Microwave intruder alarm

Multiphonic organ

Townsman aerial
Wireless World, February 1980

FOCUS INTENSITY

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FOR

FURTHER

DETAILS

Front cover shows thyristor stack with heat sinks, made by Pinnacle Electronics Ltd. Photographer: Paul Brierley.

IN OUR NEXT ISSUE

Pulse-induction metal detector incorporates method of eliminating magnetic viscosity effects

Electronic security lock uses m.n.o.s. non-volatile devices to give a four-digit combination which is vulnerable to power cuts

Acoustic measurement without the use of an-echoic conditions is described

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ISSN 0043 6062
FOCUS INTENSITY GRATICULE VERTICAL CURVE RACER TEST ENTRY OFF SET STP SPO LARI TY.

FOR FURTHER DETAILS

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- DC–20 KHZ at full power
- 0.005% harmonic distortion (typical) at 300w r.m.s. into 2.5 ohms
- 3KW dissipation from in-built force cooled dissipators

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- Full short and open circuit protection
- Drives totally reactive loads with no adverse effects

A complete range of matching transformers and peripheral equipment for closed loop, constant current and voltage use are available. Alternative input and output termination to order. Rack case for bench use built to specifications. For complete data write or call.

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HM 412 Dual Trace DC-20 MHz, 2mV/cm
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Sweep Speeds 20 ns - 5 mV/cm plus Sweep Delay £580
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A new addition to a great range of precision tools.

With the famous P1 and P2 drills now firmly established, Precision Petite have now produced the P3 hand drill with UNIVERSAL CHUCK so that all the accessories associated with the P1 & P2 can be quickly interchanged without changing the chuck. This will save considerably on the time factor where absolute accuracy is not highly essential. Employes the same motor and has the same characteristics as the P2 drill without removable head, and fits the S2 Drill Stand. Send for details of this reliable and robust new drill and accessories now and save yourself those valuable moments. SAF please.

See it at CHAF in Action Exhibition Royal Agricultural Show Hall. 13-15 Oct.

S2 DRILL STAND will accept P1, P2 and P3 drills. £17.95 inc. VAT

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Quantum Electronics
NEW PRODUCTS — NEW PRODUCTS

Our product range for the 80s is outlined below but it is impossible to cover everything in such a small space. For detailed information and a price list send a large S.A.E. or a dollar bill.

PRE-AMP & POWER AMP KITS

The pre-amp is now available in kit form in versions to suit any cartridge and consists of the module C1 below and the hardware kit HK1. No soldering is involved and assembly takes about 20 mins. There are six power amp kits, four mono and two stereo, from 45 to 260W to satisfy virtually every requirement. They use multi-built and braided p.c. boards to achieve an ease of construction similar to module based kits at lower cost. These are also multi supply kits to enable independent use of the pre-amp, which is normally powered via our power amp. Similar equipment is also available ready-built from us or via our dealers.

C1 + HK1 £68.70
C1mc + HK1 £70.95
P3 (stereo 45W per channel) kit £87.28
P4 (stereo 110W per channel) kit £108.42

MOVING-COIL & PRE-AMP MODULES

Previously restricted to trade and export, the C1 pre-amp module is now available separately in 3 versions to match any cartridge. It has unexcelled specifications, open for disc, auxiliary and 2 or 3 head tape machines and requires only a rough supply of ± 18 to ± 35V d.c. The new moving coil pre-amp achieves low thd, high overload, good r.f. rejection and good noise performance without resorting to the expensive multiple transistor design. Oxide resistors are used in the signal path and it can be powered either via the mains or a battery. Standard kits are available to build both types and they are also available ready-built.

MC1 Module £22.25. C1 Module £48.50. C1mc £51.75

POWER AMP MODULES AND SUPPLIES

The power amp modules are now also available to retail customers in a variety of powers and formats up to 260W r.m.s. They use the same high performance circuitry as the kits above, giving thd below 0.1% at 1kHz, but are capable of sustained high level use with excellent reliability. There are power supplies for use with any one or two of these modules, all of which use toroidal transformers. All available separately. The smallest type illustrated is a medium duty 150W r.m.s. type, the M1508, which requires the MS2 power supply.

M1508 £36.75. MS2 £28.28

Exports: We can deal efficiently with orders to any country. Please write with your specific requirements for a quote by return. All equipment is wired for 110V mains.

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MINIC TELEPRODUCTOR, BOX 12035, 5-709 12, UPSALA 12, SWEDEN
L.A.B. (A.P.S.), VANDAKUNSTEN 4, DK 1447, COPENHAGEN, DENMARK
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for the man in a hurry...

With the famous P1 and P2 drills now firmly established, Precision Petite have now produced the P3 hand drill with UNIVERSAL CHUCK so that all the accessories associated with the P1 & 2 can be quickly interchanged without changing the chuck. This will save considerably on the time factor where absolute accuracy is not highly essential. Employs the same motor and has the same characteristics as the P2 drill without removable head, and fits the S2 Drill Stand.

S2 Drill Stand will accept P1, P2 and P3 drills

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S2 Drill Stand

Wall - 007 for further details

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Genuine Gold Lion valves - hand built, utilising advanced pumping techniques and individually tested to a tight specification - are your answer to the high quality sound demands made by musicians and listeners alike.

Gold Lion KT77 and KT88’s covering 30-200 watts, are now available from M-OV along with data and distribution details. Find out all about the King of Quality - from M-OV.

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Dual output power supplies

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- Find out all about the King of Quality — from M-OV.

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Dual output power supplies

Now you can get on-cord dual output power supplies from Vero Systems as well.

<table>
<thead>
<tr>
<th>ORDER CODE</th>
<th>POWER LEVELS</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>DE6 3 Volts</td>
</tr>
<tr>
<td></td>
<td>DE6 5 Volts</td>
</tr>
<tr>
<td></td>
<td>DE12 3 Volts</td>
</tr>
<tr>
<td></td>
<td>DE12 5 Volts</td>
</tr>
<tr>
<td></td>
<td>MIXED 5 and 15 Volts</td>
</tr>
</tbody>
</table>

Each supply is fully regulated with independent current and thermal protection.

The cards are supplied fully tested and complete with AC-DC plug, cord handle and connection chain.

Please call or write for complete details.

For full details on these and other models, contact the M-OV sales agents, LOWE ELECTRONICS.
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- Probe test output
- Wide time base range
- Switched mode power supply
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- DC-15 MHz bandwidth over the entire screen
- Probe test output
- Wide time base range
- Switched mode power supply

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PRE-AMP KIT

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Now this technology is available to you, in 19" rackmount format with models from 150 to 800 Watts and upwards in multiples, using the X300 frequency dividing network.

So if you’re thinking that our thinking was along the right lines, then drop us a line yourself and we’ll tell you much more.

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  - 40dB, slew-rate 3V/uS; input is suitable for 20kHz. We now offer full back-up service.

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  - Power amplifiers up to 250W, for the best possible output power.
  - MC 1-12: variable frequency amplifier.
  - MC 1-12: MOS-FET.

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- The kit includes all necessary instructions and hardware, plus a complete pre-amp with the CPR 1-70 module and the MC 1-12 module integrated.

**AMPLIFIER MODULE**

- **THERMAL CUT-OFF, SVC**
  - 150W/200W/250W.
  - 500W.

**PRE-AMP KIT**

- The kit includes all necessary instructions and hardware, plus a complete pre-amp with the CPR 1-70 module and the MC 1-12 module integrated.

**REG 1-150**

- 150W/200W/250W.

**REG 1-12**

- 120-240VAC, 50/60Hz.

**TOROIDAL TRANSFORMER**

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  - Output: 100V/200V.
  - Input: 120-240VAC.

**CPS1**

- 100W.

**CPS2**

- 200W.

**CPS3**

- 500W.

**CPS4**

- 1000W.

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**FEBRUARY 1980**
The Pro Master sound system is not an evolution... it's a full-blown REVOLUTION!

The Pro Master modular sound system ushers in a new generation of sound system versatility, reliability, and quality for today's entertainers, musicians, and speakers — for use in settings as diverse as intimate clubs, lounges, large auditoriums, churches, and schools. Its multitude of performance-proven features is the result of sophisticated computer design techniques, advanced materials, and countless hours of personal consultation with performers and sound technicians.

Revolutionary New Console
Finally! The best of both worlds. A console so easy to use that it won't overwhelm the beginning group, yet with the advanced features and capabilities required by experienced professional performers — such as pre-fader monitor mixing, effects and built-in reverb, with their own tone controls.

Revolutionary Variable Dispersion Sound System
Advanced new variable dispersion high-frequency horn system projects your sound — everywhere in the house, giving you a choice of 60° or 120° dispersion with the twist of a knob.

Revolutionary New Loudspeaker
Every extra ounce — every unnecessary cubic inch — has been computer designed OUT of the Pro Master loudspeaker. Modern materials and molding techniques accommodate a high-performance 15-inch woofer and a high-frequency horn and compression driver in a startlingly small, efficient enclosure. Less than 28 inches high, 23 inches wide, 15 inches deep. Weighs an easy-to-handle 58 pounds.

Revolutionary: LED Status Indicators
Alerts you to developing trouble before it gets serious! You have time to correct the problem before it affects the performance. Temperature warning LED warns you if the amplifier is overheating. Shutdown LED indicates power amplifier and speaker protection system activation. Only the power amplifier is shut down until the internal cooling fan lowers the temperature.

Revolutionary: Feedback Finder™
Controls feedback — the number one enemy of a successful performance. Feedback Finder visually indicates the troublesome frequencies for precise adjustment of the twin 10-band equalizers. Enables you to expand for maximum gain on the house and/or monitor system. Nothing else like it!

Revolutionary: Patch Block™
Patch panel with 12 patching jacks located at appropriate points on the block diagram and patch panel for the first time, the PATCH BLOCK™ gives you all the capabilities — plus features that you can't find in any other console. At any price! Unique FEEDBACK FINDER™ circuit, exclusive PATCH BLOCK™ patch panel, wide-range LED peak output and input clipping indicators. Plus pre-fader monitor send controls. LED power amp overload, temperature warning and shutdown indicators. 8 to 30 dB input attenuators, full stereo features, simplicity and effects and/or built-in reverb, with their own tone controls.

The back panel is a unique combination block diagram and patch panel with 12 patching jacks located at appropriate points on the block diagram. For the beginner who is taking his act on the road for the first time, the Pro Master works "as is", with no special connections. But with the Patch Block, the professional can create a wide variety of setups and add auxiliary equipment without makeshift connections. And you can change setups at a moment's notice without confusion. Simplicity and versatility, the Pro Master has them both.
fact: the Pro Master™ sound system is not an evolution... it's a full-blown REVOLUTION!

The PRO MASTER modular sound system ushered in a new generation of sound system versatility, reliability, and quality for today's entertainers, musicians, and speakers — for use in settings as diverse as intimate clubs, lounges, large auditoriums, churches, and schools. Its multitude of performance-proven features is the result of sophisticated computer design techniques, advanced materials, and countless hours of personal consultation with performers and sound technicians.

Revolutionary New Console

Finally! The best of both worlds. A console so easy to use that it won't overwhelm the beginner, yet with the advanced features and capabilities required by experienced professional performers — such as pre-fader monitor mixing, effects and/or built-in reverb, with their own tone controls, LED clipping indicators, attenuators on each input, and full patching facilities for every system component. Super power: Dual 200-watt solid-state power amplifiers. Dual mic inputs as a stereo recording console for groups that want to "lay down a few tracks" without paying for studio time, or can be used as an ultra-sophisticated keyboard mixer with power, plus pre-fader monitor send controls, LED peak indicators virtually make VU meters obsolete. They respond to short transients that wouldn't budge a needle, and cover 42 dB without range switching. PA overload LED warns you if amplifier is overheating. Shutdown LED indicates power amplifier and speaker protection system activation. Only the power amplifiers are shut down until the internal cooling fan lowers the temperature.

Revolutionary: Variable Dispersion Sound System

Advanced new variable dispersion high-frequency horn system projects your sound — everywhere it's needed, giving you a choice of 60° long throw or 120° wide angle dispersion with the twist of a knob. Takes the sound to the room — even L-shaped rooms.

Revolutionary New Loudspeaker

Every extra ounce — even unnecessary cubic inch — has been computer designed OUT of the PRO MASTER loudspeaker. Modern materials and molding techniques accommodate a high performance 15-inch woofer and a high-frequency horn and compression driver in a startlingly small, efficient enclosure. Less than 28 inches high, 23 inches wide, 16 inches deep. Weighs an easy-to-handle 58 pounds. Yet, the power handling capacity is a remarkable 120 watts, and the frequency response is 50 to 15 kHz.}

Replacing All This Equipment... And Does More!

The impressive array at left includes a mixing console, two graphic equalizers, a pair of 300 watt power amps, a monitor mixer and an octave analyzer. The PRO MASTER gives you all these capabilities — plus features that you can't find in any other console, at any price. Unique REVOLUTION™ circuit, exclusive PATCH BLOCK™, patch panel, wide-range LED peak output and input clipping indicators. Plus pre-fader monitor send controls. LED power amp overload, temperature warning and shutdown indicators. On 30 db input attenuators, full stereo features, simple remote switching and a wide variety of effects and/or built-in reverb, with their own tone controls, LED peak indicators virtually make VU meters obsolete. They respond to short transients that wouldn't budge a needle, and cover 42 dB without range switching. PA overload LEDs light and alarm. And, if an overload causes problems such as bad speaker cables or too many speakers...

Revolutionary: LED Status Indicators

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The back panel is a unique combination block diagram and patch panel with 12 patching jacks located at appropriate points on the block diagram. For the beginner who is taking his act on the road for the first time, the PRO MASTER works "as is," with no special connections. But with the PATCH BLOCK, the professional can create a wide variety of setups and add auxiliary equipment without making direct connections. And you can change setups at a moment's notice without confusion. Simplicity and versatility, the PRO MASTER has them both.
Top value test equipment from TANDY

LCD DIGITAL MULTIMETER
Low-cost handheld digital multimeter with a full 3½ digit LCD display, 0.5% basic accuracy, auto polarity operation, 10 MΩ input impedance.

COMPONENTS AND PARTS

<table>
<thead>
<tr>
<th>CAT. NO.</th>
<th>DESCRIPTION</th>
<th>PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>276-032</td>
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<td>276-342</td>
<td>LCD 3½ Digit</td>
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LOW-COST LCD MULTIMETER
A portable, compact sized multimeter with a full 3½ digit LCD display. 0.5% basic accuracy, auto polarity operation, low current indicator. 10 MΩ input impedance.

AC/DC 8 MHz OSCILLOSCOPE
A new approved BMHC version of last year's winner! The advance design features of this oscilloscope make it an absolute essential for industrial use production lines, in laboratories and schools. Ideal for radio and TV servicing, audio testing, etc.

Specifications:
- Horizontal axis: Deflection sensitivity better than 250mV/div.
- Vertical axis: Deflection sensitivity better than 10mV/div.
- Bandwidth: 8MHz.
- Input impedance: 1MΩ parallel 100kΩ.
- Timebase: Sweep range: 1µs-200ms/div.
- Connection: AC powered, 230VAC.

PRICE

AC/DC 8 MHz OSCILLOSCOPE

EXHIBITIONS WORLD, FEBRUARY 1980

Finally, you can have all the advantages of DMMs and none of the disadvantages of analogues for about the same price.

Our new 169 is a tough, lightweight, battery-powered digital multimeter for use in the field or on the bench. It is a 3½ digit, full 5-function DMM with respectable 2½% DC accuracy.

Its low-parts-count, high-efficiency design keeps power consumption to a minimum for longer component life and fewer failures. MTBF is 20,000 hrs. or about 10 years.

All 5 functions are fully protected – 1400V peak on DCV and ACV, 500V on Ω, 2A (250V) on DCA and ACA. The fuse is externally accessible for quick replacement. Extensive vibration stress-testing assures the 169 will stand up to all the mechanical shock and abuse normally associated with tough applications.

Cost-conscious ease of maintenance is so thoroughly designed into the 169 that only one calibration adjustment a year is required. That adds up to a cost-of-ownership no other competitive DMM can touch. For example, the 169 needs only one battery change per year at a cost of about £1.50.

When you factor in features like function and range announcement right on the display, auto-zero, auto polarity, 60% larger display than other DMMs and the easy-to-read, colour coded front panel, we think you'll get the point.

No analogue meter or DMM can match the price/performance of the new 169. It costs £99 (plus VAT).

For information on the 169 or any Keithley DMM call (0734) 861287

Keithley Instruments Ltd.
1, Boulton Road
GB Reading, Berkshire RG2 1QJ

Keithley Instruments GmbH
Heighlhoofstrasse 5
0-800 München 70
(089) 714-40-60
Tel: 21 21 60

Keithley Instruments SARL
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LCD DIGITAL MULTIMETER.
Low-cost handheld digital multimeter with a full 3½-digit LCD display. 0.5% basic accuracy, auto polarity, 10 MΩ DC input impedance. Reading in 1980.

LOW-COST LCD MULTIMETER
A portable, compact sized multimeter with a full 3½-digit LCD display. 0.5% basic accuracy, auto polarity, low battery indication, 10MΩ DC input impedance.

COMPONENTS AND PARTS

| CM No. | DESCRIPTION | PRICE
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<thead>
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AC/DC 8 MHz OSCILLOSCOPE
A new approved BMHC version of last year's winner! The advance design features of this oscilloscope make it an absolute essential for industrial use and production lines, in laboratories and schools. Ideal for radio and TV servicing, audio testing, etc.

Specifications:
- Horizontal axis: Deflection sensitivity better than 250mV/div. Vertical axis: Deflection sensitivity better than 10mV/div.
- Bandwidth: DC to 8MHz.
- Input impedance: 10kΩ parallel shorted, 200Ω parallel open.
- Timebase: Sweep range: 1μs/div.

Price: £137.36

Is this the end for Analogue meters?

Finally, you can have all the advantages of DMMs and none of the disadvantages of analogues for about the same price.

Our new 169 is a tough, lightweight, battery-powered digital multimeter for use in the field or on the bench. It is a 1½-digit, full 5-function DMM with respectable 25% DC accuracy.

Its low-parts-count, high-efficiency design keeps power consumption to a minimum for longer component life and fewer failures. MTBF is 20,000 hrs. or about 10 years.

All 5 functions are fully protected -- 1400V peak on DCV and ACV, 300V on Ω.

When you factor in features like function and range announcement right on the display, auto-zero, auto polarity, 60% larger display than other DMMs and the easy-to-read, colour-coded front panel, you think you’ll get the point.

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

**Oscilloscopes**

**TEKTRONIX 465**

- DC-100MHz Dual Trace 5mV-5V / Div
- 0.05μs-0.5μs / Div Delayed T/B XY DC 4MHz

Price: £1200

**TEKTRONIX 475A**

- DC-250MHz Dual Trace 5mV-5V / Div
- 0.01μs-0.5μs / Div Delayed T/B XY DC 3MHz

Price: £1950

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DC-250MHz Dual Trace 5mV-5V / Div 0.01µs-0.5µs / Div Delayed T / B XY DC 3MHz

Oscilloscopes

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**MEMORY**

- 24 Monitor ROM
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**INTERFACES**

STANDALONE FULL ASCII 100 keyboard (or 32, 64 characters per 16 lines)

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Each stage has separate by a 3A/4SW/R dip switch to simplify installation and freedom from cross talk.

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- Runs with North Star controller and Floppies/CFM.

EXPLORER / 85 is expandable to meet your own requirements with easy to obtain S-100 compatible add on cards. EXPLORER / 85 can be purchased in individual levels, kit form or wired and tested. OR as a package deal as below.

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Atari's Video Computer System now offers more than 1300 different games variations and options in 16-port cassette (Novice Program) - additional video equipment.

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The Newtronics Keyboard Terminal is a low cost stand alone Video Terminal that operates upright or suspended on a wall. It will allow you to display on a monitor 19 lines of 64 characters or 16 lines of 32 characters (or 32 video characters if a TV monitor is required).

The characters can be any of the 96 ASCII II characters and any of the 32 special characters, in addition to upper/lower case capability, it has scroll up features and full 5x5 pixel control. All of which is requested by a simple ASCII format string, it also gives the option of a 20mA loop serial data plus a power supply of 5v and 6.3v AC. The steel cabinet is unbreakable and the light weight makes it easy to transport. And being robust enough the price is only £114.20 + VAT as kit, or £146.20 + VAT assembled and tested. Plus £2 P&P (Monitor not included).

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Please add VAT to all prices (except monitors) P&P £1.2. Please make cheques payable to NEWTRONICS or phone your order quoting BARKLEY/ARMFIELD, ACCESS number.

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WITH ON BOARD S-100 EXPANSION

FLEXIBILITY: Real flexibility at last! The EXPLORER / 85 features the Intel 8085 cpu 100% compatible with all 8080A and 8085 software. Runs at 3MHz. Mother Board (Level A) with 2, S-100 exploitation exposable to 8 level C.

MEMORY
24 Monitor ROM
4K WORKSPACE / USER RAM
1k Video RAM
8K Microsoft Basic in ROM or Cassette.

INTERFACE
STANDALONE FULL ASCII Keyboard Terminal, 32 / 64 characters per line
Cassette interface (with monitor control and cassette file structure)
RS-232 / 20mA loop, 4, 8, 16, 32 bit I/O ports, programmable 16bit binary counter/timer.
Direct interface for any S-100 Board.

FULL Buffering according to S-100 Bus pads, wait state generator for slow memory.

Each stage has separate by 1A regulator for improved isolation and freedom from cross talk.

S-100 requirements. 8v 3.3v AC.

Runs with North Star controller and Floppies / CFM.

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£9.75
£12.75

£13.17
£13.17
£6.30
£9.75

£9.75
£6.30
£9.75
£12.75

£2 P&P (Monitor not included).

£10.93 C22ES02
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NEWTRONICS KEYBOARD TERMINAL AT £114.20 + VAT

The Newtronics Keyboard Terminal is a low cost stand alone Video Terminal that operates entirely on an expansion free S-100 bus. It will accept a VDU or display on a monitor 16 lines of 64 characters or 16 lines of 32 characters, and receive either keyboard or TV (VIF Modulator required).

The characters can be any of the 96 ASCII II alaphaucents and any of the 32 special characters, in addition to upper / lower case capability, it has scroll-up features and fully programmable control. All that is required is the 'VIF' Modulator and a 20mA loop serial data plus a power supply of 5v DC and 3.3v AC. The steel cabinets is 1U high, and will fit on any shelf. And if that is not enough the price is only £114.20 + VAT as a kit, or £144.20 + VAT assembled and tested. Plus £2 P&P (Monitor not included).

£625+VAT

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£19.00

£57.50
£19.00

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- LMM-100 £26.04
- TEST LEADS £5.20

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Address: 

Telephone: 

Nature of enquiry:

Email: 

Lascar Electronics Ltd., Unit 1, Thomson Road, Basildon, Essex, Telephone No: Basildon (027) 7247876.
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**PA GROUP & DISCO UNITS**

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**CARREGAGE 2/18**

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**ALL PRICES INCLUDE VAT @ 15%**

*Send 30p stamp for free 38 page catalogue 'Choosing a Speaker'*

*Telephone Service on lightning powered speaker credit cards only*

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**PORTABLE PRECISION**

A RANGE OF 24V 12V-30V DC METER OFFERING HIGH-PRECISION AND EXTENDED BATTERY LIFE, WITH FEATURE FIVE FUNCTION OPERATION AC AND DC VOLS., AC AND DC CURRENT, RESISTANCE WITH ABILITY TO CHECK DOLLS 0.6" LCD DISPLAY WITH BATTERY LOW WARNING AUTOMATIC-POLARITY, AUTO-ZERO FULL PROTECTION AGAINST TRANSDIERS AND OVERLOADS WITH ABILITY TO WITHSTAND MAINS ON ANY RANGE RUGGED AIRCASES AND COMPLETE 1 YEAR WARRANTY. The LMM-200 is a compact handheld multimeter with 0.5% basic accuracy and 0.1% basic accuracy at any range. It measures AC/DC voltage from 0.1mV to 500V, AC/DC current from 0.1 µA to 2A, and resistance from 0.1 to 2MΩ. The battery life is 110 hours. The LMM-200 is a high-performance instrument with a 0.1% basic accuracy. The LMM-100 is suitable for a variety of applications, such as measuring electric circuits, checking batteries, and testing electronic devices. It features a large, easy-to-read LCD display and an automatic power-down function. It is designed to withstand rough handling and is ideal for professionals and hobbyists alike.
NEW FROM BARMECO
Introducing a new 3-element H.F. Tribander with proven performance and reliability
THE WORLD RANGER TRIBANDER

SPECIFICATION:

- Designed, engineered and manufactured in the U.K. using high-grade materials.
- Ensures high electrical stability under all weather conditions with exceptional mechanical rigidity and strength. All traps are high grade F.F.E. formers with interleaved windings.

Frequency: 10, 15 & 20 metres
Impedance: 52 ohms
R.F. Power (max.)
- 2 kW (PTT)
- 1 kW (AM)
VSWR (Max. ristung): Less than 2:1
Forward gain: Up to 8.0 dB
From-to-back ratio: 26 dB
Max. diameter: 31.75mm to 41.30mm
Wind survival: 80 mph
Turning radius: 14 10°
Longest element: 26' 0"
Boom length: 12' 0"
Net weight: 21 lbs

Price: £45.00 complete with Balun, plus carriage @ £3.50. High quality 50 ohm coaxial cable available @ 50p per metre. Balun available separately @ £12.50 each. All items subject to current VAT.

COMING SOON: A range of HF Monobanders and a 2 meter base station vertical.

Orders to:
BARNET METAL & CAR CO. LTD.
21 Emily Rd, Wembley, Middlesex, Middx.
Telephone: Wembley 24327, Telex: 28123, Cable: BARMECO

ELECTRONIC INDUSTRIAL THERMOMETER

TMEC

15 Rose Lane, Billesbade, Beds.

WWW FOR FURTHER DETAILS

THE MODERN WAY TO MEASURE TEMPERATURE

A Thermometer designed to operate as an Electronic Test Meter. Will measure temperature of Air, Meta., Liquid, Metal, Wood, etc. Just plug-in the Probe, and note the temperature on the large scale meter. Supplied with carrying case, mains and internal 1 1/2 volt standard size battery.

Model: "S" measures from —40° C to +70° C
Model: "S/2" measures from 0° C to +100° C (PYRO) £38.00
Model: "MINI-2" measures from —20° C to +120° C

(CAT 15% EXTRA)

Write for further details.

HARRIS ELECTRONICS (LONDON) LTD.
138 Gray’s Inn Road, London, WC1X 8AX
(Phone: 01-837 7937)

WWW FOR FURTHER DETAILS

CASED INVERTERS

Assembled in attractive instrument cases with carrying handles.

Squarewave output or filtered DC input: 12v or 24v types. Frequency: 50hz ± 5%. AC input 240v or 110v types off load. Panel voltage meter indicator. Reverse polarity protection. DC and AC circuitry fused. Mains output via 13A type plug. 2 year guarantee.

- SD/1-8"X8"X150 watts £24.00
- SD/2-8"X8"X300 watts £64.00
- SD/3-10"X8"X500 watts £100.00
- SD/4-10"X8"X600 watts £78.00
- SD/5-10"X8"X800 watts £125.00
- SD/6-10"X8"X1000 watts £155.00
- SD/7-12"X8"X600 watts £115.00
- SD/8-12"X8"X1000 watts £160.00

Filtered output 18% extra

SINEWAVE INVERTERS

A new range of units designed to provide power during a smooth waveform.

Assembled in tough instrument cases with carrying handles. DC input: 12v or 24v types (± 2%). DC output: 240v or 110v types off load. Frequency: 50hz ± 3%. Panel meter indicates voltage output. Reverse polarity protection. Fully fused DC and AC circuits. 2 year guarantee.

- DD/1-100 watts £90.00
- DD/2-100 watts £90.00
- DD/3-200 watts £160.00
- DD/4-300 watts £160.00
- DD/5-500 watts £390.00
- DD/6-500 watts £390.00
- DD/7-500 watts £390.00
- DD/8-500 watts £300.00

SPECIAL CONVERTERS

In response to customers’ requests we have included the range of special cases.

All units are assembled in tough ABS cases approx 4½"x4½"x4½".

- TD/1-12V DC in 24V DC 400 out £18.00
- TD/2-12V DC in 24V DC 400 out £26.00
- TD/3-24V DC in 48V DC 400 out £18.00
- TD/4-24V DC in 48V DC 400 out £18.00
- TD/5-12V DC in 12V DC 20 out £17.00

Terms of Business:

AUTO/MAINS INVERTER UNITS

These units maintain a source of AC mains power throughout any interruptions in the domestic supply. Assembled in smart instrument cases the units incorporate a built-in inverter, battery charger and full automatic switching circuits. Mains input required 230/240v AC. Inverter output 220/240v AC. DC/F.H. Frequency 50Hz ± 2% - 2 year guarantee.

- LMC/1-90 watts £84.00
- LMC/2-150 watts £84.00
- LMC/3-150 watts £84.00
- LMC/4-150 watts £84.00
- LMC/5-150 watts £84.00
- LMC/6-150 watts £84.00
- LMC/7-150 watts £84.00
- LMC/8-150 watts £84.00
- LMC/9-150 watts £84.00
- LMC/10-150 watts £84.00
- LMC/11-150 watts £84.00
- LMC/12-150 watts £84.00
- LMC/13-150 watts £84.00
- LMC/14-150 watts £84.00
- LMC/15-150 watts £84.00
- LMC/16-150 watts £84.00
- LMC/17-150 watts £84.00
- LMC/18-150 watts £84.00
- LMC/19-150 watts £84.00
- LMC/20-150 watts £84.00

INVERTER PANELS

A range of simple aluminium sheet assembled units without any fuses, inputs and outputs by polarity colour-coded leads.

- PA/1-24V AC/DC £15.00
- PA/2-24V AC/DC £18.00
- PA/3-24V AC/DC £18.00
- PA/4-24V AC/DC £18.00
- PA/5-24V AC/DC £18.00
- PA/6-24V AC/DC £18.00
- PA/7-24V AC/DC £18.00
- PA/8-24V AC/DC £18.00
- PA/9-24V AC/DC £18.00
- PA/10-24V AC/DC £18.00
- PA/11-24V AC/DC £18.00
- PA/12-24V AC/DC £18.00
- PA/13-24V AC/DC £18.00
- PA/14-24V AC/DC £18.00
- PA/15-24V AC/DC £18.00
- PA/16-24V AC/DC £18.00
- PA/17-24V AC/DC £18.00
- PA/18-24V AC/DC £18.00
- PA/19-24V AC/DC £18.00
- PA/20-24V AC/DC £18.00

BATTERY INVERTER PANELS

- BA/1-600 watts £200.00
- BA/2-900 watts £249.00
- BA/3-1200 watts £299.00
- BA/4-1500 watts £349.00
- BA/5-1800 watts £399.00
- BA/6-2100 watts £449.00
- BA/7-2400 watts £499.00
- BA/8-2700 watts £549.00
- BA/9-2900 watts £599.00
- BA/10-3200 watts £649.00
- BA/11-3500 watts £699.00
- BA/12-3800 watts £749.00
- BA/13-4100 watts £799.00
- BA/14-4400 watts £849.00
- BA/15-4800 watts £899.00
- BA/16-5100 watts £949.00
- BA/17-5500 watts £999.00
- BA/18-5900 watts £1,049.00
- BA/19-6300 watts £1,099.00
- BA/20-6700 watts £1,149.00
- BA/21-7200 watts £1,199.00
- BA/22-7700 watts £1,249.00
- BA/23-8200 watts £1,299.00
- BA/24-8700 watts £1,349.00
- BA/25-9200 watts £1,399.00
- BA/26-9800 watts £1,449.00
- BA/27-10300 watts £1,499.00

ELOHURST LIMITED

104A BRACKENBURY ROAD, LONDON, W.6
Telex: 8954666. GITS G ELECT.
TEL: 01-748 5778

INVERTERS ARE OUR BUSINESS

www.americanradiohistory.com
NEW FROM BARMECO

Introducing a new 3-element H.F. Tribander with proven performance and reliability.

**THE WORLD RANGER TRIBANDER**

Designed, engineered and manufactured in the U.K. with tough extruded P.T.F.E. material, ensures high electrical stability under all weather conditions with exceptional mechanical rigidity and strength. All traps are high grade P.T.F.E. formers with inserted windings.

**SPECIFICATION:**

- Frequency: 10, 15 & 20 metres
- Impedance: 52 ohms
- R.F. Power (max.): 3 kW (P.E.P.)
- VSWR (antenna): Less than 2:1
- Forward gain: Up to 8.0 dB
- From-to-back ratio: 22 dB
- Diameter: 31.75mm to 41.30mm
- Wind radius: 80 mph
- Turning radius: 14 1/2
- Longest element: 26' 0"'
- Boom length: 18' 0"'
- Net weight: 21 lbs

Price: £145.00 complete with Balun, plus carriage at £3.50. High quality 50ohm coaxial cable available at 50p per metre. Balun available separately at £12.50 each. All items subject to current VAT.

COMING SOON: A range of HF Monobanders and a 2 meter base station vertical.

Orders to:

BARNET METAL & CAR CO LTD.
Trevise Road, Welwyn Garden City, Herts.
Telephone: Welwyn Garden 24227, Telex: 28123, Cable: BARMECO

**ELECTRONIC INDUSTRIAL THERMOMETER**

15 Rose Lane, Biggleswade, Beds.

**TEMC 19**

A Thermometer designed to operate as a Electronic Test Meter. Will measure temperature of Air, Magnets, Motors, Transformers, etc. etc. Just plug-in in the Probe, and read the temperature on the large open scale meter. Supplied with carrying case, main and internal 1 1/2 volt standard size battery. £25.00

HARRIS ELECTRONICS (LONDON) LTD.
139 GRAY'S INN ROAD, LONDON, WC1X BAX (Phone 01-837 7937)

**INVERTESS ARE OUR BUSINESS**

**CASED INVERTERS**

Assembled in attractive instrument cases with carrying handles.

- Squarewave output or filtered DC input: 12v or 24v types. Frequency: 50Hz ± 5%. DC output 240v or 110v types off load. Panel voltage meter indicator. Reverse polarity protection. DC and AC circuitry fused. Mains output via 13A type plug. 5 year guarantee.
  - SD/1-8"x6"x6" 150 watts £42.00
  - SD/2-8"x6"x6" 200 watts £64.00
  - SD/4-8"x6"x6" 500 watts £100.00
  - SD/4-10"x8"x6" 400 watts £78.00
  - SD/6-10"x8"x6" 600 watts £115.00
  - SD/7-12"x8"x6" 800 watts £135.00
  - SD/8-12"x8"x6" 1000 watts £160.00

**SINEWAVE INVERTERS**

A new range of units designed to provide power for a wide variety of electronic equipment in a smooth waveform.

Assembled in tough instrument cases with castors. Built-in rectifier and transformer. DC input: 10v or 12v types (± 2v). AC output: 240v or 110v types off load. Panel meter indicates voltage output. Frequency 50Hz ± 3%. Reverse polarity input protection. RC filter in tough instrument cases. Fully fused DC and AC circuits. 2 types.

- DD/1-100 watts 8"x8"x6" £100.00
- DD/3-200 watts 8"x8"x6" £180.00
- DD/4-300 watts 8"x8"x6" £200.00
- DD/5-400 watts 8"x8"x6" £300.00

**SPECIAL CONVERTERS**

In response to customers' requests we have included this range of units.

All units are assembled in tough ABS cases approved 4 KVA (2-3 phase).

- TT/1-12v DC in/32v 40w output £19.00
- TT/2-24v DC in/32v 40w output £19.00
- TT/3-32v DC in/32v 40w output £19.00
- TT/4-48v DC in/32v 40w output £19.00
- TT/5-12v DC in/12v D.C. 20w output £17.00

Price: £145.00 complete with Balun, plus carriage at £3.50. High quality 50ohm coaxial cable available at 50p per metre. Balun available separately at £12.50 each. All items subject to current VAT.

Terms of Business:

Carriage U.K. inclusive in prices. Overseas charged at cost F.O.B. Cheque, P.O. or cash with orders. Official orders welcome but priority given to cash customers. Cash, credit cards subject to alteration. Delivery: some goods in stock, others up to 28 days average. Quantity discounts with pleasure.

**AUTO/MAINS INVERTER UNITS**

These units maintain a source of AC mains power throughout any interruptions in the domestic supply. Assembled in small instrument cases the units incorporate a built-in inverter, battery charger and full automatic switching circuits. Mains input required 220/240v AC. Inverter output 220/240v AC. DC 12v or 24v. Warranty: 5 years DC & AC circuits fused.

- AM-1/10"x5"x4" 100 watts £60.00
- AM-2/10"x5"x4" 150 watts £65.00
- AM-3/10"x5"x4" 200 watts £70.00
- AM-4/10"x5"x4" 300 watts £85.00
- AM-5/10"x5"x4" 400 watts £110.00
- AM-6/10"x5"x4" 500 watts £130.00
- AM-7/10"x5"x4" 600 watts £140.00
- AM-8/10"x5"x4" 750 watts £170.00
- AM-9/10"x5"x4" 1,000 watts £200.00

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**ELONHURST LIMITED**

104A BRACKENBURY ROAD, LONDON, W.6
Telex: 895466 GITS G ELECT.
TEL: 01-748 5778

**CASE SYSTEMS “CLASSIC” RANGE OF CASES**

All the cases are designed in a moulded case, they are all well finished and robust and extremely. The offer is enhanced by the provision of ordered aluminium, including back feature inspection and bottom panels. Both finishes as these panels slotting into the front and rear section as well. The panels are provided with handy handles. Additionally it ensures the impress of durability. These cases are available in a variety of finishes.

**HAUL SINK BOX**

This is an all alloy welded model for transport. These are fresh and other models available.

**WEIGHT**

Fresh Up: £14.00

**CASE SYSTEMS “CLASSIC” RANGE OF CASES**

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**WEIGHT**

Fresh Up: £14.00

www.americanradiohistory.com
TOGO MAKE THE WORLD'S BEST RANGES OF COILS.

It seems a long time since TOGO first revolutionised the coil manufacturing business with their unique ranges of miniature RF and IF coils. Many inventors have come and gone - in the meantime, but none added to the quality of TOGO's consistent quality, and still is in constant production.

However, perhaps TOGO's supremacy is destined and supplying the types of wound component that is needed to revolutionise the other product areas of TOGO's manufacturing line.

So the rest of this advertisement is devoted to revolutionising, ceramic and mechanical filters, and their new low cost ceramic resonator to replace the costly quartz crystal in many RF and ultimate systems. And don't forget - not only do we offer you some existing and innovative products in general, supply is carefully maintained at all times through the only stockist/distributor of signal frequency processing coils in the UK.

SEMI CONDUCTORS

Make sure your range using filters. KV1200 and KV1900 series

A range of matched dual dual and triode, power sensing and power supplies. The filter are supplied either a single channel or in a single package, with each assembled package is available-

The two basic series are for either 450 or 250v maximum bias, with a minimum matching deviation of 0.5% over the range bias.

SEMI CONDUCTORS

MONOGRAM PROFESSIONAL AUDIO

CARR STREET, CHESTERLENT, W. YORKS BY10 1LA

TOKO's new CF89 series of RF IF filters have been designed for use in standard electronic applications. A range of 6-500MHz is available, with other standard list prices.

Three basic bandwidths are available to each series, corresponding to the following frequencies in the 6-500MHz region are typically below 1kHz. 500kHz to 1MHz. 1MHz to 5MHz.

TOKO's CF89S series of RF IF filters is available in the range 500kHz-5MHz. This matched filter design covers the same range as the CF89S and is highly competitive with ceramic filters. A new expected range of 0.5-5MHz up to 20MHz is expected to be available soon.

FILTERS

Monogram 1980 NEW PRODUCTS

In being with TOGO's policy of being prepared for the latest advances in radio technology, AMR have been system, which is being widely used in television and audio applications where reliability is required. The new CK series is designed to respond to customer's needs.

The dual at LF has a high positive feedback, and low filter ripple, which is important for use in 18MHz stereo pilot tone processing, and other current requirements may be readily met from the standard range of components in the 1.5GHz range held by AMR.

CHOICES

Monogram 1980 NEW PRODUCTS

Amplifiers Modules

700 watts:£350*

Introduction Offer Only

Power Amplifiers

250 watts: £105 350 watts: £ 125

Send Cheque/Money Orders to: - A. SAE / $1 Bill for Literature WANTED Dealers/Distributors WORLDWIDE MONOGRAM PROFESSIONAL AUDIO, 381 Gatlford Drive, Hayes, Middlesex, ENGLAND TEL 01-572-1666 10:00 AM - 8:30 PM

WW - 008 FOR FURTHER DETAILS

Monogram 1980 NEW PRODUCTS

In hearing with TOGO's policy of being prepared for the latest advances in radio technology, AMR have been straddling out excellent work on the new digital filters and processor systems from the high end equipment, to the lowest end equipment, where reliability is required.

RMM's uniquely tailored LUT32K system for professional applications. This is an advanced digital data control system for up to around 200kHz in frequency and provides radio double conversion etc. systems, giving a single IC for professional/programmable controller plug-in.

RMM's dedicated AMF8709 or radio MPU on a stackable system, giving 6000 channels, giving 6000 channels available in the UK and other countries.

In hearing several ICs are on to this 27MHz system, Digital Frequency Readouts are available with other Flusoummers, LED or LCD. All the latest development of ICs for AMR, giving a range of systems, giving a range of systems, giving a range of systems.

DIGITAL FREQUENCY TUNING SYSTEMS

Series 1 All 75W 530W 1000W 1500W 2000W 1000W 3000W 5000W 10000W 15000W 20000W 15000W 20000W 25000W 30000W 40000W 50000W 60000W 70000W 80000W 90000W 100000W

The Togo range of ICs is based largely on custom applications to radio/audio, calculators, printers and other applications. Custom design in all major technologies are available, and the standard list prices.

AM/FM complete radio and IF amplifier device KN4002 (C)AM3999A, KN4100 (H)11177, KN4100 (MC1130), KN4116 (AM/FM portable radio IC), KM4200 (AM/FM tuner IC), KM4300 (FM radio blander IC), RB8403 (Deak Uelester IC), KB4477 (FM/AM radio IC), KB4435 (Solid state audio IC), KB4436 (Metallised BFI) audio prem- two channels.

Check list: The ICs 50/5565/50372 direct multifunction clock ICs for LED or Flourescent displays.

Driver arrays for gas discharge/burnout displays, gas discharge etc.

Load ranges of fixed band inductors is based on three main styles: to be discovered. Between them, a range covering 10 to 50,000 and an 18 series is available, with other standard list prices.

The signal gains are based on all types of automatic inductors, and are suited to all ranges.

Prices are available separately -........__

WHILE STOCKS LAST

MARTIN ASSOCIATES (ELECTRONICS) LTD.

LET US PUT A SMILE

ON YOUR LAU

AT A FIXED PRICE

PRICES INCLUDE CLEARING, CALIBRATION, TOTAL LABOUR CHARGES FOR REPAIR WORK.

THE PRICE DOES NOT INCLUDE THE REPLACEMENT OF COMPONENTS, MOVEMENTS OR CASES.

MARTIN ASSOCIATES (ELECTRONICS) LTD., 34, CROWN STREET, READING.BERKs.

TELEPHONE: READING (0734) 598563/61074

WW-004 FOR FURTHER DETAILS
TOKO MAKE THE WORLD’S BEST RANGES OF COI LS.

It seems a long time since TOKO first established the coil manufacturing business with their unique ranges of miniature RF and IF coils. Many inventors have come and gone - in the meantime, but none have been able to equal TOKO’s consistent quality, and skill in introducing new types.

However, perhaps TOKO’s supremacy is designing and supplying the types of wound component that have proved to outshine the other product areas of TOKO’s manufacturing capability.

So the rest of this advertisement is devoted to semiconductor, ceramic and mechanical filters, and their new low cost electronic resistor to replace the costly quartz crystal in many RF and ultrasonic systems. And don’t forget, not only do we offer you some exciting and innovative products in general, but supply is carefully maintained at all times through the only stockist/distributor of signal frequency components in the UK.

SEMICONDUCTORS

Small area NPN range tuning chokes: KV1230 and KV1231 series

A range of matched dual and single choke, power coupling, tuning especially in circuits of 22, 50, 0.6 and 0.125mH widths. The duals are supplied either in a single package or in a double package, while a matched output network is available.

The two basic series are for either 1k to 2m frequency band, with a maximum matching deviation of only 2% over the entire range.

Electrical characteristic

<table>
<thead>
<tr>
<th>Basic series</th>
<th>Chokes</th>
<th>No. per set</th>
<th>No. per set</th>
</tr>
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<tbody>
<tr>
<td>KV1230</td>
<td>2</td>
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</tr>
<tr>
<td>KV1231</td>
<td>4</td>
<td>400</td>
<td>200</td>
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Price: £1.75 inc. VAT.

FILTERS

The TOKO range of filters is based largely on custom applications to radio/audio, calibrator, printer, and other applications. Custom design in all major technologies are available, and the standard list includes:

- AM/FM complete radio and IF amplifier devices
- KM1000 (C10/0906), KM1050 (0110), KM1060 (AM/FM portable radio IC), KM1051 (FM AM Nurse Knob), KB1052, KB1053 (FM nurse knob, AM nurse knob, KB1055), KB433 (Nurse Ductor IC), KB437 (Nurse Ductor IC)...
- RF, IF, and VHF audio preamps - two channels
- KB1055
- The KO1065/10152 direct multivibrator/timers ICs for LED or Placemems displays.
- Driver arrays for gas discharge/blooms displays, gas generation, etc.

DIGITAL FREQUENCY TUNING SYSTEMS

In keeping with TOKO’s policy of being prepared for all the latest advances in radio technology, Amtech have been spanning out extensive work on realizing the next digital frequency tuning system from the many microcomputer and microprocessor control centres. If the future is anything like what we are all predicting, digital frequency tuning should be the next step in total system development.

TOKO's KJ4001 micro MPU is automatically aware of all the changes that will occur in the future. Where once the engineer had to worry about the changing of frequencies in a radio system, digital frequency tuning leaves the engineer free to concentrate on the end result.

Price: £1.36 inc. VAT.

OPTIONS

A range of frequency inputs is based on three basic styles: analog, digital, and crystal. Between them, a range spanning 1kHz to 100kHz in 0.1kHz steps is available, with other input options of 0.01kHz and 0.1MHz per step. Each input option is an ideal source for a specific range of applications. The size and power ratings are suitable for all types of automatic systems, and are supplied on fixed circuits.

Prices are available on request.

We offer you some exciting and innovative products in general, and supply is carefully maintained at all times through the only stockist/distributor of signal frequency components in the UK.

Monogram 1980 NEW PRODUCTS

700 watts £350

INTRODUCTION OFFER ONLY

Power Amplifiers

Amplifier Modules

700 watts £350

Power Amplifiers

250 watts £105

350 watts £125

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wireless world

Status symbols

There has lately been a great deal of talk, reaching a focus in The Times correspondence columns, on the titles that workers in our industry should grace themselves with. Considerable thought has clearly been expended on the suggestions correspondeents have made; the intention is evidently to differentiate between 'engineers', who sit at desks, lost in thought, and 'craftsman/technicians' who dwell in workshops, doing the bidding of engineers. Blame is heaped on the daily press for referring to ignoble creatures who man picket lines as engineers, as in "Engineers demand 30%", when the feeling is that they should be called 'engineering workers' or in some way dissociated from those who use their mental, instead of their manual skills. The man who repairs television sets for a living ought, it is said, to be called a technician, not an engineer.

Notions of social status, abstract except as skills are concerned, are at the root of the debate. A tenet of the status-seeker is that the more imposing his work-title, the higher the esteem in which he is held by the community; refuse-disposal operatives find it most acceptable to consult a turf accountant than to lay a bet with a bookie. The improbability of such a ploy ought, by now, to be apparent to any observer of mores.

Engineers' salaries do not compare well with those of managers who are often their educational inferiors, simply because engineers are not allowed into positions in which they can influence the direction of a company. If the control of engineers continues to be left to those who are untrained in engineering, then the dismal performance of this country in manufacturing will not improve. This is the vital reason for demanding a greater status, not a self-congratulatory assumption of grand titles. If engineers (for lack of a better word) in electronics are not accorded by society the intangible quality of status they seek, it is more likely to be due to the value society attaches to their work than to the names they are given.

The results of the work are seen to be in entertainment, which is taken for granted, and in industrial and military systems, which are not understood: put another way, the benefits are thought to be either trivial or necessary, but remote. An engineer's store of experience and knowledge is irrelevant because, unlike a doctor or accountant, he does not, visibly at least, affect their lives in any serious way.

Distinction between technician and engineer always used to be indicated by the label 'design engineer' for the originator, and if the others wanted to call themselves engineers, no-one worried: the differential was preserved.

Low standing of engineers is not of great concern to the community. Where it is of consequence is inside a company or organization, where management is too often the preserve of accountants or sales people, or even individuals who have no training in either engineering or administration. Engineers' salaries do not compare well with those of managers who are often their educational inferiors, simply because engineers are not allowed into positions in which they can influence the direction of a company. If the control of engineers continues to be left to those who are untrained in engineering, then the dismal performance of this country in manufacturing will not improve. This is the vital reason for demanding a greater status, not a self-congratulatory assumption of grand titles.

If the recommendations contained in the Finniston Report are adopted, the engineering profession will not be short of status, and it will be hard-won. The prospect of losing one's registration through complacency should lead to a level of competence not seen in any other profession.

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Microwave intruder detector — 1
Design with good interference rejection and noise monitoring

by K. Halford, C.Eng., Philips Research Laboratories

This design provides a simple but effective circuit which uses a cycle counting scheme to prevent the alarm being triggered by short movements or pulses. The circuit has excellent interference rejecting properties. A noise monitoring circuit is described in part 2 so that the alarm can be set up easily and reliably in terms of a low false-alarm probability.

A simple novel design of stabilizer allows the nominal 12V supply to have one volt or more of ripple before the basic noise level is disturbed.

This design is suitable for use in small radar design and has laid emphasis on the intrinsic immunity, reliability and simplicity of the basic micro-wave module (Gunn diode) and a mixer diode to produce the audio output signal in response to the microwave signal received. It requires a supply of about 7.0 volts d.c. at about 15mA. The module has been designed for use in a previous Wireless World design1 in 1977. The paper and reference 2 provide useful background information on movement detection by micro-waves.

The present design is the result of considerable experience over the years in small radar design and has laid emphasis on the immunity, reliability and simplicity of the basic micro-wave module (Gunn diode) and a mixer diode to produce the audio output signal in response to the microwave signal received. It requires a supply of about 7.0 volts d.c. at about 15mA. The module has been designed for use in a previous Wireless World design1 in 1977. The paper and reference 2 provide useful background information on movement detection by micro-waves.

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A simple novel design of stabilizer allows the nominal 12V supply to have one volt or more of ripple before the basic noise level is disturbed.

This design is suitable for the Mullard CL8960 microwave module, a complete microwave front-end containing both the microwave (Gunn diode) and a mixer diode to produce the audio Doppler beat signal in response to radial movement. It requires a power supply of about 7.0 volts d.c. at about 150mA. The module has Home Office approval and has been featured in a previous Wireless World design in 1977. That paper and reference 1 provide useful background to movement detection by microwaves.

The present design is the result of considerable experience over the years in small radar design and has laid emphasis on false-alarm immunity, reliability and simplicity, and the use of a single nominal 12 volt supply for the complete microwave and mixing (mixer diode) circuit (MID). The lowest usable supply voltage is important to preserve standby battery life. The circuit shows 11V although this can be reduced to ten by careful choice of component source and circuit settings, and to 9.9V by selection.

The great advantage of the MID, apart from its apparent ease of installation, is its constant vigilance. It can be set to sound an alarm regardless of the level of movement detected by the Doppler signal.

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It helps to know that the most critical aspect of this is going to be the provision of the supply to the Gunn diode. Any ripple on this and the microwave power will be modulated and in turn will result in this ripple appearing at the mixer output. This is caused by the microwave power used for the mixing which affects the direct voltage across the mixer. If this is not satisfactory the rest of the design is suspect. The mixer output signals are in any case caused by an amplitude modulation of the mixer power when the return signal, shifted by the Doppler difference, is added to the local signal used for mixing.

The return signal is many orders of magnitude less than that used for mixing and hence the modulation of microwave power due to the power supply has to be extremely small. Ultimately, the radar sensitivity is limited by noise and the design should therefore aim at not intentionally increasing this.

In the past Gunn power supplies have not received the attention in the literature that they deserve; neither have manufacturers of microwave modules volunteered information on the sensitivity to ripple. A need exists for this to be included in the data. The ripple output from the mixer will depend first on the ripple on the Gunn supply and also on the amount of microwave power being used. As a result of the design, the MID contains protection against both power supply pulses and signals caused by external short transient noise, to vibration, or simply an interference on the power supply leads which gets into the signal circuits.

The MID should contain protection against both power supply pulses and signals caused by external short transient noise, to vibration, or simply an interference on the power supply leads which gets into the signal circuits.

The actual microwave power in use is evident by the change in direct voltage when the microwave signal is turned on. Thus setting up instructions can specify the type of bias circuit used and the direct voltage that should be expected. The special anti-static precautions are needed during measurement to avoid mixer damage, given later.

- The intended optimum mixer power will occur naturally if the module is "burn in" to that across the Gunn diode. The microwave power used for mixing in the MID is limited by the local signal used for mixing.

- The actual microwave power in use is evident by the change in direct voltage when the microwave signal is turned on. Thus setting up instructions can specify the type of bias circuit used and the direct voltage that should be expected. The special anti-static precautions are needed during measurement to avoid mixer damage, given later.

**Table 1. Ripple transfer factor measured for microwave modules**

<table>
<thead>
<tr>
<th>Mixer</th>
<th>CL8960</th>
<th>CL8960</th>
<th>CL18960</th>
<th>CL18960</th>
<th>CL18960</th>
<th>CL18960</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ripple factor</td>
<td>0.016</td>
<td>0.025</td>
<td>0.06</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct voltage (V)</td>
<td>0.300</td>
<td>0.28</td>
<td>0.00</td>
<td>-0.4</td>
<td>-0.2</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2. Ripple rejection with circuit of Fig. 2.**

<table>
<thead>
<tr>
<th>Transistor type</th>
<th>BD139</th>
<th>BD139</th>
<th>BDX77</th>
<th>BY852</th>
<th>FFX85</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rejection (dB)</td>
<td>97</td>
<td>55</td>
<td>61</td>
<td>62</td>
<td>62</td>
</tr>
<tr>
<td>Load current (mA)</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>No. of samples</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

The ripple rejection was found to degrade by 2dB when the supply voltage was reduced to 2.5 volts above the zener voltage.
Improved circuit

The power transistor is the limiting factor and if, as seems likely, better types will not be made available in the form of feedback must be devised using a suitable op-amp. Ideally, the performance will approach that of the op-amp alone. One such attempt is shown in Fig. 3.

This circuit will achieve 100dB rejection although even 83dB is adequate. The ability of the circuit to reject ripple and tolerate a low supply voltage depends on the current output taken from the i.e. and, not least, who made it. The maximum current required for a CL8960 is 15mA and the minimum current gain of BD135 is 40. Thus the i.e. output current can be up to 4mA. The circuit was tested with what turned out to be a high gain transistor having a beta current of only 1.2mA, so an extra 3.5mA was taken to see the effect. Results are shown in Table 3.

<table>
<thead>
<tr>
<th>IC type</th>
<th>Noise output</th>
<th>No. of samples</th>
<th>Minimum rejection</th>
<th>Minimum $V_{min}$ for 83dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>748C</td>
<td>250μV</td>
<td>10</td>
<td>100dB</td>
<td>9.53V</td>
</tr>
<tr>
<td></td>
<td>250μV</td>
<td>10</td>
<td>100dB</td>
<td>9.7V</td>
</tr>
</tbody>
</table>

1 National Semiconductor, 2 other well-known make.

Fig. 3. Use of op-amp as shown in Fig. 3 improves ripple rejection.

Table 3. Use of op-amp as shown in Fig. 3 improves ripple rejection.

The advantage of the 748 over the 741 is important as an extra 3.5mA was taken to see the effect. Ideally, the feedback must be devised using a suitable IC with a good rejection factor.  This circuit will achieve 1.5dB better rejection than the 748 circuit with 12V supply rejection.

<table>
<thead>
<tr>
<th>IC type</th>
<th>Noise output</th>
<th>No. of samples</th>
<th>Minimum rejection</th>
<th>Minimum $V_{min}$ for 83dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>748C</td>
<td>250μV</td>
<td>10</td>
<td>&gt;100dB</td>
<td>9.63V</td>
</tr>
<tr>
<td></td>
<td>250μV</td>
<td>10</td>
<td>&gt;100dB</td>
<td>9.7V</td>
</tr>
</tbody>
</table>

1 National Semiconductor, 2 other well-known make.

Fig. 4. Rejection by Fig. 4 circuit with 12 volt supply was also over 100dB.

Table 4. Rejection by Fig. 4 circuit with 12 volt supply was also over 100dB.

The advantage of the 748 over the 741 is that the 740F capacitor can be increased if a loop stability problem is experienced. A 741 of different manufacture did oscillate when the extra 3.5mA load was applied, although with the 744 the capacitor could be reduced to 10pF before the circuit oscillated. The manufacturer is the most important factor in choosing an i.e. In this instance a National 748 out-performed five samples of a more expensive LM308 equivalent from manufacturer B, both in rejection and minimum working voltage.

Finally, a emitter-follower version of Fig. 4 is shown in Fig. 5 with some more measurements.

From the previous results it seems fair to expect that the circuit of Fig. 4 could be put into production with a minimum working voltage of 10.5V and a ripple rejection of 83dB, provided the i.e. manufacturer is selected with care, and even better if BD135s are available with $I_{min}$ of 30. A considerable percentage of the products will work satisfactorily down to a supply voltage of 10V.

Measurements were made with a zener diode selected for an accurate 7.5V voltage. Any higher voltage requires the supply minimum to be raised by the difference. But also, the use of the 7.0V specified in the CL8960 data would allow a reduction of 0.5V. Thus a 10.5V minimum could be set, even with a poor i.e.

<table>
<thead>
<tr>
<th>IC type</th>
<th>Noise output</th>
<th>No. of samples</th>
<th>Rejection $V_{min}$ 12V supply</th>
<th>Supply min. for 83dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>748C</td>
<td>3.5V</td>
<td>10</td>
<td>100dB</td>
<td>10.07V</td>
</tr>
<tr>
<td></td>
<td>3.5V</td>
<td>20</td>
<td>100dB</td>
<td>10.62V</td>
</tr>
</tbody>
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1 National Semiconductor, 2 other.

Fig. 4. The advantage of the 748 over the 741 is that the 740F capacitor can be increased if a loop stability problem is experienced.

Table 5. Two-transistor version for higher currents or poor i.e.

Ripple transfer factor for the two modules is shown in Table 1. In both cases the mixer used was the Mullard BA4V6 which is a typical type for this application. The CL8960 bias and power supply was set up to reduce the output power and bandwidth. The maximum current required for the CL8960 is 15mA and the minimum current gain of BD135 is 40. Thus the i.e. output current can be up to 4mA. The circuit was tested with what turned out to be a high gain transistor having a beta current of only 1.2mA, so an extra 3.5mA was taken to see the effect. Results are shown in Table 3.

<table>
<thead>
<tr>
<th>IC type</th>
<th>Noise output</th>
<th>No. of samples</th>
<th>Rejection $V_{min}$ 12V supply</th>
<th>Supply min. for 83dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>748C</td>
<td>3.5V</td>
<td>10</td>
<td>100dB</td>
<td>10.07V</td>
</tr>
<tr>
<td></td>
<td>3.5V</td>
<td>20</td>
<td>100dB</td>
<td>10.62V</td>
</tr>
</tbody>
</table>

1 National Semiconductor, 2 other.

Fig. 5. From the previous results it seems fair to expect that the circuit of Fig. 4 could be put into production with a minimum working voltage of 10.5V and a ripple rejection of 83dB, provided the i.e. manufacturer is selected with care, and even better if BD135s are available with $I_{min}$ of 30.

Table 6. From the previous results it seems fair to expect that the circuit of Fig. 4 could be put into production with a minimum working voltage of 10.5V and a ripple rejection of 83dB, provided the i.e. manufacturer is selected with care, and even better if BD135s are available with $I_{min}$ of 30.

The second resistor chain biases the output transistor and the direct voltage working point is established. The second resistor chain is connected to the first and the circuit is both of the zener diode by the $V_{be}$ at the transistor, see for instance the circuit of Fig. 4. Also by using 1kΩ plus 22kΩ preset series resistance between $R_1$ and $R_2$, the voltage may be set accurately using a 6.8V zener.

The rejection required of the power supply is therefore 83dB for 2.5V r.m.s. from 1V pk-pk with ripple factor of 0.1. Even a typical CL8960 is going to require BDS if ripple factor is 0.05.

The 83dB minimum ripple rejection factor is achieved (see "Gunn power supplies") so as to allow 1V pk-pk on the intruder alarm supply for a module with a ripple factor of 0.1. A typical CL8960 has a factor of 0.05 and would tolerate 5V pk-pk ripple, although due to the voltage swing at the minimum supply voltage of 10.5V would need to be increased to about 13V.

It might be thought that battery supplies would not need ripple rejection. However, this ignores practical points like switching-on and switching-off surges with long leads, possible bad connections due to corrosion and trickle charging from mains derived supplies. Thus a 1V pk-pk ripple rejection is very useful.

Doppler amplifier design had an aim of about 90dB gain and also an adequate ripple rejection. Ripple may be present due to the signals originating from outside the power supply, or caused by the power supply itself, or generated by the amplifier drawing signal current from the power supply and its associated impedance. Feeding back a voltage due to an inadequate ripple rejection can lead to an unstable amplifier. The nature of this problem is illustrated in Fig. 6. Currents $I_1$ and $I_2$ supply the amplifiers but contain components at the signal frequency. These in turn generate voltages via the finite output impedance of the power supply. A low impedance supply eases the problem, as do lightly loaded amplifiers which do not generate large signal currents. After this the amplifier should be designed for a good rejection factor.

A suitable amplifier circuit is shown in Fig. 7. It was designed to tolerate a supply impedance of more than 5 ohms which is much higher than needed for a stabilized supply, but even in a good design does not look very different from a poor one at first sight. The main point is not to inject signals from the supply via the networks which supply amplifier bias. The Gunn power supply can be used to power the amplifier and as this has a very low output impedance of about 0.05 ohms this will greatly help the design. For instance, some of the decoupling of the input bias chain can be omitted.

Starting at the left hand side the resistor chain $R_1$ and $R_2$ provides well decoupled current bias for the mixer, the diode being merely for protection against the input charging up when the mixer is absent which carries the risk of mixer damage when it is re-connected. Even without microwave bias the mixer voltage is only 0.3V which is below diode conduction with the 43μA direct current bias.

The second resistor chain biases the op-amps to the best point for a symmetrically-clipped sinewave output on overdrive. With the use of the Gunn power supply capacitance $C_1$ and $C_2$ can be omitted.

The first op-amp has a voltage gain of 100 and the second 300, a total of 90dB ignoring impedance differences. Gain of the second can be reduced 50 times with $R_4$. Because radar range varies as the fourth power of power gain, this is equivalent to a range change of one order of magnitude. For a lower range of sensitivity the first op-amp 330Ω resistor can be reduced.

The second op-amp is directly connected to the first and the circuit is both very economical in the use of components and has good ripple rejection properties. No economy is sacrificed in performance.

The amplitude-response of the amplifier is suitable for an AM. The low frequency cut-off is controlled by $C_3$.
Improved circuit

The op-amp transistor is the limiting factor and if, as seems likely, better types will not be made available in the near future, a form of feedback must be devised using a suitable op-amp. Ideally the performance will approach that of the op-amp alone. One such attempt is shown in Fig. 3.

This circuit will achieve 100dB rejection although even 83dB is adequate. The ability of the circuit to reject signal and tolerate a low supply voltage depends on the current output taken from the i.e. and not least, who made it. The maximum current required for a CL8960 is 18mA and the minimum current gain of BD135 is 40. Thus the i.e. output current can be up to 4mA. The circuit was tested with what turned out to be a high gain transistor having a beta current of only 1.2mA so an extra 3.5mA was taken to see the effect. Results are shown in Table 3.

<table>
<thead>
<tr>
<th>Table 3. Use of op-amp as shown in Fig. 3 improves ripple rejection.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IC type</strong></td>
</tr>
<tr>
<td>748</td>
</tr>
<tr>
<td>748*</td>
</tr>
</tbody>
</table>

1. National Semiconductor, 2. Other well-known make

Measurements were made at a frequency of 200Hz to avoid hum problems but at least 100Hz was measured over the band 10Hz to 1kHz. The fact that this is greater than the 94dB of the bias chain is a reflection of capacitor tolerance. The minimum voltage working was only 0.1V lower if 30dB rejection was specified and this ripple breakthrough can easily be seen on an oscilloscope. Thus it could be used as a rough check.

From these figures you can see that a poor i.e. would show advantage in using another emitter-follower with an end-of-series resistor, as the second transistor the minimum voltage fell from 11.0V to 10.5V but with a good i.e. it rose from 9.7V to 10.5V, due to the higher output direct voltage required for the extra transistor over-riding the low-current improvement. These voltages and those above assume an exact 7.5V emitter diode. With a 5% tolerance another 0.4V must be added.

The circuit of Fig. 3 can be amplified by noting that the i.e. output voltage is almost of the zero diode by the VBE of the transistor, see for instance the circuit of Fig. 4. Also by using 1kΩ plus 22kΩ preset series resistance between F and B, the voltage may be set accurately using a 0.5V source. With a BC547 as the second

Table 4. Rejection by Fig. 4 circuit with 12 volt supply was also over 100dB.

<table>
<thead>
<tr>
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<tbody>
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<td><strong>IC type</strong></td>
</tr>
<tr>
<td>748</td>
</tr>
<tr>
<td>748</td>
</tr>
</tbody>
</table>

1. National Semiconductor, 2. Other well-known make

The advantage of the 748 over the 741 is that the 300pF capacitor can be increased if a loop stability problem is experienced. A 741 of different manufacture did oscillate when the extra 3.5mA load was applied, although with the 744 the capacitor could be reduced to 10pF before the oscillation. The manufacturer is the most important factor in choosing an i.e. In this instance a National 740 out-performed five samples of a more-expensive UM308 equivalent from manufacturer D, both in rejection and minimum working voltage.

Finally a emitter-follower version of Fig. 4 is shown in Fig. 5 with some more measurements.

<table>
<thead>
<tr>
<th><strong>Table 5. Two-transistor version for higher currents or poor i.c.s</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IC type</strong></td>
</tr>
<tr>
<td>740</td>
</tr>
<tr>
<td>740</td>
</tr>
</tbody>
</table>

1. National Semiconductor, 2. Other.

From the previous results it seems fair to expect that the circuit of Fig. 4 could be put into production with a minimum working of 10.5V and a ripple rejection of 83dB, provided the i.e. manufacturer is selected with care, and even better if BD135s are available with higher minimum of 80. A considerable percentage of the products will work satisfactorily down to a supply voltage of 10V.

Measurements were made with a zener diode selected for an accurate 7.5V voltage. Any higher voltage requires the supply minimum to be raised by the difference. But also the use of the 7.0V specified in the CL8960 would allow a reduction of 0.5V. Thus a 7.5V minimum could be maintained even with a poor i.e.
against being set off by interference.

To some extent this is due to a design, because of the loss of response not within the scope of this article. The design of a suitable comb filter is offered a reasonable safety factor. The alarm level in the circuit which follows the mains can also vary over the full range of micro to audio frequencies. As familiar I shall use them as an example. The indefinite admittance matrix or admittance matrix produces the YF matrix.

The phase of the signal relative to the mains can also vary over the full range of micro to audio frequencies. Table 6 shows the typical ripple rejection for Fig. 7 and one of Y11, Y12, Y21, and Y22 as independent variables and the remaining two as the dependent variables. The four voltages as independent variables and assuming linearity, write

\[ I_1 = Y_{21}V_{12} + Y_{22}V_{22} \]

or in matrix form

\[ \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} Y_{21} & Y_{22} \\ Y_{12} & Y_{11} \end{bmatrix} \begin{bmatrix} V_{12} \\ V_{22} \end{bmatrix} \]

Where the y-parameters have the dimensions of admittance, Fig 2 gives the y-parameters with respect to the admittance of Fig. 2. The parameter equivalent circuit of any linear two-port network and Table 1 gives the gain and impedance properties

As the phase of desktop computers falls, they are coming to be regarded as another piece of lab equipment, along with oscilloscopes and analysers. Using such machines designs may be checked and components "tweaked" for optimum performance, without any danger of damaging expensive components.

This article shows the principles of computer circuit analysis; a second shows how a Commodore Pet can be used to "broad-band" circuits ranging from micro to audio frequencies. As desktop machines become more common this approach must look in increasing importance as computers are used in industry as well as non-professionals.

Many manufacturers deal with linear two-port analysis; because of their familiarity I shall use them as an introduction to a far more powerful multiport technique. The two-port network of Fig. 1. Choose any two of V1, V2, I1, I2 as independent variables and the remaining two as the dependent variables. The four voltages as independent variables and assuming linearity, write

\[ I_1 = Y_{21}V_{12} + Y_{22}V_{22} \]

or in matrix form

\[ \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} Y_{21} & Y_{22} \\ Y_{12} & Y_{11} \end{bmatrix} \begin{bmatrix} V_{12} \\ V_{22} \end{bmatrix} \]

Where the y-parameters have the dimensions of admittance, Fig 2 gives the y-parameters with respect to the admittance of Fig. 2. The parameter equivalent circuit of any linear two-port network and Table 1 gives the gain and impedance properties
terminated in a load admittance, YL, and driven from a source of admittance, YS. Consider paralleling two different two ports, as in Fig. 3. It is immediately obvious that the equivalent circuit representation that the overall two-port network and its equivalent networks A and B has the following y-parameters

\[ Y_{01} = Y_{11} + Y_{22} - Y_{21} \]

\[ Y_{02} = -Y_{12} \]

The overall y-parameters are simply the sum of the parts. It is this property of the admittance representation that we shall now generalize: the property of adding small matrices to describe the whole circuit, i.e. \( [y] = [y_a] + [y_b] \)

Indefinite admittance matrix

The indefinite admittance matrix or YF matrix relates the total current at any node in the circuit to the voltages across the nodes, where voltages are referred from the circuit's input node and output node. This is best illustrated by an example.

For passive networks node application of the four rules produces the YF matrix. For active networks use Table 2 to find the YF matrix. For a network with active and passive components simply add the independent variables and obtain admittance by considering the passive and active components on their own. YF matrix may be reduced in a simple transport network and then apply Table 1 gives the admittance and gains of the network.
Termed though flexible matrix technique lends itself to computer calculation.

by A. S. Beasley, B. Sc., McMichael Ltd.

Circuit analysis by small computer

As the price of desktop computers falls, they are coming to be regarded as another piece of lab equipment, along with oscilloscopes and analysers. Using such machines designs may be checked and components "tweaked" for optimum performance, without any danger of damaging expensive components.

This article shows the principles of computer circuit analysis; a second shows how a Commodore PET can be used to "bread-board" circuits ranging from micro to audio frequencies. As desktop machines become more common this approach must look increasingly attractive to hobbyists and competitors in industry as well as to non-professionals.

Many other people deal with linear two-port analysis; because of their familiarity I shall use them as an introduction to a far more powerful multiport technique.

As you are no doubt aware, the two-port network of Fig. 1. Choose any two of V\(_{1}\), V\(_{2}\), I\(_{1}\), I\(_{2}\) as independent variables and the remaining two as the dependent variables. All the voltages and currents as independent variables and assuming linearity, write

\[
I_{1} = v_{1}Y_{11} + v_{2}Y_{12} + i_{1}Y_{21} + i_{2}Y_{22} + o_{1}\
\]

or in matrix form

\[
\begin{pmatrix}
1 & Y_{11} & Y_{12} & 0 & 0 \\
Y_{21} & Y_{22} & 0 & 0 & 1 \\
o_{1} & 0 & 0 & 0 & 1
\end{pmatrix}
\]

where the \(y\)-parameters have the dimensions of admittance.

For Passive networks note application of the four rules produces the \(y\) matrix. For active networks use Table 2 to find the \(y\) matrix. For a network with active and passive components simply add the individual matrices obtained by considering the passive and active components on their own. The \(y\) matrix may be reduced to a simple transport network and then application Table 1 gives the impedances and gains of the network.

The technique in summary

WIRELESS WORLD, FEBRUARY 1980

The indefinite admittance matrix or \(y\) matrix relates the total current at any node in the circuit to the voltages at the nodes, where voltages are referenced from zero volts on a single chosen node. Thus this is a property of the admittance representation that we shall now generalise: the property of adding small matrices to describe the whole circuit, i.e. \([y] = [y]_{1} + [y]_{2}\)

as independent admittance matrix.

Indefinite admittance matrix

These are typical rather than worst-case examples. As we have seen, the use as a stabilizer with only 30\(\%\) rejection would allow a IV-pk-pk ripple over the supply voltage. If the amplifier is not too far from the ideal, the ri...
Reduction of the YF matrix

The way to extract information from the YF matrix concerning impedances and gains (as for the two-port network) is to note that the currents in the YF representation give the total current flowing into a particular node. By Kirchhoff's Law we know that this is zero for all internal nodes, i.e. nodes not connected to the input or output of the network. To demonstrate by means of an example, see Fig. 5. You can see that

\[
I_1 = \begin{pmatrix}
Y_{11} + Y_{12} + Y_{13} - Y_{14} \\
Y_{12} + Y_{22} + Y_{23} - Y_{24} \\
Y_{13} + Y_{23} + Y_{33} - Y_{34} \\
Y_{14} + Y_{24} + Y_{34} - Y_{44}
\end{pmatrix}
\]

where \( Y_{ij} \) are admittances.

Because \( I_1 = 0 \), eliminate \( Y_{14} \) by putting

\[
V_4 = (Y_{14}V_1 + Y_{13}V_3 + Y_{12}V_2)/2
\]

For a two-port network measure voltage from node 2 (i.e. \( V_2 = 0 \)). Substituting these relationships into the network.

\[
\begin{pmatrix}
Y_{11} & Y_{12} & Y_{13} & Y_{14} \\
Y_{12} & Y_{22} & Y_{23} & Y_{24} \\
Y_{13} & Y_{23} & Y_{33} & Y_{34} \\
Y_{14} & Y_{24} & Y_{34} & Y_{44}
\end{pmatrix}
\]

where \( Z = Y_{14} + Y_{13} + Y_{12} \):

Table 1 gives the YF matrices for other common two-port networks.

For active and passive components

Now that YF matrices of active and passive networks can be created the "parallel networks and y-parameters" rule can be used, which carries over the more general YF matrix. The following example illustrates the techniques we can now use.

It is because this technique is so flexible, handling any configuration of components, it is a route procedure with straightforward though tedious calculation, that it is ideally suited to the computer. A second article will outline a program based on the YF matrix and discuss modelling techniques.

*High Frequency Amplifiers by R. S. Carson. Wiley Interscience.

Example

To analyse

\[
YF = \begin{pmatrix}
Y_{11} & Y_{12} & Y_{13} & Y_{14} \\
Y_{12} & Y_{22} & Y_{23} & Y_{24} \\
Y_{13} & Y_{23} & Y_{33} & Y_{34} \\
Y_{14} & Y_{24} & Y_{34} & Y_{44}
\end{pmatrix}
\]

the overall YF matrix is then

\[
YF = YF + YF_1 + YF_2
\]

The tedious but simple calculations to produce the YF matrix are best left to a computer; these calculations will yield the impedances and gains of the circuit.

Adaptable anatomy for a.t.e.

A new form of integrated automatic test equipment, the GRADUATE, unveiled by its maker, Marconi Space and Defence Systems at the recent Brighton a.e. conference, offers the central advantages of "virtual instrumentation" and "reconfigurability." Although it is relatively low-down a laboured cap and gown presentation (it forms the "T" in the name whenever a mention occurs in the technical literature headings), the facilities lurking behind these two terms are quite real.

"Virtual instrumentation" involves dispensing with conventional test instruments, using instead software-configured modules, with the intention of simplifying measurement and readout, and adapting easily to different test requirements. Checks are made by the a.t.e. circuits and the results fed to the central d.v.u., which also displays simulated front panel controls, the instrument being simulated depending upon the way in which the e.t.e. has been "configured" by the software. A set of functional modules carries out the work and comprises three main sections, i.e., f.t., t.f., and digital. These modules are inserted into a kernel composed of four shelves, each of which has eight injection moulds capable of holding one double or four single modules. Matching connections are provided at each module for service inputs, permitting any module to be inserted anywhere in a kernel.

The central controller is a 24-bit word processor using bit-slice technology with a fixed microcode in p.r.o.m. and an extension e.g.r.o.m. for controller firmware development. The main memory is expandable in 32K word steps up to 1M word, and standard peripherals are a d.v.u. and keyboard, dual floppy disc drive, line printer for program development and strip printer for test results.

Part of the control process is a calibration facility, deviations of each module from its "standard" performance being stored in a.p.r.o.m. within the module at the time of calibration. This means that close-limit accuracy in the modules themselves is made unimportant and, assuming that the characteristics of each module are stable, their stimulus outputs and measured inputs can be automatically corrected using the stored data.

A self-test facility provides for individual modules and p.c.b.s to be tested using resident programs, and a self-test module permits line validation checks to be carried out during normal testing, ensuring that any failure is not incorrectly attributed to the equipment.

Module isolation is effected using a 2Kfz, three-phase power distribution system. This is transformer-coupled and rectified on the interface power assembly board contained in each module. One ribbon cable is used to supply the module to each module and another carries analogue signals between them. For high frequency and fast-edge signals the performance of the ribbon high-speed becomes inadequate and appropriate functional modules therefore have separate front panel connectors. A high-frequency, three-switch design is available, working into the microwave region.

Physically, the GRADUATE is made up by combining up to four kernels and four 19in racks, the layout being determined by the front panel connectors. A high-frequency, three-switch design is available, working into the microwave region.

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Reduction of the YF matrix

The way to extract information from the YF matrix concerning impedances and gains (as for the two-port network) is to note that the currents in the YF representation give the total current flowing into a particular node. By Kirchhoff’s Law we know that this is zero for all internal nodes, i.e., nodes not connected to the input or output of the network.

To demonstrate by means of an example, see Fig. 5. You can see that

\[
\begin{bmatrix}
I_1 \\
I_2 \\
I_3
\end{bmatrix} =
\begin{bmatrix}
Y_{11} & Y_{12} & Y_{13} \\
Y_{21} & Y_{22} & Y_{23} \\
Y_{31} & Y_{32} & Y_{33}
\end{bmatrix}
\begin{bmatrix}
V_1 \\
V_2 \\
V_3
\end{bmatrix}
\]

Because \(I_3 = 0\) eliminate \(V_3\) by putting

\[
V_3 = \frac{Y_{32} V_1 + Y_{33} V_2 + Y_{31} V_3}{2}
\]

For a two-port network measure voltage from node 2 (i.e., \(V_2 \neq 0\)). Substituting these relationships into the YF matrix:

\[
\frac{1}{2} \begin{bmatrix}
I_1 \\
I_2
\end{bmatrix} =
\begin{bmatrix}
Y_{11} & Y_{12} - Y_{13} \\
Y_{21} & Y_{22} - Y_{23} - Y_{32}
\end{bmatrix}
\begin{bmatrix}
V_1 \\
V_2
\end{bmatrix}
\]

So by equating all internal currents to zero we have found the two-port y-parameters, and using Table 1 we deduce the impedances and gains of the network.

YF matrix for active components

Consider the transistor in Fig. 6. From the data sheet we can quickly discover its common-emitter y-parameters, which relate the currents into the base and collector to the voltages applied (referenced from the emitter). Now even for active components conservation of charge is obeyed so by rule three the YF matrix for the transistor is

\[
\begin{bmatrix}
y_{11} & y_{12} & -(y_{21} + y_{22}) \\
y_{12} & y_{22} & -y_{23} \\
-(y_{21} + y_{22}) & -y_{23} & y_{33}
\end{bmatrix}
\]

where \(y_{ij} = Y_{ij} + Y_{ji}\) admittances.

YF matrix for active and passive components

Now that YF matrices of active and passive networks can be created, the “parallel networks and y-parameters” rule can be used, which carries over the more general YF matrix. The following example illustrates the techniques we can now use.

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A self-test facility provides for individual modules and the p.c.b. to be tested using resident programs, and a self-test module permits on-line validation checks to be carried out during normal testing, ensuring that any failure is not incorrectly attributed to the equipment.

Module isolation is effected using a 25kHz three-phase power distribution system. This is transformer-coupled and rectified on the interface power assembly board contained in each module. One ribbon cable is used to supply the power to each module and another carries analogue signals between them. For high frequency and fastedge signals the performance of the ribbon highways becomes inadequate and appropriate functional modules therefore have separate front panel connectors. A high-frequency, three-switch design is available, working into the microwave region.

Physically, the GRADUATE is made up by combining up to four kernels and four 19in racks, the layout being determined by the software. In this way it can be tailored to satisfy particular constraints of space or can be laid out in a different shape to cater for expansion, relocation or change of function.
More on the scientific computer - 2

An improved monitor

By J. H. Adams, M.Sc.

Since publication of the scientific computer - 1 a number of readers have suggested several features to improve the utility of the program. These suggestions incorporate many of those features and includes a general expansion of the facility for printing the results of the routines for graph plotting. By restructuring the interpreter four extra functions have been added to the program, namely: two functions for commands, I C C (0A7F) for new statements and to I D E 6 (08D2) for new functions. As a result REM has disappeared but the autoplotter is of the same effect and retains the facility for remarks.

08D1 is an example of where 08D1 is used solely to jump spaces between the line number and the first word of the statement. Therefore, it is the point to which 08D1 transfers execution after coming across an I in the text being interpreted. 08F1 transfers control off the stack, increments and pushes back the C register which is used as the line generator code and then looks for and executes that new line. Thus, it is the point to which 08D1 transfers control after finding a "0D" DHX number in the text. Because the computer scans the text for line numbers whether they exist or not, the lines in a program should be as close together as possible (say every line or the fastest program execution. Using multiple statements avoids this problem to some extent and can therefore reduce the execution time of some programs, particularly simple ones, by up to 20%.

Table 7. Additional facilities for the new monitor.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>INT</td>
<td>Outputs the number in the 57109 to 1E00 and F tests the exponent sign.</td>
</tr>
<tr>
<td>FRAC</td>
<td>Outputs the number and tests as in INT. If the exponent sign is negative, executes a jump to 0B00.</td>
</tr>
<tr>
<td>RND</td>
<td>Outputs the number and tests as in INT. If the exponent sign is zero, executes a jump to 0B00.</td>
</tr>
<tr>
<td>ABS</td>
<td>This simply uses the number cruncher test instruction 12 to test a negative number in the line number.</td>
</tr>
</tbody>
</table>

Table 8. Alternatives to the first r.o.m.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>024F</td>
<td>When RND or 03F0 is used, the 024F sets the exponent sign to RND 03F0.</td>
</tr>
<tr>
<td>024D</td>
<td>When RND or 03F0 is used, the 024D sets the 0 is   set to 0.</td>
</tr>
<tr>
<td>024E</td>
<td>When RND or 03F0 is used, the 024E sets the 0 is   set to 0.</td>
</tr>
<tr>
<td>024F</td>
<td>When RND or 03F0 is used, the 024F sets the exponent sign to RND 03F0.</td>
</tr>
</tbody>
</table>

WIRELESS WORLD, FEBRUARY 1980

WIRELESS WORLD, FEBRUARY 1980
WARC and the amateurs

The ending, early in December, of the World Administrative Radio Conference at Geneva has left both professional and amateur communications with the major problem of sorting out exactly how they will fare when the new international table of frequencies and allocations comes progressively into use over the years. The outcome of some of our forebears, that is a divided and highly political conference has added such a problem to the conditions that it has almost destroyed any remaining coherence of the frequency table, and indeed some observers go so far as to suggest that it has left world spectrum management virtually in tatters. There are also now many "resolutions" not directly reflected in the frequency table.

However, at least by comparison with some other services, radio amateurs in Region 1 (and also radio astronomers) have emerged without having suffered any immediately obvious major calamities, indeed with a few useful gains, though nobody is prepared to admit being pleased with the new allocations. The value of this hobby in both developed and developing countries.

The three new i.h.f. bands reach the international table: 10.100 to 10.150MHz (about 29.6 metres); 20.000 to 20.050MHz (18.168 metres); and 24.890 to 24.990MHz (12 metres). It will, of course, still be the case that virtually all of these allocations will become available to amateurs (possibly 10.15MHz will be the first to be transferred). The idea is that there will be no restrictions on the availability of amateur allocations at 7, 10, 14, 18, 21, and 24MHz and 28MHz which should prove a useful incentive for further ionospheric research as well as making long-distance communication possible in most of the time of the day or night, throughout most of the sunspot cycle. However the repeaters must be in operation to make the most of it. Some 100kHz wide and this will call for a high degree of self-discipline to avoid the worst results. The other bands in particular if the bands are open for all modes of operation. The 21MHz "footnote" that permits U.K. operation between 1600 and 1700 local time is now attached to the table. In fact U.K. amateurs do not appear to have lost any h.f. or v.h.f. frequencies, though it is too early to say whether or not operation on some bands will be adversely affected by any new footnotes.

According to returning delegates and observers, one of the many surprises of the conference was the very different attitude shown towards amateur radio by the Japanese delegation, despite that nation's dominance of the consumer market for amateur radio equipment. Arguments are also still being made in a negative active role taken at Geneva by the Chinese delegation may mean less use being made of amateur controlled broadcasting stations in that country — and possibly licensing of amateurs there is also a sensible chance.

There have been many different versions of the program and it is not an always-appreciated sobriquet "ham." According to a story in "World -Radio," the K3PZK program was operated by three young members of the Harvard Wireless Club: Albert Hyman, Bob Almy, and Reggy Murray. The program, in the period before official licenses were issued in the USA, they used a self-assigned call sign formed from the initial letters of their surnames, HAM. Subsequently Albert Hyman was added to appear before the US Congressional committee where his arguments against imposing license fees on American amateur stations, such as HAM, attracted nationwide publicity. It is a plausible story, but there have been other accounts suggesting that like "73" it is something best admired, in the days of line-telegraphists.

From all quarters

North American amateurs on 50MHz continued to be received in Europe daily throughout November and it seems likely that this month that full use have been the peak period of Solar Cycle 22. Even low-power stations were heard with excellent signals from the United States, Canada when the sun was at its maximum. This means that non-amateur services, indeed for a few useful gains, the new h.f. allocation for international broadcasting about 10.150MHz is unlikely to extend beyond 13MHz instead of the proposed 14.0MHz and this gives rise to the hope that a "Gordian Sanitare" will be maintained between the megawatts and the amateur bands.

In brief

An amateur, Mike Vestal, W7YVS last year became the first amateur to "Work All States" on the 3.8MHz band. The 2.0GHz R.S.G.B. National VHF Convention is to be held at the "Winning Post," Waltham, Middlesex on March 8. Forthcoming 7MHz contests organised by the Canadian Radio Society will be a telephone contest on February 23 and c.w. on February 24-25. Decisions taken at WARC, Geneva may make it possible for Class B licensees to use the 70MHz band better. The American League for Nuclear Power Alternatives, the A.R.R.L. is attempting to identify "the opportunities and the obstacles which the League should be doing to prepare for them." P. Balazs, GB9FT was due to be RSGB 46th president, and a "leaves office" position is then called so that a second call of GB9FT will generate a second number from the Z80 refresh register which is only tied to the line number. These numbers, in the Y and X registers of the 57109, are combined through a loop to calculate the new number (i.e. a reasonably random number between 0 and 1. The test that as used by the 57109 stack registers, no more than two other variables must be present in the 57109 when the new number is generated.

Hardware modifications

Changes to the firmware are detailed in sections 6 and 9. Primarily, space has been made in the first p.r.o.m. for three of the 286 zero addresses originally in the second which deal with instruction entry and control. This saves a few words, though routines for this have been implemented by an improved monitor.

The second r.o.m. has been replaced by the Z80 microprocessor and a jump is made back to KSR on the command state of the line interface machine is now cheaper and is adequate with the new facilities. Because the computer scans the text for line numbers whether they exist or not, the lines in a program should be as close together as possible (as for the previous line) for the fastest program execution. Using multiple statements avoids this problem to some extent and can therefore reduce the execution time of some programs, particularly simple ones, by up to 20%.

Table 7. Additional facilities for the new computer.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>INT (0864)</td>
<td>Outputs the number in the 57109 to 1E00D — F and tests the exponent sign. If negative, the whole number is written to zero.</td>
<td></td>
</tr>
<tr>
<td>FRAC (0B48)</td>
<td>Outputs the number and tests as INT. If the exponent sign is negative, execution of the instruction goes on with the exponent incremented by 1.</td>
<td></td>
</tr>
<tr>
<td>RND (0864)</td>
<td>Generates a random number between 0 and 1.</td>
<td></td>
</tr>
<tr>
<td>ABS (0B53)</td>
<td>This simply uses the number cracker instruction 12 to test for a negative number in the program. The result of this test governs whether the instruction to change sign, OC, is executed.</td>
<td></td>
</tr>
</tbody>
</table>

Table 8. Alternations to the first r.o.m.

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Original</th>
<th>Alternation</th>
</tr>
</thead>
<tbody>
<tr>
<td>022F</td>
<td>02BC</td>
<td>02A0</td>
</tr>
<tr>
<td>022D</td>
<td>02C9</td>
<td>0260</td>
</tr>
<tr>
<td>024D</td>
<td>02D8</td>
<td>0261</td>
</tr>
<tr>
<td>024E</td>
<td>02D9</td>
<td>0262</td>
</tr>
<tr>
<td>025C</td>
<td>02D8</td>
<td>0249</td>
</tr>
<tr>
<td>025D</td>
<td>02E4</td>
<td>024B</td>
</tr>
<tr>
<td>0267</td>
<td>02E7</td>
<td>0246</td>
</tr>
<tr>
<td>0268</td>
<td>02E8</td>
<td>0245</td>
</tr>
</tbody>
</table>

Since publication of the scientific knowledge base, the Aid to the international community has suggested several features to improve the firmware. These improvements incorporate many of those features and includes a general expansion of the feature set to fit the routines for graph plotting. By restructuring the interpreter four extra functions have been added. Routines for commands, to 1C09 (at 0A7D) for new functions and to 1D06 (at 8D8E) for new functions. As a result REN has disappeared but the atmosphere has the same effect and retains the facility for remarks.

More on the scientific firmware — 2

An improved monitor

By J. H. Adams, M.Sc.

Since publication of the scientific knowledge base, the Aid to the international community has suggested several features to improve the firmware. These improvements incorporate many of those features and includes a general expansion of the feature set to fit the routines for graph plotting. By restructuring the interpreter four extra functions have been added. Routines for commands, to 1C09 (at 0A7D) for new functions and to 1D06 (at 8D8E) for new functions. As a result REN has disappeared but the atmosphere has the same effect and retains the facility for remarks.

0B05 is an example of where 0B1D is used solely to jump spaces between the line number and the first word of the statement. Therefore, it is the point to which 0D15 transfers execution after coming across an "I" in the text being interpreted. 097F puts off the stack, increments and pushes back the C register which is used as the line number register and then looks for and executes that new line. Thus, it is the point to which 0D15 transfers control after finding a 097F or 0D1H in the text. Because the computer scans the line for a jump to another line whether it exists or not, the lines in a program should be as close together as possible (as for the previous line) for the fastest program execution. Using multiple statements avoids this problem to some extent and can therefore reduce the execution time of some programs, particularly simple ones, by up to 20%.
Using the new facilities

In low level the first feature to be noted is that READY does not disappear.
Using the new facilities

In low level the first feature to be noted is that READY does not disappear when a command is typed in nor does the first letter appear at the beginning of the second v.d.u. line. In high level the same algorithm is now used for both high and low level cases. Clashes produced in the changeover explain the changes of COR to MOD and PROM to PROG. To leave LOAD, the space key is now used instead of (i)). The main change which affects both levels is that the interrupt-and-reset, which occurred whenever any key was depressed, has been cancelled. The next character input can be controlled by using RESTART. The "arrow" keys now revert to their standard keys, RET (left), F (up), and Control (right), and the level and Control A (depressing A and the control key simultaneously) enters the high level. This leaves the key to the right of (i) can be used to delete complete bytes, or one depression per byte. Although this will cause the formatting to go out of true during the LOAD, the grouping by four is maintained and on pressing the space bar at the end of the load the format will be restored.

When loading programs in high level language, another character Control E is used to signify the end of LOADA, or ADDing. This allows the colon, which was previously used for this purpose, to be included in printed messages etc. without terminating the current operation. Ensuring correct format of the input has been eased by a cursor, although with the original monitors few problems will be encountered if a space is typed when in doubt. The DKL key backspaces and clears the last v.d.u. character and also backspaces HL. Corrections are; therefore, easily typed in, but mistaken returns and line numbers cannot be corrected in this way because Fig. 2. Modifications to the keyboard and teleprinter interface.

The radian to degree conversions have also been changed by dropping the first letter, i.e. TD for a conversion to degrees. The author is offering a set of three p.r.m.s programmed with the new monitor firmware for £0. At the time of writing this program can be reprogrammed for £0 (both plus 45p for postage and packing). The 801, Radical, Hertfordshire.

Table 10. Disassembled subroutines

<table>
<thead>
<tr>
<th>Line</th>
<th>Instruction</th>
<th>Address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0419</td>
<td>BCS</td>
<td>015D</td>
<td>Branch on condition (zero)</td>
</tr>
<tr>
<td>041A</td>
<td>BCC</td>
<td>015E</td>
<td>Branch on condition (carry)</td>
</tr>
<tr>
<td>041B</td>
<td>BCI</td>
<td>015F</td>
<td>Branch on condition (integ)</td>
</tr>
<tr>
<td>041C</td>
<td>BPL</td>
<td>0160</td>
<td>Branch plus (a. s.)</td>
</tr>
<tr>
<td>041D</td>
<td>BGE</td>
<td>0161</td>
<td>Branch greater or equal (a. s.)</td>
</tr>
<tr>
<td>041E</td>
<td>BGT</td>
<td>0162</td>
<td>Branch greater than (a. s.)</td>
</tr>
<tr>
<td>041F</td>
<td>BMI</td>
<td>0163</td>
<td>Branch minus (a. s.)</td>
</tr>
<tr>
<td>0420</td>
<td>BLS</td>
<td>0164</td>
<td>Branch less than (a. s.)</td>
</tr>
<tr>
<td>0421</td>
<td>BIC</td>
<td>0165</td>
<td>Branch on condition (overflow)</td>
</tr>
<tr>
<td>0422</td>
<td>石膏</td>
<td>0166</td>
<td>Branch on condition (integ)</td>
</tr>
<tr>
<td>0423</td>
<td>BSA</td>
<td>0167</td>
<td>Branch on condition (slope)</td>
</tr>
<tr>
<td>0424</td>
<td>BSA</td>
<td>0168</td>
<td>Branch on condition (slope)</td>
</tr>
<tr>
<td>0425</td>
<td>BSA</td>
<td>0169</td>
<td>Branch on condition (slope)</td>
</tr>
<tr>
<td>0426</td>
<td>BSA</td>
<td>016A</td>
<td>Branch on condition (slope)</td>
</tr>
<tr>
<td>0427</td>
<td>BSA</td>
<td>016B</td>
<td>Branch on condition (slope)</td>
</tr>
<tr>
<td>0428</td>
<td>BSA</td>
<td>016C</td>
<td>Branch on condition (slope)</td>
</tr>
<tr>
<td>0429</td>
<td>BSA</td>
<td>016D</td>
<td>Branch on condition (slope)</td>
</tr>
<tr>
<td>042A</td>
<td>BSA</td>
<td>016E</td>
<td>Branch on condition (slope)</td>
</tr>
<tr>
<td>042B</td>
<td>BSA</td>
<td>016F</td>
<td>Branch on condition (slope)</td>
</tr>
</tbody>
</table>

Table 11. Demonstration programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>042C</td>
<td>Program A</td>
</tr>
<tr>
<td>042D</td>
<td>Program B</td>
</tr>
<tr>
<td>042E</td>
<td>Program C</td>
</tr>
<tr>
<td>042F</td>
<td>Program D</td>
</tr>
</tbody>
</table>

Figure 2.

<table>
<thead>
<tr>
<th>Figure 2.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Program A</td>
</tr>
<tr>
<td>B</td>
<td>Program B</td>
</tr>
<tr>
<td>C</td>
<td>Program C</td>
</tr>
<tr>
<td>D</td>
<td>Program D</td>
</tr>
</tbody>
</table>
New frequency allocations

WARC 79 decisions for radio services in Region 1

The list opposite gives frequency allocations to radio services decided at the World Administrative Radio Conference (WARC 79) held by the International Telecommunication Union at Geneva, September 16 to October 6, 1978. It is taken from the revised Radio Regulations which will come into force on January 1, 1983, and will replace the allocations made at the previous event of this kind held in Geneva in 1959 (now October 1979 issue, p.52, for background). Because of lack of space, and the interests and geographical distribution of our readers, the information presented here is no more than an extract from the international table of frequency allocations which will be part of the Regulations and its present form runs to 174 pages and includes hundreds of footnotes, giving additions, qualifications, restrictions etc. for particular countries. First, our list covers only ITU Region I (Europe, Africa, Middle East and Russia). Secondly, its upper limit is 1GHz whereas the WARC allocations in fact go up as far as 275GHz. Thirdly, all the footnotes have been omitted. Nevertheless, the list does give details of many changes which are particularly important to radio services in the UK.

For example, as a result of a change in the long-wave band limits, Driwolch (Radio 4) frequency will eventually be increased to 1986kHz; the BBC have obtained a medium-wave frequency for their Carfax traffic information service; international short-wave broadcasting has acquired overall an additional 786kHz overall, including an extra band; television channel 1 (Palace and its stations) will be transferred from broadcasting to radio communication; land mobile radio may be moving into parts of television Band I and Band III by internal agreement within the UK (the 405-line television services are probably within the closing down by 1985); v.h.f. radio broadcasting will eventually be extended up to 1080kHz, though for a long time it will be sharing the top end of this band (194–1080MHz) with communication services; at u.h.f. two 8MHz channels will eventually become available, perhaps for land mobile radio or television, between television Bands IV and VI, and at the top end of the u.h.f. band there is more space for mobile services. However, it will take a good many years for all these changes to be implemented and some will not occur till near the end of the century, if the next WARC, possibly in 2000AD.

In the lists, the code shows the radio services to which the frequencies have been allocated, and these codes are explained in the key below. The terminology here is approximately the same as that used in the ITU frequency allocation document. In all cases the first code letter, to the immediate right of the frequency band, indicates a primary service (using ITU terminology) in the band, that is, a service which has equal rights with a "permitted" service but has priority of frequencies when frequency plans are made. The next code letter to the right also indicates a primary service, but in some cases it could be a "permitted" service (which has rights equal to those of a primary service except that it gets the second choice in frequencies), or a "secondary" service (which must not cause interference to primary service and cannot claim protection from interference caused by them). To avoid complications in a short article, our list does not indicate the specific categories of service applying to the second and subsequent code letters, but in general a rough guide is that order of categories when moving through the code letters from left to right is primary, permitted, secondary.

The following notes highlight some of the changes which may be of interest to our readers.

**Medium waves**

The band limits of the m.w. broadcasting band (525-1605kHz) have been adjusted upwards to 526.5-1606.5kHz to cover the correct amounts of space for the sidebands at these limits— an adjustment that was not made at the 1979-90 Region 1 L.F./m.f. broadcasting conference (January 1976 issue, p.42). Just below this the BBC have acquired a 1kHz band of 519.5 to 520.5kHz on a secondary basis for their experimental Carfax traffic information service.

**Short waves**

The short-wave broadcasters did not get the hoped-for increase of sixty per cent or more in space in broadcast bands but did acquire an extra 786kHz overall, which amounts to 32.5% over the present allocation. They acquired a new band at 13.6-13.7kHz (21m), extended the 16m, 19m, 25m and 31m bands by amounts varying from 100kHz and

### Table of frequency allocations for Region 1

<table>
<thead>
<tr>
<th>Service</th>
<th>Channel</th>
<th>Frequency (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aeronautical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AR</td>
<td></td>
<td></td>
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<tr>
<td>BS</td>
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<td>HS</td>
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<td>SAT</td>
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<td>SAT</td>
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</tr>
<tr>
<td>T</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
New frequency allocations

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As an example of a result in the long-wave band limits, Droitwich (Radio 4) frequency will eventually be transferred to 890.0-942.0 kHz. The BBC have obtained a medium-wave frequency for their Carfax traffic information service; international short-wave broadcasting has acquired overall an additional 786kHz overall, including an extra band; television channel 1 (Palace and station) will be transferred from broadcasting to radio communication; land mobile radio may be moving into parts of television Band I and Band III by internal agreement within the UK (the 405-line television services are probably still a closing down by 1985). v.h.f. radio broadcasting will eventually be extended to 1808kHz, though for a long time it will be sharing the top end of this band (180-189MHz) with communication services; at u.h.f. two 8MHz channels will eventually become available, perhaps for land mobile radio television, between television bands IV and V, and at the top end of the u.h.f. band there is more space for mobile services. However, it will take a good many years for all these changes to be implemented and some will not occur till near the turn of the century. Changes to the next WARC, possibly in 2000AD.

In the list, the code shows the radio services to which the frequencies have been allocated, and these codes are explained in the key below. The terminology here is approximately the same as that used in the ITU frequency registry document. In all cases the first code letter, to the immediate right of the frequency band, indicates a "primary service" (using ITU terminology) in the band, that is a service which has equal rights with a "permitted" service but has prior choice of frequencies when frequency plans are made. The next code letter to the right indicates a secondary service, but in some cases it could be a "permitted" service (which has rights equal to those of a primary service except that it gets the second choice in frequencies), or a "secondary service" (which must not cause interference to primary service and cannot claim protection from interference produced by them). To avoid complications in a short article, our list does not include the direct categories of service applying to the second and subsequent code letters, but in general a rough guide is that the order of categories when moving through the code letters from left to right is primary, permitted, secondary, permitted.

The following notes highlight some of the changes which may be of interest to our readers.

Key to code letters in list

A Amateur
AM Aeronautical fixed
AM Aerial mobile
AM Aerial mobile - satellite
AR Aeronautical radio navigation service
AS Amateur satellite
B Broadcasting
BS Broadcasting - satellite
ES Earth to space (satellite)
F Fixed communications
HA Hearing aid
ISM Industrial, scientific, medical
LM Land mobile
LS Land mobile service
MBS Mobile - satellite
MS Maritime communication system
MM Maritime mobile
MM Maritime mobile - satellite
MR Maritime radio
MS Maritime radio - satellite
MT Meteorological service
NF News and information
NM National mobile
NS National satellite
OM Office mobile
OS Office satellite
PP Public service
PS Public service - satellite
RN Radio navigation
RR Research
RS Research and satellite
SAT Satellite (Earth exploration)
SE Space to earth (satellite)
TE Telecommunication
SF Full service
TP Television
TM Television and miscellaneous
W World service

Medium waves

The band limits of the m.w. broadcasting band (325-1600kHz) have been adjusted upwards to 325.6-1600.3kHz to give the correct amounts of space for the sidebands at these limits -- an adjustment that was not made at the 1974-75 regional l.f./m.f. broadcasting conference (January 1976 issue, p.42). Just below this the BBC have acquired a 4 kHz band of 519.5-520.5 kHz on a secondary basis for their experimental Carfax traffic information service.

Short waves

The short-wave broadcasters did not get the hoped-for increase of sixty per cent or more in space in broadcast spectrum but did achieve an extra 786kHz overall, which amounts to 32.5% over the present allocation. They acquired a new band at 13.6-13.8kHz (2m), extended the 16m, 19m, 25m and 31m bands by amounts varying from 100kHz and continued upwards:

<table>
<thead>
<tr>
<th>Service</th>
<th>Frequency (kHz)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>FM</td>
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<td>MF</td>
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Table of frequency allocations for Region 1

<table>
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<tr>
<th>Service</th>
<th>Frequency (kHz)</th>
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<tbody>
<tr>
<td>AM</td>
<td>520-1000</td>
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www.americanradiohistory.com
The radio communication services obtained some extra space at h.f., several of the higher bands being increased by 100 kHz or more.

The maritime mobile service has also gained some extra space at h.f., several of the higher bands being increased by 100 kHz or more.

V.h.f. bands

The radio communication services obtained some extra frequencies at v.h.f., and mobile communications. Hitherto in (Britannia 41-47MHz has been allocated to television broadcasting (Channel I of Band I) and in fact the BBC will be able to keep it on a primary basis until 1987 (and the French broadcasting authorities till 1986). Furthermore, the land mobile service of 100 channels in the UK has been allocated 470-68MHz (the remainder of the UK TV Band I) on a permitted basis, leaving the possibility for the primary service. When, however, 450-line television broadcasting is closed down, and in the absence of alternative broadcasting requirements, land mobile radio could be allowed to take over the whole band.

The land mobile service of the UK and 15 other countries has also allocated the band 174-223MHz on a permitted basis. Hitherto 174-216MHz has been occupied exclusively by television broadcasting (Band III for 405-line transmissions in the UK) and this service will continue to use it, and the extension to 223MHz, on a primary basis. Land mobile radio in 19 countries including the UK will also be moving into an adjacent band 223-230MHz on a permitted basis. The primary occupant of this band will be broadcasting, while fixed and mobile communications are to use it on a secondary basis.

The land mobile and maritime mobile services have primary allocations in 29 countries, including the UK, throughout the band 136-144MHz. However, mobile radio will be losing some spectrum in the region of 100MHz v.h.f./f.m. sound broadcasting is extended upwards in frequency (January 1973, p. 65). Broadcasting in fact will eventually become the primary service in a band 87.5-108MHz and has a common worldwide allocation from 100 to 108MHz (a decision mainly for the African countries) and the UK police and fire mobile radio at present using 97.6-101MHz will have to move to the top of the band 87.5-96MHz. Up to then they will remain on a permitted basis and there will probably be a phased withdrawal over the next ten years. Meanwhile fixed and mobile services will continue to use 100-104MHz on a primary basis until a new plan made by a regional broadcasting conference (possibly in November 1982) comes into force. And 104-108MHz is allocated to mobile radio on a permitted basis till the end of 1982 on a secondary basis thereafter. In the UK this 104-108MHz is at present used for private mobile radio (e.g. the nationalized public services). This broadcasting and radio communication will be equally sharing 104-108MHz for probably the next twenty years.

The bottom end of the 87.5-108MHz band, the section 87.5-90MHz is also allocated on a permitted basis to the land mobile service in ten countries included the UK. A new conference entirely dedicated to mobile radio is likely to be held in about 1982.

U.h.f. bands

Broadcasting will be the primary service in the band 470-700MHz and will share with fixed communications, also a primary service, from 790 to 802MHz. V.h.f. television Band III and V are at present separated by three 8MHz channels of the broadcasting service using 582-600MHz. The channel at 582-590MHz will be used until the end of 1987 and the channel 598-606MHz until the end of 1994. Thus this aeronautical service will eventually be squeezed into one 8MHz band at 590-598MHz, the two could be used either for land mobile radio or television broadcasting. The top end of the u.h.f. band, 862-960MHz, has been approved for land mobile radio communications, broadcasting. A multiphonic system will be used for all events and will be used in the future for aeronautical service.

A multiphonic system is one in which there are only as many generators as notes you wish to play at the same time, as distinct from one generator for every note on the keyboard. The sound may not be harmonious, but it is possible by appropriate selection of the notes at any time.

The computer organ has a polyphonic generator system, producing a signal for each note of the keyboard, but only one basic waveform. An electronic multiphonic switching system connects this signal to one of a limited number of waveshape processing units when a key is pressed. There are typically 12 of these units, so that only 12 notes may sound at any one time. A computer organ with only 6 wave shape processing units would be an attractive proposition, if a significant reduction in cost could be achieved.

The second type uses a mechanical keyboard changeover switching system and generators, in which the frequency is determined by the value of the resistor connected to it by the keyboard switching system. Whilst these organs are satisfactory for home use, they are subject to a fundamental limitation: when the hand is lifted from the keyboard the connection to the resistor is broken, so that the signal ceases abruptly. At higher volume levels, such as those required for church or theatre use, this gives rise to objectional key clicks and thumps. The use of a reverberation unit mitigates this effect a little, but despite much work to find alternative means of reducing the clicks and thumps to an acceptable level, it appears that the only satisfactory and acceptable solution is to arrange for the waveform to die away over a few cycles when the key is released.

Most synthesizers are monophonic, which is a severe limitation. There are a number of instruments in which a polyphonic generator system is used, the output waveform from the keyboard switching system being fed to a programme, voltage-controlled filter, but the output from the keyboard switching system consists of a mixture of the different notes, so that it is not possible to process the signals individually by the usual synthesizer techniques. By combining multiphonic techniques with synthesizer techniques, it is possible to overcome the limitation of the synthesizer, namely its monophonic.

The novel keyboard switching system described in an article in this journal in June, 1973, enabled six notes to be played simultaneously with the use of only six generators. One drawback to the original system was the production of 'clucks' and 'thumps' when keys were pressed and released: this new version uses the same switching arrangement, but an additional circuit to provide a smooth decay is included.

Fig. 2. Diagram of the circuit which provides the smooth decay
200kHz (see list) but lost 70kHz from the lower end of the 11m band, which is now 25.67-26.1MHz. There was no change below 8MHz. These gains were obtained, initially against considerable opposition, at the expense of the fixed h.f. communication bands, which tend to alternate with the broadcasting services, but the fixed services will be offered replacement frequencies. The transfers will not start until 1984, but in any case it was decided that there will be a new conference for planning the h.f. broadcasting bands and this could take place in 1986. The first part will establish the technical parameters, then, when everyone has digested the same basic data, the planning proper will start a year or more later. At WARC 79, nineteen delegations, including the UK's 'reserved their positions' on h.f. broadcasting, which means that, in the absence of an adequate plan, they do not intend to be bound by these decisions. They felt, for example, that not enough spectrum was allocated in the 4m and 6m broadcasting bands.

The maritime mobile service has also gained some extra space at h.f., several of the higher bands being increased by up to 160kHz or more.

V.h.f. bands

The radio communication services gained some extra frequencies at v.h.f. in parts of the spectrum they have not been in before. For example, 41,015-47,000MHz will be exclusively for fixed and mobile communications. Hitherto in Britain 41-47MHz has been allocated to television broadcasting (Channel 1) and in fact the BBC will be able to keep it on a primary basis after 1987 (and the French broadcasters till 1986). Furthermore, the land mobile services of 30 countries including the UK have been allocated 47.0-68MHz (the remainder of the UK TV Band I) on a primary basis, leaving 20MHz for the primary use. When, however, 405-line television broadcasting is closed down, and in the absence of alternative broadcasting requirements, land mobile radio could be allowed to take up the whole band.

The land mobile service of the UK and 15 other countries has also allocated the band 174-223MHz on a permitted basis. Hitherto 174-216MHz has been occupied exclusively by non-television broadcasting (Band III for 405-line transmissions in the UK) and this service will continue to use it, and the extension to 223MHz, on a primary basis, leaving 405-line TV is closed down. And land mobile radio in 19 countries including the UK will also be moving into an adjacent band 223-230MHz on a permitted basis. The primary occupant of this band will be broadcasting, while fixed and mobile communications are to use it on a secondary basis.

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Amateur radio

The amateur radio service uses frequencies throughout the spectrum for conventional and satellite communication. For comments on the WARC 79 allocations, see World of Amateur Radio by Pat Havelock elsewhere in this issue.

We hope to deal with the allocation above 10GHz in a later issue. This is the part of the spectrum used by satellites, some noteworthy changes have been made, for example the satellite allocation in the 1GHz region has been almost doubled and provision has been made for a mobile satellite service at 14GHz which would enable transportable earth stations to be taken to remote places for relaying television news and other events directly by satellite. Direct broadcasting from satellites to domestic rooftop aerials can now take place in the three bands: 11.7-12.2GHz (see January 1979 issue), 40-42.5GHz; and 84-86GHz. (The broadcasting, satellite link is at 250-260GHz is limited to national and regional communication services.)

More detailed and complete information on the WARC 79 frequency allocations can be obtained from the Radio Regulatory Department, Home Office, Watford Bridge House, London SE1 8UA (tel: 01-275 3000).

The novel keyboard switching system described in an article in this journal in June, 1973, enabled six notes to be played simultaneously with the use of only six generators. One drawback to the original system was the production of 'clicks' and 'thumps' when keys were pressed and released: this new version uses the same switching arrangement, but an additional circuit to provide a smooth decay is included.

A multiphonic organ is one in which there are only as many generators as notes you wish to play at the same time as distinct from one generator for every note on the keyboard. The organ shown in the list applies only to certain countries in the African broadcasting area.

The computer organ has a polyphonic generator system, producing a signal for each note of the keyboard, but only one basic waveband. An electronic multiphonic switching system connects this signal to one of a limited number of waveband processing units when a key is pressed. There are typically 12 of these units, so that only 12 notes may sound at any one time. A computer organ with only 6 wave shape processing units would be an attractive proposition, if a significant reduction in cost could be achieved.

The second type uses a mechanical keyboard changeover switching system and generators, in which the frequency is determined by the value of the resistor connected to it by the keyboard switching system. Whilst these organs are satisfactory for home use, they are subject to a fundamental limitation: when the hand is lifted from the keyboard the electrical connection to the resistor is broken, so that the signal ceases abruptly. At higher volume levels, such as those required for church or theatre use, this gives rise to objectional key clicks and thumps. The use of a reverberator unit mitigates this effect a little, but despite much work to find alternative means of reducing the clicks and thumps to an acceptable level, it appears that the only satisfactory and acceptable solution is a return to an arrangement where a waveband is allowed to die away over a few cycles when the key is released.

Most synthesizers are monophonic, which is a severe limitation. There are a number of instruments in which a polyphonic generator system is used, the output waveform from the keyboard switching system being fed to a programmable, voltage-controlled filter, but the output from the keyboard switching system consists of a mixture of the different notes, so that it is not possible to process the signals individually by the usual synthesizer techniques. By combining multiphonic techniques with synthesizer techniques, it is possible to overcome the limitation of the synthesizer, namely its monophonic.

Multichannel synthesizer organ

Improved circuit to eliminate 'thumps'

by J. H. Asbery, B.Sc.
Voltage-controlled oscillators

The requirements placed on voltage-controlled oscillators depend on the application. A polyphonic organ is more stringent than a synthesizer. The purpose of the organ is to produce a multiplicity of sounds, and arrangements can be made to cause the sound to die away over a few cycles, completely eliminating click and hum. The waveform from each generator is available separately and unified for individual treatment and processing by existing synthesizer techniques.

Decay switching

The second main problem of a multi-

polaric organ is the switching of voltage and current across a number of similar voltage-controlled oscillators. Voltage-controlled oscillators are voltage-controlled oscillators: it is synthesizer over a few cycles, completely eliminating click and hum. The waveform from each generator is available separately and unified for individual treatment and processing by existing synthesizer techniques.

The design of the ramp-type v.c.o. adopted is IC1 and IC2 is conventional except for the switching circuit, which is a two-stage NMOS inverter. The output from the NMOS inverter is used to drive a transistor in conventional mode the transistor gives rise to a large variation in output voltage, and if it is sometimes used, but these are also sub-
ject to a wide tolerance spread. In con-

Theory of logarithms

If you had been possessed of Napierian knowledge, you would have known that the logarithm of a number is the power to which you must raise a given base to obtain that number. The natural logarithm is to base e, and the common logarithm is to base 10. Napier's idea of logarithms was that he conceived a system very closely related to his own, but the product of R29 in the case of the left-hand oscillator and the modulators or

The more inquisitive type of schoolboy

The product of R31 and C5 should be regulated by about a factor of two.

We understand that Mr Araby is pre-
pared to supply components from B7.

Oakington Manor Drive, Wembley, Middle-
sex.

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Oakington Manor Drive, Wembley, Middle-
sex.
What’s so natural about e?

2 The relationship of Euler’s number to logarithms

by John C. Finlay

In the previous article the author presented the popular study of Euler’s number, the key to understanding exponential change. Here he continues with his usual unheralded methods to show the relationship of e to logarithms in the invention of the logarithm by John Napier.

The more inquisitive type of schoolboy, who has just managed to conquer the technique of using logarithms to the base of 10 (thanks to Henry Briggs from Yorkshire, 1616-1630), leaps through his new book of tables and comes across another table of logarithms, variously described as natural, hyperbolic or (ceviesly) as Napier’s. He might be seeing the odd-looking figures and the cumbersome calculations required for numbers lying outside the range of 1 to 10, but he promptly skips the book and forgets about the whole "natural" idea until he suddenly comes across a text in a journal: "I doubt if a better mathematical definition of the number e is possible than the following..."

In fact, he is reading this from Napier’s work (published in 1614), and there the invention of logarithms by John Napier.

We understand that Mr. Asbury is prepared to supply components from 87, Oakington Manor Drive, Wembley, Middlesex. WIRELESS WORLD, FEBRUARY 1980

then a 'ratio-number'. What a pity it was that the laws of indices were unknown to Napier! Not only would this have eased his self-imposed task, but it would have spared us yet another redundant mathematical word (logarithm = index exponential).

The model was a dynamic one, visualizing the comparative motion of two points along two parallel lines (Fig. 11) to the same scale of distance. One point, \( P_x \), representing the logarithm, moves at steady velocity \( v_1 \) along the lower line, which is of infinite length. The other point, \( P_y \), representing the number, moves along the upper line of \( 10^7 \) units long, and at a velocity \( v_2 \) equal to its distance \( y \) from the far end of the line. At the starts, for the 1st term, both \( P_x \) and \( P_y \) move away at the same velocity, equal therefore to \( 10^7 \) units, but \( P_y \) steadily slows down as \( y \) diminishes, and gradually falls behind \( P_x \). Napier defined his logarithm as (Napierian) logarithm = the corresponding ratio-number as obtained from the model. So a zero logarithm implies a number of \( 10^0 \) and an increase in value of the logarithm corresponds to a decrease in the number. \( P_y \) also has to reach infinity before \( P_x \) arrives at the scale end at number zero.

Now consider the comparative positions of Napier's G.P. terms on the scales. The 2nd term, by definition, was \( 10^1 \) and, so the distance along the number scale from 1st to 2nd terms is 1 unit (on other scale) as marked. The corresponding logarithm for the 2nd term was estimated by Napier as \( 10^0 \), which for graphical purposes is shown on the diagram as approximately 1. This establishes the linear log. scale as 1 unit, and so the distance along the scale \( 1 \) unit, from the start, is \( 10^1 \) or 10 units.

The values of \( y \) already calculated for the first 14-place table for numbers from 1 to 100000 and 90 to 100000 which he published in 1617, and the Briggs figures in 1624, were obtained by the very simple method of exploring the history of logarithms here, encompassing the work of Newton and Leibniz was largely useless (the work of Newton and Leibniz was not yet well known) and an appropriate power of 10 to be the logarithm of (still shifting more convenient for general calculations using logarithms. This was the basis of ordinary or Briggsian logarithms. Napier died in 1617 and in the event Briggs chose the now familiar base of 10 for new 14-place tables for numbers from 1 to 20000 and 900 to 100000 which he published in 1624. Vlacq, a Dutch mathematician, filled in the gap and republished the Briggs figures in 1628.

By 1617, when you, like Napier, had no knowledge of logarithms without the decimal point, more than a century was to pass before the importance of natural logarithms was appreciated in analysis, including the work of Euler on negative and complex numbers. This is the basis for the natural logarithm. The French mathematician, discovered the Napierian and natural logarithms, a matter fundamental to the understanding of e. It is not wonder, therefore, that you, as Napier, were using the table uncluttered, and have plotted the logarithms of various numbers. Now why should the numbers between the available logarithms have any thing to do with Napier's logarithms? For the first two, that is \( e \) and \( 1 \), of which he knew nothing.

Let's make a rough graph of the numbers \( x \) and \( \log_x \) found in his series, plotted against the logarithm (\( x \)) which he allocated to them (Fig. 12).

He assigned \( 10^0 \) to a log. value of 0 and \( 10^1 \) to 1 and so on taken from tables for logs up to around 1.5 X 10\(^7\) and beyond.

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The other point, lower line, which is of infinite length, diminishes and gradually falls behind an increase in value of the logarithm corresponding to a number scale from 1st to 2nd terms is 1 approximately 1. This establishes the he had already calculated for the first of or over a long time, as suggested by Napier, defined his logarithm as a model for the definition of his logarithms.

...as the first-born, are related to e, of natural logarithms without the decimal point. More than a century was to pass before the importance of natural logarithms was appreciated in analysis, including the work of Euler on negative and complex numbers (mentioned later). Johann Bernhard Lambert, a Swiss, published the first such table in 1770.

To see how the value of $e$ can be derived from natural logarithms as the limit of a specific logarithm, you can be proud of doing more than Napier could - he didn't understand the nature fundamental to the understanding of logarithms, a matter fundamental to the understanding of Napierian and natural logarithms, a matter fundamental to the understanding of Napierian and natural logarithms, a matter fundamental to the understanding of $e$.

If $x = a^y$, then $y = \log_a(x)$ (from the definition of a logarithm).

Here are some calculated values of $y$ for various values of $x$ and $a$:

![Fig. 13](image-url)
sideways and look at it in a mirror it becomes identical with Fig. 5. The point that is hammered home in Fig. 15 is that the curves for $e^x$ and $\log x$ are shown against the same axis.

So, as well as finding another way to bring out the value of $e$, we may think is - even trickier than any I for logex, who aspire to the calculus will note that innocent-looking equation

\[ \sqrt{\text{P.M.}} \text{ I had better substitute } \]

coefficients with respect to $x$ of $e^{x}$ and of $\log x = (1/x)$. There is in still more graphical wise we can use to find $e$, which you may think is even simpler than those we have so far mentioned. Consider the innocent-looking equation $y=\sqrt{\text{P.M.}}$ and draw a table of values.

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19. Reference as above, pp. 513-523 (Logarithms), Ginn 1925.
29. Reference as above, pp. 513-523 (Logarithms), Ginn 1925.
30. A. Hooper. Makers of Mathematics, Ch 5 (Introduction to the Calculus), Faber & Faber 1949.
31. Reference as above, pp. 513-523 (Logarithms), Ginn 1925.
32. A. Hooper. Makers of Mathematics, Ch 5 (Introduction to the Calculus), Faber & Faber 1949.
33. Reference as above, pp. 513-523 (Logarithms), Ginn 1925.
34. A. Hooper. Makers of Mathematics, Ch 5 (Introduction to the Calculus), Faber & Faber 1949.
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37. Reference as above, pp. 513-523 (Logarithms), Ginn 1925.
38. A. Hooper. Makers of Mathematics, Ch 5 (Introduction to the Calculus), Faber & Faber 1949.
39. Reference as above, pp. 513-523 (Logarithms), Ginn 1925.
sideways and look at it in a mirror it becomes identical with Fig. 5. The same point is hammered home in Fig. 15 where the curves for $e^x$ and $\log_e x$ are shown against the same axes.

So, as well as finding another way to bring out the value of $e$, we have proved (no, after some ominous rumblings from you) that $\log_e x = \frac{\log x}{\log e}$ for log bases of $x$ and $e$ is thus $\log_e e = \log_10 1 = 0$, as we discovered.

References


A detailed examination of the medium and long wave broadcast bands leads to the conclusion that the bandwidth is so much to do with poor receiver and aerial performance as the cost of the signal and interference. The r.f. present at the aerial will then be much simpler, and the difference in the signal means that their neglect by many listeners is as significant as their cause for complaint.

I was interested in the article you refer to p.m.e. Mr Hill, like myself, is obviously a loop enthusiast. Nevertheless this is an excellent way of widening the scope of listening experience. Even experiments with a feedery coupled loop (described in Wireless World many years ago) a 3m x 1m six-turn m.w. tuned loop was very often used either as a “H-field multiplier” with portable receivers or coupled with or without cable to the ferrous rod of an f.m.a.m. tuner. Favourable results obtained during winter months suggested that with some receivers even larger loops would be useful. Mr Schenkel has shown in his book that $\log e = 1$ is the largest size necessary. However I find that there are several practical advantages of using a given size below the s.g. of the receivers to deal better with fading. When coupled to the ferrite rod of the tuner by a 1cm long wire the loop was set with a good receiver and a closely coupled untuned loop would indicate that an area of 1 m$^2$ is more than adequate.

For long-wave reception a 2m x 2m loop is used, situated in a loop and coupled by means of a single turn to a 10ohm cable. At the receiver end there is an item display and appears to be as sensitive as the side of the receiver case with the receiver itself as of the Hong Kong transformer is in the loop field passes from seas to 1 m$^2$ is more than adequate. A further component of the loop field must be that the receiver is near the middle of a large loop, the latter being near the middle of one of the large loops.

R. W. Hill

Department of Technology

Gloucester College

References


The author replies:

Mr. Hill, myself, in obviously a loop enthusiast, and I would only observe my own views to those in his letter. Coupling a large loop into a modern radio may be unsatisfactory, quite apart from the reasons put forward in the original article, because transmitter masks are much more liable to overload than their valve counterparts. Both overload and the decreased r.f. effectivity of the effect of producing noise. With the existing radiated power the loop tuning is far from being sufficient to increase the sensitivity. What has been insufficiently stressed so far, though, is the absolutely imperative need for individual commitment. This applies right across the board — including involvement with “defence” projects, nuclear power and telecommunications (information manipulation).

Separate tuning of the loop increases selectivity but only improves sensitivity when coupling to the first tuned circuit is insufficient. Since this useful technique may be tried by some readers, they are cautioned to avoid overcoupling. It would appear that Mr Hill, at least, does not understand how far the measure should be taken. He observes that quite large loop areas give a noticeable improvement in reception; it could also be that the receiver is of very poor sensitivity, and I can confirm that a large tuned device used in this way could do the job.

A careful exploration of the medium and long wave broadcast bands leads to the conclusion that the bandwidth is so much to do with poor receiver and aerial performance as the cost of the signal and interference. The r.f. present at the aerial will then be much simpler, and the difference in the signal means that their neglect by many listeners is as significant as their cause for complaint.

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R. E. Schenkel


COMMITMENT IN WORK

It is heartening to find an editor who is prepared to take on the task of raising (by whatever degree) the level of awareness of his readers. Your excellent editorial in the January 1979 issue on military intelligence, and more recent ones on the unpleasant social consequences of professional occupations, have been valuable. What has been insufficiently stressed so far, though, is the absolutely imperative need for individual commitment. This applies right across the board — including involvement with “defence” projects, nuclear power and telecommunications (information manipulation).

Separate tuning of the loop increases selectivity but only improves sensitivity when coupling to the first tuned circuit is insufficient. Since this useful technique may be tried by some readers, they are cautioned to avoid overcoupling. It would appear that Mr Hill, at least, does not understand how far the measure should be taken. He observes that quite large loop areas give a noticeable improvement in reception; it could also be that the receiver is of very poor sensitivity, and I can confirm that a large tuned device used in this way could do the job.

A careful exploration of the medium and long wave broadcast bands leads to the conclusion that the bandwidth is so much to do with poor receiver and aerial performance as the cost of the signal and interference. The r.f. present at the aerial will then be much simpler, and the difference in the signal means that their neglect by many listeners is as significant as their cause for complaint.

I was interested in the article you refer to p.m.e. Mr Hill, like myself, is obviously a loop enthusiast. Nevertheless this is an excellent way of widening the scope of listening experience. Even experiments with a feedery coupled loop (described in Wireless World many years ago) a 3m x 1m six-turn m.w. tuned loop was very often used either as a “H-field multiplier” with portable receivers or coupled with or without cable to the ferrous rod of an f.m.a.m. tuner. Favourable results obtained during winter months suggested that with some receivers even larger loops would be useful. Mr Schenkel has shown in his book that $\log e = 1$ is the largest size necessary. However I find that there are several practical advantages of using a given size below the s.g. of the receivers to deal better with fading. When coupled to the ferrite rod of the tuner by a 1cm long wire the loop was set with a good receiver and a closely coupled untuned loop would indicate that an area of 1 m$^2$ is more than adequate.

For long-wave reception a 2m x 2m loop is used, situated in a loop and coupled by means of a single turn to a 10ohm cable. At the receiver end there is an item display and appears to be as sensitive as the side of the receiver case with the receiver itself as of the Hong Kong transformer is in the loop field passes from seas to 1 m$^2$ is more than adequate. A further component of the loop field must be that the receiver is near the middle of a large loop, the latter being near the middle of one of the large loops.

R. E. Schenkel


THE INTELLIGENT PLUG

I was interested in the article “The intelligent plug” in your warning note you refer to p.m.e. I hope you will not mind if I mention that this stands for propaganda rather than mere search.

Where the electricity supply authority has applied this technology to the single phase distribution system, the consumer will have been offered an improved service and in fact, a connection to the neutral of the electricity supply system. The injection of a carrier frequency between the existing supply and earth on the consumer’s installation will effectively short-circuit at the network point of supply that the consumer’s earth conductor and neutral are both connected to the incoming supply neutrals.

In an electricity distribution system where the system neutral is earthed only at the distribution sub-station, the neutral and earth connections will again be short-circuited but the impedance, as seen at the consumer’s installation, will be sufficiently large not to significantly alter the feeder load carrier frequency.

I.E. Elliott

Eastern Electricity

Suffolk

committed, and neutral and the consumer who will be better protected from such interference.

Wireless World, February 1980
One point on your editorial "Trickle, which might not stop flowing when "alternative (or "appropriate") technol­ogy" is mentioned, is that alternative technology is not concerned primarily with producing goods — goods are not the only output. The needs are reliable means of feeding and sheltering the population, and functions aimed at the agricultural, building and en­tertainment industries; some of these still have a part to play. Alternative tech­nology is primarily concerned with producing a gap between its inputs and its end products, so that there is no feeling of identification between the maker and what he has made. This gap has been recognised as a major source of dissatisfac­tion in Western manufacturing industries; those of us concerned that developing countries should try to avoid this -

John Williams
Tunbridge Wells
Kent

Scientific Computer

I have followed with great interest the views of Mr R. B. Adama (April—September 1979). As an elec­tronics professional, some of the ideas put forward by Mr Adama seem to be too optimistic. I wonder if he has his facts right.

The computer “cruncher” approach seems to me to be so logical that it is surprising that more systems do not apply it. Many systems do try to use it, but fail (b) to apply it properly, (c) to take the cost of the “cruncher” into consideration, (d) to take into account the importance of the cruncher’s "intelligence" and (e) to have an effective monitoring system. I would like to see more of these systems apply the “cruncher” as a standard system to the crunching of data before any data is processed.

The “database” approach is a very good thought, but I would like to see more of these systems adopt it. I would like to see more systems take the effective use of the database and its ability to store and retrieve data in an effective way into consideration. I believe that this will be the key to the success of a system.

The "interactive" approach is also a very good thought, but I would like to see more of these systems adopt it. I would like to see more systems take the effective use of the database and its ability to store and retrieve data in an effective way into consideration. I believe that this will be the key to the success of a system.

The "networking" approach is also a very good thought, but I would like to see more of these systems adopt it. I would like to see more systems take the effective use of the database and its ability to store and retrieve data in an effective way into consideration. I believe that this will be the key to the success of a system.

The "distributed" approach is also a very good thought, but I would like to see more of these systems adopt it. I would like to see more systems take the effective use of the database and its ability to store and retrieve data in an effective way into consideration. I believe that this will be the key to the success of a system.

The "parallel" approach is also a very good thought, but I would like to see more of these systems adopt it. I would like to see more systems take the effective use of the database and its ability to store and retrieve data in an effective way into consideration. I believe that this will be the key to the success of a system.

The "real-time" approach is also a very good thought, but I would like to see more of these systems adopt it. I would like to see more systems take the effective use of the database and its ability to store and retrieve data in an effective way into consideration. I believe that this will be the key to the success of a system.

The "on-line" approach is also a very good thought, but I would like to see more of these systems adopt it. I would like to see more systems take the effective use of the database and its ability to store and retrieve data in an effective way into consideration. I believe that this will be the key to the success of a system.

The "off-line" approach is also a very good thought, but I would like to see more of these systems adopt it. I would like to see more systems take the effective use of the database and its ability to store and retrieve data in an effective way into consideration. I believe that this will be the key to the success of a system.
VHF AND ITS PROGRAMMES

May I respond to Mr MacKay and Mr Watson? Concerning the use of VHF radio.

In the early days of VHF, the BBC certainly tried to encourage listeners to change over to these channels, for very good reasons of speech and picture quality. There was no interference. I recall that we ever said that we were a bunch of deniers of the implication that medium and long wave broadcasts were a thing of the past.

In the event, the public in general have been most reluctant to make the change and we are still as a group up to our withers. People still receive BBC Radio 2 and 1 in the form of regular listeners. With so many services of these machines, it would now, I think, be a good time for some form of group to set up and publish a regular newsletter and, perhaps, organize regular get togethers.

Might I also reply to Dr Whittington's letter published last month: 'There is a mistake to look for mainframe performances of AM' which are only 3 per cent of the price of such equipment. Constraints on format, language (such as BASIC), and speed are important factors to be considered.

With so many machines of these, it would now be a good time for some form of group to set up and publish a regular newsletter and, perhaps, organize regular get togethers.

PECORING DIRECTION IN SURROUND SOUND

The article by Ken Farrar on the Soundfield Microphone (October and November 1979) presents an interesting approach to the use of surround sound. The article discusses the importance of the "soundfield" concept and its potential for creating a more natural and immersive listening experience. The author argues that the use of this technique can be beneficial for a variety of applications, including music recording, film production, and virtual reality environments.

The article also highlights the potential for the Soundfield Microphone to be used in a variety of environments, including home theaters and live performances. The author suggests that the microphone can be used to create a more immersive and realistic listening experience, which can enhance the overall enjoyment of the audience.

The article concludes by acknowledging the technical challenges associated with using the Soundfield Microphone, but argues that these challenges can be overcome with the use of advanced technology and engineering. The author suggests that the use of the microphone can be a valuable tool for anyone seeking to create a more immersive and realistic listening experience.

The article is well-written and provides a clear and concise overview of the Soundfield Microphone and its potential applications. The author's expertise in the field of audio production is evident throughout the article, and the technical details are presented in an accessible and understandable manner.
On-line information retrieval services throughout Europe are now being linked together into a comprehensive network by a dedicated team of telecommunications professionals. The system, called Euronet, promises to provide easy access to a vast array of information from general and specialized data bases in a number of European countries at a standard tariff which is independent of distance and time of day; a "pay-tone" facility is included. When dialed, another call can be made using credit still available on the line. The microprocessor, which has been programmed to check the "pay-tone," will alert the operator to the need for further action.

PET automatically checks impedance

A combination of instruments including a Rohde and Schwarz ZPV vector analyser, a signal generator and a Minolta Electrode Impedance System, were used to find out an accurate measurement of magnitude and phase, voltage measurements of magnitude and phase, and impedances. Using a combination of results, some impedance values were displayed on the screen of the PET and are fed out via an IEC bus-compatible printer.

CEI honours Sam Fedida

One of the UK's foremost engineering acco­dients, the MacRobert Award, has been given to Sam Fedida, well known to readers of this journal as the author of a series of articles on microprocessors. The award was presented by the CEI to Mr. T.F. Kelly of the Infoline, which, incidentally, will be shown a general bias towards hardware.

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Europe-wide information retrieval uses packet switching

Information Access Network for Europe and is the organisation of the various on-line information services themselves - the soft­ware side. At present there are 23 hosts, offering a spectrum of scientific, technical, medical, legal, social and economic knowl­edge. Queries about it can be made through a telephone line and a password for the system can retrieve information from general and specialised data bases in a number of European countries at a standard tariff which is independent of distance and time of day; a "pay-tone" facility is included. When dialed, another call can be made using credit still available on the line. The microprocessor, which has been programmed to check the "pay-tone," will alert the operator to the need for further action.

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On-line information retrieval services throughout Europe — the kind using computerised databases — are now being linked together into a comprehensive network by a password for the system can retrieve information from general and specialised data bases in a number of European countries at a standard tariff which is independent of distance. By the end of 1980 about 140 such data bases are expected to be available. To make connection, the user has to dial on his telephone one of the computerised information services in his own country which is linked to the system. These are known as "host" and in the UK, for example, one of them is BLAISE, the British Library's Automated Information Service. Another UK host is Infoline, which, incidentally, will be bringing into the system the well known I.R.E. Inspec database of physics, electronics, computing and mathematical information.

This European line-up called Eurotel-DIANE, was opened in November last year. Initiated by the European Communities Commission, it is intended in the first instance for the benefit of the primary education in Common Market countries but probably later will be bringing in Switzerland, Austria, Yugoslavia and Greece. Eurotel is the hardware part, operated by the telecommunications companies of the countries in the EEC. Its backbone is a dedicated high-speed data transmission system operating at 48,000 bits/s on the packet switching principle (in which packets of digital data are sent by the best route at a time to achieve the most efficient use of available lines — often interleaving packets for different addresses). The international lines carrying data streams from Europe from Dublin through London, Paris, Brussels, Frankfurt to Rome, from Amsterdam, Copenhagen, Brussels and Luxembourg. Exchanges for packet switching are located in London (in the Post Office's Electra House, Temple Place, London WC2), which also houses the management centre controlling the day-to-day operation of Eurotel (Diane) and its users.

One of the UK's foremost engineering accolades, the MacRobert Award, has been given to Sam Fedida, well-known to readers of this journal as the author of a series of articles on basics of Eurolon World, February 1975 and April to June 1975 dealing with Viewdata, the information system using telephone and television in a communication display combination which had been invented while working as a Post Office research engineer.

The prize of £25,000 and the MacRobert Model were presented to Fedida by H.H.R. the Duke of Edinburgh in his capacity as founder president of the Council of Engineering Institutions (CEI) at Buckingham Palace on 5th December 1979. The MacRobert Gold Medal was also presented on this occasion, to Post Office Telecommunications for the development of Preview, a first of its kind Viewdata service in the world.

One of the advantages of the Viewdata system is that anyone with a telephone is able to use all the services available. There is no special equipment to buy. This is achieved by a simple device which attaches to the telephone, allowing the user to call any of the available Viewdata services. The service is available 24 hours a day, 7 days a week. It is not necessary to subscribe to any regular service. The user can call from any location, and the service is accessible from public or private telephones.

Sam Fedida was born in Alexandria, Egypt, in 1914. He was educated in England and graduated with a B.S. (Hons) at Imperial College, London, and during the Second World War served as a radar officer in the R.A.F. After the war he joined Marconi, becoming a development manager in 1960 and Assistant Director of Research in 1965. He joined the Post Office Research Department as Manager of Computer Applications in 1970 and soon afterwards invented the Viewdata system, which he demonstrated publicly in 1975. He had obtained an M.Sc. in Computation from the Roehampton College, London in 1975.

The MacRobert Award has traditionally been awarded for the development of a novel engineering project or product which has shown a general bias towards hardware. However, the last two decades have shown that software aspects of complex electronic systems are now at least as technically complex and demanding work to indicate the CEI's awareness of the growing significance of information retrieval systems.

PET automatically checks impedance

A combination of instruments including a Rohde and Schwarz ZPV vector analyser, a signal generator and a two-channel scope can, according to Avelor Electric, be a complete unit for automatic in-vitro measurement of magnitude and phase, measurement of voltage magnitudes of magnitude and phase, measurement of current magnitudes and phase, and measurement of power magnitudes and phase. The instrument allows the user to determine the phase, measurement of magnitude and phase, measurement of power magnitudes and phase.

The instrument is designed for use in the medical field, particularly in the measurement of electrical parameters in living tissues. It is suitable for use in research institutions, hospitals, and clinics.

Aiwa to set up "micro" hi-fi plant in Wales

Speaking in response to Aiwa’s decision to set up a British subsidiary, the Japanese company, Lord Trenchard, Minister of State for Industry, said: "I am delighted at Aiwa's decision to locate in the United Kingdom. It is a sign that we are becoming more attractive as a manufacturing base. Aiwa’s presence will be a major boost to the Welsh economy."

In a letter to the minister, Mr. Satomi Kato, President of Aiwa, said: "We have decided to set up an electronics plant in the United Kingdom as part of our expansion plans. The plant will be located in Wales, where we have already invested in research and development. We believe that the Welsh economy has great potential for growth in the electronics sector and we are confident that Aiwa will be successful here."

Aiwa's decision is a significant milestone for the Welsh economy, as it is the first major Japanese electronics company to set up a plant in the country. The company is expected to create up to 250 new jobs and invest £6 million in the project. The plant will produce hi-fi stereo equipment and is expected to be operational by 1982.

Zenith buys Heath

Zenith Radio Corporation has completed the purchase of Heathkit from Daystrom Inc, a wholly-owned subsidiary of Schlumberger Ltd. Heath, the Michigan-based electronic kit manufacturer, will be operated as a wholly-owned subsidiary of Schlumberger. Zenith-Nixie submarines have been established to operate the 55 Heathkit Electronic Centres in the United States and the Heath business in Canada and Europe. Daystrom Inc. was acquired by Schlumberger in 1982.

Microprocessor and Electronics Centre

A showroom for electronics manufacturers, funded by private and public money, was opened by Lord Trenchard in December. Jeremy Prosser, of Prosser Scientific Instruments, had the idea of a base for electronics companies like his own in London, to conduct interviews and to meet potential customers. One or two economists and marketing experts agreed with him and combined with him to set up the entrance to the World Trade Centre in East Smithfield near the Tower of London.

One coincident exhibition helped to set the scene for the opening ceremony (it actually opened its doors in September, but the exhibition opened a few months later, although many exhibits were not ready, one of the themes was a collection of the civilised world. Examples of the ways in which electronics can enrich our lives and widen our horizons included the Korg digital synthesizers from the Dr Who television programme, a toy train controlled by a micro processor in a manner no one had quite expected, and some "Star Trek"-inspired 'phasers', which made funny noises. Measuring instruments were in evidence, as were microcomputers in various guises.

Lord Trenchard’s opening speech was a worthy example of his kind, impressing on all who are in the need to use microelectronics for all we are and all we can be. His opening speech was a reminder of the disastrous consequences of failing to do so. The effect of the boom was not heightened by his aside, on leaving the still-live exhibition, to a representative of a British company: "They have done incredibly well."

The Microprocessor and Electronics Centre will be permanently open and will run a series of small exhibitions throughout the year.
Radio amateurs provide communications in Indian disaster

Radio amateurs provided emergency communications with Indian Navy, Ministry of Defence, and the Army, during the afternoon of August 11. Unusually heavy rains caused one of the Macchu dams in the Baroda area to burst, flooding the entire city which had a population of 75,000 people. Within 10-12 hours, nearly 80% of the buildings were submerged, and 10,000 people were continued to risk to about 15 feet and when their houses were under 14 feet of mud. Communications and power supplies were cut off almost immediately, and communications aid. Aid from the Commandant to their facilities. The Commandant got out, India's Home Guard from the Bombay area, carried out by the former IBA London area, operated by the IBA and other services even if there had little opportunity to put it into practice.

The sixth European Conference on optical communications is to be held at the University of York from 16th to 18th September 1980. The papers presented will cover fibres and electrical systems, laser fabrication, communication systems and networks, integrated optics, equipment and techniques in optical and electronic systems. The deadline for abstracts is 31st March 1980 and communications regarding the conference should be addressed to Conference Dept, The IEE, Savoy Place, London WC1R 8RT.

The Federation of Amateur Radio Societies in India, realizing that communications would be needed, held an emergency meeting and within three days volunteers were mobilised, equipped with transceivers, antennae and other communications equipment, borrowed from various amateurs. Flying indirectly from Bombay to Rajkot, a squad of 24 amateurs, led by the Commandant, reached the devastated area on August 12. Between Morvi and Rajkot, the amateurs were unable to make contact with the first to reach the devastated city and they sat out for an hour from the drowned, displaying clipped calls. "The Federation of Amateur Radio Societies of India and the Radio & Electronics Society of India, realizing that communications would be needed, held an emergency meeting and within three days volunteers were mobilised, equipped with transceivers, antennae and other communications equipment, borrowed from various amateurs. Flying indirectly from Bombay to Rajkot, a squad of 24 amateurs, led by the Commandant, reached the devastated area on August 12. Between Morvi and Rajkot, the amateurs were unable to make contact.

The amateur's facilities were used by the Red Cross and many other relief groups; they provided foodstuffs for the population. A team of their trained operators were finally got out, India's Home Guard from the Bombay area, carried out by the former IBA London area, operated by the IBA and other services even if there had little opportunity to put it into practice.

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Radio amateurs provided communications in Indian disaster

Radio amateurs provided emergency communications for a team of radio amateurs, including a small team of radio amateurs who joined other radio amateurs. The team, borrowed from various amateurs, was mobilized, equipped with transceivers, and two more portable equipment in part exchanged for the land masses that were under 14 feet of mud. Communications and power supplies were cut off almost immediately, with within 10 to 15mm away from the ground, the team were finally got out, and the team from the first to the last reached the devastated city and they set about extracting the wounded from the debris, disposing of corpses, and helping to relief.

The Federation of Amateur Radio Societies of India and the Radio & Electronics Society of India, realizing that communication would be needed, held an emergency meeting and within three days volunteers were mobilised, equipped with transceivers, antennae and other communication equipment, borrowed from various amateurs. Flying indirectly from Bombay to Rajkot, a seven-man team was the first to reach the city and mobilized the first team.

The amateurs obtained a good deal of satisfaction from the provision of emergency communications but they also quick to point out that they had come to realize just how unprepared they were for the event and how lacking they were in suitable equipment, and trained manpower. Their hope now is that, with government and other help, they can improve this situation. A story like this must encourage organisations such as ARCS (Radio Amateurs Communication Network) in the UK and other countries even if it is only a small opportunity to put it into practice.

Report says “Space for 12 more radio stations in London”

A study of the spectrum availability in the London area, carried out by the former IBA engineer Fred Wise and commissioned by the Communication Communities Group (COMM) reports that there is scope for at least a dozen small radio stations in the area. The report splits the radio stations into three categories including small stations; medium size stations; and large stations. Medium size stations covering a sector of the city and larger stations, aimed at specialist interests.

The forthcoming extension of the VHF broadcast bands to 100MHz (see News columns. January 1990 Wireless World) as a result of WARC 79, means that a further six stations in the first category, four in the second and none in the third would be allowed, and the latter would have to compete for space with both the BBC and the IBA.

“Space is a word in the report on the needs of adequate representation of community and local radio interests in any plans to clear up local or national services in the VHF. £125,000 is spent on the commercial on the report, a spokesman for COMM said: “We are delighted to have experienced motorists, especially the local traffic, who are left to cope with the traffic and engine will not start until the driver has blown into it. The engine will not start when the system is fitted to automatic vehicle.

Hoff awarded microprocessor prize

The Franklin Institute has awarded the Stuart Ballantine Medal to Dr. Brian Hoff, who has received the most coveted awards for scientific and technical achievement in the field of microprocessors. Hoff is well-known for his work in developing the microprocessor.

In addition to his work on digital microprocessors, Dr. Hoff, or Ted Hoff as he prefers to be known, has contributed to the development of the first high-density memories for microprocessors and to the development of small computers, and more recently, the development of the 4004 microprocessor. Between 1962 and 1966, he worked on computer design as a research associate at Stanford. In 1966 he joined the then newly-formed Central Computer applications research manager where he worked on a variety of microprocessors and memory devices. In 1968 he and Brian Stern provided the microprocessor architecture and his work led to the development of the first microprocessor, the 4004. Dr. Hoff, 1974. Ted Hoff has specialized in Intel's telecommunications products, contributing to the development of the instruction set, which was used in the 1974, and two others. A version of the code was used in the 1980s, and the 2500 analog microprocessor.

NEWS IN BRIEF

The sixth European Conference on optical communications is being held at the University of York, 23-25th September 1982. The papers presented will cover fibres and their applications, optical amplifiers, integrated optics, and optical and electronic systems and total systems. The deadline for abstracts is 31st March 1982. Discussions regarding the conference should be addressed to Conference Dept, The Post Office, York, YO1 6EF.

The new service will operate in exactly the same way as the phone at home and will eventually be extended to eight hours a day. The service will have to be extended to take advantage of the rapid growth in the number of radio communication facilities. Customers will be required to use the necessary equipment from three authorised suppliers: Commercial Communication Services Ltd, Pye Telecommunications Ltd, and Stormo Ltd, who will maintain and install the hardware.

Two charge rates are applicable to the automatic service: normal (working hours, 49p to 50p) and cheap (evenings and weekends) at 30p for 15 seconds. The charge will depend on duration of call irrespective of distance and there will be no three-minute minimum. The quarterly rental will be £20, extra and the first few customers will be dealt with in May 1980, work on the new service as a whole will be completed in January 1982, and take the service in place.

Additional equipment is required at the Radiostation and 145 MHz for the necessary work will be provided by Pye. These improvements will also permit users of the same system to make use of the facilities in other Radio areas.

DEAL 4800

A high-speed Data service, to be known as Deal 4800, will enable customers to send data at up to 3,800 bits/s over the national telephone network. The system is to be introduced by the Post Office this month and offers three types of synchronous operation: full duplex, half duplex and simple private circuit with 1,500 bit/s over the national public network operation as a pair.

The system is also integrated with the post office and enables calls to be made on circuits or modems before calling in P0 engineers.

Is breath-testing BORIS bugger?

According to a report by Radio Australia, involving a large number of users of the 'foolish' device which will keep in preventing motorists from driving while drunk. He calls the equipment BORIS, which stands for B参考资料 to the device to be switched on. The device will be fitted to the car's ignition system and the engine will not start until the driver has blown into it. If the system is fitted to automatic vehicle.

The inventor claims that tests at Sydney University prove that the gadget is 100% effective. The practical implications of the method, unless it is now possible to breath into the engine does not turn over. He calls the device to be switched on. The device will be fitted to the car's ignition system and the engine will not start until the driver has blown into it. The engine will not start when the system is fitted to automatic vehicle.

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CIRCUIT IDEAS

Reverberation amplifier

An effective 100mW reverberation-spring amplifier can be constructed by combining a current dumping circuit with a feedback technique described by G. Hibbert in the August 1978 issue. The feedback around $R_2$, $R_3$, $R_4$ and $C_6$ provides an approximately equal output power when the load impedance drops at resonant frequencies. Current dumping is performed by $R_2$, $R_3$, $C_4$ and $C_7$. Although the open-loop voltage gain of the op-amp is insufficient to cancel all of the cross-over distortion, with reverbervation this is not audible. For other audio applications such as a headphone amplifier, the op-amp should be replaced by a high gain amplifier.

H. E. Riegstra
Amsterdam
Holland

Radio control encoder

A simple seven-channel radio control encoder can be built with two 74s as shown. The circuit operates from 5 to 15 V at 2.5 to 6mA and will provide an output current of up to 200mA. The 555 is used in the astable mode with an off time of 0.25ms and an on time between 1 and 2ms except for channel 0 which produces a 0.5ms sync pulse.

The decade counter is clocked by the falling edge of the output and is reset when Q8 goes high. Resistor $R_2$ ensures that the 555 oscillates at a low frequency if no outputs are selected. If proportional control is not required, resistors $R_2$ can be fixed values. For a supply below 8V a Zener regulator should be used to prevent variations in pulse width.

S. Ingham
Moseley
Birmingham

Unity gain buffer with wide frequency response

By d.c. coupling a p-n-p common emitter stage with a p-n-p emitter follower stage sharing a common load resistor, a unity gain buffer is formed which offers a high input impedance, wide frequency response, low output impedance and low current consumption. The 3-dB bandwidth is above 80 MHz and by selecting better transistors this can be extended. Care in minimising the lead inductance and stray capacitance will also improve this figure. Current consumption is about 1mA with a 10V supply. The circuit will operate from 3 to 30V without degrading its performance. It is important to select the correct input biasing resistors because they reduce the input impedance.

A. L. Equivalal
Vancouver
Canada

Low-frequency multivibrator

This multivibrator is based on the CA3290 dual voltage comparator which uses the bi.m.o.s. technique of combining bipolar and m.o.s. devices on a chip. The use of m.o.s. transistors in the input stage of the CA3290 provides an input impedance of around 17k and common-mode rejection for input signals below the negative supply rail.

In the circuit diagram one half of the CA3290 is used as a conventional multivibrator. Because the input impedance is very high the value of the timing resistor can be large which enables a small low leakage timing capacitor to be used for a long time delay. The second half of the CA3290 is used as an output buffer so that the multivibrator frequency is not affected by output loading.

R. Buckley
RCA Solid State
Middlesex

F.m. channel scanner

This circuit scans through 10 channels of an f.m. radio or transceiver by switching crystals in the local oscillator. Point B is connected to the audio switching transistor in the receiver which is normally saturated when no signal is present. On reception of a signal, point A rises to $V_1$ and triggers the 74211 which enables the display and gates out the 7413 oscillator. The display is enabled for three seconds and if, during this time, the channel is wanted S1 is pushed. The display disappears for the remaining period of the monostable pulse and is then enabled to confirm that the channel has been locked. If S1 is pushed again the channel is released and the circuit continues scanning.

J. W. Jarvis
Huntingdon
Cambridgeshire
Reverberation amplifier

An effective 100mW reverberation-spring amplifier can be constructed by combining a current dumping circuit with a feedback technique described by G. Hibbert in the August 1978 issue. The feedback around $R_1$, $R_2$, $R_3$, and $C_1$ provides an approximately equal output power when the load impedance drops at resonant frequencies. Current dumping is performed by $R_4$, $R_5$, $C_2$, and $C_3$. Although the open-loop voltage gain of the op-amp is insufficient to cancel all of the cross-over distortion, with reverberation this is not audible. For other audio applications such as a headphone amplifier, the op-amp should be replaced by a high gain amplifier.

H. E. Riegstra
Amsterdam
Holland

Radio control encoder

A simple seven-channel radio control encoder can be built with two ICs as shown. The circuit operates from 5 to 15 V at 2.5 to 6mA and will provide an output current of up to 200mA. The 555 is used in the astable mode with an off time of 0.25ms and an on time between 0.5ms and an on time of between 1 and 2ms except for channel 0 which produces a 0.5ms sync pulse. The decade counter is clocked by the falling edge of the output and is reset when Q8 goes high. Resistor $R_6$ ensures that the 555 oscillates at a low frequency if no outputs are selected. If proportional control is not required, resistors $R_4$ can be fixed values. For a supply below 8V a Zener regulator should be used to prevent variations in supply below 8V. The circuit will operate from 3 to 30V without degrading its performance. It is important to select the correct input biasing resistors because they reduce the input impedance.

A. E. Equivalant
Vancouver
Canada

Unity gain buffer with wide frequency response

By d.c. coupling a n-p-n. common emitter stage with a p-n-p emitter follower stage sharing a common load resistor, a unity gain buffer is formed which offers a high input impedance, wide frequency response, low output impedance and low current consumption. The 3-dB bandwidth is above 80 MHz and by selecting better transistors this can be extended.

The current consumption is about 8 mA with a 10V supply. The circuit will operate from 3 to 30V without degrading its performance. It is important to select the correct input biasing resistors because they reduce the input impedance.

A. E. Equivalant
Vancouver
Canada

Low-frequency multivibrator

This multivibrator is based on the CA3290 dual voltage comparator which uses the bi.m.o.s. technique of combining bipolar and m.o.s. devices on a chip. The use of m.o.s. transistors in the input stage of the CA3290 provides an input impedance of around 1170 and common-mode rejection for input signals below the negative supply rail. In the circuit diagram one half of the CA3290 is used as a conventional multivibrator. Because the input impedance is very high the value of the timing resistor can be large which enables a small low leakage timing capacitor to be used for a long time delay. The second half of the CA3290 is used as an output buffer so that the multivibrator frequency is not affected by output loading.

R. Buckley
RCA Solid State
Middlesex

F.m. channel scanner

This circuit scans through 10 channels of an f.m. radio or transceiver by switching crystals in the local oscillator. Point B is connected to the audio switching transistor in the receiver which is normally saturated when no signal is present. On reception of a signal point A rises to $V_c$ and triggers the 74121 which enables the display and gates out the 7413 oscillator. The display is enabled for three seconds and if, during this time, the channel is wanted $S_1$ is pushed. The display disappears for the remaining period of the monostable pulse and is then enabled to confirm that the channel has been locked. If $S_1$ is pushed again the channel is released and the circuit continues scanning.

J. W. Jarvis
Huntingdon
Cambridgeshire
**Analogue trigonometric function generator**

When a function generator is needed where the output is a trigonometric function of the input variable, this is usually accomplished with a digital memory or with a non-linear circuit which approximates the function over a limited range. This circuit is comparatively simple and simultaneously provides the sine and cosine functions over a range of ±π/2. By using analogue dividers, other trigonometric functions can also be obtained.

The circuit operates by continuously sampling two harmonic waveforms, the phases of which are displaced by 90°. An oscillator generates sine and cosine waveforms at frequencies much higher than V_i. Purity of the waveforms has a direct influence on the quality of the outputs. The two waveforms are sampled and held by a dual analogue gate, C, C\_2 and buffered by A\_1 and A\_2. Sampling is synchronized to the harmonic waveform and time displaced proportionally to the input voltage by the p.l.l. The 4046 is locked to the sine waveform and V_i is resistively summed with the phase-detector output which feeds the v.c.o. input. To remain locked to the input frequency the p.l.l. cannot allow a change in the v.c.o. input, and therefore generates a voltage at the phase-detector output which exactly opposes V_i. Due to the linear characteristic of the phase-detector, the output square wave is displaced and its leading edge is a control for the two sample and hold circuits. To be symmetrical about ground by ±4V which simulates an argument variation of ±2π. Transistor Tr\_1 squares the sinewave at the input of the p.l.l. to provide lock. Similarly, capacitor C is needed to eliminate lock loss near V_i = 0.

Y. Netzter
Haifa
Israel

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**Fuse tester**

When it is necessary to test a mains fuse, unless the plug is taken apart, a conventional check relies on the resistance of the appliance. This circuit uses the characteristic of the appliance which approximates the function over a limited range. This circuit uses a dual analogue phase-detector output which feeds the p.l.l. and holds by a dual analogue gate, C_1, C_2, and buffered by A_1 and A_2. Sampling is synchronized to the harmonic waveform and time displaced proportionally to the input voltage by the p.l.l. The 4046 is locked to the sine waveform and V_i is resistively summed with the phase-detector output which exactly opposes V_i. Due to the linear characteristic of the phase-detector, the output square wave is displaced and its leading edge is a control for the two sample and hold circuits. To be symmetrical about ground by ±4V which simulates an argument variation of ±2π. Transistor Tr\_1 squares the sinewave at the input of the p.l.l. to provide lock. Similarly, capacitor C is needed to eliminate lock loss near V_i = 0.

P. Kelly and M. Dixon
Shrewsbury
Analogue trigonometric function generator

When a function generator is needed where the output is a trigonometric function of the input variable, this is usually accomplished with a digital memory or with a non-linear circuit which approximates the function over a limited range. This circuit is comparatively simple and simultaneously provides the sine and cosine functions over an angle of ±2π.

By using analogue dividers, other trigonometric functions can also be obtained.

The circuit operates by continuously sampling two harmonic waveforms, the phases of which are displaced by 90°. An oscillator generates sine and cosine waveforms at frequencies much higher than V<sub>n</sub>. Purity of the waveform has a direct influence on the quality of the outputs. The two waveforms are sampled and held by a dual analogue gate, C<sub>n</sub>, C<sub>m</sub> and buffered by A<sub>n</sub> and A<sub>m</sub>. Sampling is synchronized to the harmonic waveform and time displaced proportionally to the input voltage by the p.l.l. The 4046 is locked to the sine waveform and V<sub>n</sub> is resistively summed with the phase-detector output which feeds the v.c.o. input. To remain locked to the input frequency the p.l.l. cannot allow a change in the v.c.o. input and therefore generates a voltage at the phase-detector output which exactly opposes V<sub>n</sub>. Due to the linear characteristic of the phase-detector, the output square wave is displaced and its leading edge used as a control for the two sample and hold circuits. To be symmetrical about V<sub>n</sub> = 0, the p.l.l. should have zero phase shift. This is achieved by adjusting the v.c.o. frequency. The input is coupled to the p.l.l. by a summing network so that V<sub>n</sub> can vary symmetrical about ground by ±4V which simulates an argument variation of ±2π. Transistor Tr<sub>1</sub> squares the sinewave at the input of the p.l.l. to provide lock. Similarly, capacitor C is needed to eliminate lock loss near V<sub>n</sub> = 0.

Y. Netzer
Haifa
Israel

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Y. Netzer
Haifa
Israel
Spectrum analyser adaptor

Using an r.f. instrument for audio frequency measurements

by R. C. V. Macario, B.Sc., Ph.D., M.I.E.E. University College of Swansea

The unit described, based on two mixer integrated circuits, enables an r.f. spectrum analyser to display a.f. system responses without loss of performance accuracy. Examples of the application of the unit presented here are measurements of the frequency responses of active audio filters and radio receivers.

Many laboratories possess versatile r.f. spectrum analysers and often associated r.f. tracking oscillators. Unfortunately the lowest frequency of operation of these instruments is often confined to a few kilohertz and this means that audio-frequency filter circuit responses usually cannot be examined directly on such instrumentation — and, indeed, if an audio frequency network analyser is not to hand the measurement of audio frequency response becomes very tedious.

![Circuit diagram and waveforms of unit.](image)

Fig. 1. The complete adaptor unit, with a photographed trace in front.

Fig. 2. Circuit diagram and waveforms of unit. To improve the carrier balance, add the circuit in the small box (top right) to pin 8 of each mixer.

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**The unit described**

A transportable recorder for fast, safe tape handling under all conditions and a new concept that brings custom-building within the price range of standard models. It takes all spool sizes up to 27cm and provides 3 speeds and positive action push buttons in association with logic circuits as well as motor sensing and command memory. Based on the Logic 7, individual specification allows choice of mono full track or half track head, stereo half track or quarter track head, line-in/line-out, microphone inputs and many other features.

**The Neal ST52 and ATU1**

An all-in-one audio test set, the ST52 puts an end to the use of separate instrumentation and its inherent complication of connections. The result is faster, cheaper servicing. It combines in one easy to use compact instrument the measurement of gain, noise, frequency response, input sensitivity, output power, distortion and the parameters relating to recording equipment such as wow and flutter, crosstalk, drift and erasure. Linked with a Ferrograph Auxiliary Test Unit, ATU1, its range of applications can be extended to include measurement on professional equipment.

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**The Neal 302**

A transportable recorder for fast, safe tape handling under all conditions and a new concept that brings custom-building within the price range of standard models. It takes all spool sizes up to 27cm and provides 3 speeds and positive action push buttons in association with logic circuits as well as motor sensing and command memory. Based on the Logic 7, individual specification allows choice of mono full track or half track head, stereo half track or quarter track head, line-in/line-out, microphone inputs and many other features.

**The Ferrograph**

A professional studio tape recorder that incorporates three a.c. motors for reliability and smooth, effortless power. It is controlled by a full solid state logic system actuated by light touch buttons. A massive decoupled flywheel and oversize capstan result in exceptionally low wow and flutter.

**The Neal 302**

A studio cassette recorder that incorporates three a.c. motors for reliability and smooth, effortless power. It is controlled by a full solid state logic system actuated by ultra light touch buttons. A massive decoupled flywheel and oversize capstan result in exceptionally low wow and flutter.

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Spectrum analyser adaptor

Using an r.f. instrument for audio frequency measurements

by R. C. V. Macario, B.Sc., Ph.D., M.I.E.E. University College of Swansea

The unit described, based on two mixer integrated circuits, enables an r.f. spectrum analyser to display a.f. system responses without loss of performance accuracy. Examples of the application of the unit presented here are measurements of the frequency responses of active audio filters and radio receivers.

Many laboratories possess versatile r.f. spectrum analysers and often associated r.f. tracking oscillators. Unfortunately the lowest frequency of operation of these instruments is often confined to a few kilohertz and this means that audio-frequency filter circuit responses usually cannot be examined directly on such instrumentation — and, indeed, if an audio frequency network analyser is not to hand the measurement of audio frequency response becomes very tedious.

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The Neal 302

A transportable recorder for fast, safe tape handling under all conditions and a new concept that brings custom-building within the price range of standard models. It takes all spool sizes up to 27cm and provides 3 speeds and positive action push buttons in association with logic circuits as well as motor sensing and command memory. Based on the Logic 7, individual specification allows choice of mono full track or half track; stereo full track or quarter track; head, line-in/line-out; microphone inputs and many other features.

The Neal 302 and ATU1

An all-in-one audio test set, the RT32 puts an end to the use of separate instrumentation and its inherent complication of connections. The result is faster, cheaper servicing. It combines in one easy-to-use compact instrument the measurement of gain, noise, frequency response, input sensitivity, output power, distortion and the parameters relating to recording equipment such as wow and flutter, Crosstalk, drift and hum. Linked with a Ferrograph auxiliary test unit, ATU1, its range of applications can be extended to include measurement on professional equipment.

The Ferrograph S37

A transportable recorder for fast, safe tape handling under all conditions and a new concept that brings custom-building within the price range of standard models. It takes all spool sizes up to 27cm and provides 3 speeds and positive action push buttons in association with logic circuits as well as motor sensing and command memory. Based on the Logic 7, individual specification allows choice of mono full track or half track; stereo full track or quarter track; head, line-in/line-out; microphone inputs and many other features.

The Ferrograph Studio 8

A professional studio tape recorder, logic controlled and offering a choice of stereo, twin track and full or half track mono heads. PPM or VU meters; IEC CB or NAB equalisation. It is designed to meet the needs of modern audio and television broadcasting organisations and features include servo-controlled rum and spooling, tape motion sensing and three editing modes. For up to 100% speed it accepts standard, long play and double play 1/4" tape and has total type protection by electronic interlocks.

The Neal Ferrograph

A complete range of reel to reel, cassette, and test equipment for the professional and enthusiast.

The Neal 302

A studio cassette recorder that incorporates three a.c. motors for reliability and smooth effortless power. It is controlled by a full solid logic system actuated by ultra light touch buttons. A massive decoupled flywheel and smooth effortless power. It is controlled by a full solid state logic system.
The unit shown in Fig. 1 provided a simple means of shifting an r.f. signal down to audio frequencies, and then up again to the same radio frequency. Operation is centred about a frequency determined by a c.m.o.s. crystal oscillator. This has good stability and its frequency is easily changed. The centre frequency can be between 1 and 5 MHz and is determined either by a crystal or by the frequency required to match a receiver system being measured.

The frequency shift operation is carried out using the Siemens S042P double balanced mixer device, which is shown in Fig. 2. The circuit diagram of the mixer device itself is shown in Fig. 3 for reference as it makes the pin connection availability clear (unbalanced here) is taken from pin 2. The principle of operation is quite simple. The swept r.f. input voltage is the second mixer i.e. type S042P.

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The frequency shift operation is carried out using the Siemens SO42P double balanced mixer device, which needs few external components. The natural signal balance of this device is about 36dB; if better than 50dB is required the balance circuit shown in a box as an option may be added. Two of these devices are used in the unit, as shown in the circuit diagram Fig. 2; Pins 11 and 13 are used as the signal input (unbalanced arrangement in Fig. 2); Pins 7 and 8 are used as the shift carrier input (balanced); the output (unbalanced here) is taken from pin 2.

The principle of operation is quite simple. The swept r.f. input voltage is simply shifted down to audio frequencies (and d.c.) by choosing the appropriate unit crystal frequency. These audio frequencies are then shifted up again to r.f. by an exactly counterpart circuit, the second SO42P. An aspect of the circuit is the symmetry of the two operations and the equality of the shifting r.f. reference waveform.

The c.m.o.s. oscillator (4011 quad 2-input Nand gate) produces a nine volt square-wave at the crystal frequency. This is divided down to produce a 100mV signal to each mixer via the untuned wideband transformer, \( T_1 \). The maximum r.f. signal level that should be applied to the mixer inputs is 100mV peak-to-peak. This produces about 400mV peak-to-peak audio as an input to the test circuit. If the audio circuit under test produces gain then an attenuator must be inserted after the circuit under test. Responses down to 100Hz can be examined; for lower frequency responses the values of \( C_1 \) and \( C_2 \) should be increased, provided the r.f. analyser has a narrower bandwidth.

The r.f. spectrum analyser is tuned to the centre frequency of the unit, say, 2MHz. The response of the audio filter appears on both sides of the centre frequency, e.g. \( \pm 10kHz \). Normally one would view one side only with an r.f. sweep of, say, 1kHz per division. The dynamic range of the unit exceeds 60dB. The normal sweep rates, etc., of the spectrum analyser apply.

**Construction**

The circuit has been committed to a p.c. board which fits in a RS Components type SO42P (14 pin dual-in-line) and is shown in Fig. 3 for reference as it makes the r.f. spectrum analyser diagram of the mixer device itself is shown in Fig. 3 for reference as it makes clear the pin connection availability. Pins 11 and 13 are used as the signal input (unbalanced arrangement in Fig. 2); Pins 7 and 8 are used as the shift carrier input (balanced); the output (unbalanced here) is taken from pin 2.

The principle of operation is quite simple. The swept r.f. input voltage is simply shifted down to audio frequencies (and d.c.) by choosing the appropriate unit crystal frequency. These audio frequencies are then shifted up again to r.f. by an exactly counterpart circuit, the second SO42P. An aspect of the circuit is the symmetry of the two operations and the equality of the shifting r.f. reference waveform.

The c.m.o.s. oscillator (4011 quad 2-input Nand gate) produces a nine volt square-wave at the crystal frequency. This is divided down to produce a 100mV signal to each mixer via the untuned wideband transformer, \( T_1 \). The maximum r.f. signal level that should be applied to the mixer inputs is 100mV peak-to-peak. This produces about 400mV peak-to-peak audio as an input to the test circuit. If the audio circuit under test produces gain then an attenuator must be inserted after the circuit under test. Responses down to 100Hz can be examined; for lower frequency responses the values of \( C_1 \) and \( C_2 \) should be increased, provided the r.f. analyser has a narrower bandwidth.

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**Applications**

**Active Filters.** The unit arose because of a need to examine certain active audio filters. In particular, there is a great interest in limiting the bandwidth of a.m. medium and long wave broadcast transmitters 1 2 and to some extent good audio filtering in a receiver can aid this desire. Also, in the construction of s.s.b./i.s.b. phase shift modulators/demodulators the design of the audio frequency low-pass filter is as important.

![Fig. 3. Circuit diagram of the Siemens symmetrical mixer i.e. type SO42P](image)

![Fig. 4. Examples of active low-pass filters; (below) pole-zero realisation using op-amps; (above) conventional LC realisation using gyros for r.f. analyser.](image)

**Consulting filter tables (Zevrev, ref. 4) indicates a promising design is an elliptic design with:**

- Maximum passband attenuation ≤ 1.25dB
- Minimum stopband attenuation ≥ 43dB

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- Maximum passband attenuation ≤ 1.25dB
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**Fig. 4 summarises the two filter realisations:**

![Fig. 5. Gyro filter response as applied to a receiver response Centre frequency is now the r.f. or i.f. frequency (vertical scale 10dB/div.; horizontal scale 5kHz/div.).](image)

![Fig. 6. Arrangement of apparatus for measuring frequency response of a radio receiver.](image)

*Continued on page 74*
Two transistor astables
by Peter Williams, Ph.D. Paisley, College of Technology

The two-transistor astable is shown in the standard text-book example. It was also justified by the standard industrial form of astable, though it needs a number of additions and modifications to improve the rise-time, remove voltage-breakdown limitations, etc. These modifications remain important as applications of principles that can be applied to other generators and pulse circuits. This form of astable also remains useful but has lost its dominance in the face of emerging circuit alternatives. If transistor Tr, increases its current in the fall in collector voltage, it is coupled through the capacitor to the other base (Tr), driving that transistor off. The resulting rise in the collector voltage of Tr, is capacitively coupled back to Tr, reinforcing its own increase in current. The switching is regenerative and any such change always proceeds to the limit of one transistor on (Tr,) and the other off (Tr). When the potential at B falls rapidly it drives C to a correspondingly negative value, C having started close to zero (in practice 0.0.4 V corresponding to VCEsat). Point C then charges towards VCC through R3, eventually passing zero and then, at 0.5 V, bringing Tr, into conduction. The process is then repeated, saturated and Tr, cut off. Independent control of the two parts of the cycle is inherent in the use of different CR sections for the two transistors.

Ideally the collector waveform should be a squarewave and the base waveform a sawtooth of a perfect exponential followed by a period at zero volts. The departures from this ideal can be indicated and can be explained as follows. When a transistor is driven into conduction the collector current can be very large depending on the current gain while the capacitor to which it is coupled sloppy the opposite base out of its conducting region. The transition is then slowed only by the device self-capacitances together with strays. Thus the fall-time at each collector is very short. When a transistor ceases to conduct the collector has to charge through the current gain which is the time is to that of 0.2 4By, the theory given earlier. As the timing cycle is of order 0.698 QRC it is practically 1.3%, R is 1.1. It is not possible to reduce this greatly by manipulating the ratio R3, R4 because that is constrained by the need to ensure the saturation of the transistors when switched on. R = 10Ω, is a typical constant leaving the rise time at 30% of the pulse width.

The rapid capacitor charging also shows up as a spike at the start of the base waveform saturation region. The collector rise-time can be drastically improved by isolating the collector from the base. Assume the base voltage of a transistor has been insufficient to propagate around the loop and raise the loop gain to an

This makes the oscillation frequency more dependent on supply variations. The simple circuit is a perfect exponential

and then, at some reference level too low for

and that is that R, is involved in the recovery period while R, is

The real difficulty arises if an otherwise satisfactorily

The collector rise-time can be dramatically improved by isolating the collector

EXAMPLES

Two transistor astables

The waveform is that of a collector waveform falling from VCC to

Note the likely tolerance on this figure is likely to be dominated by the value as the VCC, VBE, VCE values have made only a marginal difference — realizing T from 138 to 1.42V.

10% and 90% levels. This is in comparison as it falls to allow for the initial

The waveform can be improved in theory by reducing R, increasing or both

But R = 10Ω is typical to ensure saturation of the transistor i.e.

The voltage at B switches from VCC to VCEsat. Prior to that instant C is set

The corresponding value of VCEV0 = VBCBsat is the transistor emitter–

This is composed of the major term VCE + VBE, obtained for ideal

the finite transistor voltage drops in saturation. The collector waveform is shown opposite.

The figure can be improved in theory by reducing R, raising R, or both

The guaranteed figure for saturated current gain is not likely to exceed

any 20% allowing for the over-simplification.

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The circuit contains a number of points where breakdown may occur. If the breakdown voltage of the diode is exceeded, it will go into its reverse conduction region or may even be destroyed. This is true of all germanium diodes; with silicon diodes the voltage limit is lower. Therefore, breakdown voltage may be critical in such circuits. To avoid this, the diodes can be replaced by transistors.

The working principle of the astable is as follows. The circuit is divided into three sections: the input stage, the difference stage, and the output stage. The input stage is responsible for converting the input signal into a form that can be used by the difference stage. The difference stage compares the input signal with a reference voltage and generates a difference signal. The output stage amplifies the difference signal and drives the load.

The astable is a relaxation oscillator, which means that it oscillates at a frequency determined by the time constants of the circuit. The time constants are the product of the resistance and capacitance values in the circuit. The oscillation frequency is inversely proportional to the square root of the time constant. Therefore, if the time constant is doubled, the oscillation frequency is reduced by a factor of the square root of 2.

The circuit is designed such that the time constants of the input and output stages are much shorter than that of the difference stage. This ensures that the circuit oscillates at the frequency determined by the difference stage, which is the desired output frequency.

The astable is a simple and effective way to generate a stable square-wave output. It is widely used in many applications, such as timing circuits, analogue-to-digital converters, and digital-to-analogue converters.

The guaranteed figure for saturated current gain is not likely to exceed 20% or both transistors, as necessary to maintain the output frequency. This is accurate as it fails to account for the rise-time of the collector waveform. This is inaccurate as it fails to account for the rise-time of the collector waveform. This is inaccurate as it fails to account for the rise-time of the collector waveform. This is inaccurate as it fails to account for the rise-time of the collector waveform.
The continued withholding of the citizen's band by the Home Office has caused vastly increased occupancy of the amateur 2m and 70cm bands for everyday purposes of mutual communication between friends, and most of them use commercially-made private mobile radio equipment tailored for these frequencies, and for the 80 or so automatic/unattended repeater stations dotted about the UK.

Several years ago, the author foresaw the need for a somewhat tidier aerial for the average householder than the too-prevalent, quarter-wave, ground-plane, vertical aerial; an aerial which would be stick-like, with no ground-plane, and operating on both bands without switching. It should be weather-proof and cheap, and easily clamped to a short stub-mast with Jubilee clips from the local garage. It wasn't an easy job!

The first design, a half-wave rod driven from a quarter-wave concentric transformer, did work, but the thinness of the centre wire to match 50 ohms to 1200 ohms (the end resistance of a 12mm, half-wavelength rod at 145 MHz), relegated the design to the roof space.

However, in the aerial shown diagrammatically in Fig. 1, the wire is 0.7mm and the inductor can be 127mm of p.v.c.-covered wire, fashioned into a hairpin shape and soldered on in parallel to the feeder cable at the point of entry. Very careful tests disclosed the interesting fact that the transformer needed to be about 0.185 wavelength long when the insulator/spacer S was 0.015 wavelength. With 12mm tubing, v.v.a.r., could easily be made 1:1, and the feeder did not radiate. Pro rata scaling from the 2m to the 70cm band proved that the hairpin needed to be, not one third, but (1/3)³ = (0.7775) × 127 = 73mm long at three times the frequency. The inductance changed inversely as the frequency.

Already it was felt that enough was known about the aerial to go ahead with a full patent for the matching features, and this has now been obtained (British Patent No 1527800).

From a practical viewpoint, the aerial suffered in rain and high winds. It had to be precision-made and sealed if water was to be kept out of the two joints, either side of the precision-turned insulator/separators. The solution, shown in Fig. 2, was to build the aerial flat, from off-cut strips about 1 cm wide, with a flat drilled strip insulator (of Perspex, in the author's case), the whole lot being pushed into thin plastic conduit and put on a high stub mast so that it would rattle, and keep the author awake at night.

Quite right! That is exactly what the kinks are for; to stop the assembly rattling in a high wind. The kinks have no electrical purpose whatsoever. The two end-plugs, one drilled for the feeder, were actually cast from body-repair resin, but could be turned from solid material, of course.

Gone is the taut centre wire in the transformer, T. Instead (see construction diagram), the centre core of the feeder itself, UR43, (F) with the braiding stripped back, forms the "centre" wire. Actually, an insulated wire taped on to a wide strip is not unlike a coaxial line, except that there is the added advantage that, for fine matching adjustment, it can be flared away from the strip as shown.

So what about 70 centimetres? Well, around the outside of the plastic conduit, and directly over the middle of the 2m radiating element, a "cooking foil" (actually aluminium Silglas glazing strip), cylinder is glued, resonant at the third harmonic of 2m. This radiation reaction from the centre current maximum when the aerial is used at its third harmonic on 70cm, and leaves just the upper and lower half wavelengths (which are in phase) operating as a two-element colinear at 70cm.

The author is, perhaps, lucky to have discovered a matching and radiating system that can be adjusted to give very good matching at both frequencies at once. It did take four years, of course, and quite a bit of help along the way was given by other radio amateur
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friends. None of them ever saw the final model, except from a considerable distance, but a number of the early models were made by the author and farmed out for reports. GBCW, G3PCA, G3MC, GBWL, G8BAM, G8YNCE (call signs given in a random order) were early users of the aerial, and some went on to build their own. Thanks are due to all of them for the assistance they gave.

Scaling the aerial to V Televisi­on, proved a very pleasant surprise. With short, fat dipoles, and 75 ohm feeder, the inductor L is not needed. This helped the bandwidth problem. Red zone is particularly difficult in this respect, though it must be admitted that even 1cm wide material does quite a good job, and the feeder is absolutely "dead", allowing one to pin up the feeder after setting the aerial to the best position, without upsetting the picture again. Some users have been known to get quite light-headed about this particular feature, only rarely encountered, apparently.

No dark plans are afoot to manufac­ture the aerial. No doubt, however, some character will make one or other of the suggested models and sell huge quantities in a clandestine manner. Good luck.

To others, I would say, please build one with my complicity. It was a challenge to make exactly the aerial I wanted; it was a challenge, in this day and age, to invent a virtually new aerial which turned out to be a new aerial, at least within the definition of the patents law, whatever that is.

The table shows the dimensions of aerials for single-frequency use in various bands.
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The table shows the dimensions of aerials for single-frequency use in one band.

No more film for Channel

The smallest of the UK independent television companies, Channel Island Communications (Television), recently made a claim to be the first European broadcaster to use electronic news-gathering equipment exclusively. All previous electronic news-gathering film processing facilities have now been removed.

Sony Broadcast BV300 cameras, BV1900 U-matic video recorders, editing and time-base correction equipment is used and so far proved to be highly reliable in almost all conditions. Channel's managing director, Ken Ellis, expressed his enthusiasm for the new techniques, and feels that "the electronic cameras have given a new dimension to local television broadcasting". It is no longer necessary, for example, to have people in studio to interview them; the reduction in costs and elimination of film processing time means that outside interviews are now practicable. Camera sensitivity gives freedom from the necessity to use kilowatts of lighting and the automatic colour balance in the electronic cameras obviates the use of filters for different lighting conditions. But this cost is "negligible", since tape produced by the U-matic is dubbed onto a master for broadcast, the original being refused.

There has been no union opposition to the use of the equipment, the technicians being "most impressed", according to Brian Turner, Channel's operations manager.

Fig. 3. Townsman without plastic tube cover.

continued from page 69

Fig. 6. Aerial with display.

Fig. 7. Radio receiver selectivity response, measurement, a car radio with 100k V arm filter, scale output 1kHz div relative to 1kHz, horizontal scale 1kHz div relative to 1MHz centre frequency.

Finally, Fig. 5 shows the equivalent resistor and capacitors across the input stage in an a.m. radio receiver. The response bandwidth is now of course twice the audio bandwidth.

Radio receivers

Another application is the examination of overall receiver responses. Fig. 6 shows an arrangement for this measurement using a standard signal generator, e.g. Marconi type TF 2002. The adaptor unit converts both the input r.f. signal to audio and the output audio to r.f. The signal generator is tuned to the receiver centre frequency, e.g. 1MHz, and the output set to desired output level, e.g. 100V. Some adjustment in the a.f. levels may be necessary in order to keep within the 100n V-p-p requirement, but this is not difficult to arrange at audio. It will now be appreciated that the spectrum analyser tracking generator sweeps the r.f. signal generator input frequency across the passband of the receiver under test. The resultant audio response is then selectively monitored.

The response of a high quality car radio is shown in Fig. 7. This response is the aggregate of the r.f. and a.f. stages of the receiver. This spectrum analyser sweep rate must be sufficiently slow so as not to mask the a.g.c. response of the receiver.

References
The alarm timer was originally designed to operate with a time-code clock published in the February to April 1976 issues of Wireless World, but it can be adapted for use with other types of digital clock. The standard circuit offers 16 alarm times during a week, although this can be expanded to 64. Alarms can be inhibited on selected days and a back-up battery powers the volatile memory during a power cut.

There are many industrial and domestic situations where it is necessary to generate a number of alarm times. This design provides up to 16 alarm times, although it is possible to increase this to 64. The timer was primarily designed for use with a time-code clock, but it can be connected to a more conventional digital clock.

The design is based on a static 1K r.a.m. which stores the alarm times.

The MK 14 is a complete microcomputer with a keyboard, a display, a 4512 PROM programmed with BASIC, and a 256-byte RAM, programmable through the hexadecimal keyboard. As such the MK 14 can handle dozens of user-written programs through the hexadecimal keyboard. To this end, the MK 14 costs only £39.95 (+£6.60 VAT, and p+p).

More memory—and peripherals! Optional extras include:
1. Extra RAM—256 bytes.
2. Internal RAM/IO device (allowed for on the PCB giving further 256 bytes of RAM).
3. Low-cost cassette interface module—which incorporates a 64 kbyte PROM.
4. PROM programmer and blank PROMs to set up your own pre-programmed dedicated applications.
5. VDU Interface, displays 512 characters on 825 line display. TV by memory mapping interface of MK 14. Incorporates a 64 character ASCII display chip, graphic facility, video output.

All are available to owners of MK 14.

A valuable tool—and a training aid
As a complete kit it bundles all types—from compact games to digital alarm clock functions, from basic maths to a pulse meter. Programmes are in the manual, together with instructions for using your own genuinely valuable programs. And, of course, it’s a superb education and training aid—providing an ideal introduction to computer technology.

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The design is based on a static 1K RAM which stores the alarm times. Although this form of storage is only suitable for multiplexed systems, it simplifies the circuit considerably.

The alarm times are stored as four digits, BCD, so that they can be easily compared with the clock time to the nearest minute.

One advantage of using a time-code clock is its automatic setting after a power cut. To make the timer compatible, a rechargeable battery is used to power the memory and a few associated ICs during such a power cut.

If it is necessary to inhibit alarms on certain days of the week this can be achieved by using an optional circuit. A day-of-the-week indicator comprising seven LEDs is also included.

The block diagram of the complete timer. The circuit is designed for use with a multiplexed clock. All external connections refer to the time-code clock mentioned in the text.

Power supply
The power supply provides 5V to run both the timer and a clock. It also controls the charging/discharging of the back-up battery and provides control signals to prevent spurious clocking of the memory and shift registers when the mains supply is cut or restored. The 5V supply shown in Fig. 2 is based on a standard 5A regulator. Fig. 3 shows the battery charger and power control circuit which uses a constant current source around Tr1 to charge the battery through R1, with a current of about 45mA. Transistor Tr2 regulates the 5V supply to provide 5V for the memory circuits. If the mains input fails, the 10V

www.americanradiohistory.com
supply decays rapidly and at 8V $T_2$ turns off via $D_1$ which enables the voltage regulator $T_2$ to supply current from the battery to the $V_i$ line. Diodes $D_1$ and $D_2$ prevent damage to $T_3$ and $T_4$ from reverse currents. During normal operation $T_3$ is turned off and the power fail line is high. When the mains supply is removed the power fail line goes low as soon as $T_3$ has turned off and when the mains is restored, the clock display is blanked and $T_4$ is switched on via $R_9$. When the display blanking line goes low, $T_3$ switches off and the power fail line goes high.

Capacitor $C_1$ prevents any switching noise reaching the power fail line which is also used to disable the memory during power cuts so that pulses on the memory read/write pin have no effect. This prevents data in the memory from being erased because if the main 5V supply fails, the memory is left in the write mode. If the timer is used with the time-code clock mentioned previously some alterations are necessary to ensure that the display is always blanked at switch-on, see Fig. 4.

Although it is impossible to alter the data in the memory by interrupting the mains supply, the data will be lost if the battery is completely discharged after about six hours of continuous use. To indicate that a power cut has occurred, the on l.e.d. flashes until it is reset manually.

Day of the week circuit
Pressing the day key clocks a divide-by-seven counter and 7-bit shift register via a debounce circuit. The output of the counter is connected to the l.e.d. day indicator and the shift register is clocked with the counter so that they remain in step. The shift register can be set to enable or inhibit the alarm for each day of the week and the l.e.d. alarm indicator monitors the output of the shift register corresponding to the day indicated.

As shown in Figs. 5 and 6, the keyboard is incorporated with $S_5$ at run because the common line is left floating. With $S_5$ in the set position, pressing any key grounds the corresponding output pin. Therefore, pressing the day key triggers a monostable in IC$_{22}$ which produces a 15ms low pulse at pin 15. This pulse is gated through IC$_{21}$a, IC$_{20}$ and IC$_{19}$ to produce a low pulse which clocks the counter IC$_{19}$ whose output is decoded by IC$_{18}$. Pressing the day key therefore advances the indicator by one. The counter is reset when pin 9 of the decoder goes low.

If the day indicator is to be automatic it must be clocked at midnight when the tens-of-hours 8 bit goes low. This switches Schmitt trigger $T_3$, $T_9$ whose low edge is differentiated by $C_1$, $R_9$, and then fed to IC$_{19}$ via IC$_{18}$. Diode $D_1$ prevents a spike appearing at the input of IC$_{18}$ when $T_3$ is turned off at 20.00 hrs.

Any necessary correction to the time display is achieved by clocking the display at 100Hz. This causes a short pulse at IC$_{20}$ output which is filtered by $R_9$ and $C_1$ to prevent false clocking. If the power fail line goes low, IC$_{20}$ cannot be cleared and signals from IC$_{19}$ are blocked. When the mains is restored, the power fail line remains low while the 5V supply is recovering and only goes high when the display blanking line goes low. The day indicator is not clocked at midnight if the mains supply is interrupted when the midnight pulse is to be produced. If this occurs the day indicator will be one day behind when the supply is restored, but the flashing l.e.d. provides a warning.

The alarm enable/inhibit circuit is shown in Fig. 7. The output of IC$_{20}$ clocks IC$_{19}$ so that it is always in step with IC$_{19}$. The Q outputs of IC$_{19}$ are normally high and gates IC$_{20}$, IC$_{22}$ recirculate data from Q7 to the data input. The alarm enable l.e.d. monitors the output of IC$_{18}$ and indicates whether the alarm is enabled or inhibited. With $S_5$ at set and $S_5$ at day, the Z line is grounded and the alarm is inhibited for the day indicated by pressing 8 on the keyboard. This clocks IC$_{19}$ via IC$_{18}$ so that its Q output goes low which forces the data inputs of IC$_{19}$ high and switches the alarm enable l.e.d. off. If the day key is then pressed, the new data is clocked in and the low pulse IC$_{19}$ output clears IC$_{22}$ after IC$_{20}$ has been clocked.

To enable the alarm for the day indicated the 1 key is pressed which clocks IC$_{19}$ via IC$_{18}$ and clears IC$_{22}$ via IC$_{19}$ and IC$_{18}$. This forces the display inputs of IC$_{19}$ high and the alarm enable l.e.d. is switched on and, if the day key is then pressed, IC$_{19}$ is clocked into IC$_{19}$. This also resets IC$_{19}$. When entering data, an error can
supply decays rapidly and at 8V Tr4 turns off due to Diode D6 which enables the voltage regulator. Tr6 to supply current from the battery to the SCR line. Diodes D3 and D2 prevent damage to Tr3 and Tr4 from reverse currents. During normal operation Tr6 is turned off and the power fail line is high. When the mains supply is removed the power fail line goes low as soon as Tr4 has turned off and when the mains is restored, the clock display is blanked and Tr6 is switched on via R6. When the display blanking line goes low, Tr4 switches off and the power fail line goes high. Capacitor C1 prevents any switching noise reaching the power fail line which is also used to disable the memory during power cuts so that pulses on the memory read/write pin have no effect. This prevents data in the memory from being erased because if the main 5V supply fails, the memory is left in the write mode. If the timer is used with the time-code clock mentioned previously, some alterations are necessary to ensure that the display is always blanked at switch-on, see Fig. 4.

Although it is impossible to alter the data in the memory by interrupting the mains supply, the data will be lost if the battery is completely discharged after about six hours of continuous use. To indicate that a power cut has occurred, the on/l.e.d. flashes until it is reset manually.

Day of the week circuit
Pressing the day key switches a divide-by-seven counter and 7-bit shift register via a debounce circuit. The output of the counter is connected to the l.e.d. day indicator and the shift register is clocked with the counter so they remain in step. The shift register can be set to enable or inhibit the alarm for each day of the week and the l.e.d. alarm indicator monitors the output of the shift register corresponding to the day indicated.

As shown in Figs. 5 and 6, the keyboard is inoperative with S5 at run because the common line is left floating. With S5 in the set position, pressing any key grounds the corresponding output pin. Therefore, pressing the day key triggers a monostable in IC6 which produces a 150ms low pulse at pin 12. This pulse is gated through IC7, IC15, and IC16 to produce a low pulse which clocks the counter IC6 whose output is decoded by IC15. Pressing the day key therefore advances the indicator by one.

The counter is reset when pin 9 of the decoder goes low. If the day indicator is to be automatic it must be clocked at midnight when the tens-of-hours B bit goes low. This switches Schmitt trigger Tr7, Tr8 whose low edge is differentiated by C18, R38 and then fed to IC1 via IC16. Diode D1 prevents a spike appearing at the input of IC16 when Tr8 is turned off at 20.00 hrs.

Any necessary correction to the time display is achieved by clocking the display at 100Hz. This causes a short pulse at IC15 output which is filtered by R39 and C13 to prevent false clocking. If the power fail line goes low, IC6 cannot be cleared and signals from IC6 are blocked. When the mains is restored, the power fail line remains low while the 5V supply is recovering and only goes high when the display blanking line goes low. The day indicator is not clocked at midnight if the mains supply is interrupted when the midnight pulse is to be produced. If this occurs the day indicator will be one day behind when the supply is restored, but the flashing l.e.d. provides a warning.

The alarm enable/inhibit circuit is shown in Fig. 7. The output of IC16 clocks IC10 so that it is always in step with IC9. The Q outputs of IC10 are normally high and gates IC20, IC21 regenerate data from QT to the data input. The alarm enable l.e.d. monitors the output of IC14 and indicates whether the alarm is enabled or inhibited. With S5 at set and S6 at day, the Z line is grounded and the alarm is inhibited for the day indicated by pressing 8 on the keyboard. This clocks IC16 via IC14 so that its Q output goes low which forces the data inputs of IC15, high and switches the alarm enable l.e.d. off. If the day key is then pressed, the new data is clocked in and the low pulse IC15 output clears IC10 after IC10 has been clocked.

To enable the alarm for the day indicated the 1 key is pressed which clocks IC16 via IC14 and clears IC20 via IC18. This forces the display output of IC20, the alarm enable l.e.d. is switched on and if the day key is then pressed, the alarm is clocked into IC10. This also resets IC14. When entering data, an error can

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**Table 1. Power supply connections for the i.c.s.

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Fig. 2. Main 5V power supply.

Fig. 3. Battery charger and power control circuit. Resistor R15 is chosen for a trickle-charge current of about 45mA.

Fig. 4. Modifications to the time-code clock. The component numbers marked with an asterisk refer to the published clock circuit. C17 replaces a 100uf capacitor and D26 has been added to discharge C17 whenever short breaks in the mains supply.

Fig. 5. Keyboard encoder and memory input circuit.
LETTER

In recent issues of your journal I noticed a number of articles written in concurrence with the controversy surrounding the potential introduction of a police radio service in Great Britain. As I have more than 20 years experience as a user of C.B., I would like to add my thoughts on this subject.

Five years ago I installed the first C.B. set in my home. I was one of the very few who wished to be compatible to the channel set. The price of the first set was $138, and I purchased it because of its Japanese make and price. I must say that I have been delighted with it. I use C.B. mainly while traveling. Calling in to Channel 19 (by custom this is the highway channel in most of the U.S.) gives me instant information on road conditions and accidents, traffic congestion, general weather, and even conferences to find an open gasoline station etc.

When traveling in an unknown area I can find out about a good restaurant, how to get a landmark, and, of course, location of speed traps and other hazards of civilization. In general I find C.B. to be an invaluable communication which keeps me alert and awake on long trips. Being able to contact in most areas is a boon.

Here and in your country the major opposition to C.B. seems to originate in the ham radio community. C.B. is often called "trafficjc.

In my opinion, this opposition comes mostly from misunderstanding of the actual and beneficial use of C.B. Many of the arguments are nonsensical to me. The most frequent is to have the same frequency used by the ham radio community. This is an absurd argument. C.B. is used for traffic control, and not for amateur radio purposes. The ham radio community has the right to use its own channels for its own purposes. It is a matter of choice.

It is true that C.B. may be used for information and communication, but C.B. is not the only means of communication. Other means exist, such as telephones, telegraphs, and television. C.B. is not a replacement for these means of communication. It is a supplement and a complement to them.

Another argument is that C.B. is used for personal enjoyment and not for serious work. This is a false argument. C.B. is used for serious work, such as police work, fire and rescue work, and emergency services. C.B. is used for serious purposes, and not just for personal enjoyment.

It is time to recognize the benefits of C.B. and to support its use. C.B. is beneficial to the public and to the ham radio community. It is a service that is used by many people, and it is beneficial to them. It is time to give C.B. the recognition it deserves.

Sincerely,

[Signature]

[City, State, USA]

WIRELESS WORLD, FEBRUARY 1980

BOOKS

Beneath the City Streets, by Peter Laurie, is an updated version of an earlier book of the same title, concerned with the controversy about government communication systems in the UK set up to cope with "terrorist" attack, almost certainly with nuclear weapons. The city of London is well known for its secrecy, and the book itself is concerned with the chaos and confusion that arise in such situations. It is a fascinating read for those who want to understand the implications of such an event.

Teletext and Viewdata, by Steve A. Money, is an excellent introduction to these systems. The author describes the technology behind these systems, as well as the political and social implications of their use. The book is well written and easy to read, and it is highly recommended for anyone interested in these topics.

Handbook of Electronic Projects, Symbols and Standards, by R. Brandes, provides a comprehensive overview of the symbols and standards used in electronics. The book covers a wide range of topics, from basic electronics to advanced topics such as semiconductor technology and microelectronics. It is a must-read for anyone working in the field of electronics.

Electronic Logic Projects, by R. G. Gibson, is a collection of projects that demonstrate various digital logic design techniques. The projects range from simple circuits to more complex systems, and they cover a variety of topics, including the use of microcontrollers and microprocessors. The book is well illustrated and easy to follow, and it is highly recommended for anyone interested in electronics.

Microelectronics in the '80s is a view of the potential uses of microelectronics in a variety of fields. The book covers topics such as computer technology, telecommunications, and medical electronics. It is a well-written and highly informative read for anyone interested in microelectronics.

Electronic Projects Index for 1978 is a valuable resource for anyone looking for electronic projects. The book contains a comprehensive list of projects, categorized by type and subject. It is well illustrated and easy to follow, and it is highly recommended for anyone interested in electronics.
be easily rectified by pressing the correct key, 8 or 9, or skipping over the previous data. Note that the data is not entered into IC5 until the day key is pressed, therefore the action when setting the alarm enable/inhibit must be to press the day key. Capacitors C4 and C5 ensure that the Q outputs of IC5 go high when the mains supply is connected. When the power is cut, the output of IC5 stays low and ensures that IC5 cannot be clocked. Table 1 shows how the ICs are supplied by the main and the line 5V, respectively. To reduce battery drain as much as possible, low power TTL ICs are used with $\text{Vcc}$. To be continued. 

![Fig. 6. Day-of-the-week indicator](image1)

![Fig. 7. Alarm enable/inhibit circuit](image2)

**LETTER**

In recent issues of your journal I noticed a number of articles in which the controversy surrounding the potential introduction of the police radio service in Great Britain. As I have much more experience as a user of c.b. I would like to add my thoughts on this subject.

Five years ago I installed the first c.b. set in my car and found it to be a useful tool which I wished to be complementary to the channel set. The price of the first set was $35.00, while today the temptation is on to trade up to a Japanese made set perform admirably. I use c.b. mostly while travelling. Calling in to Channel 19 from the high channel in most of the US gives me instant information on road conditions many miles ahead, accidents, traffic congestion, where to find an open gasoline station etc. When travelling in an unknown area I can find out about a good restaurant, how to find a landmark, and, of course, location of speed traps and other hazards of civilization. I found that c.b. can be an invaluable companion which keeps me alert and aware on long trips. Being able to contact in most areas a member of the REACT group or a local police station on the emergency Channel 19 gives me an additional peace of mind.

Here and in your country the major opposition to c.b. seems to originate in the ham radio community having no experience with it. I believe this opposition comes mostly from misunderstanding of the actual and beneficial use of c.b. by those who are not aware of the numerous possibilities of sharing the radio spectrum with the ham radio community.

Some of the letters in your magazine also reflect a certain fear of offending authority (Government, Police, etc.) which resulted in the attitude of most US police departments in refusing to use c.b. in their patrol cars. The use of the radio frequency is not limited to the police department and in many areas Channel 9 is continuously monitored by the local police to find out for emergencies. After 10 years of motorists warning each other of speed radar they still catch enough speeders.

Case R. Lewart

Hoboken, New Jersey, USA

**Beneath the City Streets**, by Peter Laurie, an updated version of an earlier book of the same title, contains an excellent information about government communication systems in the UK set up to cope with external attack, almost certainly with nuclear weapons. If the book however, is concerned with the cities, bunkers and other dispersed centres of government, then I believe it to have such emergencies. A chapter on civil defence however, is concerned with the same subject in which advertisers tend to use pseudo-scientific expressions to give an aura of authenticity.

The first chapter is a general look at the whole field, and is followed by nine sections dealing with individual components of an audio system, their use and testing. A very useful feature is a directory of makers and distributors. Buteports and Co (Publishers) Ltd publish the book at $4.95 in paperback.

**Teletext and Videotext:** By Steve A. Money, is an excellent introduction to the subject of television data display systems in a simple way, to non-specialists. The book however, is concerned with the cities, bunkers and other dispersed centres of government, then I believe it to have such emergencies. A chapter on civil defence however, is concerned with the same subject in which advertisers tend to use pseudo-scientific expressions to give an aura of authenticity.

Microelectronics into the '90s is a view of the economic, commercial, technological and political factors which will govern the development of the industry in the next decade. A book which is published by Mackintosh International, a market consulting group who specialize in the electronics industry. Analyses of the semiconductor industry (its current state, government involvement, forward planning, finance) is presented for France, Italy, Japan, UK, USA and West Germany, with three articles by Mackintosh, Petritz and Barrone giving personal views on the future of integrated-circuit technology and applications. The book contains 88 pages and costs £5.80. Mackintosh Publications Ltd, Mackintosh House, Napper Road, Luton.

**Electronic Logic Circuits:** By R. J. Gibson, is a broad introduction to logic functions via the usual Venn imagery, its explanation gaining clarity with the omission. Symbols used are those in elementary chapters on the nature of number systems, coding and components, and leading to an explanation of logic elements. Boolean algebra and circuit formation. Functions have been expressed in standard form for attack by electronic calculator. Three main sections of the 350 page book are: passive circuits, transistors and operational amplifiers; two useful appendices give a list of ratios obtainable from 5% passive components and with such symbols - the reverse of the main book. Van Nostrand Reinhold Company Ltd, Molly Millars, 53-55 New Oxford Street, London WC1N 3PB is published in paperback, the book is £11.95 in hard back.

**Sound Recorders for Motion Pictures** by Charles B. Frater, is a broad introduction to current techniques and equipment and has helpful illustrations on most of its pages. It seems that the book is unusual and completely logical; the author has written a small enough book to be conveniently held by hand and when it is opened it gives me an additional peace of mind.

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CASE R. LEBART

Hoboken, New Jersey, USA

**Newsw Book of Audio** is another compilation of articles written by the half-dozen or so people whose names seem to crop up most frequently in the audio magazines. It is intended for those who would like to buy high-quality equipment, but who are beset by the technological inanity in which the subject in which electronics plays a leading role. If the advertisers tend to use pseudo-scientific expressions to give an aura of authenticity then I believe it to have such emergencies. A chapter on civil defence however, is concerned with the same subject in which advertisers tend to use pseudo-scientific expressions to give an aura of authenticity.

Electronic Projects Index for 1978 is now available. It is the second edition, the first covering the period 1973-77, and contains entries from a further eight publications. The compiler has taken constructive criticism from electronics magazines and has had entries submitted by them, subject with a reference and a short synopsis. The book is intended for a small company or individual electronics engineer. A small number of the projects and classifications of the articles into types of equipment described is well done, and the electronic Projects Index for 1977 will be good value to specialists in the field. Publishers are Academic Press, London.

Guide to Technical Short Courses is published by the Institution of Electrical Engineers, and is abstracted from their computer database. Chapters are concerned with the career lasting less than one year. Full-time or part-time studies are covered, including intensive courses of up to two weeks duration, and are listed under the college, university or company running them. Detailed information on courses, level of study, type and duration of the course, dates, subjects covered and general remarks. There are subject and geographical indexes. The guide is published at £6.50 by the IEEE Marketing Department, Station House, Hitchin, Herts SG10 1RJ. Volume 12 of the IBA Technical Review is entitled Techniques for Digital Television. As usual in this series, the 70 page book consists of a number of contributions by IBA engineers on a central topic — in this instance, digital video processing. The discovery some years ago of the possibility of sub-Nyquist sampling rates (less than twice the maximum analogue frequency component) led to the design of a digital television studio using the proposals, and these articles describe the components of the system. In common with the other volumes in the series, this book is extremely well presented. Libraries or engineers and students directly involved in broadcasting can obtain a free copy by writing to IBA Engineering Information Service, Crowley Court, Winchester, Hants, SO21 2QA.

**Electronic Projects Index for 1978** is now available. It is the second edition, the first covering the period 1973-77, and contains entries from a further eight publications. The compiler has taken constructive criticism from electronics magazines and has had entries submitted by them, subject with a reference and a short synopsis. The book is intended for a small company or individual electronics engineer. A small number of the projects and classifications of the articles into types of equipment described is well done, and the electronic Projects Index for 1977 will be good value to specialists in the field. Publishers are Academic Press, London.

**Z8 Instant Programs** — machine-code routines for Nascom and other Z80 Computers is published by the Institution of Engineering and Technology. The programs are listed in memory location/opcode format and are intended for a small Z80 system capable of up to 1,000 program steps. New owners of Nascom computers may find the book useful, since it begins with very simple examples, such as the production of the delays and single tones, and finishes by programming for a simple computer game. The book is published in paperback by Sigma Technical Press, 21 Doppins Mill Close, Tetshall, Woborough WV6 8AH, at the very high price of £7.50. There are 196 pages.

![Image 3](image3)
Electronic focusing

Simulation of the human eye mechanism

by D. Di Mario

Conventional focusing systems depend on the knowledge of distance but the human eye can focus without making any distance measurements. This article outlines an electronic system which simulates the eye's ability to use colour and luminosity differentiation for focusing an image.

Most readers will be familiar with the manual focusing ring and distance scale on common cameras, but Konica have produced an automatic focusing camera that performs a triangulation for indirectly calculating distance. Another system developed by Polaroid uses a beam of ultrasonic waves to measure distance. However, the human eye does not use any of the above methods. The purpose of focusing is to obtain the maximum amount of information from a given image area and the knowledge of distance is only a consequence which comes from our visual experience. The photographs in Fig. 1 illustrate what is meant by maximum information. The human eye operates more like a computer than a camera and focusing seems to be achieved by scanning the area and comparing the luminosity and colour of adjacent points. When the difference reaches a maximum the image is in focus. The use of two phototransistors has been excluded because high differentiation for television scanning is an ideal application for space differentiation focusing. The answers to these and countless other questions are?

Pocket information

Do you know...

- wavelengths for BBC external services?
- what is a grey per second?
- how to build a simple graphic equalizer?
- whether UK colour sets work in Australia?
- the function of a C.M.O.S.
- how accurate the GRR, M.S.F transmitters are?
- the exact value of the semitone ratio?
- how much speech power you need for a hall?
- a simple circuit for a 1.4V regulated supply?
- how to wind a crossover choke for 50mhz?
- the equivalent of the B.C.17F receiver?
- the maximum voltage of a completely red polyester capacitor?
- how to find the impedance of a loudspeaker?
- the Fourier series for a triangular wave?
- how to work out logs and trig functions without tables?

The authors to these and countless other questions are contained in the 1980 edition of the Wireless World Diary. The list of telephone numbers for UK electronics organisations is expanded yet again, the technical standards section brought up to date and several new sections added. Unfortunately you can't buy it directly from the publishers, T. J. & J. Smith Ltd, of Deer Park Road, London SW19, and you will need to ask a retailer to order it through the book trade. Wireless World has a limited number of copies for overseas readers, price £1.92, inclusive obtainable from the editorial office.

In use the gating time is adjusted so that the instrument reads zero with the picture out of focus. The picture is then focused which should produce a peak reading. A photographic enlarger or a slide projector can be used for experimentation. To simulate the human eye accurately, several detectors should be used to cover the picture area. However, fairly accurate results can still be achieved with only one detector. Displacement of the phototransistor is dependent upon the required accuracy. A small displacement improves the point of exact focus but reduces sensitivity. In the prototype a 0.2mm displacement was used with a 300 x 300mm picture. With very low light levels the human eye has difficulty in differentiating because the colour is absent and the depth of field is narrow. It seems that under these conditions focusing is achieved by a phase difference. The light level from a certain point is compared with the value seen a moment before until the variation of light reaches its maximum. Also, a large number of points are analyzed and when they seem to correlate we assume the picture is in focus. The diagram in Fig. 4, shows a method for constructing such a circuit. The outputs of the detectors are fed to a majority gate which gives a pulse at the output only when there are pulses simultaneously at the three inputs. Occasionally two output pulses are produced but they are always very close together and near the focusing point. Detecting a click is heard from the speaker and this corresponds to the point of best focus.

Television scanning is a useful application for space differentiation focusing and a simplified system is shown in Fig. 6. When the picture is in focus the video signal has the highest percentage of high frequency signals. The reading on the instrument is very accurate and reaches its peak when the bars are in perfect focus. In these examples there has been no attempt to implement a servomechanism for automatic focusing. The main purpose was to study the mechanism of focusing used by the human eye and to investigate an electronic simulation.
Electronic focusing
Simulation of the human eye mechanism

by D. Di Mario

Conventional focusing systems depend on the knowledge of distance but the human eye can focus without making any distance measurements. This article outlines an electronic system which simulates the eye's ability to use colour and luminosity differentiation for focusing an image.

MOST READERS will be familiar with the manual focusing ring and distance scale on common cameras, but Konica have produced an automatic focusing camera that performs a triangulation for indirectly calculating distance. Another system developed by Polaroid uses a beam of ultrasonic waves to measure distance. However, the human eye does not use any of the above methods. The purpose of focusing is to obtain the maximum amount of information from a given image area and the knowledge of distance is only a consequence which comes from our visual experience. The photographs in Fig. 1 illustrate what is meant by maximum information. The human eye operates more like a computer than a camera and focusing seems to be achieved by scanning the area and comparing the luminosity and colour of adjacent points. When the difference reaches a maximum the image is in focus. The block diagram in Fig. 2 is an electronic version of the eye, where a phototransistor moves back and forth between two positions which are close together. A reading of the light level is taken at each position and then compared, integrated, amplified, rectified and displayed as a peak reading from an instrument. The use of two phototransistors has been excluded because high linearity is required. A logarithmic amplifier was used to accommodate the great variation in input signal due to the large range of luminosity. In the prototype the phototransistor was glued to the centre of a 1% in speaker with most of its diaphragm removed to reduce acoustic noise. A 200Hz oscillator was used to drive a 1W amplifier for the speaker and to provide gating pulses for the analogue switches. To avoid a beat frequency caused by the 100Hz of artificial light, a sync pulse was derived from the mains. The speaker and phototransistor were housed in a sealed probe which was placed in the image area.

During focusing a 'click' is heard from the speaker and this corresponds to the speaker and this corresponds to the placement of the phototransistor is dependent on the required accuracy. A small displacement improves the point of focus but reduces sensitivity. In the prototype a 0.2mm displacement was used with a 300 x 300mm picture.

With very low light levels the human eye has difficulty in differentiating because the colour is absent and the depth of field is narrow. It seems that under these conditions focusing is achieved by time differentiation. The light value from a certain point is compared with the value seen a moment before until the variation of light reaches its maximum. Also, a large number of points are analyzed and when they seem to correlate we assume the picture is in focus. The diagram in Fig. 4 shows a method for constructing such a circuit. The outputs of the detectors are fed to a majority gate which gives a pulse at the output only when there are pulses simultaneously at the three inputs. Occasionally two output pulses are produced but they are always very close together and near the focusing point. During focusing a click is heard from the speaker and this corresponds to the point of best focus.

Television scanning is an ideal application for time differentiation focusing and a simplified system is shown in Fig. 6. When the picture is in focus the video signal has the highest percentage of high frequency signals. The reading on the instrument is very accurate and reaches its peak when the bars are in perfect focus.

In these examples there has been no attempt to implement a servomechanism for automatic focusing. The main purpose was to study the mechanism of focusing used by the human eye and to investigate an electronic simulation.

Pocket Information
Do you know ...
- wavelength for BBC external services?
- what is a grey a second in?
- how to build a simple graphic equalizer?
- whether UK colour sets work in Australia?
- the function of a.c.o.l. 4040?
- what is the Radio 3 1MHz test tone for?
- the band for d.c.i. television?
- how accurate the GRR, MSF transmissions are?
- the exact value of the semitone ratio?
- how much speech power you need for a hall?
- a simple circuit for a 1.4V regulated supply?
- how to wind a crossover choke for 5mH?
- what is the exact value of the semitone ratio?
- how to build a simple graphic equalizer?
- whether the RF section brought up to date and modern?
- whether the answer to these and countless other questions are contained in the 1988 edition of the Wireless World Diary. The list of telephone numbers for UK electronics organisations is expanded yet again, the methods section brought up to date and several new sections added. Unfortunately you can't buy it directly from the publishers, but it is available from several radio and electronics centres. The answers to these and countless other questions are contained in this edition of the Wireless World Diary. The list of telephone numbers for UK electronics organisations is expanded yet again, the methods section brought up to date and several new sections added. Unfortunately you can't buy it directly from the publishers, but it is available from several radio and electronics centres.

The Author
Although born in England, D. Di Mario was educated in Italy and received a diploma in telecommunications. He then studied in research and development at Autoson and he later worked with computers at NCR. After a period at Siemens where he worked on electronic PABX and switching networks, he joined Italtel as a foreign contractor where he is currently involved in radio communications.

www.americanradiohistory.com
Dot matrix print mechanism

A mobile head consisting of 7 vertical needles, using 1,620 characters on a 7 x 5 dot matrix, constitutes the heart of the Underwater 822 print mechanism. This is a 23 character machine capable of continuously feeding work at about 5800Hz, resulting in a printing speed of 2.5 lines per second at a character height of 2.8mm. Further features are a quickly replaceable ribbon and the capability, according to the makers, Roxelena Electronics, to print a good copy on 3-ply cardboard paper. Microprocessor connection to a complete interface or the controller chip alone is supplied. Dimensions are 100mm wide by 140mm long by 52.5mm high and the printer weighs 381g. The unit operates from a 12V d.c. supply and has an operating temperature range of 4° to 50° C at up to 95% relative humidity. The one-off price is £50 and £34 each for a one-off copy.
Dot matrix print mechanism

A mobile head consisting of 7 vertical needles, using 3 dot matrix characters on a 7 x 5 dot matrix, constitutes the heart of the new 822 print mechanism. This is a 23 character machine containing complete self-contained character feeding work at 56KHz, resulting in a printing speed of 2.5 lines per second at a character height of 2.8mm. Further features are a quickly replaceable ink ribbon and the capability, according to the makers, Rosehill Electrolabs, to print a good copy on 3-ply carbonless paper. For microphone connector complete interface or the control chip alone can be supplied. Dimensions are 105mm wide by 145mm long by 32.5mm high and the printer weighs 575g. The unit operates from a 12V d.c. supply and has an operating temperature range of 5°C to 40°C at up to 95% relative humidity. The one-off price is £50 and £54 each for quantities of 100 units as supplied.

Pocket i.c.d. multimeter

The model 150 i.c.d. digital multimeter has five functions, each with five ranges, and meets many of the measurement requirements for field service use. Each function and range is selected using two rotary switches. The meter has direct voltage ranging from 200mV (100V resolution) to 100V (1 V resolution) with a maximum error of ±0.5% of reading plus ±1 digit. And alternating voltage ranging from 100mV, (10V resolution) to 1000V (10V resolution) ±1% of reading plus ±5 digit. The maximum allowable inputs on these ranges are 1000V d.c. or peak a.c. non-switched, 750V peak switched, continuous except on the 200mV a.c. range where input 1500V are limited to 150. The input impedance on these ranges is 10GΩ and is unbalanced by less than 100mΩ. The meter has direct current and alternating current ranging from 20µA, (1mA range) to 200mA, (10mA range) within 1% of reading plus ±1 digit. The meter is 190 x 72 x 30mm in size and weighs 370g. The one-off price is £35.

Digital pH / mV meter

Mains or battery operation and a 3½ digit display are the principal features of the CD300 pH and mV meter recently introduced by Walden Precision Apparatus. Functions are selected by a rotary switch on the front panel and the instrument operates over the required range in five functions, each with five ranges. The meter is hand held in one hand and the body of the meter is in the other. The one-off price is £35 and £34 each for quantities of 100 units as supplied.

Underwater telephones

Designed mainly for diving bell applications, the Miniott 715B underwater telephone is completely self-contained in a rugged, pressure-proof housing. Both speaker and microphone are mounted inside the bell and the unit has been developed with high pressure tubes and oxygen atmosphere in mind. The 705A telephone unit, employing a sideband transmitter/receiver for underwater telephone and a dual frequency unit operating at frequencies of 880kHz to 2MHz, (100kHz resolution) and 2MHz to 8MHz, (10kHz resolution) is connected to a microphone by a pair of 9 gauge telephone cables. The complete set weighs only 235g and measures 30mm x 23mm x 11mm. The one-off price is £22.50.

Constant voltage transformers

Recommended by the makers, Banner Electric Co Ltd, for a.c. applications where harmonics can radically affect circuit operation, the Sola CVS range of transformers contains harmonic-neutralizing circuits which obviate the need for additional filters. These transformers are smaller and are claimed to be more rugged than conventional transformers using filters for waveform improvement, and stabilization error is within ±0.5% of quoted output voltage. This margin relates to an input range of ±20% and to a high- power audio amplifier. The unit is available for bands in the frequency range 68-174kHz. Single and two-channel versions are available. Transmission output is 1W. Various plug in options are offered and space is provided for the addition of further switching. Among the varieties available are 5-tone encoders to decode to the standard European systems. Pye calls two-tone decode, tone lock encoder/decoder, or a single tone encoder to provide switching of a talk through repeater. Mains operation is provided for field service use. Each transformer is complete with fitted connectors, case and v.a.t. Keithley Instruments Ltd, 58 Edgewater Way, Edgewater, Middlesex HA8 8BP.

Teletext / Prestel chips

Three m.o.s./l.s.i. chips are the brain of the Teletext/Prestel TV system used for teletexis and video telephone systems. This system, which can be accommodated on a single-sided circuit board, is a microprocessor chip and all functions are contained on the 3 chips. One chip is the signal processor which contains a 25-bit signal processor and 32-bit read only memory for use with solenoids, etc., and applications where digital filters are concerned. The i.c. is designed for high speed under program control and can be converted into analogue form for output. The analogue section accommodates up to 4 inputs and 8 outputs. Control of analogue and digital sections is carried out by a 5-bit microprocessor. The instruction format for each word is divided into five linked sections: digital operating instruction, address indication, presence indication, address indication, and output indication. The r.a.m. scratch pad, which handles the arithmetic, is structured as a 4K x 25-bit memory. To boost processing flow, the r.a.m. has been re-designed with dual-port cells which can be addressed through either port. Typical applications of the 250 may be low-pass and band-pass filters with up to 20 complex poles and/or zero pairs, threshold detectors, limiters, recognizers, and 1-bit multiplication and division. Approximations to non-linear functions and waveform generators are also required. The chips are available from a basic teletext or video decoder to a combined unit for remote-control transmission via a telephone line to the user's key. The set of chips is compatible with existing standard television circuits for digital timing, channel indication and remote-control, as well as external accessories such as hard copy printers and keyboards, using i.c.s. The use of a standard, mask programmed i.c. is also a possibility. The board can be operated from a 5V d.c. supply and has been designed for a 30MHz clock speed with a maximum allowable input frequency of 15MHz. Transmission speeds that, for the CD300, will move all the fibre optic cable 20 feet long completely with fitted connectors compared with the FDK2-X1 which is equipped with a six-function 1000m long cable terminated by being inserted into a loudspeaker. On a telephone line, this is the case. The new model has a self-cleaning feature and can be operated in cascade to obtain both 3 and 4 digit resolution within ±1%. The one-off price is £30.
Spy fever

Some of that breakaway group over the Atlantic are obviously not especially averse to a fast buck. In the land of the free, if we are to believe the evidence of television and film, one can no longer ring the butcher to order a couple of t-bone steaks without someone illicitly eavesdropping in on the conversation and recording it on tape for, presumably, nefarious purposes. Concealed radio microphones, miniature cameras and telephone taps are big business and, as a natural consequence, so are the countermeasures for these little horrors. One American company, CCS, claims a yearly turnover of 25 million dollars in this field of activity.

Assuming that attack is the best form of defence, or perhaps stretching the analogy of setting a thief to catch a thief, CCS has managed to square its conscience by providing not only the defence, but the attack as well. Disabling any inconvenient abstract notion of ethics as "arcane moral philosophy", Gerald Freeman, a New York public relations man, implied that if you want to get on in business, your first move must be to get yourself a bit of "candid surveillance" equipment. For example, it seems that no well-equipped businessman is now roadworthy without his security system for eavesdropping, his briefcase with a secret "conversations recorder", and a covert spy - a camera that shoots round corners.

CCS will, I think, have to recognize the new opportunities presented to them on entering the UK market. Have they properly understood the real function of the standard-issue umbrella, for instance? It is nothing to do with the weather: that long stem is of exactly being concealed in a hip-flask. All those lovely old words will come back into everyday use - scuppers, marlinspikes, gallant officers and microprocessors. Oh yes, it is not, it seems, the intention to use more than a modicum of muscle-power to raise and lower the aforementioned canvas (nylon, more like) but to do it with motors under control of silicone chips (they're the waterproof kind).

Scots who hae . . .

I have fumigated in the past over electronics being used for trivial purposes, when greater needs go unrecognised. It is gratifying, therefore, to see a genuine requirement which is capable of being fulfilled, simply and at little cost, with an array of gadgets and few words of excitement. It is gratifying, therefore, to see a genuine requirement which is capable of being fulfilled, simply and at little cost, with an array of gadgets and few words of excitement.

One of my colleagues recently received a call from someone in a Scottish village, whose sleepy charm is currently being shattered regularly by a Maxon horn. It appears that the garage owner's telephone operates the horn so he can hear it over the noise of engines and British Leyland cars disinfecting. That would be all right in the normal way, but the village is a quiet one, and every time someone rings the garage to ask if their car is done yet, please, the whole village responds with a concerted leap into the air of about six inches.

One's heart goes out to these unfortunate denizens of the northern mists. They have all the problems of the Scottsman - hills, fogs, crofts, gorse by the roadside, a bunch of gossips, and the general background noise of the Universe: if a fish happens along and is curious enough to investigate, so be it, but it's the sitting that counts. If it is to be turned into a kind of production line, then the poor old fish are in for a pretty hectic time. Simply isn't cricket, at all.

Fish and chips

I've been waiting to use that heading for a couple of years now, and I finally located the excuse in a report in a daily paper, on the subject of what the future holds in store for us. Ever since the 'microchip' became the latest understood and most quoted household word since Einstein published his thoughts on relativity, any poor hack who can't think of a thing to write about for his daily 500 words lies back with his feet on the desk for twenty minutes and dreams up a few uses for microprocessors. He then writes his piece entitled "Our Future With the Chip" or some such.

Since it is well known that the chip in question can do anything or that, if it can't new, it soon will, a lot of the brainstormed suggestions are feasible. I saw one last week, though, that gave every indication of having been brought forth by someone whose idea of a brisk walk is a belt down the M1 in an MGR; the end being confused with the means. The notion put forward was a fishing rod with an attached microprocessor, the idea being to set everything up automatically to catch any fish in any stretch of water at any time.

I've never been one for gratuitously attacking fish of any kind, except when they lie, surrounded by chips, in a piece of Daily Express, but I do have the distinct impression that whoever's diseased mind thought that one up had hold of the wrong end of the stick. The whole idea, I've always thought, was to sit reflectively on the bank, pondering on the nature of the Universe: if a fish happens along and is curious enough to investigate, then so be it, but it's the sitting that counts. If it is to be turned into a kind of production line, then the poor old fish are in for a pretty hectic time. Simply isn't cricket, at all.

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Spy fever

Some of that breakaway group over the Atlantic are obviously not especially averse to a fast buck.

In the land of the free, if we are to believe the evidence of television and film, one can no longer ring the butcher to order a couple of t-bone steaks without someone illicitly eavesdropping on the conversation and recording it on tapes for, presumably, nefarious purposes. Concealed radio microphones, miniature cameras and telephone taps are big business and, as a natural consequence, so are the countermeasures for these little horrors. One American company, CCS, claims a yearly turnover of 25 million dollars in this field of activity.

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I've never been one for gratuitously attacking fish of any kind, except when they lie, surrounded by chips, in a piece of Daily Express, but I do have the distinct impression that whoever's diseased mind thought that one up had got hold of the wrong end of the stick. The whole idea, I've always thought, was to sit reflectively on the bank, pondering on the nature of the Universe: if a fish happens along and is unwise enough to investigate, then so be it, but it's the sitting that counts. If it is to be turned into a kind of production line, then the poor old fish are in for a pretty hectic time. Simply isn't cricket, at all.

Ship tells

They tell me that sailing ships are coming back. It's all to do with the oil, you see—or rather the lack of it. I've seen several proposals, from sail assistance on propeller-driven ships to complete, full-blown latter-day clippers, cleaving through the waves with acres of canvas billowing from the masts, miles of ropes, or sheets or whatever they call them, and all the romance of the old East India Company days. All those lovely old words will come back into everyday use—scuppers, marlinespikes, galloways and microprocessors.

Oh, yes, it is not, it seems, the intention to use more than a modicum of muscle-power to raise and lower the aforementioned canvas (nylon, more like) but to do it with motors under the control of silicone chips (they're the waterproof kind).

I don't know about that. One might conceivably feel a little self-conscious bawling out "'Heave-ho, my hearties" to a couple of boards full of chips, there is also the matter of what sanctions to impose on a mutinous dog of a salt that won't.

Anyone with a little imagination could work this up into the ideal transport scheme. What you need is a sailing ship, with its computer, to start off system. With heading information and meteorological forecasts, and maybe a maintenance ship, with its computer, to set everything up automatically to catch any fish in any stretch of water or whatever.

Sailors, it seems, are in for a pretty hectic time. Simply isn't cricket, at all.

Scots who ha'e...

I have culminated in the past over electronics being used for trivial purposes when greater needs go unrecognized. It is gratifying, therefore, to see a genuine requirement which is capable of being fulfilled, simply and at little cost, with aim of giving a group of citizens a bit of peace and quiet.

One of my colleagues recently received a call from someone in a Scottish village, whose sleepy charm is currently being shattered regularly by a Klaxon horn. It appears that the garage owner's telephone operates the horn so he can hear it over the noise of old engines and British Leyland cars disin­

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**PRODUCTS OF THE WORLD'S FOREMOST SPECIALISTS IN ELECTRONIC MODULAR DESIGN**

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>HY50</th>
<th>HY55</th>
<th>HY55</th>
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<tr>
<td>Model</td>
<td>HY30</td>
<td>HY50</td>
<td>HY120</td>
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<tr>
<td>Input Power</td>
<td>15W into 8Ω</td>
<td>30W into 8Ω</td>
<td>60W into 8Ω</td>
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<td>Output Power</td>
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<td>Voltage</td>
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<tr>
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<td>155</td>
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<tr>
<td>Price</td>
<td>£6.34 + 95p</td>
<td>£7.24 + 95p</td>
<td>£15.24 + 95p</td>
</tr>
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</table>

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**PERFORMANCE MODULAR UNITS**

**HY5 PRE-AMPLIFIER**

The HY5 pre-amp is compatible with all I.L.P. amplifiers and P.S.U.'s. It is contained within a single pack 50 x 40 x 15 mm, and provides multifunction equalisation for Magnetic/ Ceramic/Tuner/Mix and Aux (Tape) inputs, all with high overload margins. Active tone control circuits: 500 mV out, Distortion at 1kHz=0.01%. Special strips are provided for connecting external pots and switching systems as required. Two HY5's connect easily in stereo. With easy to follow instructions.

**THE POWER AMPLIFIERS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Output Power</th>
<th>Distortion Typical at 1KHz</th>
<th>Minimum Signal</th>
<th>Power Supply Voltage</th>
<th>Size in mm</th>
<th>Weight in gms</th>
<th>Price or V.A.T.</th>
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<td>15W into 8Ω</td>
<td>200W</td>
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<td>HY50</td>
<td>30W into 8Ω</td>
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<tr>
<td>HY120</td>
<td>60W into 8Ω</td>
<td>500W</td>
<td>0.01%</td>
<td>100dB</td>
<td>114x50x25</td>
<td>155</td>
<td>£15.24 + 95p</td>
</tr>
<tr>
<td>HY200</td>
<td>120W into 8Ω</td>
<td>600W</td>
<td>0.01%</td>
<td>100dB</td>
<td>114x50x25</td>
<td>155</td>
<td>£18.44 + 95p</td>
</tr>
<tr>
<td>HY400</td>
<td>240W into 8Ω</td>
<td>1000W</td>
<td>0.01%</td>
<td>100dB</td>
<td>114x100x25</td>
<td>155</td>
<td>£27.88 + 95p</td>
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**THE POWER SUPPLY UNITS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Input</th>
<th>Distortion</th>
<th>Minimum</th>
<th>Power Supply Voltage</th>
<th>Size in mm</th>
<th>Weight in gms</th>
<th>Price or V.A.T.</th>
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<tbody>
<tr>
<td>PSU 30</td>
<td>15V</td>
<td>0.05%</td>
<td>0.02%</td>
<td>90V</td>
<td>114x50x25</td>
<td>155</td>
<td>£4.64 + 74p</td>
</tr>
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<td>PSU 35</td>
<td>15V</td>
<td>0.05%</td>
<td>0.02%</td>
<td>90V</td>
<td>114x50x25</td>
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<td>£4.64 + 74p</td>
</tr>
<tr>
<td>PSU 50</td>
<td>15V</td>
<td>0.05%</td>
<td>0.02%</td>
<td>90V</td>
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<td>155</td>
<td>£4.64 + 74p</td>
</tr>
<tr>
<td>PSU 70</td>
<td>15V</td>
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<td>0.02%</td>
<td>90V</td>
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<td>PSU 90</td>
<td>15V</td>
<td>0.05%</td>
<td>0.02%</td>
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<td>155</td>
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<td>PSU 180</td>
<td>15V</td>
<td>0.05%</td>
<td>0.02%</td>
<td>90V</td>
<td>114x100x25</td>
<td>155</td>
<td>£4.64 + 74p</td>
</tr>
</tbody>
</table>

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**and staying there**

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**ADDRESS**

**Signature**
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The PM 2517 has set the standard and the pace in Europe for hand-held digital multimeters and still it remains in a class of its own. Remember, its many important features include full four digits, so on mains voltage readings, for example, you might get 240.3 instead of the 240, which a 3½ digit meter would read.

Some other PM 2517 plus points:

- LED or LCD display
- True RMS readings of AC voltage and current
- Auto-ranging with manual override
- Optional accessories include temperature and data hold probes

Radio inquiry number 220

The PM 3207 - Super Scope - is a tough, general purpose oscilloscope which offers at a low price the quality and technology you expect from Philips Test and Measuring Instruments.

PATTERN FOR THE FUTURE

The PM 5519 colour TV pattern generator is already a widely used instrument. As a major manufacturer of video cassette recorders and colour television receivers, and the company which has developed the world's most advanced video disc system - Philips have carefully selected the best patterns for aligning and testing these products. With over 30 colour and black and white patterns to choose from is the most versatile pattern generator on the market.

- PM 5519 For black and white systems, available for other TV systems
- RF sync output is suitable for all types of TV and VTRs
- Variable video output (with 1volt fixed positions)
- External video and sound modulation facility
- Composite sync output for triggering includes the line frame and blanking pulses to the local TV standard

Radio inquiry number 223

Test & Measuring Instruments

All Philips audio and video service instruments are also available from Philips Service Centres (for details see end of PM 5120 section). 

Some other Philips audio and video service instruments:

- PM 5323 RF SIGNAL GENERATOR
  - 0-200 MHz in 7 overlapping ranges

Radio inquiry number 222
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The PM 2517 has set the standard and the pace in Europe for hand-held digital multimeters and still it remains in a class of its own. Remember, its many important features include full four digits, so on mains voltage readings, for example, you might get 246.3 instead of the 240, which a 3½ digit meter would read.

Some other PM 2517 plus points:
• LED or LCD display
• True RMS readings of AC voltage and current
• Autoranging with manual override
• Optional accessories include temperature and data hold probes

The PM 3207 - Super Scope is a tough, general purpose oscilloscope which offers at a low price the quality and technology you expect from Philips Test and Measuring Instruments.

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PM 5519

PM 6307 WOOW AND FLUTTER METER

Reader inquiry number 223

PM 6307 wowa and flutter meter

Bands A, B and C

Reader inquiry number 224

Some other Philips audio and video service instruments:

PM 5323 RF SIGNAL GENERATOR

Test & Measuring Instruments

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Whoever sees it, you won’t blush.

With JVC’s help, no non-broadcast video producer need feel embarrassed when a producer from the broadcast side of the fence looks at one of his tapes. That’s because JVC have developed, at an affordable cost, a portable camera which brings truly professional quality to CCTV.

It’s the three-tube CY-8800E. Nothing at anywhere near the price handles colour so faithfully, with such small a registration error, with such excellent signal-to-noise ratio even in poor light.

But you don’t have to believe an advertisement. Ask one of the Bell & Howell Video Centres (addresses opposite) to make an appointment to bring the camera to where you work. This will prove that among its other merits the CY-8800E travels well and is easy to carry around. Then try it on your shoulder and a tripod. This way you’ll discover that its going to serve you just as well in the studio as in the fields.

Finally, when you’ve admired the pictures on the colour monitor, admire the features—features to optimise performance under all conditions. Fully automatic features that help make the CY-8800E so remarkably easy to use (which means you can concentrate on images, not have to apply half your mind to controls).

With the camera and monitor, the Video Centre demonstrator will be bringing (probably wearing) the JVC CR-4400LE. This is the portable, but equally professional, recorder/player for ¾" U-format cassettes. It’s the perfect complement to the CY-8800E (indeed, it was designed to be just that). The CR-4400LE will give you colour playback, direct into a monitor, on site.

It has an automatic assemble editing function and drop-out compensation. Best of all, its designers have made no concessions to quality to achieve portability. It records and plays as well as non-portable U-format equipment (with which, of course, its tapes are fully compatible).

Are all these claims valid? It will cost nothing except a phone call to a Video Centre to discover for yourself that the CY-8800E and CR-4400LE are as good as we think they are.

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This professional quality touch sensitive keyboard has the full ASCII code set of characters available from the main keyboard plus a separate 13 additional characters. The mark III has a 'bleep' facility with volume control and power on light plus a polyester sealed wipe clean surface making the unit particularly suitable for use in hostile environments. The Mark III is supplied complete with instruction manual, operator's guide and edge card with detailed engineering notes. The metal case is of a unique matt grey plastic material used in the aircraft industry.

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- Operates from single +5 or 6.35 Volt supplies
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- Repeat pad. Dimensions 14.64 x 12 inches. 354 x 305mm.

Optional extras (all options are incorporated in the unit)

- A. Serial output compatible to RS 232/V34
- B. Internal Baud Rate Generator. For use with option A and/or C
- C. Contact Rating- 24 Volts
- D. On-board + 5 volt regulator. Requiring DC input of 7 to 12 volts
- E. Earphone socket & +5 Volt power 'on' light
- F. Collector outputs on all data bits
- G. Various other options and modifications plus are possible with this keyboard. Contact STAR DEVICES for further details.

NOTE 1: With option A and/or C the Baud Rate may be externally supplied by the user.

NOTE 2: With option A the +12 volts ±10% may be externally supplied by the user.

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Because of the lack of availability of Mk 4118 RAMs, Nascom Microcomputers are supplying their Nascom 2 without the spare 4118s but with a FREE 16k dynamic RAM board.

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So, for £255 + VAT this is what you get:

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- A2L Microsoft BASIC
- XM 4113/35's
- 1K Video RAM
- 16K WorkSpace
- User RAM
- Manual & software for the 8 x 4118s or 32K EPROMs

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FEBRUARY 1980

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Mark III

£48.50 more 2 year guarantee

This professional quality touch sensitive keyboard has the full ASCII code set of characters available from the main keyboard plus a separate 13 characters. It is ideal for home and business use. The MK III has a "feel" patch with volume control and power on light plus a polyesterured wipe clean surface making the unit particularly suitable for use in hostile environments. The MK III is supplied complete with support base, a separate 16x4 character display, & edge trigger reset switch. The keyboard has a non-protruding key top design for light touch activation.

**FEATURES**

- Positive light touch
- Unique feature is the touch sensitive hexadecimal keypad
- Special feature is the operator which allows fast numeric entry
- The key pad to allow fast numeric entry
- Encoded output with positive hysteresis
- Electronic odd/even parity
- Eliminates the need for a numeric keypad
- Positive light touch
- Unique feature is the touch sensitive hexadecimal keypad
- All character printing is done on the back surface there by ensuring that the units stays looking good even after many millions of switch requiring a light activation pressure. All characters are printed on the back surface there by ensuring that the units stays looking good even after many millions of operations per pad

**DIMENSIONS**

4x3.5x0.125 inches
101.6x88.9x3.2 mm

**PAYMENT**

Please write in full details of your requirements and include a crossed cheque for deposit, to the nearest bank.

**DELIVERY**

Please write in full details of your requirements and include a crossed cheque for deposit, to the nearest bank.

**NOTE**

1. With option A and/or C the baud rate may be externally supplied by the user.

2. With option A the 16 volts ±10% may be externally supplied by the user.
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ELECTRO-TECH COMPONENTS have secured a very large quantity of cassette transport mechanisms, equipped with all the latest improvements, as well as "SANDALO" type: 5.3 micron needle/replica heads, and solenoid-controlled auto-rewind. These were originally designed for JVC/Victor or Japan specification of TANDBERG OF NORWAY, for inclusion in a cassette deck costing over £250. This mechanism alone would normally cost over £50.

**FEATURES:**
- Instantaneous, high-quality, top-loading transport
- "San-Allloy" type B head, which in Japan is specified for TANDBERG OF NORWAY
- Solenoid-driven auto-rewind circuits
- Automatic head cleaning device
- Air-damp "stiff" cassette-reel
- Miniature microphone switch
- Through-bolt type position counter
- Two function key-pan controls: "Record", "Rewind", "Forward".
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- High-gain balanced febyweld with permanent lubrication plugs
- Full specifications for motor, leads, and switches available on request.

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WE REGRET THAT IN THE JANUARY ISSUE OF W.W., DUE TO A TYPOGRAPHICAL ERROR, "THE CASSETTE DECK KIT BELO" WAS INCORRECTLY PRICED AT £15.99. THIS SHOULD HAVE BEEN £35.99. THE COMPONENT PARTS FOR THIS KIT COST OVER £40 IF PURCHASED SEPARATELY.

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Price: £36.95 VAT Inc. plus £1.00 P&P.

Additional: A custom designed case for the kit. This is a fully enclosed,3ospert panel, soft-slip, wood end panels, professional finish.

Price of Case £7.95 VAT Inc. plus £1.00 P&P.

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**DIGITAL MULTIMETERS BRAND NEW HIGH-DEFINITION DMM. NOW AVAILABLE.**

This model incorporates all the features of the 8022A but in addition has...
**JVC-VICTOR HIGH FIDELITY STEREO CASSETTE TRANSPORT MECHANISM**

JVC-VICTOR HIGH FIDELITY STEREO CASSETTE TRANSPORT MECHANISM

**FEATURES:**
- Disappearance, high-quality, top-loading transport
- "S-Audio." 54 type B, PHD.
- Servo-driven, constant-speed, automatic, run-on, and run-on
- Air-damp, "snap" cassette-eject
- Miniature microphone, switch for listening earphones
- Speed/tape-pitch position counter
- 4 function, key-press controls: "Record," "Rewind," "Forward," "Pause." (Step), (Reset), (Pause).
- PCB connections, and cables attached.
- High-quality balanced, Feedback, permanent lubrication spindle.
- "Sen-Alloy," "Close-tolerance, high-quality, top loading." 

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  - **VFL 910** vertical face mechanism and circuit modifications to increase dynamic range. Brand new heads have been altered and improved for better cutting and punching. Includes helpful mother and daughter arrangement used on our *Linsley-Hood Recorders*.
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**LINSLEY-HOOD CASSSETTE RECORDER 2**

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  - Cut but new sets in all styles.
  - £2.50
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  - A large range of cassette heads for domestic, industrial and audio-visual purposes is available from our factory. Experience guarantees the engineering design of the Linsley-Hood mechanism.
  - **HEADING**
  - **SPECIAL PRICES**
  - **COMING SOON**

- **Lenco FFR Cassette Deck**
  - Suitable for use as the basis of a complete cassette recorder. The deck is designed to give a high level of performance and quality. It is provided with a high level of reliability and durability. It has a sturdy construction and is designed to withstand heavy use. It includes all the necessary features needed for a good quality cassette recorder. It is easy to build and is available at an affordable price.

**Photographs**

- **Photographs of Cassette Heads**
  - Photographs of the different cassette heads are available in the article.

**Norton**

- **Norton Oscilloscope**
  - Suitable for use in schools and laboratories. The oscillator is designed to give a high level of performance and quality. It is provided with a high level of reliability and durability. It has a sturdy construction and is designed to withstand heavy use. It includes all the necessary features needed for a good quality oscilloscope. It is easy to build and is available at an affordable price.

- **Norton Transistorized Oscilloscope**
  - Suitable for use in educational and research settings. The oscillator is designed to give a high level of performance and quality. It is provided with a high level of reliability and durability. It has a sturdy construction and is designed to withstand heavy use. It includes all the necessary features needed for a good quality oscilloscope. It is easy to build and is available at an affordable price.

**Radio Components**

- **Radio Components**
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**Hi-Fi Loudspeakers**

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A pre-aligned front end module makes this Wireless World designed polystyrene very simple to use and costs less than half the cost of a comparable radio. It has a wide frequency range, automatic volume tuning and a phase locked loop system designed to give very high frequency stability. It is also very easy to build. The mechanism is the gold line series 5138 with electronic speed control.

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SINGLE BOARD SYNTHESIZER

As featured in Electronics Today International

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LEVER (AUDIO) LTD
Audio and Electronic Equipment Manufacturers

LOUDSPEAKER DESIGNER

Experienced in the design and manufacture of loudspeaker systems. The applicant must have had several years experience in the industry and be familiar with the design of driver units.

We are an established expanding Company with 90% of our business over twenty different countries.

An exciting opportunity exists for someone with a practical outlook to see the product of their endeavours.

Salary is negotiable, subject to experience.

Apply in writing with a brief c.v. to the Managing Director, 29 Heathfield, Stacey Bushes, Milton Keynes, Buckinghamshire.

ELECTRONICS/CONTROL ENGINEER

Senior Mechanical Design Engineer

electronics technician

UNIVERSITY TRAINED TO JOIN OUR R & D TEAM WORKING IN MEDICAL REHABILITATION ENGINEERING

Stimulating and rewarding work with excellent pay offered by a long-established Company specialising in the development and supply of Artificial Limbs and Aids for the disabled.

Senior Mechanical Engineer:

Experience in bio-mechanical engineering, light engineering or aerospace design, preferably with experience of electronic-mechanical or plastics design work.

Responsible for design and project management from concept to manufacture on lightweight mechanism, limb frame and motorised mechanisms.

Electronics/Control Engineer:

To be responsible for all product development and liaison with sub-contractors.

Experience in design of low power, low noise analogue is essential. Familiarity with digital and electronic systems would be advantageous.

Electronics Technician:

Experience of development of proprietary electronic circuit boards. The range of work is varied and the ability to work from initial design drawings, in close liaison with an engineer and with the minimum supervision, is essential.

Applicants for the senior posts should possess a Degree or equivalent or have a proven record of achievement.

written applications/telephone calls to Mr. H. Brentley, Head of Technical Services, Rediffusion Consumer Electronics Ltd., Fuller Way South, Chessington, Surrey. KT9 1JU.

Telephone: 01 397 6311

Classified Advertisement

DISPLAYED APPOINTMENTS VACANT: £10.00 per single col. centimetre (min. 3cm).

Design & Development Engineers

Are you seeking an opportunity to work on sophisticated test gear employing the latest analogue and digital techniques?

If so, join Rediffusion and work on a number of exciting projects associated with the design and development of equipment for production line testing of our future colour TV receivers.

Effective testing plays an important part in ensuring that the finished product reaches the high quality levels necessary for success during the 1980's. To increase the scope and flexibility of our testing, new equipment will be microprocessor controlled. Even if you only have limited knowledge of digital techniques this opportunity will enable you to learn the mysteries of microprocessors and their application to testing complex electronic sub-assemblies.

Applications are invited from engineers with a creative ability to work in a congenial and stimulating environment at our Engineering Centre at Chessington, Surrey. We have vacancies at senior and intermediate levels offering opportunities for career advancement. Salaries are obviously commensurate with qualifications and experience, but will be extremely attractive to those engineers whose test equipment background is such that they can make a significant contribution to the performance of our test gear team.

The usual big company benefits, such as pension scheme, free life insurance, 4 weeks holiday with choice of leave period, medical facilities and assistance with relocation expenses are offered for these posts.

If you are interested in these challenging positions and would like more details or wish to discuss the matter in depth, please write or telephone Mr. H. Brentley, Head of Technical Services, Rediffusion Consumer Electronics Ltd., Fuller Way South, Chessington, Surrey. KT9 1JU.

Telephone: 01 397 6311

Appointments

Advertisements accepted up to 12 noon Friday, 1st March issue, subject to space being available.

Pye TVT-The challenge of world leadership in a unique city

Pye TVT is a world leader in the development, production and marketing of professional broadcast equipment. We export 90% of our production and our sales have grown rapidly in the last five years, with some notable recent successes. We are situated in Cambridge and have been closely associated with its commercial and cultural activities for many years. There are good schools, houses, buildings and large, green, open spaces. We are only 65 minutes away from London and an hour or so from the coast.

We need enthusiastic electronic engineers to work in the following areas:

Customer Service Engineering

We are looking for an enthusiastic and well motivated engineer who is able to work (after equipment training) on complex broadcast equipment with the minimum of supervision. The work involves the investigation and correction of technical problems arising on equipment, including cameras, intercom and vision mixers, both in Cambridge and in the field. The job also includes customer liaison, worldwide travel and a very high level of job responsibility. It would ideally suit someone looking for variety and a strong element of problem solving.

Studio Installation

This is another position that offers the applicant the opportunity of an independent and exciting job, coupled with the responsibility of a highly technical and important role. It involves the installation and commissioning of our studios and associated equipment worldwide. This equipment includes a variety of TV cameras, the latest video tape recorders, outside broadcast vans and sound studios. The job would probably suit a young engineer who wishes to gain a greater knowledge of TV systems.

Test Engineering

This opening is for an engineer to work with transmitter co-axial equipment. The overall purpose of the job is to test and design a broad range of coax combining and switching equipment. We're looking for someone who is able to operate independently and work to schedules, with a strong background of practical work in co-axial lines, waveguide or microstrip.

Quality Assurance

Our Quality Department plays an integral part in a complex, technical, yet highly commercial environment, auditing the safety and performance of our equipment for adequate quality levels. Our reputation depends on their judgment, expertise and integrity.

We are either looking for a young graduate in electronic engineering, who has gained 2 or 3 years experience in industry, or someone with a good background in electronic quality assurance, who qualifies for membership of I.E.Q.A. Our industry is being revolutionised by the advent of computers and the person we are looking for must be able to cope with these changes. He or she will also be involved, from the point of view, in the design and development of new equipment, as well as being concerned with the production process.

We are offering generous relocation expenses, very good salaries and excellent working conditions for all of these positions. Further information or application forms, please contact David Barnicoat on Cambridge (0223) 45115.

Electronics/Control Engineer

Senior Mechanical Design Engineer

ELECTRONICS/CONTROL ENGINEER

Senior Mechanical Design Engineer

SOMEONE TO JOIN OUR R & D TEAM WORKING IN MEDICAL REHABILITATION ENGINEERING

Stimulating and rewarding work with excellent pay offered by a long-established Company specialising in the development and supply of Artificial Limbs and Aids for the disabled.

Senior Mechanical Engineer:

Experience in bio-mechanical engineering, light engineering or aerospace design, preferably with experience of electronic-mechanical or plastics design work.

Responsible for design and project management from concept to manufacture on lightweight mechanism, limb frame and motorised mechanisms.

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To be responsible for all product development and liaison with sub-contractors.

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Applicants for the senior posts should possess a Degree or equivalent or have a proven record of achievement.

Written applications/telephone calls to Mr. H. Brentley, Head of Technical Services, Rediffusion Consumer Electronics Ltd., Fuller Way South, Chessington, Surrey. KT9 1JU.

Telephone: 01 397 6311

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Line advertisements (run on: £1.50 per line, minimum three lines.

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Phone: Neil McDonald on 01-281 8508

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**Design & Development Engineers**

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If so, join Rediffusion and work on a number of exciting projects associated with the design and development of equipment for production line testing of our future colour TV receivers.

Effective testing plays an important part in ensuring that the finished product reaches the high quality levels necessary for success during the 1980s. To increase the scope and flexibility of our testing, new equipment will be microprocessor controlled. Even if you only have limited knowledge of digital techniques, this opportunity will enable you to learn the mysteries of microprocessors and their application to testing complex electronic sub-assemblies.

Applications are invited from engineers with a creative ability to work in a congenial and stimulating environment at our Engineering Centre at Cheshunt, Herts. We have vacancies at senior and intermediate levels offering opportunities for career advancement. Salaries are obviously commensurate with qualifications and experience, but will be extremely attractive to those engineers whose test equipment background is such that they can make a significant contribution to the performance of our test gear teams.

Career advancement is available to members of the design, engineering and production departments. Benefits, such as pension and life insurance, are offered for these posts.

If you are interested in these challenging positions and would like more details, write or telephone:

Mr. H. Brentley, Head of Technical Services, Rediffusion Consumer Electronics Ltd., Fullers Way South, Cheshunt, Essex. Tel. K9 1911.

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**Senior Mechanical Design Engineer**

Electronics/Control Engineer

Senior Mechanical Design Engineer

Electronics Technician

*LEVER (AUDIO) LTD*

Audio and Electronic Equipment Manufacturers

**LOUDSPEAKER DESIGNER**

Experienced in the design and manufacture of loudspeaker systems. The applicant must have had several years experience in the industry and be familiar with the design of driver units.

We are an established expanding Company with 90% export turnover to twenty different countries.

An exciting opportunity exists for someone with a practical outlook to see the product of their endeavours.

Salary is negotiable, subject to experience.

Apply in writing with a brief c.v. to The Managing Director, 29 Heathfield, Stacey Bushes, Milton Keynes, Buckinghamshire. MK12 6HR.
Radio Technicians
Work in Communications R&D and add to your skills

At the Government Communications Headquarters we carry out research and development in radio communications and their security, including related computer applications. Practically every type of system is under investigation, including long-range radio, satellite, microwave and telephony.

Your job as a Radio Technician will concern you in developing, constructing, installing, commissioning, testing, and maintaining our equipment. In performing these tasks you will become familiar with a wide range of processing equipment in the audio to microwave range, involving modern logic techniques, microprocessors and computer systems. Such work will take you to the frontiers of technology on a broad front and widen your area of expertise—positive career assets whatever the future brings. In the rapidly expanding field of digital communications, valuable experience in modern logic and software techniques will be gained.

Training is comprehensive: special courses, both in-house and with manufacturers, will develop particular aspects of your knowledge and you will be encouraged to take advantage of appropriate day release facilities.

You could travel—we are based in Cheltenham, but we have other centres in the UK, most of which, like Cheltenham, are situated in environmentally attractive locations. All our centres require radio technicians and can call for others to make working visits. There will also be some opportunities for short trips abroad, or for longer periods of service overseas.

You should be at least 19 years of age, hold or expect to obtain shortly the City and Guilds Telecommunications Technician Certificate Part 1 (Intermediate), or its equivalent, and have a sound knowledge of the principles of telecommunication and radio, together with experience of maintenance and the use of test equipment. If you are, or have been in HM Forces your service trade may allow us to dispense with the need for formal qualifications.

Registered disabled people may be considered.

Pay scales for Radio Technicians start at £3900 per annum, rising to £5530, and promotion will put you on the road to posts carrying substantially more, there are also opportunities for overtime and on-call work, paying good rates.

Get full details from our Recruitment Officer, Robby Robinson, on
Cheltenham 0342 214 999 Ext. 2269, or write to him at GCHQ, Oakley, Priors Road, Cheltenham, Glos GL52 5AJ. We will invite suitable applicants (expenses paid) for interview at Cheltenham.

...and here...
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and add to your skills

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Pay scales for Radio Technicians start at £9,000 per annum, rising to £15,000, and promotion will put you on the road to posts carrying substantially more, there are also opportunities for overtime and on-call work, paying good rates.

Get full details from our Recruitment Office, Mr. Derek Oliver, Cheltenham (0342) 2149, or write to him at GCHQ, Oakley, Priors Road, Cheltenham, GL52 5AJ. We will invite suitable applicants (expenses paid) for interview at Cheltenham.

Deputy Supervisor
Government Communications Headquarters
Oakley, Priors Road, Cheltenham GL52 5AJ

GCHQ

Recruitment Office
Government Communications Headquarters
Oakley, Priors Road, Cheltenham GL52 5AJ

Electronics Engineers

They are also responsible for the technical standards of our broadcasts and for the maintenance of our technical equipment. You should have a degree in Electrical or Electronic Engineering, Applied Physics or a relevant science subject, an HNC/HND or higher TEC certificate or diploma, or a C&G Full Technological Certificate in Telecommunications or Electronics (Course 271 or 281), a strong interest in broadcasting, and normal colour vision and hearing.

They are based mainly in the West London area, and carry such benefits as a pension scheme, social clubs and staff restaurants.

Opportunities for personal development through training and promotion are good.

If you are interested please complete the coupon below and then return the whole advertisement to:

The Engineering Recruitment Officer, BBC, Broadcasting House, London W1A 1AA, quoting reference no.
79 E 456/WW.

Name
Mr/Mrs/Miss Address

Tel. No.

Engineering Recruitment Officer, BBC, Broadcasting House, London W1A 1AA.

Salaries, to be reviewed in April, range from £5760 to £6260 including shift allowances and the jobs, which are based mainly in the West London area, carry such benefits as a pension scheme, social clubs and staff restaurants.

Opportunities for personal development through training and promotion are good.

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The Engineering Recruitment Officer, BBC, Broadcasting House, London W1A 1AA, quoting reference no.
79 E 456/WW.

Name
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Engineering Recruitment Officer, BBC, Broadcasting House, London W1A 1AA.
We are a leading German electronics company in Munich. Our reputation is based on the manufacture of high-precision measuring instruments and communications equipment.

Our German translators need the help of a British graduate.

Electronics Engineer

qualified to give the master touch to their English translations of data sheets, catalogues and manuals on electronic measuring and communications equipment.

His/her knowledge of German should be such that after about six months he/she can also do translations.

The applicants should be willing to work for some years in our translation department in Munich where he/she will find a friendly atmosphere and British fellow-workers.

Starting salary will be in the region of £5,000 to £10,000 p.a., holiday 26-29 days depending on age. Along with the usual benefits of a large company we offer flexitime, subsidised canteen and travel costs for those living far from the office.

If you are interested, please send your application together with full curriculum vitae to ROHDE & SCHWARZ, Personnelabteilung P176.

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Salary: Excellent salary.

Young Entrepreneurial Engineers to join a multidisciplinary company with interests in: radio-controlled target systems, range finders, aerospace products, etc. Good microprocessor hardware / software experience. Wills. Salary good.

Microprocessor Hardware/Software Engineers to design systems and supply modules for a very wide range of applications. Experience in either: M6800, R.P.A. 1802; GM 1650 or INTEL 8085.

INTEL Microprocessor Engineers for message switching systems based on a microcomputer and the INTEL 8080/85/86. Surrey — to £8,000.

Digital Engineers for exceptionally advanced technology associated with an MPU control system for shipborne aircar and early warning radar. To £8,000. Berks.

Computer Engineers for either technical support, Field service, permanent site or systems test. Vacancies throughout the U.K.

For further details, please contact: \( \text{(01-741) 4011} \)

Chief Electronics Technician II

We are seeking a person with/hold an HNC/Electronics or equivalent qualification. The post holder (male/female) will be responsible to the District Engineer for the maintenance of very sophisticated Electronic and Bio Medical Equipment within this Health District. As well as day-to-day maintenance the operation and extension of a planned preventive maintenance scheme is also required.

A pleasant manner and the ability to advise and instruct operators on safety, and technical use of equipment is an important aspect of the post.

Salary: £6545-£7316 p.a. ind.

Job description and application form available from the District Personnel Department, Lewisham Hospital, High Street, SE13 6LY. Tel: 01-880 4311 ext. 346. Closing date 2 February, 1980.

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Health District

Radio Communications Engineers and Software Designers

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To join our expanding RAD Laboratories covering a wide range of R.F. spectrum, from L.F. to V.H.F. Engineers include transmitters and receivers for marine- and land-based use, radio navids and radio monitoring remote computer-controlled systems.

Electronics Engineers should have experience in transmitter or receiver design, analogue or digital circuit design, microprocessor applications. Software Designers should be experienced Programmers with an interest in control, signal processing or navigational software.

Attractive salaries are complemented by excellent prospects and generous benefits.

Contact: David Bird, Rediff Telecommunications Limited, Broadmill Road, Wandsworth, London, S.W.18. Phone: 01-874 7881 (reverse charged).
We are a leading German electronics company in Munich. Our reputation is based on the manufacture of high-precision measuring instruments and communications equipment. Our German translators need the help of a British graduate.

### Electronics Engineer

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If you are interested, please send your application together with full curriculum vitae to ROHDE & SCHWARZ, Personalabteilung P176.

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CURRENT VACANCIES INCLUDE:

**Chief Control Engineer** for multi-million pound company engaged in the manufacture of roof tiles. Managerial ability as important as the ability to create a new generation of process automation products. Surrey. Excellent salary.

Young Entrepreneurs Engineers to join a multidisciplinary company with interests in: radio-controlled target systems, range finders, aerospace products, etc. Good microprocessor hardware / software experience. Wals. Salary good.

Microprocessor Hardware/Software Engineers to design systems and supply modules for a very wide range of applications. Experience in either: NMIB0, R.P.A. 1802. GM 1650 or INTEL 8085. Berks. Salary — 'What's worth.'

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Job description and application form available from the District Personnel Department, Lewisham Hospital, High Broom, SE13 6LL. Tel: 01-840 4311 ext. 364.

Closing date 8 February, 1980.

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**Without hitting the first hurdle**

Our clients would like to meet Sales Engineers in any of the following categories - please tick where appropriate:

- **Test Engineers**
- **Calibration Engineers**

Name: ____________________________

Address: ____________________________

Lansdowne Appointments Register, Design House, The Mall, London W5 5LS

Tel: 01-579 2282 (24 hour answering service)
Field Engineers
Oil-Well Surveys — worldwide
Selenograpk is an international leader in seismic exploration for oil and gas throughout the world.

We have openings for hardy, single people, under 28, qualified in Electronics to at least HNC level, to train as Oil-Well Seismographs. Applicants must be prepared to work in all weathers on world-wide assignments at short notice. Please do not apply unless you meet these qualifications.

The job involves responsibility for the operation and servicing of electronic instrumentation and for the production of seismic information from drilled wells. You will receive specialist training at our headquarters near Bromley, Kent, and you may be based there whilst working in the UK.

We offer competitive salaries, attractive conditions of employment and leave entitlement plus generous allowances and free messing when on operations.

Please write or telephone for an application form quoting ref. GMC. Applicants Manager, Selenograpk Service (England) Limited, Didcot, Westerham Road, Kenton, Kent BR2 9HD. Tel: Farnborough Kent 5935.

Air Traffic Engineers
The Civil Aviation Authority has vacancies for men and women as Air Traffic Engineers Grade 2 in its Telecommunications Division offering a variety of work on a wide range of electronic systems and specialised equipment.

Air Traffic Engineers Grade 2 are involved in the installation and maintenance of radio, radar, air navigational and landing aids, and data processing systems. Staff are employed at Air Traffic Control Centres and some Civil Airports and other locations throughout the U.K. but at present most of the vacancies are likely to be in the South of England with some in Scotland and Shetland.

Qualifications and Experience
You should be at least 20 years of age and have obtained either the ONC (ENG) with an electronic bias or C & G Telecommunications Technician T3 Certificate or T.E.C. Telecommunications Certificate with Radio options or other similar technical qualifications.

Salary
You should also have had skilled working experience in radio, radar or data processing.

Salary
Salaries are on the incremental scale £4777-£7472. Posts in the London area attract an additional allowance (Inner London £831 — Outer London £347) Grade 1 posts (maximum salary £8880) are normally filled by promotion from Grade 2.

For full details and an application form, complete and send the coupon to: CAA Tels Staff Management (ATE2), Room K206, CAA House, 45/59 Kingsway, London WC2B 6TE.

Post Office Telecommunications

Civil Aviation Authority
Appointments

the Long Arm of the Law needs its voice...

Donent Police Forces depend upon its communications system to direct its varied operations, from crime fighting to law enforcement, so its voice must be heard.

Assistant Communications Officer

It will be your job to see that it is, by assuring the Communications Officer in the maintenance of an efficient communications systems throughout the area. This will entail you in inspecting all Force owned equipment concerned with the computer based command and control systems and in ensuring that all Force personnel in its use. You will also be expected to supervise the installation of radio and teleprinter equipment, emergency tables and telephone links and oversee the maintenance, supervision and installation of specialist electronic and electrical apparatus. This is a highly responsible and specialised post and whilst we realise that it will be difficult for someone without our exact requirements, we would prefer you to have extensive S.P.O. experience and technical training qualifications, such as a Radio Officer's Certificate. Civil Aviation Standard with relevant experience on the most modern communications equipment.

We would be interested in hearing from you when you have completed your service with the Force and we will give your training in areas that you lack experience.

We offer excellent conditions, a salary of £5,087 inclusive, an essential Car User Allowance and a generous assistance car purchase scheme.

If you'd like to find our more and help to grow the force, please contact the Chief Constable, Police Headquarters, Wiltshire, tel. Binlci Abbey (0929) 462727, ext. 254 for further details and an application form.

Closing date for completed applications: 22nd February, 1980.

PROJECT ENGINEERS

We need two Engineers to work in our Engineering Projects group and assist us with a major programme of expansion and re-equipping.

Duties within this small group include the design and construction of specialised equipment, the appraisal and acceptance testing of new equipment and the planning of system installations.

A thorough knowledge of digital techniques or modern television colour cameras would be an advantage.

Applicants should ideally be qualified to at least HND or equivalent standard and have had several years relevant training and experience in television broadcasting.

Starting salary up to £7,500 depending on qualifications and experience.

Applications in writing to:
Personnel Executive Yorkshire Television Ltd
The Television Centre, Leeds LS1 1JS

YORKSHIRE TELEVISION

Member of the Trident Television Group

GEC Medical Equipment Limited

East Lane, Wembley, Middlesex

We are the largest British manufacturer of diagnostic medical equipment and wish to expand our research, development and design teams currently engaged in X-ray and Ultrasound fields. In particular we wish to recruit:

Electronic Development Engineers

Designers

Draughtsmen

Technical Illustrators

Test Engineers & Technicians

Persons, male or female, who have experience in any of the above and are seeking a career move are invited to contact our Personnel Manager to arrange initial, informal interviews. Tel: 01-904 1289.

We offer:

• Good remuneration
• Extensive technical training
• Experience and a high standard
• A generous assistance car purchase scheme.

Closing date for completed applications: 22nd February, 1980.

Electronics in the Leisure Industry

MAM Inn Play Limited is a major national supplier of fruit machines, juke boxes, background music and video games. The technology of our industry is undergoing a rapid change and this has created the need for a small number of Senior Engineers, to be based at our service department throughout the U.K. and who will be responsible for special project, repairs, training and the co-ordination of new projects.

Applicants, qualified at O/D or HND level, equivalent, should have practical experience in a micro-computer environment. Experience as an instructor will be an advantage.

These are career appointments which offer attractive salaries and conditions for private and business use.

Telephone: 01-944 7214

Our Medical Division is a world leader in the design and manufacture of medical and scientific equipment. Currently we are seeking renewal contract specialists to provide a comprehensive service to our medical and scientific clients.

We offer:

• Excellent remuneration
• Extensive training opportunities
• Relaxed working environment
• Comprehensive pension and benefit package

Closing date for completed applications: 22nd February, 1980.

HNC Level Engineers - (Electrical or Electronic)

Train for the future as a Broadcast Transmission Engineer

Through our network of over 500 transmission stations the IBA is responsible for the transmission of all Independent Television and Local Radio services. With a steadily increasing number of stations, the preparations for the fourth television channel and second local radio stations now underway we are taking on increased responsibilities.

We take great pride in the fact that our system is one of the best in the world and great importance is placed on maintaining the efficiency of the service. To do this we have teams of highly trained and experienced engineers all over the country.

Set promotions and continued expansion have created a number of opportunities for HNC or H.L.C. or equivalent level engineers (male or female) to train for a challenging future. Our carefully devised training programme, which will commence this summer, can lead to a recognised Diploma and combines theoretical study and practical training. This comprehensive training is a step beyond traditional learning and gives a grounding in broadcast engineering that is second to none. Naturally course fees, accommodation and meals will be paid during the course. A full driving licence is required, but if you do not already have one, we will assist you by arranging and paying for instruction.

On the satisfactory completion of the training programme, your salary will be £5,800 per annum and then rise annually to £7,200 per annum, with further promotion to £8,327 per annum. (During the training period you will receive a salary of up to £4,700 per annum, depending upon experience.)

At higher levels it will be up to you to demonstrate your ability as promotions are based on internal competition – all of our Regional engineering managers started their careers at transmitting stations.

Employment benefits include Free Life Assurance and Personal Accident Scheme, a Contributory Pension Scheme, generous relocation expenses and subsidised mortgage facilities.

Please write or telephone Mike Wright for a fully illustrated information package and application form, at IBA, Crawley Court, Winchester, Hampshire SO21 2QA. Telephone: Winchester 822374.

SMALL EXPANDING COMPANY requires experienced electronic engineers for the design, development, production and testing of electronic equipment. Full training will be given to the right candidate. Experience will be required and a good practical, family orientated family. MC-TECH ELECTRONICS, Walton, tel. 01-688 0443.

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FIELD SERVICE

To report for work choice of field stations, telephone Ring 01-461 7714 Est. 300, 24 hours.

LOGEX

ELECTRONICS RECRUITMENT SERVICE

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www.americanradiohistory.com
**Appointments**

WIRELESS WORLD, FEBRUARY 1980

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### GEC Medical Equipment Limited

**East Lane, Wembley, Middlesex**

We are the largest British manufacturer of diagnostic medical equipment and wish to expand our Research, Development and Design teams, all engaged in X-ray and Ultrasound fields. In particular we wish to recruit:

**Electronic Development Engineers**

**Designers**

**Draughtsmen**

**Technical Illustrators**

**Test Engineers & Technicians**

Persons, male or female, who have experience in any of the above and are seeking a career move are invited to contact our Personnel Manager at our Initial, informal interviews. Tel: 01-904 1298.

Closing date for completed applications: 22nd February, 1980.

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### Electronics in the Leisure Industry

**MAM Inn Play Limited** is a major national supplier of fruit machines, juke boxes, background music and video games. The technology of our industry is undergoing a rapid change and this has created the need for a small number of Senior Engineers, to be based at our service departments throughout the U.K. and who will be responsible for special workshop repairs, training and the co-ordination of new projects.

Applicants, qualified at OND/HND level or equivalent, should have practical experience in a micro-processor environment. Experience as an instructor will be an advantage.

These are career appointments which offer attractive salaries and career paths for private and public companies.

**Telephone in confidence:** Brian Withers, Group Technical Manager, MAM Inn Play Limited, Theale, Berks. Telephone: Reading (0734) 302621.

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### Project Engineers

We need two Engineers to work in our Engineering Projects group and assist us with a major programme of expansion and re-equipment.

Duties within this small group include the design and construction of specialised equipment, the appraisal and acceptance testing of new equipment and the planning of system installations.

A thorough knowledge of digital techniques or modern television colour cameras would be an advantage.

Applicants should ideally be qualified to at least HND or equivalent standard and have had several years relevant training and experience in television broadcasting.

Starting salary up to £7,000 depending on qualifications and experience.

Applications in writing to:

Personal Executive Yorkshire Television Ltd

The Television Centre, Leeds LS1 1JS

YORKSHIRE TELEVISION

Member of the Trident Television Group

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Internal promotions and continued expansion have created a number of opportunities for H.N.C. or H.T.C. or equivalent level engineers (male or female) to train for a challenging future. Our carefully devised training programme, which will commence this summer, can lead to a recognised Diploma and combines theoretical study and practical training. This comprehensive training is a step beyond traditional learning and gives a grounding in broadcast engineering that is second to none. Naturally, course fees, accommodation and meals will be paid during the course. A full driving licence is required, but if you do not already have one, we will assist you by arranging and paying for instruction.

On the satisfactory completion of the training programme, your salary will be £6,800 per annum and then rise annually to £7,280 per annum, with further progression to £8,232 per annum. (During the training period you will receive a salary of at least £4,700 per annum, depending upon experience.) At higher levels it will be up to you to demonstrate your ability as promotions are based on internal competition – all of our Regional engineering managers started their careers at transmitting stations.

Employment benefits include Free Life Assurance and Personal Accident Schemes, a Contributory Pension Scheme, generous relocation expenses and subsidised mortgage facilities.

Please write to specialist Mike Wright for a fully illustrated information package and application form, at IBA, Crawley Court, Winchester, Hampshire SO21 2QA. Telephone: Winchester 822374.

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**Independent Broadcasting Authority**

01920

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**FEBRUARY 1980**
**BRIGHTON POLYTECHNIC**

**LEARNING RESOURCES**

**THREE VACANT POSTS**

**GOOD SALARIESseyereD**

**ELECTRONIC ENGINEER**

To work with a team of experienced engineers and technicians developing colour television and other audio visual facilities throughout the Polytchnic. The systems developments range from simple sound and TV production equipment to video recording and editing to near broadcast standards.

The Electronic Engineer will apply digital and analogue techniques to develop and install new equipment, upgrade existing facilities and assist with its maintenance. Formal training to Degree or equivalent standard will be expected but proven ability and experience of practical design and construction (preferably including television) will be rated even more highly.

**VIDEO RECORDING AND STUDIO ENGINEER**

To lead the work of staff in a newly equipped recording and editing area (using state of the art techniques, including Plumbicon colour technique and a wide range of VTR’s - some to broadcast standards) and to give help and advice to the engineering department of the systems area. Also to supervise the two adjoining studios, containing systems with colour correction and multi-track sound.

Operational experience of sound and colour video systems (preferably in a broadcasting or educational institution) and a degree or equivalent qualification are desirable.

**VTR ENGINEER**

Unique opportunity to work in the forefront of helical vtr developments; using new 1” high density helical and consumer formats, required a qualified engineer to work to broadcast standards but interested in working with all new formats.

Further details and application forms from the Personal Officer, Brighton Polytechnic, Moulsecoomb, Brighton BN2 4AT. Tel. 0273 693655 Extension 2536. Closing date 30th January, 1980.

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**ELECTRONICS JOURNALISM**

**FEATURES EDITOR**

Electron, the weekly technical magazine for designers and managers in electronics, requires a

We’re looking for someone with a good all-round knowledge to commission features articles. Experience of technical writing or publishing, although preferred, is not essential, but a good command of the English language is important.

Salary: £6464 plus £210 reading allowance.

Telephone: Barrie Nicholson on 0261 9111 extension 257 for an application form

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**Brunei**

**Training Officer (Teleprinter)**

**Department of Telecommunications**

**Tax free salary up to £8,100**

As part of its continuing expansion and improvement programme the Department of Telecommunications requires a Training Officer (Teleprinter).

Canditates should be over 25 years of age and have at least ten years' experience in Telecommunications with a minimum of five years in a supervisory capacity. They must have a sound knowledge of teleprinter servicing and an operational understanding of either the CREED 444 or SIEMENS 1100 terminals.

The successful candidate will be responsible for the training of local staff both formally and in the field on all aspects of the discipline.

The tax free salaries include a special allowance and attract a 25% gratuity.

For full details and application form telephone Anne Eames 01-222 7750 ext.2321 or write quoting reference MT300/WD.

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**COMMUNICATE NORTH**

Development of North Sea installations has increased the need for advanced technology in the field of telecommunications. A number of new production vessels are currently in commission. This area of the business offers challenging opportunities and career opportunities throughout the UK and beyond.

In addition to a number of leading communications companies expanding to meet the needs of its clients within the oil industry, invite applications from suitably qualified persons for the positions outlined below.

**Communications Engineer**

**Gross Salary £9,000 + **

In addition to a varied workload on shore/offshore, responsibility will also include trouble-shooting and installation. The communications engineer will also be responsible for the installation of telecommunications equipment on offshore platforms.

The position requires experience of broadband systems, multiplex and telephone exchanges, HF/SSB/ISB systems, VHF/FM Transceivers, portables and teleprinters. Candidates should hold an HNC or BS in a relevant discipline or an equivalent Forces qualification i.e. Foreman of Signals.

**Communication Technician**

**Gross Salary £7,000 + **

The position is workshop based but provides a varied and interesting workload with a commitment to offshore and field work on an ad hoc basis as and when required. A minimum of 5 years experience in installation and repair of radio and telecommunications equipment, a professional team and in the operation of associated equipment.

Full City and Guilds Telecommunications Technician or equivalent Forces qualifications would be regarded as suitable.

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**Computer Service Engineer**

**Gross Salary £9,000 + **

This is an extremely interesting position for highly qualified engineers who will be working on projects both offshore and onshore. Projects include the installation of telemetry, supervisory and computer aided oil production systems. Engineers should have a broad background in computer and peripheral maintenance and have the potential to develop systems for clients. Applicants should possess an HNC or BS in a relevant discipline and have previous supervisory experience.

Due to the fact that engineers and technicians are required to work both on and offshore it is necessary for them to live in the Aberdeen area.

Please contact Margaret Guthrie at Aberdeen 0224 28921 for an application form.

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**GTS Personnel Services**

29 York Place, Aberdeen. Telephone: (0224) 28921

Employment Agency Licence No. SC 324.

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**PME**

**MANAGEMENT SERVICES LIMITED**

**INTERNATIONAL ACCOUNTANTS**

5 East Parade, Harrogate, North Yorkshire HG1 5LF.

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**SIELECH**

**ELECTRONICS EQUIPMENT LIMITED**

New Industrial Estate, Clydebank Rd, Barony End, Bucks. L4S SAT.

Tel: 0823 980 801 or Barony End (0208) 371211
**Electronics Journalsm**

Electron, the weekly technical magazine for designers and managers in electronics, requires a **Features Editor**

We’re looking for someone with a good all-round knowledge to commission features articles. Experience of technical writing or publishing, although preferred, is not essential, but a good command of the English language is important.

Salary: £6464 plus £210 reading allowance.

**Broadcast Engineer**

**TEST AND SERVICE**

Selsech Equipment Limited is a leading supplier of broadcast equipment and its increasing share of the market requires a major expansion programme involving a move to larger modern premises and employment of additional engineering staff.

The position offered will involve testing and servicing a full range of broadcast products including television, display generation, time code, clock and audio systems, utilising the latest technology.

The successful applicant will probably be qualified to HND level but broadcast related experience is of particular advantage.

The position is based in the company’s new premises at Bourne End, Bucks. Limited travel will be required.

Salary and conditions will be in keeping with the position offered.

In the first instance apply to: D. Craddock, General Manager.
Thames Television
We have a vacancy for a TELECINE ENGINEER
based at our Euston Studios.

This post in the Department of Electronic and Electrical Engineering requires experience in the construction, modification and repair of electronic equipment and knowledge of Telecine operations and how to test them on film. Qualification or equivalent. Salary on application from £3684 per annum (from £5000 per annum, dependent upon experience) to £8434 from 1980. (9985)

Applicants should have five years experience of Telecine repair, maintenance and operation.

Telephone: Mrs. Amery on Leatherhead (03723) 76221
Or apply in writing to: Vermont Research Limited
Cleeve Road, Leatherhead
Surrey KT22 7NB

**CIRCUIT DESIGN ENGINEER**

- Do you want to join a fast growing international company manufacturing sophisticated computer disc and drum systems?
- Do you want involvement, responsibility and job satisfaction?
- Do you prefer discrete component advanced circuit design?
- Do you want to earn £6,000–£7,000?
- The above position is available to further develop our advanced disc systems incorporating high technology servo and data channel electronics.

Telephone: Mrs. Amery on Leatherhead (03723) 76221
Or apply in writing to: Vermont Research Limited
Cleeve Road, Leatherhead
Surrey KT22 7NB

**PERIPHERALS**

**IMPERIAL WAR MUSEUM
LONDON**

**Audio Technician**

The Museum illustrates and records all aspects of the two world wars and all other military operations involving Britain and the Commonwealth since 1914.

This post is in the Department of Sound Records, where the technical operations are based on a Sound Suite incorporating Leema-Rich E200 and Revox tape machines, disc recorders, a New SCM 10/2 mixing desk and accessory facilities. It carries responsibility for regular servicing of all the audio equipment, dubbing operations and training and supervising an assistant to carry out transfer operations. Duties include some location recording, control of public listening facilities, production of programme material for the Museum’s public and educational services and supervising the production of copy tapes.

Candidates should preferably have an ONC, C & G, TEC/SCOTEC or equivalent qualification in Engineering or other relevant subject, but those with special experience will be considered.

All candidates must have an aggregate of at least 8 years’ recognized training (g. apprenticeship) and experience (which may include up to 3 years’ relevant full-time study), and be experienced audio equipment technicians.

Salary starter reviews at £5780 rises to £6330. Non-contributory pension scheme.

For further details and an application form (to be returned by February 5, 1980) write to Civil Service Commission, Alcanon Link, Basingstoke, Hants, RG21 1JS, or ring Alcanon Link, Basingstoke (0256) 68551 (answering service operates outside office hours). Please quote ref: 1/ 6272.

**ELECTRONIC SERVICE ENGINEER**

We are looking for an engineer to take charge of the maintenance of our U.K. computer centre. This position will require good digital electronics background with particular experience in computer peripherals. It will be necessary to travel to the U.S.A. for training courses and liaison with service engineers in our Canadian and North American centres. A company car will be supplied after full training. Our company offer a realistic bonus and free medical schemes.

Salary offered £7,500 p.a. negotiable depending upon experience in computer systems.

Please apply to:

**SIFEL**

GEOPHYSICAL (UK) LTD.

Turriff Building

Great West Road

Brentford

Middlesex

Telephone: (01) 568 3273

**Marconi Instruments**

A GEC MARCONI ELECTRONICS COMPANY

**TEST ENGINEERS**

At senior and intermediate level to work on our range of advanced broadcast television studio products, including colour and monochrome television studio cameras.

Applicants should have an up-to-date knowledge of digital and linear circuit techniques gained from experience working on television studio equipment, radar equipment or similar sophisticated products and qualified to HND or Degree level.

**SYSTEMS ENGINEER**

You would be involved in all stages of product management on the design and building of studio and mobile TV systems and should be prepared for occasional world-wide travel. The appointment requires someone with a background in this type of work, or in the operational side of television with the ability to take charge of people and deal with problems in the field on your own initiative.

Employment benefits include excellent salary, generous holidays, free life and health insurance, pension scheme, subsidised meals and relocation expenses.

Please apply for further details and application forms to Jean Smith at the address given below.

**TELECOMMUNICATIONS ENGINEER**

To work on the development of new broadcast TV studio products. Applicants should have some knowledge of television studio techniques and be qualified to HND or Degree level.

**DEVELOPMENT ENGINEER**

To work on the development of new broadcast TV studio products. Applicants should have some knowledge of television studio techniques and be qualified to HND or Degree level.

**ADVANCED BROADCASTING EQUIMENT**

Link Electronics Limited, North Way, Andover, Hants, SP10 5AJ.

Telephone: (0264) 61345

**WIRELESS WORLD**

FEBRUARY 1980

**WIRELESS WORLD**

FEBRUARY 1980

www.americanradiohistory.com
CIRCUIT DESIGN ENGINEER

* Do you want to join a fast growing international company manufacturing sophisticated computer disc and drum systems?
* Do you want involvement, responsibility and job satisfaction?
* Do you prefer discrete component advanced circuit design?
* Do you want to earn £6,000-£7,000?

The above position is available to further develop our advanced disc systems incorporating high technology servo and data channel electronics.

Telephone: Mrs. Amery on Leatherhead (03723) 76221
Or apply in writing to: Vermont Research Limited
Cleeve Road, Leatherhead
Surrey KT22 7NB

IMPERIAL WAR MUSEUM
LONDON

Audio Technician

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Candidates should preferably have an O.N.C., C.G. TEC/SCOTEC or equivalent qualification in Engineering or other relevant subject, but those with special experience will be considered.

All candidates must have an aggregate of at least 8 years' recognised training in audio engineering and experience (which may include up to 3 years' relevant full-time study), and be experienced audio equipment technicians.

Salary and benefits are negotiable, based on skill and experience.

Return this coupon to: John Podger, Marconi Instruments Limited, FREEPOST, St. Albans, Herts, AL4 4BR, TEL St Albans 56592.
Opportunities for Test Engineers

If you've experience in tester/con controller drives, digital logic techniques, computer systems, or microprocessors, then you could be the test engineer we're looking for.

We need engineers to work on a wide range of electronic control equipment.

Ideally, you will have served an apprenticeship in the electrical industry, and be qualified to NVQ or HNC standard, although experience could well take the place of formal qualifications.

If you're interested, apply to our Personnel Officer on Rugby 5151 or write to him at:

THORN AUTOMATION
P.O. Box 4, Rugby,
Staffordshire, WV 15 1DR

The INNER LONDON EDUCATION AUTHORITY
THE LONDON COLLEGE OF PRINTING
Ceramic and Cattle

TELEVISION TECHNICIAN/ ENGINEER

Candidates should be conversant with 9", 9 1/2" and 10" black and white colour television receivers, as well as all manner of test equipment. Experience in professional broadcasting would be desirable, as well as an interest in experimental video work. The successful candidates will be expected to work as a team in the design and production department, with the production of video equipment, including the design and construction of studio and field equipment. The work will give the opportunity to work with sophisticated studio and field equipment. The working conditions are reasonably good, and fringe benefits are available. A salary of £3700 to £5360 per annum. Apply to the Director of Technical Services or the Personnel Officer at the College. Closing date: 31st January 1980.

The UNIVERSITY OF LEEDS
DEPARTMENT OF CHEMICAL AND POLYMER SCIENCE

CHEMISTRY TECHNOLOGIST

Applications for this post are invited from candidates with a first class honours degree, or equivalent qualification suitable for admission to a Postgraduate Diploma course in Physical Chemistry. Experience in some aspect of solid state chemistry is desirable. The post is expected to lead to a PhD degree. Salary £3700 to £4320 per annum. Postholder to work for a period of 12 months. To start on the first Monday of September 1980. Closing date for applications is 1st July 1980. Apply to Dr. J. A. R. Palmer, Department of Chemistry, University of Leeds, Leeds 2, or to the University of Leeds Personnel Office.

The UNIVERSITY OF LONDON

department of Electronic Engineering

ELECTRONICS TECHNICIAN

Applications are invited for the post of Electronics Technician in the Undergraduate Teaching Department of the Institute of Electronic Engineering of the Polytechnic of the South Bank. The successful candidate will be expected to assist in the practical work, and will require a good knowledge of electrical and electronic principles and practice. There will also be an opportunity for research work. The post is available from 1st August 1980. Salary £3600 to £4200. For further details and application form, please apply to the Head of the Department of Electronic Engineering, Institute of Electronic Engineering of the Polytechnic of the South Bank, 100 Southwark Bridge Road, London SE1 6BZ. (Tel: 01-278 59346; TCS: 278 59346).
Electronics Design Engineers

Rank Research Laboratories are looking for young engineers who are keen to tackle analogue and digital electronic design for signal processing systems and the application of microprocessors. This work will attract engineers with ability in digital and analogue design and keenness to exploit the power of electronics in creating new systems in the fields mentioned.

Good salaries will be offered to suitable candidates and it is a Rank Organization policy to assist professional career development. The company has a contributory pension fund and non-contributory life assurance scheme.

Man and women with a few years R & D experience and a degree or equivalent in electronic engineering or physics are invited to phone or write for an application form to the

Administration Manager, Rank Research Laboratories, P.O. Box 33, Phoenix Works, Great Road, Brentford, Middlesex TW8 5AG. Tel. 01-568 9766, extn. 26.

Opportunities for Test Engineers

If you’ve experience in thyristor control drives, digital logic techniques, computer systems, or microprocessors, then you could be the test engineer we’re looking for.

We need several engineers to work on a wide range of electronic control equipment.

Applications are welcome from both men and women with an OFTEN can serve an apprenticeship in the electrical industry, and be ideally suited to this kind of work. We are particularly interested in candidates who have experience in thyristor control drives, digital logic techniques, computer systems using the Department’s Data General computers and DEC equipment. Applicants should have a good general education in electronics and a good knowledge of circuits and construction of digital equipment and the design of computer interfaces.

Applications are invited for the above post in the Electronics Department. Applicants should have a good general education in electronics and a good knowledge of circuits and construction of digital equipment and the design of computer interfaces.

Salary range £3,313-£3,770 or equivalent (H.N.C. or equivalent in electronic engineering or physics are invited to

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