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Can be supplied with 200w power system in line of HFC. £56 extra
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- Improved acceleration/top speeds
- Up to 20% better fuel consumption

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All plinths finished in matching Teak veneer.

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THE NEW 'COMPACT' KIT

A compact bookshelf speaker system giving a high electro acoustic efficiency for the low powered amplifier.

The professional finish can be obtained with the minimum of tools, the infinite baffle type enclosures come ready wired and professionally finished, and fix together with masking tape till glue dries. The cabinet measures 12" x 8" x 5" deep approx. finished in simulated teak. Incorporating a quality 8'' speaker, maximum power handling 8 watts, impedance 8 ohms nominal, magnet size 42", approx. with 11'' parasitic tweeter.

EASY TO BUILD SPEAKER KITS

These superb simulated teak-finished speaker kits have been specially designed by RT-VC for the cost-conscious hi-fi enthusiast who wants top quality speakers but doesn't want to spend the earth. Built to EMI's exacting specifications, these new RT-VC speaker kits (300 type kit) incorporate 2 x 8'' woofers, 3'' tweeter and matching crossover. Easily put together with just a few basic tools. Specification (each speaker) - Impedance 8 ohms. Power handling 15 watts RMS (30 watts peak). Response 20-20,000 Hz. Size 20" x 11" x 5" approx. Comparable built units (EMI LIC) retail for over £45 pair.

£19.80 pair complete

+ £5.20 p&p

EMI 350 KIT

System consists of a 13" x 8" approx. woofer with a 3'' tweeter. Crossover components and circuit diagram. Frequency response: 20 Hz to 20 kHz. Power handling 15 watts RMS into 8 ohms. Peak 30 watts.

£6.55 + £1.20 p&p

Complete with crossover Diagrams and circuit diagram

VISCOUNT IV STEREO AMP COMPLETE 20 x 20 SYSTEMS

SYSTEM 1 £65.00

The new 20 x 20 watt Stereo Amplifier incorporating the latest silicon transistor solid state circuitry, the RT-VC VISCOUNT IV gives you a powerful 20 watts RMS per channel into 8 ohms. Superb teak-finished cabinet, with anodized fascia to harmonise with any decor. Polished trim and knobs.

The VISCOUNT IV has a comprehensive range of controls - volume, bass, treble, balance mono/stereo, mode selector, and scratch filter. Front panel socket for stereo headphones. And a host of sockets at the rear - for left and right speakers, tape recorder, auxiliary tuner, disc and microphone.


Approx. size: 15" x 8" x 10". MP30 type deck with magnetic cartridge, de luxe plinth and cover. Two Duo Type IIB matched speakers - Enclosure size approx. 11.5" x 7" x 7" approx. in veneer teak. Drive unit 19" with 21'' tweeter. 12 watts handling 14 watts peak.

Complete System with these speakers £65.00

+ £9.50 p&p

PRICES: SYSTEM 1

VISCOUNT IV amplifier £24.75 + £1.00 p&p

2 Duo Type IIB speakers £72.00 + £6.50 p&p

MP30 type deck with Mag. Cartridge £105.00 + £10.00 p&p

£275.50

Complete System with these speakers £286.00

+ £5.50 p&p

Note: 30 x 30 kit available only as a separate item.

SYSTEM 2 £80.00

Viscount IV amplifier (As System 1a) £24.75 + £1.00 p&p

MP30 type deck (As System 1a) £105.00 + £10.00 p&p

Two Duo Type III matched speakers - Enclosure size approx. 21" x 13" x 11" finished in teak simu late Drive units: 13 x 8" bass driver, and two 3" (approx.) tweeters 20 watts RMS, 8 ohms frequency range 20 Hz to 18,000 Hz.

Complete System with these speakers £80.00 + £7.60 p&p

PRICES: SYSTEM 2

VISCOUNT IV amplifier £24.75 + £1.00 p&p

2 Duo Type III speakers £41.40 + £7.50 p&p

MP30 type deck with Mag. Cartridge £105.00 + £10.00 p&p

£162.60

Complete System with these speakers £162.60

+ £7.60 p&p

Note: 30 x 30 kit available only as a separate item.

20 x 20 SYSTEM
NOW YOU CAN BUILD YOUR OWN PUSH BUTTON CAR RADIO!

This construction kit comprises a fully built and aligned R.F.I.F. module: Printed circuit board, with ready mounted integrated circuit output stage and all other components. The push button tuning mechanism is fully built and tested ready to mate with the printed circuit board. (once it is assembled).

NOTE: No test equipment is required for alignment, but remember you must have the ability to solder on a printed circuit board.

TECHNICAL SPECIFICATION
(1) Output 4 watts RMS output. For 12 volt operation on negative or positive earth. (2) integrated circuit output stage, pre built three stage IF Module. Controls volume manual tuning and five push buttons for station selection, illuminated tuning scale covering full, medium and long wave bands. Size chassis 7" wide, 2" high and 4½" deep approx. Speaker including baffle and fixing strip £1.80+45p. Car Aerial £7.40 +£1.05 p&p.

STEREO CASSETTE TAPE DECK KIT

Kit comprises of ready built cassette tape transport mechanism. Featuring pause control, solo/seek assisted auto stop. 3 digit tape counter, belt driven balanced fly wheel. DC motor with electronic speed control, ready built and mounted record/repay PC board, and two VU meters, power supply PC board, mains transformer, input and output sockets and two level controls. Specification power source 240 V.C. 50Hz. Output more than 0.5v input mikes -65d/10KΩ. D-IN - 47db 100KΩ. Track system 2 channel stereo record play back tape. Speed 4. 8cm/sec. Frequency response 50-12,000 Hz signal to noise ratio - 42db Recording system AC Bias Erasing system AC erase. Bias frequency 5.7KHz. Size of mechanism 8" x 5" x 3½" approx unit easy to mount onto your cabinet 3" required to clear base of mechanism approx.

For the experienced constructor who can solder correctly you can build this kit correctly.

£29.25 + p&p £1.50 or send SAE for complete details.

8 TRACK HOME CARTRIDGE PLAYER

Elegant self selector push button player for use with your stereo system. Compatible with Viscount 1V system. Unisound module and the Stereo 21 Technical specification Mains input 240V. Output sensitivity 125mV.

SPECIAL OFFER

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BUILD YOUR OWN STEREO AMPLIFIER

For the man who wants to design his own stereo - here’s your chance to start, with Unisound pre-amp, power amplifier and control panel. Just simply screw together, 4 watts per channel into 8 ohm speaker units. Size chassis 7" wide, 5½" high, 2¾" deep approx. The heart of Unisound is high efficiency I.C. monolithic power chips which ensure very low distortion over the audio spectrum. 240V, AC only £8.00 + £1.05 p&p.

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For the adventurous constructor who can solder correctly you can build this kit correctly.

£14.50 + £1.05 p&p.

NEW PRODUCT

DISCO 35 MONO AMPLIFIER

An ideal general purpose 35 watt mono amplifier with full mixing facilities. Suitable for DISCO, PUBLIC ADDRESS & GUITAR/MUSICAL INSTRUMENTS. Unit housed in an attractive light test enameled cabinet 4 input: DISC 1 & DISC 2 (both for ceramic cartridge), tape and microphone controls. All heating controls are fitted with integral switches, push button type. DISC 1 & DISC 2. Volume combined treble filter. TAPE. Volume combined bass booster switch. MASTER. Volume control combined off. MIC. Volume combined bass booster switch. INDEPENDENT BASS AND TREBLE CONTROLS.TECHNICAL SPECIFICATION

Power output: 35W RMS into 4 ohms. Speaker (Suitable for 4 to 15 ohms speakers). Sensitivities: DISC 1 & DISC 2. 2.30 mv (into 100Ω) TAPE. Treble Filter Switch: 12 db@10KHz. Tape: 100 mv (120Ω) Bass Booster Switch: 18 db@10KHz. Mic: 7 mv (equivalent for dynamic). Bass Booster Switch 20 db@60Hz. Treble Control: ±12 db@10KHz.

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One valve post 9s, each extra valve 7p (maximum 55p) LISTS s.a.e. please. VAT @ 19% incl.
**HY5 Preamplifier**

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (magn Cartridge, tuner, etc.) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease connection and mounting a P.C. connector with each pre-amplifier.

**FEATURES:** Complete pre-amplifier in simple pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.

**APPLICATIONS:** Hi-Fi—Mixers—Disco—Guitar and Organ—Public address

**SPECIFICATIONS:**
- **INPUTS:** Magnetic Pick-up 3mV; Ceramic Pick-up 30mV; Tuner 100mV; Microphone 10mV; Auxiliaries 500mV; Input impedance 4 701 at 1kHz.
- **OUTPUTS:** Tape 100mV; Main output 500mV R.M.S.
- **ACTIVE TREBLE CONTROLS:** Treble ± 10dB at 18kHz; Bass ± at 100Hz.
- **DISTORTION:** 0.1% at 1kHz. Signal/Noise Ratio 85dB.
- **OVERLOAD:** 30dB on Magnetic Pick-up. SUPPLY VOLTAGE ± 15-50V.
- **Price £4.75 + £1.19 VAT P&P free.**

**HY30**

15 Watts into 8Ω

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C. heater, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.

**FEATURES:** Complete Kit—Low Distortion—Short, Open and Thermal Protection—Easy to Build.

**APPLICATIONS:** Updated audio equipment—Guitar practice amplifier—Test amplifier—Audio oscillator.

**SPECIFICATIONS:**
- **OUTPUT POWER 15W R.M.S.** into 8Ω.
- **DISTORTION** 0.1% at 1.5W.
- **INPUT SENSITIVITY** 500mV.
- **FREQUENCY RESPONSE** 10Hz-16kHz—3dB.
- **SUPPLY VOLTAGE** ± 18V.
- **Price £4.75 + £1.19 VAT P&P free.**

**HY50**

25 Watts into 8Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the HY50 amplifier has been refined to the extent that it must be one of the most reliable and robust Hi-Fidelity modules in the World.

**FEATURES:** Low Distortion—Integral heatsink—Only five connections—7 amp output transistors—No external components.

**APPLICATIONS:** Medium Power Hi-Fi systems—Low power disco—Guitar amplifier

**SPECIFICATIONS:**
- **INPUT SENSITIVITY** 500mV.
- **OUTPUT POWER 25W RMS into 8Ω:** LOAD IMPEDANCE 4-16Ω DISTORTION 0.045% at 25W at 1kHz.
- **SIGNAL/NOISE RATIO** 95dB.
- **FREQUENCY RESPONSE** 10Hz-45kHz—3dB.
- **SUPPLY VOLTAGE** ± 25V.
- **SIZE** 110 x 90 x 25mm
- **Price £32.00 + £1.55 VAT P&P free.**

**HY120**

60 Watts into 8Ω

The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements for load line and thermal protection this amplifier sets a new standard in modular design.

**FEATURES:** Very low distortion—Integral heatsink—Load line protection—Thermal protection—Five connections—No external components.

**APPLICATIONS:** Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ.

**SPECIFICATIONS:**
- **INPUT SENSITIVITY** 500mV.
- **OUTPUT POWER 60W RMS into 8Ω:** LOAD IMPEDANCE 4-16Ω DISTORTION 0.045% at 50W at 1kHz.
- **SIGNAL/NOISE RATIO** 95dB.
- **FREQUENCY RESPONSE** 10Hz-45kHz—3dB.
- **SUPPLY VOLTAGE** ± 45V.
- **SIZE** 114 x 50 x 50mm
- **Price £14.49 + £1.76 VAT P&P free.**

**HY200**

120 Watts into 8Ω

The HY200 has now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.

**FEATURES:** Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components.

**APPLICATIONS:** Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address

**SPECIFICATIONS:**
- **INPUT SENSITIVITY** 500mV.
- **OUTPUT POWER 120W RMS into 8Ω:** LOAD IMPEDANCE 4-16Ω DISTORTION 0.05% at 100W at 1kHz.
- **SIGNAL/NOISE RATIO** 96dB.
- **FREQUENCY RESPONSE** 10Hz-45kHz—3dB.
- **SUPPLY VOLTAGE** ± 45V.
- **SIZE** 144 x 100 x 85mm
- **Price £21.20 + £1.70 VAT P&P free.**

**HY400**

240 Watts into 4Ω

The HY400 is one of the true "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco address applications. The amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power Hi-Fi fidelity power module.

**FEATURES:** Thermal shutdown—Very low distortion—Load line protection—No external components.

**APPLICATIONS:** Public address—Disco—Power slave—Industrial

**SPECIFICATIONS:**
- **OUTPUT POWER 240W RMS into 4Ω:** LOAD IMPEDANCE 4-16Ω DISTORTION 0.1% at 240W at 1kHz.
- **SIGNAL/NOISE RATIO** 96dB.
- **FREQUENCY RESPONSE** 10Hz-45kHz—3dB.
- **SUPPLY VOLTAGE** ± 45V.
- **INPUT SENSITIVITY** 500mV.
- **SIZE** 114 x 100 x 85mm
- **Price £39.00 + £2.34 VAT P&P free.**

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<table>
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<tr>
<th>PSU30 suitable for two HY50's</th>
<th>£4.75 plus £1.19 VAT, P/P free.</th>
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<tbody>
<tr>
<td>PSU60 suitable for two HY50's</td>
<td>£8.55 plus £1.55 VAT, P/P free.</td>
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<tr>
<td>PSU100 suitable for two HY200's</td>
<td>£13.90 plus £1.19 VAT, P/P free.</td>
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<td>PSU300 suitable for one HY400</td>
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Practical Wireless, August 1976 289
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<table>
<thead>
<tr>
<th>Reference</th>
<th>Description</th>
<th>Price</th>
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<tr>
<td>ERO Z 80</td>
<td>ROZ 80</td>
<td>45p</td>
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<tr>
<td>ERO Z 90</td>
<td>ROZ 90</td>
<td>55p</td>
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<tr>
<td>ERO Z 100</td>
<td>ROZ 100</td>
<td>60p</td>
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<tr>
<td>ERO Z 110</td>
<td>ROZ 110</td>
<td>65p</td>
</tr>
<tr>
<td>ERO Z 120</td>
<td>ROZ 120</td>
<td>75p</td>
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FULL Easy to follow instructions

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BF52 10p
BC117 9p
BF53 10p
BC119 8p
BF54 10p
BC120 8p
BF55 10p
BC147 4p
BF515 12p
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Practical Wireless, August 1976
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<tr>
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<tbody>
<tr>
<td>Electronic Module excl. case</td>
<td>Kit 10:50</td>
<td>8:00</td>
</tr>
<tr>
<td>Electronic Module excl. case</td>
<td>Built 11:00</td>
<td>8:50</td>
</tr>
<tr>
<td>Complete Clock countdown 10min</td>
<td>Kit 12:51</td>
<td>10:36</td>
</tr>
<tr>
<td>Complete Clock countdown 10min</td>
<td>Built 16:50</td>
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"ALPHA" 4 Green 0-5" digits 12 or 24hr
Perspex Case only

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<td>Electronic Module excl. case</td>
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<td>10:00</td>
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<tr>
<td>Complete Clock countdown 10min</td>
<td>Kit 14:00</td>
<td>11:50</td>
</tr>
<tr>
<td>Complete Clock countdown 10min</td>
<td>Built 17:00</td>
<td>14:50</td>
</tr>
</tbody>
</table>

Perspex colours: Black, White, Red, Green, Blue, Orange.

**"NOVUS"**

650 Mathbox £5.40; 850 Mathbox £6.75; 4510 Mathematician £16.20;

**CALCULATORS:**

6020 Statistician £21.60

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Telephone: HITCHIN (0462) 814477

Practical Wireless, August 1976 297
**Record-breaking Space-saving Antenna**

The average house and garden just doesn't lend itself to effective antennae... and, after all, be it milli- or Mega-Watts, a good radiato is a MUST... you need to hear them too! Flats and other restricted property can be a real headache. BUT THERE IS AN ANSWER, the JOYSTICK VFA (variable frequency antenna), the compact unit giving you a six band omnidirectional aerial that can, if wish you just stand in the corner of the shack.

This revolutionary invention has scored 599 for the best Dx vs. QRP QSO on record and inspired thousands of testimonials. One satisfied customer reports that when operated five feet below ground results equalled the station dipole, elevating the VFA just left the dipole standing!

ALREADY IN USE BY AMATEUR TRANSMITTING AND SWL STATIONS WORLD-WIDE AND GOVERNMENT COMMUNICATION.

Prices include VAT, insurance and delivery by post or carrier.

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12" 60 watt R.M.S. Plasticised Linen Cone Surround. Large Tweeter Cone. Range 15Hz 15KHz. Extra High Sensitivity. Robust Cast Chassis.

WE CONSIDER THE 'DISCO 60' TO BE THE BEST SINGLE UNIT AVAILABLE FOR ITS PURPOSE. WE'RE SURE THAT YOU WILL TOO. Impedance of 8Ω or 15Ω Rec. Price Inc. VAT £25.95

The above is one of five SPECIALIST RANGE SPEAKERS Each designed to produce the individual sound requirements for its particular purpose. Other units are as follows:— Incl. VAT £24.75 £24.75 £23.75 6Ω or 15Ω £18.25 30M Hz) £17.25 0843 62535 (or 62839 after office hours)

JOYSTICK VFA £17-25, JOYMATCH ATU's: 111 (Med. wave - 30MHz) £17-25, 111A (1-6-30M Hz) £17-25, 111B (M-ch 1-6-30 MHz) £15-76, LO-Z. 500 (8-1 thru 30 MHz, 500w) £21-86, BUDGET LINE: ATU 1-6-30 MHz £8-67, ATU Med. & SW Bands £8-67, (both in kit form £7-17), Aerial Bandswich (complete aerial system, medium & SW Bands) £7-17, DX CROSSWIND SET (Home and Worldwide reception) ready to use £4-75, COMM. HEADPHONES £8-00 £4-54, FIELD STRENGTH METER £12-25, SET VALVES 959/959S £7-25, COAXIAL CABLE £5-50 or 75 ohms, per 10 metres £1-50, SYSTEM "A" VFA + 111B £22-40, SYSTEM "D" VFA + Aerial B/switch £24-20, SYSTEM "J" VFA + LO-Z 500 £38-40.

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100 PF 40VW ELECTROLYTICS Size 11 @ 2 for £1-
2 AMP TV RF CHOICES £6 each. 10 for £56.
SILICON BRIDGE RECTIFIERS 460 PV 1 amp @ 30p, 200 PV 2 amp @ 30p, 100 PV 1 amp @ 20p.
TAPE RECORDER DIGITAL MECHANICAL COUNTERS @ 25p.
GERMANIUM TRANSISTORS AC41K, AC42K, AC135K, AC187K, AC188K all @ 20p each.
VHF TUNING VARACOR DIODES Untested 20 for 45p.
STACKPOLE ROCKER SWITCHES 5 amp 350 volt 18p, 4 for 95p.
DUAL GATE MOS FETS LIKE 40673 @ 30p or 4 for £1-10.
54 AC12 TRANSISTORS Untested Untested @ 55p.
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FERRANTI TX1 18 TRANSISTORS @ 6 for 1.55.
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SN75235 5 WATT AUDIO AMPLIFIER I.C. @ 51p each.
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18 SILICON BRIDGES 10 AMP TYPE Untested for £1-25.
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CP2 200 Resistors, mixed bag of different types, values, wattages, etc. Approx. quantity, counted by weight.
CP3 40 Wirewound resistors, mixed types, values and wattages.
CP4 12 Potentiometers, pre-set, w/wound, carbon, etc. Mixed types and values.
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CP6 50 T.D.S mounting pads, fits between transistor and board, for that finish. 60p.
CP8 500 Cable clips for G.P, 1 1/2" dia. Cable. Nylon with hardened steel pin (probably tungsten) per sealed box of 500.
CP9 3 5mm plugs, miniature jack, to fit earphones in PAK CP6.
CP10 5 3mm sub miniature jack plugs, to fit earphones in PAK CP6.
CP11 5 Screwdrivers, 1 main mains tester, 5 small screwdriver.
CP12 10 Reed relay inserts, 1" long, 1/4" dia. These will operate from mains external magnet or coil. For magnets see PAK CP13. HD.
CP13 10 Magnets of various sizes for operating reed contacts, in PAK CP12, ideal for burglar alarms on doors and windows.
CP14 40 Potentiometers, pre-sets, carbons, dual gangs, with and without switches etc. Mixed values and wattages.
CP15 12 Standard crocodile clips, screw fixing, good quality.
CP16 1 P.C. Board each containing a BFR10 UVF 800mA amplifier transistor. A good basis for building your own amplifiers on various parts inc.
CP17 25 Electret V.C. Capacitors, various values and voltages, many useful types, from T.V. to transistor radios & H.F. & L.F.
CP18 1 Light activated SCR 50 volts 1 amp type LD. Ready mounted on P.C. board with gate resistor and leads fitted. Full data and circuit diagram, with 14 projects, includes, stereo photo flash unit, burglar alarm etc.
CP19 1 Micro switches, 1 pole change over, standard model 'S' 60p.
CP20 10 Resistor packs, assorted types, ex-GPO and others, mixed voltages £1.30'

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TESTED AND GUARANTEED

CP11 35N460 integrated circuits, 14 pin dual in line TTL type. Decade counter. Get one for £1.30 each.
CP23 4 Switches, miniature push to make single pole 60p.

POWER TRANSISTORS

<table>
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INTEGRATED CIRCUITS

MM3514 Dual in line clock chip £3.50
LSM380/SL0749 Dual in line 2w audio amp. with data. £7.50
Dual 2N7O1 I.C. sockets 8 pin 14p, 14 pin 155p, 16 pin 14p'

SUMMER BARGAINS

F. M. STEREO DECODER

(Limited number) with data—neg earth £1.95
For pos. earth £1.75

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Unchecked—no speakers. Useful for experiments and parts.
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AM chasis only.
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MT11 12x 5x 50mA £1.25
SS9/1 5x 1amp £1.85
SS17 12x 1amp £2.50
SS118 18x 1amp £2.50
SS75/2 2w 2amp £2.50
SS7/3 35w 2amp £2.50
SS70/3 35w 4amp £3.00

PC BOARD CONNECTORS

Type | Sizes Pitch
|------|-------|
| SSEC | 6way 150p
| SSEC | 10way £1.50
| SSEC | 12way £1.85
| SSEC | 16way £2.30
| SSEC | 18way £3.35
| SSEC | 20way £4.50
| SSEC | 25way £5.00

Other untested packs.
UT10, 15 power resistors, PNP germanium and NPN silicon, roughly TO-3 but some plastic and some metal. 60p ea.
UT13 15 integrated circuits, experimenters pak, dual in line. TTL, DTL, marked and unmarked, some definitely good but old types.
For full range—See Catalogue

BOOKS

All free of V.A.T. We carry very large stocks of technical books by Babani & Bernard Publishers, by Newnes and Butterworths, as well as a reference books from the Common Market in English/German/Italian. All detailed in our catalogue.

SUPERSPARK Mk.5 CAPACITOR DISCHARGE IGNITION UNIT

As reviewed and described by "Practical Wireless" June, as "a very good investment indeed," Easily changed from pos. to neg. earth. Rev. limiting control. Switching for instant return to normal ignition and vehicle immobilisation. Neat indicator. Totally enclosed strong metal case. (P—50p).
KIT £7.50*, BUILT £10.50*

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VAT at 12% must be added to total value of order, except for items marked * or £, when VAT is to be added at 5%. No VAT on overseas orders. POST & PACKING Add 25p for UK orders except where shown otherwise. Minimum order—postage—15. Overseas orders, add £1.10 postage. Any difference will be credited or charged. PRICES Subject to alteration without notice. AVAILABILITY: All items available but not going to press when every effort made to ensure correctness of information.

V.A.T charged at rates effective at time of despatch of goods

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for which I enclose inc. V.A.T.

Name

Address

WRITE ORDER IMMEDIATELY AND ATTACH COUPON IF REQUIRED
Hear Hear?

A FEW years ago, the professional electronics industry was plagued by a ridiculous war which served no useful purpose and made life extremely difficult for both the manufacturer and customer alike. It was called the "Specmanship War". The idea was that in order to sell more of your equipment (or whatever) you continually tried to offer better specifications (specs) than any of your rivals. This led to the continual upgrading of equipment and specifications were commonly offered which were far in excess of those required. Designers lived in a world of seeking ever better performance while the customer (who was busy demanding even better specs) ended up by getting what he asked for and paying heavily for the privilege. Equipment became obsolete before it arrived in the sales literature and prices rose. Imagine, for example, using an oscilloscope with a 100MHz bandwidth for making simple audio measurements.

That's the story from the professional industrial sector. What about the Amateur and hobbist front? Have we learnt anything from our industrial brothers; or are we plodding on blindly following their footsteps without seeking to learn anything from their mistakes?

What of the audio enthusiast who absolutely must have that flat response from zero to 100kHz? The fact that his ears cannot detect sound above 20kHz at best makes no difference; the amplifier must be flat to 100kHz.

After the expense of (often) hundreds of pounds, what does our tyro end up with? He has an amplifier which will faithfully reproduce sound at frequencies which he cannot hear (and never will), and beautiful loudspeakers which will not respond to 100kHz anyway.

Throughout the pages of Practical Wireless there are many advertisements for audio amplifiers which are either in kit form or completely assembled into modules. Response is good and many are eminently suitable for all but the most exacting audio work. What power is needed? There are those who just have to have huge wattages—prestige specmanship! The "I need 50 Watts" brigade. Anyone who has ever sat in an average size living room and turned a 50W amplifier up to maximum will readily verify (if they have recovered their sanity) that even 15 Watts is quite a volume of sound in a small room.

Again, rolling one's own offers a chance to have a bespoke system which can be built into existing spaces or specially designed enclosures. For the real enthusiast, numerous designs have appeared for constructors in the pages of this journal.

This leader does not seek to dissuade the would-be audio enthusiast from saving up and buying good equipment. What it does ask is that one should examine not just the specs for specs sake. Surely a more sensible approach is to decide on an overall system and then seek to achieve it at a reasonable price.

As an example of this, one well known advertiser in this journal offers a complete stereo amplifier kit giving 20 Watts rms output per channel into an 8Ω load with total distortion better than 0.2% at 10 Watts. Response is from 25Hz to 25kHz at full rated output and the price is £26.25—and that includes VAT and post and packing charges.

Perhaps before you reach for your cheque book to buy equipment you should first reach for a copy of Practical Wireless, it could save you pounds. And on that reckoning, a regular subscription could save you thousands!

LIONEL E. HOWES—Editor

Open University

A ONE-YEAR course—Telecommunications Systems—is being offered by the Open University. The course, which is part of the University's Post-experience programme for 1977 looks at the basic engineering principles of telecoms. systems. It deals mainly with the way in which various elements of telecoms. systems are selected and combined; the functions they serve; the way they interact and the effects which inherent imperfections have on the overall performance of a system. Students will study in detail the telephone (including data transmission) and television. The rest of the course comprises case studies and includes an examination from the control and planning angle, of an experimental telephone exchange.

Students wishing to take this course should be familiar with elementary electronics including AC circuit theory; complex numbers; principles of amplification and feedback and simple transistor/diode circuits.

With these courses, students study at home in their own time from correspondence texts backed up by radio and TV broadcasts. There are 21 subjects to choose from in the 1977 syllabus. Anyone wishing to apply for the above-mentioned course (applications up to October 15th.) or receive further information on the Post-experience programme should write to: Post-Experience Student Office, Open University, P.O. Box 76, Milton Keynes, MK7 6AA.

Components Shops

AFTER a trial run to test the viability of selling components side-by-side with audio and Hi-Fi equipment, Henry's Lindar now have four shops offering this facility: Edgeware Road, Tottenham Court Road, Nottingham and Croydon. These shops, which offer counter and self-service selections are stocked, staffed and controlled by Henry's Radio.
Eddystone order

EDDYSTONE Radio Limited has won an order to supply 300 of its general purpose receivers type 1830/1 for use in Saudi Arabia.

Under the terms of the contract the receivers are to be supplied to the Saudi Arabian Posts, Telegraphs and Telecommunications Authority. They will then be deployed throughout the country and used by the authority for general monitoring purposes.

For those readers who don't know, the 1830/1 covers 120kHz to 31MHz in nine ranges with double-conversion and incremental tuning facility above 1.5MHz. (CW, MCW, AM-d.s.b., s.s.b.,—selective u.s.b./l.s.b.). Sensitivity is said to be 3µV for 15dB s/n (A.M. mode with 5kHz b/w). 1µV for 15dB s/n (CW, s.s.b. mode).—Eddystone Radio Limited, GEC-Marconi Electronics, Marconi House, Chelmsford, CM1 1PL.

New Solar Cells

A SOLAR battery announced by Mullard features increased efficiency and higher power ratings. Designated type BPX 47A, it consists of thirty-four 40mm diameter disc-shaped cells. Power output is typically 10.7W in sunlight conditions.

Improved cell efficiency (resulting from lower cell temperatures) is achieved because the panel transparency allows sunlight to pass through 'unused' areas of the panel with low heat absorption.

Callsign note

THE callsign for the Tyneside Amateur Radio Society is G3ZQM and not G3ZQN as previously stated in this magazine.

EMI balloon

AN 80ft high hot-air balloon nicknamed "Sounds Great" is to play an important role in the promotional plans of EMI Tape Limited, of Hayes, Middx.

The company is hoping to fly its 65,000 cu. ft balloon at special events throughout Britain and abroad.

Aerial Brochure

THE Aerial Manufacturers' Association Ltd. are giving away a very useful little booklet entitled "Aerial Sense is Good Sense"—The Enthusiasts' Guide to FM Radio Reception.

It's for anyone interested at all in getting a good signal into their FM receiver—and that's nearly all of us!

For your free copy, send a stamped, addressed envelope to: The Aerial Manufacturers' Association Ltd., 343/345 High Street, Cheltenham, Gloucestershire.

Quad 405 wins

AT a recent press conference the Design Council announced its Consumer and Contracts awards for good design. The Quad 405 was one of the nine products selected from over 5000 entries.

This is the second Design Council award for Quad. The Quad 33/303/FM3 were selected in 1969.

A particular source of pride is that on each occasion the products were designed entirely by Quad's design team.

BBC cassette

ATEST release from the BBC stable on compact cassette is:

"Out of This World"—the BBC Radiophonic Workshop (Rec 225 Stereo). A unique sound-effects album from the Radiophonic Workshop, this features noises unearthly and supernatural—everything in fact the amateur movie-maker or drama group could possibly need to produce a futuristic, sci-fi, suspense or fantasy atmosphere.

The very detailed 'sleeve' notes offer plenty of practical advice on how these effects can be put to the best use, and while the album is split into four sections entitled (a) Outer Space, (b) Magic & Fantasy, (c) Suspense & The Supernatural, and (d) The Elements, the versatility of the synthesised effects is such that they can often be interpreted in accordance with what the audience imagines is happening or by what action is taking place.

BBC Cardigan Bay

RADIO 1 transmissions from a new MW transmitter at Tywyn started recently. This brings transmissions on 1214kHz (247 metres) to over 50,000 people in Aberystwyth and an area around Cardigan Bay extending from the Lleyn peninsula to Fishguard.
CALIBRATION

On completion of assembly but before calibration can commence the stabilised supply must be set. The required voltage is 12.0V and this should be maintained over an input range of 12.5V to 19.0V. The most convenient way of providing this variation of input is to use a laboratory type power supply.

Connect the output of the power supply to the battery leads, with the battery disconnected, set it to about 13V and switch on. Adjust VR4 to give 12.0V across C3. Swing the input over the range 12.5V to 19V to check that the reading across C3 remains constant.

To check the current limiting circuit apply a short circuit across C3 via a 100mA meter. The current should be between 50mA and 60mA. The Light Emitting Diode D5 should glow. If the current indicated is outside the limits given it can be adjusted by varying R41.

The next stage is to calibrate the base current circuit. No direct current measurements are made since a common voltage is used on all ranges and variations in the actual value of the resistors R1 to R12 will affect the currents flowing. As mentioned earlier the voltage applied to the resistor chain and the base-emitter junction is 10.5V. This voltage is measured across R3 and is adjusted by VR1.

To effect the measurement, switch S4 to NPN, connect a voltmeter across R3 (negative lead to the end of R3 nearest the edge of the board), and adjust VR1 to give 10.5V on the meter. This is the hFE X1 position. Similarly, settings at 7.2V, 5.5V and 3.8V are required to give the X1.5, X2 and X3 positions. These settings, by reducing the voltage across the resistor chain, reduce the current flowing in the base-emitter junction by an equivalent factor and therefore act as multipliers. If each of the readings is reduced by 0.5V to allow for the junction voltage the ratios become obvious.

Resistor VR1 also sets the gate voltages for testing FETs and it is convenient to set and mark the unit in one volt steps from 1V up to 11V at this time.

To calibrate the collector voltage control VR3, connect the voltmeter across R30 (negative lead to the junction of R29 and R30) and adjust VR3 to give 1 volt increments. Mark the front panel at each voltage. The collector voltage should not be measured at the T.U.T. terminals because of the voltage drop across the meter (100mV at fsd).

To calibrate the meter circuit, set VR3 (Vc) to 5V, S1 to position 1 (Ic=0.1mA), VR1 (hFE) to X3, S3 to position 9 (Ie=1mA), connect the emitter and base leads of an NPN transistor to the relevant T.U.T. terminals and the transistor collector to its terminal via a 1mA meter. Increase the base current until the meters indicate between 0.4mA and full scale. By using the hFE multiplier increase the current in the external meter to read full scale. Check that the reading of the instrument meter is the same. If there are significant differences closer agreement can be reached by changing the value of R30. Should it be necessary to change R30 it will
be necessary to recheck the settings of Vc since measurements were made across it. The final item is the LED. This should just glow at 10mA and reach full brightness at 30mA. To confirm its action, connect the NPN transistor fully to the T.U.T. terminals and increase IB and IC to give transistor collector currents in the range 10mA to 30mA.

**TESTING NPN TRANSISTORS**

If an NPN small signal transistor is to be tested, it should be connected to the instrument before switching on. Next select a suitable collector current range (e.g., 0-3mA) and the desired collector voltage. Select a suitable base current. For example, if an hFE in the range 50 to 100 is expected, set IB to 0.05mA. Check that the hFE multiplier is at X1. Switch to NPN and the collector current will be shown on the meter. Since the 3mA range was selected the 0 to 3 scale will apply. However, as a 0.05mA IB was selected, a full scale reading implies an hFE of 100, so that the 0 to 10 scale (X10) reads the current gain directly. Similarly, because both the BASE CURRENT and COLLECTOR CURRENT ranges advanced in /10 steps, if IC were changed to 1mA and IB remained at 0.05mA, the instrument would read hFE over the range 0 to 30 on the 0 to 3 scale.

At positions 1 and 12 of IB the ICES and ICEO of the transistor can be read using a suitably sensitive IC range. For most silicon transistors except power types ICEO should be barely detectable, even on the 0.1µA range, and ICES will be even smaller.

![Figure 6: Front panel marking and control identification to suit the drilling details given in Part I, Fig. 3. See also the photograph used in the heading.](image)

It will be found that the gain of most transistors falls steadily as the collector current is reduced. For germanium types, however, the "gain" will apparently rise at very low currents. This is because a certain amount of collector current, ICEO, will flow without any base current.

To measure the current gain at a particular collector current, hFE may be adjusted, after increasing IB if necessary, to obtain the required collector current. The hFE is then as read by the meter, but multiplied by the hFE MULTIPLIER factor. Note that the hFE multiplier settings are not linear. Always return the multiplier to X1 after use to avoid misleading readings later on.

If the overload warning lamp lights, switch off and check the transistor connections and control settings. If in doubt, set IB to ICES, Vc to 5V and IC to 30mA. If the lamp still lights and the meter reads more than full scale the transistor has a collector to emitter short circuit. Other faults are also easily deduced. For example, if the collector current is less than the base current, either the device has an open circuit emitter (with or without a collector to base short) or the hFE is less than unity. Either way, its not much use as a transistor.

**N CHANNEL FET's**

N channel enhancement MOSFETS can be measured by connecting source, gate and drain leads to emitter, base and collector terminals respectively. IB should be set to ICES. The drain current at any drain voltage set by Vc can be measured as a function of the gate voltage indicated by Vg. Setting IB to 0.1µA should result in no change in drain current; if it does there is appreciable gate
leakage current. For example, if it were necessary to change the \( V_G \) setting by half a volt to restore the gate current to the previous value, the gate leakage under those conditions would be 0.5V/100\( \Omega \)\( \approx \)5mA.

N channel junction FETs and N channel depletion MOSFETS can be measured by connecting source, gate and drain leads to base, emitter and collector terminals respectively. With \( I_D \) set to \( I_{CES} \), the drain saturation current \( I_{DSS} \) can be measured, whilst with \( I_B \) set to 5mA the gate cut off voltage, defined as the gate/source voltage required to reduce the drain current to, say, \( I_F \), can be read from the setting of \( V_G \). Note that if \( V_G \) is set to 10V, and the cut off voltage is measured as 4V, the actual drain to source voltage across the FET is 6V only. Gate voltages corresponding to drain currents between \( I_{DSS} \) and cut off cannot conveniently be measured.

PNP transistors and P channel FETs are tested as described above for NPN and N channel types but with the PNP mode selected.

**DIODES**

To check small signal diodes, switch to DIODE, set \( I_C \) to 0.1mA and \( V_C \) to 10V. Hold \( I_F/I_F \) switch to \( I_F \), apply a temporary short circuit to the D.U.T. terminals A and K and adjust \( V_C \) to give full scale deflection. Release switch and remove short on A to K. Diodes can now be tested for reverse leakage at 10V by connecting to the terminals A and K. Conduction in the forward direction is checked at position \( I_F \) of the \( I_B/I_F \) switch. Germanium diodes will read approx two-thirds full scale, whilst, due to their higher forward voltage, silicon diodes will read approx half full scale.

**LEDs**

Light emitting diodes tend to have low reverse voltage ratings, so the following procedure should be adopted. Set \( V_C \) to 3V and \( I_B \) to \( I_{CES} \). Check the leakage. It may be appreciable but this is normally of no significance as circuits should be designed not to reverse bias the device. Check in the forward direction with the \( I_B/I_F \) switch at \( I_F \) and \( I_C \) set to 30mA. The lamp should glow brightly. The test current will be 8mA approx.

**ZENER DIODES**

Set \( V_C \) to OV, \( I_B \) to \( I_{CES} \) and select a suitable current range on \( I_C \). Zener diodes are typically specified at 5mA test current. Connect the zener to the D.U.T. terminals and increase \( V_C \) until the test current is reached. The zener voltage can now be read on \( V_C \).

**POWER TRANSISTORS**

The tester can be used to match power transistors for use in Class B output stages, as a current gain match at 10-30mA is important to minimise cross over distortion. With PNP and NPN types which are listed as complementary, the variation of gain with current will have a similar form for both types, so the match will also hold at high currents. This is obviously even more so when matching pairs of NPN devices for a “quasi-complementary” design. Indeed, where using two power transistors of the same type, matching at 30mA generally prove satisfactory even for Class A amplifier applications.

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**CONCLUSION**

The broad scope of this instrument will ensure that suspect semiconductor faults can be confirmed or eliminated. It will also ensure that the devices taken from your scrap box, jacket pocket or earlier projects are ready and able to perform the functions you require of them.

**ADDITIONAL INFORMATION AND CORRECTIONS TO PART 1.**

Transistor type BC213 is available with a range of pin configurations. Types coded BC213L, LA, LB all have the collector as centre pin. Types coded BC213K, KA, KB all have the base as centre pin. Devices by National Semiconductors coded BC213K, KA or KB are now supplied preformed with the base offset as standard. It is, therefore, essential to confirm the pin connections on purchase and insert accordingly.

An error has been made on the circuit diagram whereby the junction of D1 and D3 is shown connected to C2 as well as to the junction of R29 and R30. The correct connections are D1 and D3 junction to R29 and R30 junction (i.e. bridging the line from C2 to R33). The PCB artwork and layout is correct.

A second error is shown on the circuit diagram in the numbering of switch S1. Only 11 positions are shown. The correct numbering is: Present pin 2 should be pin 3, present pin 1 should be pin 2, a new position, pin 1 \( I_{CES} \) to be added going to switch S2 only.

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**Digital Frequency Meter, June/July 1976**

Due to demand, the printed circuit boards for the 7-segment filament tubes, previously obtainable from Doram Electronics (code no. 433-905) are no longer available.

Steps have been taken to include this board in the PW pcb Service, and prospective constructors should look out for an announcement in next month's issue.

**Wobbulator, April 1976**

On the PCB Fig. 5 page 1053, the collector and emitter of Tr2 are shown connected to the wrong pads. It is therefore advisable to sleeve the two leads and connect the collector to the OV rail and the emitter to pin 5 ICI.
APPROACHING 1000 people from the four corners of the globe attended the 22nd International VHF Convention on the 8th and 9th May, held this year for the first time at Brunel University, Uxbridge. Facilities on the campus were first-class and comfortable accommodation was enjoyed by over 100 visitors who stayed overnight.

Trade display
Another feature of the new location, was the greater space for traders, who took full advantage of this. In general, the traders reported very good sales, particularly on the Saturday. One best seller was the new edition of the RSGB VHF/UHF Manual, and shortly after the Convention reopened on the Sunday morning the last of the 260 copies had passed over the counter. The President, G3FKM, volunteered to rush to HQ to fetch further supplies!

Opening addresses
The idea of relaying the opening addresses from one of the three lecture theatres to the other two by closed-circuit TV ran into a slight problem, and although all were able to see the proceedings, not all heard what was being said.

The first speaker was RSGB President Dr. John Allaway, G3FKM, who discussed the role of the RSGB in promoting the general advancement of the science and practice of amateur radio. He pointed out that the Society was run mainly by volunteers, and that members of committees receive no payment for the considerable amount of time they devote to their duties. He went on to list some of the achievements of the Society in recent years, particularly those arising out of their relationship with the licensing authority. He mentioned the granting of the Class B licence concession, the extension of the microwave allocation and the permission to establish and use repeaters.

In other areas, the President referred to the range and quality of publications produced by the Society, equalled only by ARRL. He added that research into microwave propagation was being led by the RSGB, and that our beacon network was part of an international project which was the brainchild of the Society.

In conclusion Dr. Allaway referred to the 1979 World Administrative Radio Conference, and warned that bad behaviour on the air, whether it be through repeaters or otherwise, could contribute to us all finding ourselves off the air by the early 1980s.

The next speaker, Roy Stevens, G2BVN, RSGB telecoms liaison, continued the theme of WARC, outlining the work the Society is doing to prepare for this conference. A major brief is being prepared to justify the occupancy of our bands, and then efforts will be made to reach agreement with other users of the radio spectrum. This is so that the UK authorities can present a composite plan in 1979.

One country, one vote
G2BVN made it clear that the RSGB had no vote at the WARC, and all that the Society could do was impress upon the authorities the value of amateur radio. He explained that of the 148 member states, 58 were African and 26 south-east Asian or similar, and that each country, however small, had one vote. It was, therefore, the aim of IARU to convince administrative authorities of the virtues of amateur radio, particularly in those countries where it is held in poor esteem. IARU represents all but about 3000 of the world’s radio amateurs, even those who are not members of their national...
society. Roy Stevens concluded by saying that whatever the results of the votes in the WARC in 1970, it will not be possible to say that the amateur radio service has not done its homework.

**The lectures**

With the end of the opening addresses, the three lecture streams got under way. The scope and variety of lectures (14 sessions in two days) meant that there was something for everyone. The only problem as far as the writer was concerned was that it was not possible to be in three places at the same time. Regretfully, the OSCAR sessions in stream B, and the microwave stream C had to be left out in favour of the stream A lectures. Particularly interesting was the amount of thought devoted to the psychology of operating, and the way that the knowledge gained had been built into the Hampshire repeater. This sometimes gave GB3SN the appearance of almost human behaviour and judgement, justifying the nickname ‘Susan’.

Peter Blair, G3LTF, then gave an informed and fascinating talk on the technique and technicalities of moonbounce operation. The intriguing aspect to G3LTF of this mode is the fact that the path is just, and only just, possible using equipment that amateurs can reasonably be expected to obtain or construct. He demonstrated the calculations necessary to ascertain whether a given system was capable of being successfully used in e-m-e experiments, showing that the problems increase with the reduction of frequency. He discussed the various problems of background noise, libration fading, Faraday fading and Doppler shift, and gave his views on the various aerial systems used. As a final tip, he suggested a method of checking whether a system was really good enough for serious moonbounce work: incredibly enough (to the writer anyway) a good system will “see” the star Cygnus some 1.2dB above noise!

**Sounds peculiar**

Moving on to the Sunday lectures, the morning session in stream A started with Angus McKenzie, G3OSS, discussing audio distortion in transmitters and receivers. His experiments showed the improved readability of signals in noise with proper clipping and limiting, further demonstrating that it was possible to copy speech solidly up to 4dB below the noise level. He went on to describe some of the elementary design faults in imported commercial equipment, and the effects of these in terms of the hash and spurious transmitted by certain 144MHz “black-boxes”.

**Open forum**

Ranged in the firing line for this free-for-all last session were members of the VHF Committee and VHF Contests Committee. A lively discussion developed with no shortage of questions from the floor. The first salvo came from those questioning the wisdom of the mixed “DX” and “local” contest on 144MHz, and the VHF contest Committee were quick to confess that the experiment had not worked in practice. However, there was general agreement that the idea had been sound, even if the applica-

tion had not, and the feeling was that there was room for separate contests for the “DX” modes and “local” modes. In reply to another question, G3SEK, VHF Contests Committee chairman, made it clear that although the possibility of an alternative scoring method based on QTH locator squares had been investigated, there was no intention of introducing such a system at present.

In response to questions concerning the movement of the VHF NFD date from September to July, G3SEK explained that publicity had been given to this suggestion well before the rules had been written and no significant adverse comment had been received. One of the reasons for the change was that the September IARU event with which Field Day coincided is now 144MHz only, and there is likely to be little Continental activity on the other bands. Another contest query concerned the recent 1.3GHz and 432MHz open events, held this year on consecutive week-ends. The committee were asked to consider the possibility of combining the two events in future.

On the thorny problem of whether it is necessary in contests to record QTH as well as QRA locator, G3SEK confessed that the committee were divided on this issue, but with the licence conditions as they stand it is not sufficient for a portable station to transmit QRA only; the full QTH must be given, so the rules stay as they are for the present.

Several questions were then aimed at the VHF Committee, and there was discussion on the way that the WARC was likely to affect the VHF/UHF spectrum. Richard Baker, VHF Committee Chairman, explained that no more than speculation was possible, and that although some bands appeared less vulnerable than others, there was bound to be pressure on all four frequencies. Another questioner raised the possibility of the use of CW on a limited basis by Class B licensees, and it was explained that the present policy was that the use of CW should be preceded by a test, acting as a form of incentive licensing.

As can be seen from the above photograph, things got a bit hectic during the convention with enthusiastic eager for information. The firm shown here is Thales Electronics Ltd.
The Saturday evening dinner and dance raised only one minor criticism; the after dinner dancing (and drinking) time seemed all too short! Guest of honour, Dr. Saxton proposed the toast "the RSGB", congratulating those responsible for organising this most successful convention. He went on to stress the need for a strong RSGB, and ended by paying tribute to Roy Stevens, G2BVN, for the hard work he does as the Society's telecoms representative.

Replying to the toast, the President of the Society, Dr. John Allaway, confessed that he had never yet operated on VHF, but hoped that he might rectify this omission some day. He continued by saying that he had had the honour recently of attending the world-wide IARU conference in Miami, when, for the first time, all three IARU regions had met together to prepare a concerted policy for the 1979 World Administrative Radio Conference. Continuing, he said that he had been surprised by the lack of interest in VHF in the New World, with the exception of the States. In the USA, he noted the phenomenal growth of the Citizen's Band, with all the dangers of the media confusing CB users with radio amateurs. The President concluded by saying that it was up to us to ensure that we radiated clean signals and clean conversation to give ourselves the best possible chance in 1979.

The awards

The formalities ended with the presentation of the awards and trophies by the President. The John Rouse Memorial Trophy was awarded to G8DLZ for his excellent 144 to 1296MHz low-level mixer. The Surrey Trophy went to the March Group for their success in VHF NFD 1975, and the Mitchell Milling Trophy was awarded to the Bangor University team, GW5UCB, for winning the 144MHz Open Contest. The Golden Valley Contest Group took the VHF Manager's Trophy for the 1975 70MHz Open, and this year’s J. Frazer Shepherd award was won by G3WJG for the technical excellence and boldness of approach of his experimental 10GHz transmitter.

Acknowledgements to Russell Whitworth, G4CTP for the photographs in this article.

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**TELEVISION**

**IN THE AUGUST ISSUE**

- **ELECTROLYTIC TESTER**
  A complementary unit to Alan Willcox’s Capacitance Meter (May), this time covering electrolytic capacitors in the range 10 to 4,000μF, checking both leakage and capacitance value.

- **SYCLOPS REVISITED**
  This time last year we explained the operation of Thorn’s novel combined line output/switch-mode power supply circuit—Syclops—and its safety tripping arrangements. After a year’s experience of its operation in the field Barry Pamplin describes the day-to-day fault conditions that arise.

- **CHROMA LOCK DECODING**
  The most accurate way of decoding a PAL colour transmission is to use the colour subcarrier itself as the reference drive to the synchronous demodulators—since there would never be any phase difference between the chrominance and reference signals. This is the chroma lock technique. In practice it’s difficult to provide a reference oscillator which is both stable and yet able to track chrominance subcarrier phase shifts. The technique has nevertheless been used, and recent developments in i.c.s. could lead to its wider adoption. A full account of the principles will be given with some suggestions on how it can be tried out.

- **SERVICING TELEVISION RECEIVERS**
  Les Lawry-Johns sums up his experiences with the last of the dual-standard chassis, the Thorn 1400. Other servicing features will include more on the Decca 10/30 chassis and the Telefunken 711, and the feature on patching printed circuit boards held over from the July issue.

PLUS ALL THE REGULAR FEATURES

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- a Leak TL10 or two Leak Point One amplifiers.—B. C. Godbold, ‘Crabapple Cottage’, Aldringham, Nr. Leiston, Suffolk, IP16 4QJ.
- a pair of X81 valves for Commander communication receiver.—T. Younger, 11a The Avenue, Canvey Island, Essex.

**INFORMATION WANTED**

- Sea Cadet unit seeks article (PW) on fitting mains power supply unit to R7155 receiver.—J. Dow, 45 Gourlaybank, Haddington, East Lothian, Scotland.
- information on a ‘Constable’ burglar alarm (ultrasonic). Comprises 2 units connected to mains. I have pair but one coil damaged by capacitor explosion.—W. H. Rees, ‘Brendon’, Carlton Road, South Godstone, Surrey, RH9 8LD.
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ANY people like to use a portable cassette player or radio in their car, and it is often convenient (and much cheaper) to run it from the car battery. The unit described here will provide a well regulated supply of 6, 7.5 or 9V, is short-circuit proof, and can be connected to the supply the wrong way without damage.

The Circuit

The circuit is given in Fig. 1 and is in essence a series-pass voltage regulator with current limiting. Tr1 and Tr2 form the series-pass pair, with base current supplied by R2. R1 and C2 bias and smooth the reference voltage source D2, maintaining the emitter of Tr4 at a constant voltage. Tr4 is the control element, maintaining the output voltage at approximately 0.6V above the reference voltage by removing base current from Tr2. Current limiting is provided by Tr3 and R3. Once the voltage across R3 exceeds 0.6V, Tr3 turns on, removing the base drive from Tr2. This limits the maximum output current to about 0.6A. Noise on the supply rails is removed by C1 and C3, while D1 protects the circuit against incorrect supply polarity.

Fig. 1: Complete circuit diagram of the unit, which is basically a series-pass voltage regulator. The output in this case is 6V, although 7.5V and 9V are obtainable by the alteration of D2, R1 and R2.

Fig. 2: Actual size printed circuit board showing foil side above and component overlay below.
Dear Sir,

Info-on-Fax?

After hearing of the decision of the Home Office to allow the use of Facsimile transmission (Fax) on 3-5, 7, 14, 21, 28 and 144 MHz bands using modes A4 and F4 with a maximum bandwidth of not more than 6kHz, my curiosity was naturally aroused. However, I am having much difficulty in obtaining information about this mode of transmission, so I would like to hear from any other Amateurs who are interested in using “Fax”, or who have any further information.

It is my intention to gather as much information as possible with a view to passing it on to other readers. Therefore, if any of your readers can help me, or have an interest in this type of transmission, I would like to hear from them in writing, or by telephone at Mansfield (STD code 0625) 861545—A. W. Brown G4CCB (Notts)

Boring Letter

Thank you for the many interesting articles in Practical Wireless which I have taken regularly for a number of years since Practical Mechanics was discontinued.

I have a tip which may be useful to other readers who make their own printed circuit boards, the drilling of which can present problems due to breakage of the very small diameter drill, necessary to make the holes for mounting components.

I overcame this problem by using a centre drill of the type normally used on a lathe. This type of drill has the very small diameter tip required to make the hole, but has the advantage of a larger diameter shank which eliminates the problem of breakage even when used in a power drill.

I find that by mounting the power drill in a vertical stand it is possible to drill a complete printed circuit board in a matter of minutes as one hand is always free to position the board, and the adjustable stop can be set to prevent the drill penetrating too deeply. A size “E” drill is suitable for most jobs.

After the components have been soldered in place a pair of ordinary nail clippers makes a neat job of trimming the unwanted ends.—C J Addington (Lincoln).

Digitals rule—OK

Having asked similar questions about the recent revolution albeit “Stationary Revolution” in watches I offer the following. Most people read an analogue time-piece after they have ceased to see it and yet can read it to a better than 5 min accuracy if necessary. The best example being a work study engineer reading 3-7 second periods on a “Snap Back” stop watch.

Most watch readers are either going to write down the time, pass it on verbally or compare it with an already written or quoted time. Therefore the conversion from analogue to digital takes place anyway so the digital readout will be marginally quicker.

Ask any sailor which is quicker to use, the digital readout on a Decca Navigator or the analogue Decometer on the same set.

All the juggling with time takes place in a part of the brain having nothing to do with the actual seeing process, and which has been brought up on “Digits” anyway. The only possible delay in reading a Digital display is in the activation of the device. Most wrist watches are inside our sleeves so there is usually a hand movement to uncover it which can be modified to activate an electronic watch, but there is a fractional delay, least if there is no “button” to locate. Any good accounts clerk will be slowed down by using a calculator for simple arithmetic. However, the biggest advantage of an electronic time-piece is mainly ignored by the “Digitals” and this is its 24 hour capability. International business, in general and most forms of transport and communications home and abroad already use the 24 hour clock and yet even Sinclair only offer a 12 hour readout.

Advantage number 2 is night reading, even the best luminous analogue is not good enough and has a short life.

Advantage number 3 an accuracy requiring correction three or four times a year rather than weekly as in mechanics costing more.

Advantage number 4 moisture resistance, perhaps not yet proven but it will obviously be easier to seal an electronic than a mechanical system.

The last revolution in timepieces was about the 1880s when the Waterbury and later Ingersoll brought watches to the working man. Waterbury made the Ingersoll anyware and in 1896 one US dollar bought a “good enough” watch. The market was huge (1,000,000 Ingersolls in 1898) mainly because the working man had to get to work on time or lose money, also train services began to need accurate time-keeping for safety reasons.

If electronic digitals are kept simple they will do as well, they are already cheaper than the one dollar Ingersoll was in 1896 and will be as cheap as the cheapest mechanical digital is now, within 1-2 years.

What a con

We keep seeing “Manufacturer’s recommended price” on goods in shops. Is it really fair though, to let people think they’re getting fantastic discounts on goods just because the manufacturers have set their “suggested” retail price so high? Much imported equipment is sold like this. If one were to see, for example, a British stereo amp. with a “MRP” of £200 offered at £150 next to an imported amp. with a MRP of £250 offered at £150 (identical specs.) one would probably buy the imported one.

When will British consumers get wise to this selling method? After all, it’s the consumer who keeps the wheels of British industry turning.—A. J. Fuller (Essex).

Practical Wireless, August 1976
This hobby brings big rewards.

A soldering iron and a screwdriver. If you know how to use them, or at least know one end from the other, you know enough to enrol in our unique home electronics course.

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Practical Wireless, August 1976
FENCES HAVE EARS!

A tip for when you talk about something confidential—don't stand too close to a fence, some of them have ears! It's a system designed by an Austrian company and it forms an ingenious security alarm. The fence itself can take the form of a simple wire link type with the familiar criss cross pattern. However, in one of the fence posts is a detector which reports directly to a computer located elsewhere. Inside the detector is a sensitive sensor which can sense the stress on the fence. If someone were to lean a ladder against the mesh, then the tension would change and the sensor would detect this. Again, if any of the links in the fence were cut, the overall fence tension would change and again the sensor would detect it.

In the computer memory are sets of standard conditions or non-alarm conditions. The computer continually monitors the sensor comparing its output signals against those in its memory. If anything differs, the computer will activate an alarm. Would-be saboteurs can forget any bold ideas of rendering the system inactive. The sensor also monitors itself. Any interference with it will trigger the alarm. Also, the cable connecting the sensor with the computer is monitored. It is sensitive to any electromagnetic or electrical interference, too.

Sound waves impinging on the fence are also detected and the system is so sensitive and yet selective that it can differentiate between sound waves from a human voice and disturbances set up in the fence by weather, such as wind, rain, etc. Next time you're lonely, do what burglars do—chat up a fence!

BANG! BANG!

So there you are in your tank. You are going to fire a shell at someone you don't like. First, the range is estimated accurately. Then, the fuze in the shell of the air-burst missile (you've shot all the latest ammo) has the range set on its fuze. Then you load the shell and finally you fire. It sounds fairly straightforward, but the American military has decided that it could be simpler—even if it's more complicated to achieve, if you see what I mean?

In the latest air-burst shells, the fuze is set electronically while the missile is actually in flight on its way to do the nasty. This makes it simpler, and very much quicker to fire, but it's more complex electronically. Our new shell has two useful allies—the tank's laser rangefinder plus the services of an onboard ballistic computer. With this set up, you can now drive round happily in your tank with the shell already in the breech and ready to fire—no wasting time loading the thing.

Deep inside the new shell is the fusing device which consists of a tiny antenna, a complete radio receiver and some rather complex timing electronics. When the laser rangefinder and computer have determined that the shell is in the best position to inflict maximum nasties, the fusing data instructs it to explode.

An interesting but not so obvious fact is the absence of a battery inside the missile. The electronics gets its power from a rather clever application of a principle which dates back many years. A tiny coil of wire inside the shell has a moveable magnetic core inside it. When the shell is fired, the movement of the missile causes the magnet inside the coil to move. As it does so, its lines of force (i.e. the magnetic field) "cut" the wire of the coil inducing a current in it and thus a voltage across it. This voltage is used to charge a tantalum capacitor which acts as a power store and thus as a battery from which the electronics draws the necessary operating power.

THE HEAT'S ON

I was interested to see that one American company is marketing foil heaters. These are flexible heaters only 2 thou. thick and include a resistive temperature detector. The main application would probably be to wrap the foil around a crystal thereby eliminating the need for a more bulky crystal oven. I wonder if one will see this type of foil stitched into clothes for wearing in winter? I understand that control to within one degree is common for this type of heating element and sensor. Perhaps other applications might be in photography where solutions must be kept at a fairly constant temperature?

ON FILM

It has often been remarked that the hobbies of electronics and photography seem to attract the same people; i.e. electronics enthusiasts are commonly keen amateur photographers. It seems that the same principle has been established in the professional electronics industry. Companies are now using 35mm film as a production line aid to manufacture complex circuitry. One French company, for example, punches holes in each frame of a reel of standard 35mm film. Into these holes go substrates held in position with adhesive tape which has a fairly high resistance to heat. The reel is then fitted into a machine and the film fed to a take-up reel at the far end of the equipment. As the film slowly transfers from one reel to the other, the individually mounted substrates have various minute components mounted on and bonded to them. The last stage in this particular process is to pass the tape over an acute angle of metal. This has the effect of separating the substrates from the 35mm film.

The final act of the machine (prior to separation of the completely wired substrates from the reel of film) is the descent of a number of small needles which position themselves in exactly the right test places. These tiny needles form probes, and various voltages and currents are monitored in the substrate so that the good circuits can be separated from the bad ones when the film passes over the acutely angled metal. Imagine the saving. Once the reel of film has been fitted and the take up spool connected, the complete wiring and testing of these tiny circuits is completely automatic.

Ginsberg
The W.W. 'Everyman’s Four Valve'

In the July 28th issue of Wireless World, there appeared a design for the well-known Everyman-Four. It had one RF stage neutralised with a DE5B valve with two tuned circuits. Three-inch diameter coils were employed. They were 3½in. long and had 74 turns of 27/42 Litz wire. Over the medium wave band, the RF gain was 36·5 to 46.

The detector was of the anode-bend type employing a Cosmos SP18 blue spot valve RC coupled to a DE5B. This was in turn coupled to a DE5 output valve. Power consumption of the Everyman-Four was 10mA at 150V.

This wireless became famous because its performance was far superior to its competitors at the time, its success being largely dependent on the RF coil development and the development of neutralising.

The original title of the W.W. article was ‘Everyman’s Four Valve’ and a prototype is kept in the science museum.

A tip from 1924

CRYSTAL detectors always need delicate adjustment to give the best results, and this is particularly the case when they are used in reflex circuits. The shadow cast by components mounted above the panel may shield the catswhisker from view. If so, arrange a small mirror behind the valve (not a dull emitter of course) for this will give sufficient light to facilitate the finding of sensitive spots.

Vintage spares

Mr. Chas E. Miller (who writes for our sister mag. “Television” from time to time) recently dropped me a line and said, “It has occurred to me that there may be many readers in need not only of complete sets but also of spares for vintage radios. I have literally thousands of bits and pieces in my store rooms (he’s a radio and TV engineer) because I am one of those persons who never throws anything away. So, if anyone is stuck for valves, components or sets in general, they are welcome to write to me (s.a.e. please) or phone if they can afford it nowadays!”

Chas also says that he can undertake to recondition old radios, and where IF alignment is required, it will be done with vintage equipment i.e. Cossor Wobbulator of 1938 and converted radar display unit C1944.

Chas can be contacted at 31 Hockley Road, Uttoxeter, Staffs. Telephone: Uttoxeter 2122.

Above—a photograph of the receiver at the Science Museum

Circuit of the ‘Everyman 4’

T1 is the aerial grid transformer, T2 the RF valve transformer and T3 a Ferranti 3:1 LF type. C1, C2 (0·00027µF) square law tuner. C3 (0·01µF) C4 (balancing condenser) C5 (0·0005µF) C6 (1·0µF) C7 (2µF), R1 (2Ω rheostat) R2 (30Ω rheostat) R3 (15Ω) R4 (7·5Ω) R5 (1ΜΩ) R6 (3ΜΩ).

Thanks to Wireless World for allowing us to use the Everyman 4 information.

—continued on page 334

Practical Wireless, August 1976
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**TRANSISTORS**

| BC107 | 120 s |
| BC108 | 110 s |
| BC109 | 120 s |
| BFY 50 | 20 s |
| BFY 51 | 190 s |
| BFY 52 | 20 s |
| 2N3055 | 80 s |
| 2N2646 | 94 p |
| TIP 2955 | £1.14 |
| TIP 3005 | 61 s |
| BC237B | 110 H |
| BC28C | 10 p |
| BC239C | 120 H |
| ZTX107 | 100 H |
| ZTX108 | 90 H |
| ZTX109 | 120 H |
| ZTX300 | 130 H |
| ZTX500 | 140 H |
| MJE340 | 62 s |
| TIP31A | 36-H |
| TIP32A | 40-H |
| 2N3819 | 33 p |
| 3N141 | 60 p |
| CS715 | 180 H |
| 2N3819 | 72 p |
| BF180 | 40 s |
| BRY39 | 72 s |

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<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
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<tr>
<td>7412</td>
<td>25p</td>
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</tbody>
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TRANSMITORS, etc.

<table>
<thead>
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<th>Transistor</th>
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<td>BC148 7p</td>
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<td>BF180 30p</td>
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<td>BFX6S 35p</td>
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It is only a hundred years since Alexander Graham Bell, a Scotsman, sent the first telephone message, in Philadelphia, on March 10, 1876, yet in this age of Concorde there is an unprecedented demand for instant intercontinental communications by telephone, telex, etc. In the decade since the first telecommunications satellite became operational, intercontinental telephone traffic has increased by a factor of 17. In addition, live television programmes from other continents are regularly brought into our homes. Satellite communications are virtually essential for this latter service which has enabled us to see epoch-making live events such as men walking on the moon.

Although a single telephone conversation requires a relatively narrow bandwidth, about 3.4kHz, the bandwidth required to carry the thousands of simultaneous telephone conversations taking place at any moment between, say, the UK and the USA, is quite large. One also requires a wide bandwidth to carry a high-quality television programme.

Short wave radio signals can be reflected around the earth as they bounce between the ionised layers in the upper atmosphere and the surface of the earth or sea. Relatively low radio frequencies can be used to carry a single speech channel, but for a wide bandwidth signal, one must employ ultra-high frequencies or microwave frequencies. In addition, the use of such UHF's enables a greatly improved signal-to-noise ratio to be obtained with reliability. However, UHF and microwave frequencies are not reflected back to earth by the ionosphere but penetrate it and are lost into space.

As UHF's are not reflected around the earth, they cannot generally be used for signalling unless the transmitting and receiving aerials are almost in a line-of-sight. The Post Office use microwave aerials in reflecting dishes on their towers to carry many telephone conversations. The beam can travel some tens of miles between the towers, but as the distance increases, the height of the towers must be increased to maintain the line-of-sight condition. In theory one could convey a signal across the Atlantic by using a large number of such towers floating on the ocean and spaced at distances of a few tens of miles from one another. Even more impossible would be the task of constructing a single tower at the centre of the Atlantic which is high enough to be visible from both the USA and the UK. Such a tower would be nearly 500 miles in height!

The practical answer to a “communications switchboard in the sky” involves the use of a satellite which receives a signal, amplifies it and sends it to another point on earth. This type of link offers a very effective alternative to a sub-oceanic telephone cable.

Although satellites are used for special communication purposes, such as the Moscow-New York ‘hot line’, about 85 per cent of their use is for ordinary intercontinental telephone work involving business men and private people.

HISTORY

A telephone service with France was opened as long ago as 1896 using a copper conductor rather than a coaxial system, but it was not until January 1927 that the trans-Atlantic telephone service was inaugurated using the Rugby 60kHz radio transmitter GBT. The service was extended to India, Rhodesia and Turkey in 1933 and Japan in 1935. The first coaxial submarine cables were brought into operation in 1937 on short runs.

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TABLE 1

<table>
<thead>
<tr>
<th>Launch Date</th>
<th>Operational Region</th>
<th>Status and Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelsat I (Early Bird) April 1965</td>
<td>Atlantic</td>
<td>Placed in service over Atlantic at 325° E No longer in service.</td>
</tr>
<tr>
<td>Intelsat III (F-2) December 1966</td>
<td>Atlantic</td>
<td>Failed to achieve synchronous orbit due to launch vehicle malfunction.</td>
</tr>
<tr>
<td>Intelsat II (F-3) March 1967</td>
<td>Atlantic</td>
<td>No longer in service.</td>
</tr>
<tr>
<td>Intelsat II (F-4) September 1967</td>
<td>Pacific</td>
<td>No longer in service.</td>
</tr>
<tr>
<td>Intelsat III (F-1) September 1968</td>
<td>—</td>
<td>Failed to achieve orbit due launch vehicle malfunction.</td>
</tr>
<tr>
<td>Intelsat III (F-2) December 1968</td>
<td>Atlantic</td>
<td>Stalled aerial—not considered serviceable.</td>
</tr>
<tr>
<td>Intelsat III (F-3) February 1969</td>
<td>Pacific</td>
<td>Placed in service over the Pacific at 174° E Repositioned over Indian Ocean—now in reserve at 60° E.</td>
</tr>
<tr>
<td>Intelsat III (F-4) May 1969</td>
<td>Pacific</td>
<td>Removed from service upon availability of IV (F-4).</td>
</tr>
<tr>
<td>Intelsat III (F-5) July 1969</td>
<td>—</td>
<td>Failed to achieve proper transfer orbit due launch vehicle malfunction.</td>
</tr>
<tr>
<td>Intelsat III (F-6) January 1970</td>
<td>Atlantic</td>
<td>Relocated to Indian Ocean as emergency backup—relocated from Indian to Pacific at 177° E. Presently serving as Pacific spare.</td>
</tr>
<tr>
<td>Intelsat III (F-7) April 1970</td>
<td>Atlantic</td>
<td>Satellite failure.</td>
</tr>
<tr>
<td>Intelsat III (F-8) July 1970</td>
<td>—</td>
<td>Failed to achieve synchronous orbit due malfunction during apogee motor firing.</td>
</tr>
<tr>
<td>Intelsat IV (F-2) January 1971</td>
<td>Atlantic</td>
<td>Placed in service over the Atlantic at 335° 5° E. Now is reserve as Atlantic spare at 340° 5° E.</td>
</tr>
<tr>
<td>Intelsat IV (F-3) December 1971</td>
<td>Atlantic</td>
<td>Placed in service over the Atlantic at 340° 5° E. Now at 335° 5° E—serving presently as the Primary satellite.</td>
</tr>
<tr>
<td>Intelsat IV (F-4) January 1972</td>
<td>Pacific</td>
<td>Placed in service over the Pacific at 174° E. Now at 177° E.</td>
</tr>
<tr>
<td>Intelsat IV (F-5) June 1972</td>
<td>Indian Ocean</td>
<td>Placed in service over the Indian Ocean at 61° 4° E. Now at 60° E.</td>
</tr>
<tr>
<td>Intelsat IV (F-7) August 1973</td>
<td>Atlantic</td>
<td>Placed in service over the Atlantic at 330° E. Now at 330° 5° E—serving as Major Path satellite.</td>
</tr>
<tr>
<td>Intelsat IV (F-8) November 1974</td>
<td>Pacific</td>
<td>Placed in service over the Pacific at 174° E.</td>
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<td>Intelsat IV (F-9) February 1975</td>
<td>—</td>
<td>Failed to achieve orbit due to launch vehicle malfunction.</td>
</tr>
<tr>
<td>Intelsat IV (F-1) May 1975</td>
<td>Indian Ocean</td>
<td>Placed in service over the Indian Ocean at 63° 6° E.</td>
</tr>
<tr>
<td>Intelsat IVA September 1975</td>
<td>Atlantic</td>
<td>New Atlantic Primary Satellite 33° 5° E.</td>
</tr>
</tbody>
</table>

Intelsat was placed in service over the Atlantic at 325° E in 1960, and has since been used to relay messages between various parts of the world. It has proved to be a valuable asset in the field of international communication.

**ECHO SATELLITES**

The era of space communication dawned with the launching of the Echo-1 satellite from Cape Canaveral, Florida, on August 12th, 1960, inside a 66 cm magnesium sphere in the nose of a Delta rocket. About 1000 miles above the earth an explosive charge split open the container and allowed the chemicals inside Echo-1 to vaporise and to inflate this balloon type satellite to a diameter of 100 feet. The aluminised mylar plastic skin reflected both light and radio waves extremely well so that it could be seen by enormous numbers of people as a bright moving object in the sky, even brighter than the Pole star. It may well have been seen by more people than any other man-made object.

Echo-1 circled the earth every two hours, but served only as a passive reflector of the radio waves directed at it. It did not contain any transmitter. It was used to relay the first transcontinental telephone call by satellite made by President Eisenhower from New Jersey to California, and to relay various signals across the USA and to Europe. Although it was expected to remain in orbit for a year, it actually completed eight years before it entered the atmosphere off South America and burnt up. A larger passive reflector, Echo-2, followed on January 25th, 1964.

**TELSAR**

Before Echo-2 was launched, however, the American Telephone and Telegraph Company's Telstar-1, the first privately owned satellite, was placed in orbit on July 10, 1962. This 170lb satellite had an array of solar cells which converted the energy of the sun into electricity so that Telstar could receive signals, amplify them and re-transmit them. Thus it was a great improvement on the passive satellites.

Telstar-1 provided the first intercontinental television transmissions between the USA and Europe. The more powerful Relay-1 followed on December 15th, 1962, Telstar-2 on May 7th, 1963 and Relay-2 on January 21st, 1964. The main disadvantage of all of these satellites was that their period of use was limited to the time that they were above the horizon at both ground stations.

**GEOSYNCHRONOUS ORBIT**

Modern communications satellites are launched by powerful rockets which place them at an altitude of 22,300 miles (35,680km). At this particular distance from the earth, a satellite can be made to rotate round the earth once per day at exactly the same rate as that at which the earth rotates beneath it. The satellite therefore remains stationary over a chosen part of the earth's surface remaining in constant radio contact with the appropriate ground stations. Any such satellite can communicate with ground stations over about one-third of the earth's surface.

*Practical Wireless, August 1976*
Satellites which appear stationary at a point above the earth are said to be in "geosynchronous orbit". The first experimental satellites placed in such an orbit were known as the "Syncoms", but it is the Intelsat (International Telecommunication Satellite Organisation) satellites which have provided commercial intercontinental communications.

INTELSAT

The Intelsat organisation was formed in Washington in 1964 and it aims to provide commercial networks for high reliability international public telecommunications by satellite to all areas of the world on a non-discriminatory basis to all users. There were 14 founder nations, but Intelsat now has 91 member nations. The UK is second only to the USA as a shareholder with 11% of shares. Intelsat owns its own satellites, but the ground stations communicating with these satellites are normally owned by the appropriate authority of the country in which they are situated.

The satellites are launched by the US National Aeronautics and Space Administration (NASA) on a cost-reimburseable basis. The Communications Satellite Corporation (COMSAT) of Washington manages the satellite operations over the whole global area on a cost-plus-fee basis and also operates its own satellites for maritime communications and for operation across the USA. It also represents the USA in Intelsat.

THE SATELLITES

The Intelsat satellites launched up to the time of writing are shown in Table 1. The first was known as Intelsat-1 (or "Early Bird") and came into commercial operation on June 28th, 1965, taking telephone calls across the Atlantic from the Post Office Goonhilly Earth Station in Cornwall. It increased the trans-Atlantic telecommunications capacity by about 50%, although it could handle only 240 calls simultaneously and could communicate with only two ground stations at any time. A "squinted" aerial was used which confined the beam to the heavy traffic area between Europe and N. America.

Early Bird was followed by four Intelsat-II satellites in 1966 and 1967. As shown in Table 2, they were larger than Early Bird and had the important advantage of "multiple access capability", that is, they could communicate with several ground stations simultaneously. In addition, they provided a much wider coverage, offering service to both the northern and southern hemispheres.

Eight Intelsat-III satellites followed in the period 1968 to 1970. Each could carry 1200 telephone signals or 4 television channels or a combination of both simultaneously. They could also carry telex, data and facsimile signals. The aerials of the Intelsat-II satellites are mechanically "despun" on a shelf, which provides maximum stability by allowing the body of the satellite to spin, but keeping the aerials pointing in the required direction at all times. This system is used in all later satellites.

Between 1971 and 1975 eight of the still more advanced Intelsat-IV satellites were launched. Each can relay 4000 telephone calls or twelve television signals at any time. Two global aerials for transmitting and two for receiving are employed for covering a wide area. In addition, steerable spot beam aerials are used. The most advanced satellites of this type are the Intelsat-IVA series, the first of which was launched in September 1975 from Cape Canaveral. It now serves over 40 earth stations in the Atlantic region, being used by nearly all countries in this area. It is known as the "Primary" satellite, the other "Major Path" satellite being used mainly by the large user countries which have two or more aerials for this region.

The IVA satellites resemble the IV series, but the capacity has been greatly increased by frequency re-use. An east beam is sent to Europe and Africa with a 320MHz bandwidth, whilst the same 320MHz band is beamed West to North and South America; eight transponders are used for each of these beams. In addition, there are four global transponders which cover all ground stations in the Atlantic area, such as Atlantic islands not in the east or west beams. The 53in transmitter and 35in receiver aerials are constructed from metallic mesh on an open frame to minimise the torque experienced from the particles emitted by the sun. They are all supported on a single tubular mast with the telemetry omnidirectional bicone aerial on the mast tip.

Another five Intelsat-IVA's have been ordered from Hughes Aircraft Co., California, and these are expected to provide a sufficient capacity for the remainder of the decade. One will be used for the Pacific area, one for the Indian Ocean region and another three for the Atlantic. The total cost will be about £136 million, namely about £11.5 million per satellite and £11.2 million for each of the Atlas-Centaur launch vehicles.

Aerial No. 2 at Goonhilly which, with Aerial No. 3, operates with the Atlantic satellite in maintaining contact with many countries across the Atlantic. (Courtesy: Post Office)

Practical Wireless, August 1976
All satellites orbit near the equator. All obtain power from solar cells, the IVA series each having 17,000 solar cells on a cylindrical drum. It is essential to have unbroken communications, so each satellite contains two nickel-cadmium storage cells for use during the times when the satellite is eclipsed by the earth. These cells are a major factor in limiting the life of the satellites, but COMSAT is developing nickel-hydrogen cells with three times the storage capacity and five times the life of nickel-cadmium.

Interruptions of the service provided by an Intelsat IV in the Atlantic region occurred in 1964, apparently because solar storms affected the aerials directional control system. However, all satellites launched after November 1974 have been modified to alleviate this problem. The satellites transmit in the 4GHz (3.7 to 4.2GHz) band, but receive signals from ground stations in the 6GHz (5.925 to 6.425GHz) band so that transmission and reception can take place simultaneously. Travelling wave tubes are used in the satellite transmitters.

A series of Intelsat-V satellites is planned for about 1979. Each will have about 12,000 telephone circuits and they will probably use the 11-14GHz band in addition to the 4-6GHz band. The Post Office is currently making propagation measurements at up to 30GHz to ascertain how signals from satellites at such frequencies will be affected by rain, etc.

**TABLE 2**

<table>
<thead>
<tr>
<th>Intelsat Series number</th>
<th>Height (inches)</th>
<th>Diameter (inches)</th>
<th>Orbital weight (lb)</th>
<th>Launch weight (lb)</th>
<th>Design Life (yr)</th>
<th>Power (W)</th>
<th>Repeaters</th>
<th>Bandwidth of each repeater (MHz)</th>
<th>Channels</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I (Early Bird)</td>
<td>23</td>
<td>28</td>
<td>85</td>
<td>150</td>
<td>1.5</td>
<td>31</td>
<td>2</td>
<td>25 or 1 TV.</td>
<td></td>
<td>Squinted aerial confining service to heavy traffic N. Atlantic area. No multiple access. Wide coverage (N and S hemispheres) Multiple access.</td>
</tr>
<tr>
<td>II</td>
<td>26</td>
<td>56</td>
<td>190</td>
<td>357</td>
<td>3</td>
<td>85</td>
<td>2</td>
<td>126 or 1 TV.</td>
<td></td>
<td>Mechanically despun aerosols. TV, telephone, telegraphy, facsimile, high speed data capability. Steerable spot beam aerial and global aerial.</td>
</tr>
<tr>
<td>III</td>
<td>41</td>
<td>56</td>
<td>334</td>
<td>647</td>
<td>5</td>
<td>127</td>
<td>2</td>
<td>226 or 1 TV.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>94 (Solar panel III)</td>
<td>1610</td>
<td>3120</td>
<td>7</td>
<td>500</td>
<td>12</td>
<td>36</td>
<td>4000 and 2 TV.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IVA</td>
<td>94 (Solar panel III)</td>
<td>1820</td>
<td>3280</td>
<td>7</td>
<td>700 (650 after 7 yrs)</td>
<td>20</td>
<td>36</td>
<td>6250 and 2 TV.</td>
<td></td>
<td>Twin 53° dish transmit aerosols. Two sets of reed horns in conjunction with third dish reflector.</td>
</tr>
</tbody>
</table>

An Intelsat IVA satellite during pre-flight testing. Note the great area of solar cells and the reflectors at the top for the various aerials. (Courtesy: Intelsat Washington).

**PART 2 OF SATELLITE COMMUNICATIONS WILL BE PUBLISHED NEXT MONTH**

Practical Wireless, August 1976
THE Ferranti ZN424 device is a low noise, low distortion operational amplifier which is very suitable for both audio use and as a general purpose operational amplifier. It incorporates an internal gate which enables the output to be isolated from the input.

The ZN424 is available in three types of package. The ZN424P employs an 8-pin dual-in-line package, whilst the ZN424E is an electrically equivalent device in a 14-pin dual-in-line package. The connections to both of these types are shown in Fig. 1.

A circular metal package is employed for the ZN424T, but readers will normally find the dual-in-line devices more convenient to use, especially when one wishes to use a socket. Any of these devices may be used in the circuits to be described.

BASIC CIRCUIT

The basic circuit in which a ZN424 device can be used is shown in Fig. 2, the feedback connections, etc. being omitted for simplicity. Balanced positive and negative power supply lines are shown, the recommended voltage range being ±12V to ±18V. However, it is wise to regard the upper limit as being about ±16V so as to allow a small margin of safety and prevent possible damage to the device. The supply current required is about 5mA when ±12V supplies are used. Output voltage swings of about ±11V can be obtained with ±12V supplies.

A resistor R2 and a capacitor C1 are required between the positive line and the "balance/shaping" pin to provide frequency compensation without which oscillation may occur. The bandwidth is typically 20kHz at −3dB down without feedback, whilst the frequency at which the gain falls to unity is about 4MHz with the recommended value of C1. The slew rates are about 100V/μs (rising edge) and 20V/μs (falling edge).

**Fig. 2:** The basic circuit utilising the ZN424 gated amplifier.

The potentiometer VR1 may be adjusted so that the output voltage has a mean value equal to the mean potential. This balances out the offset voltage of the device. If this facility is not required, VR1 and R1 may be omitted.

The gain of the ZN424 is typically 86dB without feedback, this being a voltage gain of 20,000 times with a minimum value for any ZN424 device of 10,000. As in all practical operational amplifier circuits, this gain is greatly reduced by negative feedback.

The voltage difference between the two inputs should not exceed 5V in any circuit. The input resistance is about 200kΩ and the output resistance about 4kΩ.

AMPLIFIER CIRCUIT

The ZN424 can be used as an audio pre-amplifier in the type of circuit shown in Fig. 3. In order that a single positive power supply line may be used...
without any negative supply, the non-inverting (+) input is returned through R3 to the junction of two equal resistors, R1 and R2; this keeps the input of the ZN424 at a quiescent potential mid-way between that of the positive and negative supply lines.

Negative feedback is taken from the output to the potential dividing resistors R7 and R6. A fraction of the output voltage equal to R6/(R6+R7) is fed back to the inverting (−) input and this fraction determines the audio gain. However, the presence of C3 ensures that the full output voltage is fed back at zero frequency and this helps to keep the mean output voltage at V+/2.

The gain of this circuit is equal to (1+R7/R6). Thus R7 may be 100kΩ, R6 2-2kΩ, in which case the gain will be about 46 (or about 33dB). If R7, R6 and C3 are omitted and the output is connected directly to the inverting (−) input, the gain will be unity and the output voltage will follow that of the input. The optimum value of C3 varies with the resistor values, so the value shown is intended only as a guide.

**GATING**

If the gating facility is not required, the ZTX310 transistor and R5 may be omitted and the gate pin of the ZN424 left unconnected. The output may be isolated from the input merely by connecting the gate pin of the ZN424 to earth. However, it is normally required to use an electrical signal for gating. In the circuit shown any positive signal of 2V or more fed to R5 will cause the ZTX310 transistor to conduct and this effectively connects the gate pin to earth. The output signal from a TTL device is suitable for feeding to R5.

The type of transistor employed is not at all critical, and any NPN small-signal transistor will prove suitable. The output leakage current of the ZN424 when the device is gated off is about 5nA with a maximum value of 30nA.

The gate connection has an entirely different use when the device is operated from a low supply voltage and one wishes to preserve the 5mA maximum output current. An external resistor should then be connected between the gate pin and the positive supply line; the value of this resistor (in parallel with an internal 23kΩ resistor) is about (V+−1.4) kΩ for 5mA output current. The gating facility also enables the ZN424 to be used in multiplex switching applications when several signals are sent sequentially along a single line.

**AUDIO PRE-AMPLIFIER**

An audio pre-amplifier for use with a magnetic pick-up is shown in Fig. 4. The network used in the feedback circuit between the output and the inverting input (C4, C5, R6 and R7) is designed to provide the required RIAA frequency response.

If more gain is required than the 34dB provided, R8 may be reduced, but C6 should then be increased in proportion to preserve the bass response. Actually C6 and R8 limit the response in the extreme bass region and constitute a filter which helps to remove any turntable rumble.

![Fig. 3: The ZN424 in an audio amplifier circuit using the gating facility.](image)

![Fig. 4: This circuit shows the ZN424 as a pre-amplifier for use with a magnetic cartridge.](image)

If no feedback is employed in a ZN424 circuit, the total harmonic distortion added by the device is normally less than 1-5% for a 2V peak-to-peak swing at the output. The circuit of Fig. 4 employs feedback to reduce the gain of the circuit from about 86dB to about 34dB, a difference of 52dB or about 400 times. Thus the distortion is reduced to the utterly negligible level of 1-5/400% or about 0-004%!

The signal-to-noise ratio is better than 70dB below a level of 5mV at the input. The circuit layout is not at all critical.

**CONCLUSIONS**

The Ferranti ZN424 devices offer lower noise and less distortion than other IC pre-amplifiers available at the present time. The circuits of Figs. 4 and 5 have been designed by Ferranti Ltd, especially for the ZN424 and are reproduced with their permission.

All ZN424 devices are readily available from Ferranti distributors. The ZN424E is available from Radnage Radio and Electronics, 2 Bottom Road, Radnage, High Wycombe, Bucks. and from Doram Electronics Ltd., P.O. Box TR8, Leeds LS12 2UF, the price being of the order of £1-50.

*Practical Wireless, August 1976*
UP, UP and AWAY to 30uF. Switch your attack and get 1pF. No problem too big or too small for this Protector of your circuits, this Defender of your components, this Easer of your problems. Built to last with rugged construction concealed behind a smooth exterior.

Drive your TTL wild. Shriek at your audio amplifier with 18kHz. Lull both into a sense of serenity by whispering at them with a husky 18Hz or move into overdrive at the flick of a switch. Octavia promises all these to the faithful constructor.

ALSO:-

A 'Jingle' Machine

ACTIVE ROTATING AERIAL

ON SALE IN AUGUST
The unit resembles a conventional typewriter but it displays its text directly on the screen of a domestic television set or a video monitor. In the former instance connection is made via the aerial socket.

A page of text, which is alpha-numeric with a wide range of punctuation, comprises 16 lines of 32 characters. While one page of text is being displayed a second can be held in memory and this memory capacity can be readily expanded to store extra pages if required. The desired page can be recovered from memory and displayed by manual or electronic switching while the previously displayed page is transferred to memory for later recall.

APPLICATIONS
In its present form:
1. Displaying information in public areas
2. Shop window advertising
3. Cafe menus and price lists
4. Display of indoor sports scores (darts, bowling, etc.)
5. Silent paging in clubs, hotels, libraries etc.
6. Communications for the deaf and dumb
7. Games—electronic "Scrabble", etc.
8. Captioning closed circuit TV programmes

With certain modifications:
1. Long distance text communication (via telephone or radio)
2. Interfacing with a micro-processor (for home computer)
3. Home terminal for communicating with Tele-Text system

NOVEL FEATURES
1. Can be assembled at home
2. Constructional cost less than £150
3. Relies, for its economy, on the latest microcircuits
4. Simple animated displays can be presented

THE project to be described is an electronic typewriter which presents its alpha-numeric display on the screen of any British standard 625 line black and white or colour television set. It also produces a standard video level signal which can be fed into an existing closed circuit television system for titling or sub-titling programmes. As the unit incorporates a CCIR standard interlaced sync generator it could be used as the central source of sync pulses for a CCTV system. Reference to the necessary sync drive signals will be made later.

Although the project incorporates sophisticated logic in places, there is nothing which cannot be understood by the amateur with some basic knowledge of logic theory or application.

Construction is very straightforward (most is on printed circuit boards) even though over 50 integrated circuits are used. Apart from the memory circuits, readily available TTL integrated circuits are used throughout. All the semiconductors can be obtained through advertisers in Practical Wireless but in the case of the Random Access Memories and the Read Only Memory it might be better to go direct to the distribution.

The only component which might present a problem is the keyboard. These are sometimes advertised by companies dealing in computer surplus and it is worth browsing through advertisements in this and other magazines if you don't want to use the one given in the parts list. There are, also, a couple of alternative approaches which will be described later. In order to simplify the description it will be assumed that the keyboard specified will be used.

STORAGE FACILITY
The unit will display a page of data comprising 16 lines each of 32 characters and, at the same time,
will store a second page in its memory. The displayed page can be interchanged with the stored page at the push of a button and this operation can be carried out under electronic control thus allowing sequential display of the two pages. This allows simple animations to be presented for advertising purposes.

**AUXILIARY OPERATIONS**

Before attempting to describe the operating principles it might be best to start with a detailed description of how the machine is used. Firstly the output is connected via a coaxial lead to the aerial input socket of a domestic television set and the set tuned to a spare channel, a practice now common for television games. On switch-on the screen is filled with a random selection of letters, numbers and punctuation. To clear the screen it is necessary to depress the spacer bar and while it is held down the auxiliary button marked “Continuous Write” is depressed. This has the effect of writing a “Space” into every memory location for that page thus giving a blank screen. The button marked “Page 1/Page 2” should then be depressed to display the page which had been in store. Again a random selection of letters, etc, will be displayed and this should be cleared in the same manner. Depressing the “Page 1/Page 2” button once more brings us back to displaying page 1, which is still blank. The only mark on the screen will be the chequered marker we call a “CURSOR”. The cursor is used to show where the next symbol will be printed when we depress the typewriter keys. It can be switched off by depressing the “Cursor Extinguish” button if its presence spoils the appearance of the final display.

Normally one would start to type from the top left hand corner of the screen so provision is made to reset the position of the cursor to this point by a single depression of the button marked “Reset”. The four “action” buttons mentioned so far (Continuous Write, Page 1/page 2, Cursor Extinguisher and Reset) are grouped in a bank at the bottom left of the panel.

**KEYBOARD FUNCTIONS**

All other machine functions are initiated by depressing the keyboard buttons. On the keyboard listed, the result of pressing one of the keys is to produce a unique 7-bit binary code on the seven parallel lines feeding from the keyboard to the rest of the equipment.

The codes are standard ASCII, which comprises 7 data bits but, in practice, we shall only use the 6 least significant bits to generate the alpha-numeric characters. The seventh bit serves a purpose in de-
tecting "Non Writing" key functions, i.e. Carriage Return, Cursor Step, Line Feed and Forward/Reverse. When the carriage return key is pressed the cursor jumps back to the extreme left hand side of the screen ready to start a new line of type and the line feed key steps the cursor down to the next line.

One feature of this machine is not found on a conventional typewriter. It is possible to type from left to right or from right to left. This is not because there are Chinese applications in mind but because it is sometimes necessary to back space along a line or step UP several lines to effect a correction. To do this we have built in a Forward/Reverse function which is actuated by depressing the "Tab" button.

A single depression of the button will change the direction of typing and this is displayed on one of the two LEDs, located at the right of the front panel and labelled with arrows indicating "Top to Bottom and Left to Right" or "Bottom to Top and Right to Left". When the former is lit conventional typing can be carried out. Depressing the TAB button will cause the latter to light. Now the Line Feed button will step the cursor UP the screen and depressing the key will cause the cursor to move from right to left.

Depressing the Tab button a second time will put the unit back to normal operation.

It should be understood that use of the spacer bar is not an inert operation, i.e. when it is depressed the cursor will move from left to right (or right to left if in reverse mode) and on a blank screen will not produce any characters but if stepped over the top of any characters that are already present on a line it will erase them by writing a "Space" into memory at that point. In order to step backwards and forwards along a line to position the cursor in readiness for a correction we need a "Non Writing" horizontal step mechanism and for this we use the code generated by the "Back Space" key. To avoid confusion we shall call this key "Cursor Step".

Carriage Return is NOT affected by the Forward/Reverse mode and will always return the cursor to the left hand side of the screen. As said previously the selection of these non-writing instructions is done by detecting the seventh bit of the ASCII code. The remaining 6 bits give 64 permutations of binary coding to describe the 26 letters of the alphabet, the 10 numerals from 0 to 9, a writing "Space" and a host of punctuation and special symbols, asterisk, mathematical signs and, because we are using components produced in America, a "dollar" sign!

Because of self-imposed price restrictions we have limited the display to "Upper Case" only (capitals), but with the keyboard listed it is not necessary to have the "Shift Lock" key depressed. Numerals are already in lower case as on a conventional keyboard and punctuation is sometimes upper and sometimes lower, again as normal. With alternative keyboards it may be necessary to depress the Shift Lock key to type letters. (The complete character font is shown in Fig. 4.)

Apart from the special Forward/Reverse function and the fact that one has to carry out a TWO stage operation to get to the next line (Carriage Return followed by Line Feed) typing is carried out exactly as normal. When a line is filled with characters surplus letters or numbers will be "Overprinted" on top of each other in the extreme right hand position, each erasing the previous symbol, hence the operator has to be careful not to overfill a line! Likewise when the bottom of the screen is reached (line 16) an unwary operator could overprint the line. No warnings have been built in to guard against these possibilities. Such alarms are possible but in view of the additional expense and circuitry involved it was not felt necessary to incorporate them.

The provision was made in the prototype for four other auxiliary functions hence the bank of four push-buttons to the bottom right of the keyboard. These are not used in the basic unit.

CHARACTER GENERATION

Now that the reader has a basic grasp of what we are to expect from the machine it will be easier to describe its operation. Refer to Fig. 1 which shows how a character is generated within the television raster. A television picture is made up of two interlacing fields each containing 312½ lines giving a total of 625 lines. Each line scans from the left to the right of the screen in 64½S and it takes 20mS to generate the 312½ successive lines to complete a field. In practice the second field of an interlaced pair has its set of lines positioned between the lines drawn by the first field. Odd and even fields are repeated sequentially. In some displays of this type it is not considered necessary to bother about interlaced scanning because it does not make a great difference to the resolution. For the comparatively little extra cost, it was felt useful to incorporate the special synchronisation signals to facilitate interlacing for the benefit of those who might want to use the unit to caption normal television productions. Because there is basically no difference between the signals that define the characters on an interlaced or non-interlaced system we shall describe how the characters are generated in a single field (whether odd or even).

Each character is made by brightening up the screen at specific "Picture Points" as the raster lines are generated. A symbol is defined by 5 picture points horizontally and 7 vertically as shown on the matrix describing the letter "E" in Fig. 1. Note that we have built into the basic 5×7 matrix an extra row above the letter, this will form the gap between one line of letters and the next. There is also an extra column to the left of the letter; this will give a blank gap between one letter and its neighbour on the same line. It also allows a bit of time for switching to occur when the memories are accessed before the character is displayed. The complete character, including the "inter-row gap" and the "inter-character gap" thus occupies a cell comprising a matrix of 6×8 picture points. With 32 such cells along a line of text, plus a gap at either end for left and right hand margins, 16 rows of them give the page of text. Again, we shall need a margin at the top and bottom of the screen.

TIME DETERMINATION

If we now consider a single line scan of the TV raster it will be seen that we need 32×6=192 picture points plus the margins to occur within the 64½S of the scan period. It is convenient to define the horizontal width of a single picture point in terms of Time along the raster line and if this is 250½S we can see that 48½S of the 64½S line period will be taken up defining the horizontal dimensions of the 32 characters. This allows 16½S for the horizontal sync pulse, approx 4·75S, and the left and right margins. It is fortunate that such a choice of picture point width gives rise to easy numbers. The

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width of a character cell is thus 1.5µS.

For the vertical disposition of the lines we need 16×8 = 128 picture points to describe the 16 vertical cells. Because there are 312½ lines to play with it is convenient to allocate 2 raster lines to each picture point. This uses up 256 of the possible 312½ lines leaving sufficient for the field sync pulse train and top and bottom margins.

By judicious use of dividing circuitry we start by generating a master frequency signal of 4MHz, each complete phase of which will produce a picture point and then, by counting down from this frequency, generate line sync pulses, field sync trains, left and right margins, and top and bottom margins. Details of how these dividing circuits work will be given later.

**SIGNAL ROUTING**

Before going any deeper into how the characters are generated it might be best, now, to consider the overall system as shown, in abbreviated form, in Fig. 2. The heart of the system is the 4MHz oscillator already mentioned. This feeds a set of dividers which produce the line sync pulses, the width of each being 19 picture points at 0.25µS giving a line sync width of 4.75µS as opposed to the standard 4.70µS. The error in line sync width is not significant and is probably well within normal tolerances. The same dividing system produces the complex waveforms required for the interlaced field sync train (Broad pulses, Equalisation pulses etc). The mixed line and field sync are fed straight from the sync generator to the Sync Mixer near the output of the unit for later recombination with the video signal. The sync generator also produces Line Drive and Field Drive signals which are fed to the Address Counter. These drive signals could be extracted and used as a sync source for a complete closed circuit television system.

**ADDRESS INFORMATION**

The Address Counter produces three main sets of signals and a number of control signals. The three most important sets of signals are called ADDRESS-SES and are used to define specific points and areas on the television screen within the time of a raster.

It might be convenient to refer back to Fig. 1 showing the dispositions of the character cells on the screen. There are 32 columns of cells numbered sequentially from 0 to 31 inclusive. Similarly there are 16 rows numbered from 0 to 15. The cell that is ringed is thus in column 3 and row 2. These two numbers coordinate the cell and are called its Column and Row Addresses respectively. The Address Counter generates Column Addresses by waiting a discrete number of picture points after the line sync pulse has finished, to allow for a left hand margin, and then counts every six picture points starting off at zero (shown as the binary state 00000—five bit word—on the output of its counter). After the first group of six picture points (describing the column 0), the Address counter increments by 1 to give the binary number 00001 which is the address for column 1. The counter continues incrementing for every set of six picture points until it reaches the binary number 11111 which corres-
ponds to the ADDRESS for column 31. Fig. 3. The five wires that carry the 32 codes are fed to the Random Access Memory (RAM) and tell it to give out the codes for the characters that occur in that column. There will, of course, be 16 possible codes depending on which line of text (Row) we are considering and this is where the idea of matrixing comes in.

The Address Counter has a second counter within it which waits a discrete number of lines after the field drive pulse (for the top margin) and then counts up in groups of 16 lines starting with a binary code 0000 (four bits) to describe row address 0. It then increments by one to give the code 0001 which is the address for row 1 and so on up to 1111 (the Address for row 15) Fig. 3. The four wires that carry the 16 possible row addresses are also fed to the RAM and tell it which of the 16 possible characters in the column it should select from its memory. We shall describe later how the codes got into the memory. When the Address Counter reaches the limiting values of its addresses, i.e. 31 for the columns and 15 for the rows, another two signals come into play. These are Row Blanking and Column Blanking. These are used to blank the video signal to prevent unwanted characters appearing in the margins.

Because the Address Counter is precisely referenced to the line and field drive pulses the RAM knows exactly where on the display television screen the raster spot is and can thus give out the right code to generate the desired character in the cell which the spot is entering at the time.

**RANDOM ACCESS AND READ ONLY MEMORIES**

The two other main signals emanating from the Address Counter will be described presently. Firstly we must consider what happens to the code that the RAM disgorges when it is addressed for a certain position on the screen. Let us say it has received the address for the position shown ringed in Fig. 1 (Column 3 Row 2). Six separate flip-flop memory elements in the RAM will be interrogated and if the letter “E” was originally intended to appear at this point on the screen the RAM will produce the ASCII code for “E” on its 6 output data lines. This will be the binary code 000101 (only the 6 least significant bits of the full code are used).

This code is fed direct to another type of memory called a Read Only Memory (ROM) which is nothing more than a very complicated set of gates inside an integrated circuit which changes codes (similar in many respects to the principle used in BCD to Seven Segment encoding). Fortunately the constructor does not have to worry about the gate configuration because the unit used in this project is specially programmed by the manufacturer to give out codes that will generate the picture points of the character.

**Practical Wireless, August 1976**
### Collated components list

#### Resistors
- 1 off 100Ω 1W 10%
- 6 off 330Ω 1W 10%
- 4 off 470Ω 1W 10%
- 3 off 1kΩ 1W 10%
- 1 off 470kΩ 1W 10%

#### Capacitors
- 1 off 310pF Compression Trimmer
- 1 off 1,000pF Polystyrene
- 1 off 10µF 12V
- 3 off 47µF 12V
- 1 off 1,000µF 50V
- 1 off 4,700µF 25V

#### Transistors
- 3 off BC108

#### Integrated Circuits
- Standard TTL
- 6 off 7400
- 4 off 7404
- 3 off 7410
- 1 off 7414
- 2 off 7420
- 10 off 7430
- 2 off 7474
- 3 off 7485
- 4 off 7490
- 4 off 7493
- 1 off 74131
- 1 off 74174
- 4 off 74177
- 3 off 74191

#### Random Access Memories
- 6 off 2102-2 (650nS access time) Intel or TMS 4034

#### Read Only Memory
- 1 off RO-3-2513 Character Generator, General Instrument Microelectronics

#### Voltage Regulators
- 2 off 7805 in TO-3 package

#### Diodes
- 5 off 1N4148
- 1 off Bridge, 100V 3A, RS Components type REC 43 or equiv.
- 1 off 12V 400mW Zener
- 2 off LEDs type MV5025 or similar

#### Dil Sockets
- 40 off 14 pin
- 14 off 16 pin
- 1 off 24 pin

#### Coil
- 1 off Denco Aerial Coil type 3T (Blue)

#### Transformers
- 1 off Miniature 12V 50mA (or 6-6V with centre tap ignored)
- 1 off 9V 2A, Douglas MT-3-AT using 15V and 24V tappings

#### Switches
- 1 off Mains Rated 2 pole toggle
- 2 off Single pole "push-to-make"
  - RS Components type 338-434
- 2 off Single pole "push-to-make, push-to-break"
  - RS Components type 338-434
- 4 off Buttons to suit
- 1 off Bracket to suit

#### Keyboard
- 1 off Clare Pendar Keyboard with ASCII encoding ROM and Strobe (see text)

#### Miscellaneous
- 3 off PCBs, Readers PCB Service
- 2 off heatsinks, Home Radio type TR89 or equiv.
- 1 off UHF Modulator, Crofton Electronics
- Board pins, SRBP, Aluminium, Plugs, Sockets, etc.

**NOTE:** Details of individual component content and identification will be given as the relevant section is issued.

---

**Fig. 3.** Graphical representation of the Address Codes defining the Character Cells within a field and the Picture Points within a Character Cell.
that is described by the ASCII code we feed into it. There are 5 lines coming out of the ROM each of which corresponds to a vertical column of picture points within the character we want to describe.

It is not sufficient to have just this information because different rows within the character cell will have different states of picture points, bright or dark. We thus have to tell the ROM which row we are interested in and this depends on which part of the cell the display raster is entering.

Let us assume that we are just entering the top left-hand corner of the cell. Our Address Counter tells the ROM this by a 3 bit binary code 000. The ROM is pre-programmed to assume that the top row of picture points in any cell must be blank so it produces an output of "0" on each of its five output lines. The Address Counter is so designed that it will repeat this instruction when the correct position of the next line occurs because we are allowing two lines for every picture point. When the raster gets to the third line the Address Counter changes its ROM ADDRESS output to give the code 001 which instructs the ROM to put out the signals which describe the next row of picture points of the character within the cell.

In the case of "E" all the 5 lines will go to level "1". This is repeated for the fourth line of the raster and on the fifth line the ROM Address is changed to 010. It will respond by making its output line corresponding to the most left hand column of picture points "1" and the other 4 lines will go to "0". This is duplicated for the sixth line and so on until the last raster line within the cell has been dealt with. Bear in mind that this is not a static operation. As the raster progresses horizontally from cell to cell the address to the RAM will be changing. We are concerning our description only with what happens when the raster gets back to the same cell on subsequent line scans. The same argument could apply to any of the 32 possible cells along a line of text!

**LATCH FUNCTIONS**

It takes up to 1·25μs for the RAM and the ROM to respond to their instruction from the Address Counter therefore it is not possible to display the information at the same instance as the memory is addressed. A latch is therefore inserted into the system which "catches" the 5 bits of data from the ROM as they are generated and holds them until the time of the character cell AFTER the address. The timing for this operation is again controlled by the Address Counter. The effect of this latching operation means that an addressing operation is being carried out while the preceding character is being displayed on the screen.

---

**Fig. 4. Character Font and the ASCII coding used to designate each character.**
MULTIPLEXING

In order to display the state of the 5 picture points that describe a row within a cell we have to take the 5 lines from the delay latch, which are identical to the input lines except that the data is delayed by one cell width and serialise the information to make the raster spot go bright or dark as is appropriate. This is done with a Multiplexer which is designed to serialise 6 inputs. The extra input corresponds to the inter-character gap (to the left of the character) and is always dark (corresponding to logic level "0"). The six parallel inputs are selected one after another and presented on a single output line by means of a 3 bit binary code generated within the Address Counter.

Code 000 always outputs "0" because this is the inter-character gap; code 001 will cause the most left-hand bit of data describing the picture point of the character to be fed out on the serial line. Code 010 will select the next column within the cell and so on until the sixth code, 101, is reached. This corresponds to the picture point on the extreme right of the cell row in question. Following the code 101 the Multiplexer Address is reset to 000 which is then the inter-character gap for the next character cell which occurs on that particular raster line.

All this happens in synchronism with the line and field drive signals for every picture point within every cell that occurs within that particular field. It only remains to blank the signals during periods when margins should appear on the screen and then mix the sync pulse chain with the data to produce the final television signal. This is normally at video level (1V peak-to-peak) but can be fed to a UHF modulator if aerial socket access to the receiver is desired.

The only part of the system that contributes to the display which has not, as yet, been covered is the Cursor. This requires some knowledge of the Write operation of the instrument which will be described next month.

VISUAL DISPLAY UNITS

Before finishing this part a word ought to be said about the monitor shown in the photograph. It is a Heathkit GR-9900 chosen because of its convenient size, pleasing appearance and because it was exceedingly straightforward to modify it to accept a video level input. It is understood that Heath (Gloucester) Ltd still have a limited number of these kits available for those who wish to make everything for this project. For those who do make use of this kit the modification to allow a video input is to break the printed circuit wiring at the point on the IF/Video/Sound board at the junction between R16 and C18. The video output of the Video-writer is fed directly into C18, the other connection being to the chassis ground. A switch can be connected across the break in the board for normal TV reception. As a transformer is already incorporated in this model there is no worry about chassis isolation.

If the constructor does not wish to use this set as a monitor any domestic 625-line television will do if a modulator is used. UNDER NO CIRCUMSTANCES attempt to convert a domestic set to accept video signal unless an isolating transformer is used on the mains input!

Our next issue starts construction information.

Practical Wireless, August 1976

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CASSETTE POWER SUPPLY continued from page 309

**components list**

<table>
<thead>
<tr>
<th>Resistors</th>
<th>Capacitors</th>
<th>Semiconductors</th>
<th>Miscellaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1 2.2K</td>
<td>C1 1000uF</td>
<td>D1 1N4001</td>
<td>F1 0.5A anti-surge and holder. PCB (Readers PCB Service). Box to suit. Connecting cable, plugs and sockets. Tr1 insulating kit.</td>
</tr>
<tr>
<td>R2 3.3K</td>
<td>C2 2nF</td>
<td>D2 5.6V</td>
<td></td>
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<tr>
<td>R3 10K</td>
<td>C3 50uF</td>
<td>D3 200mA</td>
<td></td>
</tr>
<tr>
<td>R4 2.2K</td>
<td></td>
<td>D4 10V</td>
<td></td>
</tr>
<tr>
<td>R5 2.2K</td>
<td></td>
<td>D5 10V</td>
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<td></td>
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<td>D6</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>D7</td>
<td></td>
</tr>
</tbody>
</table>

Construction

The circuit was built on a printed circuit board for which a layout is given in Fig. 2. The board itself was mounted in an aluminium box, but any enclosure will do provided adequate provision is made for heatsinking Tr1, which can dissipate 8 to 10W under fault conditions. Tr1 may be any NPN power transistor able to handle 1A at 20V or more. Some of the ‘unmarked but tested’ types available would be perfectly adequate.

Modifications

The values given are for an output of 6V. To give other voltages, modify values as follows:

- 7.5V: D2 6.8V, R1 1.8k, R2 2.7k
- 9V: D2 8.2V, R1 1.2k, R2 2.2k

The only critical values in the circuit are R3 and D2, the other values can be altered to the next E12 series value either way without adverse effects.

Mains operation

The circuit can be modified to work from the mains by replacing D1 with a bridge rectifier or 4 x 1N4001 diodes and supplying it with 8 to 12V AC from a transformer rated at about 0.5A minimum. It may be necessary to increase C1 to about 2500uF to avoid hum.

Please mention

**PRACTICAL WIRELESS**

when replying to advertisements
ONE of the hazards facing any sailor is the possibility that he may go aground! Years ago a crew member was stationed in the bow with a lead line to plumb the depths but today we rely on echo sounders. Most small boats which have one of these fitted do not use the type which gives a continuous printed record of the depth but rather the 'flashing light' design. This type of depth gauge is fairly simple, yet robust. The light, which may be either a neon or a light emitting diode, is fitted to the end of a rotating arm of about 10cm diameter, which is rotated at a constant speed. As the light passes the zero mark on the scale a pulse of ultrasonic waves is transmitted from a transducer fitted to the hull of the boat. These travel down to the sea floor and a small proportion is reflected back up to be received by the transducer. The signal is amplified and fed to the light which it causes to flash, the process being repeated every revolution of the arm so a bar of light appears at a point on the circumference of the rotating arm. By suitable calibration of the scale, related obviously to the rate of revolution of the arm and the speed at which the pulse travels in water, one can read off the depth of water below the hull.

The problem with this class of depth gauge is that someone has to keep an eye on it at all times to see what is happening. This may not be so easy in a boat with a crew of one or two, especially if the conditions are rough or hazardous. On many boats the depth gauge is mounted inside the boat and not in direct view of the helmsman. What is needed, therefore, is some form of alarm which sounds automatically when the depth of water reaches a predetermined value.

In order to achieve this aim it was decided to use a photo electric cell to sense the flash since any internal connections to the gauge itself might cause difficulty. On testing it was found that the flash was rather weak and that quite a lot of amplification was needed in order to produce a suitable trigger for the alarm. It was therefore decided not to use a light-dependent resistor followed by operational amplifiers but rather to utilise a Light Activated Switch. This is available in either 5 or 15V versions and consists of a photosensitive device with an associated amplifier in a TO18 can, the BC108 size. Its sensitivity can be adjusted by means of an external resistor and capacitor.

The output from the LAS is used to drive a 2N3705 transistor which has an audible warning device as its load. The circuit diagram is given in Fig. 1 with the stripboard layout in Fig. 2. The capacitor C2 gives a steadier note to the alarm which would otherwise switch as the light passed it.

**SENSOR HEAD**

The LAS is built into a sensor which clips over the shade of the depth gauge. The prototype was designed for a Seafarer-3 instrument and modifications may be necessary for other makes and models to ensure that it does fit and that the LAS is directly in line with the light. A full size template of the prototype sensor is given in Fig. 3. It was constructed from 5 layers of 

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**Fig. 1**: Circuit diagram of the Audio Depth Alarm. The audible warning device gives a very penetrating note of about 2.6kHz. It is NOT a loudspeaker.

**Fig. 2**: The layout of the few components on a small piece of 0.1m stripboard.

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Practical Wireless, August 1976
problem was then to insert the LAS together with its wiring—and it could not be done! So another had to be made, only this time the laminations were not glued during the initial construction. They were in fact clamped together during these stages. The whole was then taken to pieces and built up again layer by layer with the LAS and its wiring being inserted in the correct places before a layer was glued to its neighbours. To ensure a good join it is necessary to roughen the faces of the SRBP with sandpaper. Once assembled the completed sensor was clamped whilst the glue dried and then finally cleaned up, care being exercised not to damage the lens of the LAS nor to cut the wire.

To save drilling an oversize hole when fitting the LAS the brim round the can may be carefully filed off, provided of course that the leads have been positively indentified. The connecting wire to the control box is about a metre long and was surplus GPO 4-core wire. The joints at the LAS end must be soldered with care and then insulated, preferably with heat shrinkable tubing. A further hole at the rear of the sensor can then be drilled and tapped to take a suitable 6BA clamping screw. On the prototype a nylon screw was used.

**HOUSING**

The alarm and circuit board were housed in a plastic box though anything could be used. The front panel was made from an offcut of Formica, drilled to take the alarm resonator, a switch and...
the securing screws. Internally there are eleven HP7 batteries to supply power. For boats which have their own 12V supply one could dispense with the batteries and run direct from this source. The reason why eleven batteries were used was because they fitted nicely inside the box and gave, I thought, a slightly louder alarm. The current drain when ‘on watch’ is about 0.5mA at 12V rising to about 1mA at 18V.

The only adjustment needed is with R1 since this affects the sensitivity of the instrument to the flash. The prototype used a value of 680kΩ and this gave reliable results in sunlight conditions, with other models this may not necessarily be the case and some experimentation may be needed. The higher the value of R1 the greater the sensitivity. A potentiometer could be fitted initially.

If it is planned to use the unit in a position where it might be subjected to spray then the face plate should be sealed to the box with a bath caulking compound with the wires being sealed in a similar fashion.

Whilst this is a very useful navigational aid one must emphasise that it is only an aid and that its use can not absolve a skipper from his total responsibility towards the safety of his craft and crew.

**PW TECHNICAL PUZZLE**

Solution to No. 14 presented last month

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REW IHRADF EETC OAMN IZLE UN3 NOLDK REEWS
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GOING BACK—continued from page 314

Anyone help?

A LETTER arrived here this week from Mr. H. Toon, 38 Mountfield Avenue, Reepham Road, Hellesdon, Norfolk. He sends the photograph of the British Standard Ohms unit and wonders if any readers could advise him where these were first used (date on it is 1915). When he discovered it, it was rather grubby but otherwise in mint condition. If anyone can advise, please could they contact Mr. Toon.

Adey 4

M. R. D. Vickrage writes from 27 South Road, Boscombe, Bournemouth, Hants to say that he is the proud owner of an “Adey 4” receiver.

All the valves bear the name of Adey—one is a multi grid and the other three are marked self-coupling. All have three bands of fine wire around the bakelite base insulator and one of the self-coupling valves is open circuit.

The set appears to have had an extra short wave circuit added. Whether this was an Adey mod, Mr. Vickrage does not know but it has an aerial trimmer control, and a two gang tuner with slow motion drive.

If anyone can let him know the valve equivalents or put him in touch with a supplier of Adey valves, Mr. Vickrage would be most grateful. To quote his own words, “I would like to get the old gal going again”.

**Vintage CQ FOR DISPOSAL**

Practical Wireless from September 1950; Newnes Practical Electrical Engineering (1932); Newnes Complete Wireless (19?); The Superheterodyne Receiver by Wills (1939); Modern Electrical Engineering by Magnus McLean (1919); Modern Radio Servicing by Alfred Ghirarde (1935) and lots of others.—P. M. Gray, 17 Redmead Close, Kings Norton, Birmingham, B30 1EY.


WANTED

Early radio magazines and books. We are trying to form a library.

Osram PT2K (small bulb PT2), plug-in Eddystone coils 4 and 6 pin various ranges wanted. Osram KL1 and KH1 sought (can exchange new Osram DG2, DL612, DE5 etc). I am renovating a Marconi V2 and am searching for DER valves with top pips.
—Philip Taylor, 14 Willow Walk, Canewdon, Rochford, Essex.
ELECTRONICS POCKET BOOK
Edited by P. J. McGoldrick
Published by Newnes Technical Books, Butterworths, Borough Green, Sevenoaks, Kent, TN15 8PH
349 pages 19cm x 12.5cms
Price £3.75

The first edition of this book was published thirteen years ago, and who would have ever dreamt of the technological advances that have taken place during that time? Semiconductor devices and all their derivatives are a part of our lives now and as the author points out, their small size, low power consumption and even simplicity have twisted our thoughts into thinking small. This may be the case very often but we must realise there is still a need for thermionic devices in the R.F. and industrial control fields where the semiconductor is un-economic or still operationally limited. The third edition of this pocket book (and you will need pretty big pockets!) concentrates mainly on semiconductors but the author has not entirely discarded information on thermionic devices. Contents include such chapters as Transistor Circuit Techniques, Amplifiers, Pulse Circuits, Logic Circuits, I.C.s, Photo-Electric Devices etc. and take the reader through to major electronic applications like industrial control systems and computers.

The aim of the book is to bring together up-to-date and concise information on the techniques and basic circuits used in electronics. It is written from a "practical" point of view and does not get the reader too tied up with maths.

Mr. McGoldrick's book provides a helpful and fairly wide-ranging reference manual for technicians, students of electronics and home constructors.

GATE ALGEBRA
By K. D. Turnbull
Published by Arthur H. Stockwell Ltd., Elms Court, Ilfracombe, Devon.
37 pages 18cms x 12cms
Price 75p

This book is a rationalised and systemised version of Boolean algebra. Gate algebra, as well as Boolean regards the gate as a "black box" with inputs/output rather than be concerned with the workings of it. The output is a function of the inputs and Gate algebra is concerned with expressing the output in terms of the inputs. 2-input gates are considered mainly as they are basic and restricted in numbers allowing cataloguing in a systematic manner within a reasonable space. Gate definitions apply equally well to multi-input gates and the text's only omission is that of truth tables for multi-input gates. Chapter 1 sets out the benefits of Gate algebra in relation to Boolean in terms of basic concepts. Chapters 2, 3, 4, 5 and 6 set out the basic principles and rules of Gate algebra and show how a system of gates is composed. The vocabulary is the same as that for Boolean algebra. A knowledge of algebra up to the simple factorisation stage is a must for the complete understanding of the text.

AUDIO HI-FI CONSTRUCTION PROJECTS
By B. B. Babani
Published by Babani Press, The Grampians, Shepherds Bush Road, London W6 7NF
95 pages 18cms x 11cms
Price 85p

The compiler has taken some of his material from the magazine Electronics Australia and the contents comprise three major projects—Playsmaster 143, Playmaster 145 and Playmaster 140. These are a 12-5W per channel stereo amplifier, 8-input stereo/mono mixer and a 4 x 14W quadraphonic amplifier.

In each case the projects are split into sections and full constructional details are provided. Since the projects are fairly complex it is recommended that only experienced constructors should attempt them.

VHF/UHF MANUAL—3rd EDITION
By D. S. Evans, G3RPE and G. R. Jessop, G6JP
Published by Radio Society of Great Britain, 35 Doughty Street, London, WC1N 2AE.
404 pages 24.5csm x 19cm
Price £4.95 plus 60p p & p

Since 1969 the RSGB VHF/UHF Manual has been a best seller around the world as the standard textbook on the theory and practice of Amateur radio transmission and reception at frequencies above 30MHz. It is this part of the radio spectrum, particularly the microwave bands, that has offered the greatest challenge to Amateur radio experimentation in recent years, thus creating a need for a source book of both pioneering ideas and tried-and-tested designs.

This third edition continues to offer the most comprehensive and up-to-date coverage of VHF/UHF techniques available, and includes for the first time a complete chapter on Amateur microwave techniques for bands up to 24GHz. Another innovation, resulting from the increasing use of Amateur communication satellites, is a chapter on space communication which will enable the user to make the most of this exciting development. A useful data section has been added, and of particular interest will be the inclusion of inductance charts for small VHF coils and rods.

The whole book has been revised and augmented by acknowledged experts in each specialist topic, and is now presented in a larger format to do justice to the profusion of diagrams, charts and photographs it contains.

Chapter titles are (1) Introduction (2) Propagation (3) Tuned circuits (4) Receivers (5) Transmitters (6) Filters (7) Aerials (8) Microwaves (9) Space communication (10) Test equipment and accessories (11) Data.

SERVICING WITH THE OSCILLOSCOPE
(2nd Edition)
By Gordon J. King
Published by Newnes-Butterworths, Borough Green, Sevenoaks, Kent TN15 8PH.
208 pages 22·5cms x 14cms
Price £4.50

Another gem from our good friend Gordon King—a highly respected doyen of servicing and audio journalism.

In this book Mr. King shows just what a valuable aid an oscilloscope can be for servicing and fault-finding in radio, television and audio equipment—including some of the latest colour TV circuits and stereo receivers.

Mr. King, being a practical man, has written his book in a practical manner. The illustrations include many off-screen photographs showing 'scope trace examples that could be expected in good and faulty equipment. In the TV chapters, the 'scope traces are supplemented by off-screen television faults. All the pictures have been taken in Mr. King's own laboratory over several years of design, experimentation and development.

This second edition has been brought right up-to-date and expanded and it would prove an exceedingly valuable reference for both the engineer who services radio, audio equipment and colour TV receivers, and the technician who has both to evaluate and make tests on such equipment.
Referring to the design for an updated Home Telephone Exchange published in the March edition of PW, experience has shown that two minor modifications will almost certainly be necessary if the exchange is to function reliably.

1. The junction of Tr1 base and C1 should not be connected directly to R1. Instead, R1 should be connected to a 220kΩ preset. The other end of the preset should be grounded and C1/Tr1 base connected to the slider.

2. The mark-space ratio of IC5a oscillator needs to be modified. To do this, R8 should be increased to 680kΩ. A new resistor of 100Ω should then be connected in series with an OA47 diode and this combination be connected in parallel with R8. The positive end of the diode (cathode) should be connected to pins 9, 10, 12, 13 of IC5b.

If an exchange of 8 or less lines are required, then the circuit can be simplified by omitting IC6. The BCD outputs of IC2 should be connected directly to the BCD inputs of IC4 with the exception of the connection between IC2 pin 11 and IC4 pin 4. The latter should be connected to IC5 pin 6. IC5b and pin 11 of IC2 are not used. R25 should connect with pin 16 of IC4 instead of pin 1. Finally connect an OA91 diode across the choke—Cathode to +20V supply.
NEVER has there been a greater need for a return of the old-style radio shows where everyone is under one roof. We have had various exhibitions scattered about the country which, some say, appear to be dying natural deaths but let's hope that Sound and Vision at the Birmingham National Exhibition Centre will continue to thrive in years to come, even though attendance was not as high as forecast.

In the past few years, manufacturers of radio and television equipment have held 'private' dealer-only exhibitions in the London hotels. This has not really been of much help to the consumer—and after all, he's the one who keeps the trade turning over!

As well as the manufacturers' stands with new products were the BBC and IBA with their engineering stands demonstrating CEEFAX and ORACLE. The Post Office displayed their VIEWSDATA communications system (the August issue of our 'sister' magazine Television includes a report on these) and the Home Office had a detector van and its associated equipment on display.

As space is somewhat limited, we have chosen a few of the items on show at the NEC Birmingham 28-31 May, which we think will interest readers.

Telefunken exhibited a good range of equipment and what caught our eye was the TRX 2000. It is a sophisticated receiver covering 87.6MHz-108MHz FM and 14.5-22.3MHz (SW1) 5.8-12.43MHz (SW2) 515-1630kHz (MW) and 141-331kHz (LW) AM. The crystal-controlled frequency indication is by a 5-digit nunicator display which doubles as a 24-hour clock. Seven FM stations can be preset and quickly re-tuned by touch buttons. The AFC circuitry is automatically switched out during tuning. Ten input sockets are provided for 2 or 4 channel tapes and record decks etc. and a SQ matrix decoder is built in.—AEG-Telefunken (UK) Ltd., Bath Road, Slough, SL1 4AW.

From CBM Business Machines Ltd. came the news that they had reduced the prices of their scientific calculators. SR4190R is now £49.95, the SR4148R is £36.50, the SR1800 £24 and the SR791D, £14.50. A new machine from the CBM stable is the Commodore 'Statistician' with a spec. longer than your arm (see picture).—CBM Business Machines Ltd., Industrial Estate, Eaglescliff, Stockton-on-Tees, Cleveland, TS16 0PN.

Goldring demonstrated their Lenco cassette deck C-2003, priced at about £350. Features include double capstan drive, 5 head system with separate erase, replay and record heads and an illuminated panel showing all functions as they are selected. Frequency response is quoted as 59Hz-18Hz ±3dB. With multiplex filter 50Hz-16kHz ±3dB. Weighted S/N less Dolby is -56dB and with Dolby -65dB.—Goldring Limited, Anglian Lane, Bury St. Edmonds, Suffolk, IP32 6SS.

Videomaster were showing their 'Rally' TV game. It offers tennis plus three others. Pressing a button

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The CBM Commodore 'Statistician' calculator priced at £99.95 inc VAT

Goldring's new Lenco cassette deck. New this month. Supplies should be available around August
brings the ball onto the screen and a 'click-along' indicator enables the players to keep the score. Variable speed controls are provided and a single PP3 supplies the power. Vertical and horizontal hold controls are a feature as is a cleverly designed 'space' behind the console to store the cable away after use. Price is £30 plus VAT.—Videomaster Ltd., 14-20 Headfort Place, London, SW1X 7HN.

From Philips came the N2511 stereo cassette deck with both DNL and Dolby. It takes Fe2O3 and CrO2 cassettes and a tacho motor control and hysteresis friction clutch ensure smooth tape transport. The head for record/playback is an FSX long-life type and the double-gap erase head is of ferrite. Separate recording level controls are provided for each channel.—Philips Electrical Limited, Century House, Shaftesbury Avenue, London, WC2H 8AS.

ITT announced a new range of equipment including the 'Sport' receiver at £11.95 covering long and MW bands. Features include earphone socket, 'roller' controls and logging scale. The speaker grill has special dust/damp protection.—ITT Consumer Products (UK) Ltd., Maidstone Road, Sidcup, Kent, DA14 5HT.

The most expensive radio on show was the National Panasonic RF-8000. It covers 150kHz to 230MHz in 24 bands (12 SW, 2 Marine, 1 LW, 1MW and 8 VHF). Four separate aerials are provided and the set will run from mains, dry battery or car battery. Price is around £1,500. National Panasonic say, "It costs the earth but it gives you the world!".—National Panasonic, 107-109 Whitby Road, Slough, Berkshire, SL1 3DR.

SWLs and MWLs

Short Wave Listeners and Medium Wave Listeners—if you would like to send in reports, the addresses are as below:

BROADCAST BANDS, Short Wave—these reports should be sent by the 15th of the month to Derek Bell, c/o Practical Wireless Editorial Department, Fleetway House, Farringdon Street, London, EC4A 4AD.

BROADCAST BANDS Medium Wave—also by the 15th of the month to Charles Molloy, 132 Segars Lane, Southport, PR8 3JG.

AMATEUR BANDS—logs covering any Amateur band or bands in band/alphabetical order by the 25th of the month to Eric Dowdeswell, G4AR, Silver Firs, Leatherhead Road, Ashtead, Surrey, KT21 2TW.

Practical Wireless, August 1976
BLOWER MOTORS small double ended for use on 12/24v DC size overhaul 6 x 4" new £3.60. VEEDEE COUNTERS with reset 5 digit 12/24v DC 1/2" digits £1.30. TRIMMERS 20p air spaced ceramic 10 for 80p & min round 3/10pf size 10 x 9mm 5 for 50p both new. SPECTRUM FILTERS these provide 20 tuned circuits in range 3 to 21Kc with separate O/P okay for remote control £4.30. MIN COILS with scr can & slugs 5mm dia. new 10 for 50p. SONAR IND UNITS with 5" sq. flat face tube electrostatic dual beam Blue/Yell P7 phosfor, module construction with approx 40 min & sub min valves as int RF type EHT supply reqs ext P.U. supplied with circuits £13.50. REMOTE Tx Rx crystal selector 6 chan for Hc/6u crystals as 6x BC108, 6x trim & coils etc new £1.60. CRYSTAL FILTERS min type 10-7 Mc/s both new 30Kc b.w. £1.30 12Kc b.w. £1.60. IND ASS visual as 20 wire ended neon's arranged in strip holder size 6 x 1" suitable for any voltage from 90v with lim res. £1.20. AERIAL SYSTEMS high gain 8 element Yagi for use on 180Mc/s for use with 50 ohm coax overhaul length 11ft high grade unit new in cases £21.60. TAPE DECKS & AMPS with standard BSR TD.2 tape decks with Rec/Playback amp & erase etc all transistor units are complete except for P.U. reqs 24v DC smoothed & mains. These are a two chan unit the O/Ps from both pre amps being combined in a mixer stage to give O/P for phones, can be used for stereo, deck & amps mounted on plywood base size 23 x 4" in clean cond with circuits £9.50 also similar unit with valves reqs ext HT & LT on plinth 17 x 13" with circ £6.50. IND UNIT small sector scan PPI ind with 4 1/2" dia tube electromagnetic with scan & focus coils tube is sim to 5FP7 with P7 phosfor in neat case size 14 x 6 x 6" unit reqs ext EHT supply £7.50. MIKE CABLE approx 100ft of 3 core screened cable on wind up drum £3.50. COPPER WIRE silver plated 11 swg new 60p per mt. AERIAL TUNING UNIT remote control type with 12v ledex swt 50 ohm to long wave provides 24 chan suitable Tx Rx est freq 2 to 18 Mc/s £4.50. INSULATORS small stand of ceramic 6ba stud new 10 for 50p MIN RF coupling trans wound onferrite new 20 for 50p. FERRITE CORES size 21/4 x 21/4 x 21/4 sq. 75p & 2" OSĐ x 1" with 1/4" hole ex scan coils £1 both new will split with clamps. I.T. TRANS min transis type for 455 or 465kc double wound new 3 for 75p. FREQ SYNTHESIZER part of UHF Tx drive unit provides 100 O/P chan spaced 100Kc from 20 to 29.9 Mc/s these are devided from the mixing of 20 crystals in turn the correct O/P being selected by a 3 stage 20/30 Mc/s tuned amp supplied with valves, crystals & circ £10.

Above prices inc cart/postage & V.A.T. Goods ex equip unless stated new. SAE for list or enquiry. Shop open Tues to Sat.

A. H. SUPPLIES

122, HANDSWORTH ROAD, SHEFFIELD S9 4AE
Phone 444278 (0742)

339
**EXPERIMENTERS CORNER**

THIS simple circuit gives an early warning of the discharge of batteries. In many cases, due to the varying loads on lead-acid batteries, it is often difficult to determine their state of charge. The simplest method is to use a voltmeter, and keep an eye on it when drawing current. This is adequate if the user can read a meter out of the corner of his eye, and is in a position where he can obtain meters at reasonable prices.

The circuit here will give a ‘GO’ or ‘NO GO’ visual indication of any significant fall in supply voltage. The zener diode D1 is chosen for the voltage below which an indication is required. (The values shown in this case are for 12V operation.) In this instance the zener was a 10V device and was chosen as it puts about 2V on the junction of R1/R2 causing Tr1 to conduct. The collector voltage subsequently falls to a low value keeping Tr2 switched off. Should the supply drop, however, to below 10V, D1 will cease conducting causing Tr1 to shut off. Its collector voltage will now increase, causing Tr2 to start conducting via LED1 and its limiting resistor R4.

\[ R4 = \frac{\text{voltage of zener diode} - 2}{\text{LED current}} \]

Layout is by no means critical, as fifteen prototypes have been built with uses ranging from a car battery indicator to a battery indicator in a cheap 9V radio. D1 in this particular case was a 6.8V zener.

**component list**

<table>
<thead>
<tr>
<th>Resistors</th>
<th>R1 4.7kΩ</th>
<th>R3 5.6kΩ</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2 1kΩ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All resistors 1W 10%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Semiconductors</th>
<th>Tr1 BC108 or 9</th>
<th>D2 1N4001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tr2 BC108 or 9</td>
<td>LED1 Any LED such as TIL209</td>
<td></td>
</tr>
<tr>
<td>D1 Zener diode</td>
<td>BZY88</td>
<td></td>
</tr>
</tbody>
</table>

For the purpose of this scheme, mail order advertising is defined as—

'Direct response advertisements, display or postal bargains where cash had to be sent in advance of goods being delivered'. Classified and catalogue mail order advertising are excluded.

**MAIL ORDER PROTECTION SCHEME**

The Publishers of Practical Wireless are members of the Periodical Publishers Association which has given an undertaking to the Director General of Fair Trading to refund monies sent by readers in response to mail order advertisements placed by mail order traders, who fail to supply goods or refund monies owing to liquidation or bankruptcy. This arrangement does not apply to any failure to supply goods advertised in a catalogue or in a direct mail solicitation.

In the unhappy event of the failure of a mail order trader, readers are advised to lodge a claim with Practical Wireless within three months of the date of the appearance of the advertisement, providing proof of payment. Claims lodged after this period will be considered at the Publisher’s discretion.

Since all refunds are made by the magazine voluntarily and at its own expense, this undertaking enables you to respond to our mail order advertisers with the fullest confidence.

For the purpose of this scheme, mail order advertising is defined as—

'Direct response advertisements, display or postal bargains where cash had to be sent in advance of goods being delivered'. Classified and catalogue mail order advertising are excluded.

**POST BAG**

The on-going increase in postal and telephone charges does not seem to have made any difference to our post bag or our telephone bill. Enquiries continue to flood in.

We find that there are two points we are constantly mentioning. In the first place, we just cannot afford to reply to an unhappy reader's letters, particularly those not associated with projects we have published, unless they are accompanied by a stamped addressed envelope. Were we to undertake to do so our post bill would become astronomical.

We cannot deal with technical enquiries by telephone. Readers should write in, giving details of symptoms and perhaps some test point readings, when requesting technical help so that we can at least give the relevant author some idea of the problems involved.

Finally, whilst we normally supply details as to source of components in each project we do assume that the constructor refers to advertisements and has an awareness of general sources. Thus, where goods are generally available we do not specify a source. You could save the cost of a letter by reading the advertisement pages first.

We regret that we are unable to supply any back copies of Practical Wireless.
HEATHKIT EDUCATION
One of Heath's basic business philosophies has been that of education. The firm now takes this philosophy one step further by announcing the Continuing Education Series—an instructional electronics course.

At present there are four courses covering DC Electronics, AC Electronics, Semiconductor Devices and Digital Techniques. Another, to be announced later in the year, will cover Electronic Circuits and Applications.

All Heathkit Individual Learning Programmes (ILP's) are self-instructional electronics courses designed to allow thorough, independent study at your own pace. You study when you want to and for as long as you want, repeating any section as many times as you wish. Should you wish to take the optional final examination, a passing grade will bring you a Certificate.

The ILP system teaches subjects thoroughly and efficiently. Comprehensive learning materials integrated with programmed instruction lessons and kit experiments lead you step-by-step to a good knowledge of electronics. Self-evaluation quizzes help check your progress.

Each subject is reinforced by actual "hands on" experience to help you learn and to give you practical experience of the subject.

The Experiment Trainer for the Heathkit Fundamental programmes—helps you perform each project quickly and easily. And after you finish the programmes, it's ideal for "breadboarding" your own design projects. It has solderless breadboarding sockets for fast, easy component connections, 2-range variable sine and square wave signal sources, dual-variable power supplies for positive and negative voltages (both variable over 1-2 to 16 volts, current rating 120 mA, both regulated and short-circuit protected). Built-in 1k and 100k linear potentiometers. Centre tapped power transformer secondary provides 30V rms, 50Hz for line experiments.

The three basic programmes and the ET3100 trainer cost £89-90. The Digital Techniques programme and Digital Design Experiment Trainer are priced at £65-90.

For a fully comprehensive illustrated leaflet on the series write to Heath (Gloucester) Ltd., Gloucester, GL2 8EE. Telephone (0452) 29451.

An instruction manual together with gramophone records, components and the Heath Digital Design Experiment Trainer.

The European Calculator Division of Texas Instruments Ltd. has introduced a hand-held calculator specifically designed for secondary school students. It is designated TI-1270. The 4-function machine features a store and recall "scratch pad" memory and four keys recommended by maths educators for student use: reciprocal, square, square root and π.

The TI-1270 is a single-chip calculator with a price tag of £12.95 inc. VAT. A mains adapter (AC 9900A) costs £2.95 inc. VAT—European Calculator Division (Dept. PW), Texas Instruments Ltd., 165 Bath Road, Slough, SL1 4AD.

A NOVEL IDEA
A novel idea—that's what we thought when we heard about the Hadley SX4500. It's a cassette recorder with a built-in calculator. The recorder has auto level control and built-in microphone, while the calculator has the basic 4-functions, constant × or ÷, power calculation, memory and % and goes to 7 places of decimals. The unit, which can be battery or mains operated is priced at £75 plus 8% VAT. Further information may be obtained from Hadley Sales Services, (Dept. PW) 112 Gilbert Road, Smethwick, Birmingham, B66 4PZ.

RECHARGEABLE SOLDERING IRON
New from Kelgray Products Ltd. is the Engel rechargeable soldering iron, model B.50. It comes with a charger unit and is said to give 100 operations without a recharge (which can be done in 8 hours). The B.50 is fitted with a B.50D bit for work up to 2.5mm². It heats up to about 350°C in seven seconds. The price complete is £13.55 plus VAT and the B.50 can be obtained from the sole U.K. agents, Kelgray Products Ltd. (Dept. PW) Bywell House, South Godstone, Surrey.
THUNDER EASYDRIVERS

New from Gould Advance Ltd. is the OS250A oscilloscope—an upgraded, re-styled version of the OS250. It incorporates a new input y-amplifier that gives a maximum sensitivity of 2mV/cm. It is a 10MHz dual-trace instrument with a 10 x 8cms display. The two channels may be viewed separately or alternately at high timebase speeds, or may be chopped at 250kHz at low timebase speeds. A variable level trigger control is provided with the option of a bright line in the absence of a signal, or when the trigger level is outside the range of the input signal. Price is £229 when bought at 250kHz at 2mV/cm. that re

CABLE LOCATORS

Warrior Products Limited have introduced three new metal and cable locators.

The ‘Metalloscope 40’ registers any metal and has a penetration depth of about 10in. Price is £12.32.

The ‘Electroscope 50’ detects all live wires up to a depth of 16in. Price is £11.75.

The ‘Electro-Metalloscope 70’ combines both operations and detects metals and live wires. It detects live wires up to a depth of 16in, and metal 10in. It produces a different signal for each. Price is £16.60.—Warrior Products Limited, 8 Scrubs Lane, London N.W.10. Telephone 01-969 8201.

DIGITAL PANEL METER

From B. Davis Electronics Ltd. comes the digital panel meter type DPM/3·5/01/F. Features include auto polarity with indication, large bright 12mm LED display and overrange indication. Input is 0-1-999V protected; input (Z) 1MΩ ± 2% and accuracy ±0·1 ± 1 digit. Power input across rails is 12V minimum and 15V maximum. Size of the DPM is 85mm x 60mm x 30mm deep. Fixing centres are 93mm.

This meter has been designed as a direct analogue replacement. It uses MOS/MSI devices. The price for 1-9 units is £23·85 each.

A matching power supply type SPS/DPM/01/F or 01/G is available at £9·26 for 1-9 units. Input is 110-240V at 40-60Hz (F) or 5V d.c. at 250mA (G). It’s twin rail (+VE 6V at 150mA/—VE 7·5V at 50mA). The PSU is short-circuit proof and will run two DPMs.—Further information from B. Davis Electronics Limited, Castleham Industrial Estate, St. Leonards-on-Sea, Sussex, TN38 9NR.

INSTRUMENT CASES

Olson Electronics inform us that they can supply cases and metal work to suit many P.W. projects at the keenest prices. They are shortly announcing a new range of cases and if readers would care to send them a stamped, addressed envelope, they will send out their price lists and brochures. A typical example of one of their cases is the sloping panel type shown which measures 250mm x 100mm, with a depth of 95mm and a height of 95mm. Price of this particular model is £1·95. Olson Electronics Ltd., Factory No. 8, 5-7 Long Street, London E2 8HJ.

“MICRO-POTS”

Lemo (UK) are now marketing what must surely rank among the smallest variable resistors ever made: the Siegert Type VW 00. The cylindrical body of this p.c.b. or hybrid-circuit resistor measures only 2.45mm high by 2·6mm diameter. It is of dust-tight design, and as it has a stainless-steel body it has good corrosion resistance: for example it resists perspiration.

Linear tracks are offered, from 100Ω maximum to 100kΩ, at a power rating of 70mW at 40°C. The screwdriver slot that is used to adjust the resistance also indicates the approximate setting of the wiper, which turns through about 240°.

Applications suggested by Lemo include car and pocket radios, paging devices, computers, hearing aids, calculators, electronic watches and defence circuitry.

Further information and prices from: Lemo (UK) Ltd. (Dept. P.W.), 6, South Street, Worthing, Sussex BN11 3AE. Tel.: 0903 204651.

Practical Wireless, August 1976
RETURN OF POST MAIL-ORDER SERVICE

JUST RETURN
R.C.S. 100 watt VALVE AMPLIFIER

Four inputs. Four way mixing, master volume, treble, bass and base controls. Suited all types. This professional grade amplifier is suitable for all groups, disco, P.A., where high quality power is required. 6 speaker outputs. All mains operated. Slave output. Diver demand forNEA quality valve amplifier. Send for details Suitable carrying cabinet £6. Price £85 curr. £2.00

ANOTHER R.C.S. BARGAIN!
ELAC 9 x 6m Hi-Fi SPEAKER TYPE SYM

This famous unit now available, 10 Watts, 6 ohms.

Price £3, £2. Post 60p

8" or 10" x 6" ELAC HI-FI SPEAKER

Dual cone plasticsised roll surround. Large ceramic magnet 60-16,000 c.p.s. Bass resonance £5. £5. 8 ohm impedance 10 watts.

10in round £4.95. Post 60p

TEAK VENEER HI-FI SPEAKER CABINETS

MODEL "A", 20 x 13 x 12in. For 12 in. dia. or £1-25 Post 60p 10in. speaker.

MODEL "B", 16 x 10 x 8in. For 12 x 8in. or £0.95 Post 8 in. speaker 75p

MODEL "C", 20 x 20 x 12in. Reflection cabinet will accept 1-18in. bass unit, 1-5in. mid range, 1-2in. tweeter. Teak finish, grooved front £21-50 curr. £4

LOUDSPEAKER CABINET

WADDIN 18in. wide, 88p ft.

GOODMANS CONE TWEETER

3in. diam. 16,000 c.p.s. 35 watt £0.95

BARGAIN 4 CHANNEL TRANS- SISTOR HIFI SPEAKER SYSTEM

Musical highlights and sound effects in recordings. Will mix Microphone, records, tape and tuner with separate settings into a single output. 9 volt battery operated.

STEREO VERSION OF ABOVE £9.95

BARGAIN 5 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 12 volt battery operated. Mains Supply 22.95.

THE "INSTRUMENT" BULK TAPES

ERASER & HEAD DEMAGNETISE. Suitable for cassettes, and all types of tape reels. A.C. mains 300/800V. Leaflet S.A.E.

WAFER HEATING ELEMENTS

OFFERING 1000 TYPES for every type of heating and drying applications in the home, garage, greenhouse, factories available in manufacturing quantities. Approx. size 101 x 87 x 4in. Operating voltage 200/250V, e.c. 600 watts approx. Printed circuit element enclosed in asbestos fitted with connecting wires. Completely flexible providing safe black heat. Price &2,95. Ideal for use in photocopiers and printing drying equipment. Ideal for home handcrafts and experimenters. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos, etc., to make efficient clothes dryers, lowvels etc. Ideal for airing clothes and keeping them free from dust for the same reason protecting trusses and builders as acting oil lamp heater. Use in greenhouses for seed raising purposes. Low voltage for bath houses, incubators, etc., etc. Can be used in series for lower heat. Or in parallel for higher heat in installations.

ONLY 40p EACH (FOUR FOR £1.50)

ALL POST PAID—Discounts for quantity.

RADIO COMPONENT SPECIALISTS


Practical Wireless, August 1976

Cash price includes VAT

ACCESS & BARCLAY CARDS WELCOME.

337 WHITEHORSE ROAD, CROYDON

Open 9-6 Wed. 9-1 Sat. 9-5 (Closed for lunch 1.15-2.30)

BAKER MAJOR 12" £10.35

Post 80p

20-15,000 c/s. 12in. double cone, woofer and tweeter cone together with a BAKER ceramic magnetic assembly backed with density of 14,000 grams and a total flux of 140,000 Maxwells. Bass resonance, 30 c/s rated 25 watts. NOTE: 9 or 5 or 8 or 10 ohms must be stated.

Module kit, 20-17,000 c/s with tweeter, crossover, baffle and instructions. £13

BAKER DISCO SPEAKERS

HIGH QUALITY—BRITISH MADE

2 x 12" CABINETS

for Disco or PA All fitted with carrying handle and corners. Black finish. Other cabinets in stock. BARK FOR INQUIRY.

50 WATT

R.M.S.

£43

70 WATT

R.M.S.

£46

100 WATT

R.M.S.

£59

SUPERB HI-FI

12in 25 watts

A high quality loudspeaker, its remarkable low end resonance, source clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeters, composite resulting in full range reproduction with remarkable efficiency in the upper register.

BASE REASONABLE £5 1000 c.s.

£15.50 Post 60p

AUDITORIUM

12in. 35 watts

A full range loudspeaker for high power, Electric Guitars, public address, all effects, magnetic, electric organs. Ideal for Hi-Fi and Discotheques. Base Reassembly £5 15,000 c.s.

£15.50 Post 60p

AUDITORIUM

15in. 45 watts

A high wattage loudspeaker of exceptional quality with a level response to above 8,000 c.s. Ideal for Public Address, Discotheques, Electric Instruments and the home Hi-Fi.

BASE REASSEMBLY £5 15,000 c.s.

£19.50 Post 90p

Hi-Fi Enclosures Manual containing plans, designs, crossover data and cable tables, 60p

P.W. SOUND TO LIGHT DISPLAY

Complete kit of parts with B.C.S. printed circuit. Three hundred 1,000 watts each. As featured in December Practical Wireless.

Gasket extra £5.

8 inchi PHILIPS LOUDSPEAKER

4 ohm, 4 watt, ceramic magnet £1.95

MAINS TRANSFORMERS

6 VOLT 1 AMP, £1-00 3 AMP, £4.10

12 VOLT 200 MA, £1-00 700 MA, £1-70

20 VOLT 50 AMP AND 90 VOLT 50 C.T. £4.95

20 VOLT 1 AMP, £1.75 1 AMP, £3-00 5 AMP, £8.20

E.M.I. TAPE MOTOR

4 pole, 500 v, 1500 r.p.m. 45-1800 rpm. 4 in. dia. - £1.85 Post 60p

E.M.I. GRAM MOTOR

4 pole, 500 v, 1500 r.p.m. 45-1800 rpm. £1.25 Post 60p
by Eric Dowdeswell G4AR

THERE is a treat in store for those of you who can get to the RSGB’s Radio Communication Exhibition at Alexandra Palace in North London on Friday and Saturday, 30-31 July, from 1000 to 2000 hrs and on the Sunday, 1 August, from 1000 to 1600 hrs. There are exceptionally good roads and public transport facilities to the show with adequate car and coach parking. The opening ceremony will be performed at 1200 hrs on the Friday by Lord Wallace of Coslany, next year’s President of the RSGB, and a stalwart supporter of the Amateur cause for many years.

There will be talk-in stations on 160, 80 and 2m and the entrance fee is a very reasonable 40p, and 20p for the kids. Take all the family because there are many attractions at Alexandra Palace besides the lure of Amateur radio!

Stephen Budd A8713 of Worthing in Sussex is very enthusiastic about the Geoff Watts DX News Sheet and swears by the propagation forecasts contained therein and originated by W4UMF. Perhaps that ought to be MUF! Taking advantage of a predicted good period Stephen logged 11 KH6’s, 17 KL7’s, plus KS6, KM6, KJ6 and lots of other attractive calls. I have a feeling that the ‘Zygii’ two-element beam (Radiom July 75 and October 75) for 20m helped a great deal here although it was only a few feet off the ground. Even then it was better than his 150ft wire at 35ft. Geoff Watts can be reached at 62 Belmore Road, Norwich, for those interested in the DX-NS.

R. Donaldson, Trimdon Colliery, Co. Durham, sent a first log for 20m for both SSB and CW. I’m glad to say, where he uses a Codas CR70A and a long wire. On 2m a Telford TC7 plus the G8AEV converter uses a dipole and a J-Beam crossed dipole which has brought in quite a lot of stations via Oscar 7. On 160m an Eddystone EC10 does yeoman service. How about that then? A different set for each band! R.D. is also swotting for the RAE plus the code examination.

Young Jeremy Hinton did it! Now G4EZE and what a lovely callsign! He is already hard at it working the DX for a change on 10 to 80m with an FT200. Jeremy met fellow correspondent Martin Kessel and found that they had both been to the same school and now frequent the same radio club, and that Martin is now G8LKF so congrats all round seem to be in order. Paul Barker, Sunderland, sent the usual long list of things seen on SSTV on the 20m band with nice things to say about the pics from 9K2DO and F6CHU followed closely by ON4IS. Paul found some late afternoon openings to SE Asia on 20m SSB plus quite a lot of /M, /MM1 and /MM2’s scattered around the high seas. Paul comments on the excellent signal from 7Z1AB in Jeddah who, I think, must be old friend HZ1AB who operated for so many years from the Dhahran Air Base, and was a W1 when at home.

Alastair Dyksman living in Stockton-on-Tees managed to log a few stations on a Heathkit receiver before he had to hand it back! As he is just finishing off a PW designed receiver he didn’t bother to off the air for too long. Alastair has a trapped dipole plus an inverted Vee with the top at about 40ft. The far end of the Vee is earthed which provides a good aerial usable over quite a wide range of frequencies. A go at the May RAE plus some work on the code ought to bring along yet another G4+3 before too long. A final question from Alastair was ‘Do you favour black boxes’? In general I don’t, unless one has already had some experience in building equipment such as receivers and transmitters and thus has a reasonable knowledge of what goes on inside those very expensive black boxes!

The latest bit of excitement for Peter Allen A8677 of Taunton is the arrival of a new FR50B receiver which he finds much better than the 9B5DS, which is hardly surprising! In particular he is pleased at the very much improved frequency read-out. Peter is also active on 2m with an 8-over-8 J-beam at 20ft. He finds the cost of getting QSL’s is a bit too much but still enjoys it and ‘worth every penny’.

Log extracts

P. Allen:- 15m 5H3JR 9Q5DM ZP5SD JH2EUY 2m DJ5CY GM8BKE PA0GUS
A. Dyksman:- 20m KZ5JM SV0WZ (Rhodes) A3GJ 5V4CX TA1MB
S. Budd:- 80m HK0CP ZF1MA 20m CE0AE CR9AJ FR7AT HL9WI UA9VT/JT1 KS6DV/KB6 KJ6BZ TJ1AF TL8AR VK9XX VR8A 2K1DA 9M8HB 15m DK5EC/ET5 KC4AAC VK9XX (QSL to WB7ABK) ZD8PL
R. Donaldson:- 20m CE6BFG CT3OK VP9GE 6Y5DA 2m via Oscar 7 DC92P HB9AS 13LC OE5KDG OZ1EHD W1JAA
P. Barker:- 20m STV CTV1 J6CHU G4BBF OE5DPL/6 OK3ZAS ON4IS 9K2DO 20m HM1ED VS5DB 5N2NAS 7Z1AB (7HZ1AB) 9V1NR VEBRCS.

Practical Wireless, August 1976
**ELECTRONIC DIGITAL CLOCK**

WITH ALARM AND SNOOZE FEATURES

- 0.7 INCH HIGH DIGITS
- VARIABLE INTENSITY
- 24 HOUR ALARM
- 5 MINUTE REPEATING SNOOZE ALARM
- ALARM SET INDICATOR
- SNOOZE INDICATOR
- PULSING SECOND INDICATOR
- POWER INTERRUPT INDICATOR
- ALARM CANCEL FEATURES-TILT OPERATION
- ALARM TONE OUTPUT
- A.M. P.M. INDICATOR

**Practical Information**

- **Power Supply:** 110 VAC ± 10% ± 60Hz 230 VAC ± 10% ± 5Hz
- **MANUFACTURED TO HIGH STANDARDS BY A MAJOR AMERICAN ELECTRONICS CORPORATION THIS SUPERBLY STYLED SOLID-STATE TIMEPIECE IS MADE AVAILABLE TO ALL READERS FULLY GUARANTEED.
- **FREE TRIAL IN YOUR HOME. TRY OUT THE CLOCK IN YOUR HOME. IF DIGITAL TIME IS NOT FOR YOU RETURN IT IN ORIGINAL CONDITION WITHIN 10 DAYS AND WE'LL REFUND YOUR MONEY WITHOUT QUESTION.**

**SPECIAL OFFER! £18.95 including VAT and P&P**

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**B. BAMBER ELECTRONICS**

Dept PE, STATION LITTLEPORT, CAMBS, CB6 10E
Telephone: ELY (0353) 860165 (2 lines) Tuesday to Saturday

**Please Send**

- **Electronic clocks as illustrated**
- **Cheque, postal order, money order for £18.95**

**Which includes VAT and postage.**

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**D. B. Bamber Electronics**

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Practical Wireless, August 1976
**TRANSFORMERS**

**Mains Safety Isolating**
Primary 240V, Sec. 190V or 240V.

<table>
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<th>V.A. (watts)</th>
<th>OPEN TYPE</th>
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<th>PLUGS</th>
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**12V or 24V Transformer**

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**MINIATURE TRANSFORMER**

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**348 Practical Wireless, August 1976**
SHORT WAVE BROADCASTS  
by Derek Bell

ONCE upon a time a QSL was all that a BC station ever sent but with the advent of power politics on the radio scene the humble DXer is the target of ideological propaganda pushing all shades of opinion. One has scheds, magazines and extracts from Presidents speeches delivered, and the most unusual I have ever heard of, a consignment of dates! Ken Smith from Ross-on-Wye reports that the Voice of America, one of the most enthusiastic dispensers of literature, has started to lose strength on its Greenville transmitter in the early morning due to the changing pattern of daylight hours. The enthusiasm of this organisation is confirmed by the report from John McCleod of Inverness who says that they are distributing a special Bi-Centennial bookmark in return for reports. John also states that the Adventist World Radio is now giving an address for reports as "The voice of Prophecy," 123 Regent Street, London W1R 7HA.

While dwelling on matters trans-Atlantic, Radio Canada have sent me their new style QSL. This is the one that they require listeners to fill in and send back for verification. It is black with a projection of the globe in orange and white, covered in blue concentric circles. RCI have also sent a sched, with details of their coverage of the Olympic Games starting on July 17 from 0600 to 2230, in blocks of twenty minutes on 11915, 11720, 9680 7155, 6145, 6125 and 1295 in the medium waves. As a rough guide the nearer to midnight GMT the higher the frequency with an odd slot on 15325 at 2159 to 2230. Running down the side of the sched is a handy conversion table of metres to MHz. Although there is a sports slot in every transmission RCI promise special Olympic coverage and for us in the UK. This could mean more up-to-date news than with our own domestic coverage. To me, if I may inject a personal note, this is the true way to use the short wave bands, rather than for purely political motives.

In recent months I have been chuntering on about Latin American stations and the fact that they are heard here most of the year. What we hear are the domestic transmissions serving the inaccessible parts. These stations, since they are for internal listeners, do not seem to bother QSLing anyone overseas. One who is not bothered about QSLs is Roberto Levinstein, a Brazilian student at present in London and on his General TFC2500 he has the time of his life keeping up to date with his homeland every night. Roberto has logged Radio Globo RDJ as early as 1830 on 11805 and the pick of his log is as follows:

- Radio Relógio RDJ on 4906 at 2345
- Radio Rio Mar on 9695 at 0020
- Radio Aparecida on 9635 at 2350
- Radio Clube de Pernambuco on 11865 at 0030

Roberto says that such stations as BBC, Deutsche Welle, RCI, etc don’t seem to care about the LA listener as much as they do about the Europeans. This has not stopped the Brazilians from forming the Clube de Brasil who’s address is Caixa Postal Numero 30, Recife, Pe Brasil. So, for horse’s mouth information, Latin American fans should drop them a line.

Out of the ionosphere our old friend George Hewlett has another goodie for those fans of the time signal stations. He pulsed in VNG Australia the other morn while DXing in the early bright (I wish I could get up that early). This station is only a 10 kilowatt and suffers QRM from Moscow but George assures me they will QSL, the signal is a beat note with verbal at 0745. As I mentioned earlier books and leaflets are a big part of the DX scene and Robin Bayley of Albrighton has sent a list for the novice. These are as follows “Introduction to SW Listening” 59p from Tandy shops, or the Radio Nederland “All-Round DXers Course” free from Radio Nederland, PO Box 222, Hilversum, Holland. The latter is a test course and to complete it questions are set for the student at the end of each block. I take a fatherly attitude to this latter one since when it was being prepared I met the author at an EDXC conference and he was good enough to ask for my thoughts on its contents.

Almost matching the LA and North American countries in the plenteitude of stations is the USSR. Two stations that bother my next correspondents are Stancia Atlantica and Stancia Rodina. Derek Gilbert who is from Farnham, and is the spokesman for a group of three youngsters, assures me they are Russian since they follow Moscow on the same frequency. These stations are a puzzle to me since I must admit to not having heard them so if anyone can cast a ray of light, three youngsters would be obliged.

Having mentioned previously the unwillingness of Latin American stations to QSL L. Pissas of Que Que, Rhodesia has partly proved me wrong! Since I started compiling this month’s column LPs letter has been delivered and he is in somewhat of a puzzlement. He has had a reply from Radio Nueva Esparta, Venezuela in the form of a booklet and two stickers all in Spanish and what seems to be a blank QSL card. Unless the station is following the policy of RCI in having the listener fill in the card and return it for stamping then it must be a case of sloppy secretarial work. The address of this station as given by LP is DX reports Dept., P.O. Box 58, Porlamar, Venezuela. So this would seem that the station is alive to the reports that DXers send in, and it might be worthwhile trying them, so let me know if you have any success.

To continue the address theme John Blackle of Glasgow has offered SBC, 3000, Berne, Switzerland and requires in exchange Radio Cairo which is Engineering Dept. of Propagation, P.O. Box 1186, Cairo, Egypt. One of the favoured ploys of stations is to obtain the address of a listener and put the said listener on a mailing list. This is mentioned by Cameron Lees of Inverne who writes to say that Radio Budapest have started a DX club and want letters to Brody Sandor 5-7, Budapest VIII for de-
tails. This I feel will result in regular items of mail every few weeks that the listener is not interested in, a gripe of DXers and SWLs for years.

David Wyatt of Oswestry has a problem. He has a set that is run from a battery eliminator and it is picking up electrical noise. Well, given that the earth is good, all that I can say from this distance is that it might be worth while running the set as far away from sources of noise such as mains cable, electric motors and colour TV sets. Having said that I must admit that in areas where there is a lot of industrial plant then machines, especially with thyristor devices, can play havoc and short of complaining to the Post Office, not a lot can be done. Despite the "mush" David logs the following:

Radio Pekin on 6270 at 2130
Voice of Vietnam on 15012 at 1808
Pakistan on 17910 at 1100
Radio Kuwait on 9555 at 1700
Radio New Zealand on 9540 at 0800

From Berkshire, to be exact the QTH of Bill Reid, comes the final log this month. Using a Yaesu FR101 with an old faithful Joymatch ATU hung on the end of a 60-foot inverted L, Bill reports Radio Grenada on 1510S at 2130 and a rarity 4EVH Haiti on 11835 at 2330. That rounds things up for this month I am sorry that space does not permit the inclusion of several letters from this months exceptionally heavy post bag, so 73s to you and yours.

Broadcast Bands

Medium Wave DX
by Charles Molloy

Reports again from Harold Emblem, of Mirfield in Yorkshire, with a log of summertime North American DX. Using his Eddystone 730 and medium wave loop aerial he heard three stations in Newfoundland; CBN in St. John’s on 640kHz, CKVO in Clarenville on 710kHz and CJON St. John’s on 850kHz. Others heard were WINS in New York City on 1010kHz, WCAU in Philadelphia on 1210kHz, WMEX in Boston on 1510kHz and a new Canadian outlet, CIGO in Port Hawkesbury, NS on 1410kHz. CIGO, which identifies as "Go Radio C-I-G-O" or "Cigo Radio" is located on Cape Breton Island. It transmits with a power of 10kW into a directional aerial which has a lobe pointing along the great circle bearing to the UK. Harold’s reception report was the first received from England since the station came on the air last October. The address for reception reports is "Eastern Broadcasters Ltd, PO Box 1410, Port Hawkesbury, NS, BOE 2VO, Canada.

A fine catch Harold and congratulations on being the first from England!

Robin Beyley who writes from Albrighton, Staffs, is a newcomer to the band. With his Grundig Prima Boy and internal ferrite rod aerial he logged Trans World Radio, Montecarlo on 1466kHz and an unidentified signal with the call LIC in morse, at the LF end of the band, below Athlone on 566kHz. LIC is the call of a radio beacon which is used for navigation. It is located at Lichfield in the UK and transmits on 543.5kHz just inside the lower limit of the medium waveband. Robin is constructing a medium wave loop which he hopes will help him to pull in some North American DX.

The DXer can check if an ATU is likely to give improved results with his receiver and aerial. A tapped inductor can be made by close winding 24 turns of insulated wire on a ¾in diameter insulated former, the tappings being a loop made on every second turn. The aerial goes to one side of the inductor and the other side is led to the receiver aerial socket. A flying lead from one end of the inductor ends on a crocodile clip which can be attached to any tap. Two 500pF variable capacitors are used. The fixed vanes of each are connected together and are joined to the receiver earth terminal and the earth lead. The moving vanes of one capacitor go to one side of the inductor and the moving vanes of the second capacitor are connected to the other side of the inductor. By varying the position of the croc clip and adjusting the two capacitors, the optimum setting can be found. An ATU may be suitable for use with a portable receiver that has only a single socket for use with an external aerial.

A further report from Harold Emblem gives a rundown of his efforts to log Turkish stations. Izmir on 926kHz, and Istanbul on 1016kHz are described as easy. Diyarbakir on 1061kHz as more difficult while Cukurova on 629kHz and Antalya on 890kHz are unexpectedly hard. Istanbul on 701kHz is often clear after 0100. Turkish medium and long wave stations would not, until recently, reply to a reception report. This policy seems to have changed and medium wave DXers who have Turkey on their "wanted list" now have the chance of adding to their list of Asiatic countries verified. The address for reception reports, which should be accompanied by an International Reply Coupon and perhaps a report of a Turkish shortwave transmission as well, is:—The Chief Engineer, Turkish Radio and Television Corporation, Mithatpasă Caddesi No 57, Ankara. Turkish medium and long wave stations identify on the hour and sometimes on the half hour as well, with "Burasi Turki". (Careful! Methinks Istanbul counts as Europe!—AED.)

Any country can use a common frequency provided it does not cause interference to other users. The BBC uses both channels for local radio, so DXing in some parts of the UK will only be possible between midnight and 0600. It is always worth checking these two frequencies especially during the small hours in summer. The technique is to stay on a channel for a time and hope that the slow fading, so characteristic of MW propagation, will produce a surprise. A loop aerial is a help with QRM. The writer's best catch on 1484 was a 250W American Forces station in the US base at Kenitra in Morocco, which was heard at sunrise during the month of June.

See Page 338 for reports addresses
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Practical Wireless, August 1976
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The watch normally displays HRS. and MINS. with MONTH, DAY and SECONDS on demand. The owner selects the feature where the HRS. and MINS. or MONTH and DAY display alternately for 2 second intervals until owner resets to normal display. During the alternating cycle seconds are still available on demand.

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SCRAMPI

SCRAMPI is a microprocessor kit system; it builds up into a complete micro-computer with 64K memory, VDU, cassette, I/O, teletype I/O, etc.

PART 1 should be available early in July and is presented as a facia and PCB kit to fit a standard 19" Vero case (or can be used as a stand-alone).

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