & 11). A pin is used at one end of L3 to allow for testing latter. A simple DC test should now be performed before Q1 is fitted. Apply +12V to the 'transceiver' input connection. Make sure that both relays operate reliably and that +6V8 +/-0V2 is present on R5.

Next comes the tricky bit the fitting of Q1. There exists a fair amount of paranoia about handling GaAs FETS, stemming from the fact that they are very static sensitive. After pulling a couple of 3SK112's in and out of circuits many times, with no apparent failures, it is questionable whether all the fuss is justified. Still, it is better to be safe than sorry, so here are the basic rules.

A) Avoid static potential differences between yourself, the PCB, the soldering iron and the device.

B) Solder the GaAs FET leads quickly.

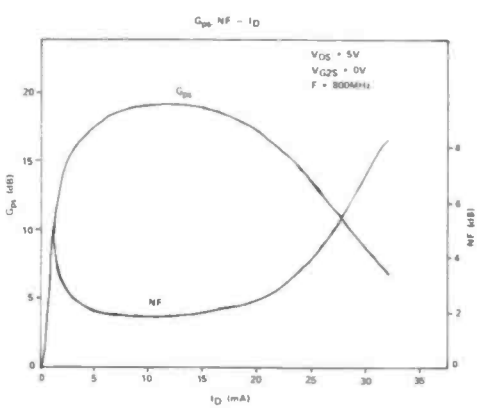
C) If you must touch the gates then make sure you also touch the drain or source at the same time.

Bend the leads of the 3SK112 downwards approximately 1mm from the body of the device and solder into the board, obeying the above precautions. (The manufacturers will not accept a blown device for replacement!)

The completed PCB is now ready for mounting in the waterproof box. The pre-drilled box has long 6mm screws fitted to act as part of the mast clamp. These screws should be fitted with a fibre washer either side of the box to keep it waterproof. Clean off paint around where the connectors mount as shown in the accompanying photograph.

Attach N-type connectors to the box with solder tags fitted to one of the four screws of each connector.

Solder a short length of 16swg wire to the input and output connections on the PCB and fit the board into the box using 4mm screws. Input and output connections are now soldered to the centres of the N-connectors and the earth leads to the solder tags.



Gain and noise figure against drain current for the 3SK112

IN OPERATION

The pre-amplifier must be aligned before it is mounted on an aerial mast.

This can conveniently be accomplished by connecting the pre-amp output to the receiver by a length of co-ax and directly powering the pre-amp. To do this desolder the L4/C11 end of L3 from the pin and apply + 12V at this point. Tune the receiver into a weak station or beacon with no supply on the pre-amp. Switch the supply on and adjust C2 until the signal is again heard. Adjust C7 and C8 for the best signal/noise ratio and then repeat for C2. The tap position of L1 has been chosen for the lowest noise figure, if this tap position has been accurately adhered to tuning for maximum gain will be coincident with lowest noise.

Resolder L3 and fit the box lid. The pre-amp is now ready for masthead mounting. The box should be positioned on the mast with the N-type connectors facing downward. The simple line powering interface shown in *Fig. 2* can either be built into a small die-cast box or built into an existing power amplifier. Switching must be arranged so that the supply cannot be connected to the pre-amp whilst transmitting, or the GaAs FET will be destroyed. If very long lengths of feeder are used, it may be necessary to use more than 12 volts at the transceiver end to ensure an adequate voltage at the masthead for relay switching.

HIGH POWER

The pre-amplifier has been used with a transmitting power of 100W. For use with higher powers, back to back protection diodes on both input and output of the pre-amp are required. Low capacitance silicon diodes can be used or for more protection Schottky diodes. If Schottky diodes are used, two diodes in series should be used on the output to prevent limiting the pre-amplifiers output capability. Provision has been made on the PCB for the fitting of these diodes if required. Also, when using high power the relays must be in the transmit position before RF is applied.

■R & EW

Your Reactions.....	Circle No.
Immediately Interesting	20
Possible application	21
Not interested in this topic	22
Bad feature/space waster	23

READERS LETTERS

Facts and opinions; Yours and Ours

Agony Aunt?

Dear R&EW,

As you run a reasonable magazine, dare I say the best buy on the market and as you appear to act upon the feedback from your readers I would like to make a suggestion or three.

Your ideas on information services are very good but why talk about it why not make a start in printed form now. The Beeb are very good at giving long range forecasts of interesting items that they slip onto channel 2 from time to time so a monthly bulletin is not impossible.

Secondly - how about a readers' problem page or discussion page - no not like the Sunday People but like PCW. If you need any help in its assembly or such I could always lend a hand.

Thirdly what happened to Dick & Smithy it was serious in a light-hearted way and was excellent in every respect. Any chance of its return.

By the way you won't find me on your subscription list due to loyalty to my newsagent.

G E D
Cheshire

R&EW:

At the moment the only problem page we have planned is one from the Editor. Seriously though, its a good idea but one which is extremely difficult to execute in a satisfactory fashion. Long range problem solving via post is often a most unsatisfactory way of tackling any specific enquiries from readers. We are also unable to spare the manpower that the production of a problem page requires. Your offer of help looks tempting though and we may be in touch if we decide to undertake such a feature.

Dick and Smithy has quite a loyal following at the R&EW office but we had thought that readers of the magazine did not miss the exploits of these two characters. If more people write and ask for their return, we'll do our best to oblige.

Question Time

Dear Sir,

I must congratulate you on your exceptional magazine. I saw the July issue, and had to order all the back numbers from October.

Can you help me with a computing/communications query?

A neighbour 400yds away has a Microtan controlling a model railway.

Is there a legitimate means to communicate (2-way) with my BBC micro? Perhaps via a modem over CB?

MF
Nottingham

R&EW:

We hope to publish details of a state-of-the-art modem in the very near future. This will allow your BBC micro to communicate not only with your neighbour's train set, quite why you want to establish such a link we're not sure, but also to access REWTEL our new 'electronic' magazine, a far more worthwhile facility. Watch this space.

Dear Sir,

I am extremely disappointed to find in the September issue of Radio & Electronics World that the follow-up article to the 10.7MHz SSB Generator does not appear. It was promised for the September issue and I should be glad if you would kindly tell me when it will now appear.

IEE
Suffolk

R&EW:

We've had a number of letters along these lines - very sorry that the mixer and buffer boards did not appear last month, one of our infamous production hitches caused it to miss our last press day. It does appear this month and we hope everyone will accept our sincere apologies.

Dear Sir,

I fully agree with your comments about The Wireless Telegraphy act in relation to allowing people only to receive certain transmissions. Anyone who was of a mind to commit a felony would hardly be put off by the fact that it was a further offence to use a radio to listen to, for example, the police. One can't help wondering why the government, or rather the civil service, finds it necessary to be so rigid and authoritarian over radio. It is more easily understood that a regime like Hitler's needs to control people's listening, because it is inherently unstable and liable to suffer severe damage resulting from the slightest incident. However, history has shown that the British parliamentary system is one of the most stable regimes in the world, and is hardly likely to be toppled by a few people listening to the police, ambulance or airband on their radios. I think it is probably a case of some small minded men in the civil service just liking the taste of power, and the sooner they can be put on the dole the better.

As a British subject, it is a matter of shame to me that my country was one of the last to legalise CB and therefore was until recently grouped with various unsavoury dictatorships in not having it.

JdR
Cornwall

Dear Sir,

Could you please inform me as to the fitting of your CB Noise Squelch into my Ham International Multi-Mode, schematic diagram of which I enclose.

If you can do this for me, I will buy the project pack as soon as possible.

I enclose a stamped addressed envelope for your reply and the return of my diagram.

AAK
Inverness

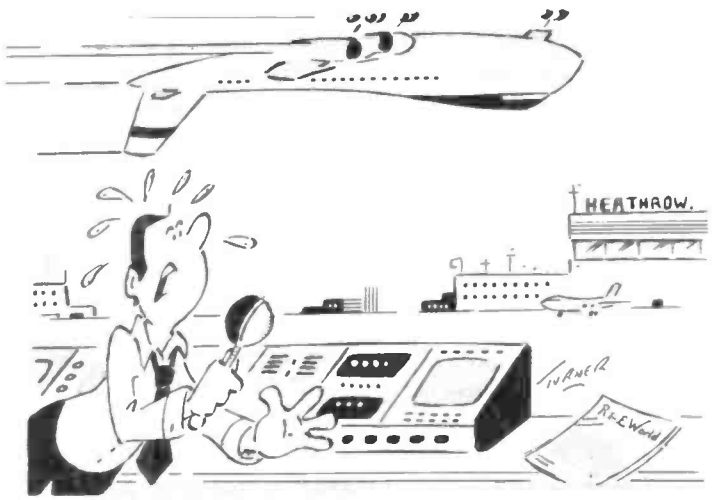
R&EW:

As we pointed out in the CB Noise Squelch article last month we are unable to provide details of special modifications to commercial equipment. We simply do not have the time to examine the multitude of variations found in different manufacturers rigs — we have a magazine to produce!

Having said that we do plan to describe detailed modifications to the more popular of sets, including fitting of the Noise Squelch.

We had a large response to our caption competition in September. The cartoon is reproduced below together with the winning entry.

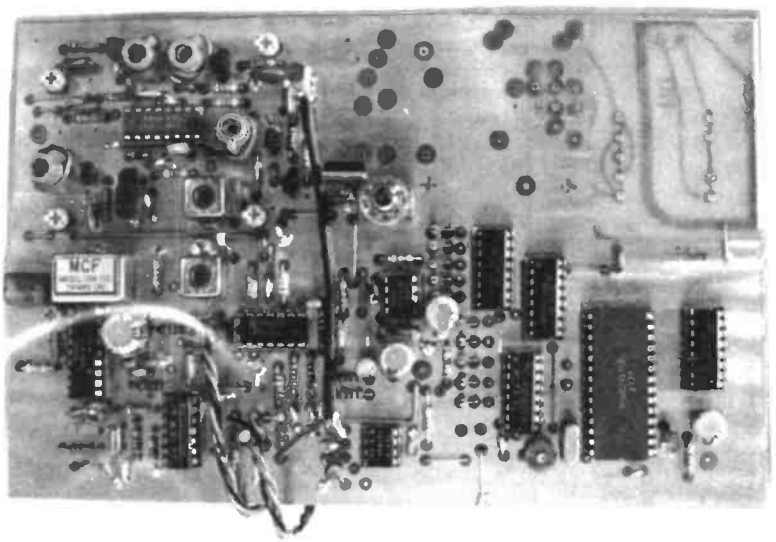
The winning entry was from M. Abbott of Lytchett Matravers, Dorset.



"WHAT DO YOU MEAN, YOUR NEW MICRO CONTROLLED FLIGHT STABILISER HELD YOU ROCK STEADY ALL THE WAY FROM SYDNEY?"

720 CHANNEL AIRBAND RECEIVER

Concluding Keith Mitchell's fully synthesised design for a VHF AM receiver covering 108MHz-136MHz.



LAST MONTH's ARTICLE described the general principles behind the operation of the airband receiver and a detailed examination of the circuit. This month the construction and alignment of the receiver is described. We shall be covering further aspects of the design of the synthesiser, and the adaptation of the receiver to other ferquencies and modes in a subsequent issue.

TESTING AND ALIGNMENT

Do not yet install the delayed AGC link between R45 and R49. Temporarily increase the AGC time constant by soldering a 100uF capacitor across C19 being careful to observe the correct polarity.

With all of the IC sockets empty, apply 12 volts (with 100mA limiting if possible) to the Ni-cad supply voltage inputs on the board. A high impedance volt meter should read 6V at the power supply connections of each IC socket - except IC4 socket which should give 10V.

At first, only insert ICs 9, 10 and 11. On applying power there should be noise from the loudspeaker which can be reduced by the volume control. (Note that the connection to the wiper of the volume control was accidentally swapped with the link to the supply end of R20 on the overlay published last month. This is non-fatal, but you won't hear a lot unless this is corrected.)

A frequency counter with a high impedance probe should show a frequency very close to 10.245MHz when applied to IC10 pins 1 or 5.

Connect a high impedance millivolt meter or oscilloscope to IC9 pin 15, and inject 10.7MHz from a signal generator, via a 15pF capacitor to pin 13 or 14 of IC1 socket. Any modulation should be audible in the loudspeaker, and an increased output at IC9 pin 15 should be perceived. Tune T1 and T2 for maximum output, reducing the input level as necessary. Correct adjustment of T2 requires the use of an oscilloscope and sweep generator (or wobulator), and T2 should then be adjusted to give the smoothest passband response as in *Fig 1*, not as in *Fig 2*. Disconnect the signal generator.

All the other ICs may now be inserted with the usual care to check orientation. On applying power, LED D6 will probably light indicating that the synthesizer loop is out of lock. If it should light momentarily and then go out you are lucky and the synthesizer is already working.

Select 127.30MHz on the thumbwheel switches and monitor the tuning voltage at pin 10 of IC4. Set VR4 to its three-quarter

COMPONENT LIST

Resistors (all ¼W 5%)

R1-10	270k
R11-14,16,17	330k
R15	5k6
R18	270R
R19,44	680R
R20	180R
R22	10k
R23,26,30	10M
R24	220k
R25,49	47k
R27,28,50	82k
R29,36,45	33k
R31	4k7
R32	56k
R33,40	1k
R34	15k
R35	220k
R37	470R
R38	15R
R39	22R
R41,42,43	56k
R46	47R
R47	2k2
R48	3k3
R51	68k
R52,53	220k
VR1,2,3,4	100k miniature preset
VR5	1k miniature preset
VR6	20k lin potentiometer
VR7	10k log potentiometer

Capacitors

C1,4,6,14,21, 22,27,28,33,54, 56,55,59	100n monolithic
C2,5,16,18	1n0 ceramic
C3	100p ceramic
C7,8	1n5 ceramic
C9,10,58	4n7 monolithic
C11,17,38,40, 45,47,48,49	10n ceramic
C12	47p ceramic
C13	60p trimmer
C15,34,35	100u electrolytic
C19	47u electrolytic
C20,36	2n2 ceramic
C23	270p ceramic
C24	15p ceramic
C25	33p ceramic
C26	47p ceramic
C29,30	1u0 electrolytic
C31,32	680p ceramic
C37	2p2 ceramic
C39,42,43, 46,50	470p ceramic
C41,44	4n7 ceramic
C51	22u electrolytic
C52	8p2 ceramic
C53	1u tantalum 35V
C57	10u 16V radial elect.

Semiconductors

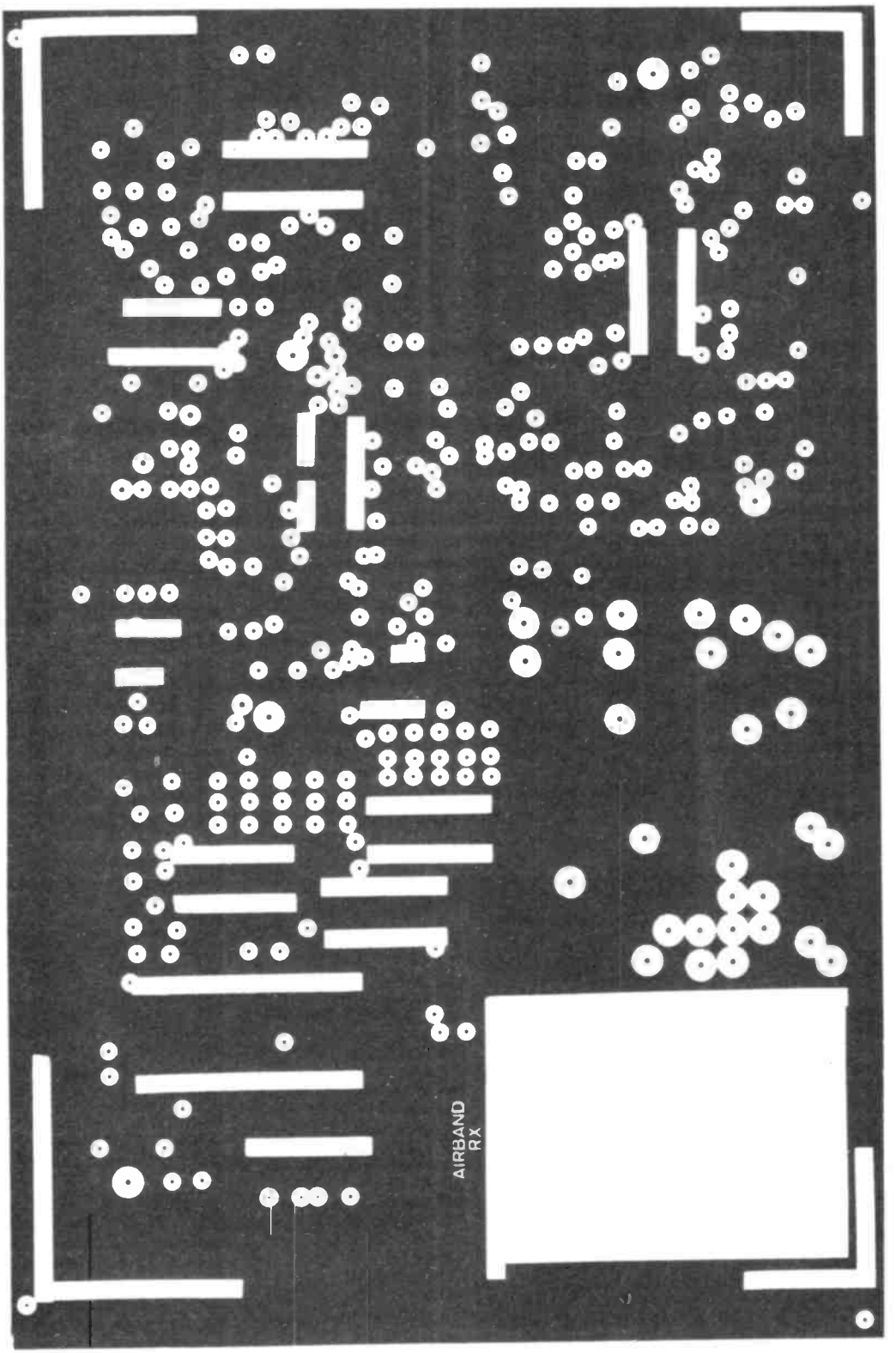
D1,2,3,4	BB204
D5	BA379
D6	Red LED
D7	10V zener 400mW
Q1	2SK55
Q2	BF274
IC1	TD1062
IC2	MC145152
IC3	SP8793
IC4	LM747
IC5,6,7	4008
IC8	4560
IC9	SL6700
IC10	4007
IC11	SL6310
IC12	7806

Inductors

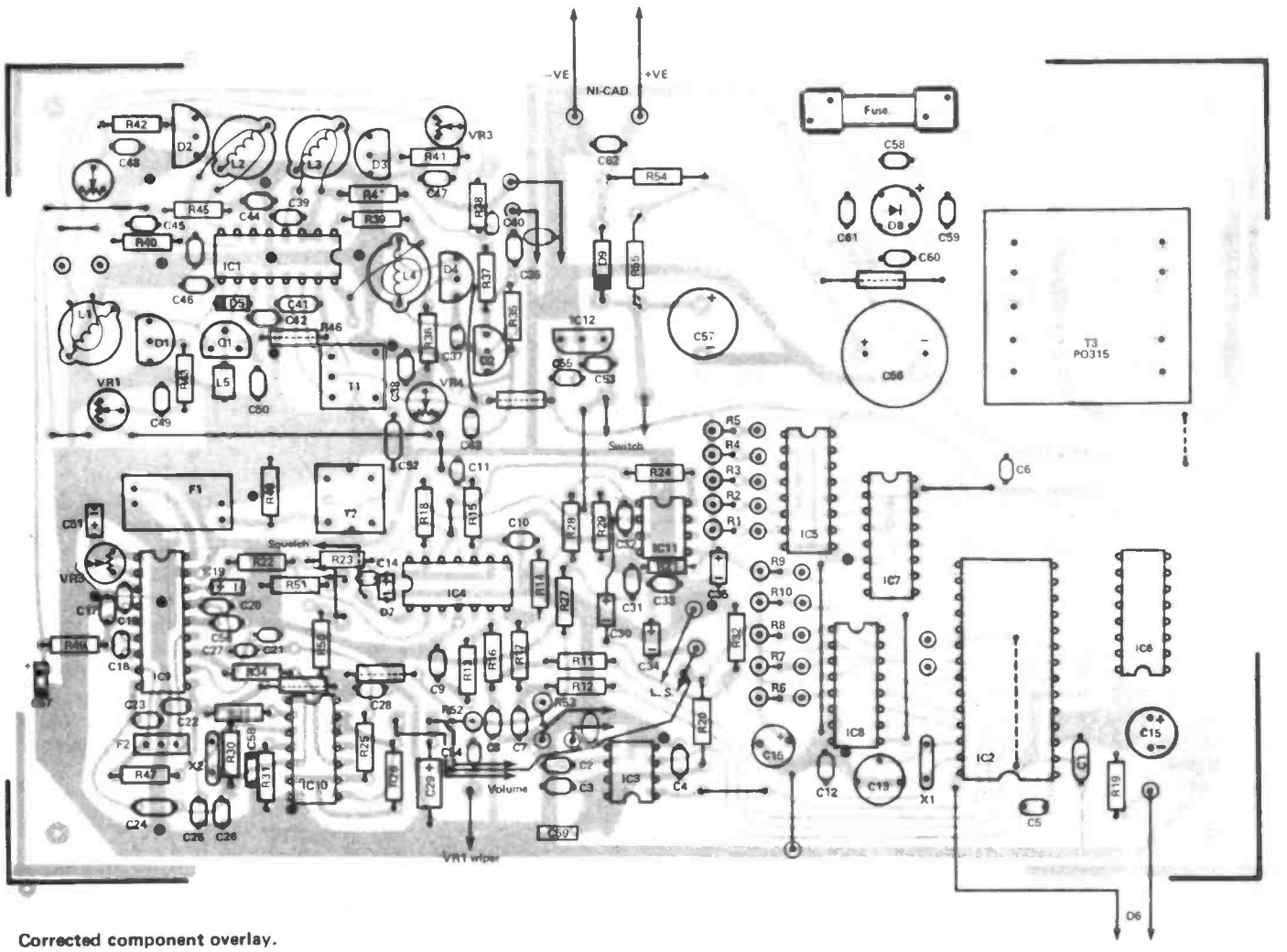
L1	S18 2.5 turns 1 turn link
L2,3	S18 2.5 turns 2 turn link
L4	S18 2.5 turns 1.5 turn link
L5	1uH choke
T1	KACS 3892A
T2	TKAC 6184A

Miscellaneous

10.7MHz crystal filter 10M 15D
455kHz filter CFM 2455D
x1 6.400MHz crystal
x2 10.245MHz crystal
IC sockets
PCB
5 BCD Switches
Case
Loudspeaker



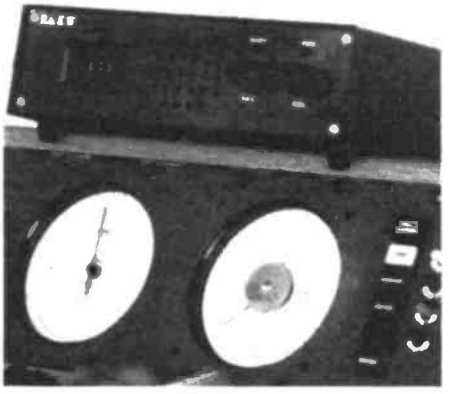
PCB Foil Pattern (Top Side).



Corrected component overlay.

clockwise position and adjust the core of L4 until D6 goes out, and then until the tuning voltage is about 5V. (Use a properly fitting hexagonal trimming tool for this as it is very easy to split the core, and removing a broken core is a pain!) A sensitive frequency counter at pin 5 of IC3 should read 138MHz, but may load the circuit enough to lose lock, in which case pin 3 of IC3 can be monitored, and the frequency should then be 3.45MHz. C13 should be adjusted to give the exact frequency. The synthesizer should stay in lock when either 118MHz or 136MHz is selected, and the tuning voltage should be above 2 volts at 118MHz and below 8 volts at 136MHz. VR4 and L4 core may need adjusting to achieve this.

Next comes the RF alignment. Set VR1 to match VR4 (approx. three-quarters clockwise) and VR2 and VR3 to the mirror image position (approx. three-quarters anticlockwise). Select 127MHz, and connect a 50 ohm signal generator output tuned to 127MHz with 30% amplitude modulation to the antenna socket. Monitor the output at IC9 pin 15, and tune the cores of L3, L2, and L1 for maximum output, when the minimum perceived input should be considerably below one microvolt. Repeat this at 136MHz, but use VR3, VR2, and



VR1 for tuning, before finally selecting 118MHz and adjusting L3, L2 and L1 cores again.

Install the wire link next to VR2 carrying the delayed AGC to R54 and set VR5 so that the voltage at IC9 pin 5 starts to rise from zero as the RF input to the antenna rises past about 50uV. A 10uF capacitor should be added from the junction of R45 and R49, or the agc may show signs of motorboating at critical input levels. When all is working well, the receiver will be usable from below 0.5uV to over 1v PD input. This completes the alignment.

FINALLY

A telescopic antenna extended to about 22 inches should receive aircraft transmissions from a wide area, and local ground transmissions. As always with VHF reception, antenna elevation makes a considerable difference, and hilltop sites are very favourable.

The basic synthesiser system may be adapted to a very wide range of frequencies (that are within the scope of the prescaler), and we hope to include some further notes in an early issue. The use of the new TOKO KV1310 VHF tuning diodes will enhance the range available from the relatively low tuning voltage, and may well enable a single unit to span 108-150MHz. Watch this space.

■ R & EW

Your Reactions.....	Circle No.
Excellent - will make one	133
Interesting - might make one	134
Seen Better	136
Comments	137

SONY F1

Peter Luke reviews the UK's smallest Beta video recorder.

THE SONY F1 VIDEO RECORDER is the smallest machine to have come **R&EW's** way and we have no doubts about Sony's claim that it's the smallest Beta recorder available in the UK. Indeed until the 'half size' VHS and Beta cassettes and associated hardware make an appearance (during 1983?) the F1 probably represents the ultimate in miniaturization of a Beta machine. The Beta system has a head start over VHS when it comes to achieving the smallest possible recorder, as Beta cassettes are significantly smaller than their VHS counterparts - although looking at the size of the Sony C5 and C6 it'sobvious that a small cassette does not automatically mean a small recorder.

The recorder's companion tuner/timer is of a similar size and the two, when stacked, take up less shelf space than a typical audio cassette recorder.

AT HOME WITH SONY

For mains operation the recorder is linked to the tuner/timer via an (extremely) multi-cored lead. An aerial signal is taken to the tuner/timer and the RF signal from this unit fed to the TV set via a co-ax cable. With the test signal switch on the recorder set to ON, the TV set can then be tuned until the monochrome, half white, half black, test pattern is received. A tone is also generated in order that the sound channel can be checked. If the channel number of the recorder's RF modulator 'clashes' with any broadcast transmissions, the modulator's frequency can be readily adjusted until it occupies a free area of the band (between channels 30 and 39).

The next step in the setting up procedure is to tune in the 12 available channels, an operation that is simplified by the automatic tuning featured on the tuner/timer.

To tune in all channels receivable it is only necessary to press two buttons - search and auto programming - this will result in the available channels being assigned to the 12 programme buttons in ascending order of channel number. This may not be the most convenient assignment however, most people chose programme 1 for BBC 1, 2 for BBC 2 etc. The automatic system also locks onto fairly weak stations — certainly not offering entertainment quality reception — and in one of the locations in which the system was tried, all stations had been 'allocated' before BBC2 had been encountered. All in all the semi-automatic approach to tuning is to be preferred. In order to assign particular stations to individual programme buttons the operation is scarcely more involved than the automatic approach, again just two buttons to press, search and this time, channel search up or down.

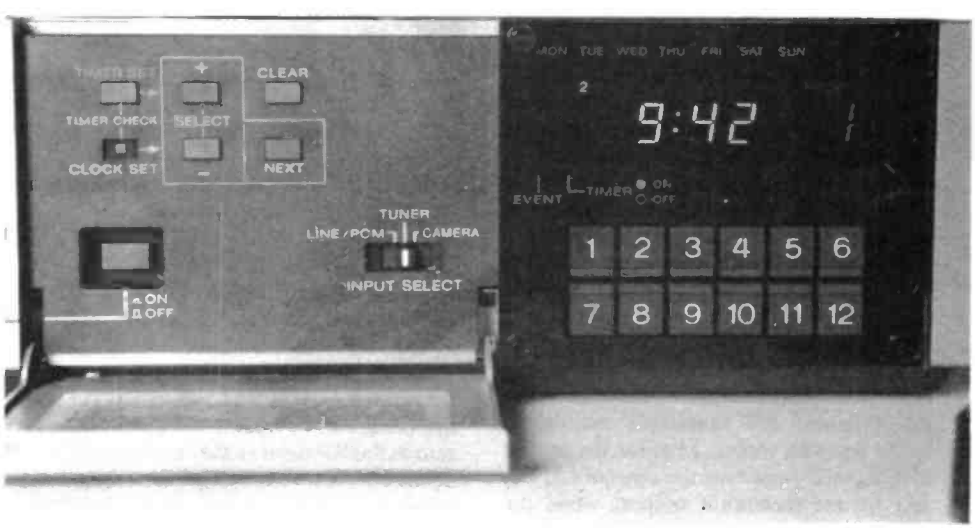
The tuning controls are located behind a flap on the top of the tuner and once set need not be disturbed. This means that in use, the recorder may be placed on top of the tuner without obstructing any controls. A line of LEDs associated with the tuning controls indicates the approximate channel number of each station selected.

CLOCKING IN

The tuner/timer's clock is straightforward to set up, this being accomplished with just three switches, + and - controls to increment/decrement the day of week and hours/minutes display with a 'next' button to move between the various entries. Instructions printed on the reverse side of the hinged flap behind which the timer's controls are covered act as an aide memoire which, along with the display's prompt facility (the specific entry being made is highlighted by virtue of the fact that it flashes) makes the set-up operation foolproof.

NO REGRETS

Before going on to describe the way in which the F1 ensemble performed it may well be as well to state that the overall impression given by the recorder is one of an extremely well designed product in which attention to detail, in particular the ergonomics of the system in use, has to be admired. Any criticisms in the following paragraphs are very minor gripes and anybody selecting the F1 in preference to other recorders should find no reason to regret the choice.



Timer Setting Controls.

GETTING IT TAPED

Inserting a cassette into the top loading F1 and depressing the cassette compartment results in the tape being threaded around the helical head assembly. This is a major difference between the Beta and VHS formats, for in the latter, the tape is only threaded in a 'play' mode. The pros and cons of the two approaches have been adequately covered in other publications and in the final analysis the differences probably do not have much effect on head wear, tape stretch etc. The Beta tape transport does seem to be of a generally smoother nature however, with less of the whirring and clicking as a tape is continually wound and unwound from the heads as different modes are selected.

The F1's transport was given the same harsh tests as the other machines we have reviewed, rapid selection of the rewind, fast forward and play modes, and behaved faultlessly throughout. The deck is solenoid operated, there would be no room for bulky mechanical keys on a machine this small.

The F1 has a full complement of 'trick' video functions. The fast search (forward and reverse) work well although a minor criticism here is that these functions are selected from play by the rewind/fast forward key. This does mean that 'stop' must be engaged before a wind operation can be entered. While it may be argued that there is no room for separate search functions on the F1's compact front panel, the same cannot be said for the recorder's remote control unit to which we will return later.

The shuttle search facility of the F1 was found to be extremely useful for locating a specific point on any tape - an edit point for example. The shuttle search function becomes active after pause has been selected, the still frame performance of the F1, incidentally, matched that of other top of the range Beta machines, with the exception of the Toshiba four head system. Back to the shuttle search, which from a particular (still) frame allows the tape to be moved forwards and backwards at either a slow (about half) speed, or at normal speed. 'Pulsing' the appropriate slow button will search the tape one frame at a time.

These buttons allow a particular point to be identifid in much the same way as the 'rocking' of an audio tape, familiar to anyone who has edited reel-to-reel tapes.

A twice speed facility is also available although there seemed to be very little point to this function - it's here if you want it.

To place the machine into its record mode both the record and play keys must be simultaneously pressed - this is common practice and prevents accidentally selecting record.

When recording from the tuner, it is impossible to change the channel being recorded. This form of record interlock is a useful feature and does prevent any recording being spoilt by an accidental operation of a channel change button.

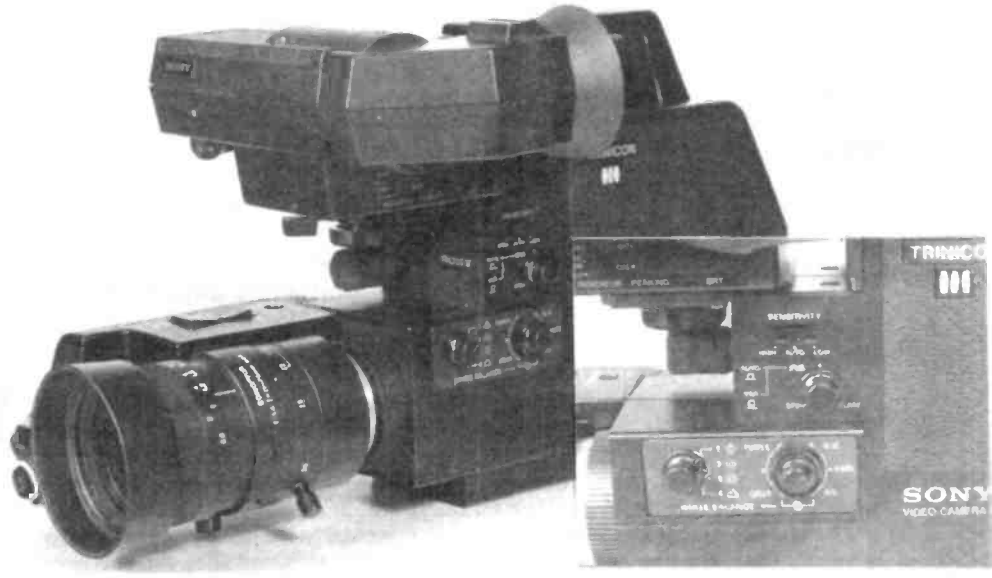
An audio dub feature is provided, allowing a new sound track to be added to a section of tape without disturbing the video. The sound-on-sound and insert features found on some portable recorders, are not present on the F1.

The tape counter on the F1 is a vast improvement over the mechanical designs found on most recorders. In fact tape counter is the wrong term, tape timer would be more accurate. The LCD display indicates the amount of tape used in hours, minutes and tens of seconds with a flashing colon indicating the passage of seconds. The convenience of knowing how much tape has been used or exactly where to wind the tape to in order to skip an hour's worth of tape is extremely useful and it is to be hoped other manufacturers will follow Sony's lead in this area.

The three buttons associated with the display are a backlight, a reset to zero and a goto zero button. The latter is the equivalent of memory rewind on other machines and if selected from the stop mode, will rewind the tape to the 'zero' point.

The display is reset if a cassette is ejected, a good idea, or if power is removed - not such a good idea. Another small moan here is that the reset and goto zero buttons are too close to each other. It is very easy, and extremely annoying to press reset instead of goto zero.

It is presumed that the tape timer works by counting vertical sync pulses, as it will not function if a blank tape is played - suggesting the spool revolutions are not being counted - but will function as normal if tapes recorded on a different model of Beta recorder are played back - suggesting that the F1 does not lay down any special sync track.



A MATTER OF TIME

The timer is capable of recording 9 events over a two week's period, quite enough for most people's needs and its operation is readily mastered.

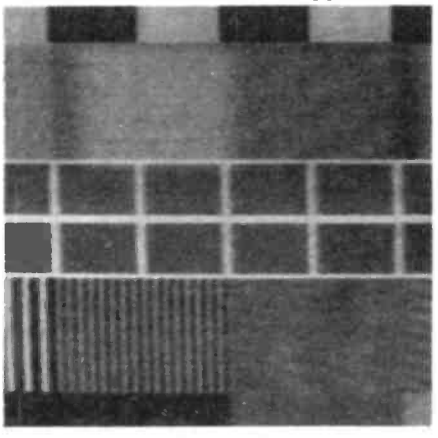
Operation is again based around increment, decrement and next buttons, and while easy to use and relatively quick to program it was felt that a, dedicated, numeric keypad would have been a better method of data entry - but that's a personal preference.

The clock display is of a 24 hour type which, and again personal preferences intrude, seems far better than a 12 hour display with AM/PM indication.

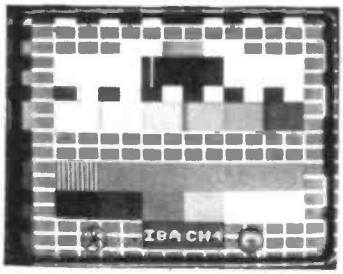
The audio and video in/out sockets are on the tuner timer's rear panel, the recorder itself only featuring an RF output so that it may be used to playback material via a TV set when used without the timer. Sony do produce an adaptor which will take the place of the tuner/timer's plug at the back of the recorder, allowing direct video and audio connections to be made without the tuner/timer

As a separate unit, the tuner/timer will also operate as if the recorder were present.

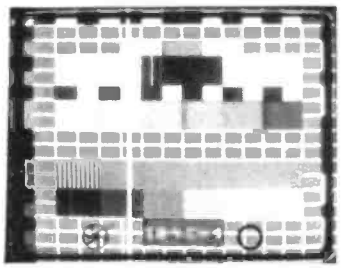
The remote control unit supplied with



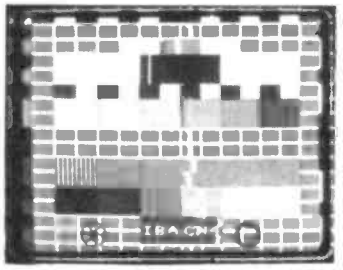
The F1's still frame display.



APERTURE



WHITE BALANCE



FOCUS

SONY HVC4000P Viewfinder Displays

the combination was of an infra red type (unusual in portable equipment) and offered all front panel controls (including channel change). The recorder can even be turned on and off from the remote unit.

The quality of both sound and vision obtained from the F1 was of the highest standard, and unlikely to be bettered by any domestic machine. The IR remote control unit, full complement of 'trick' video functions, the extremely useful tape timer and the versatility of the recorder/tuner combination not to say the elegance of the styling make the F1 system an extremely attractive to mains only, top price decks. The F1 can also be used as a portable machine.

IN CAMERA

The camera provided for review was Sony's HVC-4000P model, and what a camera it is. This beauty deserves a review of its own, we'll only be able to gloss over its features here.

Back to the F1 first, however, and removing it from the tuner only involves removing one plug and, as we've said, leaves the tuner able to operate as usual.

Power for portable operation comes from a Ni-cad battery pack that can be changed in about 5 seconds, useful for quick changes on location. A run down battery pack takes about an hour to charge from the charger that is an integral part of the tuner/timer.

Despite its small size the F1 is still rather on the heavy side and one prolonged shooting session resulted in a very sore shoulder for the cameraman. The shoulder strap can be attached to the F1 very quickly but although not supplied with the review model, the recorder would be better off if protected by the optional carrying case.

The camera plugs into the recorder via a standard Sony camera plug and is powered up when the recorder is put into record.

The viewfinder of the 4000P is, in common with other up-market cameras, a miniature CRT tube. As ever, the first operation to perform when using a camera, is the white balance adjustment.

This can either be accomplished by viewing the camera's output as displayed on a colour TV set, or more likely with the aid of the viewfinder's display. This consists of a thin, vertical, white line superimposed on the viewfinder's display. This is produced when a three position switch on the view-finder is moved from normal to the WB (white balance) position.

The white balance controls - one course (Tungsten, fluorescent, cloudy outdoor or sunny outdoor light) and two fine - are adjusted until the line is in its leftmost position. This was very quickly achieved and in fact, little improvement could be made over the standard setting although any fine tuning could just be detected on a colour TV.

The CRT could also display a signal that aids focussing. The three position switch referred to above can be set to a wave form position and will then display a vertical line which represents the amplitude of the video signal from one section of the frame. In focus shots will tend to have abrupt changes in contrast between elements of the picture and will result in a 'line' that is jagged - out of focus shots will result in a smooth line.

This particular feature was not very useful, focusing best being accomplished by eye.

In the switch's other position, a small vertical line at the bottom of the screen indicates the aperture setting of the camera.

The viewfinder's other controls are peaking on/off, this can be used to enhance the contrast of the viewfinder's picture, and screen brightness.

The other camera controls consist of a sensitivity switch this can be set to high - for shooting in low lighting conditions - or to auto and an iris control which can be used to manually adjust the camera's aperture. Another control allows the source monitored by an earpiece attached to the camera to be the recorder's audio or the output of the camera's internal microphone or an external microphone if used.

The final control can be used to 'reverse' the video output of the camera. This can be used, with an optional adaptor, to view colour slides on a TV screen.

The camera was very easy to use, despite the variety of controls,, and the grip and resultant camera position made the camera very easy to hold steady even at the extreme end of its 6:1 zoom. The power zoom produced a negligible disturbance on the sound track, an achievement very rarely found on cameras. In fact the most obvious disturbance on the sound track was the heavy breathing of the camera man when the AGC opened right up in the absence of any more interesting sound.

The camera featured an auto fade in/out facility which produced very pleasing results. The fact that this is engaged is flagged in the viewfinder.

A full battery pack provides power for between half and one hour's recording, although as mentioned previously, batteries can be changed very quickly.

The quality of results produced by the camera were of the very highest standard even when operating under very low levels of light, although under these conditions camera lag was, not surprisingly, more noticeable.

The camera can be used in a domestic situation with the recorder and tuner timer. Here the camera's output, rather than that of the tuner, is selected by a slide switch. In this set up the camera is continuously powered up. Unlike some recorders, the pause control can be used to start recording in preference to the camera's start/stop button.

BOTTOM LINE

When all is said and done, the system that was the subject of this review is about the best portable system around at present. The recorder is still a bit heavy for portable use but offers an extremely generous specification. The camera may seem like overkill in its size and complexity of controls but its styling makes steady shots easier and the quality of results obtained, very good.

Were it not for a heavy commitment to the VHS system, this reviewer's cheque book would have been at the ready, but then there's always room for another machine...

■ R & EW

Your Reactions.....	Circle No.
Immediately Interesting	32
Possible application	33
Not interested in this topic	34
Bad feature/space waster	35

R&EW Data Brief

MF10

General Description

The MF10 consists of 2 independent and extremely easy to use, general purpose CMOS active filter building blocks. Each block, together with an external clock and 3 to 4 resistors, can produce various 2nd order functions. Each building block has 3 output pins. One of the outputs can be configured to perform either an allpass, highpass or a notch function; the remaining 2 output pins perform lowpass and bandpass functions. The centre frequency of the notch and allpass functions is directly dependent on the clock frequency, while the highpass centre frequency of the lowpass and bandpass 2nd order functions can be either directly dependent on the clock frequency, or they can depend on both clock frequency and external resistor ratios. The centre frequency depends on both resistor ratio and clock. Up to 4th order functions can be performed by cascading the two 2nd order building blocks of the MF10; higher than 4th order functions can be obtained by cascading MF10 packages. Any of the classical filter configurations (such as Butterworth, Bessel, Cauer and Chebyshev) can be formed.

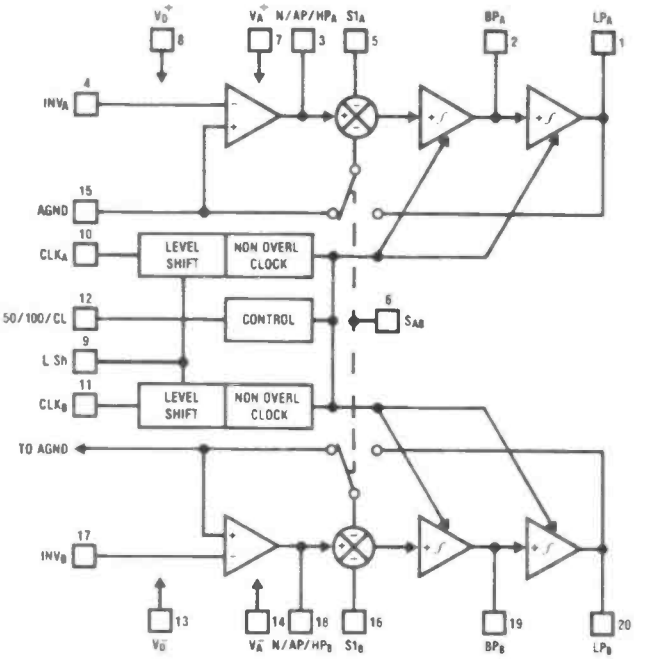


Figure 1: System Block Diagram.

Pin Description

LP,BP,N/AP/HP

These are the lowpass, bandpass, notion or allpass or highpass outputs of each 2nd order section. The LP and BP outputs can sink typically 1mA and source 3mA. The N/AP/HP output can typically sink and source 1.5mA and 3mA, respectively.

INV

This is the inverting input of the summing op amp of each filter. The pin has static discharge protection.

S1

S1 is a signal input pin used in the allpass filter configurations (see modes of operation 4 and 5). The pin should be driven with a source impedance of less than 1kΩ.

S$_{A/B}$

It activates a switch connecting one of the inputs of the filter's 2nd summer either to analog ground (S$_{A/B}$ low to V$_A$) or to the lowpass output of the circuit (S$_{A/B}$ high to V$_A$). This allows flexibility in the various modes of operation of the IC. S$_{A/B}$ is protected against static discharge.

V$_A$ V$_D$

Analog positive supply and digital positive supply. These pins are internally connected through the IC substrate and therefore V$_A$ and V$_D$ should be derived from the same power supply source. They have been brought out separately so they can be bypassed by separate capacitors, if desired. They can be externally tied together and bypassed by a single capacitor.

V$_A$ V$_D$

Analog and digital negative supply respectively. The same comments as for V$_A$ and V$_D$ apply here.

L Sh

Level shift pin; it accommodates various clock levels with dual or single supply operation. With dual +/-5V supplies, the MF10 can be driven with CMOS clock levels (+/-5V) and the L Sh pin should be tied either to the system ground or to the negative supply pin. If the same supplies as above are used but T^{2}L clock levels, derived from 0V to 5V supply, are only available, the L Sh pin should be tied to the system ground. For single supply operation (0V and 10V) the V$_D$ V$_A$ pins sould be connected to the system ground, the AGND pin should be biased at 5V and the L Sh pin should also be tied to the system ground. This will accommodate both CMOS and T^{2}L clock levels.

CLK (A or B)

Clock inputs for each switched capacitor filter building block. They should both be of the same level (T^{2}L or CMOS). The level shift (L Sh) pin description discusses how to accommodate their levels. The duty cycle of the clock should preferably be close to 50% especially when clock frequencies above 200kHz are used. This allows the maximum time for the op amps to settle which yields optimum filter operation.

50/100/CL

By tying the pin high a 50:1 clock to filter centre frequency operation is obtained. Tying the pin at mid supplies (i.e. analog ground with dual supplies) allows the filter to operate at 100:1 clock to centre frequency ratio. When the pin is tied low, a simple current limiting circuitry is triggered to limit the overall supply current down to about 2.5mA. The filtering action is then aborted.

AGND

Analog ground pin; it should be connected to the system ground for dual supply operation or biased at mid supply for single supply operation. The positive inputs of the filter op amps are connected to the AGND pin so "clean" ground is mandatory. The AGND pin is protected against static discharge.

Features

Low cost
20-pin 0.3" wide package
Easy to use
Clock to centre frequency ratio accuracy = 0.6%
Filter cutoff frequency stability directly dependent on external clock quality
Low sensitivity to external component variation
Separate highpass (or notch or allpass), bandpass, lowpass outputs.
f_O x Q range up to 200kHz
Operation up to 30kHz

Dual-In-Line Package

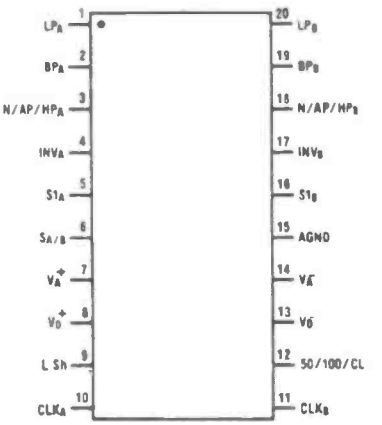


Figure 2: Pin-out.

Applications Information

How to use the FCLK/fo Ratio Specification

The MF10 is a switched capacitor filter designed to approximate the response of a 2nd order state variable filter. When the sampling frequency is much larger than the frequency band of interest, the sampled data filter is a good approximation to its continuous time equivalent. In the case of the MF10, this ratio is about 50:1 or 100:1. Nevertheless the filter's response must be examined in the z-domain in order to obtain the actual response. It can be shown that the clock frequency to centre frequency ratio, fCLK/fo and the quality factor, Q, deviate from their idea values determined in the continuous time domain. These deviations are shown graphically in *Figs 3 and 4*. The ratio, fCLK/fo is a function of the ideal Q and the largest errors occur for the lowest values of Q.

The curve for the FCLK/fo ratio versus the ideal Q has been normalized for a Q of 10 which is the Q value used for the FCLK/fo ratio testing of the MF10. At this point the FCLK/fo ratio is 49.94 in the 50:1 mode and 99.35 in the 100:1 mode. These values are within a maximum tolerance of +/-0.6% (MF10B) and +/-1.5% (MF10C). The above tolerances hold for the entire range of Q's; in other words at 50:1 an MF10B has a ratio of 49.94 +/-0.6% (Q = 10) and this ratio becomes 49.44 +/-0.6%) at Q = 2.1. If these small errors cannot be tolerated, the clock frequency or the resistor's ratio, in Mode 3 and Mode 2, can be adjusted accordingly.

Filter design using the MF10

Example 1: Design a 4th order 2kHz lowpass maximally flat (Butterworth filter). The overall gain of the filter is desired to be equal to 1V/V.

The 4th order filter can be built by cascading two 2nd order sections of (fo, Q) equal to Q = 0.541, fo = 2kHz, Q = 1.306, fo = 2kHz.

Due to the low Q values of the filter, the dynamics of the circuit are very good. Any of the modes of operation can be used but Mode 1a (see National Linear Data Book) as shown in Figs. 5 & 6 is most simple.

Since for the first section the smallest resistor is R3, choose R3 5k. Assumed R3 = 10k then R2 = 18.48k. For the second section chose R2 = 10k and then R3 = 13.06k. Both clock input pins (10,11) can be tied together and then driven with a single external clock. If the approximate ratio fCLK/100 is chosen (pin 12 is grounded) then with a 200kHz clock, the cutoff frequency, fc, will be at 2kHz with a 1.5% maximum error.

The filter schematic is shown in *Fig* 7.

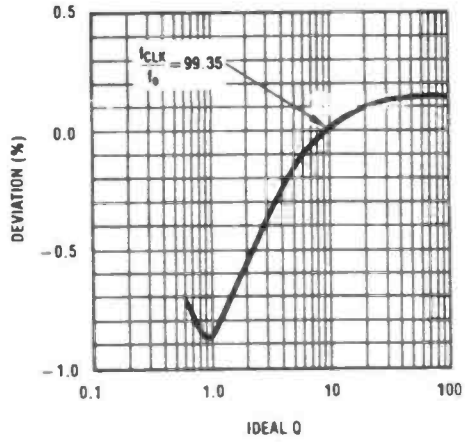


Figure 3.

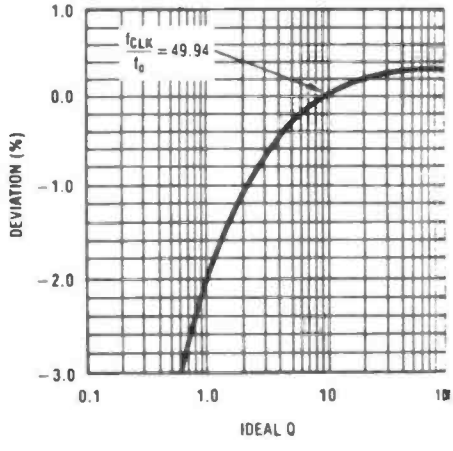


Figure 4.

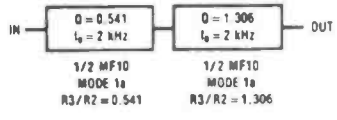


Figure 5: Fourth Order Filter Configuration.

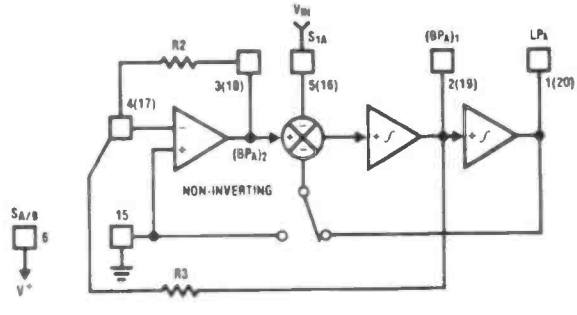


Figure 6: Fourth order, 2kHz Lowpass Butterworth Filter.

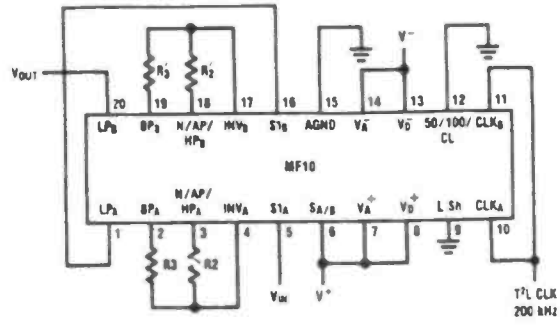


Figure 7: Non-inverting BP, LP.

WHAT TO LOOK FOR IN NOVEMBER

COMPOSITE VIDEO MODIFICATIONS

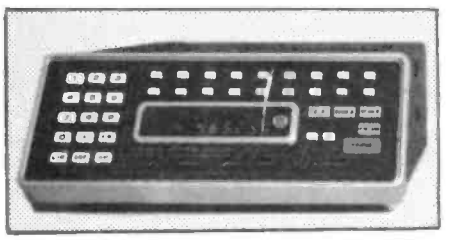
The output of microcomputers or video recorders is usually modulated onto an RF carrier and fed to the aerial socket of the TV used to monitor the machines output. This approach, however, leads to a certain amount of degradation in signal quality due to the modulating/demodulating process. This is particularly apparent in the case of colour signals.

Next month we publish two circuits that will enable owners of sets featuring the Ferguson TX9/10 chassis or of the new Amstrad CV1400 colour portable to convert these receivers to allow direct connection of composite video signals.

The Ferguson modification features audio/video in/out and is switched from the existing front panel control.

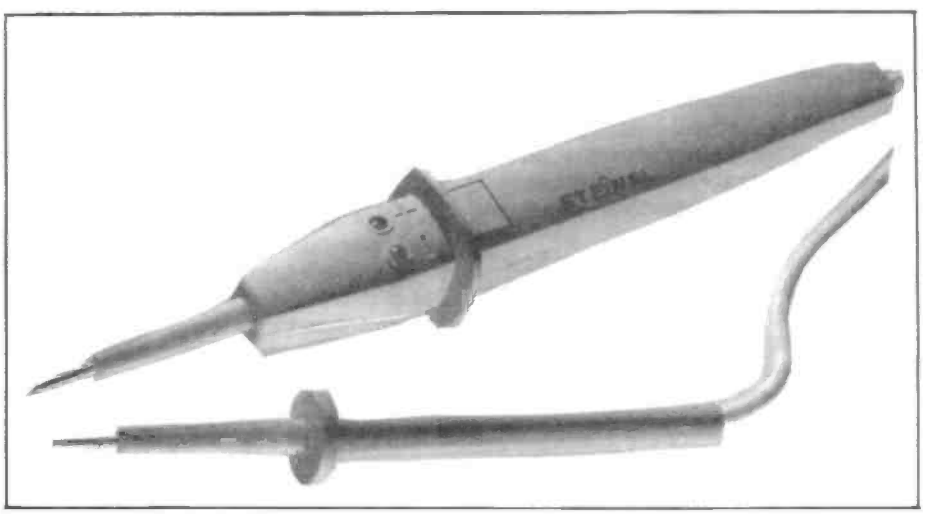
Both modifications make use of a toroidal isolating transformer ensuring that the set is completely safe.

The significant increase in picture quality and the low cost of these interfaces means there's no excuse for not carrying out these modifications.



SX200-N

The most versatile general coverage VHF/UHF scanning receiver?
We subject this set to our in-depth review procedure and report on the facilities and performance of this versatile set.



SPECIAL OFFERS

Not just one but **TWO** special offers are featured in Novembers **R&EW**.

The first is a valuable addition to anybody's range of test gear. The **multi-check** can be used to measure AC and DC voltages between 4V5 and 380V, to indicate polarity, to check continuity and to verify the operation of semiconductor junctions.

The second offer is on a glue-gun for hot, melt adhesives. These guns have — to coin a phrase — a thousand and one uses from model making, to repairs and finishing off the hardware for your electronic projects.

The gun is highly reliable and maintenance free.

Both these special offers appear in November's **R&EW** and the prices are so low we can't believe them ourselves.

5 DIGIT LCD FREQUENCY COUNTER

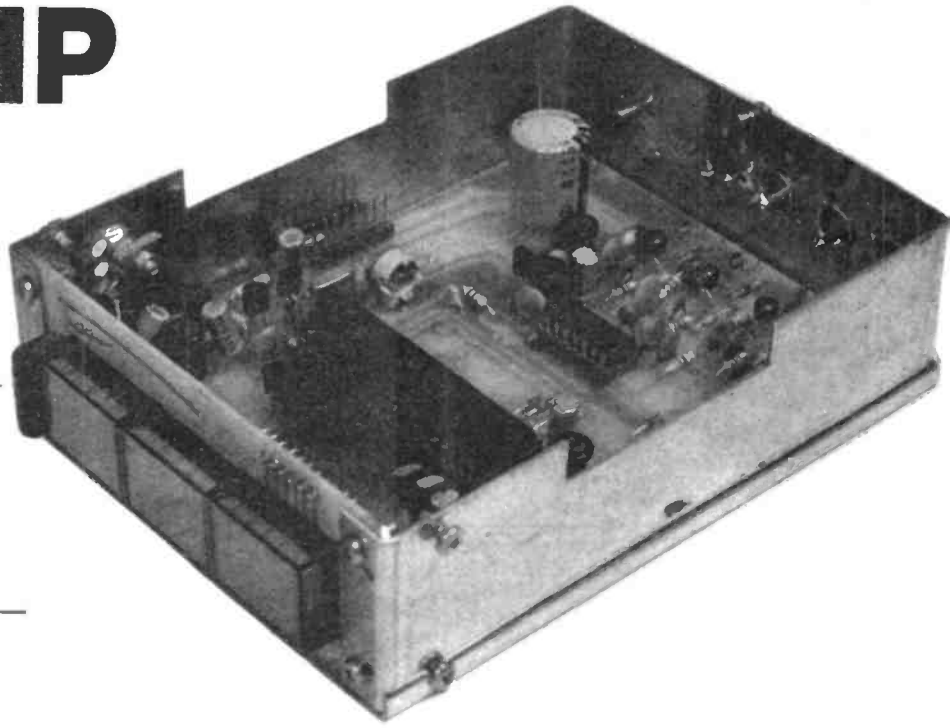
Fast and reliable readings from our new frequency counter that's built around the FC177 display module and not a lot else.

PLEASE DO REMEMBER NOVEMBER'S R&EW

Place an order with your newsagent now to reserve your copy of the november issue.

ONE CHIP DFM

PART 2



An advanced Digital Frequency Display - with a single IC counter/display.

CONSTRUCTION

Aspects of the construction technique have been considered in the circuit description — and it is worth noting that veroboard construction — although possible, is not really a good idea since RFI is greatly increased due to the spindly nature of the earth tracks, and the complexity of the circuit connection.

Certain families of device quickly emerge as contenders for the general fragility stakes, and so far, the MSM5524 has given a sturdy account of its likely life expectancy under the occasional unintentional misuse. Whilst not compulsory, the use of a screening case to encapsulate the circuit is thoroughly recommended. Separately screened compartments in a basic design for a receiver are possible, but provided the comments regarding screening are observed, together with the decoupling practise outlined, then few unexpected problems will arise.

Whether or not the novice is advised to attempt the construction of this unit is a matter of individual choice, but use of the proprietory PCB *(Photo)* and metalwork should enable simple assembly, with a strong chance of first time success.

The LED display PCB described here in uses a very cost effective solution with AEG high brightness orange LEDs. It is designed in such a way that the first digit pair is the ±1 and a full seven segment display, so that in applications with the SW display, the display is ±39.999 max., whereas AM/FM displays need only use ±1999, omitting to use the third digit pair altogether.

The ∴ display is used in conjunction with the fine tuning of FM, using a simple differential driver circuit in place of the familiar centre zero meter, so that as the tuning error is high, the + is lit, and low lights the -. Exact tuning occurs when both are equally bright — and the circuit described here also uses a transistor fed from the meter output of the now almost universal CA3089/HA1137/CA3189/KB4420 FM IF IC, so that the ∴ indicator is extinguished between stations.

The display array also uses a bank of AEG rectangular LEDs to display the mode function — and with so many modes, this is vital. It also illustrates a useful feature of the stopwatch timer, namely that the stopwatch remains active when the main display is used for other functions (except for the on and off timers). Reaccessing the stopwatch mode displays the intermediate time elapsed.

The switch controls a rather baffling array of operations. An array of pushbuttons can readily combine to suit the overall setting requirement, a 9 way unit, comprising 4 momentary, and 6 interlocked units.

If every one of the options were to be left to user selection, including all time signals etc., the switch bank would need some 12-14 ways — must be used discretion in using those functions though worthwhile.

Fig. 2 last month shows one of the more comprehensive switch arrays, the sleep and general timer functions are combined so that the various control functions of the relay switch are operated by either timer output.

The bandswitch of a radio tuner board may be used to provide automatic mode selection according to the band being used, but remember to provide some form of override so that the clock functions can be used without turning off the radio.

APPLICATIONS

As well as in the new designs of radio and tuner — this unit is suitable for 'retro-fitting' to existing tuners to improve tuning accuracy and providing clock and timer functions that you may find useful.

In many dedicated applications, you may find that some of the basic elements in the circuit can be omitted, and the following are suggestions based on some common applications:

FM only tuners, simple VHF divide by 100 (SP8629) with preamp, and display as per the FRG7. Clock and timer switching as required.

FM/AM tuners, using the basic approach of the FM only tuner, the AM preamp can be directly connected to the input of the MSM5524 along with the output of the prescalar. The IC counts on the edges of the pulses, and since the prescalar produces a square output, coupling through a relatively small capacitor provides plenty of 'edge' for the LSI to see. Even with the damping effect of the collector of the AM preamp transistor in parallel, this system works satisfactorily. The important thing to remember is to make certain the AM and FM oscillators are switched off when the alternative mode is being displayed — otherwise the results are scrambled.

As a piece of test gear, this unit with all its various options makes an excellent piece of test equipment for any radio engineer involved in the test and alignment of broadcast radio sets. A high impedance probe for connection to the unbuffered oscillators is a good idea — and so is the provision of a direct count switch where S1, S2, S3 inputs are all low. The IC then displays the input frequency without IF offset subtraction in kHz with the AM input selected, or it may be fed via the prescalar to increase resolution, from the basic 3999 kHz — to accommodate the different IFs encountered, the IF offset selection can be switched to suit (*Table Two*). Since the offsets are programmed using the digit out lines — and the digit out lines are rich in stepped squarewaves — switching is best carried out on-board, otherwise harmonic radiation is inevitable without careful choke/capacitor decoupl-

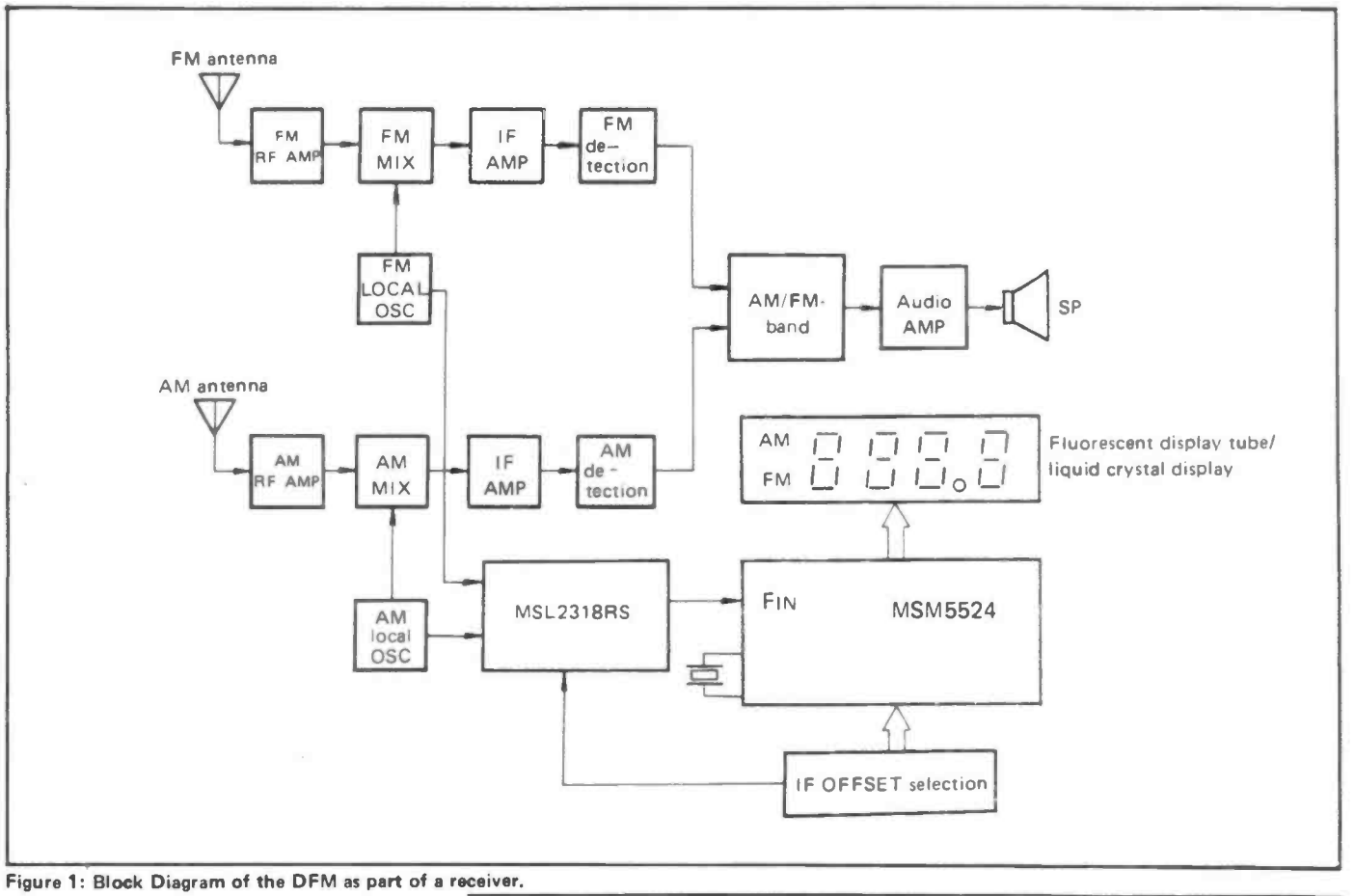


Figure 1: Block Diagram of the DFM as part of a receiver.

ing of the digit lines that are used for IF selection.

CONNECTING TO THE LO OUTPUT

Most sets do not possess the necessary low impedance signal from the local oscillator to drive the counter — and hanging long wires on the tuned circuit of the oscillator is guaranteed to cause problems brought about by instability and additional capacity that makes tracking impossible.

The local oscillator output required to drive the counter is approx. 20 mV at 50Ω for the VHF input, and the same for AM and SW inputs. The important part is the impedance — since although the LO may have several volts on the tank, the impedance is around 10-50 Ω, making such comparisons pointless.

A source follower FET is a useful active impedance transformer, and the standard connection is shown in *Fig. 9*. This must be mounted as near the oscillator source as possible, for the reasons mentioned above and frequently it can be mounted directly on the tuning capacitor, due to the few components involved. For example, the R&EW '*Watervole*' tuning capacitor provides ready access to the various LOs and the FET source follower should be mounted close along the top. But on AM and SW, many modern designs use a two terminal oscillator arrangement, where a relatively low impedance feed can be taken from a tapping/secondary on the oscillator coil — but without upsetting the tuning and calibration by much. Such is the case with pin 20 of the TDA1090/ULN2240, which provides an ideal oscillator source. And since this point is used for LW/MW and SW, the same feed is taken to the SW input of the counter.

If the feed is taken any length away from the board, however, the same type of FET source follower should be used to prevent stray oscillator radiation, leading to birdies and unwanted image reactions in the receiver.

Most VHF tunerheads now provide oscillator output terminals, and the connection to these is usually possible via a simple length of coax with no additional buffering required.

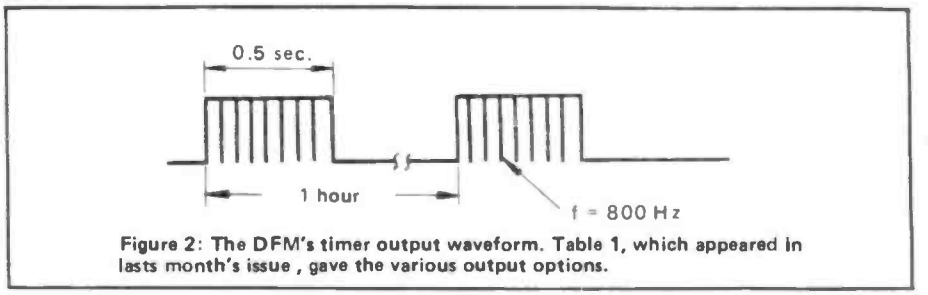


Figure 2: The DFM's timer output waveform. Table 1, which appeared in lasts month's issue, gave the various output options.

FINALLY

The brightness of the display is controlled by the resistance on pin 11. A high resistance causes the display to be dimmed by means of shortening the seg. drive pulses — not by analogue means of reducing the voltage. The progressive dimming thus brought about can be used in conjunction with a fairly basic type of light dependent resistor, such as an ORP12, to compensate for room lighting conditions. A display that is just about visible in the day, may shine like the Blackpool illuminations at night.

The second final touch concerns the use of the timer outputs. The uncommited relay contacts are only using a reed element, and so for control of power lines, a bigger relay — or SCR — is required. Contacts on the relay are suitable for low voltages only. Under no circumstances use mains!

■ R & EW

Your Reactions.....	Circle No.
Excellent - will make one	138
Interesting - might make one	139
Seen Better	140
Comments	141

Rallying to the cause?

"THERE ARE TOO MANY exhibitions, conferences, seminars, shows, rallies and exhibitions." Not necessarily our words, but some that are getting to be heard quite frequently in places where the increasingly reluctant exhibitors gather. The benefit of a well organised exhibition that is well attended and well announced is not in question - it's the rather frightening way in which these events tend to multiply.

Once upon a time, there were few opportunities for adherents to the amateur radio persuasion to get to view the equipment and allied paraphenalia - but since those days of browsing over 'surplus' equipment from the mythical elephants' graveyard up there somewhere near Cambridge, things have changed.

Look back on your old issues of *Radcom*, and see just how many advertisers were offering complete equipment ten years ago. Now check a recent issue and see just how much advertising has 'appeared' in the meantime. Most advertisers offer the facility of retail sales where the interested purchaser can browse through a wide range of equipment without driving more than 20 or 30 miles, virtually anywhere in the country.

There's a very severe temptation for the newer businesses seeking to establish themselves in what is getting to look like a crowded marketplace, to use all means at their disposal to put their name and wares around - hence the boom in outlets of amateur radio equipment for the past couple of years has been matched by a boom in the attendances at rallies - and thus the number of rallies being organised seeking support from a 'national' range of dealers.

As with any form of promotion (including magazine advertising) there is a precarious degree of 'not wishing to be left out', and once a marketplace has become established, it is very difficult for anyone to drop out without there being tales of impending financial collapse put around. In other words, an obligation has arisen that has become a millstone around the necks of many.

Dealers on the amateur radio rally scene have found costs escalate alarmingly, whilst the potential sales have been spread ever thinner across the numbers of events involved. Much the same as with the question of press advertising - and we confess that **R&EW** is as guilty as anyone here, although we would claim our basic *raison d'etre* and justification is better than most.

Organisers of shows and rallies may argue that to restrict the availability of exhibitors by their mutual agreement is unfair: but to whom? The dangerously low returns on capital employed by many dealers will drive them out of business altogether, or force them to compromise on service, neither of which will actually do much for the interests of the hobby/industry as a whole. How about some correspondence on the subject?

MARGINAL BENEFITS

Not entirely disconnected from the above subject is the continuing question of 'orderly marketing' within the business.

'Orderly Marketing' is a reasonable description of the practice whereby groups of businesses agree to abide by a common code practice when marketing goods. Some observers describe the practice as restrictive and tantamount to price fixing, others regard the concept as providing the basis for a degree of order and a code of practice that acts in the interests of the customer as much as those of the retailer.

The real answer appears to lie somewhere between, and relates back to the basic tenet of trading that:
You don't get owt for nowt...

In a free market economy, businesses are usually run along the lines that profits have to be made to cover costs, and provide a living for the proprietor. The larger the profit, the greater will be the temptation for the casual observer to assume that there is room in the market for another one that is prepared to cut margins in order to windup market share.

I'M TOLD MY OVERHEADS ARE FAR TOO HIGH, MISS PEACH... AS AN ECONOMY MEASURE I'M SACKING THE ACCOUNTANT!

Since the vast majority of the gross profit (the difference between the buying and selling prices) made by any business *usually* goes on overheads, the margin cutting can only make a significant contribution if the overheads are kept low. Commercial property and allied 'establishment' costs are amongst the highest in the world in parts of the UK, so the temptation to run a business with casual labour from a private address or a lock-up garage is rather severe.

As such a business expands (much to the chagrin of those who help fund the National Debt by paying rates, rent, NI and PAYE), there comes a point when the temptation to take all this trade and go 'legit' gets to be hard to resist. The reality of overheads has then been known to turn many an erstwhile poacher into a righteous gamekeeper, seeking to establish a policy of orderly marketing - simply to keep on eating!

The question is a vexed one, since the next most likely casualty of the marginal trader is frequently service and choice. As many a high street trader offering a specialist service has discovered, there are rather a lot of people with even less conscience than money, who will prevail upon his services for demonstrations - and then rush along to the MegaHyper Market where his carefully selected choice of product is indifferently shoved across a counter by some salesperson who has taken a degree course in abject disinterest whilst the accounts department are busy taking the money. You know the type: *'I could be a brain surgeon if I didn't have to waste my time talking to you, squire....'*

However, there comes a time when the 'stack 'em high' merchant has achieved such huge purchasing power, and such a broadly based organisation that he can once again afford to supply aftercare and sales demonstrations. Many of the leviathans of the discount warehouse business have now reached this stage, and so it is virtually impossible for the small trader to have any hope of competing in the consumer electronics business. Although you will still have to look hard to find someone with reasonably specialised knowledge prepared to demonstrate and discuss options, they do seem to exist. Indeed, there now seems to be a death wish

emerging in some smaller retailers who virtually accuse any enquirer of only wanting to waste his time before nipping down to the nearest Comet.

Dare we suggest that any small trader who feels he can make a living is probably only doing so by attempting to work a number of hours that might broadly be described as unsocial? The fact that most traders in the business of amateur radio have developed from interests as adherents to the hobby tends to cushion the hard grind, as most will confess (however grudgingly) to enjoying the business - within reason.

SO WHAT's NEW?

You may think that all the preceding is merely stating the obvious - and indeed, much the same arguments can be used when analysing the businesses supporting the electronics and computing enthusiasts. However, there is something new in the offing that could possibly change the entire nature of trading in the 'high technology' hobby industry.

It's called the computer - and despite the fact that that may seem rather trite, there are very few genuine implementations of computing outside the guises as large calculators in the business. Most first generation computers can be compared to first generation ICs : merely gathering together a few discrete functions, and wrapping them up in a single package.

The more studied and thoughtful approach requires computing to positively do things that could not conceivably be handled by manual operations, where even the 'infinite number of monkeys at typewriters' analogy begins to wear thin. The difference, it seems, is multiple access to a common database to extract and update records in a multi-user environment. Personal computers have fudged this issue for a long time past, and even the much talked of Ethernet is still very largely a paperwork excercise.

Most of the software available for low cost multi-user systems is simply based on conversions of single user concepts and operating systems. Start to write your own completely tailored around the interactive and unique aspects of a specific business, and several rather intriguing possibilities begin to emerge.

The drawback is the availability of the programming power to handle such ideas, especially at a time when the market is desperately short of the necessary skills. Combine with this the advent of ever cheaper hardware for multi-user micro configurations, and an operation with access to the necessary skills begins to emerge with a visible commercial advantage that could possibly transcend the classic rules of business.

At the end of the day, the customer will have the final say, and no matter how 'whizz-bang' and dynamic a facade a commercial operation can erect, it will be price, service and choice that settle the issue. Those who are able to implement a computing function that recognises the interaction of all three, instead of concentrating primarily on accountancy efficiency may well have changed the rules to everyone's benefit. ■ **R & EW**

Your Reactions.....	Circle No.
Immediately Interesting	1
Possible application	2
Not interested in this topic	3
Bad feature/space waster	4

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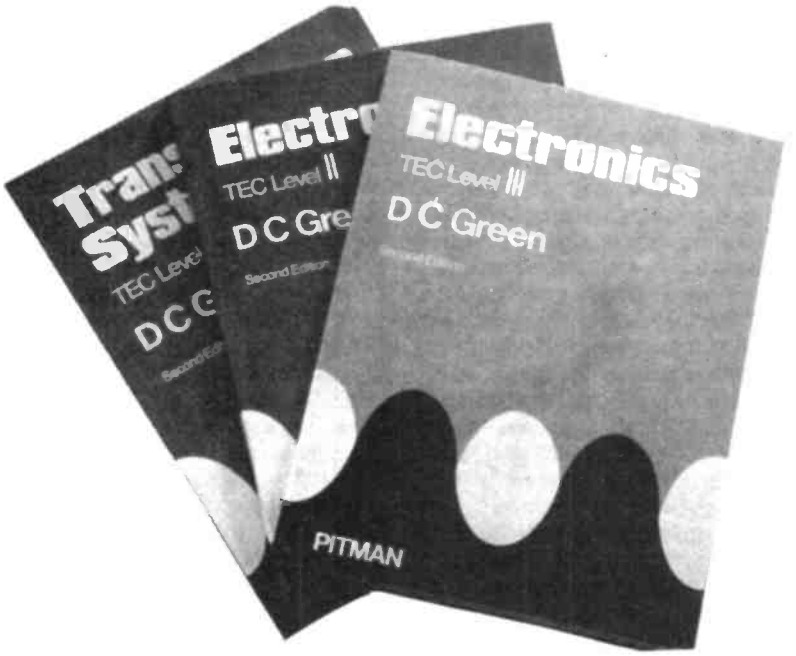

ELECTRONICS II
2nd Edition
By D C Green £4.95
1982; 150 pages; 185 x 245mm; Paperback

ELECTRONICS III
2nd Edition
By D C Green £5.50
1982; 207 pages; 185 x 245mm; Paperback

TRANSMISSION SYSTEMS II
2nd Edition
By D C Green £4.95
1982; 148 pages; 185 x 245mm; Paperback

These three books have been written to assist technicians employed in the electronic and telecommunications industries who are taking part in an educational scheme formulated by the Technical Education Council. The scheme consists of a number of standard units, or levels, that a technician is expected to complete within a period of 3 years part-time study.

Electronics is commenced at the second level - hence the title of the first book - Electronics II. It introduces the student to the basic principles of the subject which have to be well understood before he can progress to practical circuits etc.

The book completely covers the topics comprised in the TEC's unit 11. The first chapter outlines the basic theory of semiconductors and the following four explain semiconductor diodes, transistors, field-effect transistors and thermionic emission and CRT's.

Once the student has imbibed the information given in those chapters he can progress to the understanding of electronic circuits. Remaining chapters therefore firstly deal with the basic principles of operation of audio frequency amplifiers and oscillators, then there is a simple introduction to digital techniques and finally a chapter describing the operation of the common basic circuits of power supplies.

Electronics III obviously takes the student technician further into the subject. It provides an extensive coverage of the circuits and techniques employed in modern analogue electronic and telecommunications equipment.

The eleven chapters develop the subject in a very logical manner, with many worked examples, and it is all well presented making understanding easy for the student. The principles, performance and applications of bipolar and field-effect transistors and integrated circuits are described. The later chapters provide a detailed account of the basics of multivibrators, integrators, differentiators and stabilised power supplies.

Transmission Systems II provides an introductory course on the basic principles of telecommunication transmission systems. After introducing the concepts of amplitude and frequency modulation the book goes on to consider the types of signal handled by transmission systems and the factors resulting in the choice of carrier frequency and bandwidth. Filters, transmission lines and circuits are then dealt with concluding with the basic systems of frequency-division and time-division multiplex.

The chapters of each book conclude with a score or so of exercises and the answers to those requiring a numerical answer are given at the end of the book. As far as possible a non-mathematical approach is adopted in all three books.
JB

RADIO BOOKS

AMATEUR ANTENNA TESTS AND MEASUREMENT
by H D Hooton **£7.45**

BEGINNERS HANDBOOK OF AMATEUR RADIO
By C Laster **£9.70**

CB RADIO CONSTRUCTION PROJECTS
by Len Buckwalter **£2.95**

FERROMAGNETIC CORE DESIGN
by M F Doug DeMaw **£19.95**

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by Don Lancaster **£11.20**

BASIC ELECTRICITY/ELECTRONICS Vol 3 Understanding Electronic Circuits 2nd Edition
by Training & Retraining Inc **£9.70**

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by D L Heiserman **£10.35**

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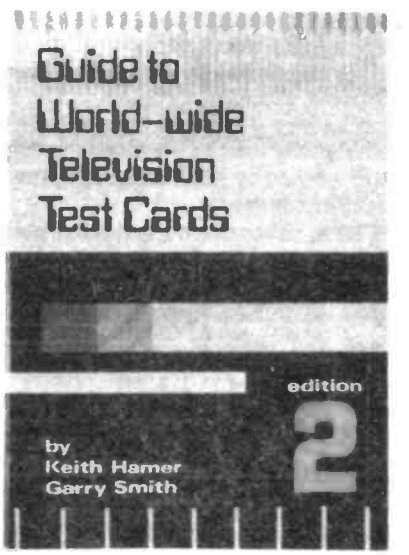

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NOTES FROM THE PAST

The early days of Broadcasting in this country saw 'officialdom' dithering and delaying over licensing arrangements. Centre Tap's article from 1950 has a familiar ring to it, from the same year another item contains some strong views on women in broadcasting.

I suppose many readers are amused whenever they hear accounts of the drives by the Post Office Engineering staff on 'pirate' listeners-those forgetful souls who fail to remember to take out receiving licences.

The solemnity with which the announcers read the item in the news bulletins, when reporting the usual rush on the local Post Offices, always seems to me to conceal a veiled threat of further 'raids'. Perhaps the effect on other districts is salutory.

It is surprising what wonders the lay public attributes to these mysterious detector vans, probably because of a combination of vague memories of the variety of uses to which radar has been put, plus a little imagination. To the guilty, the 'scenting out' of unlicensed receivers probably seems child's play to apparatus which can locate submarines, penetrate darkness and fog, reveal minefields and plot the approach of hostile aircraft. Credibility is heightened by an overdose of "scientific" cartoon strip stories and cheap fiction, so beloved by those who can read only simple words.

It is significant how effective these raids are in the poorer districts. Nothing happens in the street without it being watched by a score of inquisitive eyes, and those who do not actually see the ostentatious display of "detection" are soon warned by bush telegraph rumours which fly over the backyard fences.

I have never discovered what steps, if any, are taken to shake up the better-class areas of suburbia, where rumour would take a fortnight to travel past four houses. Perhaps there are not enough pirates in those areas to make the chase worthwhile.

THE GOOD OLD DAYS

Thinking of piracy brings back memories of the good old days when broadcasting was in its infancy. There were legions of them. At first they were incredulous and later tickled to death because they couldn't get a licence! The amazing part of it was that it went on for many moons while they openly used their receiving apparatus.

When it was at last decided to issue them with licences, nothing was said about the arrears and, needless to say, they didn't press the subject.

Broadcasting in this country had a slow and tortuous birth. Officialdom dithered and delayed. The higher the official circle, the less it was realised that broadcasting would soon sweep the country by storm and become a part of daily life. The example of America, where they had two years start of us, should have been sufficient to convince even the most obtuse.

When after prolonged negotiations regular broadcasting was commenced, a form of licence was devised which made it a condition that the receiver to be used was one manufactured by a member of the British Broadcasting Company. As more or less every radio manufacturer was a member, this, apart from the royalty payable, seemed a pleasant enough arrangement the idea being to exclude foreign-made receivers and components.

High officials, with their usual narrow outlook, estimated in their wisdom that the number who would be able to make their own receivers would be very small, and they would be adequately covered by an "experimental" licence. This was to cost the same as a Listeners licence, ten shillings.

Old timers will remember just how simple those home-made sets were. A crystal and a tapped coil and Bobs-your-Uncle!

In a couple of months, it was found that of the first 18,000 licences issued, a third of them were Experimental, and the ratio threatened to grow to alarming proportions. So the issue of Experimental licences was promptly suspended, and it was announced that they would only be granted in cases where the Post Office was reasonably satisfied that the applicant was an experimenter and actually making his own set - not simply hooking up ready made components. This would be about January, 1923, and the home contructor gaily applied for an Experimental licence and within a few days received a postcard acknowledgement. He then merely sat tight while the P.O. made up their minds whether to classify him as an "experimenter" or a "hooker up-per".

I certainly never heard of a case where anyone was classified as one or the other. Things dragged on while the issue of a third form of licence for constructors at a cost of £1 was discussed.

The constructor, as there was no licence to meet his case, was forced to remain a pirate. Needless to mention all his pals, as they too became interested in this new hobby, took good care that they also became pirates!

It was reliably estimated that within three months the ranks of the pirates had swollen to 200,000, made up of an unknown proportion of bona fide constructors plus the smart guys who simply evaded payment.

Over eighteen months elapsed while it was being decided at high levels whether the fee for a constructors licence should be 15s. or £1. Eventually a uniform licence at 10s. was started in July, 1924. It was stated afterwards that nearly a quarter of a million "pirates" stepped up to take out licences within ten days, and no charge was made for the past use of their receivers. They were the genuine constructors - the smart guys came along more gradually. Perhaps they even held out until the mysterious "detector" vans descended on their districts!

THE ETERNAL WOMAN

A careful study of radio speakers suggests that about a third of the males have good and pleasing voices. Those with a good microphone manner are somewhat rarer.

With women the proportion is deplorably low - unless I am hyper-critical. The number of women whose microphone voices and manner register pleasurably to my ear would not take long to count. The vast majority jar and jangle, and I am still uncertain which irritates me most, the shrill or the affected.

Ray Marston looks at two families of bar-graph driver ICs, the U237 and LM3914 types.

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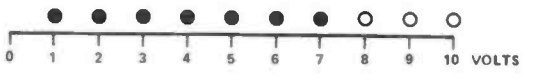


Figure 1: Bar-graph indication of 7V on a 10V 10-LED scale.

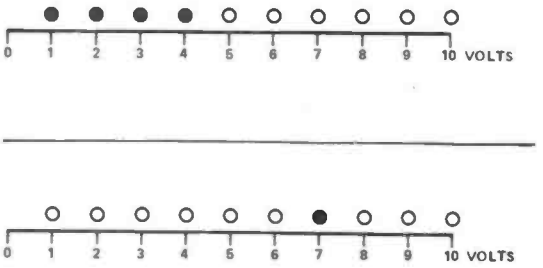
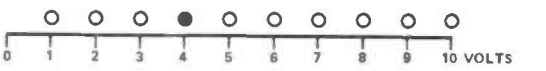


Figure 2: 'Dot' indication of 7V on a 10V 10-LED scale.



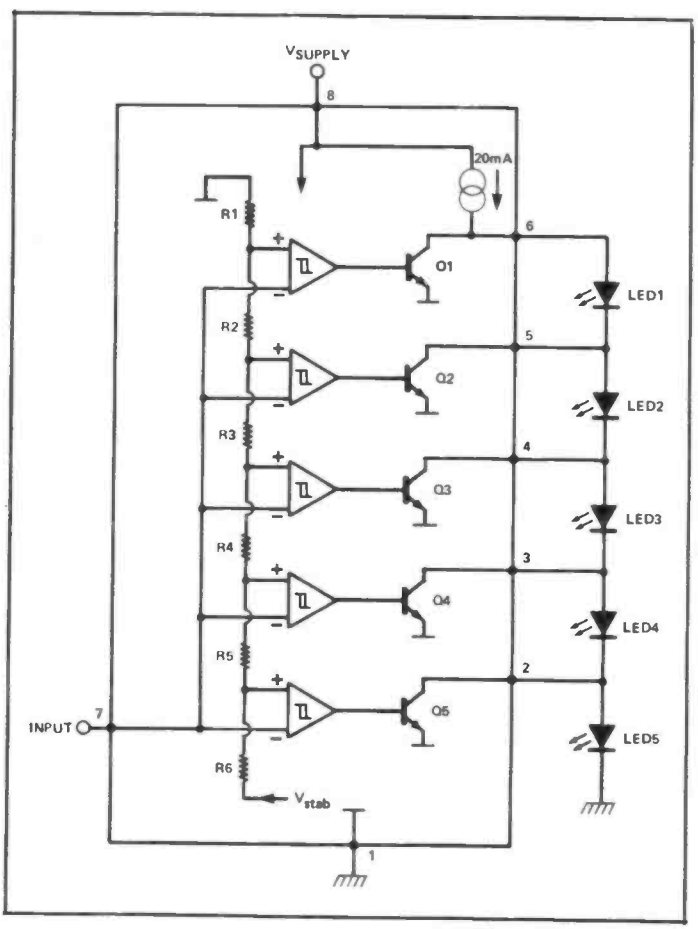


Figure 3: Block diagram of the U237-type bar-graph driver, with basic external connections.

LED BAR-GRAPH DISPLAYS are widely used to replace moving-coil meters in domestic equipment. *Fig 1* illustrates the bar-graph principle, showing a line of ten ordinary LEDs used to represent a linear-scale 0-10V meter.

Special bar-graph driver ICs are available for operating LED bar-graph displays. The two most useful types are the U237, etc., family from AEG, and the LM3914, etc., family from National Semiconductors. The U237 family are simple 'dedicated' devices which can usefully be cascaded to drive a maximum of 10 LEDs in 'bar' mode only. The LM3914 family are more-complex and highly versatile devices, which can usefully be cascaded to drive as many as 100 LEDs, and can drive them in either 'bar' or 'dot' mode. *Fig 2* shows a 10-LED 10V meter indicating 7V in the 'dot' mode.

Bar-graph displays (with suitable drivers) act as inexpensive and superior alternatives to analogue-indicating moving-coil meters. They are immune to inertia and 'sticking' problems, so are fast acting and are unaffected by vibration or attitude. Their scales can easily be given any desired shape (a vertical or horizontal straight line, an arc or circle, etc). In a given display, individual LED colours can be mixed to emphasise particular sections of the display. Electronic 'over-range' detectors can easily be activated from the driver ICs and used to sound an alarm and/or flash the entire display under the over- range condition.

Bar-graph displays have far better linearity than conventional moving-coil meters, typical linear accuracies being 0.5%. Scale definition depends on the number of LEDs used; a 10-LED display gives adequate resolution for most practical purposes.

Lets's now move on and take a detailed look at the two main families of bar-graph driver ICs, starting off with the U237 types.

BASIC PRINCIPLES-U237 TYPES

The family comprises four individual devices. The U237B and U247B produce a linear-scaled display and are intended to be used as a 'pair', driving a total of ten LEDs. The U257B and U267B produce a log-scaled display and are also intended to be used as a 'pair' driving a total of ten LEDs.

All ICs of the U237 family use the same basic internal circuitry, which is shown in block diagram form (together with external connections) in *Fig. 3*. The IC houses five sets of Schmitt voltage-comparator/transistor-switches, each of which has its threshold switching or 'step' voltage individually determined by a tapping point on the R1 to R6 voltage divider, which is powered from a built-in voltage regulator: the input of each comparator is connected to the pin-7 input terminal of the IC. The IC also houses a constant current generator (20 mA nominal), and the five external LEDs are wired in series between this generator and ground (pin 1), as shown in the diagram.

The action of the circuit is such that groups of LEDs are turned on or off by activating individual switching-transistors within the IC. Thus, if Q3 is turned on it sinks the 20 mA constant-current via LEDs 1 and 2, so LEDs 1 and 2 turn on and LEDs 3 to 5 turn off.

The U237B has step voltages spaced at 200 mV intervals. At zero volts input, all five transistors are switched on, so Q1 sinks the full 20 mA of constant-current, and all five LEDs are off. At 200 ▶

V_{IN}	Q1	Q2	Q3	Q4	Q5
1.0V	OFF	OFF	OFF	OFF	OFF
0.8V	OFF	OFF	OFF	OFF	ON
0.6V	OFF	OFF	OFF	ON	ON
0.4V	OFF	OFF	ON	ON	ON
0.2V	OFF	ON	ON	ON	ON
0V	ON	ON	ON	ON	ON

Table 1: Step voltage values of the 'U237' family of bar-graph driver ICs.

mV input, Q1 turns off but all other transistors are on, so Q2 sinks the 20 mA via LED 1, driving LED 1 on and causing all other LEDs to turn off, and so on. Eventually, at 1VO input, all transistors are off and the 20 mA flows to ground via all LEDs, so all five LEDs are on. Note that the operating current of the circuit is virtually independent of the number of LEDs turned on, so the IC generates negligible RFI as it switches transistors/LEDs.

The four ICs in the U237 family differ only in their values of 'step' voltages, which are determined by the R1 to R6 potential divider values. Table 1 shows the step values of the four ICs. Note that the U237B and U247B are linearly scaled, and can be coupled together to make a 10-LED linear meter with a basic full- scale value of 1VO. The U257B and U267B are log scaled, and can be coupled together to make a 10-LED log meter with a basic full-scale value of 2VO or +6 dB.

WHAT SUPPLY VOLTAGE?

Table 2 shows the basic specification of the U237 family of ICs. Note that the supply voltage range is specified as '8 - 25V'. In practice, the minimum supply voltage is one of the few design points that must be considered when using these devices, and must be at least equal to the sum of the ON voltages of the five LEDs, plus a couple of volts to allow correct operation of the internal constant-current generator. Thus, when driving five red LEDs, each with a forward volt drop of 2V, the supply value must be at least 12V. Different-coloured LEDs, with different forward volt drops, can be used together in the circuit, provided that the supply voltage is adequate.

DEVICE	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
U237B	200mV	400mV	600mV	800mV	1.00V
U247B	100mV	300mV	500mV	700mV	900mV
U257B	0.18V/−15dB	0.5V/−6dB	0.84V/−1.5dB	1.19V/+1.5dB	2.0V/+6dB
U267B	0.1V/−20dB	0.32V/−10dB	0.71V/−3dB	1.0V/0dB	1.41V/+3dB

Table 2: General specification of the U237 family of ICs.

PARAMETER	MIN	TYP	MAX
SUPPLY VOLTAGE (SEE TEXT)	8V	12V	25V
INPUT VOLTAGE			5V
INPUT CURRENT			0.5mA
MAX SUPPLY CURRENT		25mA	30mA
POWER DISSIPATION (AT 60°C)			690mW
STEP TOLERANCE	−30mV		+30mV
STEP HYSTERESIS		5mV	10mV
INPUT RESISTANCE		100k	
OUTPUT SATURATION VOLTAGE			1V

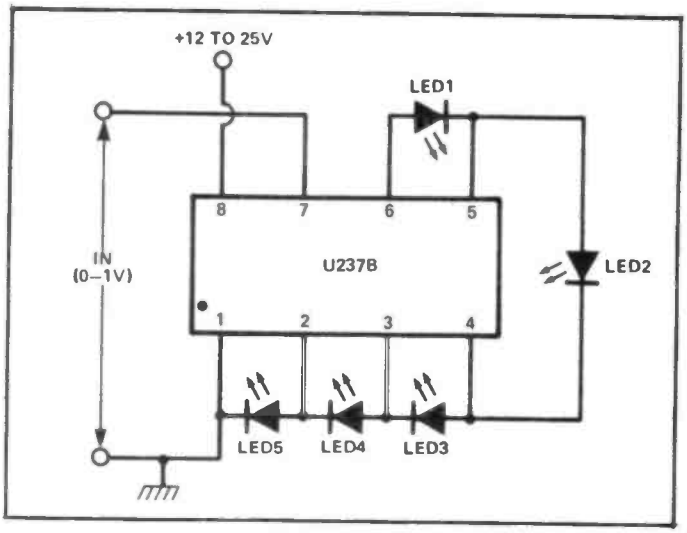


Figure 4: Practical connections for making a 0-1V 5-LED linear- scaled meter.

The only other 'usage' point concerns the input impedance of the IC. Although the input impedance is high (typically greater than 100k), the IC in fact tends to become unstable if fed from a source impedance in excess of 20k or so. Ideally, the signal feeding the input should have a source impedance less than 10k. If the source impedance is greater than 10K, stability can be enhanced by wiring a 10n capacitor between pins 7 and 1.

PRACTICAL U237 CIRCUITS.

Figures 4 to 11 show some practical ways of using the U237 family of devices. In all of these diagrams, we have shown the supply voltage as being '+12-25V', but the reader should keep in mind the constraints already mentioned.

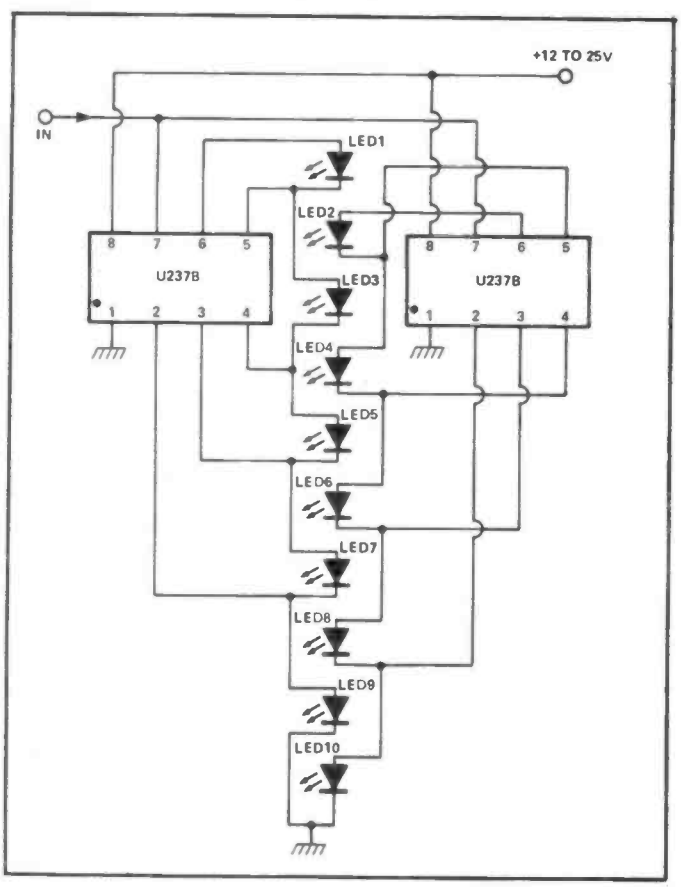


Figure 5: Practical connections for making a 0-1V 10-LED linear- scaled meter.

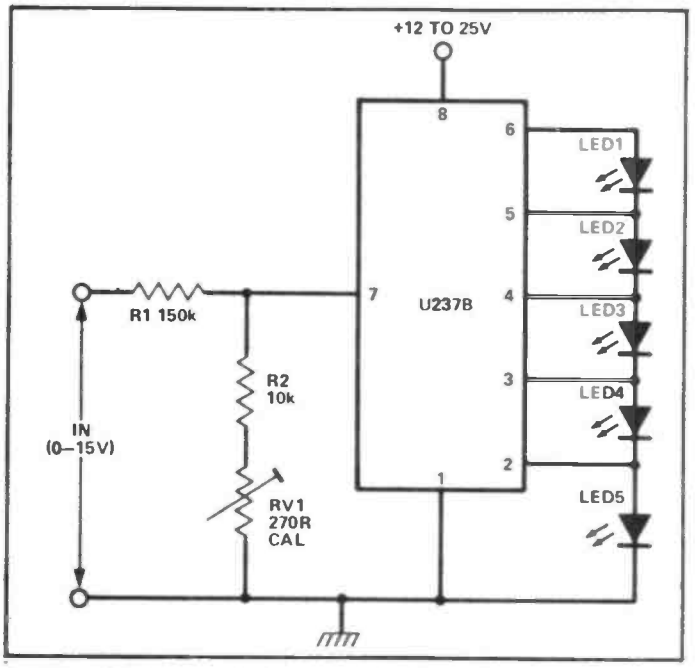


Figure 6: Method of reducing the sensitivity of the Fig. 4 circuit, via an input potential divider, to make a 0-15V 5-LED meter.

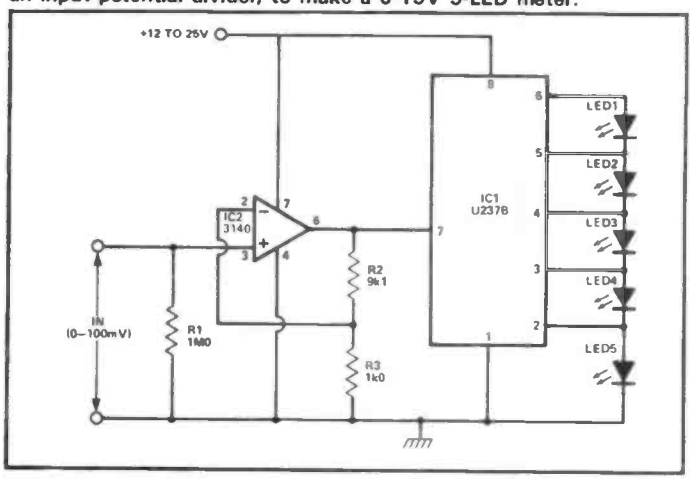


Figure 7: Method of increasing the sensitivity of the Fig. 4 circuit, via a x10 buffer amplifier, to make a 0-100 mV 5- LED meter.

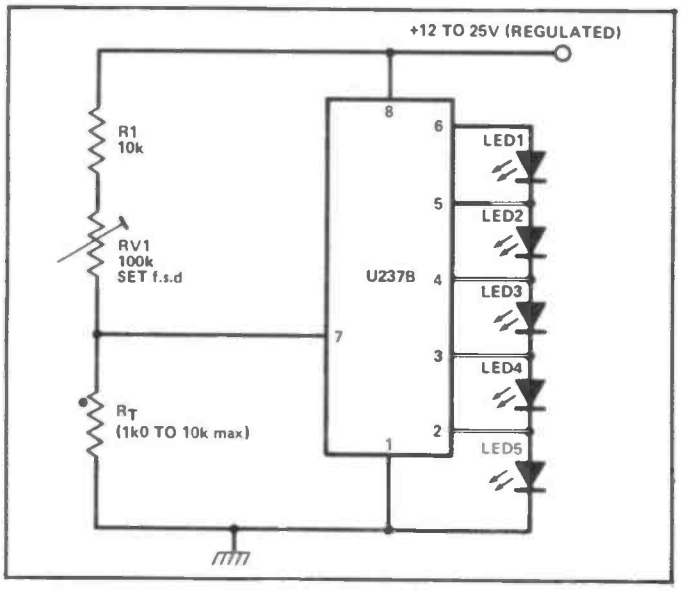


Figure 8: Simple method of using a transducer sensor to indicate the value of a physical quantity.

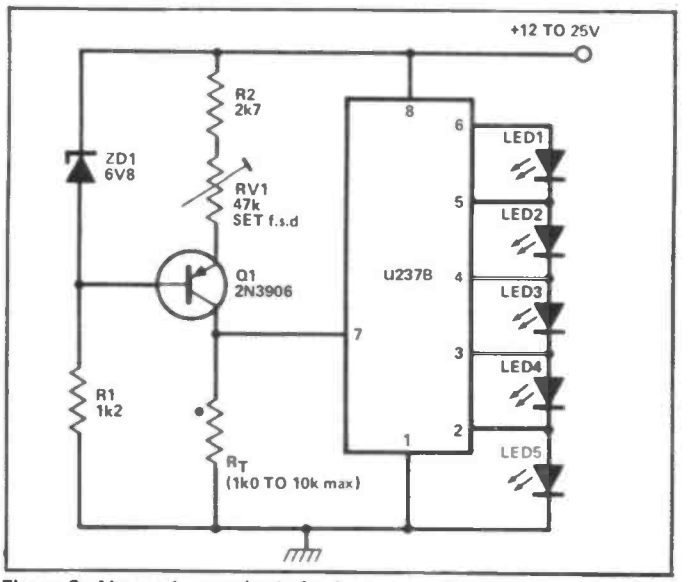


Figure 9: Alternative method of using a transducer sensor to indicate the value of a physical quantity.

Figure 4 shows the practical connections for making a 0-1V 5-LED linear-scaled meter, using a single U237B IC, and *Fig 5* shows how a U237B/U247B pair of ICs can be coupled together to make a 0-1V 10-LED linear-scaled meter. Note in the latter case that the two ICs are operated as individual *'Fig 4'* circuits (needing only a '5-LED' supply voltage), but have their input terminals tied together and have their LEDs PHYSICALLY alternated, to give a 10-LED display.

Figures 6 and 7 show how the full-scale sensitivity of the basic circuit can be altered, via external input circuitry, to suit particular applications. In *Fig. 6*, the sensitivity is reduced by an input potential divider (R1-R2- RV1), which has a 15:1 ratio and thus gives an effective full- scale sensitivity of 15V. In *Fig. 7*, the sensitivity is increased by a factor of ten, to 100 mV full-scale, via non- inverting x10 amplifier IC2, which also raises the input impedance to 1MO (determined by R1).

Figures 8 and 9 show how the basic *Fig. 4* circuit can be used to indicate the value of a physical parameter, such as light, heat, liquid level, etc., that can be represented by an analogue resistive value in a transducer (R_T). In both of these circuits, the transducer is simply fed from a constant-current generator, so that the input voltage reaching the IC is directly proportion to the transducer resistance.

In the *Fig 8* circuit, the constant current is derived from the regulated supply line via R1-RV1, and current constancy relies on the fact that the supply voltage is large relative to the 1V full-scale value of the meter. Thus, if the supply value is 20V, the transducer current varies by only 5% when the transducer resistance varies between the 'zero volts' and 'full- scale volts' values. *Fig. 9* shows how the linearity can be further improved, without the need for a regulated supply, by feeding the transducer from the output of the Q1 constant-current generator.

OVER-RANGE ALARMS, ETC.

Figure 10 shows how the basic U237B circuit can be fitted with an audio-visual over-range alarm, which generates a pulsed tone and flashes the entire display at a rate of 2 flashes/sec when fsd is reached or exceeded. The circuit is fairly simple, as follows:-

The current of LED 5 (the 'fsd' LED) flows to ground via R1 and the base-emitter junction of Q1, so Q1 turns on and pulls pin-1 of IC2a low whenever LED 5 turns on. IC2a-IC2b are wired as a gated semi-latching 0.5 Hz astable, which is gated on via a low input on pin-1. The pin-3 output of this astable is normally low, and the pin-4 output is normally high, but both pins give an astable output when the circuit is 'active'. The pin-3 output feeds the base of Q2, and the pin-4 output feeds gated tone generator IC2c-IC2d, ▶

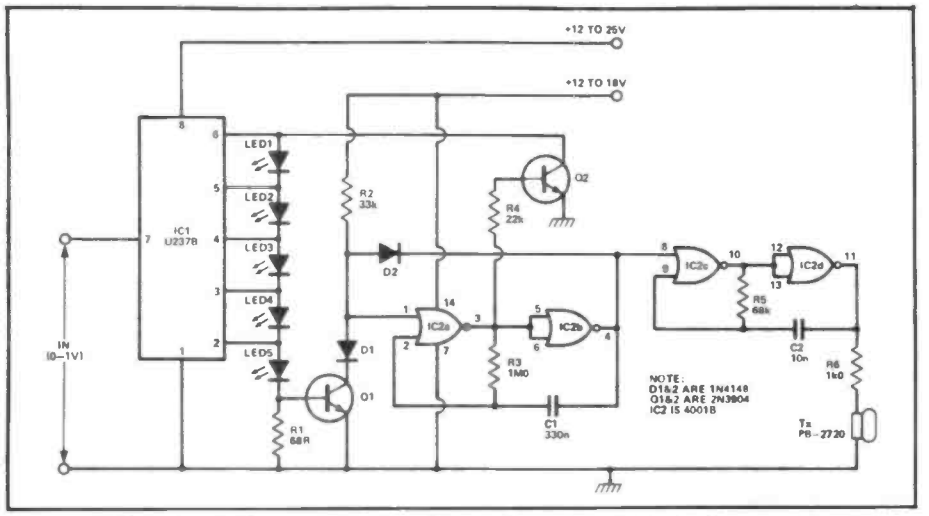


Figure 10: Method of fitting an audio-visual over-range alarm to the basic Fig 4 circuit; the entire display flashes (at a rate of 2 flashes/sec) when fsd is reached.

which feeds acoustic transducer Tx.

Thus, when IC1 output is below fsd Q1 is off and Q2 and the tone generator are inactive. When fsd is reached, LED 5 and Q1 turn on, and pin-1 of IC2a is pulled low via D1 and IC2a-IC2b enters an astable mode in which pin-4 switches low and activates the IC2c-IC2d acoustic alarm and also pulls pin-1 low via D2; simultaneously, pin-3 switches high and turns Q2 on, thereby sinking the entire 20 mA 'constant current' of IC1 and blanking all LEDs for half the duration of the astable cycle. Note that Q1 turns off as soon as Q1 turns on, but that the input (pin 1) of the astable is maintained low at this stage via D2. At the end of the half-cycle, Q2 turns off and restores the display and the IC2c-IC2d acoustic alarm turns off. As the display is restored, Q1 turns back on (if LED 5 is still active), but the IC2a-IC2b astable can not re-trigger until it completes the second 'free- wheeling' half of its cycle.

Thus, the *Fig 10* circuit flashes the entire display and generates a pulsed-tone alarm under the fsd or over-range condition. Note that if the IC1 supply rail is restricted to the 12 - 18V range, it can be made common with the supply of the alarm circuitry. If the acoustic alarm is not required, simply omit R5-C2-R6-Tx and connect the inputs of IC2c and IC2d to ground. The circuit can be made to flash only part of the display, if required, by simply connecting Q2 collector to the appropriate one of the pin-2-to-6 terminals of IC1; connection to pin-3, for example, causes only LEDs 4 and 5 to flash. If the over-range alarm circuit is to be used with the *Fig 5* 10-LED circuit, the feed to R1 and the base of Q1 should be taken from LED 10.

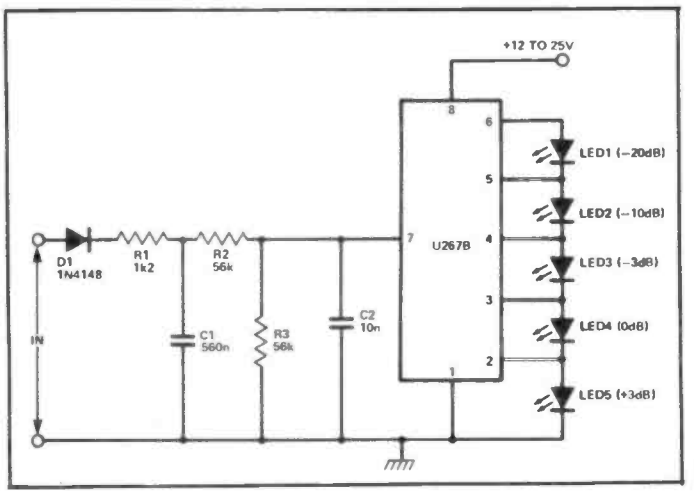


Figure 11: 5-LED AF-level meter. A 10-LED version can be made by using a U257B/U267V pair of ICs.

Finally, to complete this look at the U237 range of ICs, *Fig 11* shows how the U267B 'log' IC can be used to make a 5-LED audio-level meter. A 10-LED meter can be made by connecting the R1-R2-R3-C1-D1 input circuit to the input of a U257B/U267B pair of ICs connected in the same configuration as shown in *Fig 5*.

The basic *Fig 11* circuit has a discharge time constant of about 70 mS; the sensitivity is determined by the R2- R3 ratio and, with the values shown, indicates O dB with an input of 3V. The circuit requires a low-impedance drive, such as can be obtained (directly or via a potential divider) from a loud speaker, etc.

BASIC PRINCIPLES-LM3914 TYPES

These are fairly complex and highly versatile devices, housed in 18-pin DIL packages and each capable of directly driving up to ten LEDs in either 'dot' or 'bar' mode. The family comprises three devices, the LM3914 being a linear-scaled unit and the LM3915 and LM3916 being log and semi-log devices respectively.

All three devices in the LM3914 family use the same basic internal circuitry, and *Fig 12* shows the specific internal circuit of the linear-scaled LM3914, together with the connections for making it act

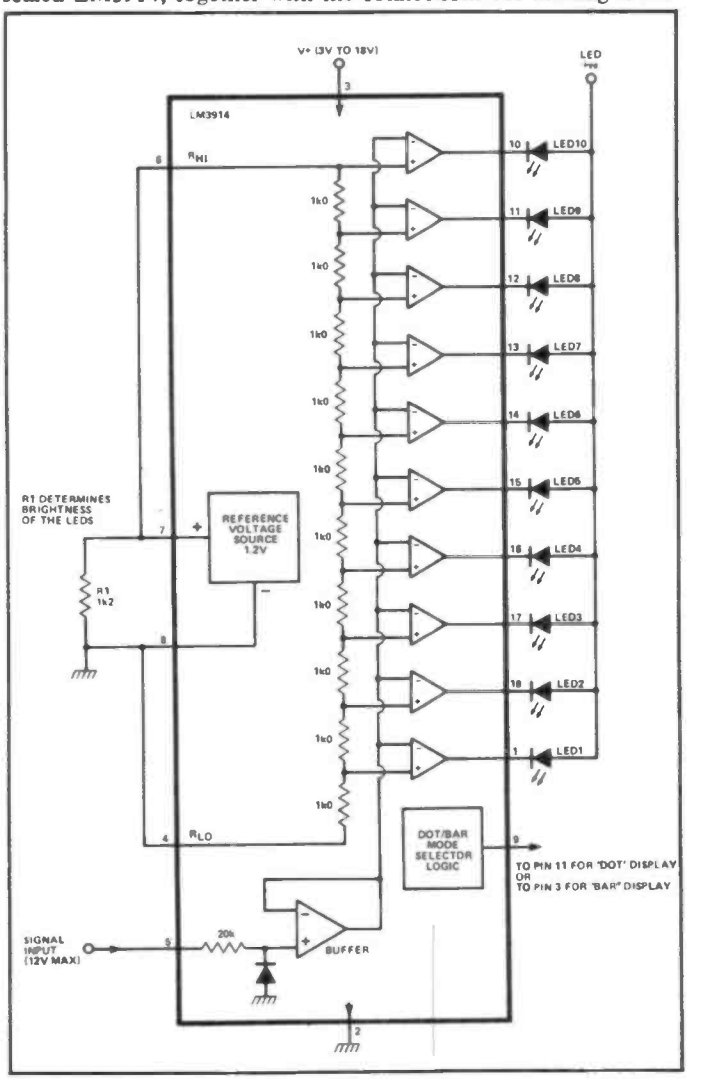


Figure 12: Internal circuit of the LM3914, with connections for making a 10-LED O-1V2 linear meter with 'dot' or 'bar' display.

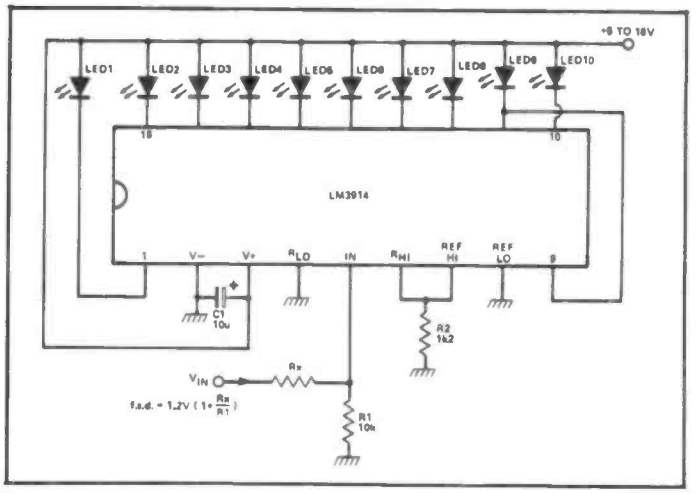


Figure 13: 1V2 to 1000V fsd 'dot'-mode voltmeter.

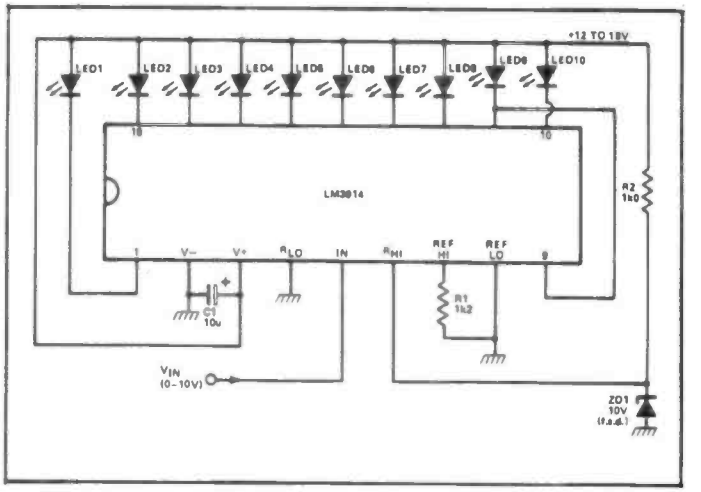


Figure 14: 10V fsd meter using an external reference.

as a simple 10-LED 0-1V2 meter. The IC contains ten voltage comparators, each with its non- inverting terminal taken to a specific tap on a 'floating' precision multi-stage potential divider and with all inverting terminals wired in parallel and taken to input pin-5 via a unity- gain buffer amplifier. The output of each comparator is externally available, and can sink up to 30 mA; the sink currents are internally limited, and can be externally pre-set via a single resistor (R1).

The IC also contains a 'floating' 1V2 reference source between pins 7 and 8. In *Fig 12* the reference is shown externally connected to potential divider pins 6 and 4, with pins 8 and 4 grounded, so in this case the bottom of the divider is at zero volts and the top is at 1V2. The IC also containes a logic network that can be externally set to give either a 'dot' or a 'bar' display from the outputs of the ten comparators.

Let's now put the above information together and see how the *Fig 12* circuit works. Assume that the logic is set for bar-mode operation and that, as already shown, the 1V2 reference is applied across the internal 10-stage divider. Thus 0V12 is applied to the inverting or reference input of the lower comparator, 0V24 to the next, OV36 to the next, and so on. If a slowly rising input voltage is now applied to pin-5 of the IC, the following sequence of actions takes place:

When input voltage is zero, the outputs of all ten comparators are disabled and all LEDs are off. When the input voltage reaches the 0V12 reference value of the first comparator, its output conducts and turns LED 1 on. When the input reaches the OV24 reference value of the second comparator, its output also conducts and turns on LED 2, so at this stage LED 1 and LED 2 are both on. As the input voltage is further increased, progressively more and more comparators and LEDs are turned on, until eventually, when the input rises to 1V2, the last comparator and LED 10 turn on, at which point all ten LEDs are illuminated.

A similar kind of action is obtained when the LM3914 logic is set for 'dot' mode operation, except that only one LED turns on at any given time. At zero volts, no LEDs are on, and at a 1V2 only LED 10 is on.

SOME FINER DETAILS

In *Fig 14*, R1 is shown connected between pins 7 and 8 (the output of the 1V2 reference), and determines the ON currents of the LEDs. The ON current of each LED is roughly ten times the output current of the 1V2 source, which can supply up to 3 mA and thus enables LED currents of up to 30 mA to be set via R1. If, for example, a total resistance of 1k2 (equal to the paralleled values of R1 and the 10k of the IC's internal potential divider) is placed across pins 7 and 8, the 1V2 source will pass 1 mA and each LED will pass 10 mA in the ON mode.

Note from the above that the IC can pass total currents up to

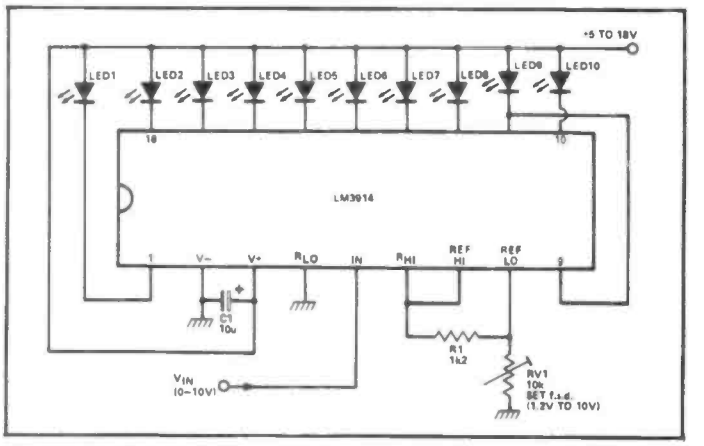


Figure 15: An alternative variable-range (1V2 to 10V) 'dot'-mode voltmeter.

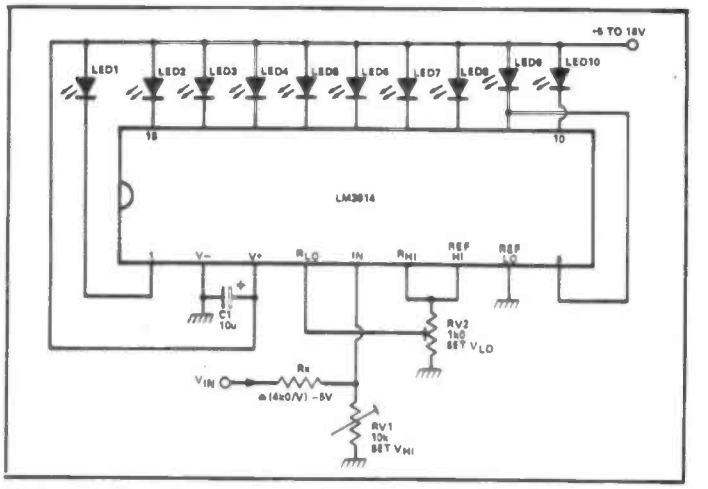


Figure 16: Expanded-scale (10V-15V, etc) 'dot'-mode voltmeter.

300 mA when used in the 'bar' mode with all ten LEDs on. The IC has a maximum power rating of only 660 mW, so there is a danger of exceeding this rating when the IC is used in the bar mode. In practice, the IC can be powered from DC supplies in the range 3- 25V, and the LEDs can use the same supply as the IC or can be independently powered; this latter option can be used to keep the power dissipation of the IC at minimal level.

The internal 10-stage potential divider of the IC is floating, with both ends externally available for maximum versatility, and can be powered from either the internal reference or from an external source or sources. If, for example, the top of the chain is connected to a 10V source, the IC will function as a 0-10V meter if the low ▶

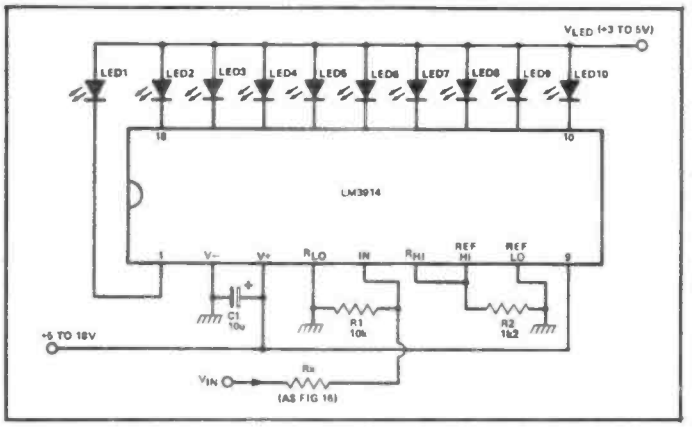


Figure 17: Bar-display voltmeter with separate LED supply.

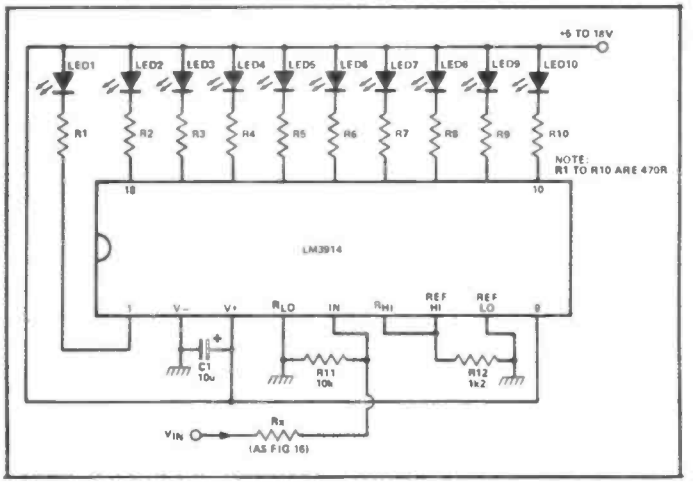


Figure 18: Bar-display voltmeter with common LED supply.

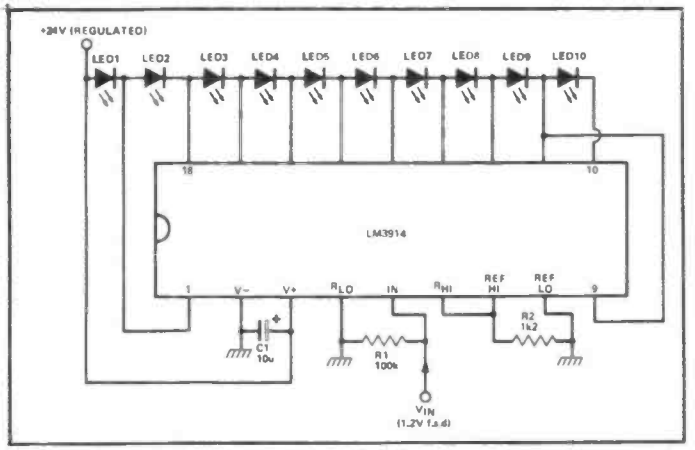


Figure 19: Method of obtaining a bar display with dot-mode operation and minimal current consumption.

end of the chain is grounded, or as a 'restricted-range' 5-10V meter if the low end of the chain is connected to a 5V source. The only constraint on using the divider is that its voltage must not be greater than 2V less than the ICs supply voltage (which is limted to 25V maximum). The input (pin 5) to the IC is fully protected against overload voltage up to plus or minus 35V.

The IC's internal voltage reference produces a nominal output of 1V28 (limits are 1V2 to 1V32), but can be externally 'programmed' to produce effective reference values up to 12V (we'll show how later).

The IC can be made to give a 'dot'-mode display by wiring pin 9 to pin 11, or a 'bar' display by wiring pin 9 to positive-supply pin 3.

Finally, it should be noted that the major difference between the three members of the LM3914 family of ICs lays in the values of resistance used in the internal 10-stage potential divider. In the LM3914, all resistors in the chain have equal values, and thus produce a linear display of ten equal steps. In the LM3915, the resistors are logarithmically weighted, and thus produce a log display that spans 30 dB in ten 3 dB steps. In the LM3916, the resistors are weighted in a semi-log fashion and produce a display that is specifically suited to VU-meter applications.

Let's now move on and look at some practical applications of this series of devices, paying particular attention to the linear LM3914 IC.

DOT-MODE VOLTMETERS

Figures 13 to *16* show various ways of using the LM3914 IC to make 10-LED 'dot'-mode voltmeters. Note in all of these circuits that pin-9 is wired to pin-11, to give 'dot'-mode operation, and that a 10u capacitor is wired directly between pins 2 and 3 to enhance circuit stability.

Figure 13 shows the connections for making a variable-range (1V.2V to 1000V fsd) voltmeter. The low ends of the internal reference and divider are grounded and their top ends are joined together, so the 'meter' has a basic full-scale sensitivity of 1V2, but variable ranging is provided by the Rx- R1 potential divider at the input of the circuit. Thus, when Rx is zero, fsd is 1V2 but when Rx is 90k the fsd is 12V. Resistor R2 is wired across the internal reference and sets the ON current of all LEDs at about 10 mA.

Figure 14 shows how to make a fixed-range 0-10V meter, using an external 10V zener (connected to the top of the internal divider) to provide a reference voltage. The supply voltage to this circuit must be at least two volts greater than the zener reference voltage.

Figure 15 shows how the internal reference of the IC can be made to effectively provide a variable voltage, enabling the meter fsd value to be set anywhere in the range 1V2 to 10V. In this case the 1 mA current (determined by R1) of the floating 1V2 internal reference flows to ground via RV1, and the resulting RV1-voltage raises the reference pins (7 and 8) above zero. If, for example, RV1 is set to 2k4, pin-8 will be at 2V4 and pin-7 at 3V6. RV1 thus enables the pin-7 voltage, which is connected to the top of the internal divider, to be varied from 1V2 to approximately 10V, and thus sets the fsd value of the meter within these values.

Finally, *Fig 16* shows the connections for making an expanded-scale meter that, for example, reads voltages in the range 10 to 15 volts. RV2 sets the LED current at above 12 mA, but also enables a reference value in the range 0-to-1V2 to be set on the low end of the internal divider. Thus, if RV2 is set to apply 0V8 to pin-4, the basic meter will read voltages in the range 0V8 to 1V2 volts only. By fitting potential divider Rx-RV1 to the input of the circuit, this range can be 'amplified' to, say, 10-15V, or whatever range is desired.

BAR-MODE VOLTMETERS

The dot-mode circuits of *Figs 13* to *16* can be made to give bar-mode operation by simply connecting pin-9 to pin-3, rather than to pin-11. When using the bar mode, however, it must be remembered that the IC's power rating must not be exceeded by allowing excessive output-terminal voltages to be developed when all ten LEDs are on. LEDs 'drop' about 2V when they are conducting, so one way around this problem is to power the LEDs from their own low-voltage (3 to 5V) supply, as shown in *Fig 17*.

An alternative solution is to power the IC and the LEDs from the same supply, but to wire a current-limiting resistor in series with each LED, as shown in *Fig 18*, so that the IC's output terminals saturate when the LEDs are on.

An alternative way of obtaining a 'bar' display without excessive power dissipation is shown in *Fig 19*. Here, the LEDs are all wired in series, but with each one connected to an individual output of the IC, and the IC is wired for dot-mode operation. Thus, when (for example) LED 5 is driven on, it draws its current via LEDs

1 to 4, so all five LEDs are on. In this case, however, the total LED current is equal to that of a single LED, so power dissipation is quite low; in this mode, the LM3914 in fact operates in a similar, fashion to the U237-type of IC. the LED supply to this circuit must be greater than the sum of all LED volt-drops when all LEDs are on, but within the voltage limits of the IC; a regulated 24V supply is thus needed.

Figure 20 shows a modification of the above circuit, which enables it to be powered from an unregulated 12-18V supply. In this case the LEDs are split into two chains, and the transistors are used to switch the lower (LED 1 to 5) chain on when the upper chain is active; the maximum total LED current is equal to twice the current of a single LED.

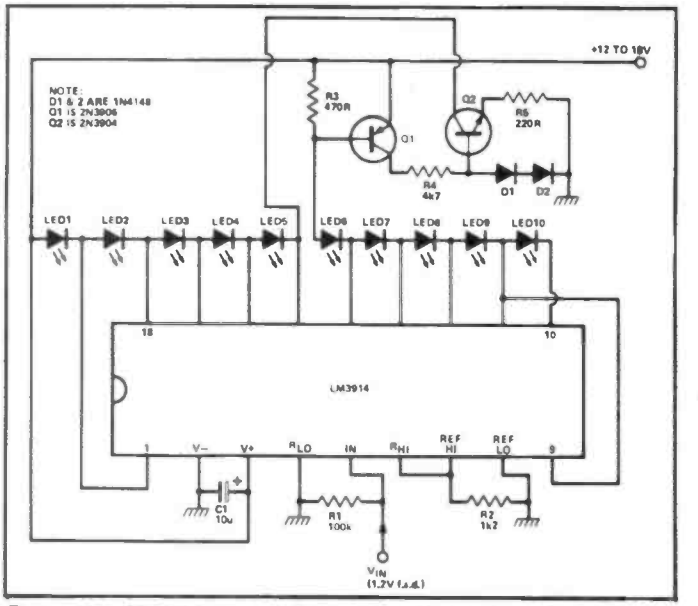


Figure 20: Modification of the Fig. 19 circuit, for operation from unregulated 12 to 18V supplies.

20-LED VOLTMETERS

To complete this edition of 'Data File', *Figs 21* and *22* show how pairs of LM3914s can be interconnected to make 20-LED 0-to-2V4 voltmeters. Here, the input terminals of the two ICs are wired in parallel, but IC1 is configured so that it reads 0 to 1V2 and IC2 is configured so that it reads 1V2 to 2V4. In the latter case, the low end of the IC2 potential divider is coupled to the 1V2 reference of IC1 and the top end of the divider is taken to the top of the 1V2 reference of IC2, which is raised 1V2 above that of IC1.

The *Fig 22* circuit is wired for dot-mode operation. Note in this case that pin-9 of IC1 is wired to pin-1 of IC2, and pin-9 of IC2 is wired to pin-11 of IC2. Also note that a 22k resistor is wired in parallel with LED 9 of IC1. The Fig 22 circuit is wired for bar-mode operation. The connections are similar to those above, except that pin-9 is taken to pin-3 of each IC, and a 470R current-limiting resistors is wired in series with each LED to reduce power dissipation of the ICs.

The voltage-ranging of the 20-LED meters of *Figs 21* and *22* can easily be altered by using techniques that have already been described.

It should be noted that although we've devoted all of the practical circuits in this second half of 'Data File 10' to the LM3914 IC, the LM3915 and LM3916 ICs can in fact be directly substituted in most of these circuits, to give log and semi-log displays respectively.

Finally, note that an over-range alarm of the type shown in *Fig 10* can be fitted to an LM3914 type IC by wiring a transistor in series with the 'top' LED to detect the full-scale state, and by wiring a transistor switch in series with the LED- brightness resistor to pulse the display on and off under the 'over-range' condition.

Next month Ray Marston examines compound op-amps and shows how an op-amp combined with one or more transistors can provide very high slew rates and output currents or output voltage swings of up to hundreds of volts.

■ R & EW

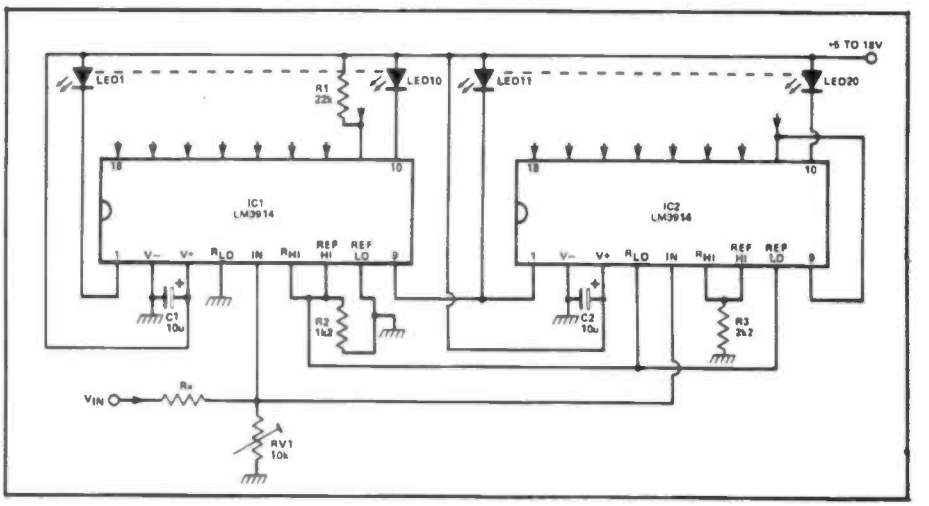


Figure 21: Dot-mode 20-LED voltmeter (fsd = 2V4 when Rx = 0).

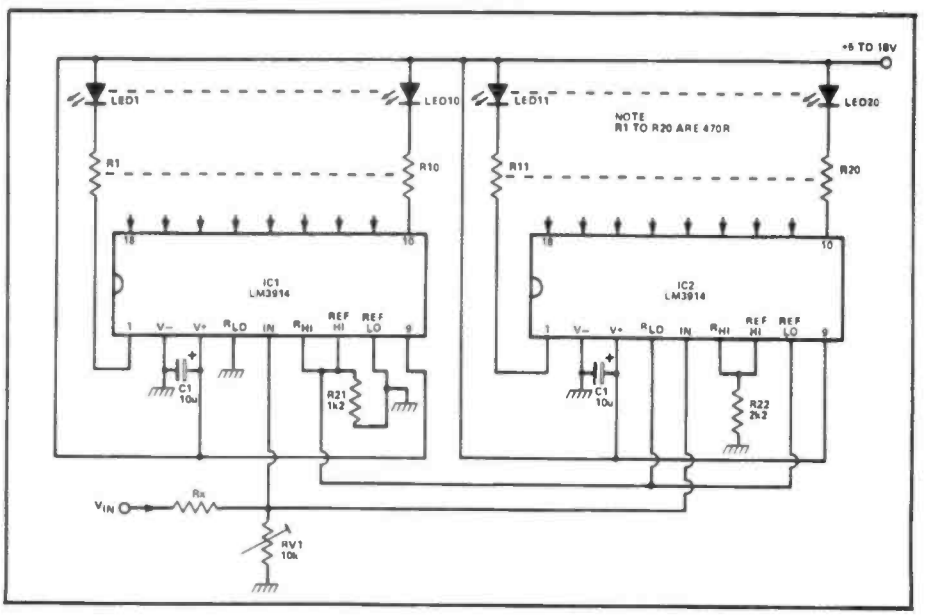
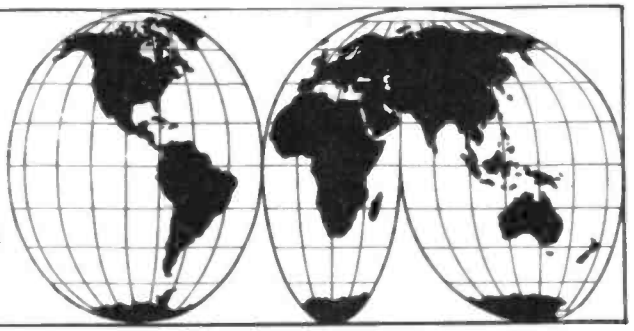


Figure 22: Bar-mode 20-LED voltmeter (fsd = 2V4 when Rx = 0).

Your Reactions.....	Circle No.
Immediately Interesting	48
Possible application	49
Not interested in this topic	50
Bad feature/space waster	51

SHORT WAVE NEWS FOR DX LISTENERS

Frank A. Baldwin



All times in GMT, bold figures indicate the frequency in kHz.

Somewhere on your receiver dial, scale or digital readout you will note the 90 metre band which is set between the limits 3200 kHz to 3400 kHz. It is largely unfrequented by most short wave listeners and tends to be only visited by the dyed-in-the-wool Dxer diligently searching amongst the commercial QRM for that elusive wanted signal.

The trouble with the 90 metre band is that it is largely covered by 'ute' - SWL term for utility - interference (QRM). Nevertheless, with a reasonably selective receiver and the right conditions at the most promising GMT and period of the calendar year, one can succeed in logging many exotic place-names in Africa, India and South America. The veteran Dxer even manages to enter some low-powered Indonesian stations in his logbook - and that represents super Dx by my standards.

Generally speaking, I find that the Africans tend to be received at their best during our late spring and summer evenings from around 1730 to 2200; the South Americans during our summertime from 2200 through to about 0330 whilst the Indians tend to appear during our late autumn, through winter and early spring from about 1500 to 1800GMT. The Indonesians also tend to be received here in the UK during the latter season and GMT period.

Apart from a selective receiver - and by this I mean a bandwidth of either 2.4 or 1.4kHz, preferably the latter, one really requires a good outside aerial erected as long and as high as possible, this terminating in an efficient ATU (Aerial Tuning Unit). Thus equipped one is then enabled to enter into the fray with some degree of possible success.

As a guide to what may be heard, the following results were achieved during a recent survey of the band undertaken by the writer for the ISWL (International Short Wave League) journal 'Monitor' - for address see end of this article.

South Africa

Johannesburg on **3250** at 1920, YL (Young Lady) with announcements in Afrikaans, pop songs and pop music. This programme was part of the Radio Five service which operates from 0300 to 0545 and from 1520 to 2200. The All Night Service is then on this channel from 2200 to 0300. The power is 100kW.

Johannesburg on **3230** at 1937, OM with announcements in Portuguese followed by a selection of local pop songs. This is the Foreign Service which is on this channel from May to August from 1856 to 1950, the power being 100kW. However, from the next entry in the logbook this schedule appears to have been altered somewhat.

Johannesburg on **3230** but at 0332 when presenting a programme of Beatles records such as 'Ticket to Ride', 'Hard Day's Night' etc., followed by OM with announcements of frequencies being used in this service and the appropriate times. Station identification was at 0336 in English, as were the foregoing announcements.

Congo

RTV Congolaise, Brazzaville on **3264** at 1924 OM's with a discussion in French. This one has a power of 50kW and operates from 0400 to 0600 and from 1700 to 2300 but this latter closing time can vary up to 2400. This one is logged often.

Botswana

Gaberone on 3355 at 1928, OM with a song in vernacular complete with local orchestral music as a backing. This transmitter is on the air from 0400 to 0530 and from 1455 to 2100. The power is 10kW. If you do tune to this channel don't confuse Gaberone with Luanda in Angola which is a co-occupant of this frequency and with a 100kW signal, although it was absent on the occasion reported here.

Ghana

Accra on a measured **3367** at 1945, OM (male announcer) followed by a YL with a selection of songs complete with local orchestral backing. Accra is in English on this channel from 0530 to 0800 (Sunday until 0900) and from 1530 to 2300. The power is 10kW.

Tanzania

Radio Tanzania, Zanzibar on **3339** at 1855, African drums then OM with a song in Swahili. The schedule is from 0300 to 0500 and from 1430 to 2000 but during the period of Ramadan this is extended to 2100. The power is 10kW.

Burundi

Bujumbura on **3300** at 1850, OM's with a discussion in vernacular in the Home Service 1 programme. Bujumbura is on the air from 0300 to 0700 (Sunday until 1000) and from 1600 to 2100. The power is 25kW and an English transmission is listed from 1645 to 1700.

Malawi

Blantyre on **3380** at 1858, OM with a talk in vernacular, the schedule of this one being from 0257 to 0530 and from 1600 to 2215. From April to October the morning session closes at 1110 and the afternoon transmission opens at 1300. The power is 100kW.

Zaire

Radio Candip, Bunia on **3390** at 1902, OM song in vernacular. The schedule is thought to be from 0400 to 0730 and from 1500 to 1930, the power 1kW.

Mozambique

Maputo on **3210** at 1936, OM with announcements in Portuguese followed by a mournful dirge of a song. Radio Mozambique operates from 0255 to 0530 (from November to February to 0430) and from 1515 (November to February from 1700) to 2210. The power is 100kW but beware - the frequency does vary between that stated above and **3208**.

Niger

Niamey on **3260** at 1943, OM's with an excited argument in vernacular - I trust they did'nt come to blows! This is the Home Service 1 which is on the air weekdays from 0530 to 0630 and from 1700 (Saturday and Sunday from 1630) to 2130 (Saturday until 2300). The power is 4kW. It is not often I hear this one, the channel is usually well covered by utility QRM.

Swaziland

TWR (Trans-World Radio), Mpangela on **3240** at 0329, OM with a religious programme and hymms in vernacular. The schedule is from 0300 to 0345 and the power is 30kW.

TWR Mpangela has also been logged on the unlisted channel of **3335** at 0259, musical box interval signal, OM with announcements and station identification in English then, at 0300, OM with a religious programme in vernacular.

Togo

Lama-Kara on **3222** at 1950, OM with a talk in French, heard with some difficulty under pulse QRM. Lama- Kara is on the air from 0530 to 0830 and from 1630 to 2230, the power being 10kW.

Rwanda

Kigali on a measured **3331** at 1933, OM with a talk in French unfortunately - see below. Radio Rwanda is on this channel from 0300 to 0600 (Sunday until 0900); from 0900 to 1200 (Saturday and Sunday until 2100) and from 1330 to 2100. The power is 5kW.

Unfortunate in that **3331** is listed as being occupied by a Dx catch in the guise of Radio Comores, Moroni which operates as follows - from 0300 to 0430 and from 1400 to 1500 in Comorian; from 1500 to 1600 in Arabic; from 1600 to 1700 in English; from 1700 to 1900 in French and from 1900 to 2000 in Swahili, the power being 4kW.

Had my logging been in Swahili I would have been highly elated. As it was, I was somewhat crestfallen! I do wish Kigali would stick to its listed **3330** channel.

Ecuador

HCJB Quito on **3220** at 0225, OM in Spanish announcing some classical music. HCJB (Herald Christ Jesus Blessing) operates here from 0900 to 1300 and from 2130 to 2200 in Quechua and from 2200 to 0500 in Spanish. The power is 10kW.

Radio Zaracay, Santo Domingo on **3395** at **0244**, OM with a song in Spanish, guitar music as a backing. The schedule is from 1000 to 1400 and from 1900 to 0500, the power being 12.5kW.

Venezuela

Radio Occidente, Tovar on **3225** at 0232, OM with a ballad in Spanish complete with local orchestral backing. Radio Occidente is on the air from 1000 to 0400 and the power is 1kW.

If you do get on this channel at this time, ensure that the language you hear is Spanish. If it happens to be Portuguese then you are listening to Lins Radio Clube, Lins in Brazil on the same channel.

Radio Mara, Maracaibo on **3275** at 0240, OM's with a local pop song in Spanish, OM with promos. This one is on the air from 1000 to 0400 - like most Venezuelans - and the power is 1kW.

Brazil

Radio Clube Dourados, Dourados on **3375** at OM with a local pop song in Portuguese. The schedule is from 0855 to 0400 and the power is 5kW.

Guatemala

Radio Chortis, Chiquimula on 3380 at 0256, local- style pipe music, YL with announcements and songs. The schedule is from 1100 to 1200 and from 2100 to 0400, the power being 1kW.

However, ensure that the transmission you are logging extends beyond 0300. At that time, Radio Iris, Esmeraldas in Ecuador signs

off this channel - and it has a power of 10kW!

All of that is the sum result of the 90 metre band survey. Now on to -

AROUND THE DIAL

Bolivia

Radio Padilla, Padilla on a measured **3479** at 0150, OM with a ballad in Spanish then YL with announcements. This one operates from 2300 to 0200, the closing time being slightly variable. The power is just 0.3kW and it is listed on **3480**.

Ecuador

CRE Guayaquil on a measured **4656.2** at 0230, YL with pop songs, OM station identification as 'Radio Tropicana', announcements in Spanish and promos. Guayaquil is on the air from 0900 (Sunday from 1100) to 0430 and the power is 10kW.

Peru

Radio Atlantida, Iquitos on **4790** at 0346, local pops on records, OM with announcements and station identification in Spanish at 0350. This often heard Peruvian is scheduled from 1000 through to 0500 and the power is 1kW. However - wait for it - the frequency can vary at times up to 4795.

Swaziland

Swazi Music Radio, Sandlane on **4980** at 1927, YL with hymns, religious programme in English. This is Swaziland Commercial Radio which operates here from 0300 on a seasonal basis. Both the season and the full schedule is unknown to me at the moment. The power is reputedly 100kw but I shouldn't have thought it from the low signal reading on my S-meter and the good conditions for Africa pertaining at the time.

Iran

Tehran on **11930** at 1931, OM with news of Iranian internal affairs during the English programme intended for Europe, the Far East, North Africa and the Americas, timed from 1930 to 2030.

Italy

Rome on 7275 at 1934, bird-song interval signal, YL with announcements followed by a newscast of world events in the English programme to the UK and Eire, scheduled from 1935 to 1955.

Romania

Bucharest on **9690** at 2015, OM with announcements, YL with a local pop song in the English programme for Europe, timed from 1930 to 2030.

AMATEUR BANDS

Turning now to the Amateur Bands and operating in the CW (Morse Code) mode, the following results emerged.

160 Metres (1800-2000kHz)

As far as I was concerned, most of the month under review was taken up with avoiding this band and abandoning it to the bangs and crashes of summer static. On one late evening session the log does show entries for EA2FR in Spain calling CQ vainly at 2333, this being followed for entries from the USSR in the guise of RB5QKI and UA3PFN - and all on the same evening.

40 Metres (7000 - 7100kHz)

Nothing startling to report on this band either, although the following were heard during the late evenings and early mornings at various times throughout the month.

Interesting was K4QHN vainly trying WAS-WY (Worked All States certificate required and wanting Wyoming to add to his list at the particular time). As far as I know, he didn't succeed. Then there were the Brazilians PY1DYO, PY2IBS, PY4AFI and PY4ZO.

The Canadians VE1AI and VE3JKE were putting good signals into the UK, as were the Venezuelans YV4BE and YV4DOU early one morning around 0400.

30 Metres (10100 - 10150kHz)

Vacating 7MHz and trying 10MHz just after logging those early morning birds mentioned above, resulted in hearing signals from VK3MR and ZL2IST, but that was all.

20 Metres (14000 - 14350kHz)

On this good old Dx standby conditions were patchy to say the least, although the following did show up during the various sessions on this band.

From Uruguay CX5AO, from Brazil PY2EXD, Australia was noted with signals from VK2DQR, VK3XU and VK5AFA whilst from Cyprus there was ZC4BI one morning calling ZL at 0541. Lastly, ZL1BEK came through from New Zealand.

15 Metres (2100 - 21450kHz)

More time was spent on this band than any of the others, it is fast becoming a favourite haunt of mine.

HC4JL (Ecuador), PY1AZ and PY2DFR (Brazil), VP9CB (Bermuda), VU2WTR (India) logged at 1430, YV4BOU (Venezuela), ZC4CW (Cyprus) together with ZC4RP, from South Africa ZS3TL, ZS4GL and ZS6AXM, 5HZFN (Tanzania) with 5H3TM logged on the same evening. Oddities, at least to me, were ZY5VX pounding away at about 25 wpm and 4N9WG - what is his QTH?

On SSB - I do sometimes use this mode - there were A4XGY and A4XYB from Oman, 5Z4BD from Kenya and lastly 9Q5VT from Zaire.

All of that is the sum result of the amateur band wanderings worthy of note during the past month.

ISWL (International Short Wave League)

For readers who wish to obtain more information about this largely SWL organisation, the address is League HQ, 88 The Barley Lea, Coventry, CV3 1DY. The annual membership for UK residents is £9.00, the monthly journal 'Monitor' being devoted to most aspects of short wave listening - and some transmitting news.

DX-TV

Reception Reports

Compiled by Keith Hamer and Garry Smith.

FOR MANY DX-TV enthusiasts, the month of June was somewhat of a disappointment due to the distinct lack of sustained reception. There were many days during the period on which DX reception was nil. Despite this, there were several mystery signals and F2- layer reception was in evidence at times.

Reception on June 1st commenced at this location at 0744 BST with an FuBK test card on channel R1 from Czechoslovakia. The identificiation was 'CST 01' and reception continued for some time. At 0800 the PM5544 test card from Italy appeared on channels IA and IB carrying the usual identification 'RAI 1'. An hour later tropospheric reception was noted on channel E21 from TDF-France. The PM5544 was received with the identification 'ANTENNE 2'. At 0923 on channel E4, standard colour bars were received which included a digital clock displaying BST + 1 hour. This signal originated from Spain (RTVE). Normally, identification is superimposed at the top of this pattern. There are four high-power channel E4 outlets in Spain located at Tibidabo (150kW ERP), Santiago (12kW), Guadalcanal (120kW) and Sollube (60kW). The low-power transmitter at Madrid (just 2kW ERP) is also received in the UK. Italy radiated their programme opening sequence at 0929 (1029 Italian time) and this was followed by a sample teletext transmission.

One of the five USSR networks (TSS) was received at 1121 on channel R1 with their electronic test card, usually referred to as the 'Leningrad' pattern. This was also present on channel R2. At 1128, TSS began their opening sequence which was followed by a current affairs programme called 'НОВОСТИ'. Spain then re- appeared (on channel E3) with an electronic test card carrying the identification 'rtve AITANA 3'. A similar test card was shown in the August column. Poland (TVP) was the next country to emerge on the screen with a transmission of their slightly modified PM5544. This has a darker background than other PM5544 s and it carries no identification. Despite extremely strong signals being received on channel R3 (77.25MHz vision), SECAM colour information was not detectable.

Later in the day at 1341, the very old and familiar '0249' monoscopic test card was received from the USSR on R3. TSS were also noted at 1800 BST on channel R1 with a clock caption showing BST + 3 hours which was followed by the main USSR news programme of the day, called 'ВРЕМЯ.' (Our apologies to the R&EW type-setters for all these awkward Russian words!)

Sporadic-E (Sp.E) activity was virtually zero for the following few days except for reception from Portugal on June 4th with their FuBK test card on channels E2 and E3 with both versions of their identification during the day, namely 'RTP 1' and 'RTP--PORTO'. Italy (RAI) was also noted on the 4th with a programme on channel IA.

June 5th was a long day for DX-TV enthusiasts. The first sign of reception came when RAI appeared on channel IA at 1310 BST. Then all was quiet throughout the bands and we thought that we were in for another signal-less afternoon! At 1529 however, an unusual test signal was noted on channel E2. It consisted of a grey-scale/colour-bar pattern with a uniform grey (or possibly red if the pattern was a colour test signal) area covering the lower quarter of the pattern. The signal displayed a 'smeary' video effect typical of F2/TE. (Trans-Equatorial) propagation. Reception was from the south and was rather weak. It is suspected that this signal originated from ZTV-Zimbabwe as shortly after it disappeared into the noise, a Zimbabwe Television identification caption appeared at similar strength and quality for almost ten minutes. At 1544, a 'ztv' caption was noted. Signals from RTVE- Spain on channels E2 and E3 were seen at 1550 and programmes from RAI were present on channel IB. It is worth mentioning that although a number of experienced DX-ers may find reception from Italy somewhat commonplace, it is always wise to check the various channels as it has been noted that RAI signals often herald reception from ZTV or RTS-Albania.

The West German network of ARD was seen on the 5th at 1859 with a clock caption on E2 followed by the news programme, 'Tagesschau'. At 1929, RTS (Albania) made an appearance with a news programme on channel IC (82.25MHz vision) which lies within the Band II spectrum. From 2000 onwards, reception was concentrated from Portugal and Spain. Excellent quality signals were noted on channels E2, E3 and E4 from RTVE with sound and good quality colour (PAL). At 2330, a feature film was received on E3 from RTP. It was an English film with Portuguese subtitles and continued until after 0045! Spain closed down at 0010 BST and following the National Anthem, standard colour bars were shown briefly. With RTP still on the air, the VHF Band I channels were monitored in the hope of receiving some 'exotic' station. All the red-hot receivers were just about to be switched off for the night when at 0047, a weak signal was located on channel E4. It is thought that this may have been the new low-power RTP transmitter at Valenca Do Douro, details of which were given in the July column.

Reception on the 7th was from Portugal and Spain with colour bars and the electronic test card carrying the

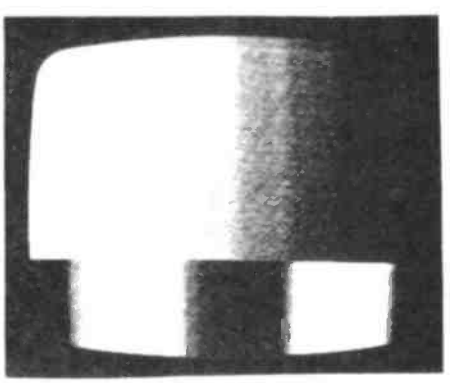


Figure 1: Mystery test pattern on E4 received on June 30th between 1935 and 1955BST.

Figure 2: USSR (TSS) announcer.

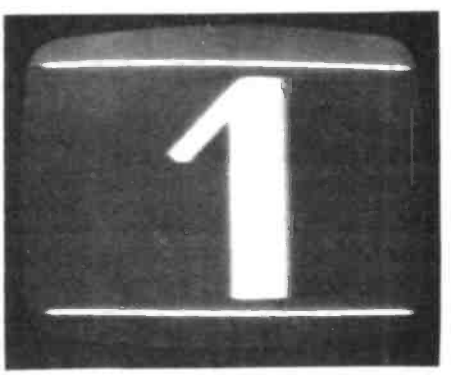


Figure 3: Austrian (ORF) 1st Network identification caption.

identification 'tve tve 1' on channels E2 and E4 from RTVE. An old monochrome pattern from RTP, which consisted of a black background with a broad, central, vertical white bar, was noted on E3. This pattern is generally referred to as the 'black-white-black' pattern. The 'RTP--PORTO' FuBK test card was also received on the 7th.

Yugoslavia was noted on the 8th at 1626 with the PM5544 test card carrying the identification 'JRT BGRD 1' on channel E3. This test card originated from the Belgrade studios. Another PM5544 was noted on E3 from Yugoslavia which was identified by the inscription 'RTV-1 LJUBLJANA'.

Zimbabwe was again noted on channel E2 via F2/TE propagation on June 21st. As we have mentioned before in previous columns, ZTV's E2 outlet is located at Gwelo. Reception on the 21st commenced at 1755 and continued for approximately one hour.

On the 24th at 2205, a weak PM5544 test card was seen on E3. This was, and still is, somewhat of a mystery bearing in mind the time. It may have been RUV-Iceland as they transmit the PM5544 until about 2000BST to be followed by a few programmes, then normally it's back to the test card, usually for the whole of the night!

Hungary made an appearance on the 25th with commercials on channel R2. MTV introduces advertisements with the caption 'tv reklam'. Austria was also received on the 25th with their monoscopic Telefunken TO 5 test card on E2a with the identification 'ORF FS 1'.

On the 26th, the FuBK test card from Finland was noted with the identification 'YLE TV 1' on E3. At 0915, two Norwegian transmitters were noted using the PM5544 with the identification 'NORGE MELHUS' (E2) and 'NORGE HEMNES' (E3). NRK-NORWAY usually includes transmitter location details on their PM5544's.

RTVE were noted on the 28th using a new opening sequence. We hope to have photographs of this in the near future but in the meantime we can report that is is as impressive as the previous video extravaganza.

The month ended with a flourish of activity. At lunch time on the 30th, the 'RS-KH' electronic test card was received from CST- Czechoslovakia on R1 and the Polish PM5544 was also present on this channel. The Austrian PM5544 was seen on E2a during the early afternoon period with brief showings of the Telefunken test card. The DDR:F electronic test card from East Germany was received on E4 and at 1636, RAI was present on channel IA. The Icelandic PM5544 was logged on E4 with the identification 'RUV ISLAND' during the early evening period.

Later, at 1900BST during an opening on E4, a colour-bar pattern appeared for a few seconds over a programme. The channel was monitored and at 1935 the pattern (see Fig. 1) re-appeared; the signal peaking with the aerial directed to the south. Reception continued until approximately 1955 when the signal faded into the noise. There is speculation that the signal could have been an Italian 'pirate' transmission, but we wonder if there could be a more interesting explanation.

If any readers can help to identify any of the mystery signals, we would be delighted to hear from them.

RECEPTION REPORTS

Ian Beckett has written from Chackmore (Buckinghamshire) with details of his latest equipment. Ian has been a DX-TV enthusiast for over 20 years and he now uses a Plustron TVR 5D which seems to perform well. It covers Bands I and III plus UHF and a facility is provided to switch between the 6.0MHz (as used in the UK) and the 5.5MHz (used throughout most of Europe) sound systems. Ian is awaiting the arrival of a JVC CX-610GB PAL/SECAM portable. This 5-inch receiver is highly recommended for DX-TV use although it carries a price tag of around £250. Fortunately for Ian, the whole family is interested in DX-TV and they have been successful in receiving TSS,SR (Sweden) and NRK.

From Robertsbridge in East Sussex, Hugh Cocks has sent details of Sp.E activity during June. On the 4th, Hugh noted a weak vision 'buzz' from the west on channel A3 at 2330. Attempts were made to receive signals on channel A2 (55.25MHz) from across the Atlantic during the intense Sp.E opening but nothing was sighted, perhaps due to strong reception from Portugal and Spain on channel E3 which would have obliterated any American Signals. On several occasions during reception of harmonics from VOA-Tangier, Hugh has seen weak signals on channel E4 and wonders if this could have been RTM-Morocco. He definitely received RTM during June on channel E4 with the PM5544 which included Arabic identification at the top and 'RTM' at the bottom. Also on the 4th, he noted ZTV-Zimbabwe at about 1600BST on channel E2 using the PM5544 test card. Reception was apparently extremely good with an almost total lack of the characteristic 'ghosting' effect normally associated with F2/TE propagation. Going back to May, and in particular the 14th, Hugh received NTV-Nigeria on channel E3 for practically the whole of the afternoon! It's a pity the signals didn't travel a little further northwards as nothing exotic was received at this location!!

Sam Faulkner (Burton-on-Trent, Staffordshire) received Zimbabwe on the 21st from 1800 on channel E2. Despite the enormous distance between Zimbabwe and the UK, it is amazing how frequently signals from ZTV are noted. Sam also received one of the Italian private/pirate stations using an identification caption which gave details of their television and FM radio frequencies. The station was NCT based at Udine in the north of Italy.

Clive Athowe at Blofield (Norfolk) has seen some unusual signals during the month. On the 23rd he noted RTP (Portugal) on channel E4 using their black-white-black pattern mentioned earlier in this column. On the 5th he had possible reception of RTVE-Canary Islands on channel E3 at about 2450 BST. On the 23rd, TSS were observed on R2 using the 'Leningrad' colour electronic test card with transmitter identification superimposed, which is rather unusual.

Ray Davies at Happisburgh (Norfolk) has been busy with DX-TV during the month and he too has noted RTM-Morocco on E4. Reception consisted of a feature film with Arabic subtitles. Ray's aerial was directed towards the south.

■ R & EW

See R&EW Databrief Part 1 September issue for details of World TV Standards.

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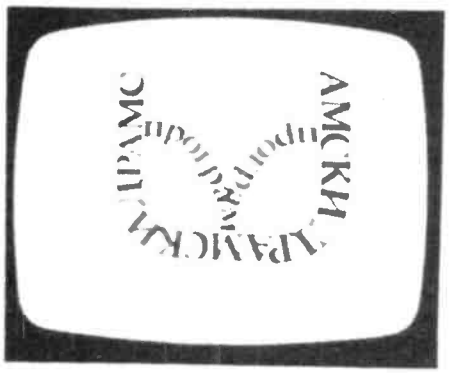

Figure 6: Finnish (YLE) FuBK electronic test card with new identification noted on channel E3.

Figure 4: Yugoslavian programme caption from the Belgrade studios (TVB 1). Note the Cyrillic alphabet.

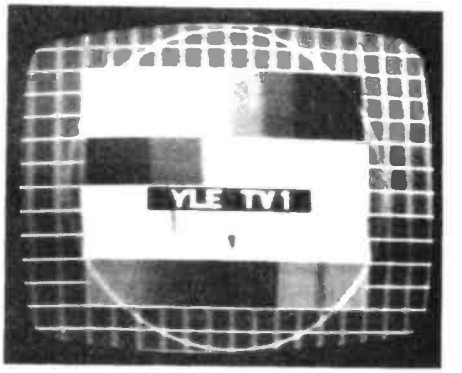

Figure 5: The Beograd (Belgrade) clock caption received on channel E3.

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The banking world has also adopted a hi-tech look over the past few years and the cash dispenser machines which work while you, and the bank staff do not, are now a familiar sight. Encounters with these machines, while usually straightforward, can however, take on nightmarish proportions if the auto teller decides that it is not to be your day.

Mechanical failure on the machine's behalf, is thankfully, a far rarer occurrence than it was a few years ago - the most common cause of frustration when attempting to get some of your hard earned cash from one of these 'hole in the wall' jobs is that it has run out of money, usually at 10.0 AM on a Bank Holiday.

If things do go wrong with the system the usual practice is for the machine to swallow the card - part of the money men's elaborate security system designed to protect our interests - and for it to be returned to you within a few days. Not a lot of good if you're flat broke, out of petrol and it's pouring with rain, grown men have been known to cry.

I recently went through this process, and while I am ashamed to admit that on this occasion it was operator error, the saga does reveal a refreshing attitude on behalf of the bank.

My card has a four digit number as its identification code, a number that must not be revealed even to the immediate family, and as a reader of many books on how to improve your memory I have 'keyed' the number to some familiar date in history. The number happens to be not far short of some famous battle, so as I stand waiting to enter my code, my thoughts are running something along the lines of 'Battle of Hastings (1066) minus 2 equals 1058.

The other day, some mental aberration or other caused me to think of the wrong battle, the result was that the 1197 I entered resulted in the machine telling me I had entered the incorrect code and that I should try again. Try again I did, and as I was so confident of my memory system, 1197 was once again keyed. Try again; 1197; goodbye card.

The post a few mornings later had amongst the bills my plastic card; I had subsequently found the correct number and realised the error of my ways which was a pity as I had composed a suitably acidic letter to the person responsible for these machines.

Upon opening the letter, the card fell out along with a printed form apologising for any trouble I may have experienced with the cash dispenser along with six or seven paragraphs detailing every form of machine malfunction possible any one of which could be ticked to indicate the problem. To the end of this last someone had handwritten, 'incorrect code entered' and duly put a tick against it.

It's nice to know that as a general rule the bank believe in the infallability of its customers - they're always right - and in the fickleness of machines. In the meantime I have taken to writing the code on the cuff of my shirt.

My mind has been playing tricks on me on more than one occasion during the past month, but the second occasion was more than enough to confuse anybody and has something to do with working for a monthly magazine.

The problem was all to do with the closing date of the caption competition in our September issue. Now for some reason lost in publishing history, magazines on sale during August are dated September. Thus a closing date for a competition in the September issue should be either August 31st or September 30th.

A further complication is the delay between producing the magazine and it appearing on the news stands. For example, these words written during July and appearing in the October issue, will be read in September. Confused? I am.

All this goes some way to explain why the August caption competition had a closing date of July 31st, a good few days before the issue was published.

Apologies and let's hope its right this month.

THE LAST WORD.

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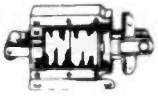
All types **£3.60 ea.** + P. & P. 75p (**£5.00** inc. VAT), except 0-50A, 0-100A. D.C. price **£5.00** + 75p. P. & P. (**£6.81** incl. VAT).



HEAVY DUTY SOLENOID, mf. by Magnetic Devices. 240V. A.C. Intermittent operation. Approx. 20 lb. pull at 1.25 in. Ex-equip. Tested. Price: **£5.95** P. & P. £1.50. (**£8.57** incl. VAT). R.&T.

240V AC SOLENOID. Approx: 10lb pull. 10% rating. Size 80×33×26mm. Price **£1.76** + P. & P. 54p (**£2.63** incl. VAT & P.)

12V D.C. SOLENOID. Price: **£1.50** + P. & P. 40p. (**£2.18** incl. VAT). N.M.S.

WESTOOL SERIES D6 Model A3 24V. D.C. Price **£1.50** + 50p p. & p. (Total Incl. VAT **£2.30**).

WESTOOL SERIES D4 Model A. 24V. D.C. Price **£1.00** + 30p p. & p. (Total Incl. VAT **£1.50**). N.M.S.

AG/GT 24V. D.C. 70 ohm Coil Solenoid. Push or Pull. Adjustable travel to 3/16 in. Fitted with mounting brackets and spark suppressor. Size: 100 × 65 × 25 mm. Price: 3 for **£2.85** P. & P. 50p. (min 3 off.) (**£3.85** incl. VAT). N.M.S.

MINIATURE SOLENOID FLUID VALVE

12V D.C. 15 ohm coil normally closed. Stainless steel body with variable flow adjuster ¼" B.S.T. Inlet and outlet.
Size: 58×27×25mm. Weight: 130 gr.
Price: **£2.60** + 35p. P. & P. (Total Incl. VAT **£3.39**).

230V A.C. SOLENOID OPERATED FLUID VALVE.

Media: Air, Gas, 7 psi. Water 5 psi. 3/8" Inlet/outlet. Forged brass body. Normally closed. Manuf. by Durance Asco. Price: **£5.50** + £1.00 p. & p. (Total Incl. VAT – **£7.48**).

SOLID STATE EHT UNIT

Input 230V ac. Fully isolated output 10mm spark. Approx. 15Kv. Built in 10 sec. Timer. Easily modified for 20 sec. 30 sec. to a continuous operation.
Designed for boiler ignition. Dozens of uses in the field of physics and electronics, eg. supplying neon or argon tubes etc.
Size: Length 155mm, width 85mm, height 50mm. Weight 530 grammes. Price **£5.00** + 75 pence post & packing. Total inc. VAT **£6.61**. N.M.S.

A.E.G. CONTACTOR

Type LS6/L11. Coil 240V 50 Rs. Contacts – 3 make: 600V: 20amp. 1 break: 600V: 20amp. Price: **£5.75** P. & P. 75p. (**£7.47** Incl. VAT). N.M.S.

AMF CONTACTOR

230V AC coil 2/0 25amp contacts **£5.50** P. & P. 75p total £7.19.

SMITH BLOWER

Type FFB. 1706. Small, quiet, smooth running, 240V. A.C. operation. Output aperture 45×40mm. Overall size 135×165mm. Flange mounting. Price: **£4.75**. P. & P. £1.00 (**£6.61** Incl. VAT). Other types available. S.A.E. for details. N.M.S.

MICRO SWITCHES

Sub. Min. Honeywell Lever m/s type 3115m 906ft. 10 for **£3.50** post paid (**£4.03** incl. VAT). These V3 types.
Button type (Pye) 10 for **£3.00** (**£3.45** Incl. VAT).
Short Lever type 16amp. rating (Crouzet) 10 for **£4.00** (**£4.60** incl VAT).
Long Lever 10 amp C.O. 10 for **£4.50** (**£5.18** Incl. VAT).
Roller Type (Bonnella) 10 for **£3.50**. (**£4.03** Incl. VAT). N.M.S.
D.P. C/O lever m/switch mfg. by Cherry Co. USA. Precious metal low resistance contacts. 10 for **£3.00** P. & P. 50p. (**£4.02** incl. VAT). (min. order 10). N.M.S.

A.C. Wkg. TUBULAR CAPACITORS.

Fraction pf makers price. Motor start etc.

1.5 mfd.	440V.A.C.	**60p**	4.1 mfd.	440V.A.C.	**£1.00**
2 mfd.	250V.A.C.	**60p**	5 mfd.	400V.A.C.	**£1.25**
2 mfd.	450V.A.C.	**75p**	5.3 mfd.	160V.A.C.	**60p**
2.2 mfd.	440VA.C.	**75p**	5.4 mfd.	280V.A.C.	**75p**
3 mfd.	440V.A.C.	**£1.00**	7.5 mfd.	200V.A.C.	**£1.00**

P. & P. up to 2.5 mfd. 25p. 3 mfd. to 20 mfd. 50p. All plus VAT.
SPECIAL DISCOUNT FOR BULK ORDERS N.M.S.

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Precision 24 volt. D.C. 0-8 amp Blower that works well on 12V 0.4 amp D.C. Producing 30 cu. ft. min at normal air pressure. **£4.50** P. & P. 75p. (Incl. VAT **£6.04**). N.M.S.

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Dual Input 200-240V, or 380-415V. Star connected.

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SNIPS OF THE MONTH

National R. Relay 12V. D.C. high speed 1 c/o. 1 amp contacts. Magnetically shielded. 1 pitch. Price: **£1.25** post paid (**£1.44** Incl. VAT).
Omron Type M. 24V. A.C. 4 c/o. h.d. Price: **80p** post paid (**92p** Incl. VAT). Base **20p** post paid (**23p** incl. VAT).
220/240V. Primary, secondary 24V a 4A. L.T. Transformer, fully shrouded. Price: **£4.50** + £1 p. & p. (**£6.38** incl. VAT).

INDUSTRIAL STROBE. Suitable for both industrial and educational purposes. Kit when assembled produces a variable speed 1 to approx. 70 flash per second. Light output approx. 0.5 Joules. Price, less case, £27 + £2 P&P (total including VAT £33.36). Suitable case **£11** + £2 P&P (total including VAT £14.95).

XENON FLASHGUN TUBES

Range available from stock. S.A.E. for details.

ULTRA VIOLET BLACK LIGHT FLUORESCENT TUBES

4ft. 40 Watt £8.70 incl. VAT **£10.00** (callers only).
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Complete ballast unit for either 6", 9" or 12" tube 230V AC op **£5.50** P. & P. 55p (**£6.96** incl. VAT). Also available for 12V DC op **£5.50** P. & P. 55p (**£6.96** incl. VAT).
400 watt UV lamp and ballast complete **£38.00**. Post £3.50 (**£47.73** incl. VAT + P). 400 watt UV lamp only **£14.00**. P. & P. £2.00 (**£18.40** incl. VAT).

BLACK LIGHT

Self-ballasted Mercury U.V. 175W Bulbs. Available for either B.C. or E.S. fitting. Price incl. p&p & VAT **£11.50.**
Black Light U.V. Tubes from 6in to 4ft from stock. Foolscap s.a.e. for details.

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WARNING: Tube used in this circuit is highly dangerous to the eyes. Unit MUST be fitted in suitable case.

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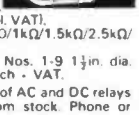

New ceramic construction, embedded winding heavy duty brush assembly, continuously rated.
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Black, Silver, Skirted knob calibrated in Nos. 1-9 1¼in. dia. brass bush. Ideal for above Rheostats **24p** each + VAT.

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Wide range of AC and DC relays available from stock. Phone or write in your enquiries.

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24V D.C. Sealed 3 c/o. 7a. 11-pin. **£1.35** + 30p P. & P. (**£1.90** incl. VAT).
24V D.C. 2 c/o. 7 amp contacts. Sealed, octal base. **£1.30** P. & P. 30p (**£1.84** Incl. VAT).
Mercury Wetted contact relay mfg. by Clare. Type HGSM 1003. 18/24V D.C. 1 c/o. **£2.00** P. & P. 30p (**£2.65** inc. VAT).
VERY SPECIAL OFFER 0-12V DC. 2 make contacts. NEW. 3 for **£1.75** + 25p P. & P. (**£2.30** inc. VAT).
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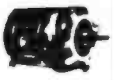
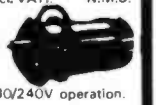
8/12V. D.C. Sealed 10a contacts 2 c/o. **£1.50** + 25p P. & P. (**£2.01** Incl. VAT).

GEARED MOTORS



5rpm 240V A.C. Mf. by Carter. **£5.50** + £1.00 P. & P. (**£7.48** incl. VAT).
7½rpm KLAXON motors approx. 25lb inch.
71rpm WYNSCALE motor approx. 10lb inch.
Above two motors are designed for 110V.
A.C. supplied with auto transformer 240V.
A.C. operation, **£9.75** P. & P. £1.50 (**£12.94** incl. VAT). N.M.S.
30 rpm. 230/240V. a.c. 50lb in. mf **PARVALUX.** Price **£15.50** P. & P. £2.00 (**£20.13** incl. VAT). N.M.S.
240V. A.C. 5rpm Motor (Mf. Carter) non-reversible. Price: **£5.50** + £1.00 p. & p. (**£7.48** incl. VAT).
42 R.P.M. 110 A.C. 50hz. 100lb incl. reversible will operate on 230 A.C. Speed remains at 42 R.P.M. but torque reduces by 50%. Price **£16.50** P. & P. £2.50 (**£21.28** incl. VAT). N.M.S.



100 rpm. 110V. a.c. 115lb. in., 50Hz. 2.8 amp. single phase split capacitor. Length 250mm. Dia. 135mm. Spindle dia. 15.5mm. length 145mm. Tested. Price: **£14.00** P. & P. £2.00 (**£18.40** incl. VAT). R. & T. Suitable Transformer for 230/240V operation. Price **£8.00** P. & P. £1.50 (**£10.93** incl. VAT).
200 rpm. 35lbs. in. 115V. 50kH. Price: **£16.50** P. & P. £2.00 (**£21.28** incl. VAT). N.M.S. Suitable Transformer for 230/240V. a.c. Price. **£6.00** P. & P. £1.50 (**£8.62** Incl. VAT). N.M.S.

230/240V A.C. SYNCHRONOUS GEARED MOTORS

1rpm, 2rpm, 6rpm, 12rpm. 6 revs. per day. 12 revs. per day. Any type. Price: **£3.90** + 40p p. & p. (**£4.94** incl. VAT).

Geared Motor. 120 rpm 1/10 hp approx. 15 lb.in. 230V. A.C. Cont. Rating. Non-reversible. Size 150mm · 90mm · 85mm spindle 8mm dia · 30mm long. Complete with capacitor and relay for max. load starting. Offered at mere fraction of mfrs. price – **£11.50** incl. of p. & p. & VAT.

Brand new CASSETTE TYPE MOTORS

3 types – 6V. 7½V. 12V. Price: 3 for **£2.00** + 50p p. & p. (Total Incl. VAT – **£2.88**).

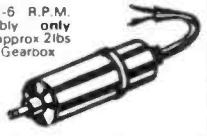
230V a.c. FAN ASSEMBLY

Powerful continuously rated a.c. motor complete with 5 blade 6½in. or 4 blade 3in. aluminium fan. Price **£4.50** P. & P. 75p (**£6.04** incl. VAT).

24V. D.C. GEARED MOTOR

24V. D.C. 200 rpm 10lbs/ins. continuously rated geared Motor mfg. by either Parvalux or Carter. Easily removed from chassis containing 9×24V. D.C. Solenoids, microswitches, friction clutch, precision gearing etc. etc. Ex-equipment London Transport Ticket Printer. Price: **£8.00** P. & P. £2.00 (**£11.50** incl. VAT).

SUB-MINIATURE PRECISION BUILT GEARED MOTOR



3-9v. D.C. operation, speed 2-6 R.P.M. Current consumption Incredibly **only 2-5 M.A.** Ratio 1670-1. Torque approx 2lbs inch plus. Motor – German. Gearbox Swiss.
Size: L 48 mm. Dia. 16 mm.
Shaft L. 5 mm. Shaft Dia. 2 mm.
Price **£8.50** inc. P. & P.
(Total inc VAT **£9.78**).

24V D.C. REVERSIBLE MOTOR

Parvalux type SD 12L. 24 D.C. shunt wound Motor, either 133 rpm 65lbs in Gearbox ratio 30:1. Current 6.8 amp. Ratlng continuous. Will operate on reduced power and speed at 9V D.C. or less. Size Dia. 16mm. Width 150mm. Shaft dia. 16mm. Price **£16.50** P. & P. £2.00 (**£21.28** incl. VAT). N.M.S.
100W Rheostat 1 ohm speed control available **£7.25** + P. & P. 75p (**£9.20** incl. VAT).

ROTARY CARBON VANE VACUUM & COMPRESSOR.

Direct coupled to 1/3 h.p. 110/115V. A.C. Motor 4.2 amp. 1380 rpm. Motor manuf. by A.E.I or G.E.C. Pump by Williams. Max. Vac. 25" H.G. Max. pressure cont. 10 p.s.i. Int. 15 p.s.i. Max. air-flow 3 c.f.m. at "0" H.G. Price: **£30.00** P. & P. £4.00 (**£39.10** incl. VAT). N.M.S.
Suitable transformer for 240V. op. **£10.00** P. & P. £2.00 (**£13.80** incl. VAT). N.M.S.

WATER PUMP

Mfg. by S.P.A. Astaisi of Italy. 220/240v A.C. 50 hz. 2800 R.P.M. approx. 1/3hp. Centrifugal pump with 1¼" Inlet/outlet. Delivery approx. 40 gals per min. at 10lbs head. (Non self priming). Price **£16.50** P. & P. £2.50 (**£21.85** Incl. VAT). N.M.S.

VEEDER-ROOT PRE-SET COUNTER

Type MG1636. 3 fig. countdown any number from 999 to 001. 230V A.C. 2 Wheel setting. Changeover Microswitch to inform external circuitry on completion of countdown. Size: Width 85mm. Ht. 65mm. Dpth. 70mm. Price **£4.00** + 75p P. & P. (Total Incl. VAT **£5.46**).

SANGAMO WESTON TIME SWITCH

Type S251 200/250V. a.c. 2 on/2 off every 24 hours. 20 amps contacts with override switch dia. 4 + 3 price **£9.50** P. & P. £1.50 (**£12.08** incl. VAT). Also available with Solar dial. R. & T. Type S288 **1 on, or 1 timed c/o every 24 hours,** day omitting device. Price: **£11.00** + £1.00 p. & p. (**£13.80** incl. VAT). Type S388. As above, plus 36-hours spring reserve. Less perspex cover. Price: **£13.00** + £1.00 p. & p. (**£16.10** incl. VAT).

TIME SWITCH VENNER TYPE

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80amp. 2-on/off Spring Reserve Timeswitch, Price **£15.50** P. & P. £1.50 (**£19.55** inc. VAT)
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