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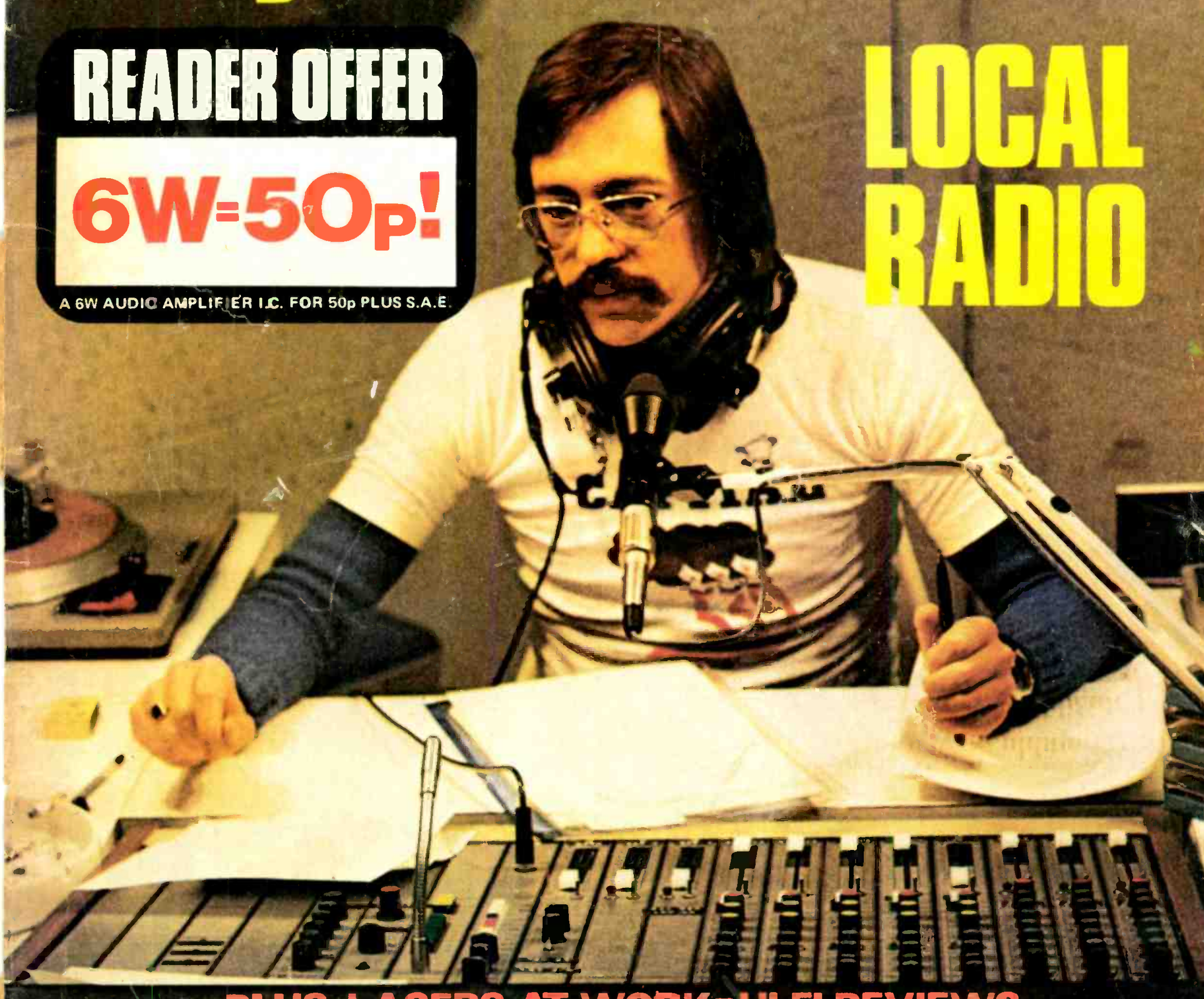

PLUS: LASERS AT WORK ■ HI-FI REVIEWS
NICKEL CADMIUM BATTERY CHARGER

HI-FI

... CONSTRUCTION ... COMMUNICATIONS ... DEVELOPMENTS

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MAY 1974 Vol.3 No.5.

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Cover: Capital Radio's Tommy Vance at work on Tommy and Joan's 'Music and Swop Shop'. This photograph was taken at Capital's special studio at the Ideal Home Exhibition. See Local Radio in Britain starting on page 28. (Photograph courtesy of Capital Radio).

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CRAFTSMANSHIP

IT HAS BECOME the 'in-thing' to revere the fine workmanship of the past. This is best demonstrated in the considerable interest in antiques. There is nothing wrong in this, of course, but all too often the reason given for this reverence of the past is that craftsmanship is a dying, if not a dead, art. "People don't care any more" ... "They don't make beautiful things anymore", are common sayings. This, of course, is rubbish.

A couple of centuries ago there were certainly people dedicated to their trades. A man would spend days with hammer and chisel carving a 'ball and claw' for a table. A clock maker may have taken months to complete a single unit. These people produced superb work, even if we ignore the limitations of their tools and it is good that much still survives. Today we have similar craftsmen: the furniture maker of yesteryear can be equated with the tool maker for some plastic moulding machines. The fact that his work may be duplicated a million times by an automatic process in no way degrades his original craftsmanship.

The clock maker could be equated with the production engineer for some electronic test gear. Can anyone who has looked inside a recently built oscilloscope made by one of the major manufacturers say that craftsmanship is dead? There is beauty in the design, both circuit wise and in layout, if only one is objective enough to see it.

Anyone who wants their great-grandchildren to make a few pounds could do a lot worse than putting on one side a few of the items that we take for granted today.

No, craftsmanship is alive and well: It is just present in different forms. —HWM.

electronics today international

news digest

GO TO WORK ON A BATTERY

The oil situation has increased interest in the battery-powered cars but despite years of research and development this seems no nearer than it ever was. The weight of the batteries, the limited range and the long recharging time have proved to be major problems.

There is one branch of transportation however where these problems are not too serious: buses. Analysis of bus usage has shown that half the buses on city centre journeys during peak periods cover less than 25 miles with an average speed of 8.5 m.p.h.

These facts led to the cooperation of Chloride and Selnec (South East Lancs and North East Cheshire Transport Authority) to produce a full size, battery-powered bus. The makers and operators emphasis that this is *not* an experimental vehicle and it will be in daily operation within months.

Silent Rider, as the bus is known, carries 50 passengers and, as the name makers clear, has a very low noise level and is pollution free. It has a range of 40 miles with a top speed of 40 m.p.h. and an acceleration of 3.3 ft/s/s.

The power pack comprises a lead acid battery with 165 cells giving 330V fitted with an automatic topping up device. A revolutionary charger is used which cuts the time from 8 hours to 3½ hours. The charger is known as PRV (Programmed Rate of Rise of Voltage). It can also be used for boost charging, replacing 1% of the battery capacity every minute up to 75% capacity.

Other companies associated with this project are Sevcon, who developed the electronic controller, Seddon who built the body and EDC who made the special motors.

Precise control of speed is provided by a thyristor chopper system which is regulated by the accelerator pedal. The controller can handle 280A at 330V continuously and for short periods up to 1000A.

Breaking is mainly electronic and, during breaking, the motors act in reverse as generators and partially recharge the batteries thus improving the range.

In the event of failure of either the main batteries or the main circuitry, a separate 24V battery can be connected to the motor giving sufficient power to move slowly out of the main thoroughfare. To reduce maintenance costs the direction contactors, which often create problems, are switched in the zero current condition.

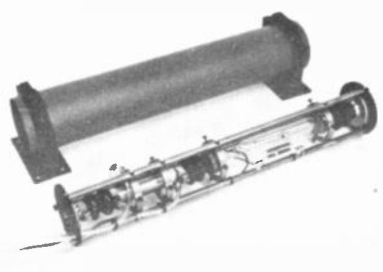
Among the companies involved, Chloride especially have great faith in the future of battery powered buses. A Mark 2 version is already being developed with a replaceable battery pack. Chloride has spent considerable sums in TV and Press advertising promoting the idea, presumably in the hope that other transport authorities will take up the idea.

The cost of Silent Rider is considerably more than for a conventional diesel, though running costs are similar. The Mark 2 however is expected to show running costs in favour of the battery-powered buses.

LASER SYSTEM TO DETECT GASES

A laser system for the detection of methane and other infrared absorbing gases has been developed by International Research and Development Co. Ltd and A.M.G. Zuubier Ltd, of Doncaster, in collaboration with the Safety in Mines Research Establishment.

It is for use in natural gas safety surveying, petrochemical safety monitoring or concentration measuring, and high sensitivity gas leakage alarm systems.



In its first application the equipment has been installed in a patrol vehicle for the detection of small quantities of methane, typically 100 ppm, utilising the rapid detector response time of less than one second.

The operation relies on the absorption of 3.39 micron radiation by the sample gas in a cell located within a laser cavity. Gases and vapours which absorb strongly in the 3.39 micron band include butane, ethane, propane, hexane, heptane, butadience, dimethylamine, dimethyleter, ethylether, ethyl mercaptan, ethylene, ethylene oxide, propylene and many others.

The new detector has a fast response and high gas flow rate and a wide range of sensitivities. Unlike flame-based techniques, it measures concentrations of infrared absorbing gases in inert atmospheres and, unlike some solid state detectors, cannot be poisoned.

VOLTAGE REGULATOR SELECTION GUIDES

Two new, updated voltage regulator selection guides are now available from National Semiconductor. The new guides contain complete information on all of National's voltage regulators including the new LM123 3A 5V regulator.

One of the new guides contains complete information on National's fixed-voltage regulators, and the other contains information on National's variable-voltage regulators. And each guide is divided into two sections - one for positive voltage devices and one for negative voltage units.

For each regulator, key specifications are listed to make device selection simple. The parameters include input and output voltage range, line regulation, load regulation, ripple rejection, stability, quiescent current and output current.

National Semiconductor, The Precinct, Broxbourne, Herts.

DEVELOPMENT OF FULLY ELECTRONIC DIGITAL SWITCHING SYSTEM

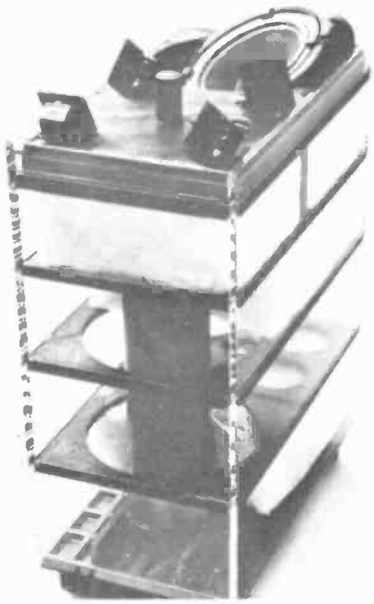
CIT-Alcatel of France, and Plessey Telecommunications of Britain, have signed an agreement to collaborate in in the development, manufacture and marketing of a new fully-electronic digital telecommunications switching system.

It will be based on a combination of the existing E10 digital switch - developed by CIT-Alcatel for the French P and T and presently operated in the French public network - and the System 250 stored programme control processor, developed by Plessey and already in use in the United Kingdom.

This agreement has been made in recognition of the decisions by the French P and T and the British Post Office that digital techniques are increasingly to be used in their telephone networks. It will be designed to be suitable for use in both national networks. From this position, CIT-Alcatel and Plessey each expect to establish strong bases from which to launch major international sales.

NEW LOUDSPEAKERS FROM SONAB

With an eye to the future development of quadraphony Sonab has added two new loudspeakers to its existing range. Called the OA14 and OA12 the new speakers have been designed to produce an optimal balance between direct and reflected sound during either stereo or quadraphonic reproduction.



An inside view of one of the new Sonab speakers, the right-hand unit of the OA14.
The speaker elements are angled. The floating suspension of the bass and mid-range element prevents vibrations being transmitted to the cabinet.

The OA14 which has five speaker elements, one for bass and mid-range and four for treble range is equivalent in power to the existing OA5. The OA12 has three speaker elements, one for bass and mid-range and two for treble. It fits into the Sonab range between the OA14 and the VI.

The new speakers combine omni-directional characteristics with the more directional requirements for quadraphonics. This is achieved by positioning the speaker elements, still mounted in the top of the enclosures, at specific angles. Those angled inwards provide the direct sound. They also determine on which side of the room the speakers should be placed, i.e. there are left hand and right hand speakers for the left and right hand channels.

Sonab has added other features to the new speakers which are claimed to contribute significantly to their high performance.

They incorporate a new bass and mid-range speaker element, the SC165 which is only 165mm in diameter. This was designed by Sonab's Stig Carlsson to meet specifications which Sonab was unable to find in existing elements. The SC165 has enabled Sonab to reduce the size of its speaker cabinets - a decided advantage in the quadraphonics field - without suffering any reduction in the power handling capacity.

The SC165 can handle 40W without overheating. It achieves very great amplitude with low distortion and frequency ranges of 25 - 18000Hz and 35 - 18000Hz for the OA14 and OA12 respectively. To ensure high performance of the crossover network and to reduce distortion at low frequency, Sonab has used coreless coils instead of metal cored coils and a strong plastic sheeting capacitor instead of the bipolar electrolytic type.

The frequency response of the new speakers is very flat. It is within ±3dB from 29 - 15000Hz for the OA14 and ±3dB from 42 - 15000Hz for the OA12. In addition there is a facility for adjusting the high frequency response to different acoustic environments.

The speaker cabinets are built up around the top board, the base board and the reinforcement cross-sections in injection moulded ABS. This material makes the cabinet extremely robust and is much lighter than wood. The walls of the cabinets are made from high density, heat pressurised particle board.

Supplied in rosewood, walnut, teak, oak and black or white lacquered, the OA14 and OA12 speakers are being delivered now and all Sonab dealers should have them in stock by mid-March. Retail prices (including VAT) are £179.97 for the OA14 and £149.95 for the OA12.

CHAMELEON LED'S

Under a contract from NASA, Bowmar Canada has developed a single LED that can change colour — from red to green — depending on current levels.

Whilst the device has an efficiency of 1% to 2% for red light, and 0.1% to 0.2% for green light, both will be seen subjectively as being of similar brightness because the human eye is approximately 10 times more sensitive to green.

SINCLAIR AIM FOR WORLD LEADERSHIP IN SCIENTIFIC CALCULATORS

"Our commanding lead in this technology enables me to predict that Sinclair will be the world's major manufacturers of scientific calculators", claimed Clive Sinclair, Managing Director of Sinclair Radionics at the company's first international sales conference held in London recently.

Speaking to delegates from more than 40 countries, he estimated that by early 1975 20 per cent of all calculators will be purchased by professional scientists, engineers, architects, teachers and students. In 1975 this will represent 3 million units throughout the world. Purpose of the conference was to introduce the company's £49 scientific pocket calculator, the "Sinclair Scientific" mentioned in March ETI.

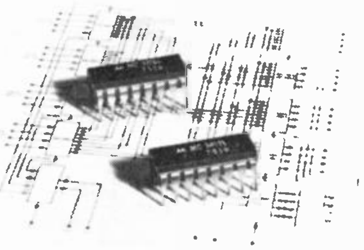
By the end of this year total calculator production on the entire Sinclair range will top 100,000 units per month. The company is expected to introduce further additions to its calculator ranges over the next 9 months.

QUAD LINE DRIVERS AND RECEIVERS FOR DATA TRANSMISSION

Three new components have been introduced by Motorola which can further reduce the complexity of 'party-line' type data transmission systems.

The new devices comprises two quadruple line receivers (MC3450 and MC3452) and a quadruple line driver (MC3453). The receivers are almost identical, the only difference being that the MC3450 has active pull-up outputs and the MC3452 has open collector outputs (making possible the implied-AND output connection). The receivers' IC's have a strobe input which puts all four individual receivers on a chip into a high-impedance output state (three-state) in order to reduce line loading effects in party-line applications. The sensitivity of ±25mV makes these devices ideal for sensing in 1103 type main-frame memories. All outputs are at TTL levels and propagation delay is 25nsec maximum. The MC3450 and MC3452 are quadruple versions of the earlier popular dual receivers MC75107 and MC75108.

The line-driver of the new family is the MC3453 - a quadruple version of the earlier dual, the MC75110 - featuring an inhibit input which is common to all the four drivers in a package. When this inhibit input is 'high', output current is switched between each pair of output terminals in response to channel input signals. When the inhibit input is low, all drivers in the package are switched off to minimise party-line loading. Propagation delay is typically 9nsec and the common mode output voltage range is from -3 to +10V. Output current drive is 12mA.



NEW AUDIO SCOPE

A recent addition to the Heathkit range is the AD-1013 Audio Scope, a sophisticated solid-state instrument designed for use with any 2-channel or 4-channel stereo system to provide visual checking and monitoring of such parameters as channel separation, phasing, relative signal strengths, multipath reception, centre tuning of receivers and tuners.

A built-in four-channel decoder gives independent or simultaneous visual indication of all four channels. Triggered sweep assures a stable, jitter-free signal trace. An automatic base line generator displays a straight line across the CRT screen when no signal is present. Inputs are provided on the rear panel for Left-Front, Left-Back, Right-Front, Right-Back and Multipath. Any of these inputs can be switched and observed on the screen, independently or in combination. Lighted function indicators at the edge of the CRT screen on the front panel show at a glance what function is being displayed.

A built-in independent 20Hz to 20kHz low distortion audio oscillator provides convenient means of adjusting and checking any stereo system. Front panel controls are provided for frequency selection of the audio oscillator as well as controlling the amplitude of the generated signal.

Most of the solid-state components mount on a single circuit board in a wide-open arrangement.

Price of the AD-1013 is £99.55, mail order, Carriage extra. For more information, contact *Heath (Gloucester) Limited, Bristol Road, Gloucester GL2 6EE.*

ADVENT TO MARKET VIDEO-BEAM TV

The Advent Corporation is currently making definate plans to market its video beam TV projection system.

Intended primarily for very large domestic rooms, business and institutional use, the system projects signals from normal TV, video, or CATV sources onto a screen 122cm high x 183cm wide.

The unit will be priced at $ 2495 and production is expected to commence in April.

Advent are well known in the audio field for their range of loudspeakers and cassette recorders.

AUDIO UNIT FROM HITACHI

Launched last month is the Hitachi SP 2821, an 8-track Multiplex FM long stereo system.

Operated from the mains the 2812 in all white plastic design with two matching speakers sells at a retail price of £89.00.

Sales are seen in the middle range of the audio market. The unit is very similar in design to the ST 3412 cassette player and radio tuner which Hitachi introduced last year onto the British market.

OFF–AIR FREQUENCY STANDARD

The recently introduced Advance OFS 2B off-air frequency standard generates output frequencies of 1MHz and 10MHz from the BBC's high-stability 200kHz transmission from Droitwich. The instrument receives the Droitwich signal, strips it of its amplitude modulation, and phaselocks the 10MHz signal to the Droitwich transmission.

The long-term accuracy (for more than 1000s) is equal to that of the Droitwich transmitter, while the short-term (1s) accuracy is typically one part in 10^8.

To keep spurious phase modulation (caused by amplitude modulation of the 100kHz signal) to a minimum for short-term measurements, the receiver utilises a narrowband crystal filter to remove the modulation, and a comparatively long time constant in the lock loop. An automatic-gain-control loop stabilises the signal level fed into the phase discriminator.

A ferrite rod aerial fitted at the rear of the instrument, making it suitable for most UK locations as well as many European countries. An external aerial can also be used. The instrument can be powered from the a.c. mains or an internal battery.

Advance Electronics Limited, Roebuck Road, Hainault, Essex.

WORLD FIRST IN UNDERWATER TELEGRAPHY

Marconi Communication Systems has completed the design and development of what is believed to be the first telegraph error detection and correction equipment designed specifically to provide teleprinter to teleprinter communication under water. The equipment, designated Sonar 2010 by the Royal Navy, was designed in collaboration with the Admiralty Underwater Weapons Establishment for the Royal Navy for underwater tactical communications.

The programme to produce the type 2010 equipment started in 1967 with a series of studies in which research equipment was taken to sea on vessels of the Royal Navy to determine the techniques that could be best employed to overcome the many difficulties that face the underwater communicator. The problem is particularly acute in data transmission, which has to cope with the effects of fades, mulitpath, noise bursts and doppler shifts caused by the relative motion between communicating vessels.

From the early research trials, a combination of techniques was involved, and this was followed by the design and manufacture of prototype production equipment. A further series of sea trials took place and the equipment was evaluated under a variety of propagation conditions chosen to represent those found in service use.

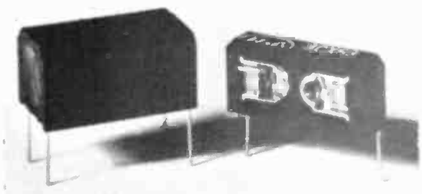
During the seas trials, the new Marconi Underwater Telephone, designated Sonar 2008 by the Royal Navy, was used as the transmitter and receiver of the telegraph signals.

The trials were highly successful and beat the target of 98 per cent error free copy under a wide range of propagation conditions from shallow water deep sea and rough sea to calm tropical conditions. It was also shown that the 2010 can pass traffic at a greater transmission rate than can be achieved by speech, and together with the greatly increased range provided by the type 2008 Underwater Telephone has extended the communications abilities of the submariner by many times.

Production is scheduled to start this year and will cover a shipfitting programme of existing and new R.N. vessels over a periods of years. Interest has also been expressed by NATO and Commonwealth countries.

OPTOELECTRONIC SIGNAL COUPLER

A new optoelectronic signal coupler - the Hafo 3C63 - has recently become



available from MCP Electronics.

The 3C63 is essentially a four-terminal switch with complete electrical isolation between the input and output terminals. It consists of a GaAs infrared light emitting diode and a silicon NPN phototransistor, both hermetically encapsulated inside a polycarbonate case.

Maximum ratings include: Input-to-output DC voltage, ±5kV (continuous), ±15kV (1 min); Input diode reverse voltage, 7V; Input diode forward current, 100mA; and junction temperature range, -55°C to +125°C.

Overall package size is .76 x .40 x .41in, excluding leads.

MCP Electronics Limited, Alperton, Wembley, Middlesex HAO 4PE.

TV INTRUDER DETECTOR

No matter how conscientious a security guard may be, it is virtually impossible for him to monitor closed-circuit TV screens for protracted periods.

A system, developed by information Processing Systems of Belmont, California, takes the responsibility from the guard by triggering an alarm signal if there is any change in the displayed video image.

The system samples the video image, integrating energy levels in the video signal and detecting changes in the energy content.

ANTISTATIC FIBRES

Antistantic fibre will soon be available from ICI's Aycliffe Plant.

The new fibres, say ICI, are the first ever to be produced with truly conductive properties. Based on either polyester or nylon, they contain small amounts of particulate carbon embedded on the surfaces – but forming an integral part of each fibre.

Although there are countless applications throughout science, and industry, initial marketing areas will be in carpeting and industrial fibres – two areas where spark supression is often an important safety consideration.

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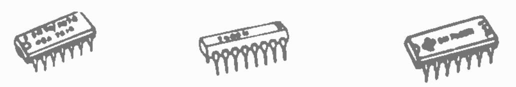

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SN7402N	0 20	0 18	0 16
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SN7403AN	0 38	0 38	0 33
SN7404N	0 24	0 21	0 18
SN7405N	0 20	0 18	0 16
SN7405AN	0 44	0 44	0 38
SN7406N	0 40	0 38	0 35
SN7407N	0 40	0 38	0 35
SN7408N	0 25	0 22	0 19
SN7409N	0 33	0 33	0 28
SN7409AN	0 44	0 44	0 38
SN7410N	0 20	0 18	0·16
SN7411N	0 25	0 23	0 21
SN7412N	0 28	0 28	0 25
SN7412AN	0 38	0 38	0 33
SN7413N	0 30	0 27	0 25
SN7414N	0 72	0 72	0 63
SN7416N	0 30	0 27	0 25
SN7417N	0 30	0 27	0 25
SN7420N	0 20	0 18	0 16
SN7422N	0 28	0 28	0 25
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SN7428N	0 43	0 43	0 37
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SN7433N	0 43	0 43	0 38
SN7433AN	0 57	0 57	0 50
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SN7441AN	0 85	0 79	0 73
SN7442N	0 85	0 79	0 73
SN7443N	1 50	1 27	1 13
SN7444N	1 50	1·27	1 13
SN7445N	2 16	2 16	1·89
SN7446N	2 16	2 16	1 89
SN7447AN	1 80	1 80	1 57

Type	1/11 £ p	12/29 £ p	30/99 £ p
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SN7460N	0 20	0·18	0·16
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SN7475N	0·59	0·55	0·51
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SN74148N	2·01	2·01	1·63
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SN74156N	1·09	1·09	1·00
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SN74188N	6·48	6·48	5·67
SN74190N	2·30	2 30	2·01
SN74191N	2·30	2·30	2·01
SN74192N	2 30	2 30	2 01
SN74193N	2·30	2·30	2 01
SN74194N	1·72	1·72	1·51
SN74195N	1·44	1·44	1 26
SN74196N	1·58	1·58	1·38
SN74197N	1·58	1·58	1·38
SN74198N	3·16	3 16	2·77
SN74199N	2·88	2·88	2·52

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AC128	20p	BCY39	10p	GET111	55p	OC45	18p	ZTX302	18p	2N3773	2 25
AC187	20p	BCY55	2 50	GET115	75p	OC71	15p	ZTX500	15p	2N3790	2 25
ACY17	35p	BCY70	15p	GET880	55p	OC72	25p	2G301	40p	2N3819	35p
ACY39	65p	BCY71	20p	LM309K	1 87	OC77	55p	2N697	15p	2N3866	75p
AO149	50p	BCY72	13p	MAT121	25p	OC81	28p	2N706	10p	2N3903	15p
AO161	38p	BO124	80p	MJE340	50p	OC83	25p	2N930	20p	2N4002	14p
AO152	38p	BO131	45p	MJE520	65p	OC140	65p	2N987	45p	2N4126	15p
AF117	20p	BF115	22p	MJE3055	75p	OC170	25p	2N1132	25p	2N4871	35p
AF118	50p	BF180	33p	MPF105	40p	OC200	55p	2N1304	22p	2N5457	38p
AF139	33p	BF194	13p	NKT217	45p	OC202	90p	2N1613	20p	2S001	3 00
AF186	40p	BFX13	25p	NKT404	60p	OCP71	1·00	2N1671	1·00	2S026	8·90
AF239	44p	BFX34	55p	OA5	60p	ORP12	55p	2N2147	75p	2S303	70p
ASY27	30p	BFX88	22p	OA81	10p	ORP60	45p	2N2160	69p	40250	45p
BA115	10p	BFY50	20p	OA200	8p	P346A	20p	2N2926	10p	40361	45p
BAX13	5p	BFY51	20p	OA202	10p	TIL209	25p	2N3053	20p	40362	40p
BC107	15p	BFY64	45p	OC16	85p	TIP29A	49p	2N3054	45p	40408	50p
BC108	15p	BFY90	75p	OC20	1 25	TIP30A	58p	2N3055	45p	40486	75p
BC109	15p	BLY36	6 25	OC28	65p	TIP31A	61p	2N3440	50p	40636	1·00
BC109C	14p	BSX20	15p	OC35	55p	TIP41A	74p	2N3442	1·10	40430	85p
BC113	16p	BU105	2 20			TIP42A	90p	2N3525	80p		
BC147	12p	BY100	15p			TIS43	26p	2N3614	59p		
BC169C	14p	BY127	15p			V405A	25p	2N3702	11p		

TRIACS Stnd. mounting with accessories

3 AMP RANGE

Type	P.I.V.	1-11 Price Each
SC35A	100v	80p
SC35B	200v	85p
SC35O	400v	90p
SC35E	500v	£1 20

6 AMP RANGE

SC40A	100v	90p
SC40B	200v	95p
SC40O	400v	£1 20
SC40E	500v	£1 50

10 AMP RANGE

SC45A	100v	£1 05
SC45B	200v	£1·15
SC45O	400v	£1·45
SC45E	500v	£1 85

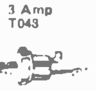
15 AMP RANGE

SC50A	100v	£1·45
SC50B	200v	£1·65
SC50O	400v	£1·95
SC50E	500v	£2·25

TRIACS Additional Types

40430 TRIAC (T066) 85p
40669 TRIAC (Plastic) 90p
40486 TRIAC (T05) 75p

3 Amp T043



15 Amp T048

SILICON CONTROLLED RECTIFIERS

Type		1-11
ONE AMP (T05) P.I.V.		
CRS 1/05AF	50v	30p
CRS 1/10AF	100v	30p
CRS 1/20AF	200v	35p
CRS 1/40AF	400v	45p
CRS 1/60AF	600v	55p
THREE AMP (T048)		
CRS 3/05AF	50v	40p
CRS 3/10AF	100v	40p
CRS 3/20AF	200v	45p
CRS 3/40AF	400v	55p
CRS 3/60AF	600v	65p
FIVE AMP		
CRS 5/400	400v	60p
SEVEN AMP (T048)		
CRS 7/100	100v	60p
CRS 7/200	200v	67p
CRS 7/400	400v	85p
CRS 7/600	600v	95p
SIXTEEN AMP (T043)		
CRS 16/100	100v	70p
CRS 16/200	200v	75p
CRS 16/400	400v	85p
CRS 16/600	600v	£1·10

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120	12 watt amplifier	4·70
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130	Mono control unit	3·60
605	Power supply for 115	4·55
610	Power supply for 120	4·55
615	Power supply for 2 x 120	5·73
230	AM/FM aerial amplifier	2·93
240	Auto packing light	5·90
275	Mic. preamplifier	6·06
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590	SWR meter	12·65
620	Ni-CAO Charger 1 2-12v	6·00
630	STAB Power supply 6-12v 0·25-0-1A	8·15
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705	Windscreen wiper timer	6·90
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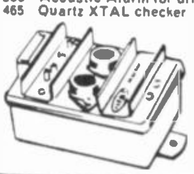
80	Scope Calibrator	2·25
255	Level indicator	6·15
525	120-160mHz VHF timer	11·30
715	Photo cell switch	7·70
795	Electronic continuity tester	4·30
860	Photo timer	13·25
371	Slide projector auto. feed control	7·15
235	Acoustic Alarm for driver	7·60
465	Quartz XTAL checker	8·75



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(– Earth) with speakers in pods and fixings £12·80 carr packg 40p
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RH700 £6·75
RH430 £3·30
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BRIDGE RECTIFIERS

FEATURES SMALL SIZE AND LOW COST. Sizes are approximate.

250M/A QUARTER AMP

B025/05	50 PIV	16p
B025/10	100 PIV	18p

¼ x ¼ x ¼" dia.

½ AMP 1-11 Pricing

Type	P.I.V.	Price ea.
B05/05	50v	20p
B05/10	100v	22p
B05/20	200v	23p
B05/40	400v	25p
B05/60	600v	27p

½H x ½L x $\frac{3}{16}$" dia.

1 AMP P.I.V.

B1/05	50v	25p
B1/10	100v	25p
B1/20	200v	28p
B1/60	600v	30p

½H x ½L x $\frac{3}{16}$" dia.

1 AMP P.I.V.

W005	50v	29p
W01	100v	30p
W02	200v	32p
W06	600v	35p

⅜ x ⅜" Tubular

2 AMPS P.I.V.

B2/05	50v	35p
B2/10	100v	40p
B2/20	200v	45p
B2/60	600v	50p
B2/100	1000v	55p

½H x ½L x $\frac{3}{16}$" dia.

4 AMPS P.I.V.

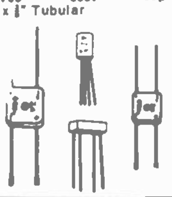
B4/100	100v	55p
B4/200	200v	59p
B4/400	400v	65p
B4/600	600v	75p
B4/800	800v	£1·00

½H x ½L x $\frac{3}{16}$" dia.

6 AMPS P.I.V.

B6/05	50v	65p
B6/10	100v	70p
B6/20	200v	80p
B6/40	400v	90p
B6/6x0	600v	£1·00

½H x ½L x $\frac{3}{16}$" dia.



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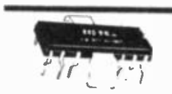
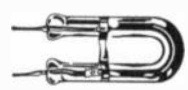


TBA800 5 WATT IC
Suitable alternative to SL403D 5/30 volt operated. 8/16 OHM 5 watt output. With circuits and data £1·50.



Strobe Tube
ZFT4A/XTF2 Suitable for Oec. '73 Pract. Electronics £2·50
ST2 (O32) DIAC 25p
CRS1/40 SCR 45p

Sinclair IC12
with circuits and data. 6 watt IC with printed circuit board. 28 volt. operated. £2·00.

Ultrasonic Transducers
Operate at 40Khz up to 100 yds. Ideal remote switching and signalling. Complete with data transmitter and receiver new I.C circuits. Per pair £5·90.
TA960 with socket £1·80

ZN414 IC
Integrated circuit radio as featured by many magazines (PW Jan. 73 Reprint Ref. No. 19 for 10p). £1·20.

3015F 7 SEG.
I.C. size complete with data price £1·70 each (digital clock circuits ref. No. 31, 15p).

TIL209 LED
24p each 22p per 10

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A complete kit, packaged in a polystyrene container and taking about 3 hours to assemble—thats the Sinclair Cambridge pocket calculator from Henry's. Some of the many features include interface chip, thick-film resistor pack, printed circuit board, electronic components pack. Size 4⅓" long x 2" wide x $\frac{11}{16}$" deep.
Free of charge with the kit for the more advanced technologist is a 32-page booklet explaining how to calculate Logs, Tangents, Sines etc.
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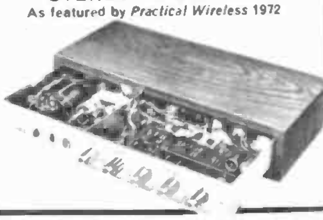
FREE—Teak cabinet with complete kit.



KIT PRICE £28·50

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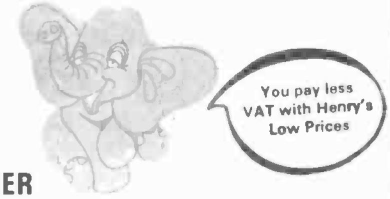
BUILD THE NEW HENELEC STEREO FM TUNER



A completely new high stability stereo FM tuner. Features variable capacity diode tuning, stabiliser power supply, IC Decoder, high gain low noise, IF stages, LED indicators, Tuning meter, AFC, easy to construct and use. Mains operated. Slim modern design with fibre glass PC, teak cabinet etc. Available as a kit to build or ready built. Overall size 8" x 2¾" x 6¾".

Produced to give high performance with a realistic price. (Parts list and constructional details Ref. No. 5 30p). Henry's are sole distributors UK and Europe.

Kit price £21·00 (+ VAT)

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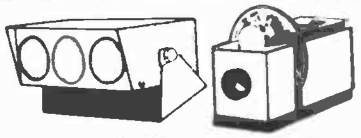

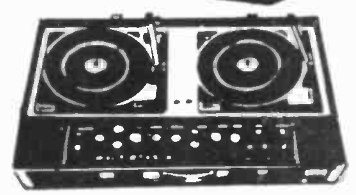

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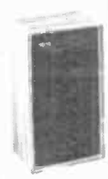

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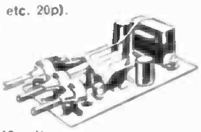

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TRANSFORMER FOR PZ8	£3·95
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STEREO DECODER	£7·45

All items post paid.

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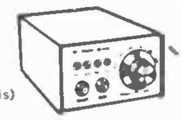

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P1080 12v 1 amp (chassis)	£4·25 post 20p
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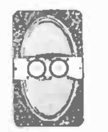

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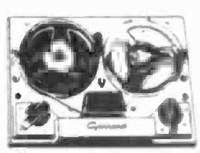

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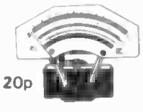

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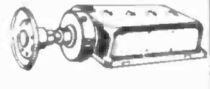

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Output Voltage = 9 ranges 10V to 2500V
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news digest

TEXAS INSTRUMENTS ATTACK H-P CALCULATOR MARKET

Texas Instruments has just introduced a very advanced hand-held calculator intended to compete directly with the Hewlett-Packard HP-35.

Priced at $169.95, and to be sold intially only by direct mail the calculator drastically undercuts H-P's current US price of $295.

Bill Terry, vice-president of H-P's told an industry reporter that the new TI SR50 appeared to be directly competitive.

STEREO RECEIVER WITH BUILT-IN STEREO CASSETTE PLAYER

The JVC 9470 LS is a compact FM/MW/LW Stereo Receiver complete with a built-in Stereo Cassette Deck making a versatile centrepiece for a stereo system.

The amplifier section of the 9470 LS provides 15W r.m.s. per channel into 8 ohms over the full 25-30,000Hz audio range with 0.3% distortion. Individual slider controls are provided for the Bass and Treble, and there is a separate switched loudness control. The amplifier will drive two sets of speakers either of which may be selected by a front panel control, and there is a full range of input phono and DIN sockets to cater for phono, mic, aux and tape inputs and a tape output with a front panel headphone socket.

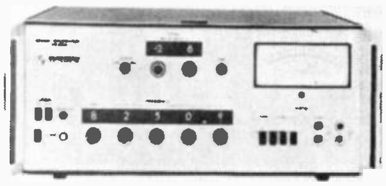
The tuner section incorporates an F.E.T. front-end and achieves an S/N ration of 60dB with less than 0.5% distortion.

The unit is fitted with one of JVC's precision cassette decks featuring full Auto-Stop facilities, and controlled by a set of piano-keys including a handy locking Pause Control Key. Each channel has its own individual slider-type recording level control coupled with a large scale VU meter. The FM muting switch acts as a Dynamic Noise Limiter (D.N.L.) when the recorder is in use so that background tape hiss is reduced to give an S/N tatio of 50dB. A tape Selector switch is provided to bias normal to chrome tapes correctly.

Price of the JVC 9470 LS is £181.50 recommended retail price including VAT.

FREQUENCY–SYNTHESIZED SIGNAL GENERATOR

Cushman Electronics, a Dana group member, has just introduced a frequency-synthesized signal generator that provides a flat, precisely tunable signal over the frequency range 4kHz to 9.1MHz. This is the Model CE-26A, a new instrument that can make a variety of accurate general-purpose measurements within these limits. It is especially suited to measuring the frequency response of filters and similar devices, and to cable attenuation measurements. It can be set to give

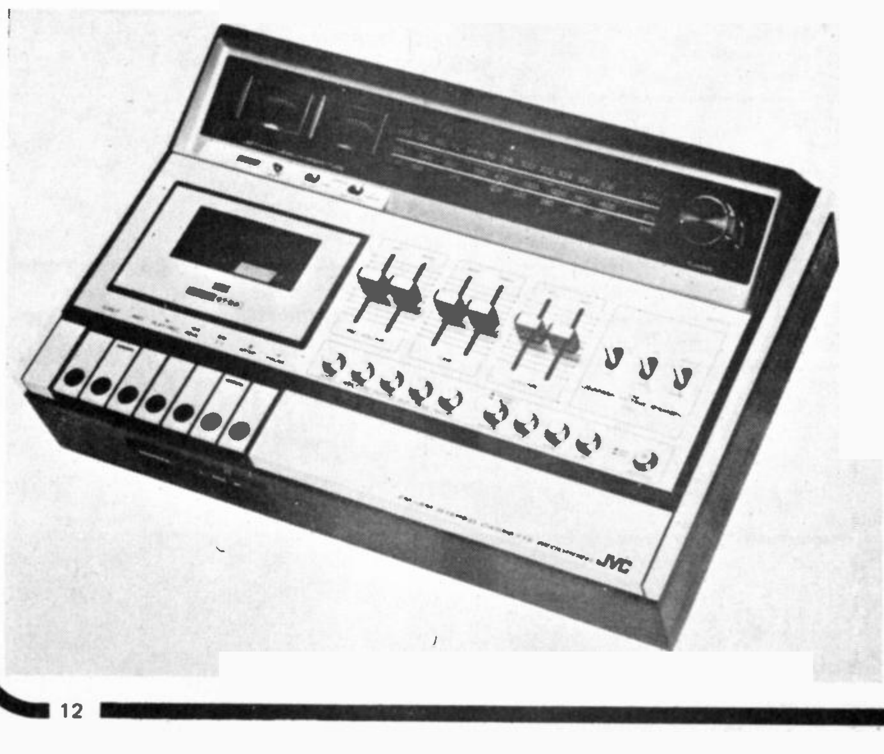


highly accurate output levels from -70 to +10dB for insertion-loss measurements, and to make wide dynamic-range measurements, such as linearity.

Its very stable frequencies are generated by a synthesizer that is phase locked to a 2MHz crystal oscillator. The required frequency is dialled in, and is displayed on the front panel in large bright digits. Resolution is 1kHz on the four digital frequency dials, and 25Hz with the fine tuning control. Harmonic distortion referred to the fundamental is greater than 40dB down at signal levels below 0dBm, and intermodulation distortion is greater than 50dB down.

The signal level output is stablised, and an automatic level control eliminates the need for resetting the level as frequency is changed.

Dana Electronics Limited, Collingdon Street, Luton, Beds.



TWO–WAY RADIO BASE STATION MICROPHONE

Reslosound Limited have recently released a new base station, or paging, microphone, the Reslo Dispatcher which is available in both dynamic and capacitor electret versions.

Styled by Keith English, the Derritron Group's industrial designer, the microphone is claimed to have not only outstanding visual appeal, but to meet ergonomic principles important in operation.

A "press-to-talk" switch is incorporated in the base of the unit for operator use whilst sitting down, and if it is picked up by a standing operator an alternative press bar falls naturally under the operator's thumb.

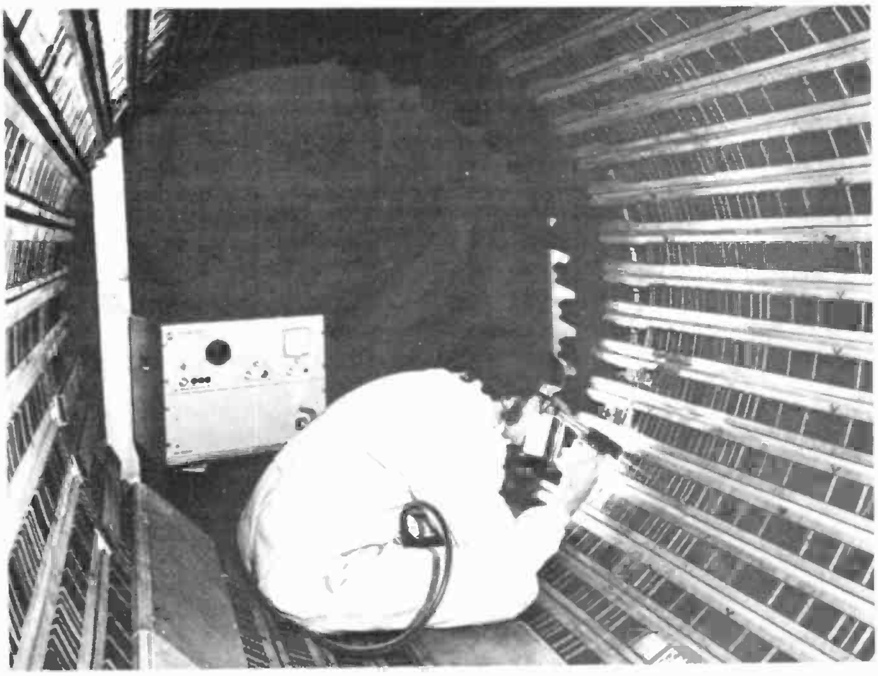
340A THYRISTOR TURNS-OFF IN 25 µSEC

High frequency inverter circuits demand the use of fast turn-off thryistors. Where these circuits are also required to operate from high input voltages short turn-off time must be combined with high voltage ratings; for the thryistor, a combination of parameters which has proved difficult to achieve with existing processes.

AEG have resolved this problem in their latest device - the T340F - which, although it has the very fast turn-off time of 25µsec, will handle up to 1.2kV (maximum allowable repetitive peak forward off-state and reverse voltage). This device is available from AEG's UK agents, Walmore Electronics Ltd., in several versions with ratings from 200V to 1.2kV and with a choice of 20, 25 or 30µsec turn-off times.

Housed in a capsule package, which allows cooling of both sides of the chip simultaneously, the T340F will withstand surge current up to 6,200A peak for a period of 10msec. Other significant figures from the specification include a critical dv/dt rating of 400V/µsec and a di/dt of 150A/µsec.

PORTABLE LASER MICROWELDER



A small hand-held ruby laser micro-welder has been designed and built by International Research and Development Co. Ltd., of Newcastle-upon-Tyne and is expected to have many industrial applications.

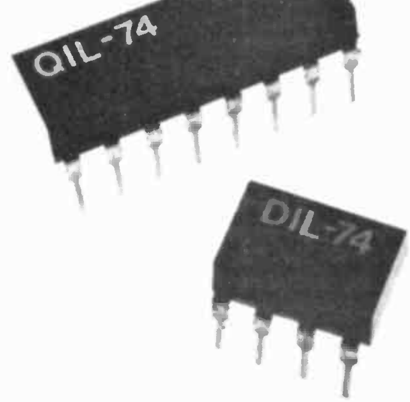
The big advantage of the new system is that the laser can be taken to the workpiece. Its compactness and portability make it ideal for on-site uses such as the attachment of electrical contacts, thermocouples and strain gauges to research and production equipment, particulary when welds have to be made in awkward positions or where they are inaccessible to other welding systems.

The photograph shows the welder in use, welding probe leads inside the stator core of an experimental generator.

In designing this system, IRD has drawn on considerable experience gained in the development and construction of laser micro-welding and drilling systems for a wide range of applications. The operating head is robust with a module for the aiming and focussing optics attached to a handle containing the laser.

Both the charging of the separate 1 kilojoule power supply, which is connected to the head by a cable, and the firing of the laser are controlled by the operator at the working point using a double-action button on the head.

QUAD OPTO-ISOLATOR



Litronix announces the availability of a quad opto-isolator, the ILQ-74.

It contains four independent infra-red LEDs and NPN phototransistors in a 16-pin dual-in-line package. Each quad channel has a 12½% minimum current transfer ratio and very low leakage current of only 5nA. Breakdown voltage is 1,500V.

A dual version, the ILD-74, is also available. It contains two independent infra-red LEDs and NPN phototransistors in an 8-pin dual-in-line package. It has the same characteristics per channel as the ILQ-74.

Both devices are designed to interface directly into and out of TTL, in place of relays and transformers. They are especially useful for eliminating ground loop and noise problems in TTL applications.

Litronix, Bevan House, Bancroft Court, Hitchin, Herts SG5 1LW.

CONTROL DEVICE FOR DISABLED

Using this system people can control up to ten devices by a single movement of any part of their body. A 3 x 2in capacitive sensing pad is the key to "System 7", a product of Zambette Electronics.

The pad can be fixed in any position to suit the patient. By adjusting the sensitivity control the system can be tuned into the specific movement which has been chosen as the one which will operate the system. The pad is very directional – responding only to movements within the 3 x 2in column perpendicular to the surface.

The pad is connected to a display panel, which carries 10 lamps, each lamp is labelled to indicate the corresponding function – TV, lights, etc. The lights come on, one by one, in a time-shared cycle of 20 seconds or longer. By operating the device when the light for a particular device is lit, the operator can switch it on or off.

It is possible to hold one particular function, such as TV, and then transmit a series of pulses, which in this example could select the channel. Curtains could be similarly opened in stages, or heating be gradually increased and decreased.

Accessories enable opening of the front door for visitors (after establishing their identity by intercom) and an alarm system to call for help. There is also a telephone connection system to deal with ingoing and outgoing calls.

The basic unit with ten on-off functions is £175.

Zambette Electronics, 3 Avon Way, Shoeburyness, Essex, SS3 9DZ.

NEW BROCHURE FROM EAGLE

Just released is a new 24 page brochure from Eagle International, entitled PA '74. As the name suggests, it contains details of the entire range of Eagle public address equipment.

PA '74 however, does not restrict itself to the trade or contract end of the market, instead it opens with 4 pages devoted to the wide range of uses the equipment can be put to. From the obvious factory/office needs, to stage, entertainment and general audio uses.

The equipment shown includes general paging amplifiers, special microphones and a host of mixers both microphone and programme type. It also includes many new lines for 1974.

PA '74 can be obtained by phoning or writing to:

Eagle International, Precision Centre, Heather Park Drive, Wembley, Middlesex.

Continued on page 68

LASERS AT WORK

The Simrad LP3 Laser Range finder, developed and manufactured in Norway for that country's army is one example of how lasers are finding new applications.

This unit, which has been approved by NATO, has been supplied to a number of armed forces and is currently undergoing trials with the British army. The unit is completely portable and weighs less than 15kg in its case.

The target is lined up in a telescopic sight and the distance — between 200 and 20000 metres — is displayed on a digital display with an accuracy of within 5 metres.

Objects such as fences or foliage which could give misleading readings can be excluded from the readout.

Once described as 'the ideal solution to yet unfound problems', the laser now finds innumerable applications throughout science, industry and commerce. Here, Dr. Sydenham discusses its use in measurement. A second article, will deal with power, communications and a whole host of other uses.

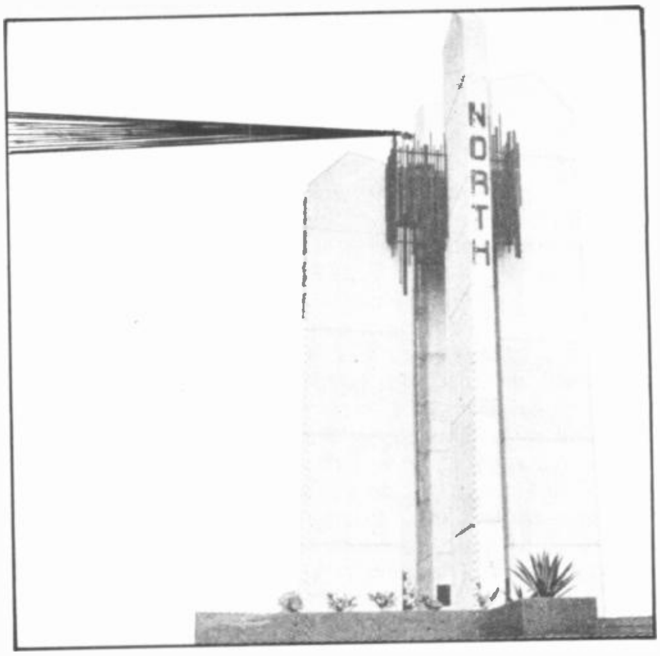


Fig. 1. The World's first laser light-house The 2 m high unit sits atop the Captain Cook Memorial on the East Coast of Australia.

WAY back in 1637, Descartes laid the foundations of optical behaviour, leading up to the laws of diffraction. The concept of light as a wave of radiation was born. Newton, around 1670, suggested that light was corpuscular in nature, thus providing a second concept of light that also works in many cases. (Today we use either as is appropriate). It was another 130 years before the properties of interference were realised. This was the work of Young. In close succession various other laws of light were explained in terms of what we call classical optics.

But it was not until the 1920s, that the structure of the atom was understood, showing us that electrons can only exist in discrete states of energy level. This modern thought enabled the laser concept to be envisaged on paper. More years passed before a practical device was built, a microwave laser having been demonstrated first.

In 1960 Maimans prototype laser produced the first laser light.

The laser source was termed at the time "the ideal solution to yet unfound problems". There can be no doubt now that the problems have been found and that one type of laser or another provides a closely ideal solution to large and varied fields of need.

It took a year or two after 1960 before widespread application of lasers commenced. This was mainly due to their initially high cost. What now costs less than £100 (the recent ETI laser project, for example) then commanded several thousand pounds and many month's wait.

Today most of the mystery has gone out of laser manufacture. Technicians can assemble them, tune them and service them after a few hours' tuition. The reliability has steadily risen from days or months of operation to a point where manufacturers of CW lasers now offer 18 months' guarantee (and usually live up to it without a murmur). The robustness has been vastly improved. They are flown in vibrating aircraft, used in mines, in steel plants, in harbours: it is hard to find a place they haven't been used.

Expenditures on laser research and applications each year run to 50p a head in the USA and 11p in Britain. Military expenditure is vast, especially in the search for the death-ray weapon.

PROPERTIES OF LASER RADIATION

Useful application of any phenomena is based on a working knowledge of the properties of the effect. The laser offers more than one unique characteristic over other radiation sources operating in the visible and infrared region.

Firstly, its radiation is extremely chromatic, that is, it occurs as a specific very narrow band-width of frequencies — it is, therefore, a useful spectrally-pure source. This property enables laser radiation to be detected in the presence of considerable levels of background optical noise with little more than a good optical filter.

Secondly, the beam is coherent. This means that the majority of energy wave trains emitted are in phase, giving the radiation the ability to be used in interference modes of application. As yet technology has not delivered a

Recent Optical Maser Experiments

Recent physical experiments at Bell Laboratories have confirmed several predictions of the behavior of an optical maser. The theory of this device is discussed in the accompanying article.

In the experiments, Laboratories scientists used a synthetic ruby rod, ½ inch long and 1/5 inch in diameter. The ends of this rod were polished until extremely flat and parallel, and were covered with a reflecting, yet slightly transparent, layer of silver. This rod was held in the centre of a spiral photoflash lamp and illuminated with an intense flash of ordinary white light.

The investigators found that when the power applied to the flash lamps exceeded a certain value, a nearly parallel beam of light was emitted through the silvered ends. This light was red, like the ordinary fluorescent light from ruby, but differed from it in several important ways.

First, it was sixty times closer to being "monochromatic" (of a single frequency) than the ordinary ruby light. Second, the light is "coherent" as was demonstrated by arranging two fine, parallel slits in a thick silver coating on one end of a ruby rod. The pattern of emerging light showed the light from one slit to be interfering with the light from the other, indicating that the emitted light was in phase across the end of the rod. Third, almost all of this monochromatic light was emitted within a cone angle of only one-tenth degree. Within this cone, the intensity of the light was far higher than could be obtained by the ordinary fluorescent process.

As a communications experiment, a ruby optical maser was set up at the Holmdel, N.J., location of the Laboratories and aimed at the Murray Hill Laboratories, 25 miles away. Red flashes, clearly visible to the naked eye, registered on photo multiplier tubes. The circle illuminated by the beam at Murray Hill was only about 200 feet in diameter.

Another experiment involved transmitting pulses of light along a quarter mile of two-inch diameter circular waveguide, where the dust and fog of the atmosphere could not attenuate the beam. Photomultiplier tubes at one end of the waveguide recorded clear pulses of high-intensity light.

With further developments, a beam from an optical maser might be used for a variety of scientific applications, including communications. At present, messages can be sent only in a code based on repeated flashes. However, since the coherent light is emitted in short bursts rather than as a smooth pulse, it may eventually be possible to modulate the signal, permitting many telephone conversations or television signals to be transmitted simultaneously over such a link.

"This short article released details of the first experiments testing the application of lasers — from Bell Laboratories Record — November 1960."

LASERS AT WORK

detector that can respond to frequencies of 10^{14} Hz, so interference must be carried out optically rather than electronically (as is done at lower frequencies). An infrared frequency detector was recently demonstrated at MIT so it should not be long before we have visible wavelength devices.

The third unique feature is that the laser beam emerges, not as a point source radiating in all directions, but as an already collimated ray diverging typically by only a part in a thousand (one milliradian). There is an exception to this generalisation, for the solid-state junction lasers do not possess this feature. Without modification the beam can act as a weightless line in space enabling a whole host of alignment measurements to be made. There is, however, much more to this feature than that, for it means that the radiation is already gathered into a narrow aperture and is, therefore, of high intensity. It also means that it can be further focussed in an efficient manner by collecting all of the radiation with a collimator (normally termed the telescope in laser technology). This can either provide tighter beam control or fine spots of extreme power density. As Brian Chapman outlined previously ("Lasers" ETI August 1973) powerful lasers can be focussed to provide temperatures of the order of millions of degrees.

There is no universal laser. They are offered with varying power outputs (milliwatts to megawatts), as pulse or continuous wave (CW) devices and can be at one of a number of discrete wavelengths ranging from infrared to near ultraviolet. Also now available is a tuneable laser system in which the output colour can be smoothly swept across the spectrum at the turn of a knob. There is even talk of an x-ray laser. It seems any substance can be made to lase — jelly has!

One type of laser that does not quite fit the above description of characteristics is the Ga-As junction laser. It produces spectrally-pure radiation but lacks both the collimation and long-term coherence features. Its virtue is that it is easy to modulate and, being pure in wavelength, is easy to detect in ambient light conditions.

Overall, the efficiency of lasers is poor. For instance, a 5 mW output CW He-Ne laser has an input of 40 W. This is still, however, by a long way, the most efficient method of producing radiation with the above properties. The characteristics of the smallest laser render it visible hundreds of metres away in daylight. The laser lighthouse (shown in Fig. 1) for instance, has a power input of 250 volt-amperes and can be seen twice as far as existing formulae for lighthouses predicted — a new code has been formulated to cover them.

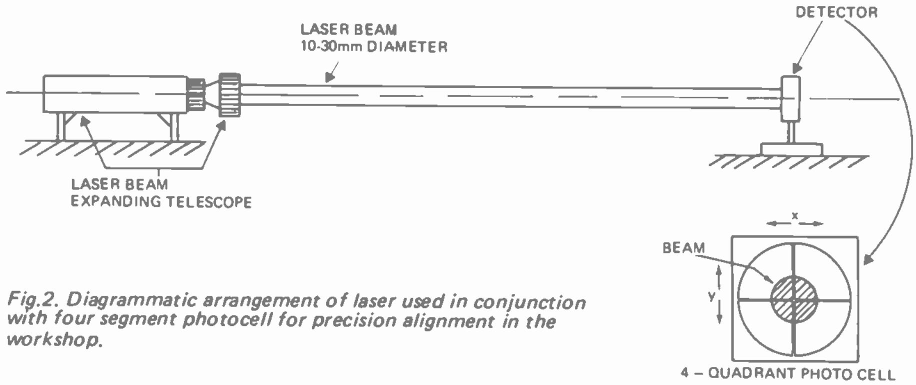


Fig.2. Diagrammatic arrangement of laser used in conjunction with four segment photocell for precision alignment in the workshop.

Applications divide broadly. There are those concerned with measurement, as found in surveying, in the workshop, in the laboratory, at sea and in the air.

The main uses for the newly discovered lasers were at first in communications (see Bell Lab's Record account), but since then very many other applications have been found.

These include the cutting of materials ranging from ceramics, exotic and ordinary metals, wood, cloth and paper.

In the communications field, the bandwidth offered by coherent laser light is way beyond the requirements of most situations. This fact, and the cost of terminal equipment and transmission designed so far, does not make it an attractive proposition compared with waveguide alternatives.

After these applications we are left with a whole host of other uses like those in art, teaching and computing.

THE LASER AND SURVEY WORK

The narrowness of the beam and its good penetration of the atmosphere immediately suggests the use of the CW laser to provide a reference line in space. By 1966 several firms were offering tooling lasers for use in precision workshop metrology. These used the normal CW He-Ne source encapsulated inside a precision-ground cylindrical tube, providing a beam that emerged from the centre of the tube. They were designed to provide a centre line through a system — such as a row of main-bearings in a large engine.

The centre of the beam, (see Fig.2), is detected using a four-segment photo-detector. In this, each pair of opposite cells are differentially connected and drive a meter. Thus the operator is provided with x and y deviation display, reading to fractions of millimetres. Devices such as these have been extensively adopted in

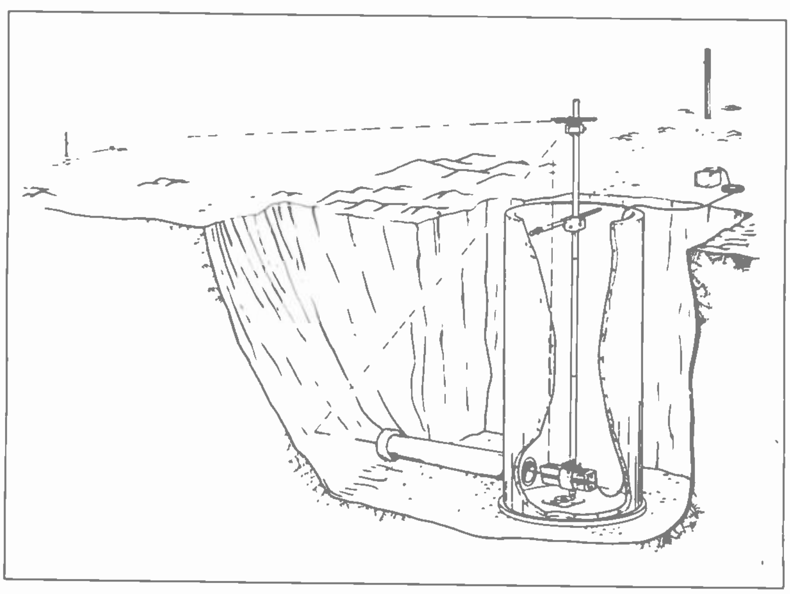


Fig.3. The Spectra Physics Dialgrade system has many accessories — here it is set up for alignment of pipes in the bottom of a manhole.

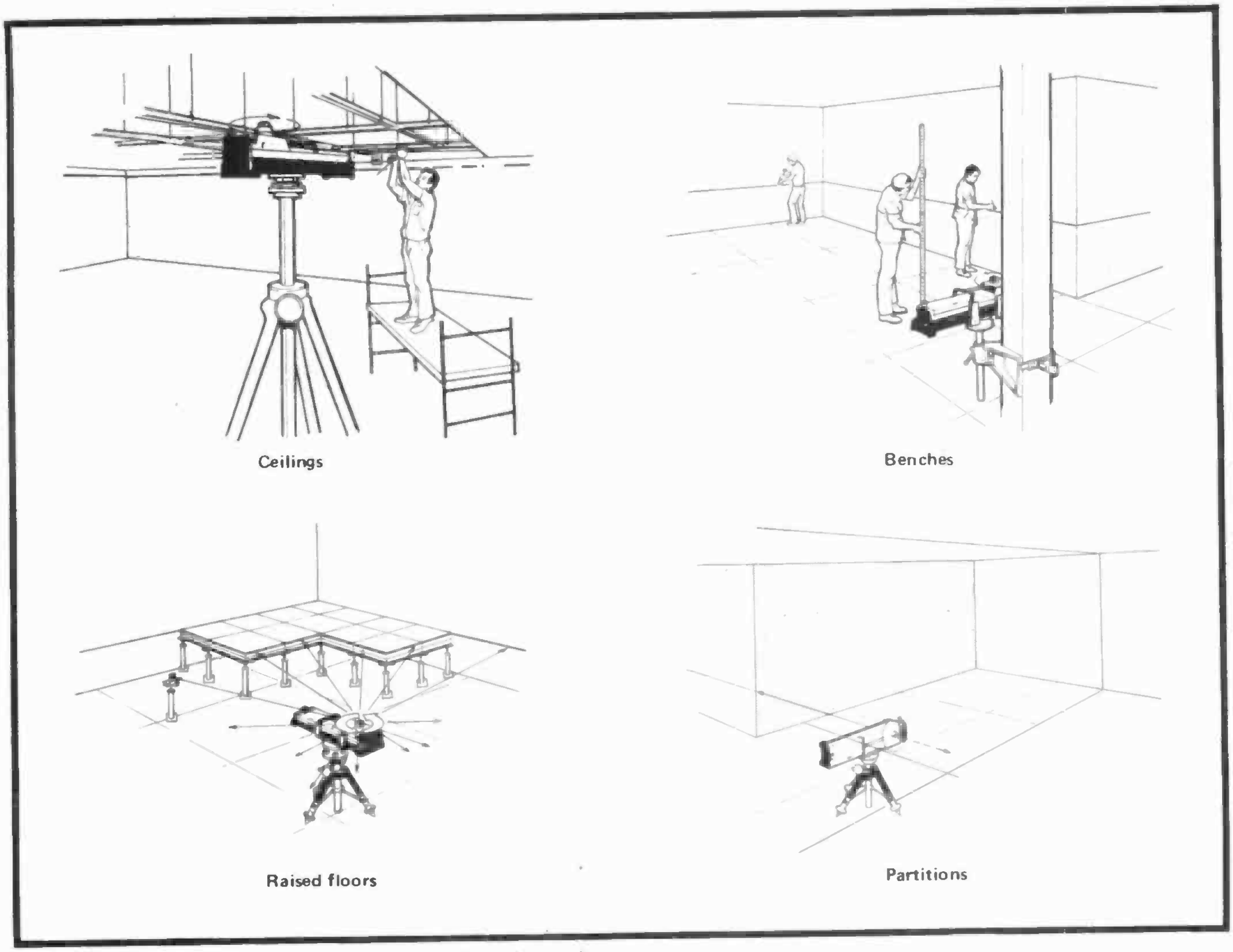


Fig. 4. The scanning laser beam sweeps around providing a datum plane.

industry – their cost certainly exceeds that of a stretched wire but they are more precise and easier to use than their closer cost equivalent – the tooling telescope.

The major advance with these units over the last eight or so years has been the recognition that the normal laser cavity design is generally inadequate for alignment use. Quality systems now have special mirrors provided at the cavity ends, and a narrower bore, to ensure that the beam emerges always from the same place and maintains the same pointing angle in space.

Somewhat slower to gain acceptance, but now probably the biggest use of the laser in metrology, is the similar application to constructional and surveying alignment in the field, in tunnels and across harbours.

Basically, there is little difference between these systems and the tooling laser, the major addition needed being a telescope (collimator) to improve the collimation. This reduces the beam width at long ranges, giving improved precision in alignment. (The Laser Electronics range of survey lasers has a beam spread of 250 mm per kilometre.) It is also necessary to broaden the beam near the source, as the power density could be hazardous to the eyes – it is hard to ensure safety with unenclosed beams that stretch over distances of kilometres.

Survey alignment lasers need not be bore sighted to the same precision as a tooling laser. The mounting requirements also differ; usually they are fixed in the position of the telescope in a theodolite style frame. Most have self-contained supplies for use where mains power does not exist. Naturally, special alignment applications often call for a different type of mount. For instance, stands are available that point the laser vertically – for aligning lift shaft tracks and similar tall structures.

The first survey lasers were laboratory units mounted on theodolite frames. In the last two or three years there has been rapid development toward special-purpose, highly rugged, integrated systems that can confidently be used under the hardest of constructional situations.

The Dialgrade unit, marketed by Spectra-Physics and illustrated in Fig. 3, looks little like the normal run of CW laser package. It is a system developed mainly for pipe-laying under all conditions. Each unit is immersed in water to test for leaks; frozen in the inside of a block of ice and shock tested to 40 G.

Companies, such as Wild and Siemens, also produce units for establishing grade – they have that continental appearance of being obviously workable in hard environments.

Applications abound for these units. Manual layout of pipes, foundations and trenches, and automatic applications such as tunnel boring 'mole' control and unmanned coal-face digging machines come to mind.

Another problem of construction surveying is the definition of a plane. Fewer companies have developed equipment for this – however both Spectra Physics and Laser Electronics market devices. In these, the CW laser beam is reflected from a rotating mirror providing a line that sweeps around in the horizontal (or, if need be, in the vertical) direction. Rotolite is Spectra Physics product name for their integrated system – it has been invaluable in the setting of raised floors, suspended ceilings and partitions – see Fig. 4. A special readout unit is also available to go with it – it provides an amplified

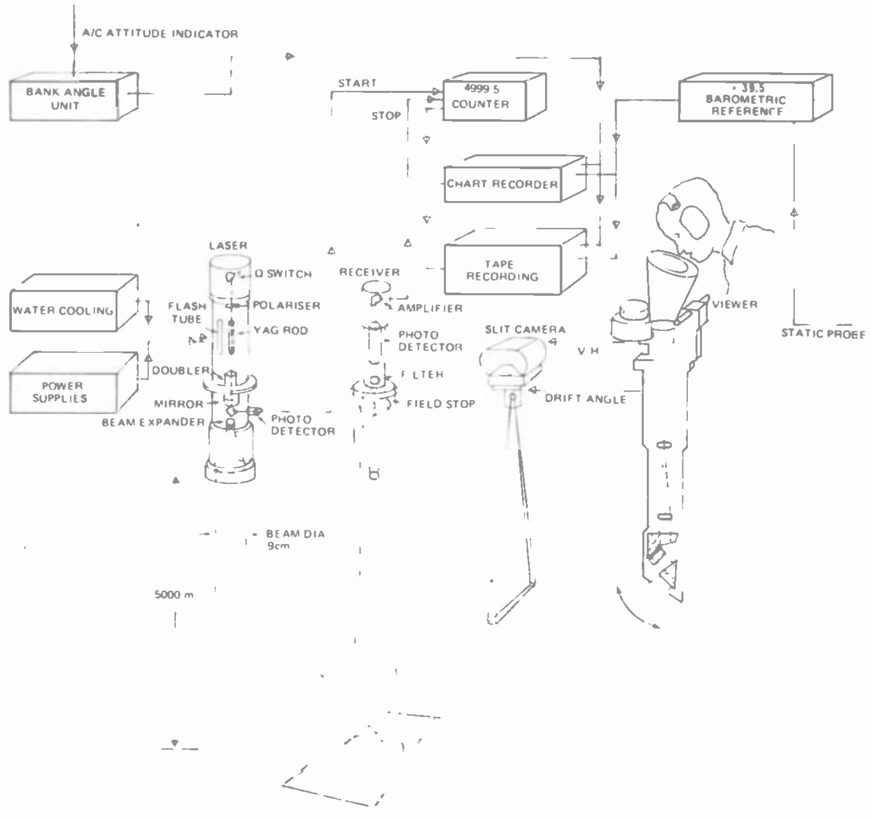


Fig.5. Block schematic of WREMAPS II laser terrain profiler. All of the equipment shown is flown in the aircraft.

meter movement of beam displacement. With this unit, levelling operations become a one-man task. The user sets up the central scanner unit placing the defined plane where it is needed. He then moves out, as far as 150 m, with a measuring staff (that supports the detector) checking levels as the beam sweeps past repetitively.

In the marine field, alignment needs are met by the Channel Light of Laser Electronics. This is a dual output, parallel-beam unit, in which each beam is switched for 0.5 s on and 1.5s off on one side, and 1.5 s on and 0.5 s off on the other. The beams overlap in the centre appearing steady when the observer is in the centre looking toward the source, whilst on either side they flash at 1.5 s or 0.5 s intervals indicating which way the ship has deviated. This guidance system can be used to guide ships and dredges along a straight line of lengths to 20 km.

Surveyors use lasers in various ways to measure range. A modulated beam of laser light (it may be pulsed carrier or continuous radiation) is transmitted out to a suitable target where it is reflected back to the sending terminal. Knowing the velocity of light (which we do to about 1 part in 10^6 in ambient air) the transit time taken for the beam to go out and return enables the distance to be determined. (EM radiation travels about 300 mm in a nano-second). The main design task is to 'mark' the beam in some way in order that a sent pulse can be detected on return in order to time the flight. This can be achieved in one of two ways — firstly, by sending a single pulse and waiting for the return; or secondly, by transmitting a continuous modulated beam and then comparing the phase difference between the outgoing and returning signals. In the latter it is usually necessary to operate on a second frequency in order to define distance more uniquely.

These electro-magnetic distance measuring devices (EMD for short), do not rely on laser light for their operation — they were in existence many years before lasers. Incorporating a laser source has, however, increased the available daylight range and raised the ranging precision by a factor of two. Units, such as the laser Geodimeter, measure ranges of many kilometres this way, competing with the best microwave equivalent.

Problems of timing the rapidly travelling EM radiation limits the resolution of these units to a few centimetres, restricting their usefulness to long-range work. It is a pulsed laser system like this that is being used to measure the distance to the Moon to extreme precision. (The atmosphere error effects that normally limit EDM measurements to parts in 10^6 are not present for the majority of the flight path. Furthermore, longer distance relaxes the timing requirements).

Around 1969 the surveying instrument manufacturers of Europe each released (within months of each other) less expensive ranging units that made use of a Ga-As diode laser as the source. The diode current is varied directly to modulate the beam. These rangers were designed for shorter distances with the same centimetre precision (lower *relative* accuracy), and usually provide distance on a digital readout display.

Map making is a slow and somewhat tedious task, for millions of topographical data points must be measured to make a simple map. One recent device now helping to speed up the process is the laser-powered WREAAP terrain profiler. (Two models exist — MkI and MkII). The latest design (see Fig. 5) uses a solid-state pulsed laser (Q-switched neodymium-doped YAG) to produce infra-red radiation. This is frequency doubled to produce pulses of green radiation. These pulses are

Fig. 6. Schematic of interferometer layout and displacement sensing scheme used in the Hewlett Packard interferometer.

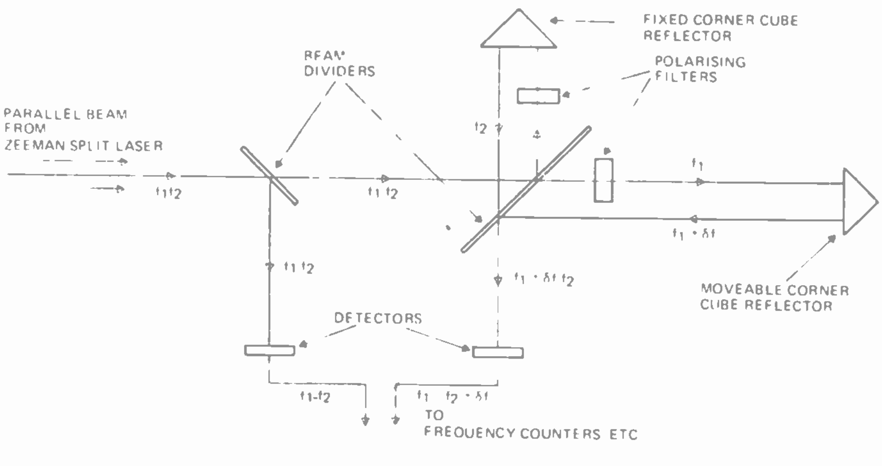


Fig.7. Calibrating machine-tool movements with the Rank Precision Industries laser interferometer.

transmitted, at 25 per second, through the belly of the aircraft to the ground below. They leave at 90 mm diameter, expanding to about three times this, 2000 m below. Reflected energy is detected back at the plane, and by using a fast timing counter it is possible to determine height to about a half-metre. Corrections are needed for aircraft roll, and for the changes in height of the aircraft as it flies. The profilers have been in active use for several seasons producing mapping data at a huge rate.

When the profilers were used over open sea or lakes, misleading answers were sometimes obtained. Careful analysis of the data revealed that the pulses were often penetrating the water giving, in fact, a profile of the bottom *under* the water. This led to the start of another programme (now in progress) to develop a mapping system for undersea work. The attenuation of even muddy water is not extreme – about 3 dB per metre – so a return signal can confidently be expected. Combined with a sideways scanner, the flown profiler can become a three-dimensional mapping tool for above and below water surveying.

Another large-scale measurement to which the laser has been put is the detection of the minute earth-strains that are induced in rock by the changing attraction of Moon and Sun, by earthquakes and by tectonic movements. Here the problem is not one of measuring absolute length to parts in 10^6 but one of detecting changes in length to parts in 10^{10} (an atom diameter in a 10 m distance).

One form of earth-strain meter uses a laser to power a long-path Michelson type of interferometer that is enclosed in evacuated pipes. As the far-end reflector moves relative to the near end, the fringes translate: these are monitored and the movements recorded for periods of months to years. The lengths of the nine or so interferometers built in Britain, USA, Italy, Japan and Australia range from 20 m to 1000 m. In this application it is necessary to stabilise the wavelength of the laser output to parts in 10^{10} using a special technique that is explained later.

WORKSHOP METROLOGY

We have already mentioned the use of the laser as an alignment tool. It can also be used in the workshop to measure absolute lengths to great precision, (the best, in fact), by implementing the interferometer principle. Within two years of the realisation of the laser, several commercial enterprises had workshops interferometers on the market. By 1965 they were well accepted, but due to their extremely high price, (£25,000 then) few places could afford to have them. Today the price has been halved and the facility afforded by the basic equipment has been greatly expanded to include angle, alignment, velocity, flatness, pitch and yaw measurements.

The Hewlett-Packard model incorporates frequency stabilisation of the laser and detects frequency difference, avoiding the use of fringe counting. A block-diagram is given in Fig. 6 where it can be seen to be based upon a Michelson interferometer using corner-cube reflectors instead of plane mirrors. Corner cubes have the very useful property that they return a beam parallel to the incoming one regardless of small rotations of the cube – it is considerably easier to align an interferometer using these.

Being incremental by nature, a length can only be measured with an interferometer by translating the free corner cube over the total distance to be measured. If the beam is lost at any time whilst moving along the path the value will be incorrect. This means that the laser interferometer can only be used where a guideway straight to about 2 mm exists. Range capability varies from micrometres to decametres, the laser providing the coherence length needed for the greatly different path lengths between the references and the measuring arms. Figure 7 shows a machine-tool being checked with a commercial laser.

Interferometers have also been permanently incorporated into high accuracy inspection machines, into numerically-controlled machine tools and into scale calibrating machines.

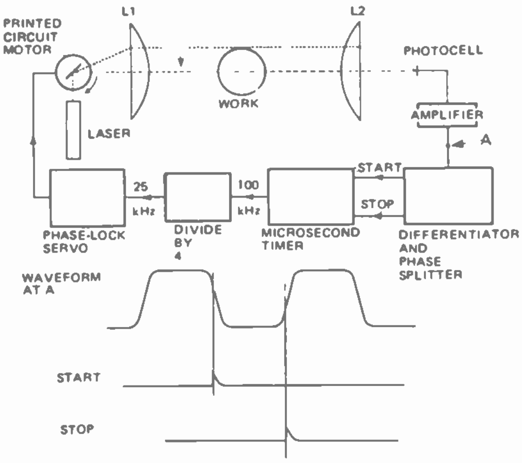
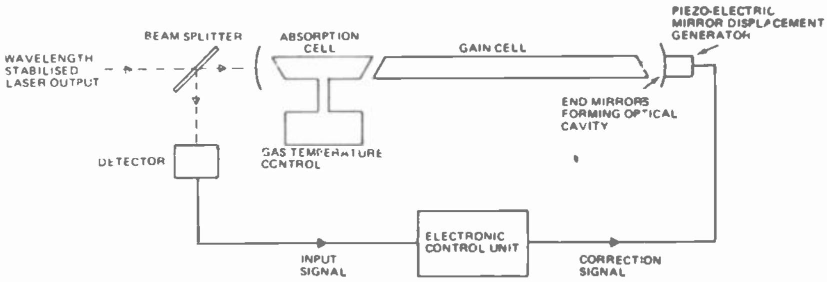


Fig.8. Block diagram of the Machine Tool Industries Research Association in-process bar gauge.

Fig.9. Simplified diagram of the stabilised laser that will soon become the new length standard.



LASERS AT WORK

The need to guide the corner cube is, however, a very real disadvantage. The use of hand-held corner-cubes as large as 150 mm across has been proposed for measurement in cases where no guides exist but does not seem to have been developed very far.

A less well-known application of the property of laser light is in the gauging of fine wire and filament diameters. This is achieved by simply placing the wire in the beam — diffraction effects around the wire cause the beam to break up, producing a line of dots on a screen placed beyond the wire. The various distances — screen to wire, spot separation and laser wavelength — enable the wire diameter to be calculated. This method has been used for continuous sizing control by placing a position-sensitive photo-detector to view one of the diffraction spots formed. As the wire diameter varies, the spot moves, providing a correcting signal. It is interesting to note that the accuracy of diameter measurement *increases* as the wire-size *decreases* with this method.

Larger diameters can be measured by scanning the laser beam across the round stock, see Fig. 8, monitoring the angle during which it is vignetted on the other side. This is used in steel mills for gauging the size of red-hot bars as they are rolled.

HOLOGRAPHY

Several years before the first laser had been made, a revolutionary new concept for recording shape on a photographic plate had been proposed. It could not be demonstrated until the laser was developed, so its practical use had to wait. It is known as holography because it provides a kind of photograph in which three dimensional 'hollow' pictures are made. The basic technique of holography is explained on the last page of this article.

An extension of the procedure — time resolved holography — superimposes the hologram of an object at one time with that of another. If any differences exist between the two — shape changes or relative movement — fringes are formed. Study of the fringe spacing and smoothness reveals much about distortion of the shape. As each fringe separation corresponds to fractional micrometre movements the method is very sensitive.

Holography has numerous uses. In the workshop and research it has been used to study distortions in turbine blades, loudspeaker cones, vibrating disks, gas cylinders, car-type treads and cylinder bores. Although most examples we hear about are only in a once-off investigational stage of development, special purpose plants incorporating holography are slowly appearing. For example, a tyre testing machine is now available commercially. In operation, a hologram is made of the inflated tyre tread; the pressure is slightly changed and the before and after holograms interfered. If an area of abnormal stress exists (a piece of tread unvulcanised to the case, for instance) rings of fringes appear that visually stand out with respect to the broad-pitch fringes produced across the rest of the tyre.

SCIENTIFIC MEASUREMENT

The majority of industrially accepted devices have their genesis in the scientific laboratory. This is certainly true of the laser. There exists in various fields of research many more measurement applications that will, no doubt, gradually find their way into industry.

The first we will consider is the wavelength stabilisation method mentioned earlier, for this will shortly become the new improved international standard of length. A normally constructed He-Ne CW laser produces radiation that drifts in wavelength with time by parts in 10^6. Any interferometric length measuring method using such a source cannot provide absolute measures of interval to better than this limit. Since the early sixties various means have been devised to stabilise the wavelength, the best (until recently) achieving parts in 10^8 control. This order, however, is not better than the already existing krypton wavelength standard produced with a gaseous discharge source.

Over the last three or four years several groups, at each of the Standards Laboratories in the USA, Canada, Britain, Germany and Australia have been working on an advanced principle that will give parts in 10^{10} reproducibility. Several units have been tested and it is now generally agreed that it is only a matter of time before the krypton source will be replaced by a laser stabilised with this new method — called molecular absorption stabilisation Its operation is as follows.

A normal CW laser has a gain cell (wherein energy levels of the atoms are pumped up) placed between two mirrors that form the cavity. As the cavity length is slowly altered, it is found that the power output from the laser varies, having a maximum at a certain length. Careful study of this peak reveals that there is, in fact, a slight drop of power in the middle — we call this the Lamb dip. Early stabilisation schemes servo-controlled the length to keep the output at the bottom of this dip realising parts in 10^8 control of wave length.

Theoretical considerations suggested that this could be improved upon, and this is the case in practice. If a cell containing gas, as shown in Fig. 9, is also placed in the cavity and the length again varied it is found that there are, in the width of the Lamb-dip curve, a number of small narrow peaks. These are the result of absorption effects in the gas cell, and they occur at precisely defined wavelengths — far more precisely, in fact, than the Lamb-dip definition. In practical use

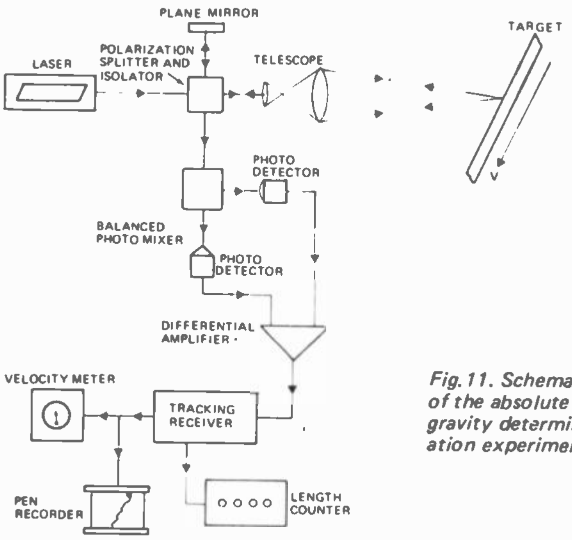


Fig. 10. The laser doppler velocimeter can be used to detect speeds ranging over many orders of magnitude.

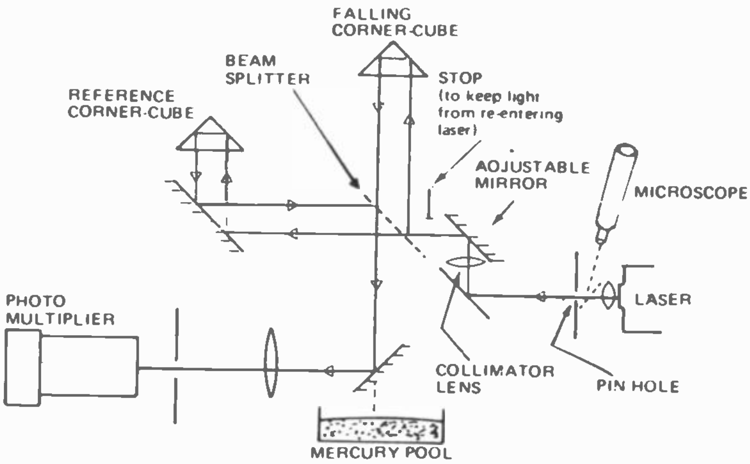


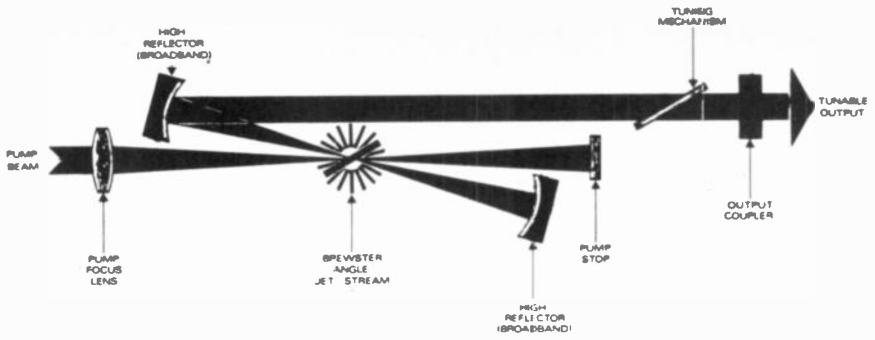
Fig. 11. Schematic of the absolute gravity determination experiment.

the cavity length is varied with a piezo-electric microdisplacement device to hold the power output on top of one of these peaks. Now that the practical problems are virtually solved — the electronic detection is sophisticated — it should not be long before these units are available commercially.

A second laser measurement device, used mainly in research, is the laser velocimeter; it can measure the velocity of a moving medium, fluid or solid, looking at an extremely small portion of it. Laser light, (see Fig. 10) is shone onto the medium. Particles, such as surface defects on solids or aerosols in fluids, reflect some radiation back to the source where it is optically-mixed to produce an interference pattern. If there is no movement the pattern is stationary; if moving, the 'fringes' translate at a speed proportional to the velocity of the medium — it is a kind of doppler effect. The period of the detected fringes is therefore related to speed. The principle is easy to understand, but there are several practical problems, not the least being the short duration (one to five cycles only) of useful fringe signals that result because of the poor signal-to-noise ratio of the method. A description of the laser Doppler velocimeter was given in an earlier issue of ETI.

Other interesting scientific applications for the laser interferometer are worthy of note. For instance, diffraction gratings (ruled lines on a substrate — used to disperse infrared and visible radiation into the various wavelengths) are now ruled using laser control of the ruling carriage. The lines are placed only micrometres apart. Another use of the interferometer has been in the determination of the absolute value of gravity. The original scheme proposed by the staff at the Wesleyan University in the USA is given in Fig. 11. A solenoid releases the top corner-cube allowing it to fall. Timing circuits (not shown) measure the time taken for the reflector to fall through a certain distance. The experiment is performed in vacuo to eliminate air friction effects.

Laser radiation is spectrally pure and, therefore, very useful in spectroscopic studies. Initially, there was only a few specific wavelengths available, these being the characteristic colours of the various types of lasers. Today, we have the tuneable dye laser in which the colour can be swept across the spectrum at the turn of a knob. A high-intensity source — the argon ion laser, for instance — optically pumps an inorganic dye solution causing it to lase at wavelengths different from the pump radiation — refer to Fig. 12. The



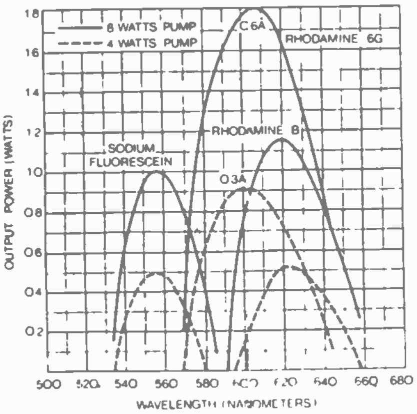


Fig.12. Layout of Coherent Radiation's tuneable dye laser. The dye flows across the optically-pumping area being confined only by its inertia forces — no cell is used. The inset graph shows the range of wavelengths available with different dyes.

output of the cell does not occur at a discrete colour but as a broad band of wavelengths; a particular colour is filtered out using a tuneable Fabry-Perot etalon selector. In essence, changing the length of the etalon (a cavity formed between two parallel flat mirrors) alters its spectral transmission allowing only a very narrow band of colour through for a given spacing.

The short duration pulses available from some lasers have given a new dimension to high-speed photography. Picosecond pulse lengths of high intensity light enable extremely fast events to be effectively frozen.

AN X-RAY LASER

For many years there has been talk of ways to produce coherent x-rays. Now it seems an x-ray laser has been demonstrated, for reports are circulating of success by a London group. Theoretical considerations predict x-ray radiation will occur by laser action; the practical problem is to raise the energy levels sufficiently to move electrons into far-enough-out orbits. Energy levels to 20 000 electron volts are needed. Calculations show that a material raised in temperature to 20.10^6 degrees Celsius should suffice. It is rumoured that the London group used a glass laser (the most powerful) focussed onto graphite to produce x-ray emission.

When x-ray lasers become common practice they will greatly extend the capability of radiography. They will enable holograms to be made of the inside of optically opaque objects. Being coherent, such sources would also extend the fields of microscopy.

THE LASER AND CRIME DETECTION

The potential of holographic methods is being investigated to see where it can help in the detection of crime. One case already demonstrated is the detection of footprints left in carpet — hours after they are made. A hologram of the suspected area is made, followed by a second exposure a little time later. If anyone has been standing there, the indentation thus caused will still be creeping back giving small differences in distortion even hours later. The combined holograms appear as fringes that have the shape of the foot. They also indicate weight and distribution of load on the foot.

Another device that can be used in crime detection and espionage is the laser listening unit. Conversation in a room causes the window panes to vibrate in sympathy with the acoustical pressure changes. An infrared laser (one that cannot be visually detected) is aimed at the window from some distance away. Reflected radiation from the window is mixed with that sent, forming a doppler velocimeter in which velocity represents speech inside the room. These devices do exist.

MEDICAL MEASUREMENTS

In surgical transplants the problem of rejection is yet to be completely mastered. Kidney transplants, for instance, do not always take. If the degree of acceptance could be monitored daily it would be possible to remove a rejected organ before secondary effects set in. Current research aims to produce a pulsed holographic method that will enable viewable pictures to be produced of the organ showing the development of the all-important blood vessels.

Holography has also been suggested as a way to improve the fit of dental plates — the dual exposed hologram of palate and plate can show tiny difference.

We will see in the second part of this article that the laser has many more uses in medicine than for measurement alone.

WHO KNOWS WHAT OTHER USES EXIST?

To round off this survey we finish with a quick list of other measurement uses of the laser.

In missile tracking, a laser has been used to 'mark' the missile with a heat patch enabling a heat-seeking missile to seek and destroy it. Bombs are guided down laser beams with unerring accuracy. Cloud heights and the extent of pollution in air are being measured using laser readers, (Lidar for short).

The Migros supermarket chain in Europe uses laser reading heads to scan the coded labels marked on goods. Not only does the head supply figures for the till automatically to ring up the total charge, it also provides inventory and reordering data.

A meat tenderness meter has been reported — this measures the diameter of the fibres providing a more objective definition of meat quality.

No doubt there are numerous other measurement applications waiting to be tried! ●

HOLOGRAPHY — A 3-D PICTURE FROM A 2-D PHOTO

In 1948, Gabor discovered a technique (in theory) called wave-front reconstruction — we now refer to it as holography. Leith and Upatnieieks demonstrated it in 1962.

A normal photograph contains only amplitude information about reflected light from a subject. If the subject is photographed in a special way with coherent light it is possible to produce a photographic negative having both amplitude and phase information. It looks nothing like a normal photo (Fig 1) — rings, speckles, dots are all there is to be seen — but when it is looked through, using coherent radiation shining from behind, the object appears to be reconstructed. Move the viewing angle and one sees around the object. Even more unexpected is that any fragment of the hologram will give the same reconstruction — all that suffers is brilliance level.

Although the mathematical explanation is complex the practice is quite straightforward provided stable supports exist. A typical setup is shown in Fig. 2. Incident coherent light falls on the object and on the photographic plate. Reflected light from the object also falls on the plate providing an interference pattern that is recorded photographically. To reconstruct the object (as an image) the set up is slightly altered as seen in Fig. 3.

By superimposing an object on a distorted replica of itself it is possible to detect changes in shape or position as differences. Time-lapse holography does just this — a hologram replica image is "placed" over the object forming fringes corresponding to differences — see Fig. 4. ●

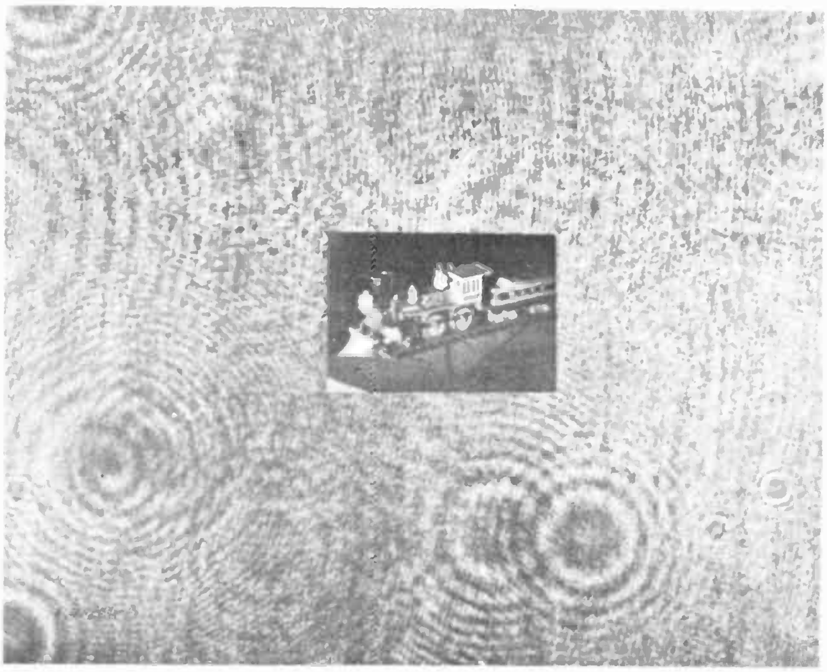


Fig. 1

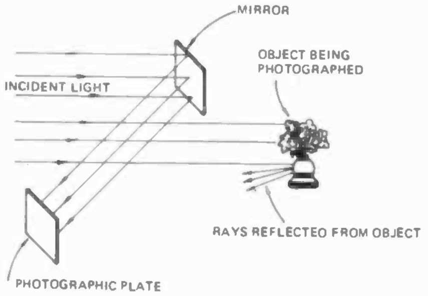
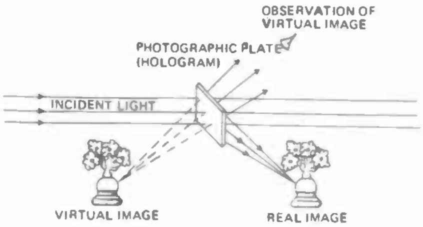


Fig. 2

Fig. 3



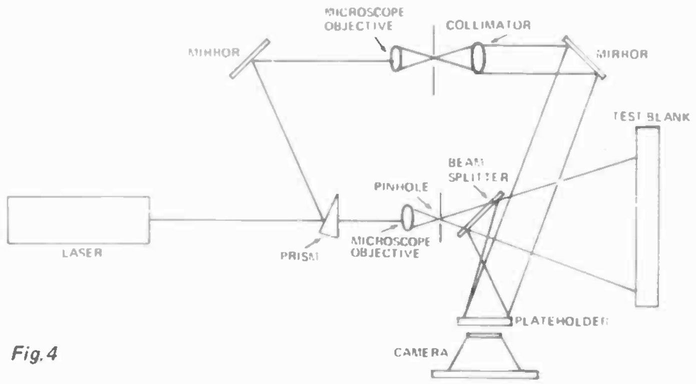


Fig. 4

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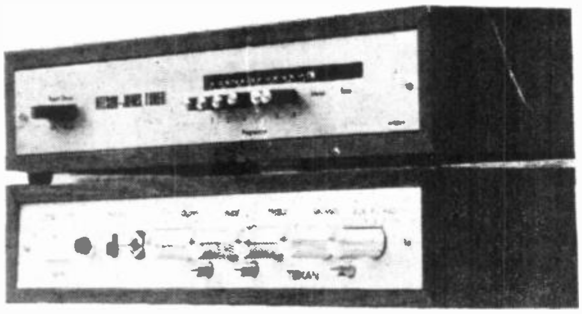

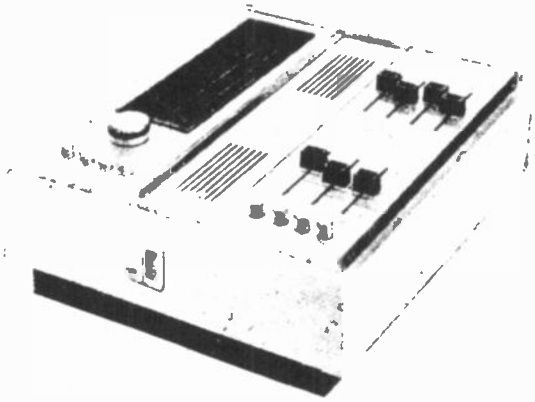

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POWER CONTROL WITH THE SL440

By J. B. DANCE, M.Sc.

IN AC CIRCUITS the power developed in a load can be controlled by devices known as triacs. They are rather like thyristors, but can conduct in either direction. Triacs may be triggered into conduction by various means including a number of specialised integrated circuits designed specifically for the purpose. A new device of this type is the SL440 from Plessey.

INTEGRATED CIRCUIT

The device is a 14 pin dual-in-line integrated circuit known as the SL440. The connections to the device are shown in the block diagram of Fig. 1; it should be noted that only pins 1 to 4 and 11 to 14 have any internal connections.

In the past, triacs have usually been fired by means of circuits employing discrete components. However, the use of the SL440 greatly simplifies the circuitry and at the same time provides more facilities than most of the discrete component circuits in current use.

POWER CONTROL

The power applied to the load is controlled by varying the time at which the firing pulse is applied to the triac. As the alternating voltage is applied across the triac and the load in series, no current will flow through the load until the triac is switched to conduction. A pulse is applied to the triac during each half cycle of the power supply voltage. The earlier this pulse is applied in each half cycle, the greater the power applied to the load, since the current flows for a longer time. The triac automatically returns to its non-conducting state at the end of each half cycle of the power supply voltage.

This article will be mainly devoted to the practical applications of the SL440, but we will nevertheless consider the basic operation of the circuits.

Each time the alternating power supply voltage passes through the zero voltage point, this is detected by the zero cross-over detector in the SL440 and an external timing capacitor is quickly charged.

The capacitor discharges at a rate determined by the external circuit. This will normally include a variable resistor so that the discharge rate can be altered. If the capacitor is discharged very rapidly, this is detected by the SL440 circuit and a firing pulse is passed to the triac early in the half cycle of the power supply. The power developed in the load is then large.

If, however, the capacitor is discharged more slowly, the voltage across it will take a longer time to fall to the point at which the firing pulse is produced. The triac will then conduct later in the half cycle and the power passed to the load will be smaller. The discharge time should not exceed the time for one half cycle of the mains supply.

SPECIAL FEATURES

The SL440 does not require a separate power supply to drive it. A diode is used, in the circuits to be described, to supply a half-wave rectified power input to the I.C. An internal voltage stabiliser circuit provides an 11.3 V stabilised supply for the operation of the internal circuit of the device and also for the external timing circuit.

If the inhibit input of pin 4 is connected to the negative line of pin 11 or to a point less than +5 V relative to pin 11, the firing of the triac circuit is inhibited. This inhibit input can therefore be used to switch off the power to the load.

CIRCUIT APPLICATIONS

The SL440 is a versatile device which can be used in quite a variety of applications, but the circuits to be described are well tested ones recommended by the manufacturers of the device.

A simple circuit for controlling the brilliance of a lamp is shown in Fig. 2. The internal amplifier connected to pin 12 is not used in this circuit.

The diode D1 should have a peak inverse voltage rating of not less than 400 V; a 1N4004 device is suitable. The triac used must have a peak reverse voltage rating of at least 400 V and it must be able to pass the current taken by the lamp. The Tag 306-400 triac can control up to 8 amps, whilst the Mullard BTX94-400 can control up to 25 amps. It is therefore quite easy to control a large amount of power using circuits of this type.

The control potentiometer RV1 taps off a certain fraction of the 11.3 V stabilised supply and applies this voltage to pin 13. This pin is connected to the output of the unused amplifier inside the device and affects the discharge control circuit. The current passing to pin 13 is very small.

AUTOMATIC LAMP FADING CIRCUIT

The circuit shown in Fig. 3 can be used to cause the brilliance of a lamp to gradually fade away — in a period of 20 to 30 minutes with the values shown.

When S1 and S2 are both open, the brightness of the lamp is controlled by RV1 directly, but if S1 is closed the lamp will be at maximum brilliance.

If S1 is open and S2 is closed, the brilliance of the lamp gradually falls.

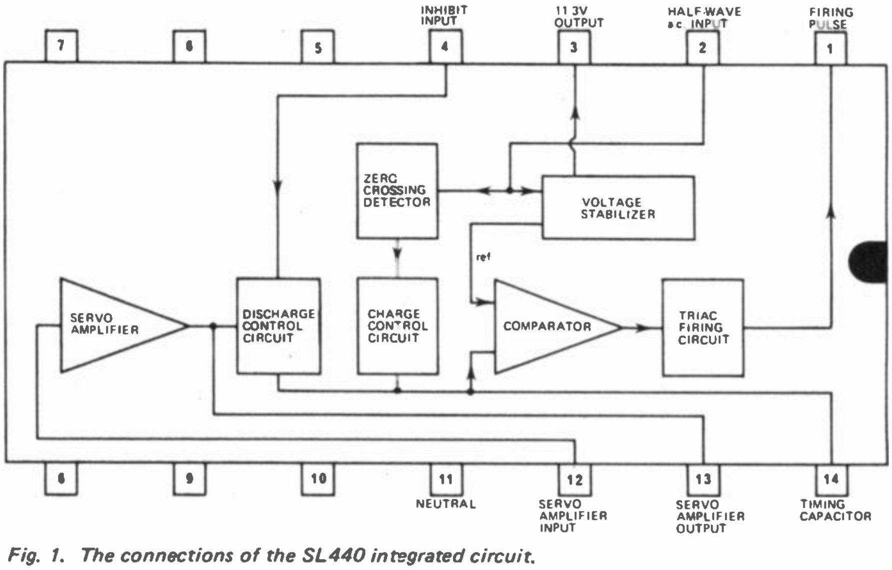


Fig. 1. The connections of the SL440 integrated circuit.

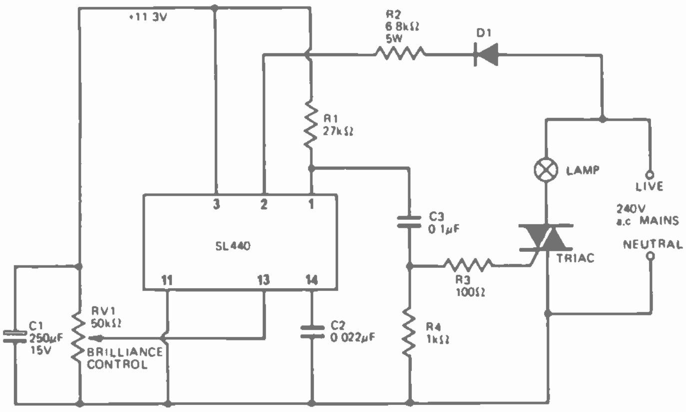


Fig. 2. A simple lamp dimming circuit using few components.

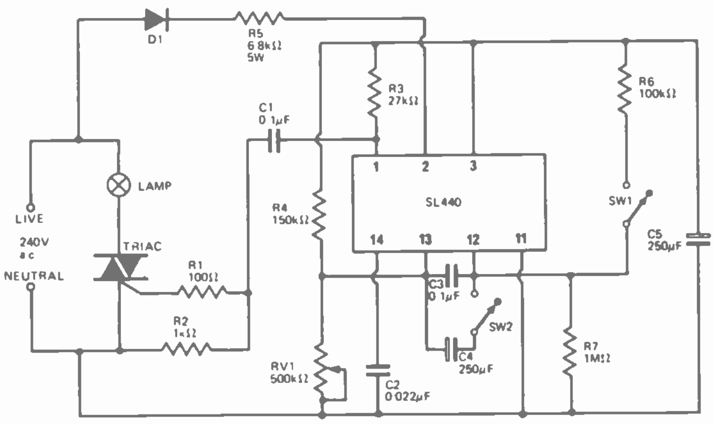


Fig. 3. A lamp brilliance control circuit with automatic fading facility.

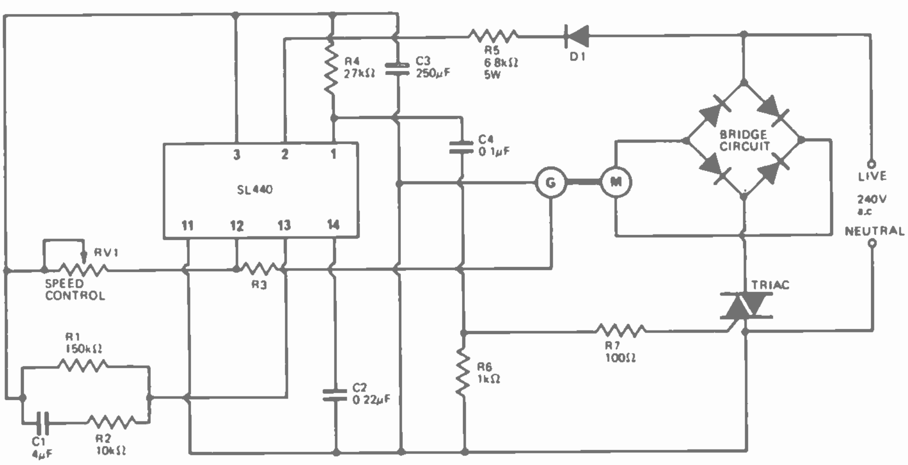


Fig. 4. A motor speed control circuit.

When the brilliance of the lamp has fallen to a point corresponding to the setting of RV1, it will remain constant at this lower level.

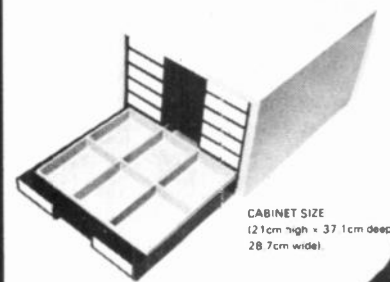
In this mode of operation capacitor C4 acts as an integrator, since it is connected between the output and input of the servo amplifier inside the integrated circuit. Although the value of C4 shown in Fig. 3 produces an imperceptibly slow rate of fade over a period of 20 to 30 minutes, larger or smaller values can be employed to produce any reasonable rate of fade.

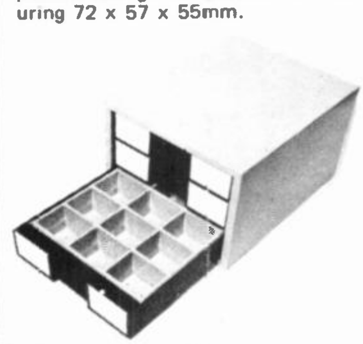
MOTOR SPEED CONTROL

The circuit in Fig. 4 shows how the SL440 can be used for the control of the speed of an electric motor. The motor itself (marked M) is connected by a spindle to the tachogenerator (marked T in Fig. 4). The motor and tachogenerator form part of a servo loop. The motor velocity is linearly proportional to the setting of RV1.

AVAILABILITY

The SL440 is available from S.D.S. Components Ltd., Portsmouth PO3 5JW at the current price of £2.08 in small quantities.





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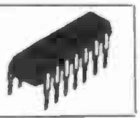

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7402	0·18	0·17	0·16	7451	0·18	0·17	0·16	74141	0·85	0·82	0·79
7403	0·18	0·17	0·16	7453	0·18	0·17	0·16	74145	£1·65	£1·55	£1·45
7404	0·18	0·17	0·16	7454	0·18	0·17	0·16	74150	£2·90	£2·80	£2·70
7405	0·18	0·17	0·16	7460	0·18	0·17	0·16	74151	£1·10	£1·05	£1·00
7406	0·39	0·34	0·31	7470	0·32	0·29	0·27	74153	£1·30	£1·20	£1·10
7407	0·39	0·34	0·31	7472	0·32	0·29	0·27	74154	£1·98	£1·90	£1·75
7408	0·20	0·19	0·18	7473	0·41	0·39	0·35	74155	£1·50	£1·45	£1·35
7409	0·20	0·19	0·18	7474	0·41	0·39	0·35	74156	£1·50	£1·45	£1·35
7410	0·18	0·17	0·16	7475	0·50	0·48	0·46	74157	£2·00	£1·90	£1·80
7411	0·28	0·27	0·26	7476	0·44	0·43	0·42	74160	£2·10	£2·00	£1·90
7412	0·39	0·34	0·31	7480	0·74	0·71	0·64	74161	£2·10	£2·00	£1·90
7413	0·32	0·31	0·30	7481	£1·30	£1·25	£1·20	74162	£4·40	£4·15	£3·85
7416	0·48	0·44	0·42	7482	0·96	0·95	0·94	74163	£4·40	£4·15	£3·85
7417	0·48	0·44	0·42	7483	£1·20	£1·15	£1·05	74164	£2·20	£2·10	£2·00
7420	0·18	0·17	0·16	7484	£1·10	£1·05	£1·00	74165	£2·20	£2·10	£2·00
7422	0·55	0·53	0·50	7485	£3·50	£3·40	£3·30	74166	£3·20	£3·10	£3·00
7423	0·55	0·53	0·50	7486	0·35	0·34	0·33	74174	£2·50	£2·40	£2·30
7425	0·55	0·53	0·50	7489	£4·00	£3·75	£3·50	74175	£1·75	£1·65	£1·55
7426	0·50	0·46	0·44	7490	0·74	0·71	0·64	74176	£1·85	£1·75	£1·65
7427	0·50	0·46	0·44	7491	£1·10	£1·05	£1·00	74177	£1·85	£1·75	£1·65
7428	0·55	0·53	0·50	7492	0·74	0·71	0·64	74180	£1·50	£1·40	£1·30
7430	0·18	0·17	0·16	7493	0·74	0·71	0·64	74181	£5·00	£4·50	£4·00
7432	0·50	0·46	0·44	7494	0·85	0·82	0·75	74182	£2·00	£1·90	£1·75
7433	0·75	0·73	0·70	7495	0·85	0·82	0·75	74184	£3·20	£3·10	£3·00
7437	0·70	0·68	0·65	7496	0·96	0·93	0·86	74190	£2·15	£2·10	£2·00
7438	0·70	0·68	0·65	74100	£1·50	£1·45	£1·40	74191	£2·15	£2·10	£2·00
7440	0·18	0·17	0·16	74104	£1·07	£1·04	£1·00	74192	£2·15	£2·10	£2·00
7441	0·74	0·71	0·64	74105	£1·07	£1·04	£1·00	74193	£2·15	£2·10	£2·00
7442	0·74	0·71	0·64	74107	0·44	0·42	0·40	74194	£2·98	£2·86	£2·75
7443	£1·20	£1·15	£1·10	74110	0·60	0·55	0·50	74195	£2·00	£1·95	£1·90
7444	£1·20	£1·15	£1·10	74111	£1·38	£1·27	£1·21	74196	£1·95	£1·90	£1·85
7445	£1·98	£1·95	£1·90	74118	£1·10	£1·05	£1·00	74197	£1·95	£1·90	£1·85
7446	£1·20	£1·15	£1·10	74119	£1·50	£1·40	£1·30	74198	£5·00	£4·75	£4·50
7447	£1·10	£1·07	£1·05	74121	0·50	0·48	0·45	74199	£5·00	£4·75	£4·50

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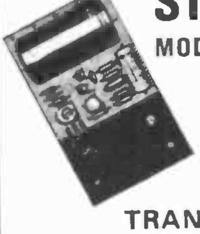

AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63 mm x 105 mm x 20 mm. These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including: Disco Systems, Public Address, Intercom Units, etc. Handbook available, 10p.

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UIC02	12 x 7402	0·55	UIC50	12 x 7450	0·55	UIC92	5 x 7492	0·55
UIC03	12 x 7403	0·55	UIC51	12 x 7451	0·55	UIC93	5 x 7493	0·55
UIC04	12 x 7404	0·55	UIC53	12 x 7453	0·55	UIC94	5 x 7494	0·55
UIC05	12 x 7405	0·55	UIC54	12 x 7454	0·55	UIC95	5 x 7495	0·55
UIC06	8 x 7406	0·55	UIC60	12 x 7460	0·55	UIC96	5 x 7496	0·55
UIC07	8 x 7407	0·55	UIC70	8 x 7470	0·55	UIC100	5 x 74100	0·55
UIC10	12 x 7410	0·55	UIC72	8 x 7472	0·55	UIC121	5 x 74121	0·55
UIC20	12 x 7420	0·55	UIC73	8 x 7473	0·55	UIC141	5 x 74141	0·55
UIC30	12 x 7430	0·55	UIC74	8 x 7474	0·55	UIC151	5 x 74151	0·55
UIC40	12 x 7440	0·55	UIC76	8 x 7476	0·55	UIC154	5 x 74154	0·55
UIC41	5 x 7441	0·55	UIC80	5 x 7480	0·55	UIC193	5 x 74193	0·55
UIC42	5 x 7442	0·55	UIC81	5 x 7481	0·55	UIC199	5 x 74199	0·55
UIC43	5 x 7443	0·55	UIC82	5 x 7482	0·55			
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Packs cannot be split, but 25 assorted pieces (our mix) is available as PAK UIC X1.

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit techniques. Designed for use with the AL50 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATION:

Frequency response	20Hz—20kHz ±1dB	Bass control	±15dB at 20Hz
Harmonic distortion	better than 0·1%	Treble control	±15dB at 20kHz
Inputs: 1. Tape head	1·25mV into 50KΩ	Filters: Rumble (high pass)	100 Hz
2. Radio, Tuner	35mV into 50KΩ	Scratch (low pass)	8kHz
3. Magnetic P.U.	1·5mV into 50KΩ	Signal/noise ratio	better than +65dB
		Input overload	+26dB
		Supply	+35 volts at 20mA
		Dimensions	292 x 82 x 35 mm

All input voltages are for an output of 250mV.
Tape and P.U. inputs equalised to RIAA curve within ±1dB from 20Hz to 20kHz.

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72710	DIL	14	0.45	0.43	0.40
72741	DIL	14	0.40	0.38	0.35
72741C	TO-5	8	0.45	0.43	0.40
72741P	DIL	8	0.38	0.36	0.34
72748P	DIL	8	0.38	0.36	0.34
SL201C	TO-5	8	0.50	0.45	0.40
SL701C	TO-5	8	0.50	0.45	0.40
SL702C	TO-5	8	0.50	0.45	0.40
TAA263	TO-72	4	0.80	0.70	0.60
TAA293	TO-74	10	£1.00	0.85	0.90
TAA350A	TO-74	10	£1.85	£1.80	£1.70
μA703C	TO-5	6	0.28	0.26	0.24
μA709C	TO-5	8	0.35	0.33	0.30
μA711	TO-5	10	0.45	0.43	0.40
ZN414	TO-18	4	1.30		

DTL 930 SERIES LOGIC I.C's

Type	1	25	100+
BP930	0.15	0.14	0.13
BP932	0.16	0.15	0.14
BP933	0.16	0.15	0.14
BP935	0.16	0.15	0.14
BP936	0.16	0.15	0.14
BP944	0.16	0.15	0.14
BP945	0.30	0.28	0.25
BP946	0.15	0.14	0.13
BP948	0.30	0.28	0.25
BP951	0.70	0.65	0.60
BP962	0.15	0.14	0.13
BP9093	0.45	0.43	0.40
BP9094	0.45	0.43	0.40
BP9097	0.45	0.43	0.40
BP9099	0.45	0.43	0.40

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TSO 16	38p	35p	32p
TO 24	75p	70p	68p
LOW COST No.			
BPS 8 pin type	13p	13p	11p
BPS 14	16p	14p	12p
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GR 116	Side Viewing Nixie Type Tube 13 m/m	£1.70

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AL10/AL20/AL30 AUDIO AMPLIFIER MODULES

The AL10, AL20 and AL30 units are similar in their appearance and in their general specification. However, careful selection of the plastic power devices has resulted in a range of output powers from 3 to 10 watts R.M.S.
The versatility of their design makes them ideal for use in record players, tape recorders, stereo amplifiers and cassette and cartridge tape players in the car and at home.

Parameter	Conditions	Performance
HARMONIC DISTORTION	Po = 3 WATTS f = 1KHz	0·25%
LOAD IMPEDANCE	—	8 – 16Ω
INPUT IMPEDANCE	f = 1KHz	100 kΩ
FREQUENCY RESPONSE ⊕ 3dB	Po = 2 WATTS	50 Hz – 25KHz
SENSITIVITY for RATED O/P	Vs = 25V. Rl = 8Ω f = 1KHz	75mV. RMS
DIMENSIONS	—	3" x 2½" x 1"

The above table relates to the AL10, AL20 and AL30 modules. The following table outlines the differences in their working conditions.

Parameter	AL10	AL20	AL30
Maximum Supply Voltage	25	30	30
Power output for 2% T.H.D. (RL = 8Ω f = 1 KHz)	3 watts RMS Min.	5 watts RMS Min.	10 watts RMS Min.
PRICE	£2·20	£2·59	£3·3

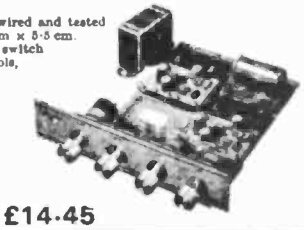
TEAK VENEERED CABINETS for:

STEREO 20
TC 20. £3·95 p&p 30p.

MK 50 KIT
TC 100. £6·50 p&p 40p

E.M.I. LEK 350 Loudspeaker System Enclosure kit in Teak Veneer, including speakers. Rec Retail Price £45·50 per pr. OUR SPECIAL PRICE £35·50 per pair p&p £1. *ONLY WHILE STOCKS LAST!*

The STEREO 20



The 'Stereo 20' amplifier is mounted, ready wired and tested on a one-piece chassis measuring 20 cm x 14 cm x 5·5 cm. This compact unit comes complete with on/off switch volume control, balance, bass and treble controls, Transformer, Power supply and Power amps. Attractively printed front panel and matching control knobs. The 'Stereo 20' has been designed to fit into most turntable plinths without interfering with the mechanism or, alternatively, into a separate cabinet. Output power 20w peak. Input 1 (Cer.) 300mV into 1M. Freq. res. 25Hz-25kHz. Input 2 (Aux.) 4mV into 30K. Harmonic distortion. Bass control ±12dB at 60Hz typically 0·25% at 1 watt. Treble con. ±14dB at 14kHz.

£14·45

FRONT PANEL. 4 knobs. Headphone Socket, on/off switch and neon for PA 100/MK 50. FPK 100 £2·95.

TRANSFORMERS

T461 (Use with AL10) £1·38 P & P 15p
T538 (Use with AL20) £1·93 P & P 15p
BMT80 (Use with AL30 & AL50) £2·15 P & P 25p

POWER SUPPLIES

PS 12. (Use with AL10 & AL20) 88p
SPM 80. (Use with also AL30 & AL50) £3·25

PA 12. PRE-AMPLIFIER SPECIFICATION

The PA 12 pre-amplifier has been designed to match into most budget stereo systems. It is compatible with the AL 10, AL 20 and AL 30 audio power amplifiers and it can be supplied from their associated power supplies. There are two stereo inputs, one has been designed for use with *Ceramic cartridges while the auxiliary input will suit most †Magnetic cartridges. Full details are given in the specification table. The four controls are, from left to right: Volume and on/off switch, balance, bass and treble. Size 152mm x 84mm x 35mm. PRICE £4·35

Frequency response—
20Hz – 50KHz (–3dB)
Bass control—
± 12dB at 60Hz
Treble control—
± 14dB at 14KHz
*Input 1. Impedance
1 Meg. ohm
Sensitivity 300mV
†Input 2. Impedance
30 K ohms
Sensitivity 4mV

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LOCAL RADIO IN BRITAIN

KEITH PITT REPORTS

One cold evening in late 1967 the South Coast region around Brighton and Hove was cut off by a freak blizzard. The conditions meant that many of the thousands of local commuters would be home extremely late with no way of warning their families. As soon as he saw the severity of the storm, Bob Gunnell obtained permission to put BBC Radio Brighton on the air during the emergency by interrupting the station's test transmissions with news flashes. This initiative helped the area to overcome its weather problems and, incidentally, allayed the fears of those sitting at home waiting for the late travellers by giving them as much up to date information as possible. When conditions returned to normal the special transmissions went off the air until the official opening date. This was the first of many emergencies which have since been covered promptly and efficiently by the BBC's local radio network.

BBC Radio Brighton was one of the first group of eight local radio stations given a provisional go-ahead by Harold Wilson's government in 1966-7. Once these were shown to be performing a community service, permission was given to the BBC to expand to 20 stations covering about 74% of the population of England. The BBC had hoped to increase the number still more, but, in 1970 a Conservative Government was returned pledged to introduce commercial local radio, a service to be financed by advertisements. They sanctioned the the completion of the chain of 20 but stopped any further expansion. Their Broadcasting Act, 1972, modified the Television Act of 1964 to enable the Independent Television Authority, ITA, to take responsibility for the new network and changed its name to Independent Broadcasting Authority, IBA.

This article traces the growth of local radio in Britain from its origins in the BBC Regions and discusses the services it can render to the community. It also discusses the future expansion of the networks and some of the technical aspects as well as looking more closely at two, individual stations, one BBC and the other independent.

BACKGROUND

Apart from the very early days BBC programmes were organised on a national basis with a small part of one of the services being available for regional 'opt-outs'. Scottish and Welsh radio had and still have, considerably larger differences to cater for the special needs of their national populations. The English regions each had a distinctive local flavour and some of their products were networked while others only went out to relatively local audiences.

West Region from Bristol was typical with its local serial, "At the Luscombes", its specialised sports coverage, its local news and magazines and, especially, its wild life programmes. Total regional coverage was only a few hours a week and the local service was not very comprehensive because of the large areas and the short available time. Nevertheless, each of the regions helped their communities by providing programmes of more specialised local interest than London could give. Many of today's top names started locally and gained experience there before graduating to London. Benny Hill's first radio shows were for the West Region; (he comes from the Southampton area).

In the 1960's there was a decline in radio audiences with the growth of television. Some of the regional characteristics transferred to daily BBC television programmes. These are now the main local output of the regions and their news magazine formats contribute to the daily "Nationwide" programme. Wavelength restrictions made it difficult to combat the effect of TV on sound radio, but the arrival of VHF with its sharp transmission contours offered a new hope. For six weeks in the early 1960's the BBC West of England Home Service transmitter at Wenvoe was taken over for an experiment. The emphasis was on local content and participation. It was in effect a prototype local radio.

No more was heard directly of this, but, later in the same decade the government gave the BBC permission to set up eight stations on a temporary, experimental basis. These were to be financed by local authorities as far as possible and were established between the end of 1967 and the middle of 1968 at Leicester, Sheffield, Merseyside, Nottingham, Brighton, Stoke, Leeds and Durham. About a year after the start of the last of these the BBC published its future plans -- "Broadcasting in the Seventies" -- including a list of twelve more later approved by the Government. The change of Government in 1970 had a profound effect on the shape of local radio as mentioned above with the formation of the IBA and its commercial network.

THE CHANGING PATTERN OF RADIO LISTENING

For many years radio was the main medium of public entertainment in the home. The arrival of TV changed its function very much. It was now likely to have an audience which changed widely in numbers and make-up with the time of day. It could no longer rely, as in the past, on holding the attention of the majority of the population for long periods. At the same time, with the greater pace and technology of living, a need grew for an information service covering much more than the standard news bulletins.

In the USA, due mainly to the vast distances, there always had been an emphasis on local stations, usually with several operating in one city financed by advertising in general and sponsoring in particular. These declined sharply in popularity with the rise of TV but have recently recovered much lost ground by re thinking their approach. Stations now tend to fall into two main categories, 'general' and 'news'. The latter, as the name suggests tend to concentrate on news and information together with some commentary on it. They provide a frequent in-depth coverage of events as they happen and are extremely popular with good listening figures and, consequently, high advertising revenue. The general stations are more biased towards music or entertainment but also provide an information service, but, necessarily, a less comprehensive one.

In Britain in the 1950's and 1960's, particularly in England, the national radio networks fell roughly into the pattern of news, serious programmes and entertainment, (Home Service), music and entertainment, (Light Programme), and serious music and literature, (Third Programme). This pattern was shaken violently in the early 1960's by the arrival of various 'lady' pirates such as Caroline just outside territorial waters these provided continuous pop music and advertisements to most of England. Apart from the ever popular Radio Luxemborg, this was virtually the first taste of commercial radio in Britain. Although they were eventually put out of business, their effect was to cause the BBC to develop a whole new pattern of national broadcasting with the introduction of the present Radios 1,2, 3 and 4. They also raised the question of an alternative source of radio to the BBC, together with the problem of how to finance it.

An alternative service on a national basis would not have the attraction of a more localised system reflecting the modern needs for instant information and helping to provide a community service. It would also repeat one much criticised facet of the BBC -- remoteness from the listener and his important, but, often, essentially local problems. Before such an alternative could be proposed in detail the BBC put forward its own plans for a form of radio more suited to the changing pattern of listening -- a chain of local stations each with a large measure of autonomy and providing a community service for a limited and carefully defined area. Much of the output was to be for and by local people and would give information on anything that might be of interest to the surrounding area. This concept of community radio has been taken even further with the more recent growth of 'phone in' and 'talk back' programmes. Typical of the service envisaged was the broadcasting of regular travel and traffic information and news flashes for any sudden happening.

In short, the developments of the sixties, including the arrival of the transistor radio, led logically to a local radio system where everyone could find something of interest. It might be as little as the reading of the local football results or, in more serious vein, perhaps, a warning of imminent power cuts. Properly developed it could help to bring the lonely and the housebound closer to the rest of the community by providing a much more personal and detailed link than a national network ever could.

Where the protagonists differed was in how to organise and finance such a service. The Government's answer was to subsidise stations from local authority grants, but these proved too uncertain and insufficient to plan a

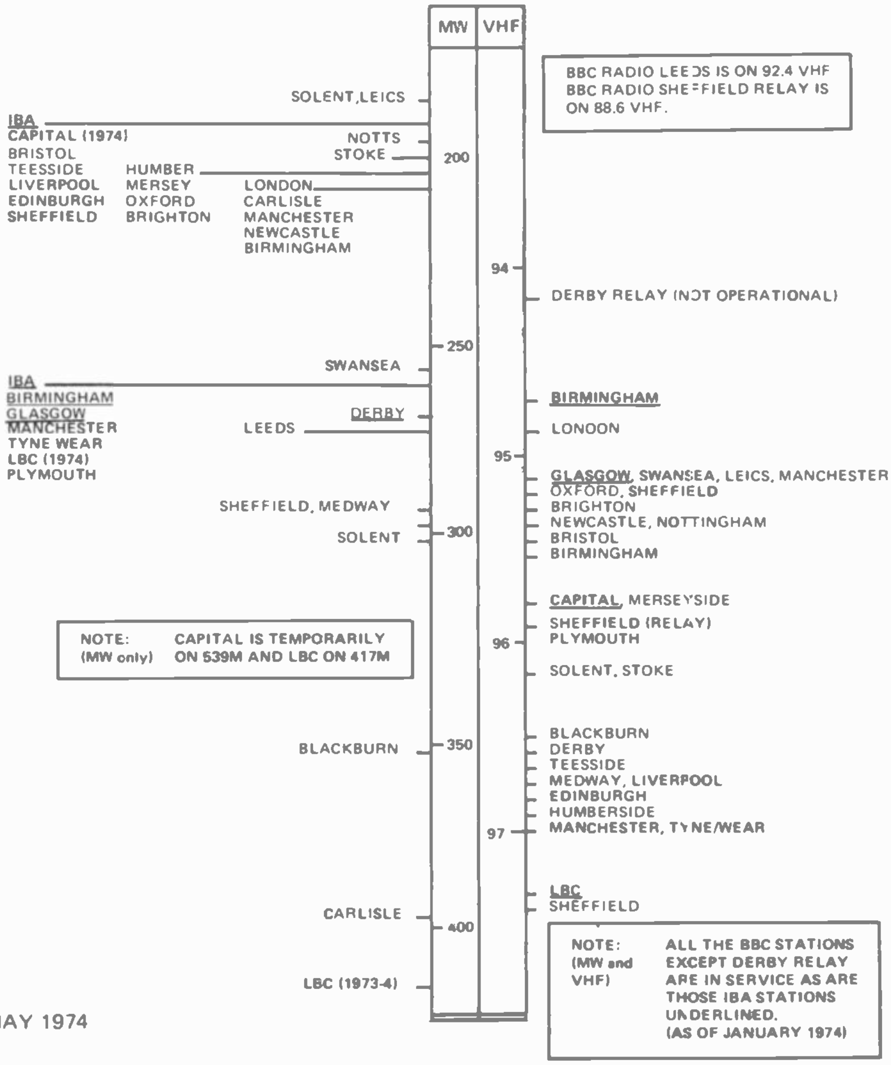
worthwhile service. When the eight experiments proved a success the Government decided to make them permanent and to finance them entirely out of licence revenue and the fee was increased to allow for this.

The obvious alternative to the BBC was a chain of stations licensed by a central authority and receiving their revenue from advertising in a way analogous to that existing in independent television. This was adopted in the Broadcasting Act of 1972 and is now in process of being set up with five stations already on the air.

BBC LOCAL RADIO

When the first eight stations opened they were under a severe technical disadvantage operating on VHF only. The number of VHF sets was then relatively small, and, hence, the potential audience was limited. Gradually, thanks to advertising campaigns by radio shops anc to the interest arising in the stations due to their type of output, the number of VHF sets rose until it was claimed that in

DIAL SETTINGS FOR LOCAL RADIO



some areas up to 40% of the population had access to local radio. Even so, they were still at a major disadvantage compared with the BBC's national networks. One particular problem was that they could only reach a small fraction of the potential car radio audience because most of these sets are medium and long wave only. (Even if it could receive VHF, the reception would be generally poor because most car aerials are vertical rods, while the transmissions were horizontally polarised. A compromise using slant polarisation was made in a number of cases and the IBA have adopted circular polarisation).

In September 1972 the BBC were allowed to introduce medium wave back up for their local stations (At the time of writing the last of these has recently come into use at Derby, although several others are still using temporary equipment and will later be increasing their powers). The medium wave and VHF transmissions are designed to give approximately the same day time service areas although the former will be severely restricted at night by co-channel interference. The display panel shows the wavelengths or frequencies of the BBC network. The coverage varies according to the nature of the area and ranges from a radius of 25-30 miles for BBC Radio London to about 10-15 miles for small stations such as Leicester, Brighton or Nottingham.

The second series actually contained thirteen not twelve stations. The service areas of Newcastle and Teesside both overlapped that of Durham and many people had coverage from all three. In contrast, the extreme north west of England, centred around Carlisle and Whitehaven, was without any local radio. A decision was made to close Radio Durham in mid 1972 and replace it with Radio Carlisle which became the twentieth station in November 1973 with one VHF and two medium wave transmitters.

With the addition of medium wave the BBC claims that the local radio audience has doubled and that, in some areas, the listening figures are comparable to those of Radios 1 and 2. Certainly one section of the public that has benefitted directly from the change is the motorist because he can now get prompt and more detailed travel information than, for example, Radio 2 can supply. The older mains sets that many people still have at home, often in the kitchen are now able to receive the locals and this is reflected by the great popularity of programmes such as London's "Women in Town" and Solent's daily phone-in which enables listeners, (mainly, but not exclusively, women), to exchange tips on a wide range of domestic matters.

The stations each provide about nine to twelve hours of locally produced material every day and take the remainder of their programmes from the national networks, usually Radios 1 or 2, in most cases with the main daytime news bulletins from Radio 4. They are a forum for the exchange of information and for minority interests to be aired. They have actively developed and encouraged local cultural activities. As examples, Radio Manchester has helped in setting up a Chamber Orchestra and Radio Blackburn a Jazz Club. In the literary field Medway have had many entertaining entries in their story competitions and Humberside were similarly successful with a drama contest. Radio Brighton is closely associated with an International Arts Festival held in the town. The station's contribution, a radio drama, "Oluwali" by Jeremy Sandford, author of "Cathy Come Home" narrated by Brightonian Paul Scofield has since been broadcast more than once on Radio 3.

Many stations have regular live childrens shows when the studios are filled with keen young participants -- often over sixty of them have taken part in Bristol programmes. Magazines for the blind, including warnings of pavement obstructions, are an important part of the schedules of most stations. Particularly popular are the programmes for immigrants. Those for the Indian and Pakistani communities in the Birmingham and Derby areas give news, views and entertainment including request records and provide strong link with the home countries. Many of the listeners are from well outside the official service areas and many get a 'double ration' by listening to both of the stations.

London, by far the biggest of all the BBC's local radios, besides providing a number of programmes for its minority groups, pioneered a new approach with "Platform". In this a particular organisation is given the 'freedom of the air' for a couple of hours with full support from the station's technical staff. Thus, they can not only contact directly people with similar interests, but they can also bring their topic to the attention of an audience which would otherwise be unaware of it. One of London's most popular programmes has a strong West Indian flavour but is listened to by a very wide cross section of the public -- Steve Barnard's "Reggae Time". Steve is shown in the picture surrounded by records in his Carribean studio.

Some programmes are made available to other local stations including a fascinating series on Lewis Carroll produced by Radio Oxford and rebroadcast by Medway. They collaborate too on sports events. News of the away match of the local football team is often given by reporters from the station near the host club. The coverage of the 1973 Gillette Cricket Cup Semi-Final at Lords was shared between London (Middlesex) and Brighton (Sussex) and that of the Final between Bristol (Gloucestershire) and Brighton.

Many of the stations collaborate with local authorities in the production of local schools programmes, usually with financial support also. One survey showed that thirteen thousand school children regularly heard the educational output of Radio Stoke. In a number of cases special training is given to teachers in broadcasting techniques.

In addition to the regular features mentioned above, one major function of the stations is to help in times of local or national crisis, such as the Brighton snow storm referred to at the start of this article. Emergency services have been set up during times of postal strikes, rail disputes and power cuts. In the latter case staff were often sitting in studios lit by candles and with equipment run from batteries while broadcasting street by street details of the cuts.

In the next section we shall take a closer look at the working of one particular local station, BBC Radio Brighton.

BBC RADIO BRIGHTON

Brighton is one of the smaller stations having a potential audience of about four hundred thousand. (Leicester and Medway are roughly similar in size, although the latter, due to its geographical position, has as many potential 'guest' listeners outside as 'official' ones inside its editorial area).

The Brighton area tended to be isolated from full regional coverage of the BBC Home Service by its location on the extreme finge of the West Region. (Local agitation persuaded the BBC to install its first 'booster' to give TV coverage of the Coronation in 1953 to the coastal strip lying in the shadow of the South Downs).

The BBC took the opportunity of answering frequent representations about poor local sound coverage by making Radio Brighton one of its first group of experimental stations in 1967-8. The nature of the area gave natural boundaries to a VHF station. The addition of medium wave stretched the coverage inland but the main editorial area has remained along the Sussex coast although the installation of a new and more powerful VHF transmitter improved the reception in areas like Lewes, Newhaven and Seaford.

There is a permanent staff of 25 with part time contributions from many others, free-lance journalists and local experts alike. Many have been associated with Radio Brighton from its start, but, like most of the other stations, opportunity is taken to give experience to young professional broadcasters before they move on to central BBC positions. (Desmond Lynam, now a well known member of Radio 2's sports staff, was an early member of the team with a special interest in the fortunes of Brighton and Hove Albion. John Henty, shown with the Radio Car at Sussex University, has recently left the coast to take a post in continuity on Radio 2. Steve Merike crossed channels to join London Broadcasting). The traffic is two way -- for example Paul Hollingdale, formerly a Radio 2 disc jockey, now has a regular two hour music programme every Saturday afternoon.

Radio Brighton's manager, Bob Gunnell, is a local man who has been with the BBC since 1944. Before

setting up the local station, he was a talks producer and commuted to London. He was also active in local affairs and was an independent member of Hove Council. He is heard on the air regularly as chairman of a discussion programme "Table Talk" which is similar to "Any Questions" and also in interviews with local personalities. Mr. Gunnell's deputy in effect is John Behague, the programme organiser. He moved to the coast joining Radio Brighton, while news editor, Tony Talmage started his career as a journalist in Worthing. The engineer is Ted Castle who has been a member of the BBC's technical staff for many years.

Of the other full time contributers a few are local, but many have come to the area to gain experience and then move on to other jobs. Someone who has travelled farther than most is Maryanne Smith from Australia. There are contributions from a large number of part time broadcasters as well. Three of the members of the sports team are respectively a bank official, a solicitor and an architect when they are not on radio duty and the boxing commentator in private life is a postman.

Like the other BBC local station Brighton has the accent on information. There are fourteen bulletins of local news every weekday with eight on Saturday and five on Sunday. In addition there is a Monday to Friday news magazine at lunch time covering national, international and local affairs. There are also between two and four full, Radio 4, news bulletins every day regular national head lines. The weather forecast (from the Southampton Weather Centre by telex) is given either in full or in summary form with every local news and tide times and sailing forecasts several times a day. Although travel information is often inserted into programmes as flashes, there are regular times assigned for news about trains, buses and traffic.

The news bulletins form a skeleton round which the other programmes are fitted. Peak hour morning listening is "Coastwise" a magazine of news, events, reports, comments and music In the summer the visitor is welcomed with suggestions for getting out and about on his holiday. Another two hour magazine, rather more devoted to music than "Coastwise" is "On Our Way" which is designed for tea time listening and those returning home by car. Every morning with a repeat of highlights at weekends is "Coffee Break" for and (mainly) by women.

Music forms a vital part of Radio Brighton's output and, in addition to the records played in the magazines, there are a number of request and similar programmes. Devotees of the classics are catered for with "Counterpoint" reviewing local concerts and so are the lovers of folk and jazz with their own regular series.

Sport also figures high in listening popularity. The fortunes (and misfortunes) of Brighton and Hove Albion are given detailed coverage including frequent score flashes during matches. The local amateur players are not neglected either with reports and results on both senior and junior teams covering sides from Worthing and Haywards Heath to Seaford. Hockey, rugby, athletics, table tennis and many others are all featured in several regular weekly programmes. In summer the cricket news includes commentaries on Sussex County matches and scores and comments from club fixtures.

There are specialist programmes for minority interests such as Alan Wrangle's weekly "Strike" for anglers and "Seasports" for sailing enthusiasta. Cinemas, books and the theatre are all featured in Brighton's schedules and gardeners have their own regular series. On the more serious side, education and religion are also covered. Reports from Parliament are given in turn by the local M.P.s and "Table Talk" is a discussuon programme chaired by the station manager.

Locally produced programmes are about eight hours a day during the week and Radio 2 is taken for the rest of the time the station is on the air.

This description of some of Brighton's output is typical of the BBC local radio stations. The emphasis and style are characteristic in each case but they all have in common the aim of reflecting what their town or city wants to hear and keep it abreast of local events as they arc happening. Judging by the BBC's latest figures, since the addition of medium wave transmissions, they appear to be doing their job well. In many cases early morning peak audiences are comparable with Radios 1 and 2 and the impact of the stations is growing as they become better known. Local radio is now established as the bottom tier of the BBC's news operations. Brighton, for example, was responsible for covering the Hove by-election, some of the Maria Colwell enquiry and the collapse of part of the Palace Pier. Similarly, Humberside had responsibility for reporting on the Cod War with Iceland. In addition, local radio sometimes makes sound only contributions into television's "Nationwide".

In the next section we look at how an alternative to the BBC chain was conceived and how the first of the independents are accepting the challenge.

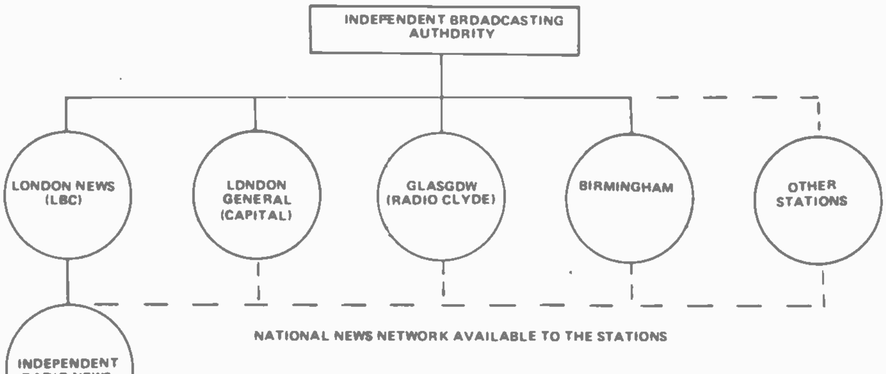


Fig. 1a) INDEPENDENT LOCAL RADIO NETWORK

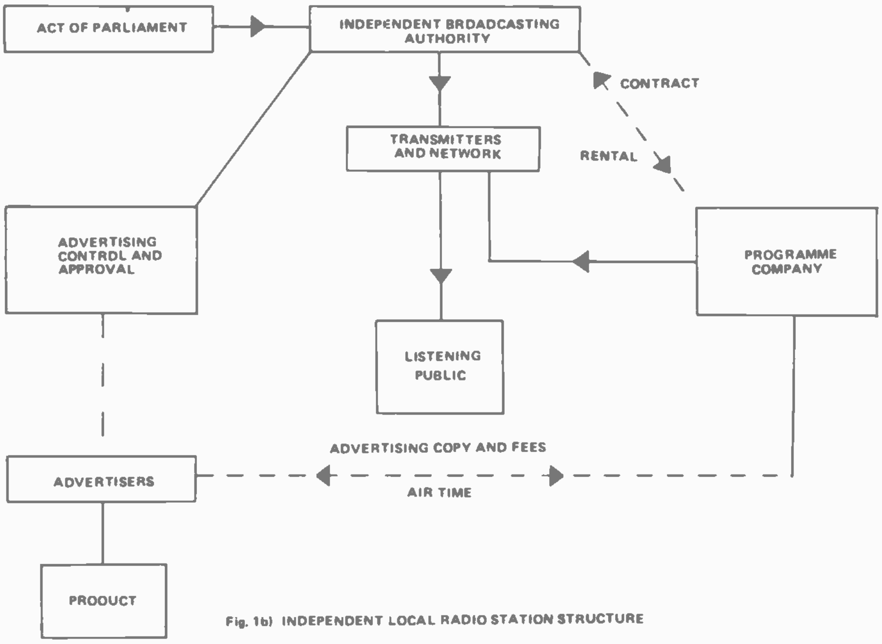


Fig. 1b) INDEPENDENT LOCAL RADIO STATION STRUCTURE

THE INDEPENDENT LOCAL RADIO NETWORK

One of the most important features of the ITV network is how it is financed. The Independent Broadcasting Authority awards a Contract to a Programme Company in a given area and is paid a fee depending on the population to be covered. The Companies gain their revenue from advertisers who pay rates dependant on time of day and location. The latter have no contact with programme content and can only suggest, but not demand, when a particular advertisement is to be televised, provided it is the appropriate time slot for the fee. The nature and content of advertising material is vetted by IBA before approval is given for its use and over 20000 fresh items are submitted for TV alone every year. A very strict Code is enforced to which all adverts must comply. IBA has complete control over all network equipment and the transmitters and supplies them as a service in return for the Contract fee.

The commercial radio network has been organised to follow the same pattern as closely as practicable. Contracts are awarded for a three year period with extensions if a satisfactory performance has been shown. In the same way as for television, the IBA owns the network and the transmitters. With only minor changes a similar advertising Code applies -- the main difference is in the maximum of nine minutes in any hour as opposed to an average of six for TV with a peak of seven. Fig. 1a shows the ILR network including the national news service (see below). Fig. 1b shows the relationship between the IBA, its programme Companies and the advertisers.

The radio transmissions are primarily on VHF with stereo provision. The actual frequency, in the band 94.5–97.5MHz, of course varies from station to station. In some cases the transmitters may be co-sited with BBC local or national stations; often they will be on an ITV mast such as the Croydon station which transmits the programmes of both the London News and London General stations, (LBC and Capital respectively); Radio Clyde is broadcast from the ITV station at Black Hill in central Scotland. To help with the initial growth of the network all stations will have medium wave back up, at least for the next few years. (The pending revision of European medium wave transmissions may limit future local broadcasting in this band). Medium waves are liable to fading and interference from distant stations at night and, although the daylight coverage of the two services are designed to be as similar as possible, only the VHF is likely to give satisfactory reception after dark, except fairly close to the transmitter. Some areas will have both BBC and IBA local stations and, while some may be co-sited, there will often be a considerable difference in signal strength and even the direction from which they come. The map shows all the existing BBC local radios (in orange) and existing or planned IBA stations (in black). It can be seen that in many cases there will be a certain amount of overlap while there are still large blank spaces with no presently planned services.

One technical innovation introduced by the IBA is a new design of four mast highly directional medium wave aerial. This will enable them to use only two frequencies, 1151KHz (261m) and 1546KHz (194m) for their first batch of stations. (Swansea will use 257m). 1151KHz is exclusive to IBA and 1546KHz is shared with the BBC. The special technical features enable the coverage to be engineered relatively accurately to minimise co-channel interference and to prevent wasteful broadcasting to areas outside the stations' franchise. This will mean that, eventually, Manchester, Birmingham and London will all have stations on 261m without any significant interference.

London, as will be seen, has two commercial stations and these will eventually transfer to 194 and 261m. To get them on the air quickly, a temporary transmitting aerial has been draped around the chimneys of Lotts Road power station in Fulham -- known colloquially as 'Radio Clothesline'. The signals on 539 and 417m have been received at great distances, but suffer severely from co-channel interference, even in daylight in some areas and are rather poor at night in parts of London officially in the service area. A new site at Saffron Green on the Barnet Bypass will transmit from the end of 1974 with the new four mast design on 261m (London Broadcasting) and 194m (Capital). This should then improve the London coverage while probably restricting the service to outer areas like Sussex and Berks which are outside the official range. Both stations are stereo equipped on VHF and provide a good signal to most of the

THE SHAPE OF LOCAL RADIO IN THE MID NINETEEN SEVENTIES

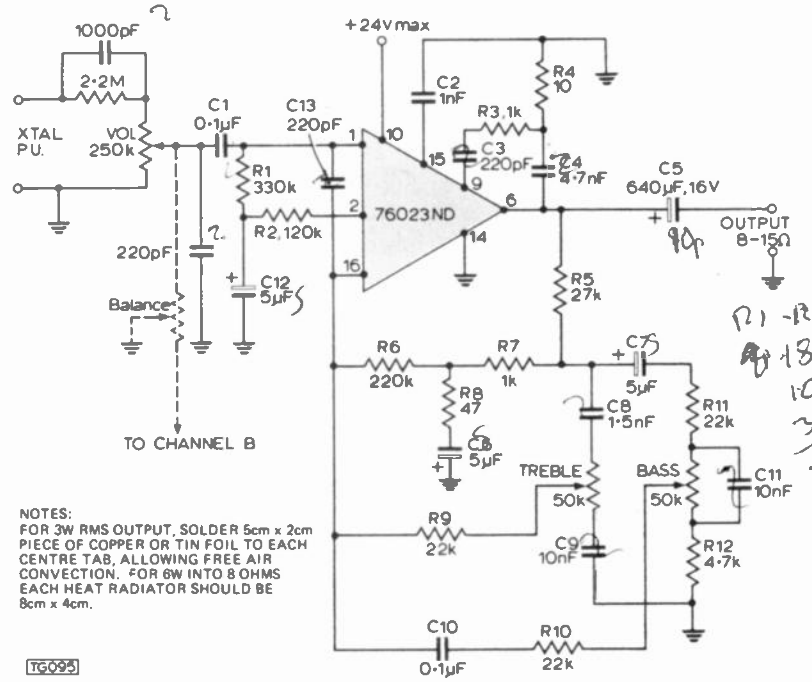
GLC area from IBA Croydon with about 2kW power. (BBC Radio London, in mono only, transmits from Wrotham in NW Kent at a much higher power and may sometimes be more easily received than the commercials. The author found it necessary to install a directional loft aerial carefully aligned towards Croydon at a receiving site on very high high ground in North London at a distance of 17 miles in order to get an acceptably noise free stereo signal.

The table shows the ILR network as it is currently planned. The first stage is well under way with Capital and London Broadcasting which opened in October 1973 and Radio Clyde at the New Year 1973-4. Birmingham started on the 19th February and Manchester on April 1st. Tentatively, Swansea will follow in June and Tyneside/Wearside in July 1974. The start of the next stage is provisionally set for Autumn 1974 with contractors chosen for stations at Liverpool and Edinburgh. This will be in two parts as shown in the table but information on order and timing is not yet available. Forward planning at present envisages a third group of possible stations but no definite Government approval has yet been given. This makes a present list of twenty seven local IBA stations with a probable 50% U.K. population coverage. The eventual target is 60%.

To be continued next month

eti reader offer

6W AUDIO IC FOR 50p!



Suggested circuit using the SN76023ND with active tone controls

LIMITED TO THE FIRST 5000 APPLICANTS

Once again ETI have arranged for an irresistable offer for our readers: a 6W audio IC (SN 76023ND) for just **50p** plus a stamped, self addressed envelope.

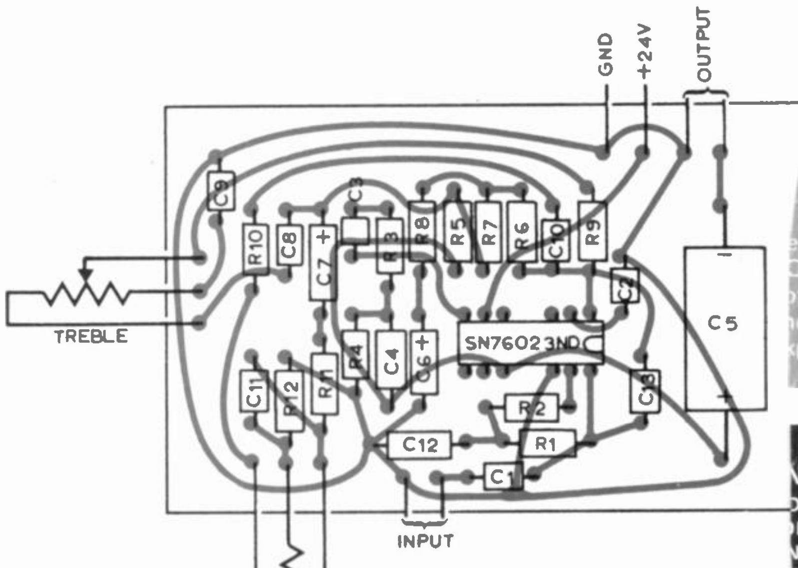
The offer is limited to the first 5,000 orders and orders will be dealt with in strict rotation – it is a matter of first come, first served (overseas readers should enclose an international reply coupon. They are also responsible for any duty payable).

If you think that 5,000 is plenty, bear in mind that the response to recent ETI offers lead us to believe that this offer will be cleared very quickly. Please allow at least two weeks for delivery: orders will be dealt with as soon as possible.

Readers may order as many units as they like but a separate coupon must accompany each.

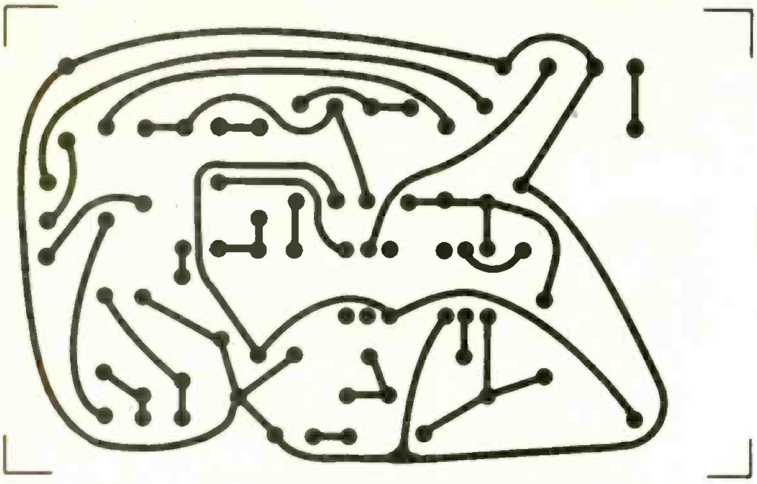
The suggested circuit on the left may be used and a printed circuit board layout is given on the next page with the component siting shown below.

Should the offer be oversubscribed, your cheque or postal order will be returned in your SAE.



Component layout on the suggested p.c. This is shown from the track side. A full pattern of the board is shown overleaf.

6W AUDIO IC FOR 50p!



The printed circuit board pattern for the circuit and layout shown on page 35. Neither Cosmic nor ETI are able to supply ready-made p.c. boards but advertisers elsewhere in the magazine do offer facilities for making p.c. boards.

What to look for in June's ETI

FREE COMPETITION OPEN TO READERS AGED 17 AND UNDER

10 START-YOU-OFF KITS TO BE WON

In conjunction with our current series 'Electronics – It's Easy', we are holding a competition for our younger readers. There will be 10 prizes, each comprising a soldering iron kit, a tool kit and a multimeter.

EARLY RADIO PATENTS

When we say early, we mean it. This survey covers patented inventions in the field of telecommunications up to the first World War. Did you know that the first 'Wireless' transmitter was patented 33 years before Marconi in 1863? The first portable radio and first car radio were both patented in 1900. But this article is much more than a collection of [illegible] velop-

'SURROUND–SOUND'

Why has 4-channel sound not been the overwhelming success that many thought it would be? There is the problem of the different and competing systems but apart from this there are many who feel that 4-channel sound does not add a great deal to their listening pleasure. In the June issue, two highly respected authors discuss this and question the uses made of the systems as well as the systems themselves.

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PLUS:
HI-FI REVIEWS
ETI MUSIC SYNTHESISER
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GENERAL SPECIFICATIONS:

TRIPLETONE AMPLIFIER HI-FI—1818 MK II

Power Output	20 watts RMS EACH CHANNEL
(Both Channels running at 1 KHz 8 ohms)	
Half Power Bandwidth	10Hz—100KHz
Full Power Bandwidth	20Hz— 20KHz ± 1dB
Distortion (THD) (20 watts RMS, 1 KHz)	Less Than 0.08%
Signal To Noise Ratio (All Inputs)	Better Than —70dB
Input Sensitivities	MAG (47 Kohms, RIAA) 2.5mV
	CER 30mV
	TUNER 100mV
	TAPE 100mV
Damping Factor (40Hz)	Better Than 40
Tape Outputs	100mV
Speaker Outputs	8 ohms (Minimum)—16 ohms
Tone Controls	BASS— ± 17dB @ 40 Hz
	MIDDLE— 9dB @ 1KHz
	TREBLE— ± 15dB @ 14KHz

TRIPLETONE AMPLIFIER HI-FI 77 MK II same as for the HI-FI 1818 MKII except for the following:

Power Output	10 watts RMS EACH CHANNEL
(Both Channels running at 1KHz 8 ohms)	

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MEASURED PERFORMANCE

Record to Replay Frequency Response With BASF CrO_2 Tape at:			
	0 VU	20 Hz – 6 kHz ±3 dB	
	–10 VU	20 Hz – 12 kHz ±3 dB	
	–20 VU	20 Hz – 17 kHz ±3 dB	
With BASF -C60 Tape at:			
	0 VU	20 Hz – 6 kHz ±3 dB	
	–10 VU	20 Hz – 10 kHz ±3 dB	
	–20 VU	20 Hz – 16.5 kHz ± 3 dB	
Intermodulation Distortion (at 1 kHz and 960 Hz):		0 VU	0.4%
		–10 VU	0.2%
Signal to Noise Ratio (CrO_2 tape + Dolby 0 VU re 1 kHz)		with Dolby	withou
		54 dB (Lin)	52 dB (
		58 db (A)	56 dB (/
Erase Ratio for 1 kHz Signal (Prerecorded at 0 VU)		–70 dB	
Cross Talk at 0 VU:		100 Hz	40 dB
		1 kHz	45 dB
Wow & Flutter % – Weighted:			0.17%
Line Input Sensitivity for 0 VU (Low)			18 mV
(High)			160 m\
Microphone Input Sensitivity for 0 VU			0.2 mV
Line Output Sensitivity for 0 VU			1.4 V

IN THE FIELD of hi-fi, equipment development is an ongoing process. For some devices, such as amplifiers, perfection is virtually within sight and a great deal of effort is now spent on improving facilities rather than performance. Record players too are now practically as good as they need to be and a machine bought today will not be technically obsolete in five years time.

But cassette recorders and tapes are very much in the throes of a development period and many a machine that was technically brilliant two years ago – or even one year ago – may now be well and truly surpassed by later products from its own and other manufacturers.

The HK 1000 is a particularly attractive machine. It features a wooden base with teak veneer and a deck section which is basically a black plastic moulding with inserts of satin brushed anodised aluminium with black engraving.

One of the features of the machine which warrants special comment, and possible criticism ergonomically, is the provision of the record and playback calibration potentiometers recessed behind the front panel and readily accessible. Harman/Kardon point out that this is a special facility and claim that there are definite advantages to be gained from having ready access to the Dolby set-level controls particularly if one purchases one of the "Dolby Reference Cassettes". Their philosophy is that the user has inbuilt facilities to optimize the Dolby system in the recording mode for every type of tape.

This adjustment is done using an internal calibration signal which is recorded on the tape. Any adjustment then required is made using the record calibration controls and the procedure repeated to check the new setting. Calibration is only required if a new type of tape is being used. As delivered, the machine is correctly adjusted for playback and the playback calibration controls (which are located on the front panel) should only be adjusted using the special calibration tape supplied by Harman/Kardon. This calibration is already performed in the factory and should not be necessary in normal use.

The machine has obviously been designed for easy servicing and most of the printed circuit cards used are mounted with plug and socket connections to facilitate removal, checking, and if need be, replacement. The standard of the electronic wiring is particularly good. The nine printed circuit boards are clearly labelled on the component side with component numbers incorporated. The cards themselves are clearly designated with their purpose and operation.

An internal feature that we particularly liked was that the main transformer is well shielded. A mu-metal wrapping is used to reduce residual magnetic leakage.

The handbook was not up to the same standard as the machine itself, nor as good as those provided with other high fidelity equipment manufactured in Japan. It does provide operating details, but no circuit diagram is provided.

A good feature which is clearly noticeable when the unit is removed from its cabinet is the very effective automatic motor and mechanism shut off. This is operative in both the play, fast forward, and rewind modes.

MEASURED PERFORMANCE

Our first test was to measure the

ON

SUMMARY:
The HK 1000 is a very good machine indeed and most of the performance parameters are far better than found in practically every other cassette machine on the market.

performance of the unit with chromium dioxide and standard gamma ferric oxide tape at 0 VU, -10 VU, and -20 VU.

The performance under these conditions was particularly creditable at -10 VU and -20 VU. In fact this was virtually the first machine, where the performance with gamma ferric oxide tape was of the same order as that obtainable from chromium dioxide. Without any special adjustment the machine turned out a very creditable 20 Hz to 16.5 kHz +3 dB at -20 VU.

Harman Kardon make a strong selling feature of this machine's ability to provide an almost flat frequency response between 20 Hz. and 100 Hz. This claim is justified and the low frequency performance is better than most reel to reel machines, let alone most other cassette recorders that we have measured.

t Dolby
Lin)
A)

Total harmonic distortion was quite acceptable at 1 kHz and 6.3 kHz, but was considerably higher than normal at 100 Hz.

On the machine tested it was 10% at 0 VU.

Intermodulation distortion was particularly low, and even at 0 VU was considerably better than obtained from other cassette recorders.

Signal to noise ratio was extremely commendable. At 0 VU with a 1 kHz signal (without Dolby) it was -52 dB. With Dolby it was -54 dB.

'A' weighted it was -56 dB (A) without Dolby and -58 dB(A) with Dolby. They are easily the best that we have yet seen with Dolby and DNL.

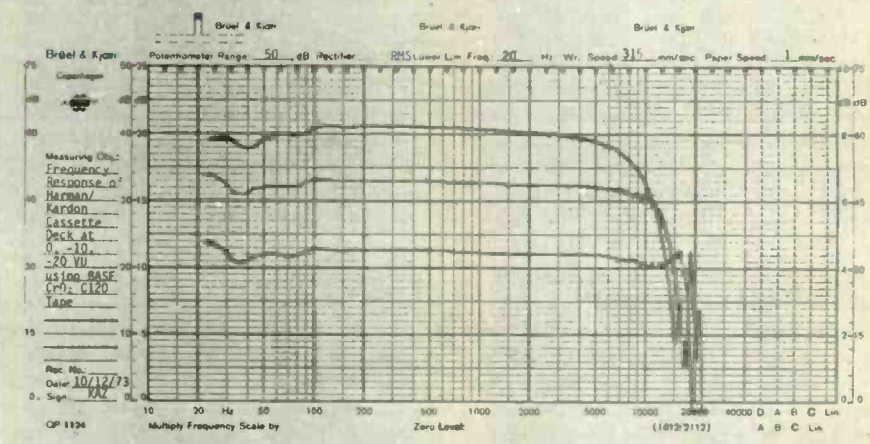
The erase ratio for a 1 kHz signal pre-recorded at 0 VU, was -70 dB. This is the best erase ratio that we have yet measured on a cassette recorder.

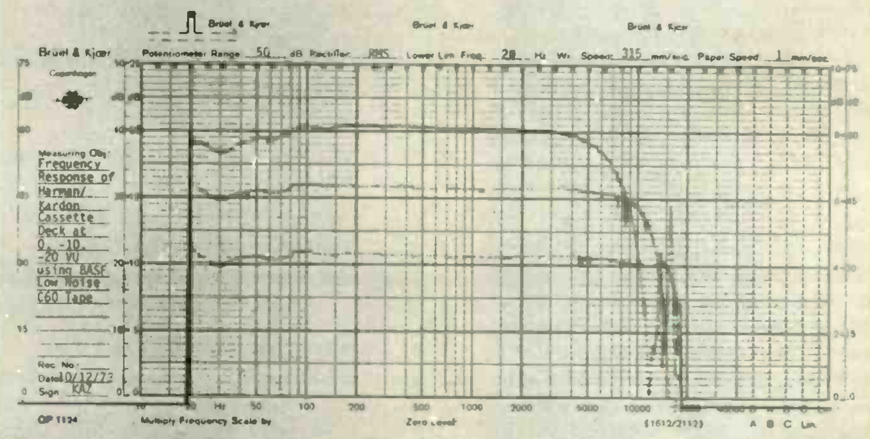
Cross talk figures are quite acceptable, being 40 dB at 100 Hz and 45 dB at 1 kHz.

Wow and flutter figures are reasonably good being 0.17% on the unit tested compared with the manufacturer's specification of 0.13% or less.

Line input sensitivities were respectively, 18 mV for the low signal low impedance input, and 150 mV for the high impedance high sensitivity input.

The microphone sensitivity was 0.2 mV for 0 VU whilst the line output sensitivity if 1.4 volts. This is a substantially higher output than stated in the handbook.





The most interesting feature of the HK1000 is one of the techniques used to obtain the extended frequency response. This is achieved, in part, through the use of a replay head which is not inserted as deeply into the cassette body as it is in other machines.

This modifies the angle of contact between the head and tape so that the extent of magnetic coupling at the fringe of the gap is reduced and thus the "effective gap width" is reduced.

The penalty that is paid for the reduction in effective gap width is a simultaneous reduction in the stability of the contact pressure between the tape and the head with certain brands and types of magnetic tape.

This can and does result in these tapes lifting slightly from the head and results in a loss of replay signal level. The problem can of course be obviated by suitably selecting tapes.

On a theoretical basis it can be shown that there is a 55 dB loss per wave length of spacing between the tape and head. At 7.5 kHz the recorded wave length is 0.25 mil, thus a tape head spacing of only 0.025 mil (which is not very much) will result in a drop of signal of 5.5 dB.

The performance of the HK 1000 is good — in fact with normal programme material it is particularly difficult to tell the difference between the original and the replayed material.

Frequency response is really excellent but, on the machine tested at least, this was achieved at the expense of tape/head contact.

eti product test

ALPHA R150 TUNER AMPLIFIER

WHEN A REVIEWER of technical equipment sets about his task of forming an opinion on the worth of any piece of equipment he needs to bear in mind the price of the equipment under review. In the case of the Alpha R150 the recommended price is so low at £59 that I must say I expected very little from the unit. In fact I did not expect it to be Hi-Fi at all but I was very pleasantly surprised at the performance figures obtained during the laboratory tests. This is not to say that there was no area where the low price did show, as we shall see later, but only that on balance Highgate Acoustic seems to have got their sums right and to provide very good value for money in the R150 tuner amplifier.

All the foregoing is an explanation of the state of mind of your reviewer while testing the R150 .... but to work: the R150 is a neat 4¼" x 15" x 10 3/8" unit with a rated output of 8W for each channel. As can be seen from the table, this was marginally exceeded on test with both channels being driven up to the rated distortion of the receiver. With a single channel being driven, a slightly greater output was possible for the same total harmonic distortion. At speaker impedances of 4Ω and 16Ω the 8W output was not achieved as can be seen from the table.

The bandwidth was from 15Hz to 90kHz, comfortably in excess of the manufacturer's specification of 30Hz to 30kHz but the unusual flat frequency/output graph could only be obtained by offsetting the bass tone control about 10dB in the direction of bass boost. This was not thought at the time to be significant but later tests revealed several like faults pointing to errors in the negative feedback etc. at the low frequency end.

The frequency response of the amplifier to RIAA pre-emphasised signal fed via the PU input was within −1db +1.5db of flat and about the accuracy to be expected of, what is after all, an inexpensive amplifier.

Distortion of the amplifier was at all frequencies and levels, except at rated power and 40Hz, well within the specification and in fact up to the standards expected of very much more expensive amplifiers, albeit with greater power output. It was not possible to achieve rated output at 40Hz before very severe clipping of the peaks of a sine wave occured pointing to some deficiency in the power amplifier at low frequency (particularly in view of the creditable frequency response at 1W level). This was again apparent when I came to measure the damping factor of the amplifier for on 8Ω load, in fact the damping factor taken at the recommended 40Hz

MEASURED PERFORMANCE OF ALPHA R150 TUNER AMPLIFIER

AMPLIFIER SECTION

Power Output
- 8.2W into 8 ohms, both channels driven
- 7.7W into 4 ohms, both channels driven
- 5.5W into 16 ohms, both channels driven

Frequency Response (±1dB)
- 20Hz to 60kHz (slight adjustment on bass control necessary to achieve flattest response)

Channel Separation at 1kHz: 26dB

Hum and Noise with respect to Rated Output

Pickup:	57dB
Others:	63dB

Input Sensitivities for Rated Output

Mag. P.U.	3.3mV
Ceramic P.U.	260mV
Aux.	270mV

Total Harmonic Distortion

	40Hz	1kHz	10kHz
Rated Output	—	0.3%	0.3%
½ Rated Output	0.3%	0.2%	0.2%
1 Watt	0.25%	0.15%	0.17%

Tone Controls: See Graph

Damping Factor for 8 ohms: 16 at 40Hz, 75 at 200Hz

Deviation from RIAA Response : ±1.5dB

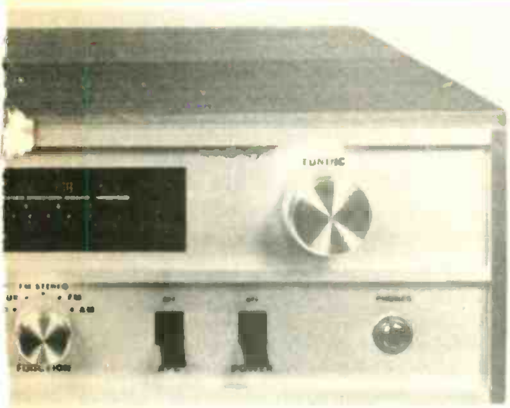
TUNER SECTION

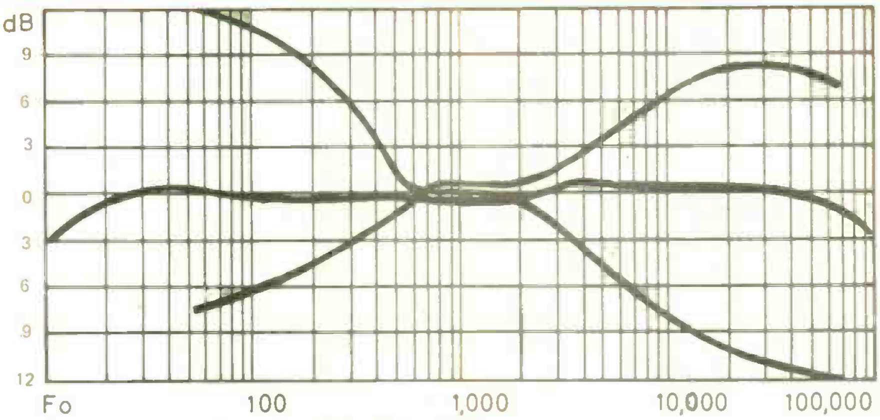
Sensitivity:	4.5μV	Harmonic Distortion:	0.45%
Signal/Noise Ratio:	50dB	Channel Separation:	26dB
AM Rejection:	50dB	Capture Ratio:	3dB
Pilot Tone Rejection:	50dB	Image Rejection:	60dB

RECOMMENDED RESALE PRICE (inc. VAT): £64.90

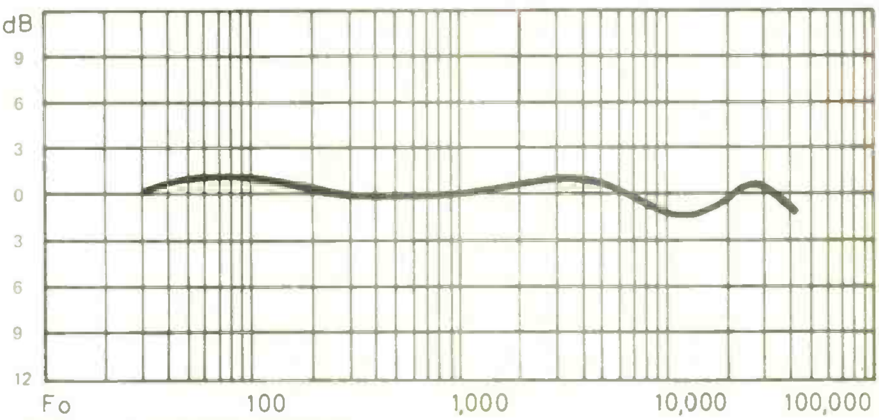
SUMMARY

With a recommended price of £64.90, but often available from discount houses for under £50, the Alpha R150 is low priced. On test however, it shows up as a surprisingly good unit with excellent performance on several parameters and satisfactory operation on the others. One of the best value-for-money units we have ever come across.

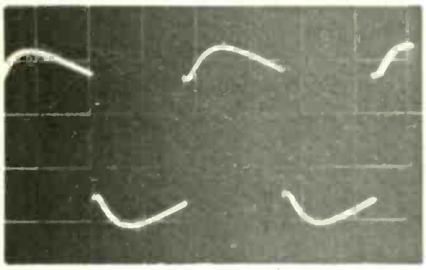




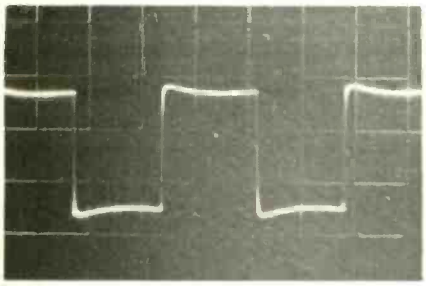
Frequency response curves of the Alpha R150.



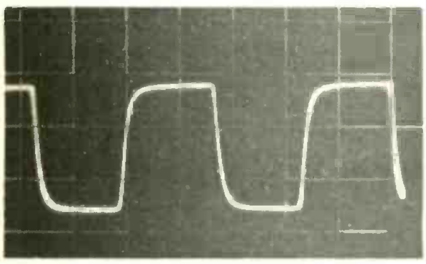
Deviation from RIAA equalisation.



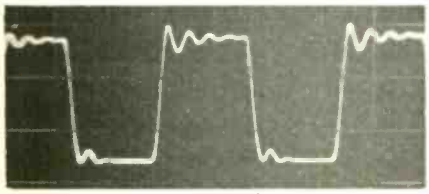
100Hz square-wave, 8 ohm load.



1kHz square-wave, 8 ohm load.



10kHz square-wave, 8 ohm load.



10kHz square-wave, load 8 ohms plus 2µF.

was so low for a modern amplifier design that it was measured twice before the figures were believed!!

Damping factor measurements taken at 100Hz and 200Hz showed steady improvements (at 200Hz it was 75 which is quite good). The manufacturers suggest this may be due to relatively small output capacitors being used as the d.c. blocking components on the output of the amplifier.

The only other point of note on the amplifier section is the separation between stereo channels is only 26db with one channel driven at full output and the other undriven. This figure is low but the test is extreme and better crosstalk figures could be expected at lower drive levels.

The performance of the tuner section was tested using a modified Heathkit 1G37 FM stereo test generator and a Taylor FM generator. The performance obtained again was fairly good especially bearing in mind the price. The sensitivity of the unit at 4.5µV for 30db signal-to-noise is such that would have been considered very good only two or three years ago and is more than adequate for anything except extreme fringe area reception. Improved performance in this area would necessarily put up the price of the unit considerably. The ultimate signal-to-noise on a mono signal at 50db is not particularly good but also not unacceptable.

It is fair to say that the Alpha Arena R150 is very good value for money with the savings being more apparent in the tuner section than the amplifier section which was excellent measured by the standards of other equipment in its price bracket. That a company such as Highgate Acoustic should have to go to Japan to have it built seems a pity; this sort of low priced yet good quality product should sell well and I think deserves the label MADE IN BRITAIN. ●

eti product test

TRIPLETONE 1818 MKII AMPLIFIER

THE TRIPLETONE 1818 takes its names from the three tone controls which are a special feature of the amplifier which provides lift and cut at bass, midrange and treble. The 1818 is a fully integrated amplifier, caters for the usual Hi-Fi signal inputs, namely magnetic or ceramic pickup cartridges, radio tuner and tape recorder and has a power output of 20W r.m.s. per channel for 8Ω speakers. Construction is simple but robust and the 'electronics' are dispersed over three interchangeable circuit boards, designed to facilitate quick servicing should this ever be necessary.

Aside from the three tone controls, stereo balance and volume, which are dual concentric types allowing separate adjustment for each channel, there are also six push buttons for selection of signal inputs, mono/stereo operation and a scratch filter. There is a jack socket on the front panel for stereo headphones but all inputs and speaker connections are otherwise at the rear and via DIN sockets. Details of the signal input sensitivities are given in the test results table but these are conventional. A connection is provided for recording from the pre-amplifier section which can be done with or without the loudspeakers in operation i.e., the main volume control can be turned off. The front panel is matt chrome finished with control knobs and push buttons to match and the amplifier is housed in a pale woodgrained surround type case.

MEASURED PERFORMANCE OF TRIPLETONE 1818 Mk II

Power Output: 22W per channel into 8 ohms, both channels driven
Power Bandwidth: 16Hz to 70kHz (–3dB points)
Frequency Response: See Graph

Total Harmonic Distortion	100Hz	1kHz	10kHz
At 20W	0.15%	0.07%	0.45%
At 10W	–	0.03%	–
At 1W	–	0.04%	–

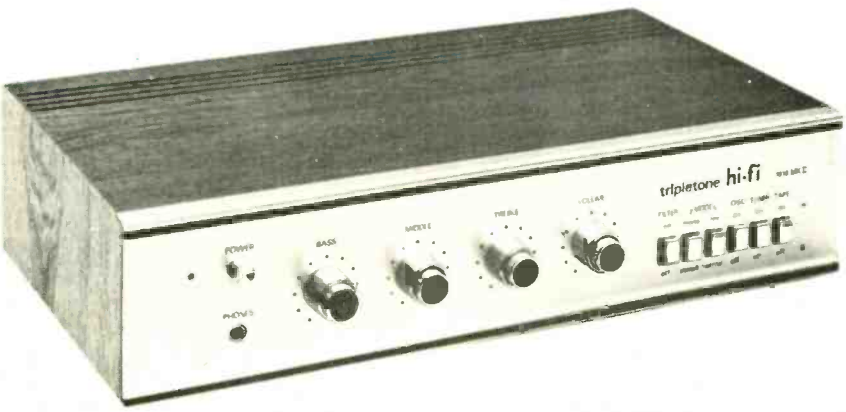
Signal to Noise Ratio: Pickup –62dB; Tuner –64dB; Tape –64dB
Crosstalk: Better than –50dB all channels

Inputs:	
Mag. P.U.	2.5mV
Ceramic	30mV
Tuner	100mV
Tape	100mV

Tape Output: 100mV

Tone Controls:	
Bass	±17dB 40Hz
Middle	±9dB 1000Hz
Treble	±15dB 14kHz

Recommended Retail Price (inc. VAT): £59.40



PERFORMANCE

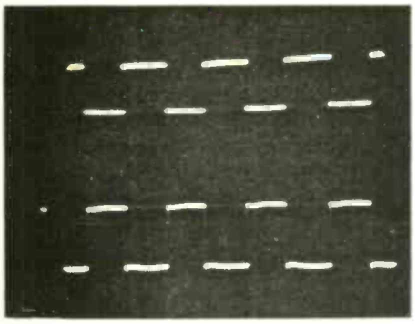
The results obtained from the various tests to which the 1818 was subjected given in the panel. Except on one issue, they all compare quite favourably with the manufacturers specified performance figures and this definately rates the amplifier as 'Hi-Fi' in spite of the low cost.

The overall frequency response is shown in one of the graphs together with the response of the scratch filter (marked F) and is well supported by the results of the square-wave oscillograms. In each case the input square-wave (from the generator) is shown at the top and the output from the amplifier at the bottom.

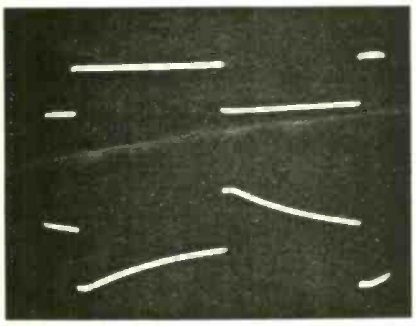
The responses of the three tone controls are shown against the overall response of the amplifier. In this graph the amplifier flat response is marked A and the responses of the three tone controls B, M and T, for bass, middle and treble. The bass and treble controls produce the usual amount of lift or cut i.e., around ±15dB whilst the mid range control gives a maximum of ±9dB centred on 1000Hz. Just how effective this middle range control can really be is an arguable point but it could, for example, be used to increase the 'presence' of voices, or diminish an overpowering voice, particularly as most of the lift or cut is available within the voice frequency range. From the purely musical point of view its use must be entirely to suit aesthetic taste or at most to apply a little correction to the not always perfect balance one gets from recorded or broadcast music.

Still on frequency response, the graph shows the not quite uniform response from pickup input. This

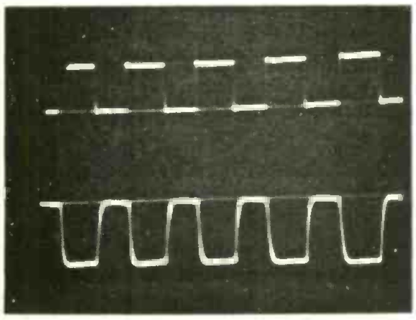
SUMMARY:
The Tripletone 1818 Mk II, made by K & K Electronics Ltd., 60 St. Marks Rise, London E8, is an unusual amplifier in that it features an additional tone control covering the mid-range frequencies. The tests show this amplifier to have a good specification and for those considering an amplifier in this price bracket, we consider it good value for money.



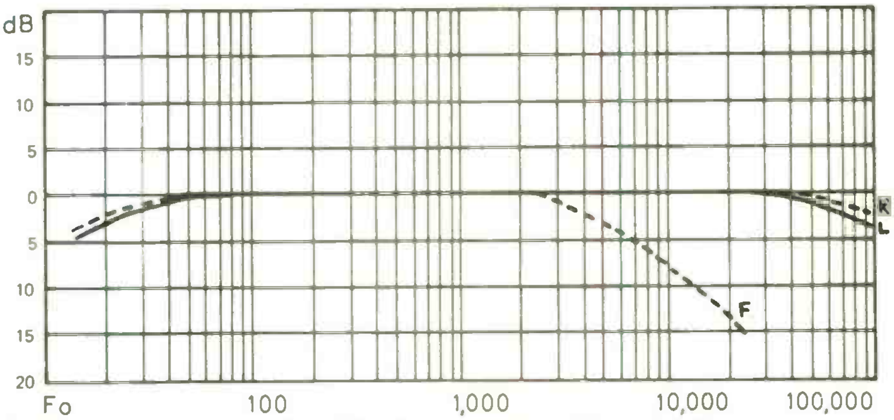
Square-wave tests at 1kHz: input at the top, output from amplifier at the bottom.



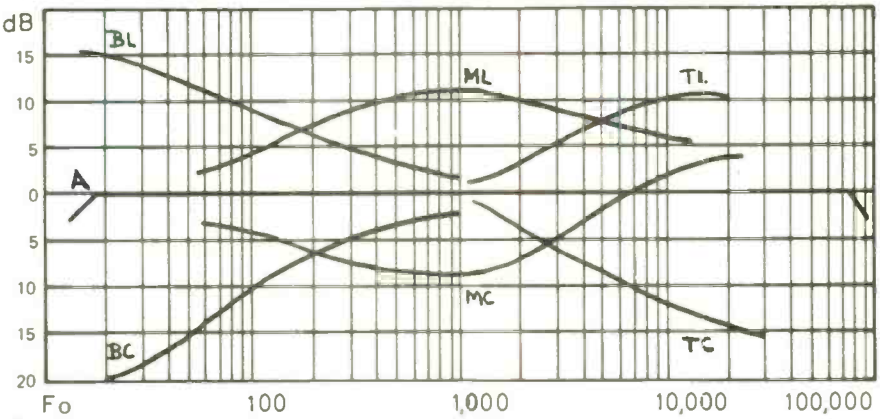
Square-wave tests at 100Hz; input at top, output at the bottom. The slope is not significant.



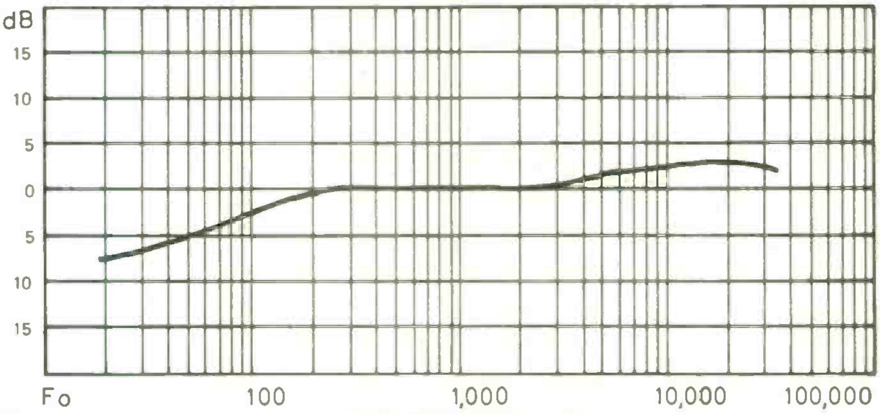
Square-wave tests at 10kHz; input at the top, output at the bottom.



Overall frequency response. Dotted line F is the response of the scratch filter.



Responses of the tone controls. BL/BC bass; ML/MC middle; TL/TC treble.



Response from pickup input using equalised (RIAA) input signal.

test was made using an equalized (RIAA) input so the curve should ideally be virtually flat from at least 50 to 12,000Hz. The fall off below 100Hz might be advantageous however, for reducing rumble from not-so-good record players.

Signal-to-noise performance, although not quite to that specified, could be considered as more than adequate as is crosstalk (-50dB all channels). The THD factor was well within spec on one channel but a little higher on the other. The manufacturer's pointed out that this could have been due to a minor fault in the sample amplifier sent for review and with this I agree.

At £59.40, including VAT, the Tripletone 1818 Mk.2 is an amplifier well worth considering. You could of course pay much more for something with extra but usually quite superfluous features, or perhaps a very high output power and still only get the same low distortion, wide frequency response and low hum and noise performance which is the essence of a good stereo amplifier. It is the latter points that make the 1818 good value for money.

etl product test

ROTEL RA611 AMPLIFIER

ROTEL amplifiers have achieved a deserved popularity, offering as they do, particularly good performance at a modest price.

The Rotel RA611 is no exception.

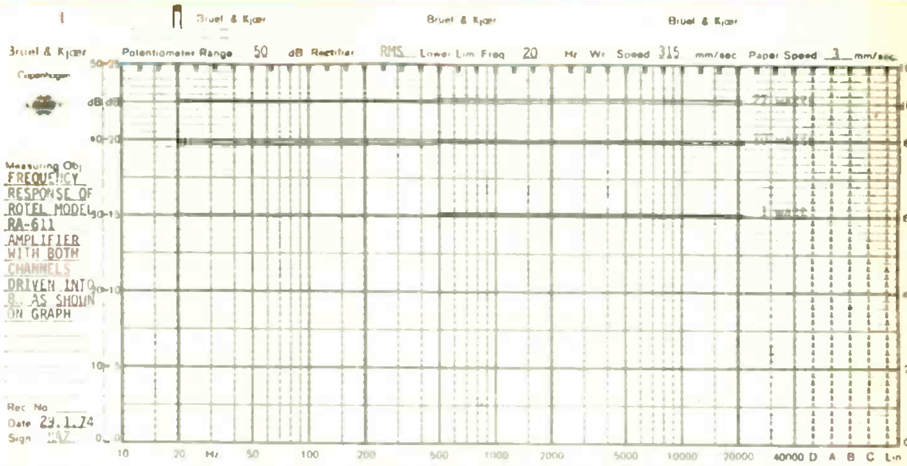
It develops 27 watts per channel, with both channels driven, and has more than acceptable distortion figures.

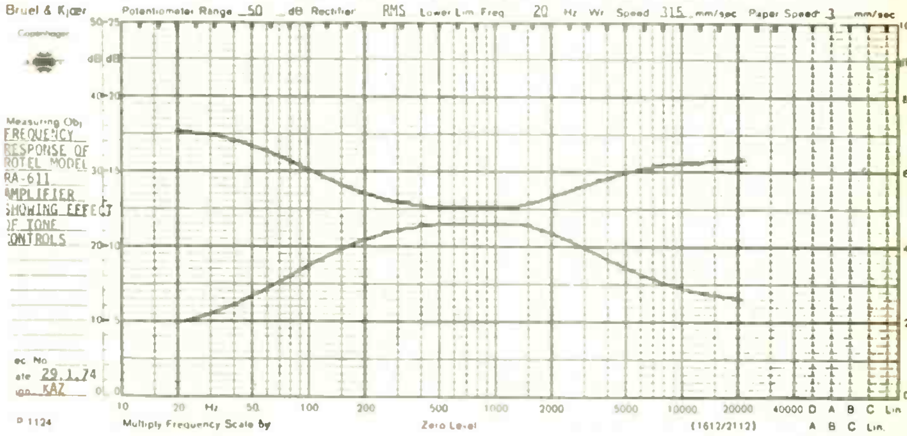
The amplifier casing is constructed from well veneered teak plywood with a moderately large black expanded aluminium grill for heat sink cooling near the rear.

The rear panel provides extremely comprehensive inputs including quick release speaker terminals with fully captive connections together with speaker fuses, mains fuses, and switched and unswitched mains power output connections.

INTERNAL CONSTRUCTION

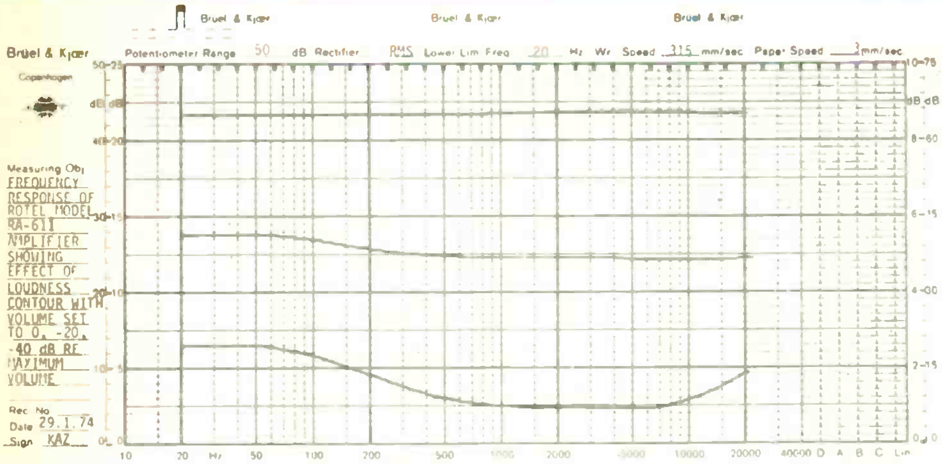
The inside of the amplifier is very well constructed. The preamplifier card is well-screened, the phono preamplifier is fully enclosed and shielded, and the main transistors are mounted on a large aluminium heat sink constructed from 12 gauge aluminium which apparently performs its task quite well. Temperature rise at

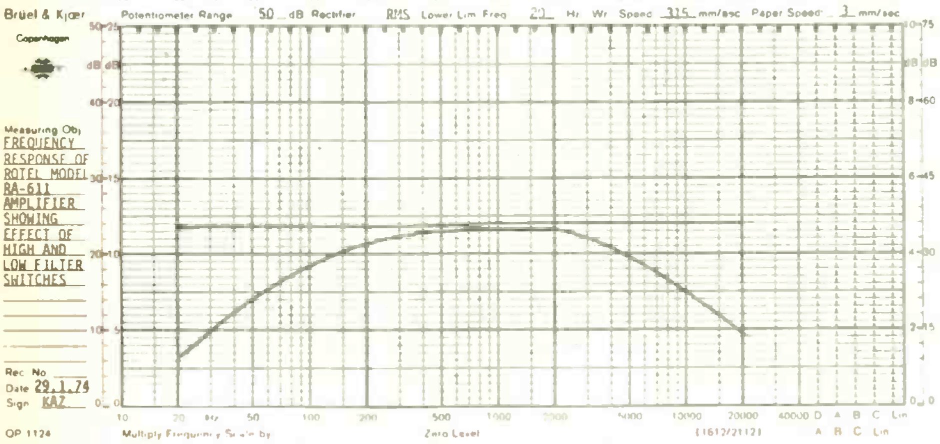




SUMMARY

It is good to see that Rotel, throughout this unit, have provided performance characteristics that are down-to-earth. All parameters are just a bit better than necessary – but not so much better that the customer is paying needlessly for a technical excellence that is meaningless outside a research laboratory.





the grill was a modest 25°C after two hours continuous running with both channels driven.

The general construction of the unit and its wiring is neat and the designers have taken some care in the fitting of many of the components to preclude long term problems, taking such precautions as tinning the printed circuit board where components are screw connected to the circuit.

MEASURED PERFORMANCE

We proceeded to test the main parameters of the amplifier and it was quite pleasing to find that *all* the performance measurements exceeded the manufacturer's specification.

Maximum power output was 27 watts into eight ohms with both channels driven. This is very good performance at 0.15% total harmonic distortion.

Frequency response at rated output of 25 watts was 20 Hz to 20 kHz ±0.5 dB. This is now virtually an industry standard.

Channel separation at rated output was 30 dB. This is lower than many other amplifiers – but is realistic and totally adequate.

Hum and noise, with respect to rated power output, was –73 dB unweighted and –85 dB ('A' scale) weighted.

Input sensitivities were all particularly good, with the magnetic input having 2 mV sensitivity.

The tone controls offer a slightly lower range of adjustment than we have become used to, providing 9.5 dB boost at 50 Hz and 7 dB boost at 10 kHz – this is just acceptable.

The loudness control provides 8 dB boost at 50 Hz and 1 dB boost at 10 kHz with both channels driven.

Perhaps our only real gripe about this amplifier is the choice of the anti-log potentiometer used in the volume control circuit. This characteristic results in little control until the volume knob is nearly fully clockwise. This is a little disconcerting at first.

In summary – Rotel's RA611 amplifier has very good performance. It is also more flexible in its facilities than many more run of the mill units.

MEASURED PERFORMANCE OF ROTEL RA611 AMPLIFIER

Power Output: 27W per channel into 8 ohms, both channels driven

Frequency Response: 20Hz to 20kHz ±½dB (tested at 1W,10W and at rated output.

Total Harmonic Distortion (at rated output, both channels driven).

100Hz	1kHz	6.3kHz
0.1%	0.125%	0.31%

Hum and Noise with Respect to Rated Power:
–73dB unweighted –85dB weighted

Channel Separation at Rated Output: –30dB

Inputs:		
	Aux 1 & 2	125mV/40kohm
	Tuner	125mV/40kohm
	Mag. P.U.	2mV/77kohm
	Monitor 1 & 2	190mV/47kohm
	Main Amp.	600mV/33kohm

Tone Controls:		
	Bass	+9.5dB –10.5dB at 50Hz
	Treble	+7.5dB –9.5dB at 10kHz

Loudness Control (at –40dB re 0dB maximum volume setting).
+8dB at 50Hz and +1dB at 10kHz

Intermodulation Distortion: 0.5%

Recommended Resale Price (inc. V.A.T.) : £103.50

CREATIVE AUDIO PART SIX

A practical guide to creating and producing your own sound
by Terry Mendoza B. Sc. (Hons).

THE very real attraction that electronic music offers to the composer/realiser is that it can produce results far exceeding the limitations of the human performer. For example, on a conventional instrument a musician may simultaneously instigate a dozen or so tones and their harmonics. This is meagre in comparison with a burst of pure white noise which will contain samples of *every* audible frequency. Another benefit offered by electronic music is that the performer will be freed from many limits imposed upon him by conventional instruments. Once a piano has been tuned to chromatic intervals, it is normally left this way, but a synthesizer keyboard may be played chromatically at one moment, then macro or micro-tonally at the next.

Composition of electronic music is in fact so free and loose that a composer has to impose his own limitations to give structure to his work. The most basic of the boundaries he will introduce will probably be that the frequency range of his music remains in the human 'audio' region — unless he wants to entertain the bats!

He will now have the choice between electronic music and music concrete, although there is no reason why these methods should be mutually exclusive. In its present sense, electronic music entails the derivation of material solely from wave-forms originating in electronic circuits. It further sub-divides into additive and subtractive tonal methods, additive techniques building complex timbres from pure tones, and subtractive methods utilising enharmonic (i.e. — a whole set of harmonics not related by any multiple of a semitone) and noise sources which are precisely filtered to the desired result. Both types of device are to be found in the majority of synthesizers and electronic music studios.

Music concrete, on the other hand, uses existing sounds for raw material, which can be quite literally anything from a pneumatic drill to a snatch of birdsong. It implies an input transducer of some kind, air-microphone or contact-microphone. Tape manipulation and electronic modification, are its prime tools.

Electronic music covers too wide an area to describe a typical approach to a creation, as there is no single 'correct' method. We will therefore survey in general terms the various devices that can be constructed or purchased for this activity.

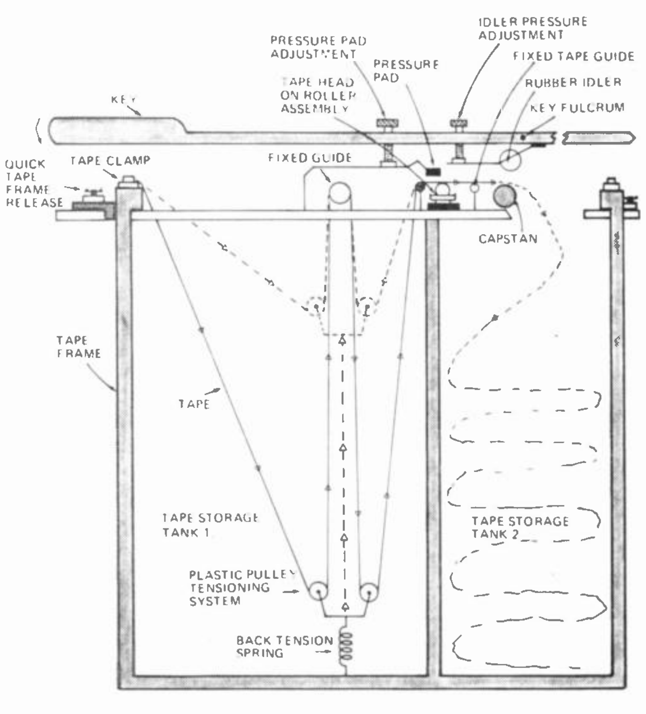


Fig. 1. Tape transport system of a Mellotron 400.

MELLOTRON

This device was introduced by a British firm in the mid-sixties. It took two forms, the first intended to be a complete sound effects library, and the second a kind of 'portable orchestra'. Ingenious though they were, they were also unwieldy, complicated and expensive, and so in 1970 gave way to a much simpler second generation based on the same principles, and known as the Mellotron 400 range.

The devices are equipped with an organ-type keyboard (the key-return achieved by a spring attached to the rear of the pivot-point) and owe their success in imitative 'synthesis' to the fact that their sounds are derived from tapes of actual musical instruments. For simplicity let us consider just one key mechanism (see Fig. 1). Previously a tape will have been made of the note relating to that key; it is cut to eight seconds, on the assumption that very few pieces will require a single note duration longer than this, at the same time ensuring that the 'attack' of the note is intact. This tape is kept in a storage tank under very light tension using spring-loaded pulley-guides. The tape is laid from the storage tank over various guides, a replay head, and thence over a capstan in the form of a finely-machined bar running behind the length of the keyboard, coupled to a servo controlled dc motor. From the capstan, the tape traverses another tank, being fixed on the far side of the tank. A small rubber pinch-wheel and a felt pressure-pad on a phosphor-bronze strip are attached to the underside of the key which is pivoted near the back.

The majority of the tape is held by the sprung pulleys in the first storage tank, with the 'attack' portion of the note adjacent to the replay head when the key is at rest. When the key is depressed, it can be likened to a tape recorder mechanism moving from 'pause' to 'run' — the pinch-wheel, tape and capstan are brought into contact, and simultaneously the pressure pad pushes the tape against the head. The tape plays for as long as pressure is maintained on the key; the instant it is released, the sprung guides

Fig. 2. Tempo-Regulator.

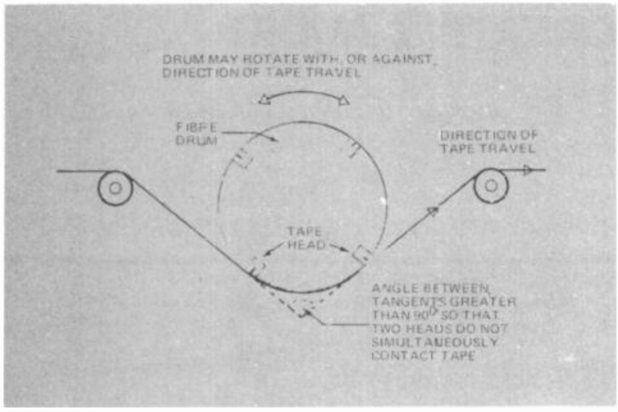


Fig. 3. Mechanical layout of tempo regulator.

from the first tank, which have been keeping the tape tensioned, return the tape to its start. This system is duplicated along the keyboard, with the multiple head block feeding its own amplifier.

The motor governing the capstan has its speed controlled by a servo-amplifier, which is in turn controlled by a single potentiometer. This permits the musician to tune the device, or introduce glissando effects which may be of large magnitude, if desired.

The tapes, which are of non-standard 3/8" width, each contain three tracks enabling the reproduction of three instruments (flute, violin and brass on the standard model) and utilise a purely mechanical track-change system — the tape guides are a fixture, and the complete head block is displaced to line the heads up with the required track. One advantage that this gives is the possibility for the musician to cross-fade between instruments, or even play combinations of instruments when the head gap is staggered across two tracks.

Simply by playing the relevant chords, whole violin sections may be effectively created. The one slight disadvantage of the Mellotron system is that, although the attacks are accurate, each note stops dead when the key is released, i.e. there is no true decay. However to an extent this is masked when chords are played, and may be further disguised by feeding the instrument through a reverberation unit.

The characteristic of this instrument that most lends itself to creative application is that the tapes, guides and storage tank can be lifted out as a self-contained unit, and another substituted to take the conventional ¼" tape width — the composer can then programme the Mellotron with any type of sound or instrument that he wishes.

THE MORPHOPHONE

Many years ago, a prototype Morphophone was developed for use in the Music Concrete Studio in France. The general principle was that a tape loop fixed to the circumference of a metal wheel was rotated, with between four and 10 heads around the loop to pick-off the signal. These could be moved within wide limits, and each had its own individually controllable filter, enabling not only prolongation of the signal, but also subtle variations of the reverberation response curve. However, its specialized nature precluded the possibility of its going into mass-production.

THE TEMPO-REGULATOR OR TEMPOPHON

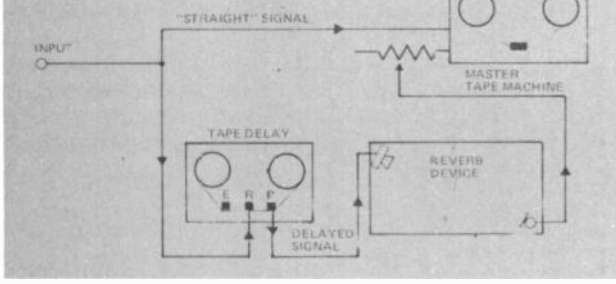
This device, in essence, performs a tape sampling operation, joining the sampled portion to compress the time scale or re-iterating the samples to expand the time scale (See Figs 2, 3).

It is used in conjunction with a variable speed tape deck, and is equally capable of converse operation which changes the pitch whilst leaving the time scale unaffected.

The device, developed by A. Springer, consists of a fibre drum with four integral magnetic heads. The magnetic tape wraps around the drum and is reproduced by the head nearest the tangential tape contact when the drum is static. If the drum is rotated in the same direction as the tape travel, then, although 60 seconds of tape will still take 60 seconds to travel from the feed spool to the take-up spool, the relative tape/head speed will have been decreased, causing a drop in the replay pitch. Increasing this tape speed in order to bring the pitch back to normal will result in the tempo being

Fig. 4 Lexicon Varispeech IA.

Fig. 5. Using a tape-delay in conjunction with a reverberation device.



CREATIVE AUDIO

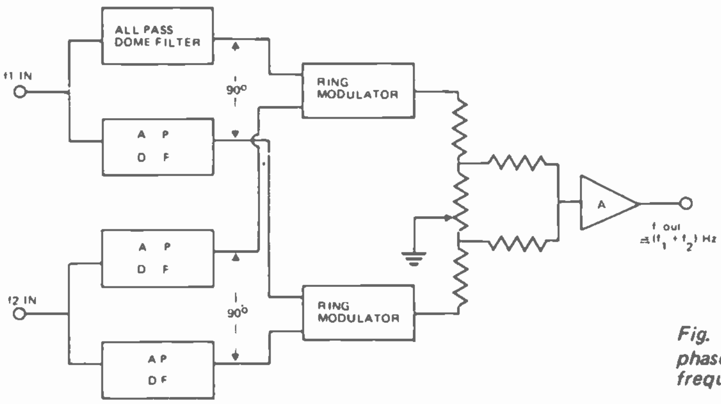


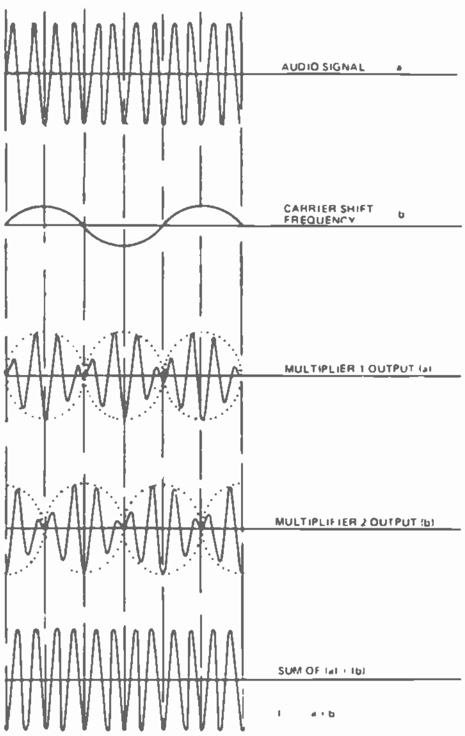
Fig. 11. Schematic of phase-shifting type frequency shifter.

2. PHASE-SHIFTING TYPE SHIFTERS.

The audio signal is split and routed to a pair of all-pass dome-filters which give two outputs, one shifted through 90° relative to the other throughout the audio range. The carrier frequency, which is the frequency by which the audio signal is to be shifted in this case, is similarly treated. The 'advanced' waveforms from audio and carrier signals are fed to one ring modulator, and both 'retarded' waveforms fed to a second.

Summing the outputs of the two ring modulators gives a waveform of a frequency equal to the arithmetic addition of the audio and carrier waves (Figs. 11, 12).

Fig. 12. Waveforms involved with phase-shifting type frequency shifter (after Bode and Moog).



A more complete mathematical analysis of the system, together with details of several other designs, can be found in the Bode and Moog paper "A High-Accuracy Frequency Shifter for Professional Audio Applications", Journal of the Audio Engineering Society, July/August 1970 Vol. 20 No.6.

One possible application of either device is found by mixing the output with the untreated signal. When no frequency shift is being caused, the mix will emerge 'straight'. An accurately controllable 'phasing' effect occurs as soon as any frequency shift is applied.

When inserted in the familiar tape-echo arrangement, in the feed-back line between the replay head and the record head, it gives the resulting tape-echo a glissando — each repeat being of a slightly higher pitch when the shifter is set to add a few cycles, and vice-versa when it is set to lower the output frequency.

MIXERS

When it comes to the task of controlling the amplitude of pure tones, the majority of commercially-available mixers are unsuitable, as sine waves highlight the slighest wiper crackle unmercifully, especially in the case of wire-wound or stepped potentiometers. Current thinking lies with indirect operation via a voltage-controlled amplifier, but long before the advent of widespread voltage-control, the B.B.C. Radiophonic Workshop had devised its own particular solution (Fig. 13), using a Wheatstone Bridge Null circuit in each channel.

One pair of opposing arms of the bridge each has a photocell placed in parallel with the arms resistance. The other two arms are trimmed for null output. The photocells are placed in a light-proof housing, together with a lamp fed from a separate dc potential divider circuit formed by the fader of that particular channel. Any wiper noise is smoothed over by the bulb's filament.

The lamp can, when required, be fed with ac, which will modulate the signal at twice the frequency of the alternating supply.

Electronic music need not be bound by the conventions which apply to orchestral works, hence stereo movement often plays a big part. The Workshop has a mixer designed with this in mind — each of the linear fader controls can also be operated in a rotary fashion to pan the relevant channel, in this way doubling the capabilities of one pair of hands!

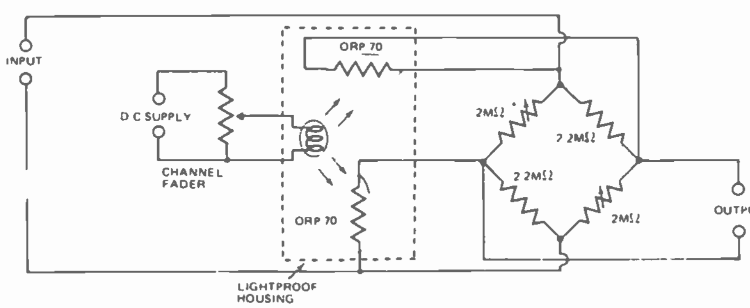
THE THEREMIN

This is the only musical instrument known to the writer that is played without being touched! The Theremin is named after Professor Theremin who, in 1928, amazed New York audiences when he demonstrated his ability "to obtain music from the ether".

The instrument has two rods protruding from its housing, each one forming one 'plate' of a capacitor. The performer's hands become the second 'plates' when held near the rods. The capacitive changes engendered in one rod controls the pitch of the tone, the other rod responding by varying the amplitude of the output.

A simple experimental circuit is

Fig. 13. Noiseless fader circuit devised by the BBC Radiophonic Workshop.



illustrated in Fig.14; the plate should be around 30 cm. square. It is placed next to a radio receiver tuned to a fairly strong station around 900 kHz. The slug of the coil is then adjusted to obtain the most pleasing tone. When the hand is moved near the plate, the pitch of the tone will change.

THE TRAUTONIUM.

In the same year that the Theremin was first shown, Professor Friederich Trautwien finalised his design for what has been claimed to be one of the first electronic synthesising devices incorporating voltage control.

The Trautonium consists of an oscillator, the grid bias of which is controlled by an ingenious variable resistor. This is in the form of an insulated drum with a winding of resistance wire, the whole suspended in a wire gauze cylinder. The inside 'ceiling' of the cylinder has a silver-plated bronze strip attached to it, which is brought into contact with the resistance wire when the gauge is depressed.

A dummy rubber keyboard mounted on top of the drum gives an approximate guide to chromatic interval, but the number of possible notes in an octave is limited by the windings on the drum under the keyboard, and is in the region of 1200 rather than 12! (Fig.15).

To be continued . .

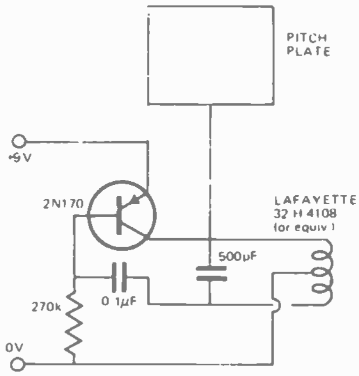


Fig. 14. Elementary Theremin Circuit.

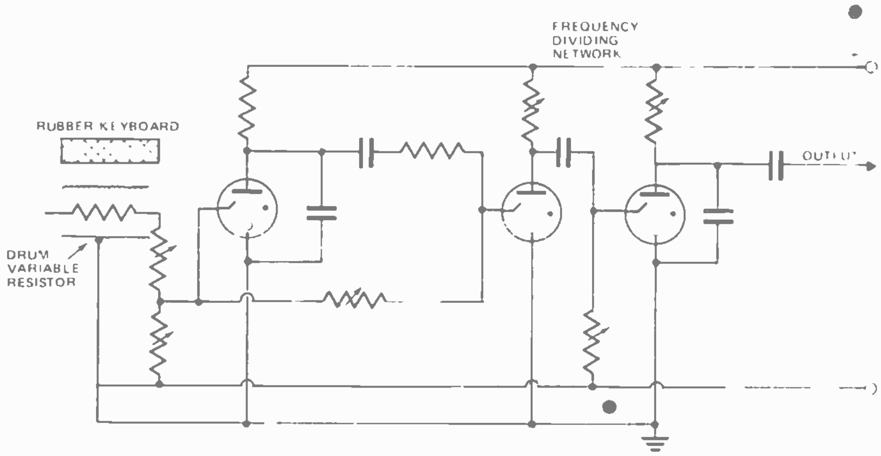
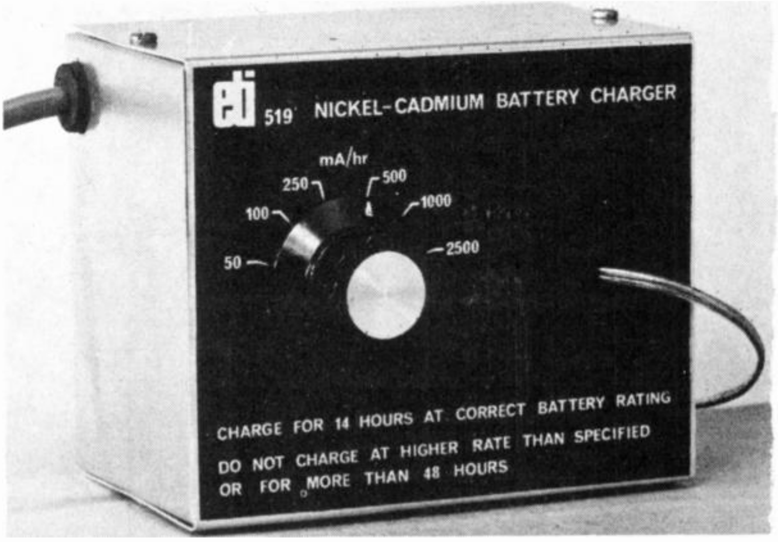


Fig. 15. Circuit of the 'Trautonium'.

NICKEL-CADMIUM BATTERY CHARGER

Universal unit will charge practically any nickel-cadmium battery currently in use.



PROJECT 519

THERE is an increasing proliferation of portable equipment, such as flash guns and calculators, which could, or already do, use rechargeable batteries of the nickel-cadmium type.

If the equipment was originally fitted with rechargeable batteries, a charger may well have been provided. But when replacing ordinary dry cells with rechargeable types a charger will be required. Unfortunately, nickel-cadmium battery packs come in a variety of voltages and ampere-hour ratings and a charger supplied for one piece of equipment (eg, an electronic flash) will seldom, if ever, be suitable for other equipment such as an electronic calculator.

The ETI 519 battery charger will charge almost any nickel-cadmium battery in use today. The charging rate is switch-selectable for batteries from 50 mA/h to 2500 mA/h capacity.

Any battery voltage up to 20 volts is *automatically* accommodated. No voltage selection is required.

Charging time is approximately 14 hours for a flat battery and proportionally less for one that is partially discharged.

Overcharging at the correct ampere/hour rate will not damage a nickel-cadmium battery. Thus an overnight charge for a partially discharged battery may be safely given. In fact, provided the correct ampere/hour charging rate has been selected no damage will occur if left on charge for 48 hours.

CONSTRUCTION

The circuit is a very simple one. Practically any method of construction may be used provided care is taken with the insulation of 240 Vac wiring.

In our prototype unit we assembled all components on tag strips, with the exception of the range resistors which were mounted directly on the range switch itself.

If only a single range is required, a

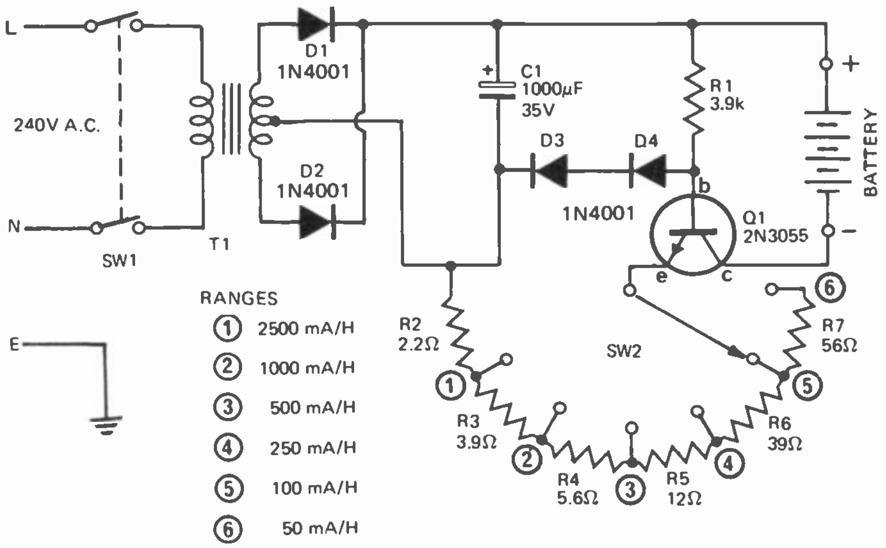


Fig. 1. Circuit diagram of the Nickel-Cadmium Battery Charger.

TABLE 1

BATTERY VOLTAGE	TRANSFORMER **	R1
1.25 – 3.75	12.6 V CT	1 k
5 – 10	24 V CT	2.2 k
11.25 – 20	40 V CT	3.9 k
21 – 30 *	60 V CT	5.6 k

* Capacitor C1 voltage rating should be 50 V.

** Current rating of the transformer, in mA, should be greater than the maximum mA/h battery rating divided by 10. A single winding transformer of half voltage may be used if a bridge rectifier is employed.

single resistor may be used. Its value in ohms should be 6000 divided by the mA/h rating of the battery. The nearest 5% nominal value to that calculated as above will be adequate.

By virtue of the nature of the constant current supply any battery, or bank of batteries up to 20 volts may be charged. If the 20 volt capability is not required a different transformer may be used as detailed in Table 1.

The transistor dissipates a fair amount of heat and hence should be mounted on a piece of aluminium to act as a heatsink. This piece of aluminium should be insulated from the case, or if not, the transistor should be mounted on the aluminium via a mica washer and insulating bushes. ●

HOW IT WORKS

Current regulators operate in opposite fashion to voltage regulators. In a current regulator, the current remains constant regardless of changes in load impedance – the output voltage varies to maintain constant load current.

In this circuit, the 240 Vac mains is reduced by T1 to 40 Vac. This is then rectified by D1, D2 and filtered by C1 to provide approximately 28 Vdc.

This dc supply is then regulated by Q1 and its associated components to produce a current level selected by SW2.

Transistor Q1 is biased by D3 and D4 such that there is about 1.2 V between the base of Q1 and the negative side of C1. As there is 0.6 V between base and emitter of Q1, there will be 0.6 V developed across the resistor network R2-R7. Therefore the emitter current of Q1 must be 0.6 V divided by the resistor value selected by SW2.

The emitter current generated as above will produce an approximately equal collector current which charges the battery and remains constant provided there is at least one volt between the collector and emitter of Q1.

PARTS LIST
ETI 519

R1	Resistor	3.9 k	½W	5%
R2	"	2.2 Ω	"	"
R3	"	3.9 Ω	"	"
R4	"	5.6 Ω	"	"
R5	"	12 Ω	"	"
R6	"	39 Ω	"	"
R7	"	56 Ω	"	"

D1-D4 Diodes 1N4001 or similar
C1 Capacitor 1000μF 35V electrolytic
Q1 Transistor 2N3055
T1 Transformer 240V/20-0-20V, 500mA
SW1 Two-pole on-off switch
SW2 Six-position single-pole rotary switch
Metal box, bracket for 2N3005, 3-core flex and plug.

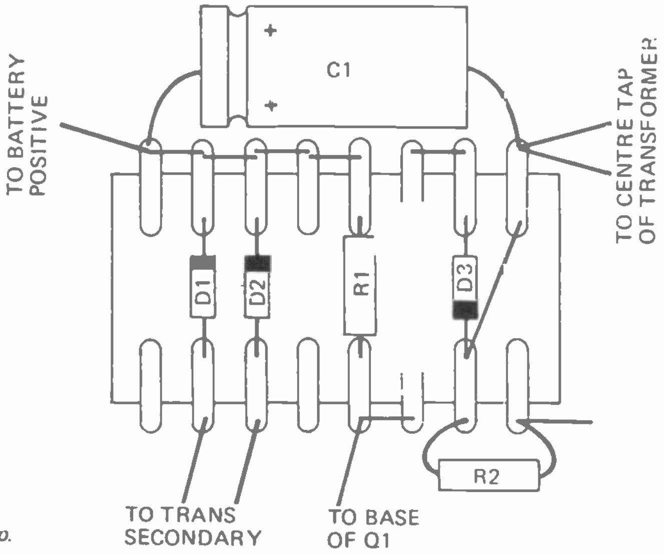


Fig. 2. Layout of components on the tag-strip.

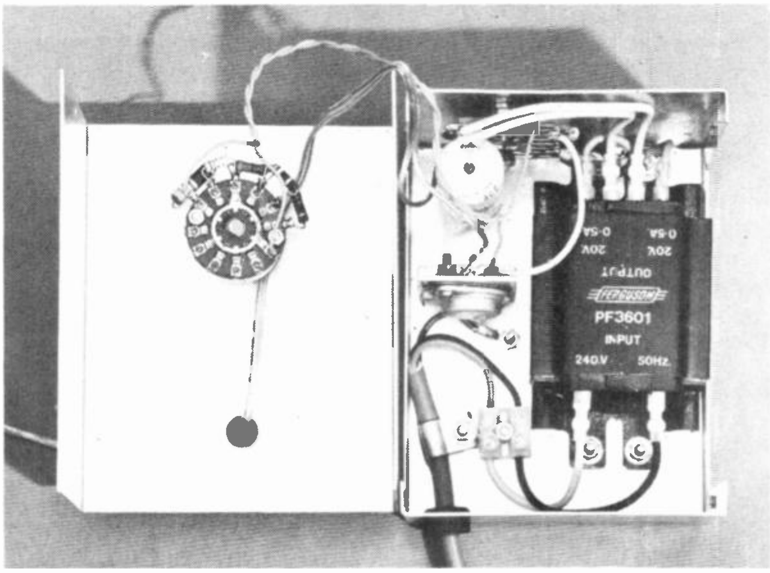
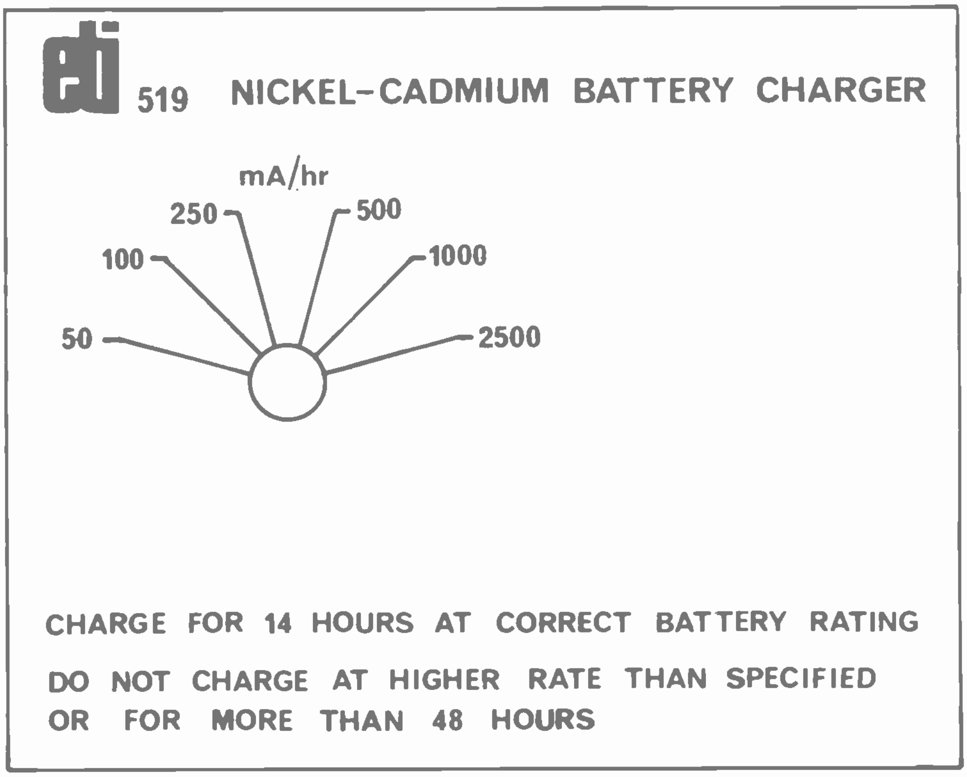
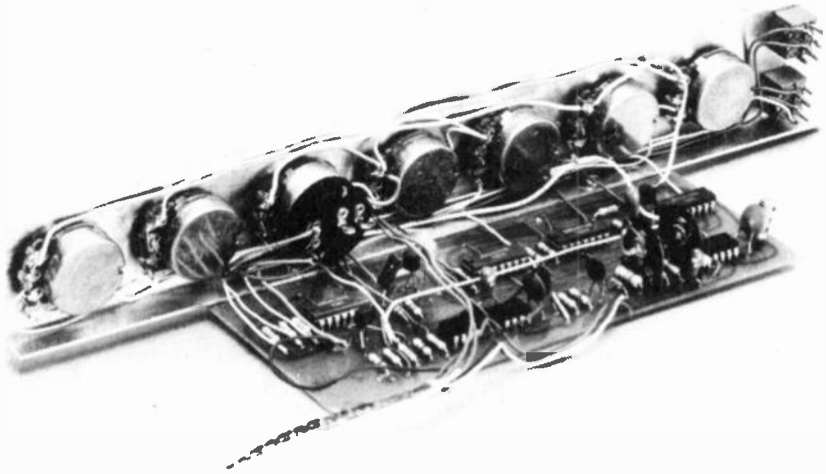


Fig. 4. Front panel artwork.



3600/4600 INTERNATIONAL MUSIC SYNTHESIZERS



TRANSIENT Generator 2 module provides an almost infinite variety of output shapes.

It may for example be used to modify the keyboard output voltage. Such a keyboard output would, when applied to an oscillator for example, cause it to commence the note in tune, raise to say one octave higher, hold the note for a preset period and then drop the note to one octave lower than the basic frequency.

The number of semitones or octaves, shifted up or down, is uniform over the entire keyboard range. The maximum design range of control is of the order of plus or minus two octaves.

Usually this module will be used to control a Voltage Controlled Filter (VCF), in the bandpass mode, being fed from a complex waveform (considerable harmonic content). Upon pressing a keyboard key the Transient 2 waveform could for example, cause the filter to commence at the timbre as selected the VCF "TUNE" control, sweep up to the higher overtones and finish on the lower fundamentals.

CONSTRUCTION

With the aid of the component overlay (Fig. 2), assemble components to the printed circuit board paying particular attention to the orientation of integrated circuits, transistors, diodes and electrolytic capacitors.

It is recommended that sockets be used – for the CMOS ICs at least. These CMOS ICs should also be the last components to be fitted to the board.

The mechanical assembly is similar to

PARTS LIST

Transient Generator 2

R1, 19, 22	Resistor	100k	¼W	5%
R2, 13, 18	"	10k	"	"
R3	"	15k	"	"
R4	"	680 ohms		
R5	"	470 ohms		
R6	"	8.2k		
R7, 9, 11	"	1M		
R8, 12, 15, 16, 17	"	1.2k		
R10	"	1.8k		
R14	"	39k		
R20	"	3.3k		
R21	"	470k		
RV1, 2, 6		2M log rotary		
RV3, 4		22k trim potentiometer		
RV7, 8, 9		25k lin rotary		
RV5		2M log rotary switched		
C1,	Capacitor	4.7μF 25 V tag tantalum		
C2, 6,	"	33pF ceramic		
C3, 5	"	0.0033μF polyester		
C9, 10	"	10 μF 25 V tag tantalum		
C8	"	10pF ceramic		
C4, 7	"	2.2 μF tag tantalum		

IC1, 2, 3	Integrated circuit	LM301A
IC4, 5	" "	SCL4016AE*
IC6, 7	" "	SCL4011AE**

* the prefix and suffix of CMOS varies from manufacturer to manufacturer.
** should be Solid State Scientific only (CEMA)

Q1,	Transistor	PN3638 or similar
Q2, 3, 4	"	PN3643 or similar
D1, 2,	Diode	IN914 or similar
SW1, 3	Switch	SPDT miniature toggle
SW2	"	Part of RV5
PC Board	ETI 601g	

Metal bracket to Fig 4.

Recommended extras

8 pin socket Molex type M2139-8 off
Molex type M1238 pin 8 off
14 pin IC socket 4 off.

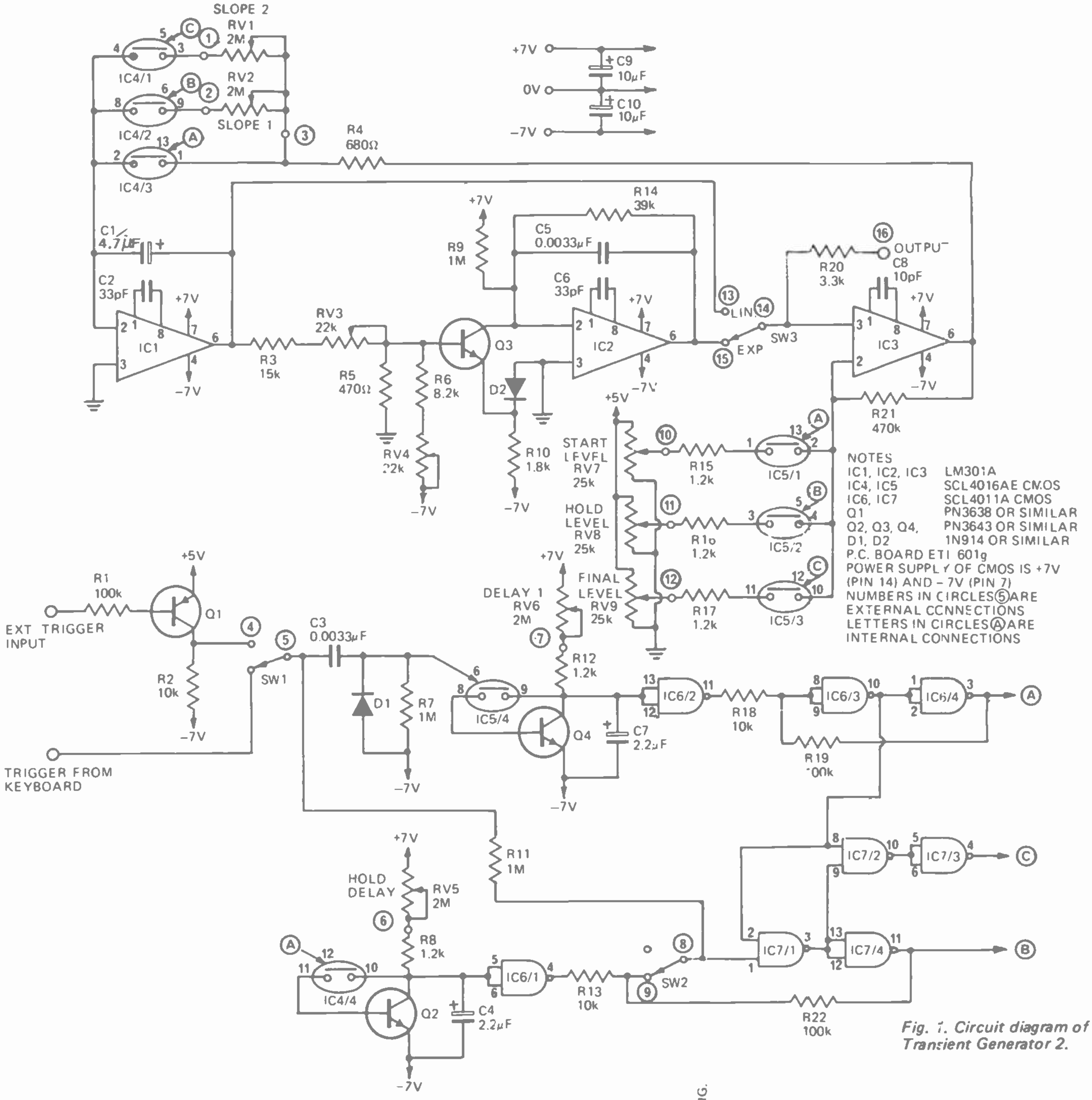


Fig. 1. Circuit diagram of Transient Generator 2.

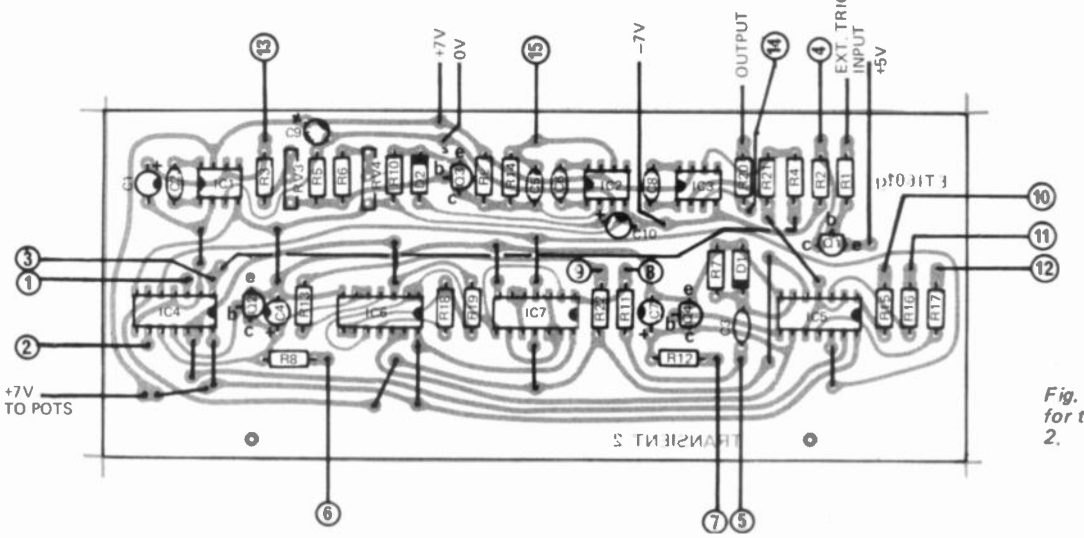


Fig. 2. Component overlay for the Transient Generator 2.

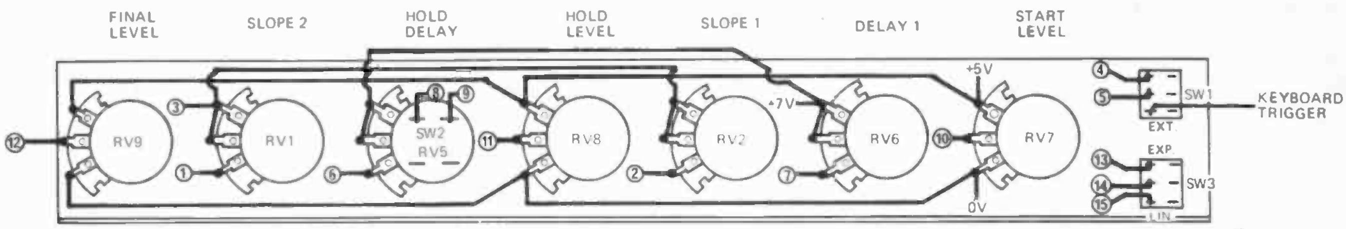


Fig. 3. Wiring diagram to switches and potentiometers on the mounting bracket.

INTERNATIONAL MUSIC SYNTHESIZERS

that for Transient 1 (described last month). All rotary potentiometers and switches are mounted onto the bracket, drilling details for which are shown in Fig. 4. The bracket, in turn, is mounted onto the component side of the printed circuit board.

Wiring between the potentiometers and switches, and the connection points to the printed board is illustrated in Fig. 3.

CALIBRATION

As with Transient Generator 1, the exponential converter section has to be calibrated. Begin by setting SW3 to the LINEAR position and SLOPE 2 to maximum rate.

Measure the output voltage and check that it is variable between '0' volts and +5 volts by means of the FINAL LEVEL control.

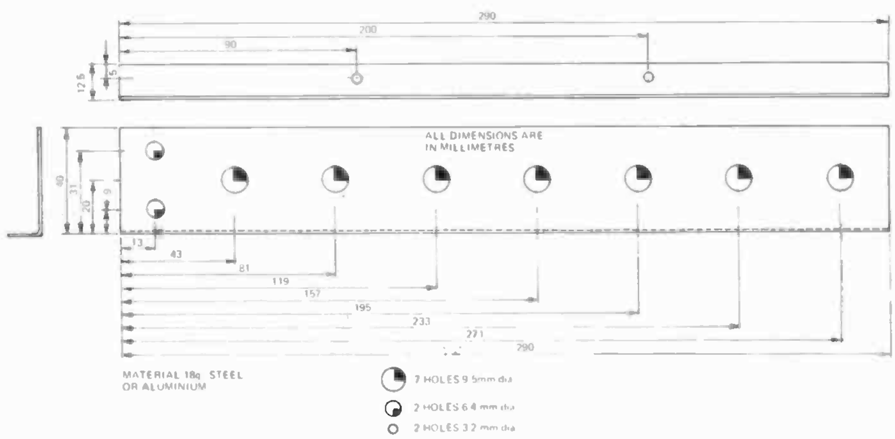
Adjust the output to '0' volts by means of the LEVEL CONTROL and adjust RV4 so that the output of IC2 is exactly zero.

Adjust the output to +5 volts with the level control and then adjust RV3 for +5 volts at the output of IC2.

Repeat the previous two adjustments until the settings remain correct when the level control is varied from one end to the other.

Switch to EXPONENTIAL and check that the output of IC1 does not go negative at any setting.

Fig. 4. Mounting bracket for Transient Generator 2.



HOW IT WORKS

Transient Generator 2

This module is very similar to the Transient 1 generator described last month. It consists of two main sections.

1) The wave shaping circuitry (analogue).

2) The control circuitry (digital).

The analogue section is almost identical to that of Transient 1, described last month, and reference should be made to that article. The main exception is the omission of the reset-transistor across the integrator IC. Additionally the three inputs to the comparator are all adjustable, the 'ATTACK' potentiometer has been deleted and the 'attack time' is thus always at its maximum rate.

Last month's "How it works", in conjunction with both circuit diagrams should readily explain the operation of this section.

The digital section of the two modules is different. That for Transient 2 works as follows:–

When a trigger pulse is presented to gate IC5/4, it turns on for about 3 millisecs. This discharges C7 via Q4. The resulting low level at the input of IC6/2 gives 'high' output at (A) (IC6/4). Whilst (A) is high C4 will remain discharged.

The digital ICs used in this module are 2-input NAND gates (four per package), the truth table for which is shown below:–

INPUT 1	INPUT 2	OUTPUT
0	0	1
0	1	1
1	0	1
1	1	0

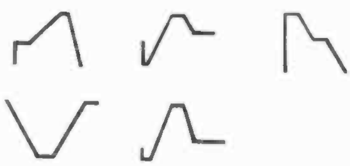
Note that for the ±7 volt supplies as used, '0' means less than –1 V and '1' means greater than +1 V at the inputs. In the case of outputs, '0' means close to –7 V and '1' means close to +7 V.

A high output at (A) will select the maximum slope rate and the START LEVEL potentiometer RV7. The output will go rapidly (within 5m-secs) to the level set by RV7.

After the initial 3 m-sec period C7 begins to charge at a rate selected by 'DELAY 1' control, RV6. When C7 charges to approximately 0V the output at (A) will go low allowing output (B) to go high selecting 'SLOPE 1' and the HOLD LEVEL as set by RV8. The output will now charge towards this new level at the SLOPE 1 selected rate. At the same time capacitor C4 is also released and begins to charge. When about half charged (around 0V) the output (B) will go low and output (C) high. Thus 'SLOPE 2' is selected and the 'FINAL LEVEL' set by RV9. The output cycle is thus complete and the final level will be maintained until the unit is retriggered.

Note that the slopes can be in either direction depending only on the settings of the level potentiometers.

Below are examples of output waveforms available.



If the 'HOLD DELAY' potentiometer (RV5) is switched off, the key hold time replaces the hold delay, and, if the key hold time is less than DELAY 1, then at the completion of DELAY 1, SLOPE 2 and FINAL LEVEL will be selected – thus eliminating SLOPE 1 AND HOLD LEVEL.

ELECTRONICS -it's easy!

PART 4

This course, written in down-to-earth language, takes the mystery out of electronics — explaining it as the logical, fundamentally simple, yet far ranging subject it really is.

WE HAVE seen that a voltage source will provide the force needed to cause charges to circulate in an electronic circuit. Electrons, negatively charged, flow from negative to positive in an attempt to cancel out the charge imbalance created at the supply.

But not all voltage sources create a *static* charge imbalance. It is, in fact, quite possible to produce a condition in which the charge imbalance alternates from positive — negative and then negative — positive, repeating the cycle continuously, thus causing a corresponding alternating direction of current flow.

The principle of alternating current (ac) is simple, and as easy to grasp as that of direct current (dc). Its implications however, go much deeper, for our thinking must allow for the time element present in all ac excited systems.

FREQUENCY AND WAVELENGTH

In a dc circuit, the current always flows in the same direction. It does so with an amplitude that may vary from virtually zero through small to large.

This amplitude — either of voltage or current — may be measured, as we saw last month, by using an appropriate meter.

The result may be visually presented in the form of a graph with time on the horizontal axis, and meter reading on the vertical axis. A dc voltage level is shown graphically in Fig. 2a.

In an ac circuit, the current reverses periodically, and voltage sources that operate in this fashion are called alternating current generators.

As electrical energy flows at the speed of light it is possible to regard it as instantaneously following the charge imbalance created at the generator terminals. Note that it is not the electrons themselves that travel at such a speed.

Electrons start moving in a circuit virtually instantaneously when a potential difference is established. They cease moving equally fast when the potential difference is removed.

The effect is rather like turning on a tap.

Water flows immediately, because the pressure from the pump or reservoir is exerting a force on the water in the pipe.

But although *water* flows the moment the tap is opened, it may take hours or even days for any given drop of water in the reservoir to travel along the intervening pipes to the tap.

So with electrons. Although they start and stop moving virtually instantaneously — their actual rate of flow in a conductor is very slow, in fact individual electrons move at mere centimetres a minute.

At first sight it might seem pointless to have an electrical circuit in which electron flow continuously changes direction. The change flow averages out to precisely zero — so why bother!

Nevertheless, this form of current flow is absolutely essential for the operation of innumerable electronic devices. This will become clearer as the course proceeds. For the time being one can regard the effect of alternating currents (ac) as being similar to the action of a cross-cut saw or double acting steam engine — i.e. work is done during both half-cycles of movement.

In an ac circuit, the current reverses periodically, with a peak amplitude that is usually equal in both directions. As with a dc current, ac currents may vary from practically nothing (fractions of picoamps) to millions of amps. Not only are ac currents variable in amplitude. There are many other ways by which the current can rise, fall, and reverse, with time. Some of these are shown in Fig. 2b.

The behaviour with respect to time is called the waveform of an ac signal. In the case of Fig. 2b, where the reversal of current flow takes place instantaneously, a waveform is produced which, for obvious reasons, is called a square wave.

Waveforms are characterized by three attributes. Shape, amplitude, and cycle time.

If the waveform resembles a common geometric shape it is usually referred to accordingly — square, triangular, staircase — are three examples. If the waveform does not resemble a

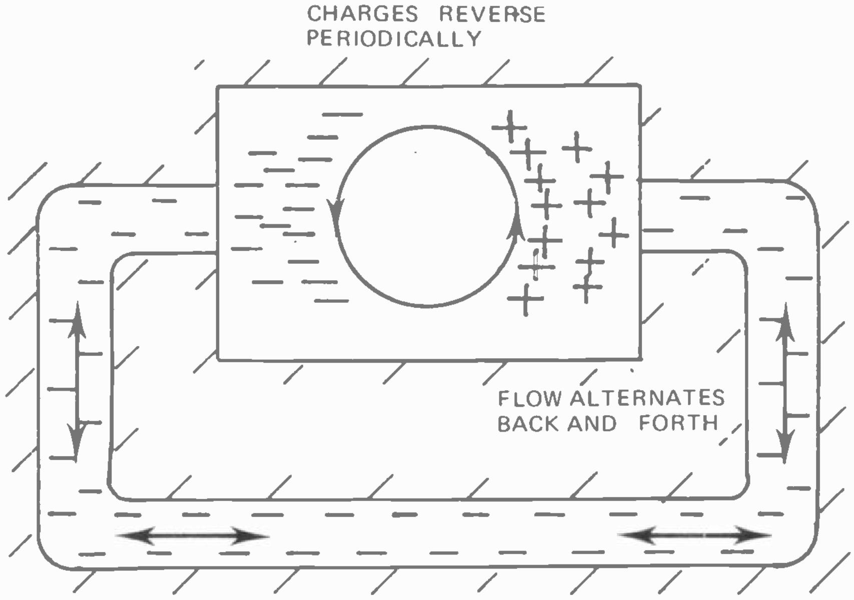


Fig.1. With alternating current, the charges periodically reverse direction.

ELECTRONICS - it's easy!

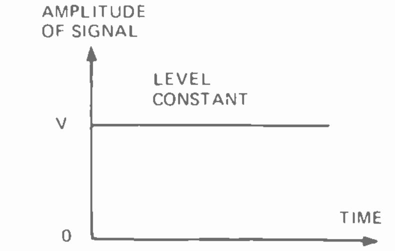


Fig.2a. This form of graph shows how signal amplitude varies with time – this is a dc signal.

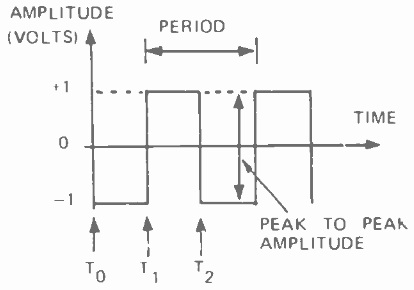


Fig.2b. Amplitude – time graph of squarewave ac signal.

common geometric shape then we define it in other ways appropriate to its characteristic.

Amplitude can be specified in several ways – the most obvious being its value from one peak, through zero, to the opposite peak. This is known as the peak-to-peak value (usually abbreviated to pp or p-p). The square wave shown in Fig. 2b has an amplitude of 2 volts peak to peak.

The cycle time of a waveform – usually known as its 'period' – is the time that a waveform takes to swing from any given point through one complete cycle and back to a similar starting point. It is usually denoted as T. In the case of Fig. 2b the period is from T_0 to T_2.

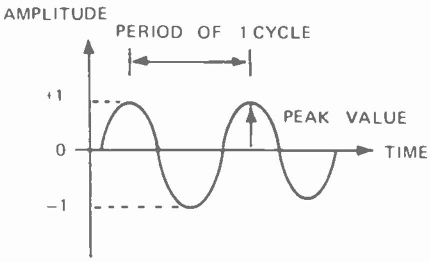


Fig.3. The most basic waveform is the sinusoid.

The period of electronic waveforms varies from one cycle every few thousand seconds to one cycle every fraction of a picosecond (one million-millionth of a second), or less.

The number of such periods occurring in a given time is known as the 'frequency' (usually denoted as f). Thus frequency and period are related – as f = 1/t, provided both are measured on the same units of time; seconds being generally used. The number of cycles occurring in one second used to be known (reasonably enough!) as 'cycles per second'. Nowadays the term Hertz is used for the same parameter. Hertz is generally abbreviated to Hz, often with a multiplier prefix such as kHz (one thousand Hertz) or MHz (one million Hertz).

To illustrate the inter-relationship between period and frequency, a 1 MHz squarewave has say, a cycle time (or period) of 10^{-6} seconds. Thus it repeats the waveform one million times a second. At the low end of the spectrum a 1 millihertz waveform takes 1000 seconds to pass through each complete cycle. (Note – although the abbreviation 'm' denotes milli – it is not generally so used as a prefix when denoting frequency. i.e. the abbreviation mHz is correct but millihertz will nevertheless normally be written. This is because frequencies of less than 1 Hz are not commonly encountered in electronics, and because of its rarity, 1 mHz may well be mistaken for 1 MHz – a unit one 1000 million times larger!).

INTRODUCING THE SINE-WAVE

Although the square wave is the easiest alternating waveform to comprehend – it may be produced simply by a battery and a continuously reversing switch – it is not the most basic waveform that exists.

Square waves, and in fact all other waveforms, are really composed of multiple waveforms called 'sinewaves'.

As the name implies, the amplitude/time graph of a sinewave is sinusoidal. It follows the trigonometric sine function as time proceeds. The shape of a sinewave is shown in Fig.3.

The instantaneous values for a sinewave of two 'units' peak to peak can be obtained from a set of natural sine tables by giving it the appropriate sign change during the cycle.

Unlike square waves, a sinewave current does not have rapid transitions (called 'transients') but varies smoothly from zero, rises to a positive maximum, falling through zero, to rise in amplitude in the opposite sense.

It is often necessary to be able to equate the mean energy value of sinewave current to that of dc current. Clearly the total charge moved (energy, therefore) in a given time by a sinewave differs from that moved by a dc current having the same *peak* value (the peak value of a dc current is of course the same as its mean, or average, value). The peak to peak value of a sinewave does not express the true mean energy flowing.

The equivalence occurs when we use a value less than the peak of a sinewave. This lower value is known as the rms value. The term rms is short for Root of the Mean of the sum of the Squares – of the instantaneous values and this turns out to be 0.707 of the zero to peak value.

In other words the rms current (or voltage) in an ac system fed with sinewave power has the same energy level as a dc system fed with dc power of the same numerical value.

Heating illustrates this well. Our household 240 volt 50 Hz ac supply is not 240 volts peak to peak, but 240 volts rms. An electric heater energized by the 240 volt mains ac supply would therefore produce the same amount of heat if fed from a 240 volt dc supply instead.

It is not generally appreciated that our 240 volts 50 Hz ac mains has a zero to peak value of 340 volts. Considerably higher than the value quoted!

In many designs the peak value of an ac waveform must be very carefully considered for it is this value that determines the insulation required. Because of this many components have their voltage ratings quoted in peak not rms value.

Sinewave power is sometimes quoted as an 'average' value. This is the average of the sum of instantaneous values). It works out at 0.637 of the zero to peak value. Average power is

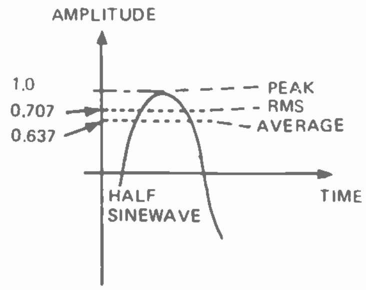


Fig.4. Relationship between average, peak, and rms. of a sinusoidal waveform.

rarely quoted as it has relevance in special applications only. Figure 4 shows the relationship of peak, rms and average values.

HOW SINEWAVES ARE GENERATED

Most of the world's electrical energy is generated as sinewaves.

The basic principle, used in everything from power stations to the alternator now fitted to modern cars, is very simple.

When a loop of wire is rotated in a magnetic field a current is caused to flow in the wire by the influence of the magnetic field.

The direction of current flow is determined by the direction of the magnetic field with respect to the direction of motion of the conductor. By examining Fig.5 it may be seen that each side of the loop will cut the magnetic field alternately downwards and upwards as it rotates. Thus the current must reverse in the loop of wire. The current is at maximum when cutting the field parallel to the North/South pole axis, and at minimum when perpendicular to it. Thus the current is *also proportional to the angle of the conductor in the field.* These two effects combined produce the waveshape output known as a sinewave. The law governing the direction of current flow in a conductor is known as Faraday's law and will be discussed in more detail later.

In practice, the rotating loops of alternating-current generators have many turns and, more often than not many pairs of magnetic poles.

The rotating alternator is an efficient way of generating electricity in large quantity, but only in large quantity — i.e. fifty watts upwards. Because of this and for reasons of practicality, the majority of sinewaves used in electronic equipment are in fact generated by special electronic circuitry powered from dc, that in turn, is either generated by batteries, or produced from the 240 volt ac mains. More about this later.

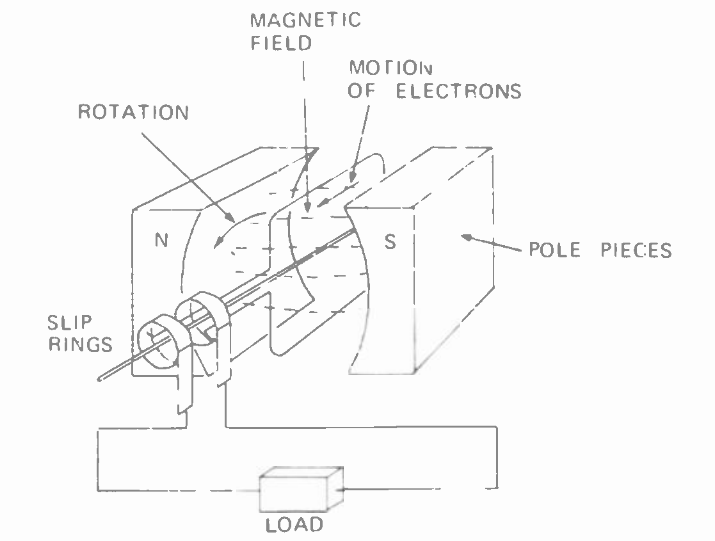


Fig.5. Basic electromechanical sinewave generator.

NOTHING IS PURER THAN A SINEWAVE

In the 1800's, when science was more devoted to thought than hardware, and electricity was still a 'magic' trick, mathematicians were laying the foundations of our present-day sophisticated theories.

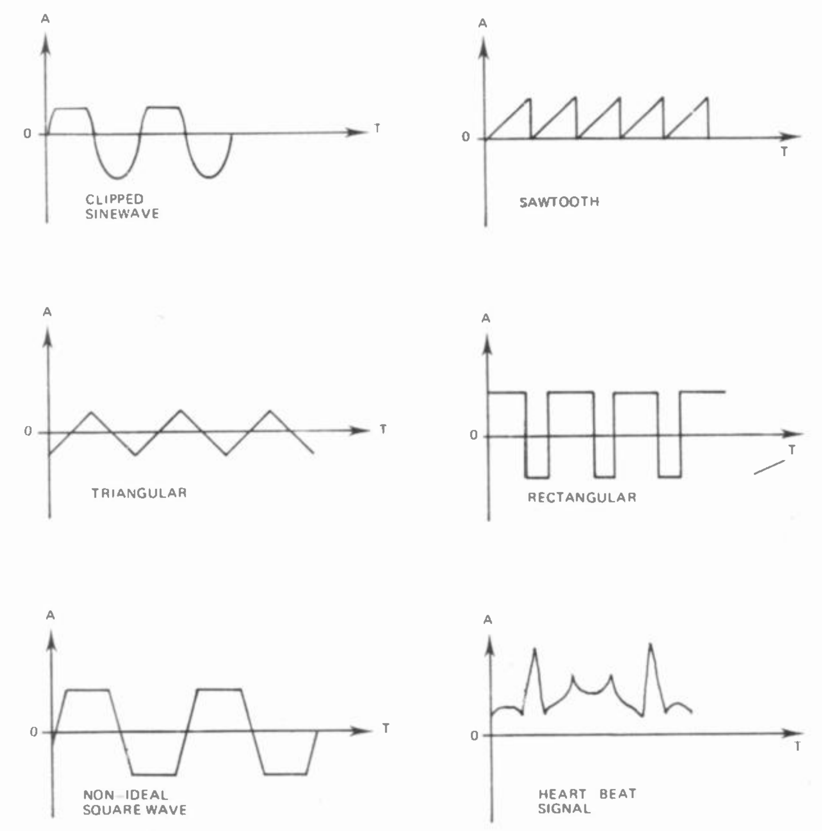
One such mathematician was Jean Fourier, a Frenchman.

Fourier's thing was the solution of numerical equations. He eventually proved that all *periodic* functions (i.e. all functions that repeat periodically) could be broken down into a sum of sinewaves having different amplitudes and frequencies. As each individual sinewave cannot be broken down any further it seems that the sinewave is the purest of waveforms obtainable.

The method, now known universally as 'Fourier Analysis', involves relatively advanced mathematics. Nevertheless the concept can easily be demonstrated using our now familiar amplitude/time graphs

Waveforms that are not strictly sinusoidal are known as 'complex'. Various complex waveforms are shown in Fig.6. As will be shown, our

Fig.6. A number of complex waveforms.



ELECTRONICS - it's easy!

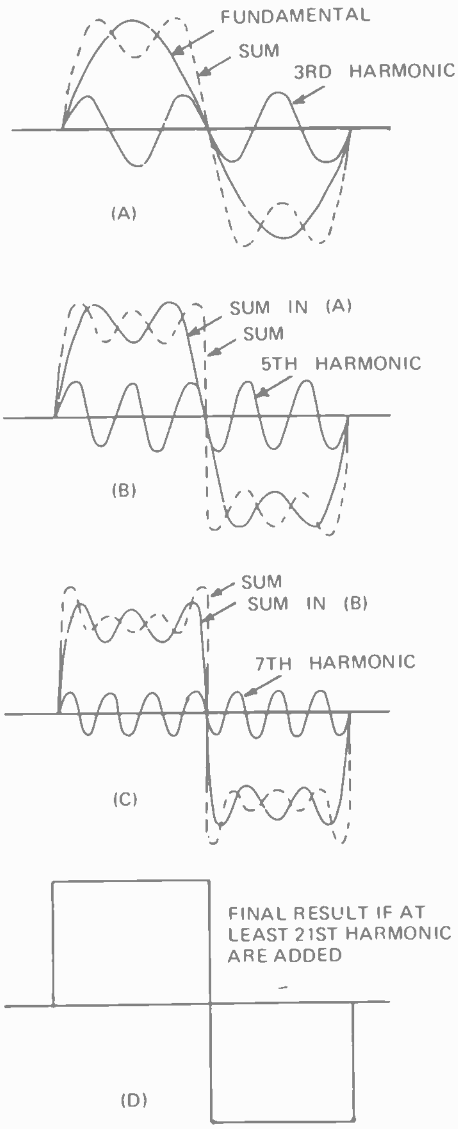


Fig.7. The apparently simple squarewave is really made up of the addition of numerous sinewaves of different frequency and amplitude.

apparently simple looking squarewave is in fact quite complex. It contains sinewave frequencies varying from one having a period identical to that of the squarewave, to one with (theoretically) infinite cycles per second.

Figure 7 shows how a squarewave is made up of a (theoretically) infinite number of sinewaves. In (a) a sinewave, with period equal to that of the squarewave (this one is called fundamental frequency) is added graphically to another sinewave of three times the frequency (known as the third harmonic) but only one third the amplitude. Already the addition of the third harmonic makes the waveform begin to look like a squarewave.

In Fig.7b we have added the fifth harmonic at an amplitude one fifth that of the fundamental — the waveform now looks even closer to a squarewave. In (c) we have added the seventh harmonic — at one seventh the amplitude.

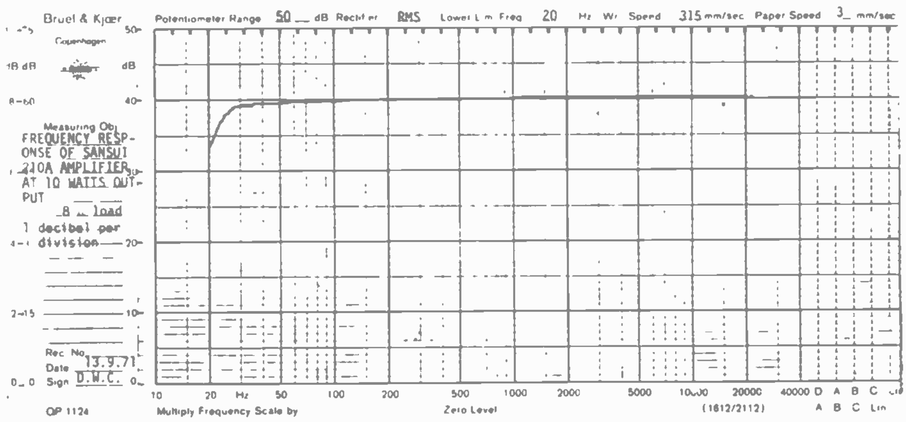
By continually adding frequencies in this way we eventually obtain our final squarewave. In practice, up to the 21st harmonic will be required to obtain a reasonably shaped squarewave.

All complex waveforms can be broken down in this way, not only in theory but also in practice, in fact one way of generating sinewaves is to generate a basic squarewave — perhaps even by using a battery and an automatic polarity reversing switch — and then to use an electronic filter to extract the fundamental frequency.

The concept of Fourier analysis is another basic tool of the person trained in electronics — we will refer to it again throughout the course.

TO BE CONTINUED

Fig.8. This frequency-response plot (of a hi-fi amplifier) was obtained using an automatic recording chart plotter.



DX MONITOR

Compiled by Alan Thompson

I find it hard to believe that this is the end of the first year of DX-MONITOR: it seems only yesterday since I wrote the first lot of copy for the June 1973 issue, with a great deal of trepidation and a sense of treading, like the old explorers, onto ground marked on the map with the hair-raising inscription "Here be dragons!". Just what a departure DX MONITOR was, was brought home by our beloved (!?!) Editor's comment that it was, perhaps, the first time that a serious level Electronics magazine had run a feature on BC-band DXing. Of course, there had been innumerable features on DXing over the years in all sorts of magazines, ranging from ones for the tryo experimenter in radio to the ones which - so they strike me! - are written for the very small band of geniuses who can understand the headlines, let alone the text. The past year has shown me that there is a very considerable band of readers of serious electronics magazines who like to try their hand at DXing, from time to time, and who are prepared to admit that it contains a considerable element of "art" as compared with the "science" which makes up the bulk of the magazine. I am very grateful to all the readers who have written to me over the months with suggestions, comments (happily, few have been adverse) and queries: they will know that their letters are never read and forgotten and most of them, ultimately, form the basis of an item in one of our monthly get-togethers.

There must be more books written on radio propagation than on any other aspect of radio, with the possible reservation that aerials has proved to be a slightly more popular subject. Regrettably few of those texts are of much use to the practical DXer since either they assume that he is possessed of a few acres in which to erect a series of Beverage aerials (VERY long, VERY efficient but VERY impracticable for Mr. Average who lives in a conventional semi-detached with just enough room for the cat to turn round between the rose-bed and the ornamental pond!), or they tacitly assume that the reader is of equal knowledge on the subject and is familiar with the latest advances in radio-physics and has an I.Q. which makes him a candidate for "MENSA". There is one work which falls nicely into the mid-range of knowledge-assumption and clear exposition of a complex theme and that is "Sun, Earth and Radio: An introduction to the ionosphere and magnetosphere", by J.A. Ratcliffe, published by World University Library at 80p. Dr. Ratcliffe could not have a more suitable background for writing a book of this type as he has "worked for most of his life at the Cavendish Laboratory at Cambridge and was head of the Radio Research Section set up to study the ionosphere. From 1960 to 1966 he was director of the Radio and Space Research Station at Slough". A neat little paper covered volume "Sun, Earth and Radio" runs to 256pp and is illustrated with 15 black and white photographs and 83 two-colour diagrams. Even if your mathematics and physics haven't progressed very far for many years you shouldn't have any real trouble in understanding this quite absorbing volume. One note which caught my eye comes at the head of a comprehensive list of references described as a "Selective bibliography" – "The subject discussed in this book is advancing so rapidly that it is important to note the date of any publication". Would that all writers were as honest!

Some readers' letters keep on occurring from different writers, if you see what I mean! One of the most common reads something like this:- "I have read a number of books about aerials for short-wave reception and would like your advice as to the type that I should erect". The writer usually goes on to say that he has read one or other of the usual works on aerials for SW reception and is more confused than he was when he started his researches. The aerial most usually suggested for SW listening, or indeed for DXing, is the standard half-wave dipole which, in the simplest of terms, is an aerial insulated at each end, divided in the middle and with the two halves connected by coaxial cable, or open line, to the two aerial terminals of the receiver. The dipole is an admirable aerial for the wavelength to which it is cut and the total length (i.e. from end to end) can be calculated from the formula

$$\text{Length (in feet)} = \frac{468}{\text{frequency in MHz.}}$$

So, for a dipole to operate on the 6MHz (or 49 metre band) the length of each of the halves is about 39 feet which means that you require a total length of something like 80 feet, allowing for the necessary support ropes – rather too long for the average garden! If a half-wave dipole is required for the 60 metre band the dimensions grow to total length of 100 feet approximately.

Of course, dipoles will operate on frequencies other than those for which they are designed but at somewhat reduced gain. The loss of gain can be reduced in two ways - (a) by fitting a simple pi-type aerial tuner between the aerial and the receiver, and (b) by arranging the two feeders from the dipole so that they can be switched together with the result that they are both connected to one of the receiver's aerial terminals and the effect is that the aerial has been converted into a "T" shape. This aerial, especially if used with an aerial tuning unit, will then operate very satisfactorily over the whole of the shortwave spectrum up to about 30MHz, and the half-wave dipole for the 49 metre band can always be brought back into use just by moving over a switch: a DPCO type switch is very easily wired in this way.

Two very good booklets on aerial construction are free for the asking. One is available from the BBC Engineering Information Service, Broadcasting House, London W1A 1AA, and the other from "DX Juke Box", Radio Nederland, P.O. Box 222, Hilversum, Holland. The booklet issued by Radio Nederland also includes details of a simple to build aerial matching unit of which there must be many thousands in use throughout the world, as this is one of those units which has been in circulation for a very long time, the circuitry of which gets passed on from DXer to DXer.

Maybe, you don't feel like going to the trouble of building a half-wave dipole and many DXers do not trouble with the somewhat troublesome job of erecting one, especially if they are not possessed of a nice straight run which will accommodate the chosen half-wave dipole without one, or both, of the elements having to be folded in order to get it into the available space. If this is your feeling, then the simplest advice is to erect the longest, highest, straightest piece of sky-wire that you can and feed it from one end, or if that is not practicable, to feed it at its centre point. Many DXers with very impressive records have managed to log anything up to some 200 countries on just that piece of wire, a suitable aerial tuner and some very subtle use of the receiver controls! Even better results can be achieved if the aerial is connected to the receiver through a pre-selector which includes an aerial tuning circuit and one which I have used to good effect is the P.M. IIB type manufactured by Hamgear Electronics (their address is 2, Cromwell Road, Sprowston, Norwich NOR 65R). If anyone likes statistics - my own tally is 204 countries heard on the shortwave broadcast bands over a period of some 8 years: I would guess that the maximum possible in the U.K. is probably something of the order of 208-210, although, of course, there is always the chance that the Cook Islands will suddenly land their signals on your antenna when you happen to be listening although I should not take any bets on its being likely to happen.

The purpose of the above notes is to indicate that a very specialised aerial system is not necessary for even quite advanced DXing. Many of the theoretical handbooks are really designed for use at transmitting and receiving stations used for general broadcasting or commercial purposes: their needs are vastly different from those of the DXer. The DXer is interested in hearing the station well enough to be able to report that he has heard it: the commercial broadcaster is concerned with getting a usable signal into a certain area. The DXers signal would, very seldom, be of usable commercial standard but, then that's not what he is aiming at any more than the do-it-yourselfer knocking up a few shelves for the garage is concerned with achieving cabinet maker's standards.

As ever, your letters with comments, queries and general observations are always welcomed and, if possible, should reach me by the 10th of the month. There's a slight change of address owing to the boundary changes so send your letters to: Alan Thompson, 16 Ena Avenue, Neath, West Glamorgan SA11 3AD. If you would like a personal reply, then a stamped, addressed envelope is a necessity.

Editor's Footnote: A suitable Aerial Tuning Unit was featured in the April 1974 issue of ETI on page 31.

Electronics Tomorrow

by John Miller-Kirkpatrick

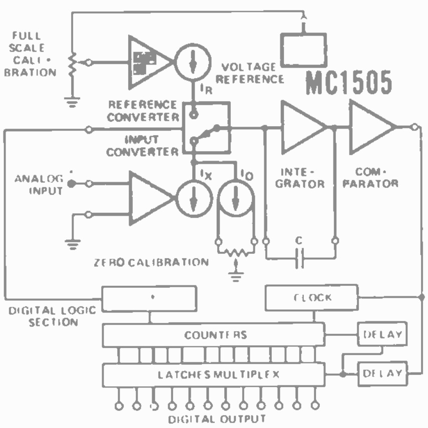
ALTHOUGH the 10.30 television closedown is now well behind us, there are still some very good reasons for a better entertainment level during the later hours. With a choice between News at Ten, Midweek and a documentary on the price of Ethiopian beef in the lower Yangtze, a fourth TV channel would be a blessing. As the IBA are not yet going to give us one, the only alternative is to provide your own, and here you have a choice of systems. If you happen to be one of those lucky people who can easily pick up an alternative IBA station or have 'piped' TV, then the solution is simple. If you are one of our elite rich then a videorecorder can be yours from about £350 and of course you are supposed to use expensive pre-recorded cassettes (recording from the TV is against copyright regulations in theory anyway). An alternative to these systems is to use a minicomputer to give you simulated games which can be played on a normal household TV set. Many of you may already have come across these games in clubs and pubs with games of tennis, football, etc. Already these games are available in the USA in the form of a little "black box" which can be plugged into the aerial socket of a normal TV, the latest of these is from a company called Telattach Corporation of Chevy Chase, Maryland, USA.

The TelaRacing terminal consists of a wheel and dashboard connected by a cable to a toy racing car mounted on a frame that is attached by suction cups to a TV screen. Yes, the days of little electric racing cars running round a boring circular track are over, with this system the car runs on a track that is projected onto the TV screen. The system requires one of twenty programmes which are transmitted by cable TV companies or sold as video cassettes. The viewer attempts to steer the model car around the course appearing on the screen, but if the toy car passes over an obstacle or the side of the track, a sensor under the car sets off a buzzer and a 'skill' recorder reduces the driver's score on a tally wheel to the right of the dashboard. The car is steered by turning the steering wheel which pulls on a cable which in turn moves the car along the frame and thus across the screen. The price of this racer set is intended to be $24.95 (about £11).

It is rumoured that the "black boxes" referred to earlier may be available in the UK in the near future but prices have not yet been finalised and no further information is yet available.

DPM FRONT END

Motorola have recently announced the MC1505L functional block integrated circuit which performs the diverse roles required of analogue-to-digital converter subsystems. The IC uses the dual ramp integration technique with an internal voltage reference to give a very accurate output.

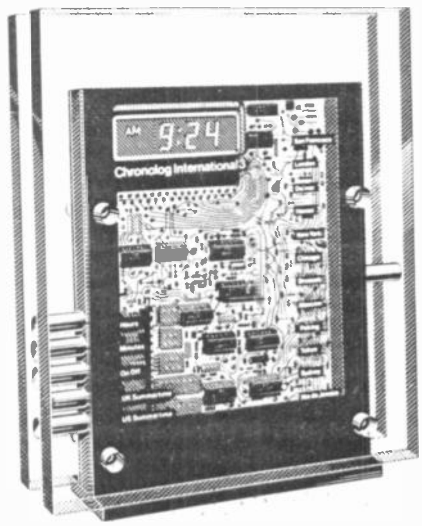


Motorola MC1505L A–D sub-system.

On the front end the unit requires only two calibration potentiometers (full scale and zero adjust) and one integrating capacitor for normal operation. On the back end, the system requires an oscillator (clock), two delay units (multivibrators) and a count, latch, display system. It is possible that some of the LSI count, latch, display chips available from several manufacturers could be used on the output of the MC1505L. Price of the chips are in the region of £5 and the best people to approach for data are Jermyn Industries at Vestry Estate, Sevenoaks, Kent. Data may not yet be available in the UK.

A ROUND THE WORLD TRIP FOR £825

If you have a spare £825 you can



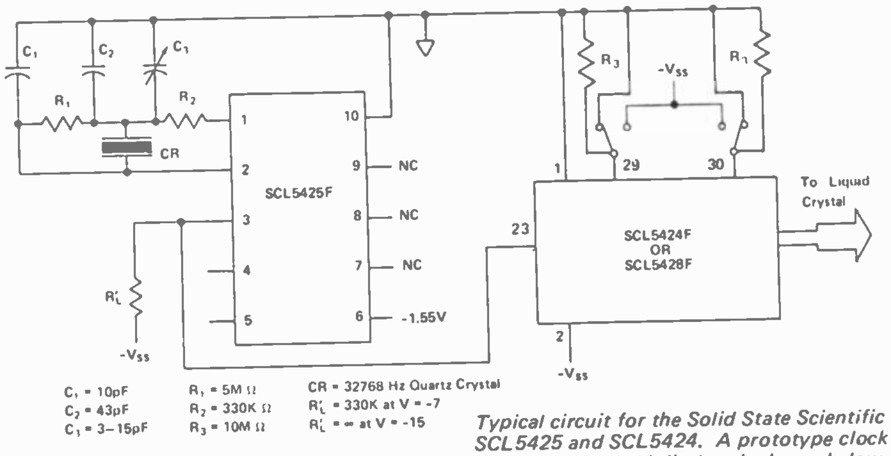
For the man who has everything, the Chronolog International 3 "computer" clock which tells the time in any of 12 time zones.

visit London, San Francisco, Denver, Hawaii, New York, Chicago, Brussels, Moscow, Peking, Tokyo, Sydney and Rio de Janeiro with no passport and VAT included. Well, maybe you cannot actually visit those places physically but you can visit them in spirit and live at their time for a while.

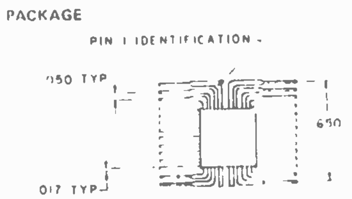
You can travel round the world in 24 seconds with *Chronolog International 3*, a unique solid-state "computer" clock which tells the time in 12 international time zones. The hours and minutes are shown on a liquid crystal display panel, by moving a magnetic button on the side of the clock different reed switches are actuated thus causing the display to show the time in the new selected time zone. The clock can also be easily corrected for Summer Time in 3 continents. Chronolog International 3 costs £750 plus VAT and can be purchased from Chronolog Systems Limited, BCM6543, London WC1V 6XX.

A similar system could possibly be constructed using one of the many digital clock chips plus a simple calculator chip to add or subtract the appropriate number of hours (and days if necessary) as required, now there's a fascinating project to work on!

A cheaper digital clock for the stay-at-home types, but still using a



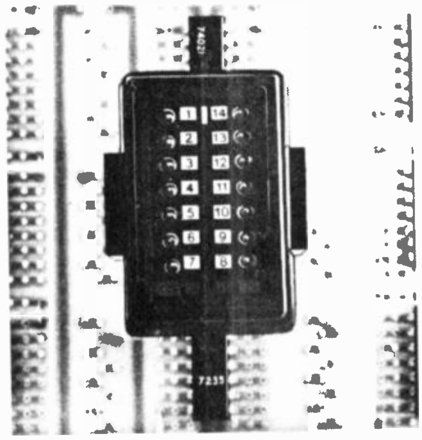
Typical circuit for the Solid State Scientific SCL5425 and SCL5424. A prototype clock using liquid crystal displays is shown below.



liquid crystal display can be built using some chips from Solid State Scientific. The chips themselves are not new but are now available in the UK. The system is similar to the Cal-Tex CT6002 mentioned recently but this is presented in two chips, the SCL5424 and the SCL5425. One accepts as input a 32,768kHz crystal and outputs 256Hz and 1Hz, the second accepts these two frequencies and counts them down and outputs digital clock information to a liquid-crystal display. The system will run field-effect or dynamic scattering L-C displays and thus the reasonably cheap Siemens display could be used. The main disadvantage is that these chips are only available in the flattie packages which are not easy to work with as they cannot be used in sockets and the pins are on 0.05" centres (normal DIL ICs are 0.01" centres). If you have the facilities for DIY PCBs and some fine soldering equipment then the devices are available from Transworld Scientific Limited, Short Street, High Wycombe, HP11 2QH. The price of the chips is £19 per pair and TWS can also supply a display (for which a connector is required). Unfortuneatly TWS are a distributor in the big leaque and are not too keen to handle enquiries from the amateur and one-offs type of market.

ANOTHER TLL LOGIC CHECKER

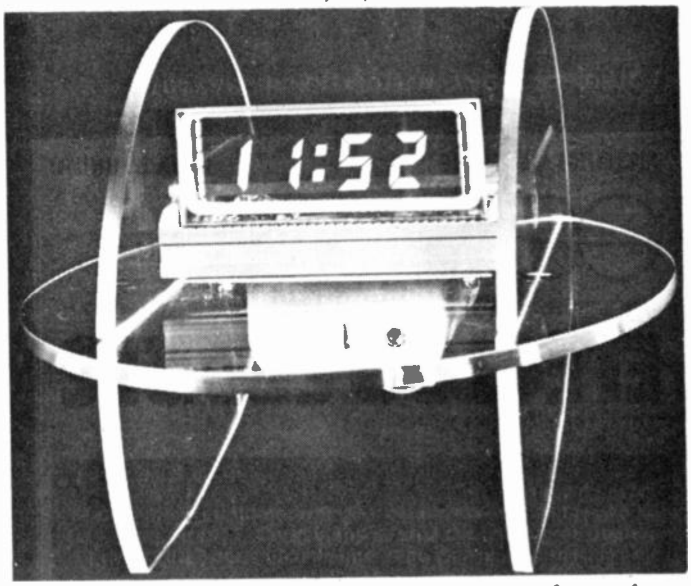
Electroplan have introduced the new Ryley Logic clip which displays logic states at a glance. The clip is powered from the test circuit and immediately shows the input and output states of the DIL package on sixteen LEDs. As the clip needs only a low input current it can be used with high impedance 5V CMOS, low power TTL, standard TTL or DTL. Similar clips have been released by Jermyn and Guest International both at about the same price of the Ryley clip at £24, a DIY version at about £10 is shown in the Bywood Electronics catalogue. The Ryley clip is available from Electroplan Limited, P.O. Box 19, Orchard Road, Royston, Herts.

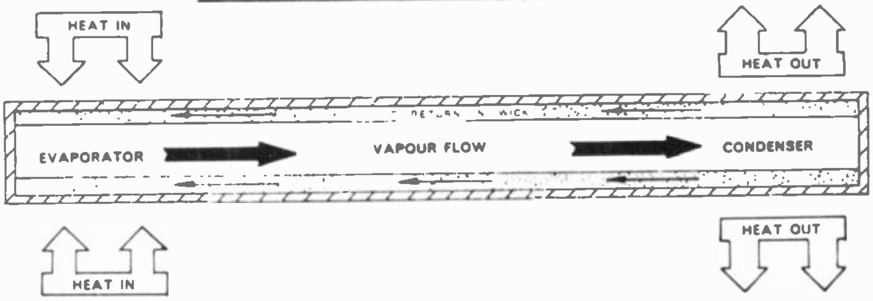


The new Ryley Logic Clip from Electroplan.

PIPE YOUR HEAT ALONG

Heat pipes are finding increasing usage in high efficiency heat exchangers. Basically a heat pipe is a sealed tube containing fluid and a wick. One end of the tube is heated thus causing the liquid to evaporate. The evaporated liquid travels along the tube (and usually upwards) towards the cooler end where it condenses, thus transferring the heat, as latent heat, to the cooler end of the tube. The liquid is recirculated from the condenser to the evaporator by the capillary action of the wick (and usually gravity). Heat pipes are lightweight and transfer heat silently, reliably and with temperature gradients some hundred times smaller than a similarly dimensioned copper bar. The pipes are used to transport heat from electronic equipment, lasers, motors, transformers, brakes and clutches. They have also been used to help to cook joints of meat evenly. Heat pipes are available from Redpoint Associates Limited, Cheney Manor, Swindon, Wilts at prices of £5.00 for ¼" diameter 150mm long to £32.00 for 1" by 600mm.





Operation of a heat pipe. These were described in some detail in the February 1974 issue.

 Continued from page 13

BETTER ELECTRON MICROSCOPES RESOLUTION

A new way of using a scanning electron microscope permits much more detailed study of solid surfaces such as those of microelectronic devices, and should be equally applicable to studying biological specimens. The new technique, proposed by IBM's research labs, permits resolution of surface details at least three times smaller than could previously be seen.

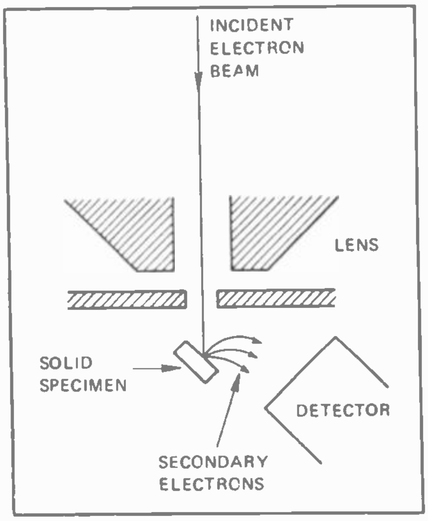
Surface scanning microscopes have come into wide use in recent years as one of the most powerful new tools for study of materials, especially biological specimens ranging from pollen grains to cell membranes. The instrument can provide pictures of an intact specimen having a striking three-dimensional quality, and for many studies it is more useful than a transmission microscope, which produces X-ray-like pictures of very thin slices of a specimen.

The new scanning microscope technique has achieved point-to-point resolution of better than 30 Angstroms and an edge sharpness of 15 Angstroms. Ultimate resolution should be about 10 Angstroms, or about 8 atomic spacings.

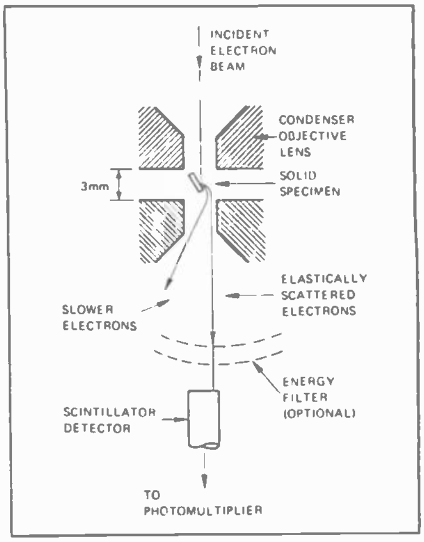
The new technique allows a solid sample to be placed inside the objective lens of the microscope. With this arrangement the diameter of the scanning electron beam can be made much smaller - 5 to 10 Angstroms - than in conventional surface scanning instruments. This approach brings the advantages inherent in the use of a short focal length electron lens - a lens similar to the type which permits the high resolution attainable in transmission microscopy.

In a conventional surface scanning microscope, a beam of electrons is accelerated to high energy and focused on the sample surface by a magnetic lens. The high energy electrons eject secondary electrons from the surface of the sample and, as the beam is scanned back and forth across the sample, the secondary electrons ejected from each point give a picture of the surface, which is displayed on a television picture tube.

Secondary electrons have an energy of only a few electron volts, so the sample must be located well away from the strong magnetic field in the condensing lens, consequently this lens thus must have a long focal length, with its large aberrations, which limit beam sharpness at the sample surface. Resolution is also limited by the effect of the secondary electrons emitted from an area larger than the scanning beam diameter (because of scattering in the sample).



In a conventional surface scanning electron microscope, a high energy beam of electrons is focused on the sample surface by a magnetic lens. Secondary electrons ejected by the beam are detected as the beam is scanned across the sample, and provide the signal used to generate a television picture of the surface. Because the secondary electrons have very little energy and would be easily deflected by the intense magnetic field of the lens, the sample must be located well away from the lens. Thus a long focal length lens, with its inherent large aberrations, must be used.



In the new surface scanning technique, proposed by IBM's Research Laboratory, the solid sample is located inside the magnetic lens of the electron microscope. Electrons in the scanning beam glance off the surface of the sample with little energy loss are pulled back into the axis of the microscope by the lower half of the lens and are detected to provide the output signal. Electrons which penetrate more deeply lose more energy and so are deflected more sharply by the lens, out of the field of view of the detector. This method of operation permits use of a short focal lens, and thus a major improvement in resolution over conventional surface scanning microscopes.

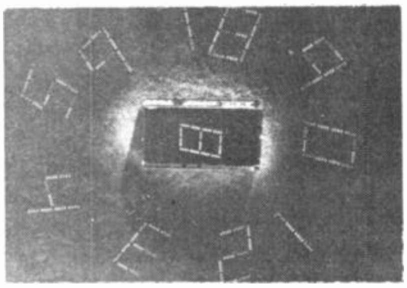
By placing the sample inside the lens, a very short focal length, with minimum aberrations, is possible. The first part of the lens focuses the beam on the sample, which is mounted at a glancing angle. Electrons which are elastically scattered (deflected with little loss of energy) by the sample are bent back toward the axis of the microscope by the second half of the lens. These electrons, which have penetrated only shallowly into the surface of the specimen, are collected to provide the output signal. Electrons that have penetrated the sample more deeply suffer a greater energy loss and are deflected by the lens out of the field of view of the collector.

This sharp discrimination among electrons according to how far they have penetrated the surface produces a very high contrast image. In an alternative arrangement, an energy filter can be placed between the lens and the collector to reject the less energetic electrons.

HIGH-BRIGHTNESS LED DISPLAY

A new seven-segment LED display is announced by ITT. Coded D7NF, the GaAsP device is suited to general instrumentation applications.

Character size is 0.27in. (6.9mm). Decimal point is included in addition to the seven character segments. Brightness is 2500 cd/m^2 at 20mA



per segment current. The characters are readable over a wide angle.

The D7NF has a low voltage requirement which is compatible with TTL or DTL circuits and current ratings make the device suitable for either continuous or time-shared operation.

ITT Components Group Europe, Valve Product Division, Brixham Road, Paignton, Devon, TQ4 7BE.

INSTANT MAINS CONNECTOR

R.S. Components, have introducted to their range the 'Safebloc' designed to provide a safe yet simple method of connecting flexible leads to a.c. mains. The unit incorporates three nickel-plated clips for the output connections which are automatically isolated when the cover is raised, while the input cable is internally connected and includes a cable clamp.

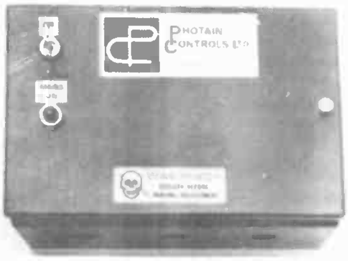
Priced at £2.95, the 'Safebloc' may be used up to 13A., and is made from tough thermosetting plastic with a glass-filled nylon lid. Further information may be obtained from *R. S. Components Limited, 13-17 Epworth Street, London E.C.2.*

FIRE ALARM KIT

Photain Controls have announced a new Fire Alarm Kit which has been designed to meet the requirements of the Fire Precautions Act 1971. Under these regulations premises (in particular Hotels and Boarding Houses) must obtain a Fire Certificate from the local Fire Officer and in many instances this is not given until a suitable Fire Alarm System has been installed. The Fire Alarm System must comply with the specification laid down by the Fire Officer or it must be approved by him.

Every item is detailed and priced separately, the owner of the premises can now choose a system "tailor made" to his own particular needs.

The following items are available.



Control Unit. This is contained in a wall mounting housing and is complete with fully floated NiCad batteries providing 24V at 0.5A. It is complete with battery charging circuit.

It will operate with any type of "Open" or "Closed" sensor including solid state ionisation smoke detectors and any number of sensors can be connected on one circuit. The standby batteries will maintain the operation of the system in the event of a mains supply failure for over 72 hours and will operate 3 alarm bells for over 30 minutes. The batteries will recharge to full capacity within 24 hours.

Ionisation Smoke Detector Type P1D-B. This unit consists of an inner and outer chamber, the insides of which are ionised. The inner chamber is sealed from the atmosphere. When smoke and/or combustion gases enter the outer chamber the voltage ratio between the two chambers is changed. This voltage difference is amplified by a hybrid integrated circuit and the signal transmitted to the Control Unit. Any number of detectors can be connected on a single (twin wire) circuit. Stable operation is provided irrespective of voltage variations and over a wide temperature range. Each unit is supplied with an adaptor plate for fitting to a standard conduit box.

Each unit will normally protect up to 10,000 cubic feet of enclosed area, subject to any special limiting factors such as excessive air movement away from the detector. When several detectors are fitted in a large area they should be mounted up to a maximum of 40 feet apart and within 20 feet of any outside or party walls.

Heatswitch. This is a Bi-Metallic combined rate-of-rise and fixed temperature Automatic Fire Detector. A set of contacts close when the temperature reaches 57°C. The unit can be mounted in any position and when protecting a large area they should be fitted at a maximum distance apart of 32 feet and in corridors at a maximum distance of 50 feet apart. They provide coverage of approximately 500 square feet per Heatswitch.

Preswitch. This is a break glass unit with a plastic front plate and can be supplied for surface mounting or flush mounting as required. Breaking the glass operates the microswitch which activates the alarm.

Heat Detector. This is a temperature sensitive reed switch. The normally closed contact opens when the ambient temperature reaches 60°C and remains open until the temperature drops to 50°C at which point the contacts close again automatically.

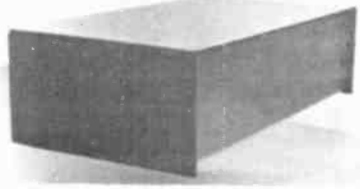
Loop Sensor. This is a "balancing" resistor mounted in a plastic housing complete with terminals. It is fitted at the end of the loop circuit. Breaking the loop circuit wiring or shorting across the two wires activates the alarm circuit.

Installation and wiring can be carried out very simply and easily and any type of 24V d.c. sounder can be connected to the system both for local and remote warning.

A complete kit comprising a Control Unit, Heatswitch, Heat Detector, Preswitch and two Alarm Bells costs £68.00 (plus VAT).

Photain Controls Limited, Randalls Road, Leatherhead, Surrey.

PROJECT CASES



PROJECT CASES are a range of inexpensive cabinets being produced by Sound Systems, 30 Foxholes Road, Bournemouth, Hants. They are of two part all aluminium construction, with a rich blue hammer finish. The facia is available either brushed, matt black or silver.

The cases have the feet included and four Vero printed circuit mounting posts. These require only a suitable size hole for them to 'snap' into, thus providing a quick and simple fixing.

Sizes (in inches) are at present 2 x 8 x 4 (£1.20), 2 x 10 x 6 (£1.50), 3 x 10 x 6 (£1.75), 4 x 10 x 6 (£2.00). Prices include VAT and post and packing. Enquiries for special sizes for individual requirements are welcomed in a s.a.e., quotations being sent by return.

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Fane Pop 15 watt 12"	£ 4.40
Fane Crescendo 18	£47.50
Fane Crescendo 15	£36.00
Fane Crescendo 12A or 12B	£29.00
Fane Crescendo 12BL	£30.00
Fane 807T 8"roll surr.8or15 ohm	£ 3.85
Elac 59RM109 15 ohm,59RM114 8 ohm	£ 2.65
Elac 6½"d/c roll surr.8 ohm	£ 3.35
Elac 4" tweeter TW4	£ 1.21
Goodmans 8P 8 or 15 ohm	£ 4.49
Goodmans 10P 8 or 15 ohm	£ 4.70
Goodmans 12P 8 or 15 ohm	£11.65
Goodmans 15P 8 or 15 ohm	£18.00
Goodmans 18P 8 or 15 ohm	£31.00
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Goodmans 12PG 8 or 15 ohm	£14.50
Goodmans Audiomax 12AX	£39.65
Goodmans Audio 100	£ 9.50
Goodmans Axent 100	£ 6.60
Goodmans Axiom 401	£15.10
Goodmans Twinaxiom 8	£ 6.79
Goodmans Twinaxiom 10	£ 7.61
Kef T27	£ 4.75
Kef T15	£ 5.75
Kef B110	£ 6.75
Kef B200	£ 7.50
Kef B139	£11.75
Kef DN8	£ 1.92
Kef DN12	£ 4.12
Kef DN13	£ 2.75
Richard Allan CG8T 8"d/c 8ohm	£ 6.35
Wharfedale Super 10 RS/DD	£ 9.80
Wharfedale Lintin 11 kit (pair)	£19.25
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Wharfedale Dovedale (pair)	£52.00
Richard Allan Twinkit each	£ 8.25
Richard Allan Triple 8 each	£13.00
Richard Allan Triple each	£18.00
Richard Allan Super Triple each	£21.50
Goodmans DIN 20 each	£ 8.75
Fane Mode 1 each	£ 9.90
Helme XLK25 (pair)	£18.17
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Dept ETI

Swan Works, Bank Square, Wilmslow, Cheshire SK9 IHF.

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BACK NUMBERS

Back numbers are available for 25p each plus 7p postage for one, 10p for two, 13p for three. We are unable to supply the following: April and May 1972 and March 1974. There are very limited supplies of November 1973 and January, February and April 1974.

Orders should be sent to the Back Numbers Dept, ETI, 36 Ebury Street, London SW1.

CHEAPER CLOCK KITS

We have a few "Timtronic" kits (ETI Sept. 73) left and when these have gone we cannot guarantee future availability of this kit. If you want one take advantage of our special £4 voucher. The voucher is valid for £4 off the pre-VAT price of any one of our clock kits advertised below only and is valid until 30th April 1974. The coupon must accompany each order (C.W.O. only).

The special offer kit prices are thus: Timtronic £20; 5316-LC £28; 5314-Jumbo £22.80; all plus VAT and p.p.

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DL34	Four 0.1in digits in 14-pin DIL pack, Common C.	£10.00
TIL360	Six 0.1in digits in 16-pin DIL pack, Common C.	£15.00
TA8055	Four 0.6in Liquid-crystal digits	£13.00

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TIMTRONIC	Kit for ETI article, MK5017AA, four DG12s, IC socket, PCB and full instructions.	£24.00
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