

wireless world

EXCLUSIVE TRIETEXT DESIGN (Production)

NOVEMBER 1975 35p

Teletext decoder Audio Fair



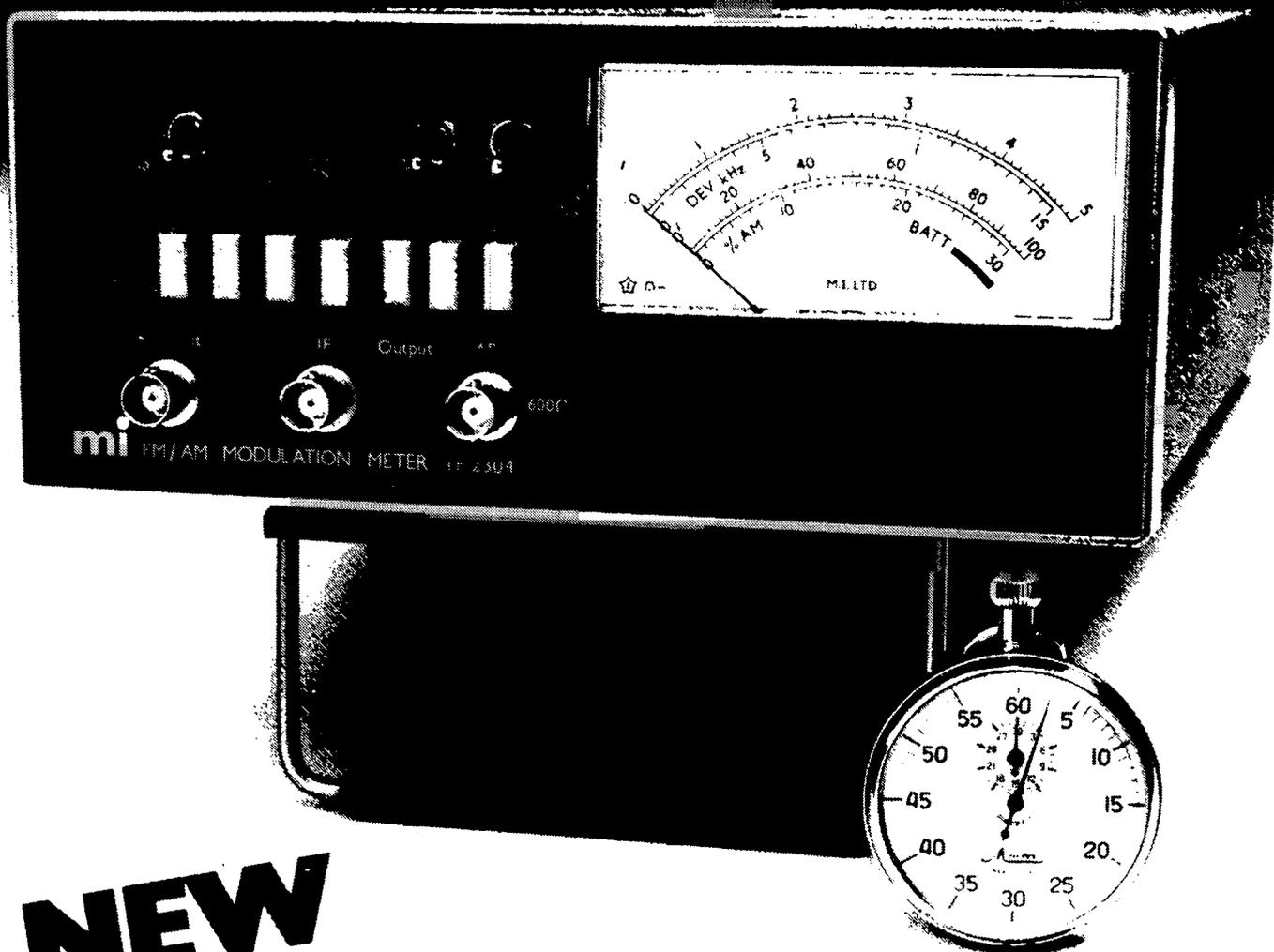
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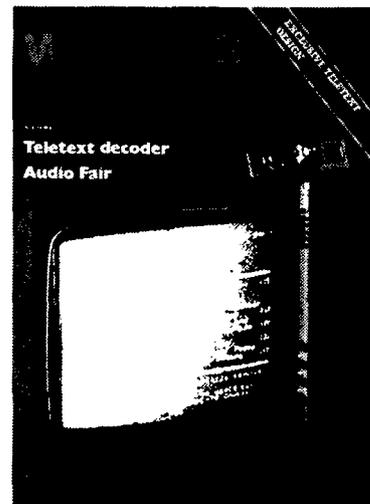
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This month's front cover shows a colour TV receiver displaying a Teletext page, processed by the Wireless World Teletext decoder seen on top of the set (see page 498). (Receiver lent by Thorn Television Rentals)

IN OUR NEXT ISSUE

Microprocessors for computer control. What they are and how they work, with a table of types on the market

New audio amplifier design uses "current dumping" output transistors and feedforward distortion correction

Interference from pocket calculators can cause trouble. Measurements of electromagnetic radiation from three named calculators

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LAP 93

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The dugs of war

It's a sad comment on our times that you can now get a degree in destruction. To be more precise, an M.Sc. in guided weapon systems, under the auspices of the Council for National Academic Awards. Look into the olive-grove of Academe and what do you see but a war-head pointing out at you.

This little fact is only a symptom of our permanent involvement in war technology. To adapt Von Clausewitz's famous saying, "Peace is nothing more than the continuation of war by other means." Commentators speak nowadays of "the industrial-military complex" and by this they mean that certain parts of manufacturing industry have become closely identified with, and commercially dependent upon, the production of military equipment. This is certainly true of electronics. The art of war has come to depend on rapid communication and information processing, continuous surveillance and accurate control of mechanisms. And why? Because electronics has made these things possible. But electronics technology itself has been greatly developed by the pressures of actual wars — for example radar and the electronic digital computer in the 1939-45 war — and it continues to be stimulated by our fear of aggression and our consequent need to maintain the nuclear and military balance of power. It is really a chicken-and-egg situation.

Even though the basic drives in this reproductive cycle are fear and profit, it is possible to draw up an impressive list of benefits. For example, one of the significant "spin-offs" of nuclear missile development was the integrated circuit. This has produced a revolution in the design of electronic equipment. Calculator chips, microprocessors, counters, decoders and the like have made possible, simply and cheaply, the kind of information processing operations which, in the days when there were only discrete active devices, would have been quite inconceivable in domestic and industrial applications. Military electronics business is becoming an important factor in the economy of industrial countries. In the UK the Ministry of Defence is the biggest single customer for electronics. Profits are made, dividends are issued, jobs are created, and the export of the military equipment helps to pay for the import of essential raw materials and food.

Although engineers and technologists are beginning to show concern about the effects of their work on the environment, they seem not to be worried by the use of their technologies for destroying life and property. Perhaps we have been bamboozled by the use of the word "defence" as a euphemism for war. More likely, we are just too far away to see the blood being spilt. Anyway, "it's just a job." As long as the milch cow of defence expenditure continues to provide a steady flow of cash there will be plenty of us — individuals and firms — lining up and ready to feed off it, without looking too closely at the implications.

Wireless World Teletext decoder

1 — The background

by Philip Darrington

The first of a series of articles on the Teletext television information display system and the construction of a decoder for use with domestic television receivers.

In succeeding articles of this series we shall describe the design and construction of the *Wireless World* Teletext Decoder. But, before we do that, it seems only sensible to make sure that readers are up to date with current activity in the field and have an idea of other systems which have been proposed. We will also describe the basic operation of Teletext and mention the techniques used to decode the transmissions for display on a domestic television receiver.

In the early years of "wireless", the vision of millions of people being entertained by transmissions was just not credible. Television was thought to be sheer science fiction and wireless itself was for the transmission of vital information. Even if it had been possible to communicate phonically, that was not the idea at all — ships were the real users of radio and if amateurs could derive pleasure from listening to marine morse traffic or Eiffel Tower time signals, so much the better.

Then, of course, radio telephony was developed and the entertainment possibilities were recognized. It is now an extraordinary and rather depressing fact that out of the few thousand megahertz available for radio transmission, nearly 600MHz are taken up by broadcasting stations, most of which put out entertainment of one sort or another. Sound is reasonably restrained in its use of bandwidth, but television occupies 566MHz — a staggering figure, particularly as the television signal contains so much redundancy. Anything designed to make better use of this signal is to be welcomed and Teletext is one way of doing that, in that a previously unused part of the waveform is used to transmit more information.

Many ways of using television transmissions to better effect have been proposed^{1, 2}. Since the early sixties, test signals inserted in the field blanking interval have been in common use, and have been supplemented by coded data

transmitted on lines 16 and 329 of each frame³. It apparently did not, at the time, occur to ORTF, who originally used the system, that the technique could be developed to allow the transmission of visible information, but the system was used for switching remote transmitters, identification for remote supervision purposes, etc.

Other systems of transmission aimed at "still" display, with or without sound and in colour or monochrome depend on the exclusive use of a television or sound channel. For instance, the NHK "A" system⁴ is able to carry over 50 channels of colour still pictures, with sound, in the bandwidth of one normal television channel. The pictures are transmitted at the rate of one still per frame, together with a code to enable a magnetic disc memory in the receiving equipment to record a selected frame, which is then continuously replayed. Sound is multiplexed with video information and transmitted in the frame intervals.

The NHK "B"⁴ system falls into the multiplexed television channel category, using uncoded signals. Three unused lines per field are used to transmit three lines of a still picture, which is magnetically recorded at the receiver. Sound is transmitted by the use of additional sound carriers at low level, spaced further in the spectrum from the vision channel than the original sound carrier.

In 1971, W. D. Houghton of RCA described the Homefax⁵ system in which additional information was multiplexed with a broadcast television waveform to produce "hard copy" from an electro-optical printer, using a cathode-ray tube to produce the "printing" on Electrofax paper. The information, uncoded, was carried in an unused vertical interval line and transmitted in the normal way — each of these lines producing part of one line of a row of print on the receiver paper. Transmission tests of this system had been carried out in 1967, and improve-

ments were being carried out in 1970. A method of data transmission not using the vertical blanking interval⁶ was described by P. T. King of Hazeltine Research, Inc., at the SMPTE Technical Conference in 1973. In this system, known as an "add-on" type, a low-level subcarrier was inserted on the vision signal at an odd multiple of half the line frequency, a method which is well known in colour television circles as a method of avoiding interference between two signals in a common waveform. The added signal is shifted in phase from line to line and the visible effects are reduced. The actual frequency is chosen to be between 2 and 3MHz in the NTSC standard, because radiated energy is at a minimum in that region in a typical picture. The data signal is biphase modulated at 21 kilobits per second and at the receiver is synchronously detected, the data decoded and used to operate a character generator, which can, for example, produce subtitles in languages using the characters available.

These two techniques — the use of previously blank lines in the vertical blanking interval and the provision of a character generator at the receiving end — paved the way for Teletext. A system of this kind is able to carry more information, more flexibly, by leaving the receiver to do rather more of the work than an analogue or uncoded digital system. If the transmitted signal is made to carry instructions to the receiver on what to do, the receiver can then hold much of the information in store, releasing it when commanded to do so.

Peter Hutt of the IBA described an embodiment of this principle in a paper read to the IPC, 1972⁷. The system was named SLICE and was primarily intended for the labelling of programmes with a source identification. The information was carried on lines 16 and 329 in the form of 112 binary digits per line and, at the receiver, was read

into a memory where a complete message was assembled. SLICE was the fore-runner of ORACLE and CEEFAX. (Hutt mentioned the possibility of a domestic information service in his paper.)

Teletext

ORACLE was developed by the Independent Broadcasting Authority in the light of its experience with SLICE and the BBC announced their own system, which was very similar and bore the name CEEFAX. (ORACLE is an acronym — Optional Reception of Announcements by Coded Line Electronics — CEEFAX is See Facts as pronounced by an adenoidal dyslexic.) There is little profit in trying to decide which organization hit upon the idea first, or which was on the air first, as the two were quickly and sensibly to agree on a common standard of transmission, in conjunction with BREMA³. Both names will probably continue to be used for each organization's broadcasts, but the generic term "Teletext" is now common, and will be used henceforth. Teletext has been broadcast on the present standard since September 1974 — the beginning of a two-year experimental period. The system uses a multiplex-with-vision type of transmission and uses lines 17 and 18/330 and 331 to carry coded information. There is no accompanying Teletext sound.

Before proceeding further, a look at the facilities offered by a Teletext transmission and a résumé of some of the specification will be a help when considering the equipment needed in the receiver. Briefly, the Teletext page consists of 23 rows of 40 characters each, plus a page header, which is only partly displayed. As seen in Fig. 1, the header gives the name of the service (Ceefax or Oracle), the page number, the date and the time. The time display is continually changing and is always visible.

Visible characters are either capitals or lower-case letters assembled on a 7 × 5 dot matrix and in one of six colours or white: diagrams or low-resolution "pictures" can be assembled by the use of a block of cells on a 3 × 2 pattern, each of which can be "on" or "off", in colour. A variety of other symbols (commas, brackets, @, £, etc.) can also be shown, and the set of characters is known as the ISO-7 code, which is a version of the ASCII code with some of the "National usage" characters substituted. Characters can be made to flash on and off, though our own feeling is that this will be used rather less when the service is finally in use than it is now, if it infuriates other people as it does the writer.

The Teletext editing teams can use the pages in three different ways, the norm being single pages which appear when selected by the viewer at any time and which are up-dated perhaps once or twice a day. A second type is one of a

ORACLE p100 Thu 14 Aug 10 44/74		
ORACLE		
SPECIAL OFFERS		
IN NEWS INDEX	200	ABOUT ORACLE 101
ABOUT ORACLE	201	PUBLIC ADVICE 550
WEATHER	220	HELP 750
ISRAEL	230	POLICE & EMERGENCY SERVICES 720
ENTERTAINMENTS	230	WEATHER 300
RECORDS & BOOKS	300	ITU PROGRAMMES 400
THE ITU REGIONS	300	ISRAEL 500
	160	ENTERTAINMENTS 600
	190	RECORDS & BOOKS 190
	800	THE ITU REGIONS 800
	490	ENGINEERING 490
		SHOPPING 115
		HOME ADVICE 350
		JUNIOR ORACLE 650

Fig. 1. The main index page (p. 100) of ORACLE for August 14, 1975, produced by the W.W. decoder on a Thorn colour receiver.

group of, perhaps, four such pages which change at about one minute intervals. They will usually be on a related topic, such as sport, and are identified by the letters A B C or D, the relevant letter being in a different colour so that the viewer knows which point in the set of pages has been reached. This type is really the same as the first variety, but pages are changed automatically at minute intervals. The third kind of page can be selected by the time-code on the header, so that it can be received, placed in store and read out at a convenient time.

The data to be displayed can be presented as a complete page or, in the case of news flashes or subtitles, can be inserted in a blank rectangle on the screen, leaving the rest of the picture visible. The full page can be superimposed on the picture, but in our experience this is a good way to ruin one's eyesight.

A typical magazine has the capacity of 100 pages. Four lines are transmitted per television frame and there are 24 lines per Teletext page. A full magazine would therefore take 600 frames or 24 seconds to cycle. The BBC and IBA appear to differ on what they consider acceptable access times; the BBC suggest a typical time of 12 seconds (for an unspecified number of pages) while a recent check on Oracle gave an access time of 28 seconds for well over 100 pages. The theoretical time can be reduced considerably by not transmit-

ting blank lines, a practice which is already followed by the IBA and which the BBC intend to change to shortly (they already omit blank lines at the bottom of a page).

To select a Teletext page, one first switches the signal path through the decoder, selects a page by means of thumbwheel switches or a set of push-buttons and waits for the selected page to be assembled.

Teletext signal

The method of transmission of the Teletext data is of interest at this point. As has been said, the data signals are carried by lines 17 and 18 and the corresponding lines in the alternate field, 330 and 331. The choice of lines is influenced by the need to avoid the early part of the vertical blanking interval and the few lines near the start of the video signal (lines 23 and 336). If early lines were used, it is possible that data would appear on the field flyback on some receivers and if lines later than 18/331 carried the information, receivers with incorrect picture height adjustment or with a downward-shifted picture might show the data as an extremely "busy" pattern of dots at the top of the screen — this sometimes occurs even with the present line allocations. A further reason for avoiding lines 19/332, 20/333 is that they are currently used for insertion test signals, which are often visible but, being static, are not obtrusive.

A form of binary code is used for the data, known as non-return-to-zero, which possesses the advantage over a complemented-element code of a reduced bandwidth requirement. As its name suggests, the resulting waveform is not a continuous train of pulses, but rather a series of voltage levels. A

typical sequence is shown in Fig. 2(b), where it is seen that a "1" level does not automatically return to zero at the end of the pulse and if the succeeding level is also 1, the voltage merely stays up — similarly with a succession of "0". One result of this is seen in Fig. 2(c) where a train of the form 010101 etc. turns out to be a square wave at half the repetition frequency of the clock. As transmitted the pulses are "raised-cosine" in form and the square wave becomes a half-clock-frequency sinusoid.

The diagram in Fig. 3 shows one line of the complete picture frame. A complete line occupies 64µs, of which about 12µs are taken up with the synchronizing pulse, back porch with colour burst and front porch. The first 40 of the 360 bits are concerned with clock synchronization (in a manner similar to that of the colour burst), a series of bits which constitute a "start" sequence and 16 bits for control and row address information. The rest of the line contains 320 bits for display and control. Figure 4 shows the layout of information in the line.

Coding

All transmission paths are subject to errors, and television has its share. Noise can be a problem, but the type of distortion caused by multipath propagation is perhaps the deadliest source of error. Both BBC and IBA have done work on this in the U.K., Sweden and Germany, and have come to the conclusion that Teletext transmissions are fairly robust, but require a good performance in the receiver. This relative invulnerability to attack is assisted by the application of code protection — additional bits of information transmitted with the data.

Code protection is applied in two levels. Data bits which are intended for addressing and control are heavily protected, while those used to produce the displayed characters are protected rather less. The transmitting authorities consider that the occasional error in, or rejection of, a character is not serious as it will quite probably be corrected on the succeeding transmission of the page, but that an error in an address would lead to complete nonsense and must be avoided in the presence of the average amount of noise and ghosting.

The character code is basically 7-bit ISO-7 and is protected quite simply by means of a parity bit, giving odd parity. This means that if the total of "1s" in the basic 7 bits is odd, the parity bit is "0". An even total of "1"s in the 7 bits dictates a "1" parity bit to maintain an odd overall total. On examination at the receiver, any byte (the name for a "word" of 8 bits) with an even number of "1"s is seen to contain one error and is rejected. Previously-correct words in a display will not, therefore, be overwritten by an incorrect one and the effect is a reduction in errors in succeeding pages. Double errors, pre-

serving odd parity, are not rejected and will be written.

Address data bits, on the other hand, are more heavily protected by being transmitted in a type of code which will detect 2, 4 or 6 errors in the byte and will detect and correct a single error. This type of code was described by R. W. Hamming in a classic paper⁹ in 1950, and is known as the Hamming code. It takes the form of four parity bits in positions 1, 3, 5 and 7 of the eight-bit byte (the addresses are in a four-bit code). Three of the parity checks are associated with groups of three of the four message bits and the overall parity check covers all message and parity bits. Failure of the overall parity indicates an error and the position of the error is identified by the checks on the groups of three bits. If the overall parity appears true, but the individual checks show that a correction is required, there will have been a double error and the byte will be rejected as unusable.

Figs. 3 and 4 indicate that the bits at

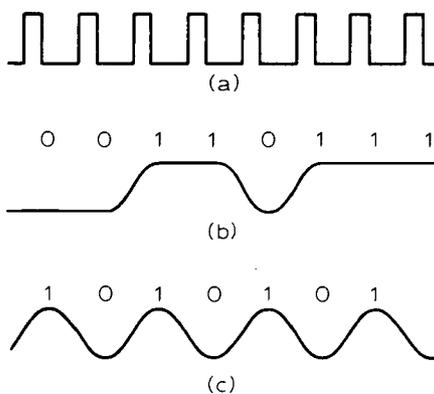
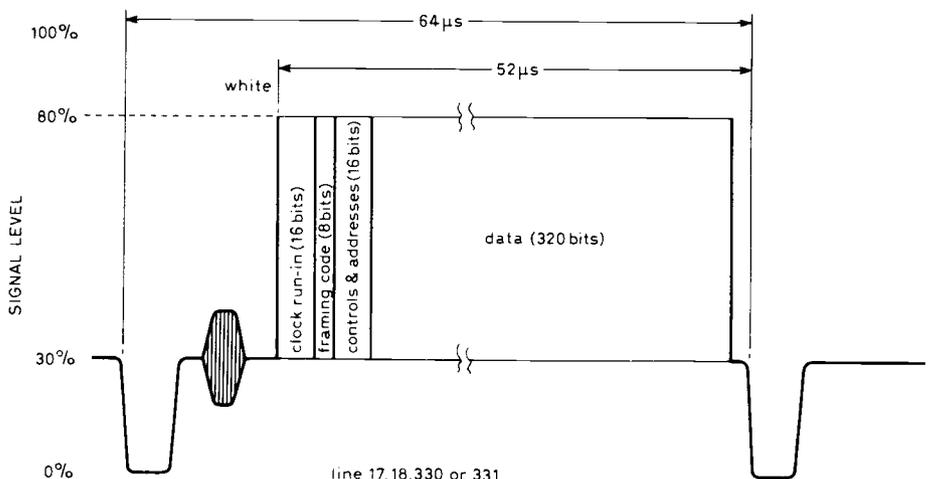


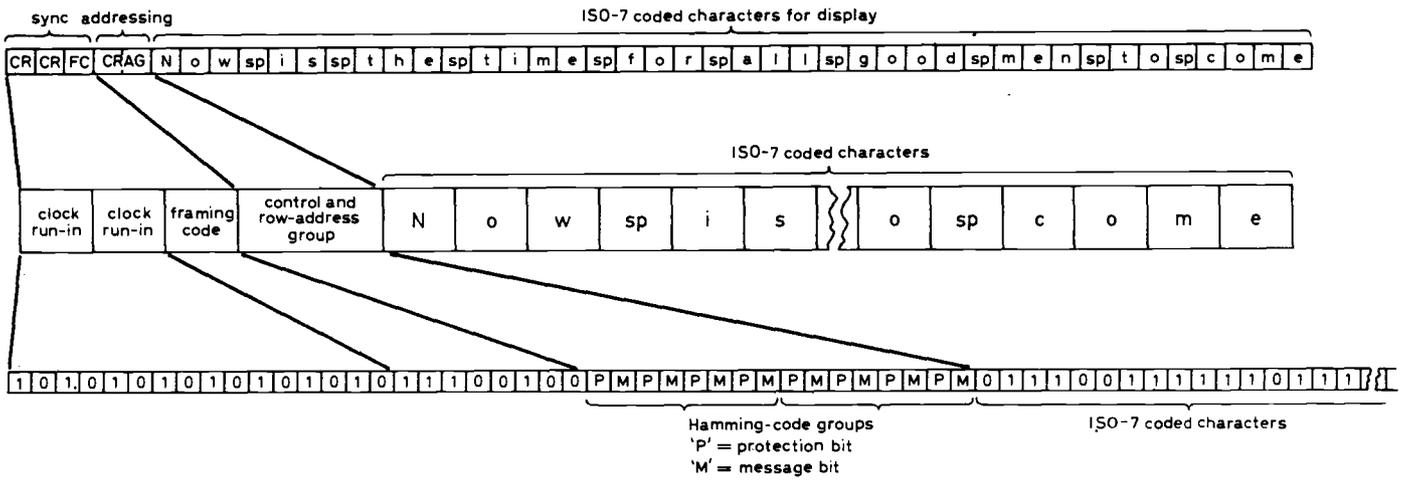
Fig. 2. The non-return-to-zero method of transmitting binary information is at (b) with the attendant clock at (a). A succession of 101010 etc. gives a half-clock frequency waveform and, if the pulse shape is a raised cosine, as used in Teletext, the result is a sinusoid at 3.5 MHz.

Fig. 3. A line of Teletext data. Sync. pulses are the 30% pulses and the colour burst is on the back porch.



the beginning of the line are not concerned with the displayed message. Three groups of bits are transmitted, of which one is two bytes (16 bits) designed to lock the receiver's clock in frequency and phase with the transmission, in a similar manner to the way in which the colour burst dictates phase in a colour receiver. The 16 bits are termed the clock run-in and consist of a train of 10101s. It is a penalty of the n.r.z. code used that this run-in is necessary, as it entails a code which is not self-clocking. In other words, unless the data are of the 101010 variety, which conveys no information, the transitions do not occur at every interval, and the data pulses themselves could not be used as a clock source, if it were not for the choice of odd parity for the protection code, ensuring at least one transition per character, which can be used to refresh the clock generator. The 16-bit burst of 3.5MHz is also detected and used to identify the transmission as Teletext and not some other data system such as SLICE (IBA), ICE (BBC) or insertion test signals.

The second group of 8 bits forms the framing code, which is always the same and is used to indicate the start of the first 8-bit word. The order of bits used is 11100100 — an arrangement which is designed to avoid errors. A common way to detect the framing code is to pass all data through an 8-bit shift register and to examine the parallel outputs of the register. There will be only one step, when the register contains all eight bits of the framing code, when the above order of bits is present at the outputs of the shift register and gives a positive comparison with the "permanent" word used for detection. The framing code is shown in progress through the shift register in Fig. 6, which indicates that, even in the presence of bits from the clock run-in (c.r.i.) and succeeding information, a maximum of 5 bits "look like" the framing code. By means of more or less extensive circuitry, the framing code detector can be made to recognize the code in the presence of one error.



Row addressing. The 16 bits following the framing code are concerned with the identification of the following data. Each of the 24 rows of characters must be identified and this is done by numbering each with a row number from 0-23 and a magazine number (1 to 8). The bottom line of Fig. 4 shows the layout of bits in the 16-bit group and also indicates the fact that these are protected by being Hamming-coded. As, at the moment, we are not concerned with protection, the bits marked "P" can be ignored, and the groups become 4-bit words. In fact, this is an artificial distinction, because they form one word of three bits and one of five. The first group of three message bits (marked "M") identifies the magazine, and the remaining five contain the row address in a pure binary code (00001 is Row 1, 10111 is Row 23). The least significant bit is transmitted first.

Data. The rest of the line is filled with data for display, the previous bits not, of course, being visible on the screen. Fig. 5 shows the complete set (in use until Sept. 1, 1975) of available characters and blocks for graphic displays, together with the address code (bits 1-7). Bit 8 is the parity bit and plays no part in the display. A slightly modified table will be used exclusively after September, 1976, and the system is now in transition between the two.

Decoding

The circuitry for decoding Teletext transmissions is extra to that in an ordinary receiver and is mainly digital in nature. When the services are established and commercial receivers are sold (several firms already have models), the decoders will be built in, but before that happens, many viewers will want to convert their existing receivers, an add-on unit being the obvious solution, with video signals into and out of the decoder. U.h.f. input and output will probably not be used, the cost of a colour modulator, for instance, being prohibitive.

The extra circuitry needed can be considered in three groups; data acquisition, storage and output processing.

The detected vision signal is taken from the television receiver, having been disconnected from the video amplifier, and taken to the decoder, where clock regeneration, framing-code detection, parity checking, serial-to-parallel conversion and page selection are carried out. The selected and organized information is then passed to a store (either a multitude of shift registers or a random-access read/write memory) until the selected page is assembled. When this has been done, the store addresses the character generator in the output processor (a read-only memory containing the ISO-7 characters) which indirectly drives the guns of the display tube.

Input processor. This preliminary canter through the decoder is, of course, grossly over-simplified and a closer look at the sections is necessary, the first of these being the video processor which operates on the video signal to derive data and clock pulses. As has been said, the n.r.z. code in which data are transmitted, is not a self-clocking code and the decoder must contain its own clock. The clock run-in contained in the Teletext signal can operate as either a locking sequence for an oscillator which is continuously running, but which drifts out of phase with the Teletext clock between lines, or can be used to excite a passive oscillatory circuit which then rings for at least the duration of the Teletext line, being automatically in phase and frequency synchronization with the signal when the LC circuit is properly tuned. Each transition of the data "refreshes" the tuned circuit.

The diagrammatic input processor of Fig. 7 shows that the data is first passed through a serial-in, parallel-out store — the shift register, which is clocked at data rate. The register is 8 bits long and can contain one word, complete with its parity bit (4 parity bits in the case of Hamming-protected words). The 8 bits, in parallel, are examined by the framing-code detector for coincidence with the 11100100 "start" sequence which, when detected, resets a "divide-by-eight" counter to zero. The

Fig. 4. A row of data. It is seen that each group of 8 bits (1 byte) has a separate function. Clock run-in and Control and Row address each have two groups.

output of the counter is a pulse at one-eighth the rate of the clock and is used to identify correctly-framed words of 8-bit words in the shift register. In other words, framing-code detection indicates a reference point and the counter produces a pulse every eighth clock period which transfers the group of eight bits currently in the shift register, through latches, to the data lines. The output if the latch only changes when the counter indicates that the eight bits being presented to it are, in fact, a word. Complete characters are therefore presented on the eight, parallel data lines in serial form, reducing the 6.9375MHz rate to 867kHz.

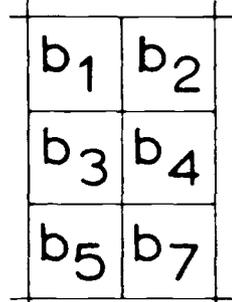
The parallel data presented to the latches are also examined by the Hamming-code checker which, as was seen, can correct one error and detect 2, 4 or 6 errors in address and time information. Following this block, an 8-bit latch finds and holds the 3-bit magazine address and 5-bit row address, referred to in Fig. 4, after a two-character holding time, inserted to allow the two four-bit words (or one three-bit word and a five-bit word) to be assembled.

Parity checks on character words are performed by the parity block, operating from the main data line, its output determining the acceptability or otherwise of a word.

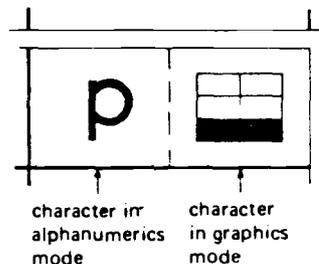
The rest of the input processor is concerned with the selection of a page by the viewer, who will be provided with three thumbwheel switches or a keyboard with ten number keys and keys for several other functions. A page having been "dialed in", the row address latch block examines the row address words until row zero is detected — the page header — when the selector will examine the following address information to compare it with the required page keyed in by the viewer. On detection of the required page code,

Bits					0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1		
b7	b6	b5	b4	b3	Column	0	1	2	3	4	5	6	7	
b4	b3	b2	b1	Row										
0	0	0	0	0				SP	0	@ ^②	P	P ^③	p	
0	0	0	1	1	Graphics Red			l	1	A A ^③	Q Q ^③	a	q	
0	0	1	0	2	Graphics Green			"	2	B B ^③	R R ^③	b	r	
0	0	1	1	3	Graphics Yellow	①		£ ^②	3	C C ^③	S S ^③	c	s	
0	1	0	0	4	Graphics Blue			\$	4	D D ^③	T T ^③	d	t	
0	1	0	1	5	Graphics Magenta			%	5	E E ^③	U U ^③	e	u	
0	1	1	0	6	Graphics Cyan			&	6	F F ^③	V V ^③	f	v	
0	1	1	1	7	Graphics White			'	7	G G ^③	W W ^③	g	w	
1	0	0	0	8				(	8	H H ^③	X X ^③	h	x
1	0	0	1	9	Alpha ⁿ Red			)	9	I I ^③	Y Y ^③	i	y
1	0	1	0	10	Alpha ⁿ Green			*	:	J J ^③	Z Z ^③	j	z	
1	0	1	1	11	Alpha ⁿ Yellow			+	;	K K ^③	[^②]	{ ^② }	k	{ ^② }
1	1	0	0	12	Flash Alpha ⁿ Blue			,	<	L L ^③	\ ^②	|^②	|^②	
1	1	0	1	13	Steady Alpha ⁿ Magenta			-	=	M M ^③] ^②	} ^②	m	} ^②
1	1	1	0	14	End Box Alpha ⁿ Cyan			.	>	N N ^③	↑ ^②	↑ ^②	n	↑ ^②
1	1	1	1	15	Start Box Alpha ⁿ White			/	?	O O ^③	— ^③	— ^③	o	DEL

control characters (columns 1 and 2) to be displayed as spaces



Graphics display rectangle showing the allocation of bit numbers to the individual cells



- Notes**
- ① This character code (position 0/3) is reserved for internal use by broadcasters
 - ② UK version of national use character in the ISO-7 code
 - ③ In the graphics mode when bit 6 = 0 the corresponding alphanumeric-mode character should be displayed
 - ④ All character rows start in the 'Steady', 'Alphanumeric White' and 'unboxed' condition, without control characters.

Fig. 5. Characters possible in a Teletext display. Graphics are not in the ROM, being produced directly by the data bits.

the data which follows is written into the store, assuming that the parity checker is in agreement.

The outputs of the input processor are taken to the store and are (a) the 7-bit data (b) the "write" or "reject" command to the store (c) the row address and (d) the character address.

Store. Storage can take many forms, but the most convenient way to store the data while the page is assembled is the random-access memory, which is an

array of semiconductor devices, often bistable circuits, set to "1" or "0" by input signals and which can be interrogated non-destructively when required by examining any desired location in the memory. No "order" is entailed: data can be lodged at any part of the memory.

Data are stored in 7-bit code as received from the 7-bit latch driving the data line in Fig. 7.

Display. The display of characters depends on the use of a large-scale integrated circuit — another form of store called a read-only memory. This is again an array of memory cells, but this time the pattern of bits read out of a given address in the memory is not under the control of the user. The form of the data is decided at the time of

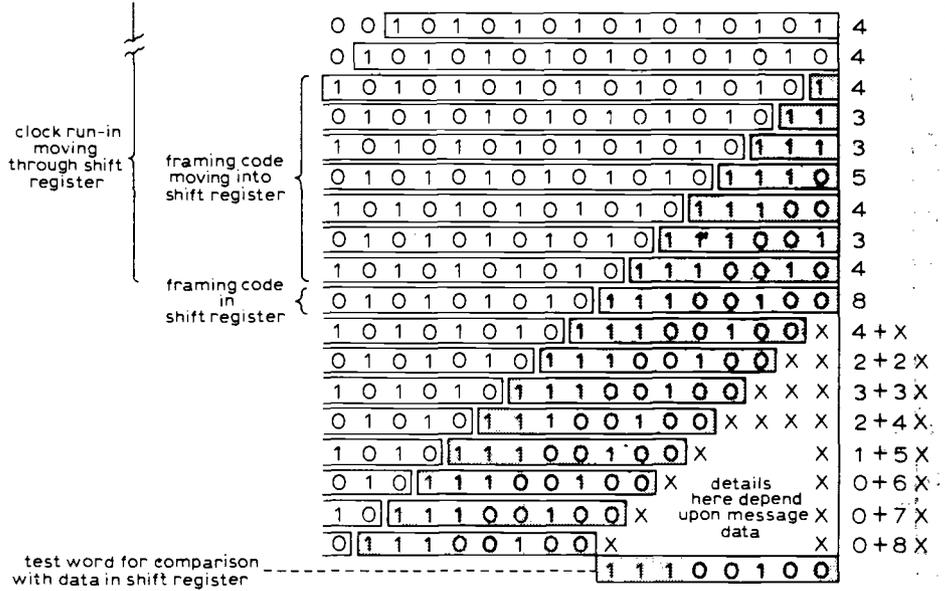
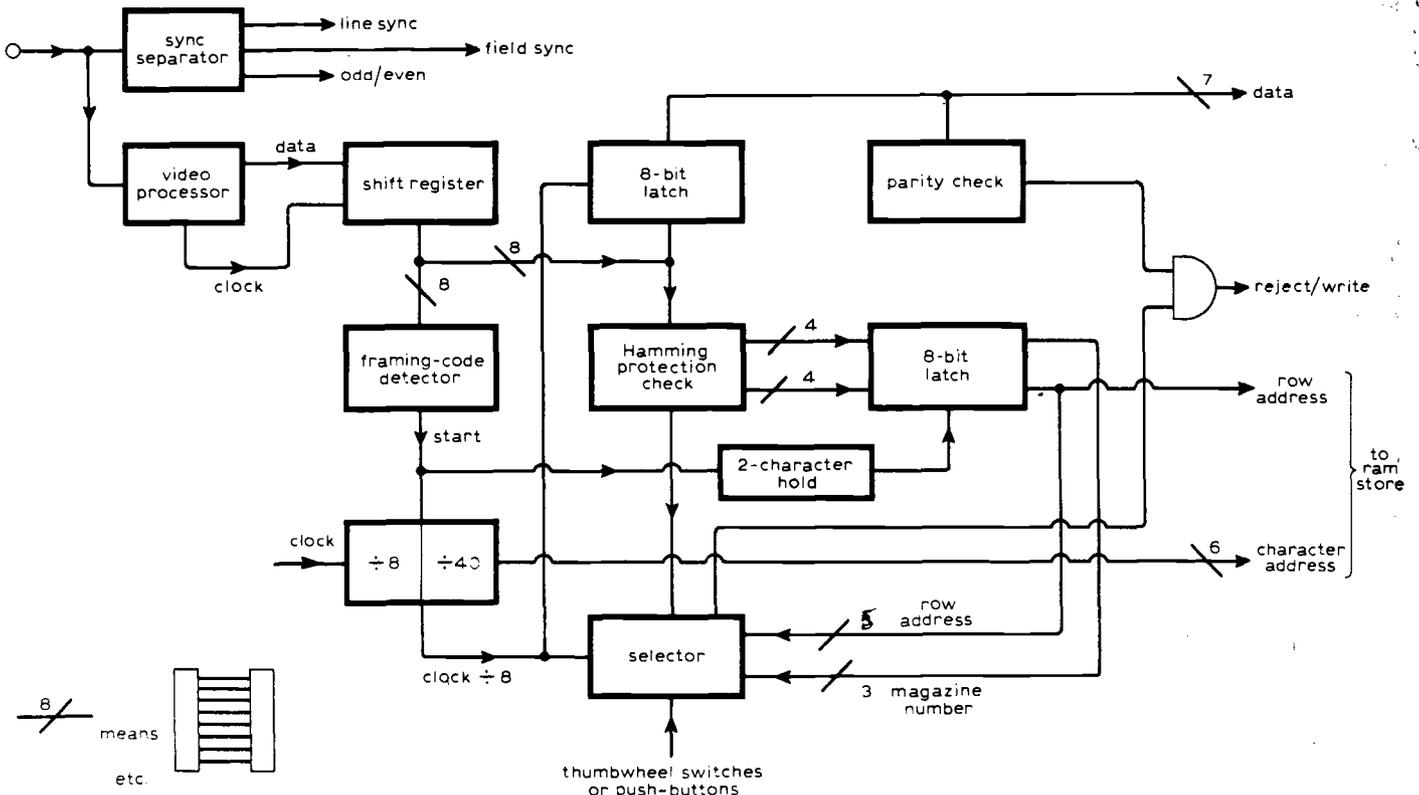
manufacture to perform a variety of functions, but the one in a Teletext decoder is a character generator, arranged to contain the characters shown in Fig. 5. Bits 1-7 in the configurations shown on the left, control the selection of display at the output. Bits 1-4 determine which row of character bits should be read out, while bits 5-7 indicate the column. For example, if the seven bits from the store were 0011010, bits 7, 6 and 5 (001) indicate that one of the undisplayed control characters in column 1 should be generated and bits 4, 3, 2 and 1 show that ROW 10 — alphanumeric, green — is required. The use of this invisible control character means that the visible, succeeding character shall be a green alphanumeric one, as opposed to the graphics alternative in columns 2, 3, 6 and 7. The next group of

bits could be 1101001, in which case the result would be a green, lower-case "i" on the screen. A control character is not displayed, so that whenever the mode is changed — from alphanumerics to graphics or from picture to insert or from white to red — a space must appear.

There is one exception to this, and the space can be avoided when an alphanumeric character is needed close to graphics, with no control character space. Although the graphics characters are shown in Fig. 5, it is not meant to imply that they are contained in the ROM. Only the alphanumeric characters are held in the memory, the graphics being generated directly by the 7-bit code as received, as shown in Fig. 5. The area occupied by a character and its surrounding space can be separated into six "cells" which each have a bit of data allocated to them. All codes intended for display as graphics have a 1 as bit 6. However, if, while in the graphics mode, a code occurs with a 0 as bit 6, then those characters in columns 4 and 5 of Fig. 5 will be displayed — a limited selection of alphanumerics, termed "blast-through" alphanumerics.

Fig. 8 shows the output processor, complete with character generator and timing circuits, synchronized by line and field sync pulses. Characters are built up from dots at the 7MHz clock frequency and a dot clock is therefore required. The number of elements or dots in the width of a character is six (5 in the character and a space) and a

Fig. 7. The input processor block diagram.



6-counter produces an output at each character. These two outputs are used to serialize the outputs of the ROM, and a 40-counter with a 6-line output is applied to the store, instructing it to provide successive character codes to the ROM which generates the pattern for each new character.

Line sync is also applied to a "divide-by-10" counter, which ensures that the store addresses the ROM for 10 lines in each character, giving 7 scanning lines for the character and 3 scanning lines space between characters. A 24-counter addresses the 24 rows of data in the store.

A further block in the display circuitry is the controls decoder which recognizes the control characters in columns 0 and 1 of Fig. 6, to produce RGB drives, blanking to provide a box

Fig. 6. The framing code in progress through the shift register, and in position on the 10th row down. At no time other than at coincidence are more than 5 bits in the register in correspondence with the reference word 11100100.

for inserts and a "flashing" instruction. Graphics are produced, under command from the controls decoder, by the graphics generator on the principle previously mentioned and illustrated in Fig. 5.

Finally, the interpolator can be used to obtain a slightly improved appearance to characters which include a diagonal (Y, Z, K, etc.). The principle is to take advantage of the fact that interlacing effectively provides 14 lines

in a character, not 7, and to "fill in" the steps produced by the 7 stored lines. An odd/even field command can be derived and used to synchronize the interpolator, which is also used to make the flashing signal effective.

That is the principle of the decoder, very briefly. In a short article, it is not possible to cover all aspects and it was not the intention. Forthcoming articles will describe the circuit in detail and provide complete information on the construction of a decoder that will differ from this general picture in several respects. Many savings in cost have been found possible by circuit changes which have also made possible a unit which is much smaller than envisaged.

(To be continued)

References

1. Gassman, G.-G. "Twelve Sound Channels during the Vertical Sync Interval of the Television Signal", ITT Chicago Spring Conference, June 1970.
2. Ball, J. D. & Wells, D. R. "Encoded captioning of television for the deaf". International Television Symposium, Montreux, 1973.
3. Guillermin, J., Dumont, J. & Guinet, Y. "Transmission of remote control and identification signals within audio and video channels in radio and television broadcasting", I.E.E. Conference Publication No. 25, November, 1966.
4. Numaguchi, Yasutaka. "Still Picture Broadcasting System", NHK Laboratories Note No. 174, January 1974.
5. Houghton, W. D. "Homefax - a consumer information system", RCA Engineer, Vol. 16, No. 5, Feb./Mar., 1971.
6. King, Patrick T. "A Novel Television Add-On Data Communication System", Journal of the S.M.P.T.E., Vol. 83, January 1974.
7. Hutt, P. R. "A system of Data Transmission in the Vertical Interval of the Television Signal. IBC 1972 Conference Publication No. 88, pp. 131-140.
8. "Specification of standards for information transmission by digitally-coded signals in the field-blanking interval of 625-line television systems". Published jointly by BBC, IBA and BREMA. October 1974.
9. Hamming, R. W. "Error Detecting and Error Correcting Codes," Bell System Technical Journal, Vol. XXVI, 2 April, 1950.

Fig. 10. Extracts from an Oracle index page, showing the normal appearance at (top) and the effect of character rounding (bottom). This is an IBA photograph taken from the screen of a studio monitor. On a domestic receiver, the effect is not as pronounced.

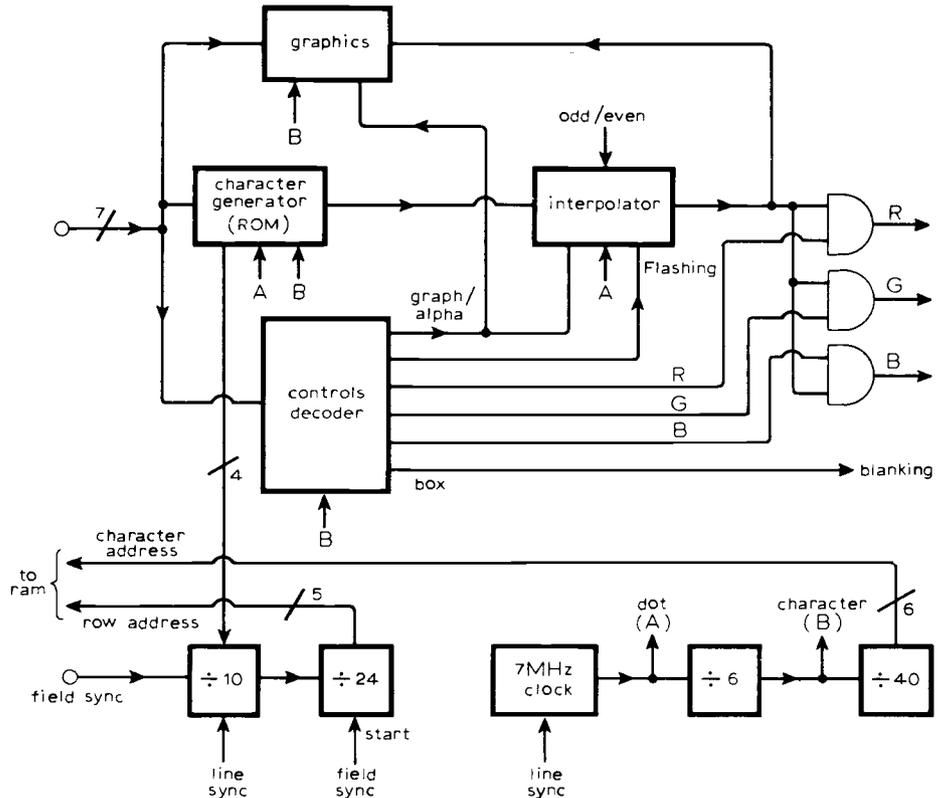
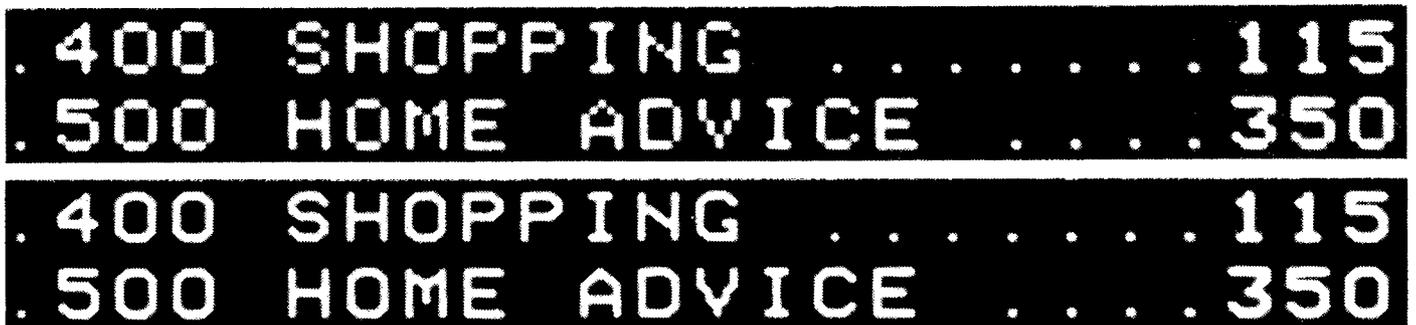


Fig. 8. A typical output processor.

Fig. 9. An example of the use of graphics.



The consultants

An investigation of the role of independent engineering consultants

by John Dwyer

"Most consultants leave a trail of disaster in their wake . . . Most of the so-called household names I wouldn't let within two miles of our factory." This trenchant observation came from Raymond Cooke, managing director of KEF Electronics, who went on to say in a recent interview that he thought the name consultant was grossly misused: "Anyone with an Avo with a bent needle can set himself up as a consultant."

His view was echoed by Derek Bond of Ferrograph, who was in no doubt about the capabilities of consultants: 'It would be disastrous in my opinion to use these guys where you're committed to a tight production schedule, because they're just not suited to it. They are generally much more aware of the trends in basics but they haven't got a clue about equipment practice.'

These comments seem particularly significant because they come from people who do employ consultants. At one time or another such diverse organisations as EMI, Plessey, Cambridge Audio, Rank, Garrard, Ferrograph, Sinclair, Marsden Hall, Strathearn Audio, Quad, Decca, Lecson, IMF, Metrosound, Audiotronics (Laskys), Technics, Sony, 3M, BASF, B&W, Capitol, Audio Devices and the BBC and IBA have used consultants, even though many of them denied that they did so. One or two firms, particularly in the hi-fi market, make such extensive use of outside contractors and advice that all they can be said to do is to market a product someone else has designed, made and put the client's name to.

As the foregoing list shows, there is no particular type of company that uses consultants more than another, but the reasons for which they use them tend to be similar. Peter Walker of Acoustical Manufacturing said: 'If we need expertise in a particular area or we're a bit busy we take on a consultant.'

Another common use of consultants is to assess equipment about to go into production, as Grahame West of National Panasonic explained: 'The reason is that we're totally involved in what we're doing and we can't see the wood for the trees. An outside person may be able to pick out things we hadn't noticed.'

Another reason for the need for assessment is to check that imported

equipment, whether from a parent company or some other, conforms to its specifications and to British safety standards. British law is often more strict in these matters than foreign law.

The law, indeed, often provides consultants with work, perhaps the best known example being Hugh Ford's study of covert tape recordings, which was extensively publicised during the trial of the two Scotland Yard detectives who were bugged by *The Times* newspaper. James Moir, an expert in



Well known contributor to Wireless World, Peter Baxandall.

loudspeaker designing and assessment, noise problems in council flats, prisons, penthouses, and power stations, and electronic circuit design, was retained by Tandberg during their patent suit against Akai.

In manufacturing, free advice is plentiful but often such advice is not independent. You can't be sure a man selling i.c.s is conveying the best way of doing a job, or purveying the best way of swelling his commission. You employ a technical consultant to get advice on a subject with which you are unfamiliar, for which you are not equipped or your capacity is overloaded, in the hope that the advice will be free of commercial bias. This means not only that the consultant is not financially linked with any manufacturer but that ideally any

private shareholdings he has are unconnected with his work. In another case, like that of Angus McKenzie, who has shares in EMI, Plessey and other firms, the consultant should agree to tell you what those shareholdings are. Mr McKenzie said he would be glad to tell any clients of his interests.

There are many other reasons for a consultant's need to be independent. One is that the potential client must not feel the consultant may be in competition with him. Another was advanced by Geoff Evans, founder and managing director of Warren Point: 'A supplier can only supply from what's in his brochure. An independent consultant can often find a supplier who suits what you want. The point is we can shop around.'

Warren Point have set up a company which supplies automatic test equipment, but they say they keep even that 'at arm's length.' Evans likes to think that the company has to wear two hats: 'The first is advisory, then there's the implementation hat. We're in touch with the implementation people, but not influenced by them. If you get your hands dirty you can advise, if you don't, you can't.'

Indeed, one of the major criticisms of consultants was that they tended to know a lot of theory and a lot less about the practicalities. Raymond Cooke explained his views more fully: 'A consultant soon runs to the end of his knowledge. A good example is the use of solid state devices. Those who use them on a large scale know a great deal more about these than the chap who does a "lashup" now and again . . . The specification is not enough. Most manufacturers will tell you that the running specifications are miles outside what they should be and the other parameters, the crucial ones, are not quoted, and those are the ones that let you down. Ask any manufacturer what his

greatest problem is and he will tell you the variability of devices.'

Stan Curtis of Cambridge Audio said that one consultant had produced a superb design 'but it was too good. It would have been all right if we had only wanted to produce one a month.' In future they would use consultants for specific problems rather than hand over entire projects to them.

Production engineering is a specialised skill which some thought outside the ken of consultants, and one engineer remarked that the production engineer needed to be familiar with the constraints of the plant and staff, which would only be possible if the engineer were loaned to the client for a year or so, in which case the client may as well hire one himself.

Yet many firms use consultants to advise them how to fill up spare production capacity, and let them see a new product through from design to production. The company of PA Consultants have often done this, perhaps the best example being Strathearn Audio, which had no product line at all before PA arrived. The Advanced Production Technology Unit of PA will develop, research, and produce a product, recruit and train staff, build any special production machinery and even make a small production line which can then be transferred to the client's plant.

Peter Baxandall, with far less commercial test gear at his command and a preference for using easily modified home-made equipment for much of his work, had a similar view. 'There are two schools of thought on this. One is that the designer does his sums and draws a diagram and that's the end of it, and if it hums and needs a bit of screening that isn't really his concern. I never take that view. The job of the good circuit designer is to see the thing through and these practical things are part of it.' To quote from Cherry and Hooper,† 'If pen and paper design is an art, then completion of the design to the hardware stage is an art of a higher order.'

He admitted he sometimes became absorbed in the merely interesting but unremunerative. Hugh Ford agreed. 'You're always looking for perfection, but you've got to give and take. You've got to compromise because the thing has got to be made to a price. Usually what you're doing is saying "These are the areas for improvement".'

On this, one observer, who has worked in most branches of electronic engineering, said he thought it was not the consultant's job to keep his own feet on the ground. 'For instance, if the consultant says the best way to do this is to use high vacuum technology, someone has to say to him "Well we don't want to get involved in that. What are the alternatives?" And he says this, this and this and the client says "We'll



Roger Driscoll, of the North London Polytechnic.

do this because we know how to do it".' There had to be continuous communication between client and consultant.

Geoff Evans of Warren Point even stressed the value of knowing how to use the client's old plant, say an oven, in the design of the new system, if that were what the client wanted.

Academics in consultancy

Because he thinks many consultants haven't got their feet on the ground John Deutsch calls himself a freelance computer systems designer, and he's particularly critical of the practical ability of many of his colleagues: 'They've overlooked the problems that can occur, and this is particularly true of academics. My job in the computer industry is to make the equipment do what the user wants. For example any systems where money is concerned have to be safe. There has to be a deliberate rigidity built into the system so that it's not easy to access once you've put the information in.'

His feeling about academics is widespread, and one commentator remarked about their 'Ivory Tower' approach. Roger Driscoll, lecturer at the North London Polytechnic, dismissed the charge: 'On the contrary the very fact that we have this close association with the press and with industry keeps us in touch.' Some might be churlish enough to argue that close association with industry is not the same as being in industry, but if one accepts that the academic community has a great deal to offer industry, there are still other sources of resentment against the academics. One that gives a great deal of contemptuous amusement is the perpetual paper chase through Milton's 'grove of Academe,' the ceaseless agglomeration of honorifics to add to the notepaper, a sense that scientific knowledge is of less importance than the acknowledgement of other scien-

tists. Another reason for the resentment is even older.

It was perhaps best expressed by James Moir, a man who is obviously successful, drives a powder green Jaguar and owns a slice of Hertfordshire that extends, as he puts it, 'as far as you can see'. Yet he feels threatened by competition from the denizens of university departments that are equipped with public money. 'They're all at this,' he said. 'It even goes down to the technical colleges where the physics master has set himself up as an acoustic consultant. And not just acoustics, they're doing all kinds of other things as well.' The apogee of sheer cheek must have been reached in one individual who attended a symposium Moir gave some years ago. 'He took away the notes we handed out and said to himself "This looks like a good thing", and the next thing I saw was that he was advertising himself as an independent consultant.'

How did Roger Driscoll of the North London Polytechnic justify this use of public resources, presumably to fill his own pocket: 'The money isn't the thing that counts. My consultancy work helps the college because it is good for the recruitment of interested students. Our connections with the press and with local industry helps the students to become known in industry and make it easier to place graduate students when the time comes for them to leave college.'

He acknowledged that he was using publicly owned equipment but said that he didn't charge nearly as much as outside consultants. 'I estimate that my income from consultancy could be counted in hundreds of pounds before tax.' Until recently all consultancy fees at the N.L.P. used to go into various pockets but now a pool has been started into which the lecturers pay part of the fees they receive. 'It varies. It's usually about a third.'

About one in six of the lecturers at the N.L.P. did consultancy work, mostly because they were not in disciplines where such work was appropriate. Driscoll emphasised that the amount of free time lecturers had was exaggerated: 'The amount of time actually spent in the lecture room may seem small, possibly only five or six hours a week, but a considerable amount more, maybe 15 or 20 hours a week, is spent in preparation for lectures.'

Many of the reasons for or against using consultants are paradoxical. For instance, their non-involvement in manufacturing gives them independence, but that non-involvement may reduce their ability to help.

Cambridge Consultants used to be involved in manufacturing, and it was a none too happy experience. They set up three companies not long after the firm was founded in 1960, one of which was Cambridge Audio, now no longer linked with them. The consultancy service did well but the manufacturing interests

†Amplifying Devices and Low Pass Amplifier Design by E. M. Cherry and D. E. Hooper, Wiley, 1968.

founded and dragged Cambridge Consultants down with them. The bankruptcy may still be having its effects.

Peter Baxandall: 'The consultant is dependent on being successful, because if he makes a mess of it it will get around. So he has to be careful not to take on the wrong job, either because it's too large or too difficult or it's likely to have an unsatisfactory outcome. He has to have a knowledge of the firm he's dealing with.'

Paying a consultant to learn

Another paradox of using a consultant is that the client, having called him in, has to brief him extensively, not just on one particular problem perhaps, but on the client's entire process, of which the consultant may have no previous knowledge. Thus the client is paying the consultant to gain knowledge and experience that may one day benefit the client's competitors.

Dr Robin Smith-Saville of Cambridge Consultants did not think this was a problem. 'First of all if you're working for the government they don't mind your learning at their expense. Secondly if a company is working with a product that is going to give them a good market they don't mind putting cash into it.' Bob Stuart of Boothroyd Stuart said they didn't charge clients for learning time. Others said that not knowing the process would be part of the objectivity the client was paying for. Many gained clients because of their experience of other manufacturers in the same business; many firms take on a consultant because they want to know what their competitors are doing. This particularly applies in consumer electronics, where many consultants may do a great deal of equipment reviewing for magazines.

Technical reviews for magazines are a fruitful source of revenue for consultants. This is not because the magazines pay well, as any consultant, particularly one who doesn't seem to need the money, will tell you, but because signed articles attract business. The consultants I spoke to did not advertise directly, though only one of them, Moir, indicated that he was aware of any restriction on doing so. 'Most professional people are prevented from advertising,' he said.

A spokesman for the I.E.E. admitted that their restrictions were largely imitative of the legal and medical professions. Rules 9 and 14 state: 'A member shall not, in self-laudatory language or in any manner derogatory to the dignity of the profession of electrical engineers, advertise or write articles for publication, nor shall he authorise any such advertisement or article to be written or published by any person.' An explanatory paragraph later explains that the stress is on the word 'self-laudatory,' and the engineer must not suggest he is more competent than other engineers. He is not allowed, as a consultant, to 'improperly solicit' work.

Most of the consultants I spoke to said their work came either from personal recommendation or from people with whom they had worked before.

The relationship with the press introduces the extent to which the activities of consultants are secret. A difficulty here is that for a consultant to carry on his business successfully he must tell potential clients what he has worked on in the past and, if he over conscientious, this may put him in a difficulty. In practice this does not seem to present too much of a problem.

The most secretive consultant organisation perhaps, is PA, which started as Personnel Administration in 1943 when it was advising on Spitfire production. They now claim to be the largest consultancy in the world, with a world-wide staff of 2,000 and a staff of 100, many of them Ph.Ds, at their new research centre in the Hertfordshire countryside. To begin with they have taken elaborate precautions to make sure the firm is not taken over and its secrets plundered thereby. In the mid-fifties they made PA a profit making trust, which is now administered by 'three or four people of sound reputation' in the city and elsewhere. Unlike other consultants, who did not regard working at some future date for a present client's competitor a problem, PA undertake never to work for a competitor.



Angus McKenzie in his laboratory.

Potential recruits to PA, 90 per cent of whose consultants have degrees or a professional qualification, have to undertake not to leave to work for a client, and not only do PA give the usual undertaking not to disclose for whom they are working, but they bind the client contractually from telling anyone that they have PA working for them.

However, other parts of the PA organisation may be working for competitors and so some PA staff are not allowed into the PATS Centre International Laboratories in Hertfordshire. PA have made confidentiality a special part of their service. 'Our secrecy,' said Gordon Edge, 'is an added recommendation.'

One can see why clients should keep their use of consultants quiet, before a product goes on the market. What seems more strange is that the use of a consultant should be kept secret after that, particularly in electronic consumer products. Many firms insisted they did not use consultants even

though incontrovertible evidence existed that they did.

Angus McKenzie offered a simple but appealing explanation: 'They feel their prestige will be much lower if the public is told that (the company) had to go outside their big empire. They like to think they've got all the best brains in the country under one roof.'

One would have thought the public might be impressed by the resourcefulness of a company that used consultants. Graham West, of Technics, said: 'I think it's just pride. I think it's a mistake because it must be of benefit to them to let the consumer know they've taken a lot of trouble to make sure the product is correct.' Many suggested, however, that idea was much too complicated. Alan Hall-Williams, of Strathearn, said: 'Talking about whether or not a company uses consultants may cloud the issue.' The public didn't care as long as the product worked properly.

Gordon Edge thought the companies had better reasons: 'It's not pride. This is silly because the modern sophisticated company treats the consultant as one of the tools he has available to help him do the job. Firms don't rely on us to do all the R & D by any means and they buy the tools they need, use them and then turn the tool off.'

Sony UK's marketing manager said that Sony had never used consultants but thought the reason that other firms might want to conceal their own use of them was that 'maybe they don't want to lose the consultant to another manufacturer, or that he may sell a similar design to another manufacturer. That's the only danger I think.'

Perhaps some are afraid, like the sign writer who makes all the newsagents within five miles look as if they're under the same ownership, the use of a specialist consultant will produce uniformity. This might be true if the same consultant were asked to design similar products for competing manufacturers at the same time. As Hugh Ford said, this rarely happens: 'Ideas change, new products come on the market, new transistors, new ICs become available so that's not a problem. It depends on the period of time that elapses between working for a client and his competitor. If there is a problem you can phone up the previous people you did the work for and say "Look, I've been asked to do this." Usually they don't mind but if they do, you tell the customer "I'm sorry I can't do it. I suggest you contact X".'

Peter Baxandall commented that he tried to avoid working for directly competing firms, and had, for instance, only accepted one audio amplifier design commission. In many cases there is no conflict because an amplifier costing £150 is a very different product from one that costs £50.

Many firms commented that a consultant would not appreciate their design philosophy as well as their own

staff. Hugh Ford reported: 'In fact, I think this is a strong case for getting a consultant. Firms get dyed in their ways and they ought to bring somebody in to examine the end product. Manufacturers don't do this enough, and you'd be amazed at the awful clangers that have been dropped by even well known firms.' Bob Stuart also thought the complaint groundless: 'If a company is bringing in a consultant they must be wanting to change their image anyway.'

Although the consultant has no loyalty to the firm other than the fee, in Bob Stuart's words 'You want clients to come back to you.' Indeed he said he regarded this as a measure of a consultant's success. In each case research staff are not obliged to stay with companies forever, and consultants may provide better continuity than one's own staff.

In this connection Geoff Evans saw a problem for the client who went to a large-system house for a one-off system. 'They are basically production companies and they are prototype oriented. Their engineers are there to fill spare production capacity, so that the one-off job is given to the young graduates, with obvious results. They have a high staff turnover because the lad gets so far into the job, panics, leaves and usually leaves no documentation behind him when he goes.' The customer will get this equipment in the end, said Evans — probably one of the reasons he went to a large system house was that he knew it wouldn't go broke — but it will often be late, 'and usually if a firm can put up with late delivery it means that either they've ordered the thing at the wrong time or they don't need it at all. Most of his own staff, he said, had been at Warren Point for seven years.

One view often expressed was that having one's own staff on the premises was much more convenient than calling out a consultant when a problem occurred. This indeed, was the basis of Derek Bond's remark at the beginning of this article. On the other hand, in a recent article in the journal *Communications International*, Dr Robin Smith-Saville of Cambridge Consultants made the following point about consultants: 'In communications it would be rash to claim that they can do anything which is beyond the capabilities of the rest of the industry but they have outstanding skills in special areas. These skills coupled with their independence and accessibility give them their special role in the industry.' In what way accessible? 'I meant accessible as opposed to a specialist engineer in Marconi or one of the other large firms', he said. Often such an engineer couldn't be found when he was wanted.

One design manager, who wished to remain anonymous, said hiring a consultant was much more convenient than going through the business of advertising for staff, interviewing and waiting for the successful candidate to



Jonathan Pope, a consultant at PATS Centre.

work out his notice. In addition the R & D engineer needs to be kept fully occupied and has to be backed up with a great deal of expensive equipment in addition to the non-productive space he takes up.

Mike East, public relations adviser to Warren Point, said, 'In the present economic situation using consultants becomes more important not less. It's a shelter for many firms because they pay a fixed fee, there are no overheads and so they cost for it.'

As regards fees, there are various methods of computation. Boothroyd Stuart work on a flat fee plus a royalty. 'This gives us an incentive to ensure success, and it limits the client's costs at the beginning, the very time when he needs the money.' Roger Driscoll saw a snag: 'With a royalty payment you could become identified with the company.' On the other hand, many manufacturers do as Marsden Hall do, paying consultants on an annual retainer with an additional fee for specific projects. This too would identify the consultant with the company.

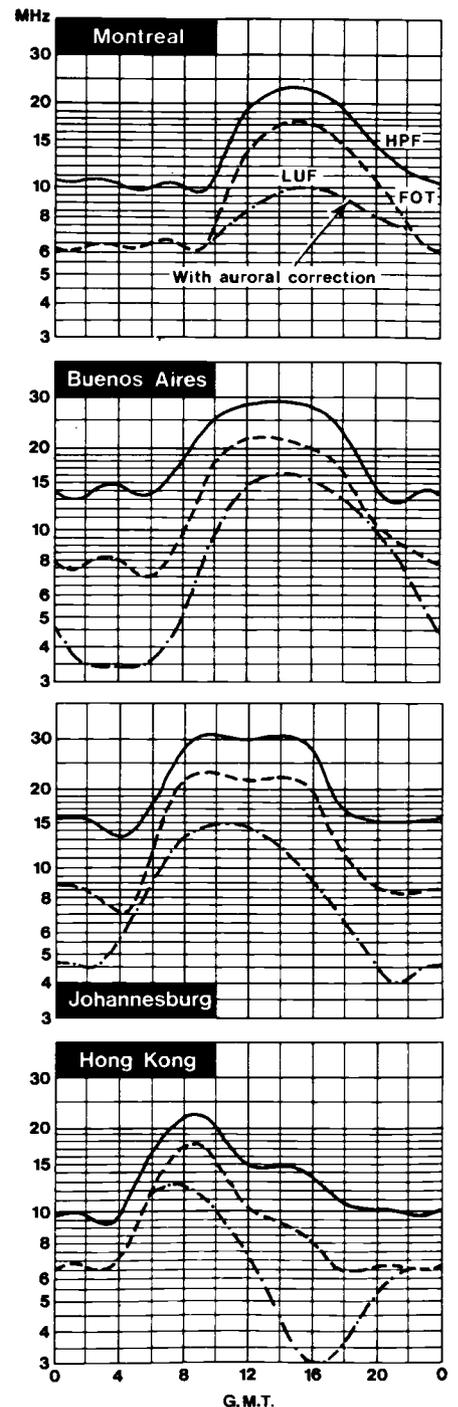
For £100 a day the client may buy the services of the large group consultancies. Individual consultants normally charge a great deal less, £50 a day upwards, although Angus McKenzie charges £100, he told me, which does seem just a little high. A university or college lecturer using borrowed equipment may charge £30 or £40 a day; one suggestion is that whatever they charge, and it could be raised to the usual rate, the money should be returned to the education service and the work counted as part of the duties for which the lecturers are already well paid, a productive means of lengthening that 26-hour week.

Whoever the consultant is, Derek Bond warns: 'Unless they pull their socks up and get a bit more production oriented we won't be using consultants much in future. If they're cheap we'll use them, but if they're not, we won't.'

HF predictions

Onset of winter conditions brings a notable increase in northern hemisphere mid-latitude daytime FOTs. The charts show how this effect is modified by differences in local time at the ends of a circuit. For example taking UK daytime as 07 to 19GMT and Hongkong daytime as 23 through 11GMT the complete path is in daylight from 07 to 11GMT. Similarly the Montreal path is not fully lit until 11GMT, since it lies to the west, but then continues lit until 19GMT as path length is relatively short.

The southern hemisphere is of course changing to summer conditions. Ionospheric control points for Johannesburg and Buenos Aires are at equatorial and lower mid-latitudes so their FOTs are not greatly affected however.



Meetings

NOVEMBER

LONDON

4th. IEE — Colloquium on "Piezoelectric and pyroelectric materials and applications" at 10.30 at Savoy Pl., WC2.

4th. IEE/RTS/BKSTS—"A dual-gauge multi-standard telecine" by J. D. Millward at 19.00 at Savoy Pl., WC2.

5th. AES — "Blumlein in the low frequency jungle" by P. B. Vanderlyn at 19.15 at the IEE, Savoy Pl., WC2.

6th. IEE — Colloquium on "Electrical phenomena on insulating surfaces in gases and in vacuum" at 10.30 at Savoy Pl., WC2.

6th. IEE/IERE — Colloquium on "Distributed information systems" at 14.00 at 9 Bedford Sq., WC1.

10th. IEE — Discussion on "SAW resonators: a new challenge to conventional crystal filters and oscillators" at 17.30 at Savoy Pl., WC2.

11th. IEE — "Fuzzy algorithms — systems and control applications" by Dr E. H. Mamdani, Prof. P. K. M'Pherson and Dr B. R. Gaines at 17.30 at Savoy Pl., WC2.

11th. IEE — "A single axis tracking earth station" by D. W. Longhurst and "Investigation of step track aerial steering techniques" by R. J. Jones at 17.30 at Savoy Pl., WC2.

12th. IERE — Colloquium on "Wedding calculators to instruments" at 10.00 at 9 Bedford Sq., WC1.

12th. I. Phys./IEE — One-day meeting on "Compound semiconductors" at Imperial College, SW7.

12th. IEE — "The scanning acoustical microscope" by Prof. R. Kompfner at 17.30 at Savoy Pl., WC2.

12th. BKSTS. — "The history and use of slides" by Brian Coe at 20.30 at NFT2, National Film Theatre, South Bank, Waterloo, SE1.

13th. RTS — "RTS Convention in retrospect" at 19.00 at the Conference Suite, London Weekend Television, South Bank TV Centre, Upper Ground, SE1.

14th. IEE — Colloquium on "Reliability of solid state microwave devices" at 10.30 at Savoy Pl., WC2.

14th. IEE — Colloquium on "Standard computer interfaces — where next?" at 10.30 at Savoy Pl., WC2.

17th. IEE — "What the common market means to engineers" by G. L. E. Metz at 18.30 at Savoy Pl., WC2.

18th. IEE — Colloquium on "Field effect device applications" at 10.30 at Savoy Pl., WC2.

20th. RTS — "SECAM — the other European colour standard" by Michael Cox at 19.00 at the Conference Suite, London Weekend Television, South Bank TV Centre, Upper Ground, SE1.

21st. I. Phys. — Meeting on "Metals and metallic compounds" at 10.00 at the Lecture Theatre, Geological Society, Burlington House, Piccadilly, W1.

25th. IEE — Colloquium on "Radio interference and the BSI" at 10.30 at Savoy Pl., WC2.

25th. IEE/IERE — Colloquium on "Patient monitoring" at 10.30 at Savoy Pl., WC2.

25th. IEE/IEETE — Discussion on "Aids in the teaching and learning of electrical subjects" at Polytechnic of Central London, 309 Regent St., W1.

26th. IERE — Colloquium on "Industrial cathode ray tubes" at 14.00 at 9 Bedford Sq., WC1.

26th. BKSTS. — "The overhead projector — a versatile visual aid" by L. S. Powell at 19.30 at Thames Television Theatre, 308-316 Euston Rd., NW1.

27th. RTS — "Computers in support of the production and transmission processes" by R. C. Evens and C. Lashmar at 19.00 at the Conference Suite, London Weekend Television, South Bank TV Centre, Upper Ground, SE1.

27th. IERE — Two joint lectures on "The development of the Mediator project for air traffic control" at 18.00 at 9 Bedford Sq., WC1.

BEDFORD

18th. IERE — "Large scale integrated circuits for Teletext decoding" by D. Spicer at 19.45 at Room 7/1, Mander College.

BELFAST

4th. IERE — "Voice recognition by computer" by Dr R. Lingard at 19.00 at Cregagh Technical College.

BIRMINGHAM

19th. SERT — "The selection of the correct hi-fi record cartridge for a given system" by A. Munro at 19.30 at the Byng Kendrick Suite, University of Aston.

19th. RTS — 1975 Fleming Memorial lecture "Television: Parliament and people" at 19.00 at BBC Broadcasting Centre, Pebble Mill Road.

20th. CEI/IERE — "Space technology" by G. K. C. Pardoe at 18.30 at Vaughan Jeffreys Lecture Theatre, University of Birmingham (School of Education).

BRIDGWATER

11th. IEETE. — "Mobile radio communications" by Prof. W. Gosling, at 19.30 at Royal Clarence Hotel, Cornhill.

BRISTOL

19th. CEI — "Engineering for survival" by Prof. Meredith Thring at 19.00 at the Lecture Room, School of Chemistry, University of Bristol.

BROMLEY

12th. IEETE. — "Electronics in commercial vehicles" by G. Leonard at 19.30 at Bromley College of Technology, Rookery Lane.

CAMBRIDGE

27th. IEE/IERE — "Videodisc" by speaker from Mullard at 18.00 at The University Engineering Laboratories, Trumpington Street.

CARDIFF

12th. IERE — AGM South Wales Section followed by "The Omega system of navigation" by R. C. V. Macario at 18.15 at the Dept. of Applied Physics and Electronics, UWIST.

CHATHAM

27th. IERE — "Recent advances in calculator technology" by R. Bradbeer at 19.00 at Medway and Maidstone College of Technology.

COLCHESTER

12th. IEE — "Techniques and achievements of radio astronomy" by Prof. A. Hewish at 19.00 at University of Essex.

HEMEL HEMPSTEAD

20th. IEE — "Thermal imaging — techniques and applications" by W. Lawson at 19.30 at Dacorum College of Further Education.

HULL

12th. SERT — "U-matic video cassette" by a representative of Sony (UK) Ltd at 19.00 at Hull College of Technology.

IPSWICH

5th. IEE/IERE — "Viewdata — an interactive information service for the general public" by S. Fedida at 18.30 at The Great White Horse Hotel, Tavern Street.

LEICESTER

11th. IEE/IERE — "Dolby noise reduction system" by I. Hardcastle at 19.00 at the Lecture Theatre, Chemistry Dept., Leicester University.

LINCOLN

20th. SERT — "Receiving aeriels" by R. S. Roberts at 20.00 at the Refectory of Lincoln Technical College.

LIVERPOOL

12th. IERE — "Radio astronomy" by Dr A. G. Lyne at 19.00 at the Dept. of Electrical Engineering and Electronics, University of Liverpool.

MANCHESTER

13th. IERE — "Radio astronomy — bird's-eye view" by Miss Hilary Exton at 18.15 at the Lecture Theatre R/H10, Renold Building, UMIST.

27th. SERT — "TCE 9000 colour television chassis" by K. Harris at 19.00 at the Lecture Theatre C10, Manchester Polytechnic.

NEWPORT, Lo.W.

14th. IERE — "Hybrid integrated microwave amplifiers" by Dr S. J. Hewitt and R. S. Pengelly at 19.00 at Isle of Wight College of Arts and Technology.

NORWICH

12th. IERE — "Communications of the future" by Dr P. D. Whitaker at 19.00 at The Audio Visual Centre, University of East Anglia.

PLYMOUTH

13th. IEE/IERE — "ORACLE — a broadcast information service" by D. Wood at 19.00 at Plymouth Polytechnic.

PORTSMOUTH

26th. IERE — "Future trends in primary radar systems" by K. Milne at 19.30 at Portsmouth Polytechnic, Park Road, Room ABO 11.

READING

3rd. SERT — "Medical instrumentation" by P. Sibley at 20.00 at the Post House Hotel, Basingstoke Road.

4th. IERE — "Electronics in medicine" by Dr D. W. Hill at 19.30 at Caversham Bridge Hotel, Caversham Road.

REDHILL

11th. IEE — "MADGE — helicopter landing system" by H. L. Derwent at 19.30 at Mullard Research Labs, Cross Oak Lane, Salfords.

SHEFFIELD

19th. IERE — "Electronic control and communications on motorways" by Supt. Hambrey at 19.00 at Dept. of Physics, Sheffield University.

26th. IERE — "Signals and systems — what do we know?" by D. Brook at 18.30 at Sheffield Telephone House, Charter Square.

SLOUGH

5th. I. Phys. — One-day meeting on "Physics of detection and surveillance" at the Fulmer Research Institute, Stoke Poges.

SOUTHAMPTON

12th. IERE — "V.h.f./f.m. broadcast reception" by R. S. Broom at 19.30 at Southampton College of Technology, East Park Terrace.

19th. IEE/IERE — "Application of semiconductor devices to protection" by M. C. S. Simpson at 18.30 at Lanchester Building, University of Southampton.

UXBRIDGE

28th. IEE — "Some aspect of artificial intelligence" by Prof. I. Aleksander at 18.30 at Brunel University, Kingston Lane.

WHITBY

11th. IERE — "Fly-by-wire flight control systems" by Flt.Lt. P. L. Hills at 19.00 at Botham's Cafe.

Tickets are required for some meetings: readers are advised therefore to contact the society concerned.

News of the Month

IEE to resign from CEI

The Institute of Electrical Engineers has decided to give notice of its intention to resign from the Council of Engineering Institutions on December 31 next year. A statement by the IEE's President, James H. H. Merriman was issued as follows.

"As you know, we have endeavoured, with colleagues in other institutions, to secure a reform of the CEI that would make it representative of individual Chartered Engineers, regardless of their specialisation, who would freely elect its governing Board. We consider it essential to eliminate, or at least substantially dilute, responsibility of the Board to the institutions because we are sure this has been the main cause of the CEI's inability to act promptly and effectively. It is excessively difficult for fifteen sovereign institutions—probably more in the future — to reach agreement on important matters.

"The constitutional changes agreed by twelve of the fifteen institutions at the CEI meeting on 24th July, by which each institution will elect one representative on the Board, would not, in our view, dissociate the CEI from the overriding influence of the institutions. We considered that this decision represented the limit to which a majority of other institutions were prepared to go to meet our views, and that further progress could only be expected to take place, if at all, in a future far more distant than we believe our members would tolerate. In these circumstances, our council thought the only proper course was to give notice of resignation . . . In the meantime, we shall play our part in the CEI in a constructive and conciliatory manner so that if, at the end of the day, we decide we must withdraw, we may do so without rancour, and in circumstances that will enable us to collaborate in friendship with the other engineering institutions and with the CEI itself."

Buy British audio

September saw the announcement of two campaigns intended to promote British audio products both here and overseas. The first starts with a recent exhibition at the Design Centre, Haymarket, and is promoted jointly with a group of 18 well known retailers from all parts of the U.K.

Based on the slogan "the best of British", the advertisements list the dealers who have joined the group and outline the advantages of a new guarantee and service agreement

offered. In each instance, the dealers are promoting British made products and providing a passport-like document, with each purchase. This offers a two-year free parts and labour guarantee on listed British items, purchased and entered in the document, with the exception of the pick-up cartridge stylus.

Parallel to this campaign a loose grouping of a number of well known British manufacturers has been created to improve overseas promotion and exhibition activity. The impetus to this movement came from what one spokesman called "the poor stand location and tatty appearance" of the joint British stand at this year's Chicago Consumer Electronic Show.

The group plan to start a twice yearly promotional magazine which will be circulated among some U.K. dealers and extensively in potential overseas markets. The magazine is to be edited by Denys Killick, the technical editor of *Cassettes and Cartridges*.

Just how successful this latest idea will be is difficult to judge, since it is embryonic, but one leading British manufacturer, Rank-Audio Visual, pointed out that they and some other companies could be embarrassed by such a campaign, since they have a foot in both camps, importing Japanese products as well as making Leak and Wharfedale products. The comment was made that British products should be offered on the basis of a direct technical and quality comparison, not relying on patriotism to boost sales.

Push-button 'phones introduced

Push-button telephones will become generally available to customers in London next spring and elsewhere later in 1976. Calls are made by keying (see photograph), which is easier than dialling and enables users to put numbers into the telephone faster. Called the SC Keyphone, it is interchangeable with an ordinary dial telephone and may be used on most exchange lines and extensions. It uses an m.o.s. microcircuit designed by Pye TMC engineers which translates the keyed number into a chain of pulses identical to that produced by conventional rotary dial telephones. The Post Office's new D4000 specification has been drawn up to ensure that equipment incorporating m.o.s. circuits will achieve a 30-year fault-free lifetime and requires that test circuits designed to check process and production parameters be regularly submitted to the P.O. for accelerated life-time testing at extremes of temperature. Following successful market trials in London and the provinces, the P.O. has now placed contracts with GEC Telecommunications and Pye TMC for a total of 145,000 SC Keyphones. They will be offered to



Vernon H. Cooper Ltd's new yarn speed monitor can be used in conjunction with all types of knitting machines, both circular and flat and having varied rates of feed. The monitor incorporates EMI's electronic fabric control system.



Britain's telephone of the future is the self-contained Keyphone – see news item for details.

customers at an extra rental of £4 a quarter and there is an installation charge of £5.

Data buoy commissioned

The UK National Data Buoy was formally commissioned at Lowestoft on Friday, August 22 and is expected to be in position reporting automatically on sea and weather condition in the North Sea, in the early autumn (see 'Electronics in Oil', Jan. 1975 issue, p.8). The items of equipment have been supplied by Harwell's Electronics and Applied Physics Division. One of these measures the rate and direction of movement of the water while the other produces electric power for the buoy's instrumentation. In the current meter, ultrasonic pulses pass horizontally between two pairs of transducers mounted at right-angles to each other on spars projecting beneath the buoy. Differences between the times taken for the pulse forward and return journeys are measured electronically and combined with the buoy's compass bearing to give true direction and speed of the water's movement.

The thermomechanical generator, which powers all the buoy's instruments and the sea-to-shore communications system, is a Harwell development of the Stirling Cycle Engine and provides a continuous output of 25W from the combustion of 200kg/year of propane gas.

New computer breed

The Science Research Council has made a grant of £8,000 for work on a graphically patched hybrid computer being undertaken by Mr Peter Atkinson of the Department of Engineering and Cybernetics at Reading University. In a hybrid computer, simulation runs on the analogue computer are controlled by a digital machine which also logs data. Once a problem has been programmed it can then be left on the hybrid computer to run itself until the

problem has been solved. The one remaining difficulty at present is that the analogue machine has to be wire connected ("patched") by hand before the programme may be run. The patching must be carefully checked for errors and this process is time consuming. Earlier work by the investigator has shown that digital computers may be automatically programmed to solve simulation problems by drawing up the block diagram of the system to be simulated on a cathode ray screen. The object of this present research is to produce a small demonstration system which allows the analogue component of a hybrid computer to be similarly automatically patched up by drawing a block diagram on the c.r.t. screen. The digital computer will be programmed to recognize the system's topology and will make connections between the analogous blocks in the analogue machine. The numerical values of the elements within each block will then be typed into the digital computer via a conventional teletypewriter keyboard and the digital computer will set up the component values in the analogue machine.

This research is not the first attempt to produce an automatically patched hybrid computer but it possesses new features which ease the solution of the problem considerably.

No interference from experimental tube train

Measurements have been made to monitor interference signals induced in

the running rails by London Transport's experimental tube train and it was found that resolved signals were obtained at considerably lower levels than expected. The train is experimental in that control of the traction motor's power unit is solid state, employing thyristors rather than banks of resistors. The result is a 5% saving in power, smoother control and less maintenance. Interference from the power unit could have affected vital signalling information but the tests have showed that operation of the train does not introduce spurious signals of sufficient level to affect running safety. While operating, interference in the region 500-600Hz was expected while on starting, a frequency of 16Hz could have been induced from the motor. The Fenlow instrumentation recorder used for monitoring the signals has facilities for recording on up to four channels using standard ¼in magnetic tape at a speed of 7½ i.p.s. Signal to noise ratio is better than 43dB and linearity is 0.5%.

Briefly

And now Roberts Video. Roberts Radio has entered the colour television market and will operate Roberts Video from the same address and will trade within the same sales policy.

Electrical safety. The Department of Prices and Consumer Protection have just released information on the new guidance document dealing with the Electrical Safety Regulations 1975. This is available from HMSO.

Bathtime at the British Hovercraft Corporation has now advanced beyond the rubber duck stage to the remotely controlled model hovercraft which is here undergoing hydrodynamic tests using an SE Labs eight-channel portable magnetic tape recorder.



Letters to the Editor

VANISHING COMPONENTS SHOPS

Can anyone tell me what has happened to the service that used to be provided by London's electronic component shops? I have been aware that the situation had deteriorated, but not until two recent occasions, when I attempted to make purchases in such shops, how far the deterioration had gone.

There was a time when you could take your "shopping list" for whatever equipment you were building to one of a score of shops in Edgware Road, Tottenham Court Road, and Lisle Street with a high probability of getting your requirements met, if not in one shop, in two, at the most. And these shops were manned by people with actual experience of circuitry, radio hams and the like. Now all these shops are owned by two or three big chains and staffed by salesmen who, generally speaking, know nothing about electronics and in many cases have only a limited grasp of English. Look in the advertising pages of this magazine: most of the component suppliers are in the North of England or in the West Country, which means buying components blind as no one seems to give manufacturers' type numbers of the components they advertise and therefore volume and configuration of these items remain a mystery until purchase has been made.

Perhaps other readers would tell us how they manage to build complex electronic equipment to professional standards, using miniature close-tolerance components with such an impossible supply situation — or do they all use their employers' stores?

Perhaps one of the tycoons who own these super-chains of resistorless capacitorless radio shops will tell us why we are not getting the service we used to get and which, judging by the number of electronic magazines sold, many would be eager to take advantage of. Maybe such tycoons don't regard it as their function to provide a service — only to make a profit!

Perhaps, moving into the area of pipe-dreams, someone will open up an experimenters' materials supply super-market, not just for electronics but also where one could buy optical components, mechanical engineering materials, chemicals, specialist photographic materials . . . let others add their special needs! And all at 8% VAT!

B. W. B. Pethers,
Welling,
Kent.

PEAK READING LEVEL METER

On some of the issues raised by Messrs Dawson and Evans in October letters we find ourselves in agreement. In mid-1972 we built a resistor chain/comparator instrument, but later investigated the analogue/digital approach because this seemed a powerful and flexible method.

We appreciate that our design seems complex, but the two-channel prototypes were built for the authors' satisfaction and as a demonstration of the principle, not really for presentation as a design for construction — hence the absence of p.c.b. layouts. However, if one considers the application of our design to a multichannel system — e.g. on a 24/8 mixing console where 32 channels are to be monitored — it can provide a simple and economic solution, as we need use only one set of logarithmic, clock and display logic; we then multiplex sequentially:

- (a) 1 out of 32 rectifier/storage capacitor outputs into the reference capacitor (C_9 , Fig. 3)
- (b) 1 out of 32 columns of I.e.d.s, enabling that column alone to respond to the previously processed input signal.

Very little circuitry is needed to effect the multiplexing, the power consumption per channel is greatly reduced and calibration of the logarithmic intervals for all channels simultaneously is by a single potentiometer setting.

A digital system can permit variations in dB increments: for example, a system of 1 dB resolution may be designed so that each step is displayed at the highest levels, every other step at mid-levels for 2 dB resolution and 1 out of 4 at low levels for 4 dB resolution.

Referring to the question of drift, we should like to point out that:

- (a) The capacitor C_9 , Fig. 3, is a polystyrene type, as was mentioned in the article as submitted for publication but subsequently omitted on publication.
- (b) The reference voltage, V_{REF} tracks the 10V zener sub-rail voltage to almost 99%.
- (c) The hysteresis drift in the 74132 clock oscillator is typically less than 1% over a 25°C free air temperature change.

Our prototypes do indeed dissipate

heat, but this is minimised by the use of a 20V + 5V power supply; they were designed in 1973 and our article had been awaiting publication for some eighteen months. If we were now to up-date its design, we should certainly use c.m.o.s. logic, greatly reducing power consumption.

We consider the suggestion of a series I.e.d. chain an excellent one and are grateful for this.

For domestic/prototype use, the low-cost 748 amplifier has an acceptable h.f. performance, but we would agree with Messrs Dawson and Evans that for professional purposes faster devices should be used.

We are not concerned to attempt to imitate the inertia of a moving-coil instrument, nor do we claim to have produced a direct replacement for the BBC p.p.m.; we simply used the BBC specification for rise and decay times as a guide — other tastes or standards could easily be accommodated.

In 1973 the price differential between red and green I.e.d.s determined our preference — that differential has now changed.

We would like to thank Messrs Dawson and Evans for their interest and suggestions, but feel that they may have mistaken our intentions somewhat.

S. F. Bywaters and J. E. West,
London, NW11.

"SORTING OUT SIGNS"

In his article in your September issue, on conventions in circuit and phasor diagrams, A. T. Morgan introduces it with the words "it is important to be logical and consistent. This article outlines a logical system . . ." And he goes on to repeat "logical and consistent" and "logical" with reference to the system he is about to commend. At the same time he is kind enough to refer to my book "Phasor Diagrams", but by contrast describes the system therein merely as "new and interesting". As for newness, it was given embryonically in *Wireless World* and *Electrical Review* more than 24 years ago, and fairly fully in *Electrical Review*, Jan. 1, 15 and 22, 1954). He finishes, in a Summary, with the observation that if his instructions are followed "no confusion should arise." So one reads on with high hopes.

His Figs. 1 and 3 show two opposite conventions for indicating positive directions of voltage and current, and Figs. 2 and 4 show the corresponding opposite phasor diagrams. But instead of coming down *logically* on one side or the other, Mr Morgan tells us neither is better than the other and we can take our pick as fancy moves us! This does not strike me as the emphatically logical and consistent approach we had been promised. And as for no confusion, I can hardly think of anything more likely to give rise to it.

Mr Morgan's opposing conventions are of course familiar, and in a recent paper* I showed that the existence of this conflict of viewpoint was due to the use of totally unnecessary arrows in circuit and phasor diagrams, and that the dispute just did not arise if my system was used. My claim that whatever arrow methods can do, even when used in such a way as to be valid, those I advocated can do better (often very much better) still after more than two decades does not appear to have been refuted. So what is the point of clinging to arrows, etc., with resulting diversity of conventions, risk of confusion, greater complication and restricted capability (strikingly exemplified in "Phasor Diagrams") when there is no need?

As regards restricted capability, it is significant that out of Mr Morgan's 35 diagrams no fewer than 25 are devoted to the simple series circuit. Parallel circuits are not mentioned at all (nor Kirchhoff's current law), except one complicated circuit (Fig. 18) for which again significantly no phasor diagram is attempted. It would be interesting to see Mr Morgan's phasor diagram for a two-stage amplifier with feedback, such as Fig. 7.63 in "Phasor Diagrams."

Fig. 1, a simple generator-and-resistor series circuit, shows, in variety (b), two voltage arrows pointing in the same direction around the circuit, both of them in the same direction as the current and therefore, one might think, in phase with it. But Mr Morgan says that the two voltages are opposite, and shows them so in the phasor diagram. Is that not likely to confuse? Especially when the reader has just been given two versions, each upside down relative to the other. Even after one of these has been selected for the remainder of the article. Figs. 15 and 16 show two different phasor diagrams for the same transformer. One of the features of the arrowless system is that every circuit has one and only one correct general phasor diagram shape; a fact that should endear it to student and exam paper marker alike!

Regarding the claim for consistency, one notes that some of the phasor diagrams have been drawn on the closed-figure principle while others are of the star form. Some of the current arrows are incorporated in the wiring; others are drawn alongside like the voltage ones. The same kind of arrow is used for both voltage and current. The usual convention of E for e.m.f. and V for p.d., upheld by the BSI, is reversed for no apparent reason. Since one undoubted merit of the system is that it does not necessitate distinguishing between e.m.f.s and p.d.s (just as well, since nobody, not even the BSI, has been able to define them in such a way that all can agree about which is which)

one wonders why Mr Morgan bothers to use different symbols for them.

I am confused by a phrase near the top of the last page: "If the force F moves in the direction of the force." There are two obvious errors in Fig. 10(b), and eqn. 3 does not agree with the text.

I feel that Mr Morgan's article tends to confirm the case I put in "Phasor Diagrams", that "conventional methods of dealing with circuit and phasor diagrams" are so confusing and inadequate at best that it is a waste of time trying to bolster them up. Why not make a clean sweep of them, as was done so expeditiously with the c.g.s. systems of units?

M. G. Scroggie,
Bexhill,
Sussex.

Mr Morgan replies:

First of all, I would like to point out some printing errors in my article.

Page 436, column 2, the last equation should read

$$v = iR \text{ and } e_R = -iR$$

Page 439, column 2, equation 3 should read

$$V_2 = -ZI_2$$

In Fig. 10, (a) and (b) the equation should read

$$V_Z = IZ$$

I will now try to answer Mr Scroggie's points.

It seems to me that what Mr Scroggie is saying is that no method is acceptable or can possibly be clear and logical unless it is the Scroggie method. I am well aware of the fact that Mr Scroggie's "new" method has been published from time to time over a period of over 20 years. However, it has still not been generally accepted and although I find it "interesting" and perfectly acceptable I certainly do not agree that it is the only acceptable method.

As explained in my paper, what I have tried to do is to take the traditional methods, which my students find in all the text books they read, and try to clarify the points which cause confusion.

I do indeed show two different conventions in Figs. 1 and 3, but as clearly explained in the article, I see no logical reason why one *must* be used in preference to the other. I have my own preferences, of course, but I do not wish, as Mr Scroggie appears to do, to force these on all other readers. All I ask is that the chosen conventions be clearly stated and that the writer then sticks to them. Having personally chosen in my paper the conventions of Fig. 1(a) and 3(a), I have not departed from this subsequently. Fig. 16, as stated in the article, is an example of a way of dealing with the transformer which is often used but which I do not find acceptable for the reasons stated.

The length of my article was obviously restricted for publication

purposes and the reason that considerable attention was paid to series circuits is because this is where the confusion often starts, i.e. right at the beginning. If the basic principles as outlined for series circuits is well understood, I don't think Fig. 18 would necessarily be described as "complicated". The method of dealing with it has been carefully outlined. The reason I have not attempted to draw a phasor diagram for Fig. 18 is because I don't see any useful purpose in doing so. The circuit would be solved from the equations as given.

I just cannot understand why Mr Scroggie thinks that in Fig. 1(b) the fact that both voltage arrows point the same way round the circuit as the current arrow indicates that all three quantities are in phase. As explained quite clearly, the arrows only indicate the chosen positive directions. If two quantities are in phase, they are always positive together and negative together. If in antiphase, vice versa. Clearly in Fig. 1(b) if v is positive, then e_R must be negative. Positive in one direction is the same thing as negative in the opposite direction.

Mr Scroggie apparently objects to my drawing some phasor diagrams closed and others in star form. As far as I am concerned this is perfectly acceptable as phasors, like vectors, have only magnitude and direction (with respect to other phasors). I agree it would be nice to have only one way of drawing the phasor diagram for a given circuit, but I live in a real world and I have to teach my students to understand the text books which they are likely to read.

The point about type and position of current and voltage arrows, I feel, is rather trivial as it doesn't affect the *understanding* of the diagrams.

I am not interested in the distinction between e.m.f. and p.d. for my method does not necessitate the distinction and, as Mr Scroggie admits, the distinction between the two is another point which causes confusion. I have used the symbol e for voltage across an impedance, whether it be resistance, inductance or capacitance. Everyone uses e for inductance so why not also for resistance and capacitance? They all impede the flow of current in an a.c. circuit. That is consistent, isn't it?

SMALL SHOPS CARE

I take exception to certain remarks in your September issue in the article "Electrical safety, standards and the law."

The impression is given that small retailers are a second best, technically dim section of the trading community. This is not so. For technical knowledge, experience and simply caring about what we sell and whether our customers will survive, we are far ahead of the multiples and others. How many

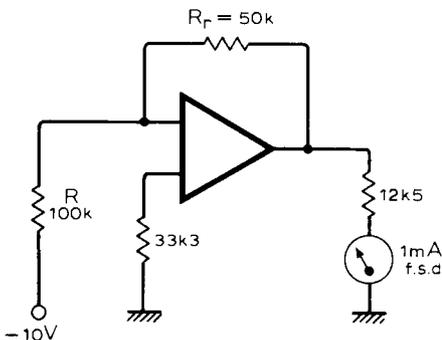
* "An Unnecessary Controversy," *Int. J. Elect. Enging. Educ.*, Vol. 12, pp. 125-8.

of these selling organisations even keep a Megger at the point of sale, let alone know how to use it? Perhaps a quick check by your readers would turn up some interesting figures on 13-amp plugs sold complete with 13-amp fuses and no enquiry about the appliance to be connected. Small is beautiful.

G. J. Badman,
Watts Radio,
Somerton,
Somerset.

RESISTANCE COMPARATOR

I may be wrong — but! Surely the circuit shown solves the Griffiths-Choi problem (Letters, September issue) even more simply.



It uses a current instead of voltage meter, but as these are the only moving-coil types made it's of no practical concern.

A. Sandman,
London NW3.

SAFETY REGULATIONS

With reference to the article "Electrical safety, standards and the law" in the September issue, I should like to draw your attention to a problem concerning the connection of electronic circuits to the earthed metal cases of instruments.

It is the practice of some manufacturers of electronic test equipment (such as oscilloscopes) to connect the low-potential terminal of the electronic circuit directly to the metal case and to provide a three-core cable to facilitate the earthing of the case. The combined use of a number of such equipments in a test may lead to the induction of a spurious e.m.f. into the loop formed by the low potential signal wire and the mains wiring between the two earthed metal instrument cases. To defeat this difficulty, some people (illegally) cut the earth lead(s) to one or more instruments. Following the test, the earth connection which has been severed is seldom repaired, with the result that the instrument now represents a hazard to the next unsuspecting user.

Having suffered many bad electric shocks from equipment which has been subjected to this illegal practice, I have very strong feelings on this subject.

The difficulty may be eliminated by insulating the low-potential terminal of the electronic circuit from the earthed case. Alternatively a manufacturer may connect a resistor of low value, say 100 ohms, between the low-potential terminal and the mains earth lead in order to reduce the magnitude of current that can flow around any such earth loop. In either case, the temptation to cut an earth wire is thus removed.

Finally, I suggest that the direct connection of the electronic circuit to the earth wire *within the instrument* be forbidden. There is nothing to stop the user from making his own *external* connection if he should so wish.

Roy C. Whitehead,
Sutton,
Surrey.

LAWN MOWER POWERED GENERATOR

It is to be expected that such a simple emergency generator as that described by J. M. Caunter (February issue) would not be free from danger, but something which most of your readers may overlook is the fact that the Electricity Boards expect all persons with their own generators to provide proper two-pole changeover switching. Otherwise, as they point out, it is possible for their workmen to be exposed to risk.

Not, I think, a very likely risk, but it is possible. My own Board started a rather acrimonious correspondence with me even after they had seen the installation but, it appears, failed to appreciate there was the necessary isolating switch. In my case the supply was 240V d.c. from accumulators, which could supply a very high current for a few minutes.

D.c.-to-a.c. converters are usually constructed so that the load is plugged in, so isolation is automatic. Otherwise quite extensive house wiring alterations may be needed to satisfy the Electricity Board.

L. Sreatfield,
Poole,
Dorset.

READ-OUT FOR THE VISUALLY HANDICAPPED

A near-blind physicist is in a good position to stimulate his electronics colleagues to think along the lines suggested by Mr John Osborne in his letter in your July issue and this has been going on here for some years. We should not like to see wasted effort so I am writing to give brief details of current activities.

With financial assistance from the RNIB Mr David Smith has produced an audio-output unit designed for adding on to three current Advance calculators and this is on the verge of commercial manufacture. He is also working on a similar unit for the Hewlett Packard calculators and has built a prototype audio read-out for a computer.

We have also produced a c.c.t.v. reader for the partially sighted which is based upon standard British equipment but which includes a circuit designed by our Mr John Ward which reverses black and white and also enhances contrast. Although similar equipment has been developed in parallel in other countries we believe ours to be better as well as much cheaper.

There are of course many other fields of activity in the application of electronics to helping the visually handicapped. Anyone wanting to find out what is being done should consult the International Register maintained by Dr John Gill of the University of Warwick.

A. J. Croft,
Clarendon Laboratory,
University of Oxford.

BLOWERS ON AMPLIFIERS

Our attention has been drawn to the article in the August issue describing the Chicago Consumer Electronics Show.

In the third column is a report that suggests that, due to the new Federal Trade Commission ruling on amplifiers, Crown amongst others have had to incorporate blowers or fans on their amplifiers.

This is incorrect and your contributor may have been misled into believing this by seeing the M600 Amplifier which does have fan cooling but was designed some 3-4 years before the new ruling was introduced. The DC300A model has no fans incorporated but in America is offered with additional clip-on heat-sinks which greatly improve the heat dissipation.

I. M. Marshall,
Macinnes Laboratories Ltd,
Saxmundham,
Suffolk.

The BS1852 resistance code contains the letters F, G, J, K, M which refer, respectively, to $\pm 1\%$, $\pm 2\%$, $\pm 5\%$, $\pm 10\%$, $\pm 20\%$ tolerance. For those who find it difficult to remember the letter sequence reader B. L. Hart suggests the following mnemonic:

FEW GOOD JUDGES KNOW MUCH

Audio Fair preview

New in amplifiers, tuners, tape recorders and turntables

Fighting the current trend against a declining market and ever-reducing profits, audio manufacturers seem to be retaliating with an amazing range of technical innovations and new products for this season. It seems that every branch of technology has been drawn upon, from carbon fibres, popularly associated with Rolls Royce turbo-jet fan blades, to the recently developed power f.e.t.s. Technique is not the only factor brought to bear upon the public since speakers, tuners and amplifiers all seem to have grown bigger since last year. One new amplifier, for example, weighs 115lb (52kg) and is unusual in that it is fitted with a pair of castors to help in moving it about the floor!

It will be interesting to see how the public reacts to the present sympathy for buying British, since many of the remaining British manufacturers seriously in the hi-fi business are making obvious attempts to fight back against the Japanese invasion, with high quality designs and a degree of innovation. What is disappointing is that so few of these British manufacturers have come to the Audio Fair. Perhaps they should be encouraged by the example of the small Northern company of North East Audio Ltd, which has not only survived since it was opened some years ago, but has actually thrived and is producing a wider range of models than ever before. Certainly, the hi-fi enthusiast is becoming more discriminating in the choice of products and not only demands value for money, but also a very high standard. That NEAL should have been able to meet these criteria in the face of competition from giant manufacturers from overseas is all credit to them.

This review cannot hope to survey the complete range of new products that appears at the 1975 Audio Fair. Instead, a few highlights will be selected from the major product divisions to illustrate some of the technical trends which can be expected in the New Year.

Surround-sound

Developments in surround-sound this year have centred mainly around improved equipment and a gradual

increase in the number of records available, notably for the CD-4 system. As far as the quest for system dominance goes, informed opinion is that the early systems were launched too soon — before the theory of surround-sound was properly developed and understood. This premature marketing, resulting in a less than wholehearted commitment by record companies and indifferent demonstrations, taken with the recent economic situation has given the surround-sound industry a slap in the face.

Nonetheless, new equipment continues to be developed. The initial spate of extended-response cartridges has been followed by some improved designs, for example Pickering's XUV/4500Q, JVC's X-1 and Empire's 4000D/111. The X-1 uses a beryllium cantilever, rather than the more usual aluminium or titanium, with lower density, higher sound velocity and higher Young's modulus. A special coating gives protection against possible beryllium poisoning. It uses the recently developed samarium cobalt polymer magnet, its high energy product (BH) allowing a significant reduction of weight in moving magnet systems. The magnetic circuit is improved by a laminated core and smaller gap, reducing dips in the h.f. response.

The Pickering XUV is the first low-tracking-force extended-response pickup ($1 \pm 0.5g$). This is achieved using a tiny moving samarium-cobalt magnet (about $0.6 \times 1.3mm$ dia.) giving reduced damping, in addition to mass, with consequent improvement in mid-range tracking. The well-known Pickering slide-in stylus assembly carries a four-surface tip (Shibata has two) called Quadrahedral. Tracking force of the fixed-magnet Empire is also low at $0.75 \pm 0.5g$.

Notable recent demodulators are the Technics SH400, using the QS1 CD-4 chip. Facilities include pre-set controls that push into the front panel to avoid accidental alteration, a "high-blend" switch to reduce the effect of noise on worn recordings, and a facility for use with the Technics semiconductor car-

tridge. The JVC "professional series" CD4-1000 uses phase-locked loop demodulation with the full two-band a.n.r.s. circuit (earlier demodulators used the one-band version). Increased signal-to-noise ratio, decreased distortion and increased separation are claimed and the carrier-to-baseband time delay is adjustable to allow optimization with different pickups. A switchable 10kHz filter ($-6dB$) is provided in the carrier-channel circuits.

An extremely useful and under-publicized demodulator is the Denon type UDA-100 (Nippon Columbia). This features demodulation circuitry for both CD-4 and UD-4 systems, as well as having switched positions for the basic SQ and QS matrix systems. An optional expander circuit allows reduction of the carrier channel levels at low signal levels. (If this were used in the CD-4 system, loss of carrier channel would spoil sound localization but with UD-4 loss of carrier would result only in a broadening of directivity.) This decoder/demodulator is the only model on the market that caters for all four marketed surround-sound systems. (From Johnsons of Hendon Ltd.)

At the recording ends both JVC and RCA now use modulator equipment based on phase-locked loop principles. The JVC mark III equipment claims improved dynamic and frequency range and eliminates the need for advance heads on the tape transport (used for carrier level control). Price is around \$30,000. The Ortofon 731 cutter head has improved crosstalk — 30dB over the critical range of 10 to 22.5kHz, which range is equivalent to 20 to 45kHz as cutting is done at half speed. Positional feedback at low frequencies controls amplitude response down to 10Hz. Its "T-bar" structure is claimed to provide tight coupling between stylus tip motion and the motional feedback coils.

Though not in public use in the UK the artificial head recording technique is in popular use by broadcasters in Germany, especially for drama. While its limitations are widely recognised — particularly the loss of realhead movement, making front images difficult to place — it has stimulated one company

at least to investigate techniques of achieving an out-of-head stereo image with normal recordings (see page 523).

Amplifiers

Over the past three or four years, loudspeaker manufacturers have tended to produce loudspeakers with lower and lower efficiency. This, in turn, has brought the reaction of amplifiers with steadily increasing power outputs. This year must surely have seen the ultimate in the race for higher powers from amplifiers, since quite a large number of 200 and 300-watt amplifiers are on show on various manufacturers stands.

The I15lb amplifier with castors mentioned in the introduction, is the Luxman M6000. This is the power amplifier part of a complete system including a preamplifier-control unit in a separate cabinet. The specification suggests a 300-watt continuous power output per channel, into 8 ohm loads, from 20Hz to 20kHz at no more than 0.05% total harmonic distortion. Additionally, the rated intermodulation distortion is suggested as being no more than 0.05% into an 8 ohm load at 300 watts using test signals of 60Hz and 7kHz in an amplitude ratio of 4:1. (Such wealth of detail in a specification is a new trend to be welcomed, but it is questionable whether most consumers will understand what all this means.) The frequency response for the M6000 is said to be ± 1 dB from 5Hz to 50kHz and the signal-to-noise ratio is better than 100dB, referred to the input voltage required to produce 300 watts output. Just as an added statistic, the power consumption is said to be 150VA with no input signal and 1.3kVA when driving the maximum output into an 8 ohm load.

As if all these statistics are not enough, combined with the weight of the unit mentioned above, the circuitry features 12 transistors arranged in 6 pairs, complementary symmetry for each channel, with each output transistor individually fused and protected (see circuit). The protection circuitry is quite complex, and occupies a remarkably large panel inside the amplifier. The high standard of mechanical engineering is undoubted, with almost every part of the chassis being hand made. This perhaps provides a clue to the sales potential of such an amplifier, and it is suggested that it is more of a prestige product than a practical part of an audio system for the home.

Coming to more practical aspects of amplifiers, of direct interest to many readers of this journal are the Dynaco kit amplifiers being offered by Sound Incorporated (Sutton) Ltd. One integrated amplifier, the SCA 80Q, is offered together with two pre-amplifiers, the PAT 4 and PAT 5 and a choice of up to six power amplifiers ranging in price from £75.95 up to £261.95 plus VAT. At least one of these amplifiers should interest many of our older readers, being the Model Stereo 70.

This is a valve amplifier offering a 70W continuous power output, with both channels driven at 1kHz into 4, 8 or 16 ohms. The harmonic and intermodulation distortion is claimed to be under 1% at the rated output and under 0.05% at 1W. Hum and noise are claimed to be more than 90dB below 35W on each channel, and the frequency response ± 0.5 dB from 10Hz to 40kHz.

Circuit diagram of the Luxman M-6000 output stage for one channel.

It would seem that valve amplifiers are simply refusing to die!

Tape and cassette recorders

Tandberg deserve special attention for their interesting reel-to-reel tape recorder, the Model 10XD Stereo. This represents a step up in the existing range of machines offered by Tandberg, since the 10XD will accept 10½in NAB centered spools. Capable of tape speeds from 3¼i.p.s. through 7½i.p.s. to 15i.p.s., the recorder uses three motors and a total of four tape heads.

However, all of this seems relatively mundane by modern standards, until it is realised that Dolby B noise reduction is offered at all tape speeds. This must make the Tandberg the first reel-to-reel tape recorder to 'officially' record a Dolby B processed signal onto a tape, running at what is normally regarded as a "professional" tape speed. Since the introduction of the Dolby B system there has been a resistance from Dolby to tape recorders being offered with the B system operative at 15 i.p.s.

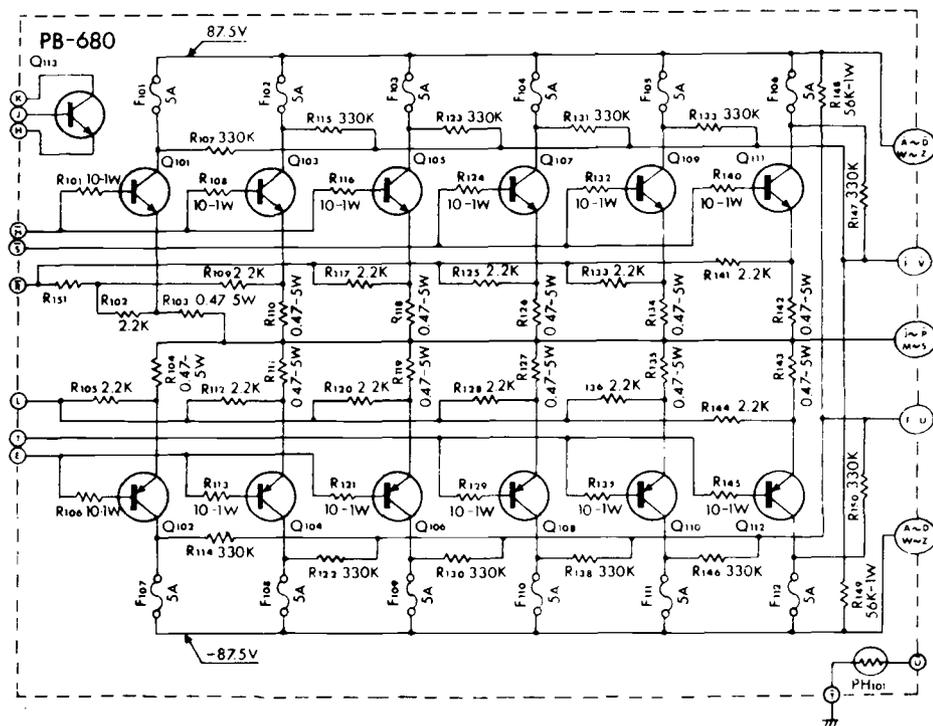
Some time ago Revox planned to offer a model of this type, but were discouraged by Dolby. Obviously Tandberg have been able to persuade Dolby that their fears about the dangers of two systems of noise reduction at this tape speed (Dolby A being the professional system used at 15 i.p.s. and higher speeds) causing confusion were unfounded. Probably we will see a spate of new machines which later will incorporate Dolby B at a tape speed of 15 i.p.s. The 10XD Stereo features many other facilities familiar to the users of the other Tandberg tape recorder models and includes a remote control facility to operate the deck at some distance. Additionally, since electronic servo speed regulation is employed, it has been possible to fit an external control socket which permits the basic tape speed to be varied over a range of values, by a simple add-on accessory.

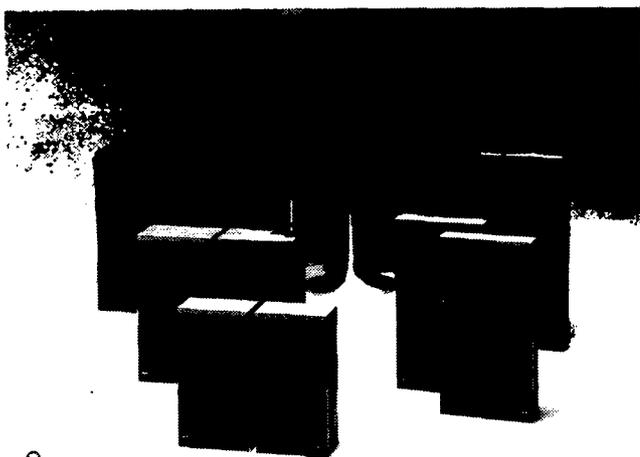
Among the large numbers of cassette recorders being introduced perhaps the most remarkable is that being offered by Akai, the model GXC325D. This machine is a development of the three-head principle in cassette recorders, but avoids the problem of having to rearrange other components in the tape path in order to accommodate the additional head.

This is achieved by combining the record and replay head into a single moulded block, occupying the normal position for the record/replay head.

Turntables and arms

Among the many turntables which will be shown for the first time at the Audio Fair will be a piece of innovative engineering from A. R. Sugden. This is the Connoisseur Transcription unit, which represents a considerable advance from their simpler, but very effective, BD1 and BD2 units. The turntable platter is driven by a 9V d.c.

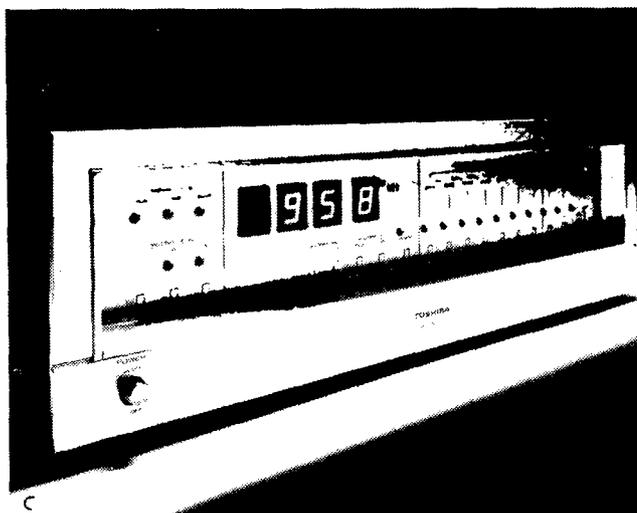




a



b



c



d

servo-controlled motor, at a choice of one of three speeds, 33 $\frac{1}{3}$, 45 or 78 r.p.m., selected by a control on the front edge of the plinth. The power supply for the system is housed in a separate unit, thus eliminating hum fields, and is convertible for 120 or 230V mains supply.

One of the unusual features of this turntable is its two-part platter, consisting of a continuously revolving flywheel, on the surface of which are a series of rubber studs. Set above this, and separate from the flywheel, is an aluminium platter 11 $\frac{1}{2}$ in in diameter, which carries the record itself. Operating a lever on the left hand side of the plinth raises the large diameter flywheel up until the rubber studs come into contact with the underside of the aluminium plate causing it to revolve.

Further movement of the lever raises the flywheel and platter together, a fraction of an inch, to come into contact with the stylus tip. Thus the arm does not lower to the disc, rather the disc rises under the stylus tip. This means that the vertical movement of the arm is restricted, that instant start and rapid cueing is possible, and the problem of side drift caused by bias compensation on the tonearm during lowering, is avoided.

The tonearm is of unusual design, being of very low effective mass and mounted on a unipivot for horizontal motion and knife-edges for the vertical

(a) B&O Uni-phase loudspeakers. (b) Toshiba digital tuner. (c) Tandberg TR2075 tuner. (d) Strathearn STA4 turntable.

motion. Magnetic stabilization is used on the unipivot bearings to prevent side-slop. Magnetic bias, which is adjustable, and calibrated for spherical and elliptical styli is available via a large knob set on top of the housing for the tonearm bearings.

The headshell is lightweight and interchangeable, and fits into an aluminium anodized straight cube. As in many other turntables at present on the market, isolation from vibration from the outside world is provided by special rubber feet, while the platter and arm themselves are solidly mounted in the plinth. Clearly, this turntable is aimed directly at the semi-professional and professional market, particularly broadcast studios. The price is between £80 and £90.

Contrasting with the efforts of Sugden, Technics have developed a professional turntable with precisely the same market in mind, but bringing to bear a different technique. This turntable is the SP-10 MkII, utilizing a direct drive motor. Rather than use a clutch system to disengage the motor during run-up periods, the motor has been made to

have a very high starting torque, to provide a virtually instant start facility. From standstill, the motor can take the 3kg platter up to 33 $\frac{1}{3}$ r.p.m. in 0.25s or only 25 deg of revolution. Braking the platter is equally as fast, taking only 0.3s or 1/12 of a turn to come to a standstill from the rated speed. Motor control is achieved by a quartz crystal controlled phase-lock loop servo. The main power supply for the system is housed in a separate box in the same manner as the Connoisseur turntable.

Since the torque of the drive motor is so high, the platter has had to be bolted to the motor shaft itself. Again, with the mass of the rotating system and the large torque of the drive motor, a significant problem has been to design a plinth which does not twist during acceleration or braking. In the example to be shown at the Audio Fair, the turntable has been mounted in a plinth consisting of finely ground black granite, compressed in a matrix of plastic. Technics claim that the plinth consists of over 75% granite! The price is estimated to be about £450 plus VAT and the system is expected to sell purely in the professional and semi-professional world.

Finally, before leaving the subject of turntables, it is interesting to mention another UK effort at designing advanced record players. This comes from Strathearn, the new Northern Ireland company set up by Government

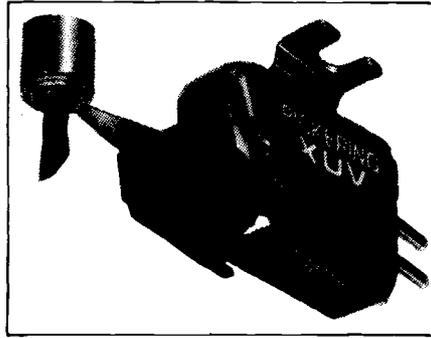
grant. Two turntables will be shown by Strathearn and both use a direct drive motor developed in the UK. One of the two turntables, the STA 4 is remarkably priced at £58.75. This includes a low mass pick-up arm and provides two speed, automatic electronic servo operation.

Loudspeakers

As is customary with the loudspeaker market, the end of the summer usually sees the emergence onto the public market of a new design trend taking us one step nearer the state of "perfection" which audio engineers have the notion that they are approaching. This year's talking-point is "linear phase," several manufacturers having produced designs in which the phase characteristics have been tailored to be linear with respect to frequency, the aim being to reproduce the "ideal" amplitude and phase characteristics of a band-pass filter. It is claimed that benefits in clarity and definition of sound reproduction can be obtained in this manner. Those companies participating at the Audio Fair who are manufacturing linear phase loudspeakers include Bang & Olufsen with their Uni-phase range consisting of six loudspeakers, a selection of wall-, shelf-mounting and free-standing speakers whose power handling capacity ranges from 30W to 70W. Technics are also into linear phase with their SB-700 "Flat Phase" loudspeaker system. This is a three-speaker bass reflex system which produces an SPL of 93dB at 1m for a 1W input. External dimensions are 480 × 845 × 410mm.

Leak have introduced an improved treble unit into their 2000 series of loudspeakers which is claimed to have a smoother response than the previous unit while retaining similar power handling capabilities. The speaker units used in the 2000 system were designed using holographic test methods for spotting and control of unwanted resonances in the cone material.

Improvement of systems by paying extra attention to the drive units themselves has resulted from several developments in test and measurement techniques from the use of holography



Pickering XUV cartridge.

to the digital analysis of performance characteristics à la KEF (who are not, incidentally, exhibiting at this year's Audio Fair). Design techniques have not improved greatly from the classical work done during the 1950s but improvement of materials and manufacturing techniques have led to refinements hitherto unknown.

Bookshelf units are no longer necessarily so relatively inefficient and lacking in bass due to improvement in power handling capacity and reduction in natural resonant frequency of the smaller drive units used in bookshelf units. Reflex techniques also seem to be making a comeback, again advantage being taken of this technique in small cabinet volumes to keep efficiency up at low frequencies and also to extend the bass response.

Tuners

Despite the recent norm in quality f.m. tuner circuits of dual-gate f.e.t.s, voltage-tuned front ends, piezo filters and i.c. demodulators and decoders, there is still a wide variation in specifications. Not so much in sensitivity or distortion — figures of 1 to 2 μ V for a mono signal-to-noise ratio of 30dB and 0.2 to 0.8% harmonic distortion on stereo being typical — but frequently with selectivity and susceptibility to unwanted signals.

Part of the service area planning process is to minimize the occurrence of difficult reception problems, but planners are much like ordinary mortals in

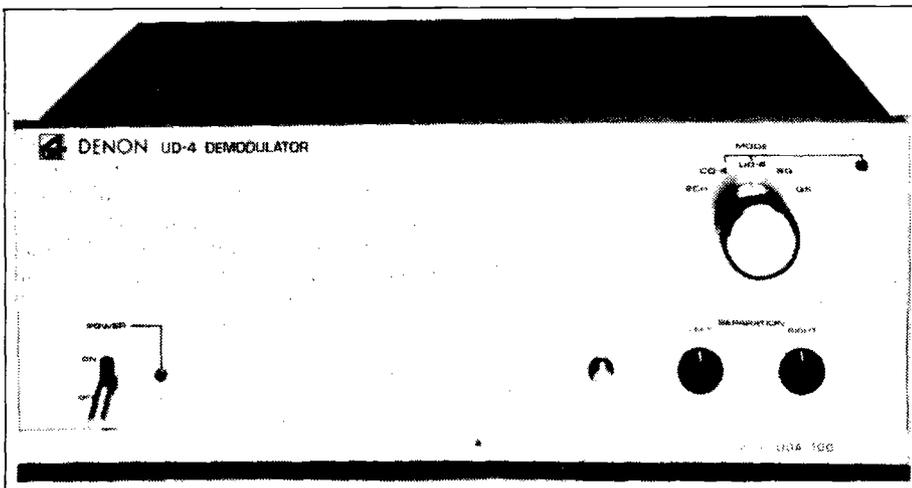
Denon surround-sound demodulator / decoder features UD-4, CD-4, QS and SQ decoding.

their ability to see into the future. The demands of a full stereo service were unknown when the U.K. mono service was planned in the 1950s; it is now well known that stereo reception is much more susceptible to interference from other stations than mono. But of course, most reception problems are parochial and it would be unfair to expect everyone to pay for refinements intended for a minority.

A new receiver whose specification appears to cover many eventualities is the Tandberg TR-2075, with a sensitivity of 1.8 μ V for 30dB signal-to-noise ratio (IHF, 300 ohms) and a distortion of 0.3% in stereo (75kHz deviation). The receiver gives low unwanted outputs of pilot tone and subcarrier (-70dB), and has an IHF signal-to-noise ratio of 68dB in stereo and 1mV antenna voltage (61dB DIN). Suppression of unwanted signals is: a.m. 65dB, image frequency 70dB, i.f. 95dB and 1/2 i.f. 95dB. Selectivity for the alternate channel (\pm 400kHz) is 100dB and 40dB for the adjacent channel. Facilities on this tuner include a 25 μ s time constant (Dolby f.m.) switch for the American market. (It has many other facilities, such as tape copying, tape input prior to tone controls, peak power meter, that belong to the a.f. section.) Performance of the a.m. section is good too (image rejection 90dB) and it is relatively unusual to see a.m. distortion quoted (0.8% for 30% modulation, 1.5% for 80%). Appearance of the set is distinctive but the scales are of the type fitted to many Japanese made tuners.

Technics, who claim their range of receivers is the only one to include a phase-locked loop circuit in the decoder in all their models, use linearly-phased ceramic filters in three i.f. stages to maintain a flat group delay time. The range includes the ST3050 "budget" tuner, the ST3150 tuner, the SA5150, 5250, 5350 and 5550 receivers, all with very similar circuitry.

A few receivers are available now equipped with Dolby B processors, such as the NAD 300, but these are made primarily for the American market. Another feature becoming more common is that of a local oscillator frequency synthesized in steps, usually 200kHz (channel spacing). The Toshiba ST-910 goes the whole hog and gives a digital readout of frequency which, with its seven-station sensor panel, gives the tuner a distinctive appearance. Automatic tuning and stepped manual tuning is provided (100kHz or 1MHz steps) together with a memory. Such memories need to be kept supplied with power and in some tuners a battery is provided so that memory is retained for a limited time (48h) in the event of power failure. Three lamps indicate signal strength in 20dB steps the lowest two to indicate sufficient signal for mono and stereo reception, though one would have thought the ear would have been the best test. A useful feature is a three-level muting control.

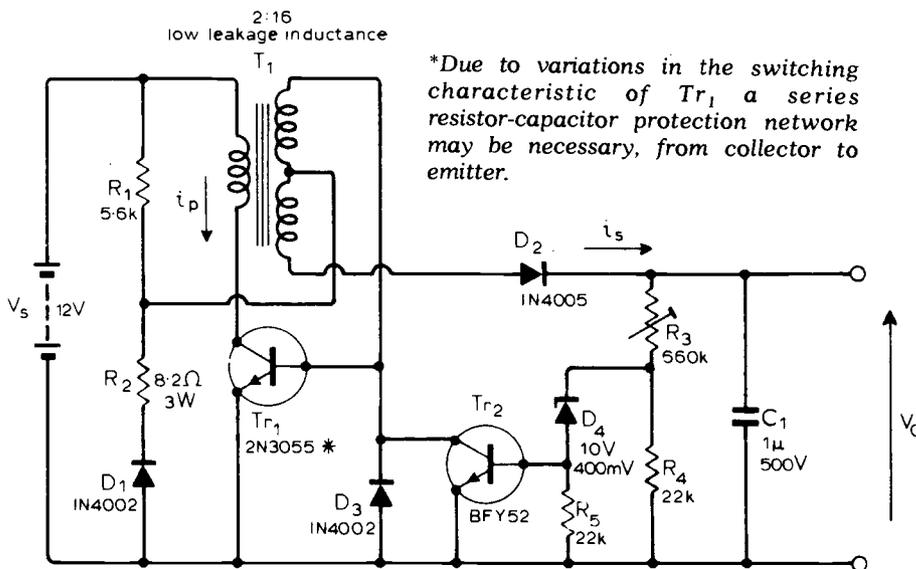


Circuit Ideas

Variable voltage-ratio transistor converter

Conventional square wave inverter circuits give an output voltage proportional to the d.c. supply. The efficiency of such a system can never exceed 50% due to voltage limiting and component losses. The circuit described can charge a capacitor from zero volts at efficiencies of over 80%. When a conventional series stabilizer is used to drop the voltage of a 9V battery to 5V the average efficiency, taking the end point voltage of the battery as 6V, is only 67%. The use of this inverter extends a battery life in two ways: firstly by the higher efficiency and secondly by allowing the battery to be used to a lower end point voltage.

The primary current in T_1 is controlled by Tr_1 and oscillation is started by a low current passing through R_1 and the feedback winding of T_1 to the base of Tr_1 . The transistor switches on due to the positive feedback action of the transformer and the main base drive is provided by the feedback winding through R_2 and D_1 . While Tr_1 is conducting, D_2 is reverse biased and there is no current in the secondary winding. The collector current is therefore the sum of the referred base drive current and the



**Due to variations in the switching characteristic of Tr_1 a series resistor-capacitor protection network may be necessary, from collector to emitter.*

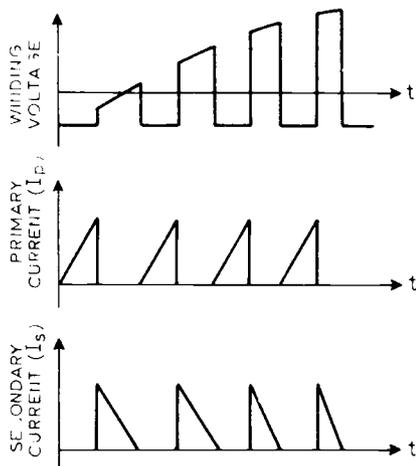
magnetizing current which rises linearly according to the equation

$$\frac{di_p}{dt} = \frac{V_{cc} - V_{ces}}{L_p}$$

where V_{ces} is the transistor saturation voltage, L_p the primary inductance of transformer and i_p the primary current. Thus the collector current rises until the base current is insufficient to saturate T_1 , the positive feedback action then causes it to switch off. Reverse voltage on the transformer windings rises until D_2 and D_3 conduct and secondary current passes into the reservoir capacitor C_1 . Diode D_1 is then reverse biased. Energy stored in the magnetic field of the transformer is transferred to C_1 and, when the current has dropped to zero, the winding voltages collapse and the oscillation is repeated until C_1 has charged up to a voltage which causes D_4 to conduct through the resistor R_3 and the base of Tr_2 . This transistor then diverts the base current from Tr_1 and stops the oscillator until C_1 has discharged through the load circuit. Resistor R_5 carries the leakage current of D_4 and so prevents Tr_2 from conducting before the zener voltage has been reached. Waveforms are shown as C_1 is charged from zero. For fast switching it

is essential that the leakage inductance between primary and feedback winding is very low. The leakage inductance between primary and secondary must also be low because the energy stored in the leakage flux cannot be transferred to the secondary when the transistor switches off. Air-gapped cores have been found most successful. There are two types of application where the circuit is of particular interest. For pulse generators where repetitive charging of a capacitor in a pulse-forming network is required or for generating one or more stabilized voltages from a dry battery. The circuit enables voltages above or below the battery voltage to be generated and the efficiency remains high throughout battery life. In the case of capacitor-discharge ignition systems the power conversion efficiency is so high that a heatsink is not required and only one power transistor is needed. The full output voltage is obtainable when the battery voltage is less than half its nominal value which results in an improvement in cold starting.

R. M. Carter,
Lincarc Ltd,
Lincoln.

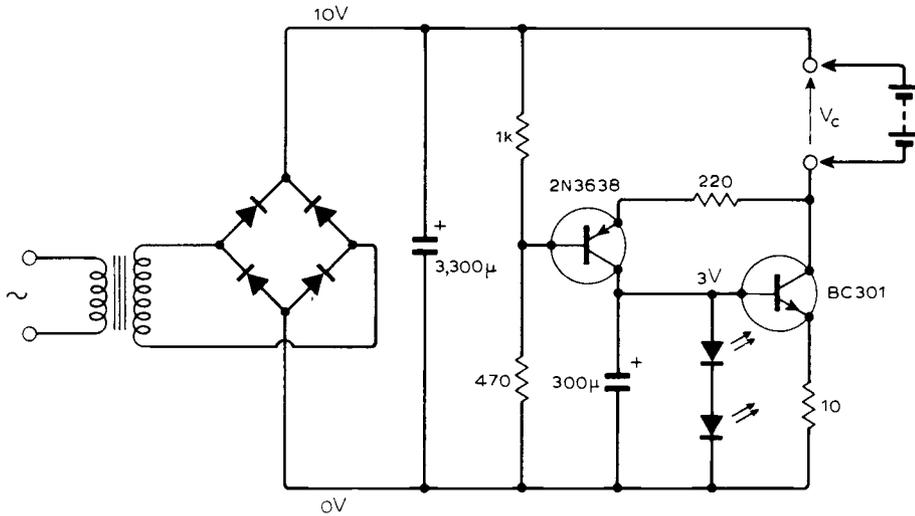


Battery charger

The simple circuit shown is for charging four size D nickel cadmium cells in series at constant current and with automatic voltage limiting. The BC301 acts as a current source, its base voltage being stabilized at about 3V by two l.e.d.s, which may also be used to indicate the charge condition. The 2N3638 provides voltage limiting by cutting off the BC301 when V_c ap-

proaches the voltage across the $1k\Omega$ branch of the voltage divider. For the component values shown, charge current is 260mA at low V_c , 200mA at V_c of 5V, and decreases to virtually zero at V_c of 6.5V.

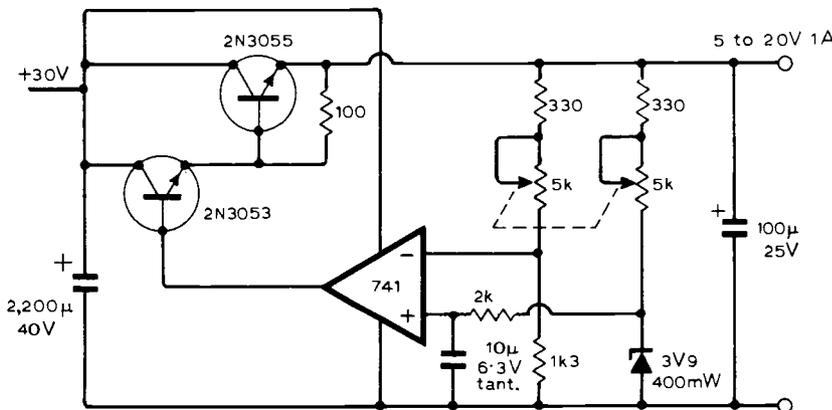
N. H. Sabah,
American University,
Beirut.



Variable power supply with zener stabilization

In regulated power supplies it is advantageous to feed the reference zener diode from the stabilized line. This is more difficult with a variable voltage supply; however, a simple solution to

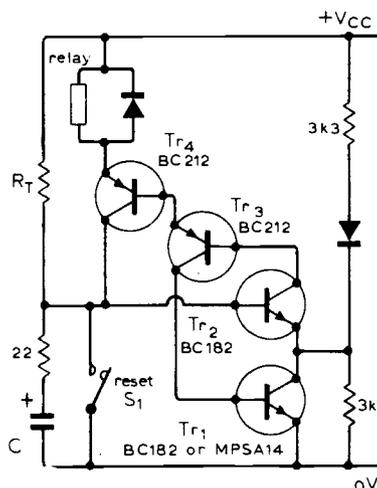
the problem is to use a dual linear potentiometer as in the circuit shown. L. J. Baughan,
Charlbury,
Oxon.



One-shot timer circuit

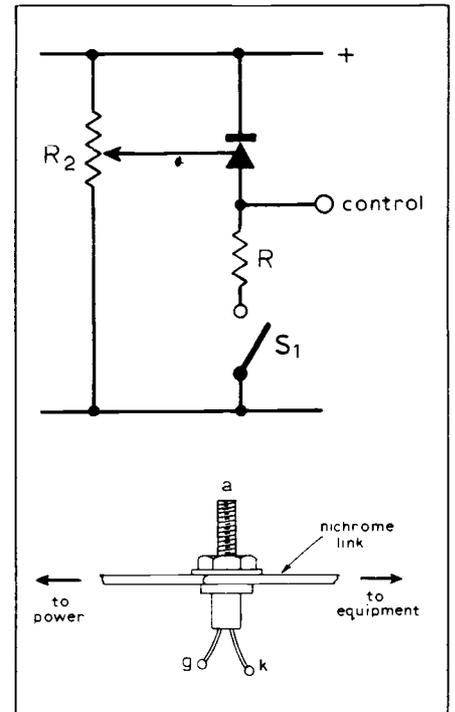
The circuit shown is a four-transistor configuration which is similar in operation to the well-known 555 device but, since the normal state is all transistors on, the circuit has a high degree of impulse noise immunity — thereby avoiding the occurrence of spurious timing cycles which are sometimes troublesome in i.c. timing circuits.

In operation, the voltage on the timing capacitor C rises until Tr_2 begins to conduct which in turn causes Tr_3 , Tr_4 and Tr_1 also to switch on. Regeneration in the circuit is caused by the interaction of Tr_2 and Tr_4 , and the timing capacitor is discharged to about 0.6V by the operation of Tr_3 and Tr_1 . The timing



Thermal overload cut-out

Thyristors provide a simple and economic answer to the older mechanical overload cut-out. Four-layer devices have a trigger threshold that is temperature dependent. By arranging that the gate current is just below the threshold, any increase in temperature will cause triggering. Potentiometer R_2 sets the bias current to the "just untriggered" level. Once triggered the thyristor latches and can only be reset by opening S_1 . Circuit control can be via relays and/or transistors.



The heating element can be isolated from the thyristor case, or it can be a short resistive link, in the positive line or bolted to a heat sink, and connected to the thyristor anode as shown. In d.c. circuits a $1/25\Omega$ will monitor a 25A circuit with ease. Thyristor packaging and mounting govern the thermal inertia of the system.

C. Woolf,
Swanland,
Yorks.

cycle is initiated either by the application of V_{cc} or by the opening of S_1 . As in the 555, the timing period is V_{cc} independent as long as it is stable during the timing cycle.

J. L. Linsley Hood,
Taunton,
Somerset.

Contributors to Circuit Ideas are urged to say what is new or improved about their circuit early in the item, preferably in the first sentence.

International Radio and Television Exhibition

Berlin, 29 August — 7 September

Infra-red sound links and m.o.s. l.s.i. in colour receivers

With rising labour costs forcing German manufacturers to increase prices from September this year (colour television set prices had so far remained relatively constant or fallen slightly since colour tv was introduced in 1967), it's not surprising that many of the innovations appearing in television sets are designed to reduce labour content and servicing time. Modular construction has enabled 95% of all components to be housed in modules, and 100% of the receiver circuits. Introduction this year of the Philips 20AX self-convergent in-line tubes by Valvo has made setting up simpler and self-diagnostic systems reduce servicing time. At the same time, integrated circuits are used wherever possible, especially thick-film circuits, the latest ideas involving digital m.o.s. i.c.s in ultrasonic remote control links and programme selection.

Philips, for instance, are proposing a digital channel-selection technique that would provide up to 16 pre-selections (the numbers game applies to television as well as audio equipment!) replacing two costly pull-out drawers of specially-tested pre-set potentiometers with frequency-synthesis m.o.s. circuits and an m.o.s. memory. The technique is part of a concept to provide circuits for search tuning, remote control, local control and on-screen displays of memorized sound level, brightness, colour setting and tuning, with Valvo m.o.s. l.s.i. circuits that could be available in production quantities next year. A small current drain would be needed to keep the memory "alive", and a nickel-cadium battery would prevent loss during a mains failure.

Remote units have become digitized. The Blaupunkt and Siemens FM100 chassis, the Nordmende Spectra and Prestige sets and the Körting colour chassis 8 incorporates the ITT-Intermetall p.m.o.s. circuit SAA1025 for decoding a maximum of 30 commands. A c.m.o.s. SAA1024 coder in the remote unit, with a 4.43MHz oscillator, accepts control inputs and converts them to a 5-bit code for an adjustable divider. (Types SAA1000 and 1010 provide up to 15 channels). Twelve channel selections, mains on/off, sound on/off, and

At the time of going to press, attendance figures for the 1975 international radio and television exhibition were not available. But if the 1973 event is anything to go by, it will be over the half-million mark. With 386 manufacturers represented, showing around 800 new products in 23 halls and two pavilions, and in an area of 88,000 square metres, this report of the largest event of its kind cannot possibly be complete. What follows then is a mere sampling of some of the more interesting things seen.

"up" and "down" movements of colour saturation, brightness and sound level are typically provided by dividing the band into 30 frequencies, 346Hz apart, between 33.945kHz and 43.990kHz, this range lying between the second and third harmonic of the line oscillator frequency.

These frequencies, representing the commands, are received by a wideband pre-amplifier, measured by the 1025 i.c. and converted to 5-bit codes (4-bit for

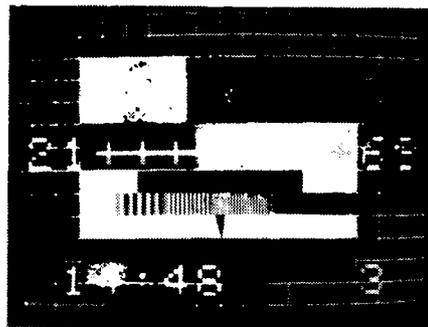
the 1010), and fed to programme selection circuits via a decoder. Signals for the analogue variables are stored and delivered in the form of variable mark-space ratio pulses.

Three Siemens circuits SAB1000, 1001 and 1002 provided similar functions for 36 channels of control, but these appear to have been superseded. Valvo have produced l.s.i. c.m.o.s. chips, SAB1011 and 1012, with a capability of 32 commands using a carrier pulse-coding system. The latest circuit—used in the Telefunken Supersonic sets — is capable of handling 32 commands using only two frequencies. In the coding circuit, a p.m.o.s. i.c. type SAB2000, the number of cycles from an external oscillator is counted until it agrees with the number allocated to the selected button (varying from 1760 to 7360 cycles at intervals of 160 cycles). After this number, the oscillator is changed to a second frequency, until the button is released, for 480 cycles. After release, the i.c. is disconnected from the supply to reduce consumption from 10mA to 100µA.

In the SAB2010 decoder, commands are identified by counting the number of initial cycles. Commands for any one of 16 programmes result in an output signal having a number of pulses corresponding to the selected programme. Six commands for increasing and decreasing colour, volume and brightness are passed in serial form to an SAB2020 and converted into an analogue voltage. If buttons are depressed for longer than 100ms the selected setting is changed by one out of 32 voltage steps at clocking time of 100ms (it therefore takes 3.2s to change from one extreme to the other).

A facility is provided for bringing the analogue outputs to a mid-position prior to entering commands, as on the ITT i.c., the command button or sensor for this having been dubbed "granny button" or, in more polite circles, Ideal Color (ITT).

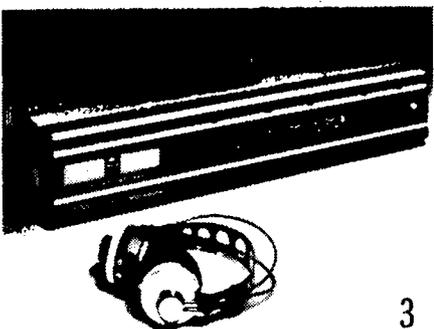
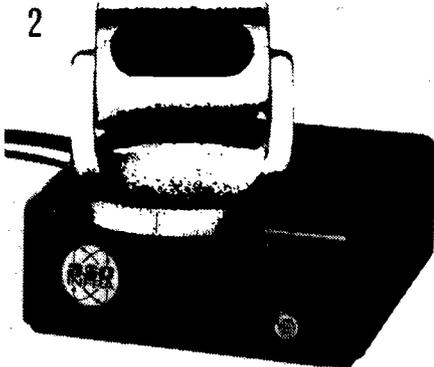
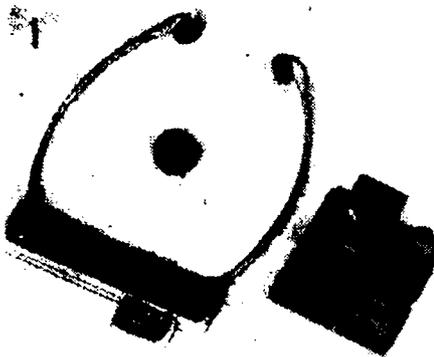
With such remote units, the user has no indication of control setting. Some makers provide a display on the set, next to the screen, as in the Nordmende "spectra color TM-3-infra". There are three eight-point scales, illuminated by



On-screen display of time, channel number and tuning scale in Grundig S9000 chassis.

i.e.d.s, for brightness (coloured yellow), saturation (red) and sound level (green) that light when a sensor key is touched. This remote unit also has a standby position which immediately restores picture and sound when one of the channel selections is made. A timer in the remote unit enables the receiver to be switched on or off at a pre-selected time. (This set also has the facility to transmit sound via infra-red transmission to headphones or tape recorder (see later). And it has a built-in 30-watt amplifier to DIN45,500, with a three-way loudspeaker system. Following Grundig's lead in 1973, this set can accept a Secam decoder for reception of programmes from the Democratic Republic.)

In the case of the Körting circuit the variable mark-space ratio outputs from the SAA1025 i.c. — which ratio is proportional to the value of the three analogue parameters — are used to produce horizontal bars across the bottom 30 lines of picture, the length representing that value. Green is used for brightness, red for saturation and blue for volume. A "band" is switched off a second or so after the control has been activated.



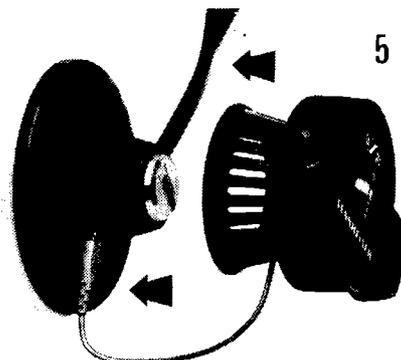
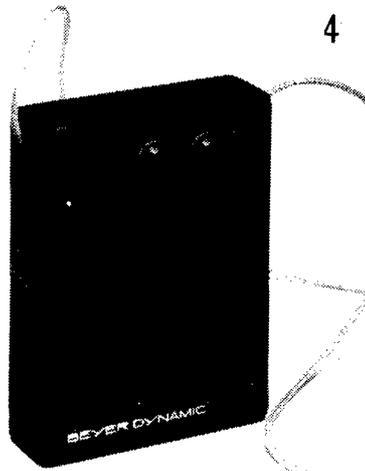
Television receiver statistics			
(Germany)			
Licenceholders 19 million, estimated penetration: 34% colour, 84% with black and white.			
	Millions of units		
	1973	1974	½ 1975
Production colour	2.1	2.4	1.1
b & w	1.6	1.7	0.66
Sales* colour	2.0	2.4	0.96
b & w	2.0	2.1	0.81
Exports: colour	0.53	0.60	0.30
b & w	0.77	0.90	0.33
Imports: colour	0.13	0.29	0.15
b & w	0.9	0.91	0.44

*Domestic plus export sales.

DISPLAY OF TIME and channel number on the screen for a few seconds after command is a feature of one Telefunken variant. After a mains failure, the need to reset the clock is indicated by flashing. Another Telefunken model includes a seven-watt sound i.c., type TCA940, with tone controls and remotely controlled switching for speech or music — giving two different amplitude-frequency responses (18dB boost at 100Hz and 10kHz for music).

Grundig's new colour S9000 set provides high-quality sound to DIN 45,500 from its 15-watt amplifier with tone

New infra-red equipment: 1-Sennheiser receiver and transmitter module; 2-Nordmende receiving adapter; 3-Saba tuner-amplifier with transmitters and AKG phones; 4-Beyer neck-slung receiver; 5-Sennheiser receiver adapter.



controls and two-way speaker system. This model, and eight others with various styles of cabinet all using 66m 20AX self-convergent tubes, includes a clock circuit and character generator for on-screen display of time, in addition to showing channel number. Digits are 4-cm high and coloured green. Seconds are indicated by a blinking colour. A tuning scale can also be superposed on the screen (see photograph) to facilitate setting the programme selector. Saba, Blaupunkt and Telefunken colour sets also display time and channel number on the picture.

Rather than indicate time on the picture area, ITT models 1789 and 2689, along with Philips model 567, include digital clocks that can be used as timers. In the ITT sets, a stand-by mode enables time to be normally displayed, but control buttons allow switch-on time to be set and memorized. The clock is normally switched off when the set is in operation.

Unlike the Loewe, Saba and Grundig sets, with their plug-in diagnostic aids, ITT, Blaupunkt and Siemens use on-board i.e.d. indicators to speed fault location. Blaupunkt call their concept ISA, using nine i.e.d.s, and ITT (Schaub-Lorenz and Graetz) call theirs Vidom. Using six i.e.d.s to signify correct voltages at various points, with another that flashes if the electronic fuse in the switched-mode power unit fails, the Vidom concept also includes board markings to ease component location, signal-path identification and to indicate test points, with voltage readings where appropriate.

These innovations of i.s.i. in remote controls, built-in clocks and timers, on-screen identification of channel, time and tuning, infra-red sound links, self-convergent in-line tubes, and almost total modular construction are complemented by options for addition of Secam converters and tuners for cable television at a later time. And all the new colour sets have provision for connection with audio and video recorders, often including automatic switching for line synchronization time constant.

Infra-red sound links

Our report of the 1973 Berlin exhibition mentioned the development by Nordmende of an infra-red link between television set and headphones. Now two years later most of the major German television receiver and headphone manufacturers were showing sets equipped with such links and the industry standardized on system details last June. In on the act are Blaupunkt, Grundig, ITT (with the Graetz and Schaub-Lorenz brand names), Loewe-Opta, Metz, Nordmende, Saba and Siemens, together with headphone makers AKG, Beyer and Sennheiser.

Use of a frequency-modulated sub-carrier in the infra-red links is clearly the way to avoid noise problems from

a.c. filament lamps and the frequency agreed is 95kHz with a maximum deviation of $\pm 50\text{kHz}$, although some makers are quoting other figures, e.g. Loewe-Opta with 93.7kHz (presumably to minimize beating with the sixth harmonic of the line frequency), Saba who quote 100kHz with a deviation of $\pm 10\text{kHz}$, and Beyer who use $\pm 30\text{kHz}$ deviation. Pre- and de-emphasis of $50\mu\text{s}$ is used and with an a.f. bandwidth of 40Hz to 10kHz and distortion figures being quoted range from 1 to 3%.

The Sennheiser AD416 infra-red headset is a stethoscope-type headphone with transducer, receiver with volume control, and nickel-cadmium battery mounted as shown in the photograph and weighing 70g. Signal-to-noise ratio achieved depends on the transmitter power; distance from transmitter, room size and surface absorption. Measurements taken 4 metres from a transmitter (60mW emitted) in a room $4 \times 6 \times 3$ metres with light walls and a tiled ceiling gave a signal-to-noise ratio of 58dB in daylight (200 lux). This worsens to 40dB when the receiver faces away from the transmitter. The 50mAh receiver battery module contains components for recharging at 1.5mA and one merely plugs it into a mains outlet.

Grundig, Nordmende, Blaupunkt (who also make sets for Siemens) and Metz have adopted the Sennheiser approach in their new ranges of television receivers. An add-on unit for existing sets will be available in February next year. To provide present owners of Sennheiser headphones with the capability to receive i-r transmissions a receiving adapter has been developed that clips on to both earpieces (see photograph).

AKG use Körting's circuitry in their new system. The infra-red transmitter type G-20wl can be connected to the line, loudspeaker or headphone outputs of monophonic equipment and provides 100mW of radiated power at 940nm, over an angle of $\pm 60^\circ$ in the horizontal plane and $\pm 35^\circ$ in the vertical plane ($\pm 6\text{dB}$ figures). Bandwidth is 30Hz to 12.5kHz. The headphones, a modified version of the K140 model, contain the receiver in one earpiece and an automatic-off manual-on switch. Loss of signal or very poor signal-to-noise ratio causes the circuit to switch off. Sockets on the phones allow them to be used with an ordinary stereo input and an a.f. output is provided for connection to a tape recorder or amplifier. The five-cell battery is charged by connecting to a separate charger unit. A miniature neck-slung receiver E-10sl is available too, for current owners of headphones, providing an output of 1.55V at the 1% distortion level.

Beyer Dynamic make a transmitter IS76, using ten diodes and operating with $\pm 30\text{kHz}$ deviation at 1.5% distortion, a receiver IE76 for existing head-

phones (neck slung and about the size of a cigarette packet), a DT444 "infra-phone" with 9-V rechargeable battery, and a charger.

Most transmitter circuits use a TBA120S limiter/demodulator whose input is the 5.5MHz sound signal. In the Loewe-Opta circuit the audio output modulates a 95kHz multivibrator, whereas in the Nordmende circuit there is no audio stage, the 95kHz signal being generated by mixing the 5.5MHz signal with the output of a 5.595MHz oscillator. Another difference in the Nordmende circuit is the use of a single 60mW infra-red diode, SLH8, transformer coupled to a BF457 output transistor. Most manufacturers fit ten CQY38 diodes (Telefunken) or eight LD241 diodes (Siemens) in series, rather than use high-power Valvo or Texas emitters, on cost grounds. The Sennheiser transmitter circuit is the simplest, the Intersil 8038 circuit providing a pulse frequency modulated output (see Fig.1.). Constant-width pulses can be transmitted as an alternative to reduce dissipation in the emitting diodes.

Receiver circuits use the Siemens BPW34 p-i-n photodiode, reversed biased to give better linearity and low capacitances. Despite its large area $3 \times 3 \text{ mm}^2$ its capacitance is only around 15-33pF. This is followed by either an f.e.t. preamplifier and Siemens SO41P f.m. limiter/detector, as in the Körting circuit, or a three-stage bipolar preamplifier and SO41P, as in the Loewe circuit. Another variant, used in the Nordmende "infra-adapter", has a three-stage bipolar amplifier following an f.e.t., providing a signal voltage that is rectified and used to switch off the TBA120S i.c. when signal level drops below a certain threshold.

The infra-red transmission approach can of course be applied to stereo amplifiers and receivers by using two subcarrier frequencies. Though there is no agreement yet on frequencies and deviation, 200kHz and 280kHz have

been used with a deviation of $\pm 20\text{kHz}$. Page 522 has a photograph of a Saba receiver fitted with two infra-red transmitters — model 8101 "audiomatic".

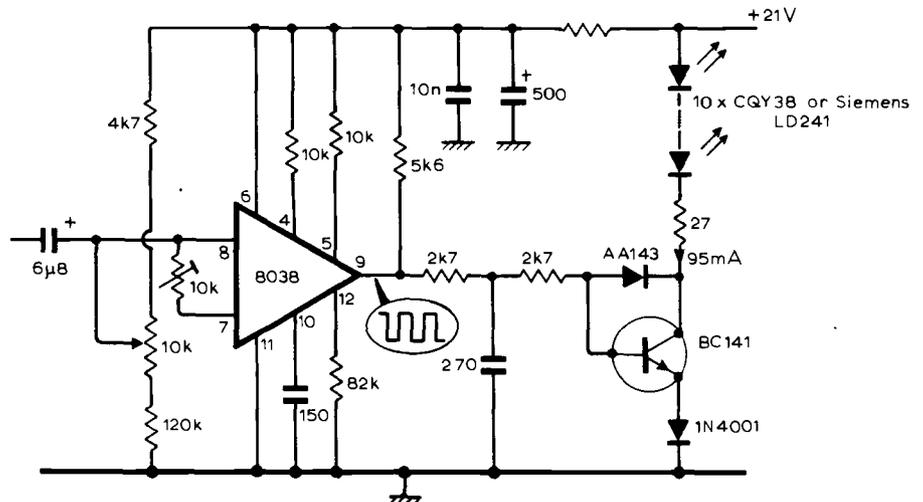
Pot-pourri

The interest which the dummy-head stereo demonstrations created at the 1973 exhibition abounds: there were many demonstrations of the technique, especially by the broadcasting interests. One of the results of the artificial-head work, evidently, has been to stimulate interest in obtaining out-of-head images with headphones. Engineers from Matsushita were showing the results of their work in the form of a prototype "ambience phone" system. They have conducted experiments which led them to believe that out-of-head localization is possible by synthesizing a proper proportion of indirect to direct sound energy. These experiments showed that perception of out-of-head images depends not only on the amount of indirect sound present in recordings, but also to the decay time of the first reflected sound and to the decay envelope. A Matsushita "bucket-brigade" analogue delay device is used to obtain a simulation of indirect sounds. In addition some modification is made to amplitude-frequency response in cross-feeding left and right signals to simulate the effect of the head on high-frequency perception.

Full details are not available yet, but results of their preliminary work has shown that consistent in-head localizations are obtained when the ratio is zero, that out-of-head images obtain in 80% or more auditions when the ratio is about 0.5 or more, and that for a ratio of 0.12, localizations are 50:50 in or out. Initial tests used two loudspeakers, with narrow and wide directivity, which, together with sound absorbers and an anechoic room, enabled five values of energy density ratio to be investigated.*

*Additionally, the sound source direction was moved through 180° at 30° intervals, with the interesting result that the occurrence of out-of-head images depended on source direction, maximizing around $80-130^\circ$, and in particular for the case of zero reflected energy it reached 50% of auditions at 120° .

Fig.1. Sennheiser's suggested circuit for mono transmitter.



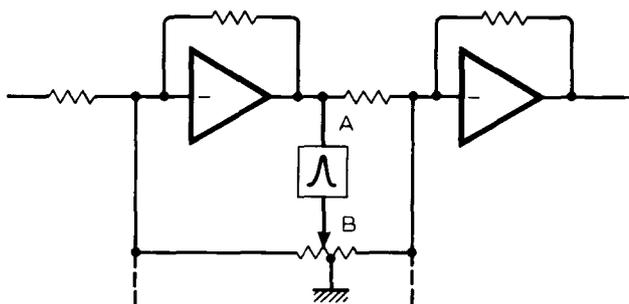
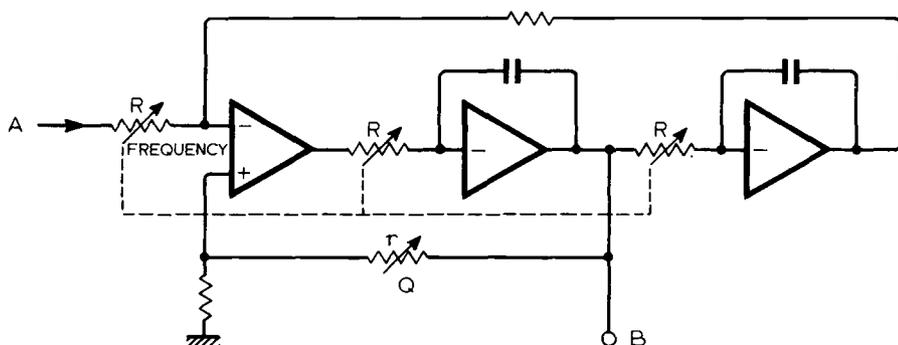


Fig.2. Two-integrator loop used in Technics equalizer permits independent control of Q and centre frequency (using three-gauged control).



Later experiments used two separate recording rooms, one anechoic and one reverberant with speaker facing away from the dummy head, signals from the two being mixed after electronically delaying the reverberant signals. (A corrective filter was included in the two combined stereo channels to take account of the coloration produced by transmission down, effectively, two auditory canals.) This time the percentage of in and out-of-head localizations of the listeners and subjective distance were investigated as a function of energy density ratio, with delay time and reverberation time as parameters. Results showed that out-of-head localizations could be achieved in anechoic conditions even for centre front sources some of the time and that perception depended not only on the energy density ratio but also on delay time and decay envelope. (For an r.t. of 0.25s a 98% score of outer localizations was possible with a ratio of unity — whether delay was 5 or 20ms — while for 0.15 s.r.t., ratio had to be 3 to produce the same effect.) T. Goto, manager of Matsushita's acoustics research lab., tells us that their further work on the correlation of these various parameters will be reported shortly.

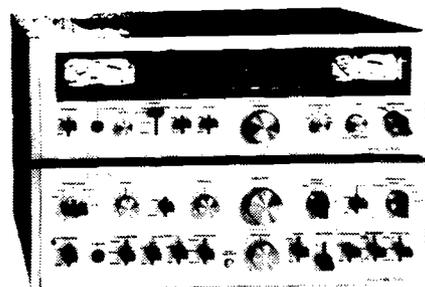
An interesting product from Matsushita is the Technics equalizer, SH-9090. Interesting because it appears to be the first equalizer with independent control of centre frequency, level and Q. It achieves this using 12 two-integrator loop RC active filters, with triple-gauged variable resistors for centre frequency (see Fig.2.). Each of the 12 octave-band sections is adjustable in centre frequency by \pm one octave, and Q is variable between 0.7 and 7.0. A wide range of curves can be synthesized with this unit by virtue of the ability to overlap three curves. Filter characteristics from one octave above and below a

selected frequency can be moved to coincide at that frequency. The equipment is mono, and harmonic distortion is below 0.05%. Phase response curves are given in the operating instructions.

Receivers and tuners

Two frequency synthesis tuners were shown for the first time in Europe, having been announced at the Chicago CES. Unlike the Kenwood/Trio tuner with its synthesized local oscillator frequencies and conventional analogue scale, mentioned in our report in the August issue, the Scott RD1000 receiver has digital readout and a frequency input keyboard. It adopts the same technique used in their five-year-old digital tuner but with the addition of a memory section. Up to ten frequencies may be stored and called up on command. To keep the memory "alive" a constant drain of 1.5mA is incurred provided by a nickel-cadmium cell in the event of short-term mains failure. Scanning, at 5 channels per second, can be on a stereo-only or all-station basis. Four l.e.d.s indicate signal strength; de-emphasis is switchable between 25,

Denon tuner has fixed pointer, moving tuning scale, and separate headphone level control. Meters can be used for external measurement.



50 and 75 μ s; tuning accuracy is 0.001%!

Three further tuners and receivers stood out. BASF introduced receiver with four audio channels in two versions, model 8440 with 40 watts output and 8425 with 25 watts output. Its outstanding feature is a slot that accepts plug-in modules for the Philips dynamic noise limiter, Dolby B processor unit, SQ decoder, CD-4 demodulator and a UD-4 demodulator (under development), making it an extremely versatile receiver. BASF are believed to be the first European company to plan a facility for the Nippon Columbia UD-4 surround-sound system. The new Thorrens AT410 receiver has a very fresh appearance. With five preset f.m. channels and, unusually, two a.m. channels, its field strength meter also functions as a tuning scale for the preset controls. Two filters, one at 9kHz and one at 6.5kHz can be switched in simultaneously to give a 14dB/octave slope with a cut-off frequency of 4.8kHz for use with a.m. radio. The Denon tuner was shown by Bolex, together with the studio-quality amplifier PMA700Z. The tuner features a null balancing arrangement, a meter attenuator to enable the two level meters to be used with external signals (meters double as signal level and null balance indicators) and the all too rare facility of separate headphone level adjustment is provided. The tuning scale, with fixed pointer and moving scale, is a welcome change from most Japanese scales.

More motional feedback loudspeakers

Rather than use the motional feedback system to reduce distortion in normal-sized loudspeaker enclosures, Philips chose to reduce enclosure size (at the expense of weight) in their RH532 system. They have now taken this a step further with an even smaller system (eight litres) using two instead of three drive units. Model RH541 measures 23 \times 29 \times 17cm and weighs half of the RH532 (6.5kg). Amplifier power is 20 watts at 0.1% distortion and 30 watts at 1%. A new version of the 532 is also available finished in black (RH544).

Jamo of Denmark are producing a motional feedback system using the Philips bass drive unit in a box 46 \times 28 \times 24cm. Upper crossover frequency is 4.5kHz rather than the 3kHz of the RH544 and adjustable level controls are provided for the three speakers. The low-frequency amplifier provides 40 watts at 0.1% distortion and the lower half-power frequency is 30Hz.

Bolex were showing a speaker from 3a in France, that uses an apparently similar technique to the Servosound system. A bridge circuit is used to cancel out the static properties of the voice coil, leaving the dynamic effects to be used in a feedback arrangement (see, for example, WW 1947, pp.401/2).

Continued on page 539

Television tuner and design — 2

Gives quality sound as well as vision signals

by D. C. Read, B.Sc.

Using a varicap u.h.f. front-end, this tuner design provides quality sound and vision outputs for connection to a separate sound reproduction system and to a monitor-type receiver. It provides a group-delay corrected signal and proper black-level registration. Sound information is removed prior to the video demodulator, overcoming the problem of sound and colour subcarrier interference. Modifications, to be described subsequently, enable it to be used with a varned-capacitor u.h.f. tuner, a domestic-type receiver — using an opto-coupler — and as a simplified sound-only unit.

The expected tuner performance up to the MC1330 demodulator input is illustrated by the frequency sweep photographs in Figs. 3 to 7. Fig. 3 was obtained by feeding the sweep signal to the base of Tr_1 , with the soldered link disconnected and using the oscilloscope to inspect the signal appearing at the test points provided across C_{22} (i.e. at the demodulator input). For this measurement, C_{23} and the L_{19}/L_{20} circuit were also disconnected and L_{21} was

shorted. The response shown in Fig. 3 is therefore simply that of the second i.f. pass-band shaping circuit.

For Fig. 4, the sound trap/take-off circuit was reconnected and the resulting deep notch at 33.5MHz caused by phase cancellation is clearly shown both here and in the magnified version of the response in this region given in Fig. 7.

Comparison of Fig. 3 with Fig. 4 reveals an unfortunate but not disas-

trous side effect caused by action in this circuit. Because the injected signal phase becomes additive on either side of the notch, there is an increase in signal level in the range 30 to 33MHz which includes the adjacent-channel vision-carrier frequency. Fortunately, transmitter siting and frequency allocation in the U.K. has been carefully arranged so that adjacent-channel interference is rarely a serious problem under normal reception conditions. Thus, the conventional 31.5MHz trap at the input to Tr_1 reduces the overall response in this region by a sufficient amount (about 15dB, see Fig. 6) despite the unwanted increase given here.

A more helpful result of the sound-trap/take-off circuit operation is that the video i.f. pass-band response cut-off between 33 and 34MHz is made steeper as is also shown by comparison of Figs. 3 and 4.

With the input link to Tr_1 replaced and the adjacent sound and vision trap circuits disconnected, or tuned out-of-band, a sweep injected at the ECL1043 test point gives the basic overall i.f. response, shown in Fig. 5. Re-connection of the traps then gives the final

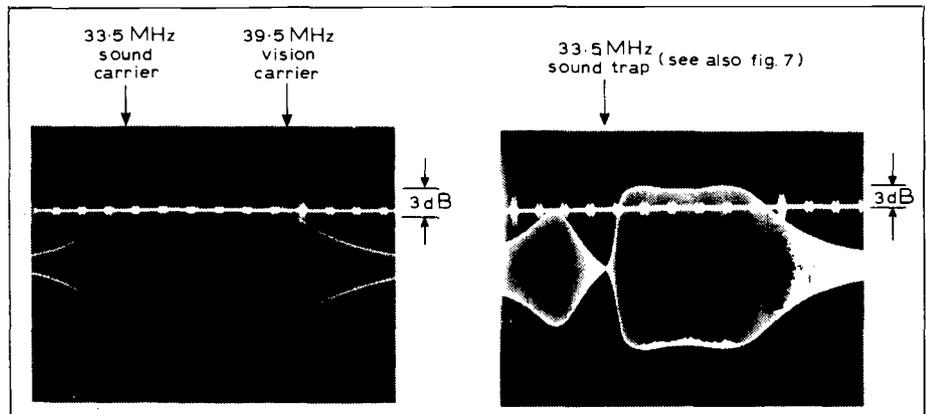


Fig. 3. Sweep response of second band-pass filter (L_4/L_5) feeding demodulator (sound trap/take-off circuit disconnected).

Fig. 4. As for Fig. 3 but with sound trap/take-off circuit connected.

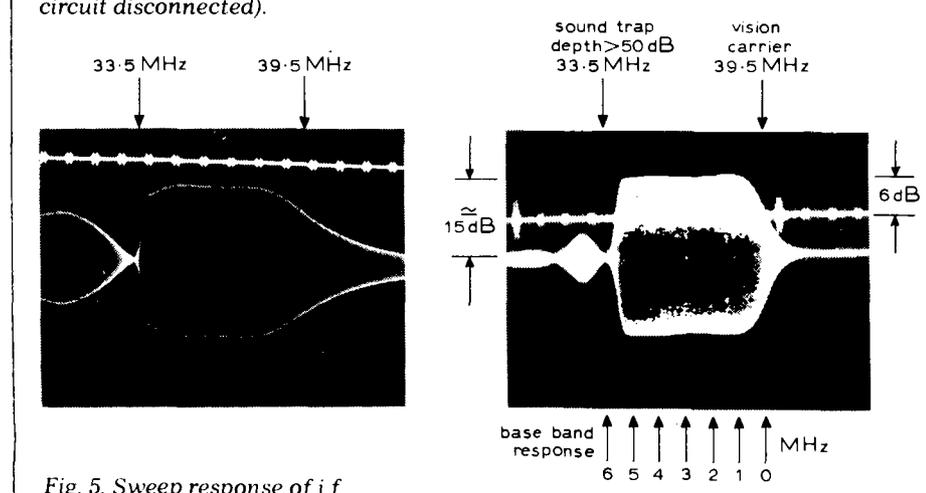


Fig. 5. Sweep response of i.f. chain (first and second band-pass filters); adjacent-channel traps (L_1, L_2) disconnected

Fig. 6. As for Fig. 5 but with adjacent-channel traps connected. This is the complete response of the video i.f. chain.

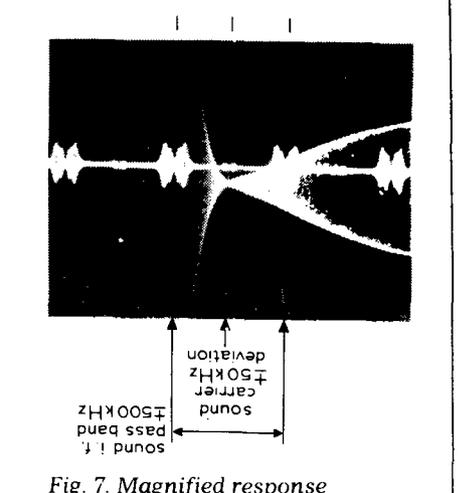


Fig. 7. Magnified response sweep showing phase cancellation of sound carrier giving > 50 dB notch in vision response.

complete pass-band shape as in Fig. 6. An approximate scale indicating the eventual baseband signal frequencies has been added here to show that the shape obtained is a good approximation to the ideal receiver response (Fig. 8). In particular, the adjacent-vision trap has modified the response cut-off at the vestigial side band end so that the correct rate of fall is obtained with the vision carrier frequency positioned at the 6dB-down point.

The MC1330 video demodulator is connected in a standard manner with L_7 and C_{26} supplying the two necessary unmodulated carrier feeds in phase opposition; and Fig. 9 explains the essential circuit action in this type of synchronous demodulator.

Two other points regarding this circuit deserve comment. Because the following video circuits are directly coupled (allowing true blanking-level measurement and control) it is important that the demodulated output at pin 4 of the i.c. carries the correct d.c. component. Normally, the 200-300 ohm value of R_{18} plus R_{19} will provide for this, but as there is some spread in the MC1330 operating characteristics, it will be necessary to set R_{19} so that the required clipping action occurs at Tr_{13} emitter.

The dotted components including the 'line-linearity' variable, R_{17} , form an optional extra circuit which provides the means to adjust for accurate balance of the demodulator internal circuit. In practice, the degree of improvement possible is usually quite small and, in any event, can only be obtained by accurate measurement. Therefore, this part of the circuit should be omitted unless suitable high-grade test equipment is available.

Following the demodulator, two trap circuits L_8/C_{28} , L_9/C_{29} create notches in the video response at the sound carrier offset of 6MHz and 8.86MHz (twice colour subcarrier), as shown in the oscillogram of Fig. 10. Separate traps are used instead of a 5.5MHz low-pass network because it is an easier way to arrange the required baseband cut-off, and also reject the two out-of-band components likely to cause interference in subsequent circuits.

In view of the almost total removal of sound carrier by phase cancellation at the take-off point, it may seem that the 6MHz trap is an unnecessary extravagance; for most of the time that the tuner is operating this is true. Exceptionally, however, such as when first switching on in a cold room and before a.f.c. has become fully effective, there may be an appreciable frequency shift of the phase-cancellation point. As the 'expanded' sweep photograph of the sound take-off circuit response (Fig. 7) shows, a relatively small shift would result in a considerably increased 6MHz component in the tuner output and hence, in the absence of any other precaution, a large amount of interference on the picture.

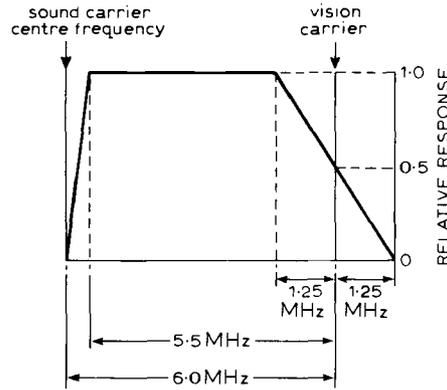


Fig. 8. Ideal receiver vision-channel response (taken from BBC/ITA publication: "Specification of television standards for 625-line system I transmissions". — 1971).

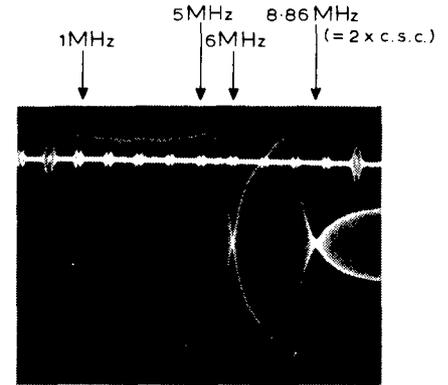


Fig. 10. Sweep response showing effect of 6MHz and 8.86MHz trap circuits.

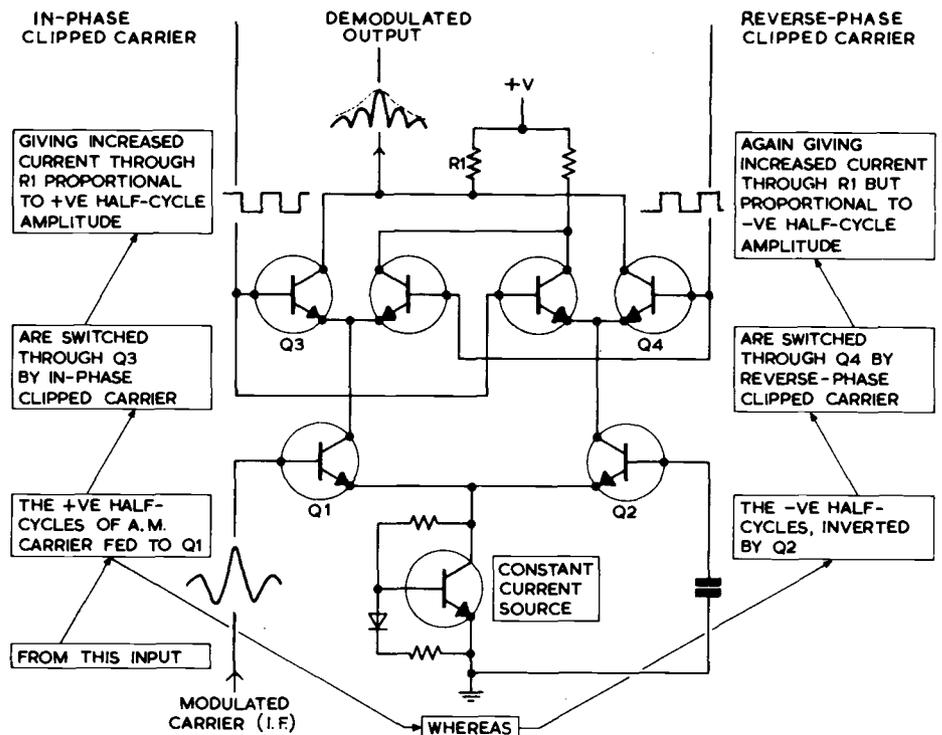


Fig. 9. Circuit action and waveforms of synchronous demodulator.

An even more important benefit obtained by having this 6MHz notch circuit is that its action is helpful during initial tuner line-up; various adjustments — particularly of the sound take-off circuit itself — would be more difficult without it, again because of high-level unwanted output-signal components.

The complementary-pair amplifier, Tr_4 , Tr_5 has three main functions. It provides about 7dB gain; it presents the correct terminating impedance for the notch circuits and feeding impedance for the group-delay equaliser; it produces an additional feed of video with the required amount of d.c. shift for the direct-coupled Tr_{13} to Tr_{18} circuits which measures blanking level and generates the a.g.c. voltage.

The group-delay corrector has two resonant sections each acting over a different part of the video band such that their combined effect changes the basic delay characteristic (lower curve

in Fig. 11b) to the fully corrected (upper) curve. No attempt has been made to correct the sudden change in delay beyond 5MHz because the incoming video signal contains little information above this frequency. In fact, there is some compensation for delay variation at these higher frequencies given as a by-product of modifications to the PAL decoder to be discussed in a later article.

Fig. 11a has been included for reference. It shows the approximate spectral energy response curves relating to two important components of the insertion test signal (i.t.s.) radiated as part of the television signal by U.K. transmitters. The two components are known as the 2T luminance and 10T composite pulses which, as explained in the line-up procedure, are most useful when adjusting the four inductors in the group-delay equaliser.

The final stage of the video signal circuit is a complementary-pair ampli-

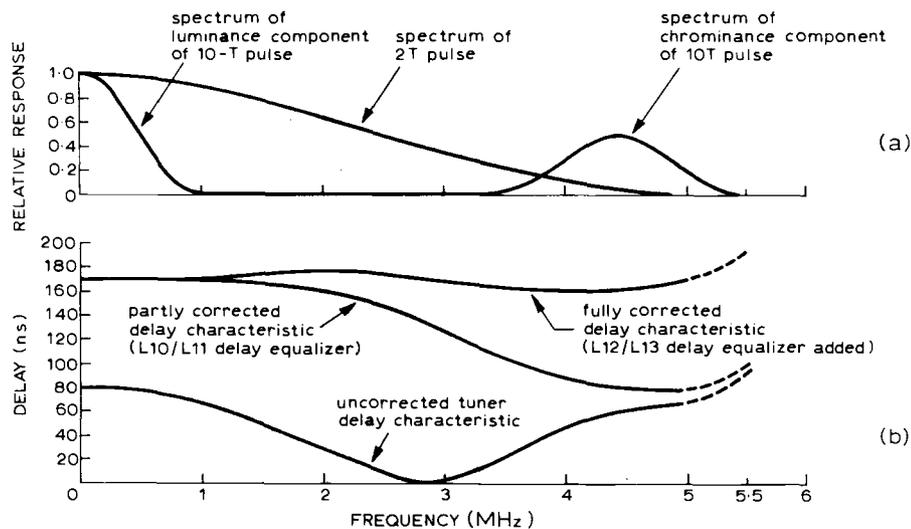


Fig. 11. (a) Spectral response of Insertion Test Signal pulses. (b) Curves showing result of two-stage delay correction.

fier which can provide up to three 75-ohm outputs or, if constructed as shown in the circuit diagram, gives one 75-ohm output for coax distribution and one medium-impedance output for direct connection to the monitor decoder (in the same box).

Fig. 12 illustrates the overall performance of the tuner using a line-repetitive frequency sweep test signal injected at the aerial input. The top trace shows the d.c. to 6MHz response up to the terminated tuner output; the lower trace displays the same signal in its i.f. carrier form before demodulation as observed at the C₂₃ test terminals (see Fig. 2). To avoid adding confusing stray impedances here, a Hewlett-Packard 'twin-legged' oscilloscope probe attachment was connected in place of C₂₃ to obtain this oscillogram; a photograph of this attachment together with possible home-constructed alternatives will be included in the line-up instructions.

Sound and a.f.c. circuit

The 33.5MHz sound carrier from the take-off point is fed first to an impedance-matching common-base stage, Tr₈, and thence to the 'top-C' over-coupled band-pass pair comprising L₁₄ and L₁₅ which gives a double-humped response with a band-width of about 1MHz. The tuning of the 'secondary' coil, L₁₅, is offset to give a lop-sided overall characteristic which counteracts the response tilt in the video band-shaping (i.f.) circuits. An asymmetrical response here is particularly important so that the resulting a.f.c. action is equally effective on either side of the correct tuning point.

Most of the sound i.f. amplification is provided by the cascode pair, Tr₉, Tr₁₀. In this stage, part of the load is formed by a resonant circuit which is tuned to 33.5MHz so that it fills in the dip in the L₁₄/L₁₅ response.

The amplified signal is then fed to the long-tailed-pair limiter circuit of Tr₁₁ and Tr₁₂. Only one stage of limiting is needed because a.g.c. action on the

tuner r.f. and video i.f. circuits maintains the level of the extracted sound carrier at a nearly constant value. (There is, of course, a specified fixed difference of 5 to 6dB between the sound and vision carriers leaving the transmitter.) The back-to-back diodes D₅ and D₆ are included to by-pass high-level signals which may exceptionally appear at the limiter input; e.g. such as might occur if the vision carrier level is drastically reduced at the transmitter because of a fault. Normal limiting takes place for signals in excess of about 0.2 volts peak-to-peak; the diodes clip signals of about 1.4 volts peak-to-peak.

The circuit including L₁₇, L₁₈ and diodes D₇, D₈ forms a discriminator of the Foster-Seeley type. 'Top-C' coupling between the two tuned circuits is provided by C₅₃ to feed an in-phase 33.5MHz carrier component to the diodes; the quadrature component is injected via C₅₀ to the secondary 'centre-tap' formed by C₅₁ and C₅₂. Resistors R₅₂ and R₅₃ act as the diode loads, and the demodulated a.f. signal appearing across C₅₄ is de-emphasized by R₅₄ with parallel resistances and C₅₆.

There are two further points which

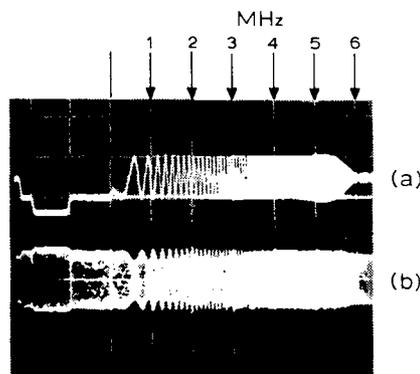


Fig. 12. (a) Tuner overall response (video terminated output) with line-repetitive sweep d.c. to 6MHz. (b) i.f. vision carrier envelope at input to MC1330 for the same signal as in (a).

need mention in respect of this circuit. One is purely practical and concerns the series inductors (not numbered) shown on either side of D₇ and D₈. These are constructed by winding the diode leads in small-diameter coils using, for instance, a piece of 10-gauge wire as a temporary former. The inductance of a few turns here – as near to the diode body as possible – will help to prevent radiation of the sound-carrier harmonics which are generated as a result of diode non-linearity and which could cause interference in the r.f. circuits.

The second point is more important and relates to another function of this circuit: that of producing the a.f.c. voltage and combining it with the switched tuning-control voltage developed in a subsidiary circuit. Fig. 2 shows that the discriminator secondary circuit has no direct connection to earth. Therefore, in addition to the audio signal across C₅₄, the discriminator output contains a d.c. component varying by up to ±10 volts from the mean value in proportion to the difference between the incoming sound i.f. (ideally, at 33.5MHz) and the frequency corresponding to the discriminator conversion curve centre (also set at 33.5MHz). When the a.f.c. inhibit switch is on, a reduced-voltage feed of this varying d.c. is taken via R₆₂ and other resistors to the high-impedance input of zero-gain amplifier IC_{2b}, where it is mixed with the switched tuning-control voltage which, for tuners operated in the London area, will have a value between 3.7 and 8.3 volts according to the station selected. The combined tuning and frequency control voltages are filtered by R₆₄ and C₆₀ to remove a.f. modulation before being fed to the u.h.f. module.

Diodes, D₁₅ and D₁₆, are included to restrict the a.f.c. range and so prevent the tuner capturing the wrong carrier when re-selection takes place. Figures quoted for the ECL1043 module indicate that a tuning-voltage change of ±0.5 volts, i.e. the total available from the a.f.c. circuit without the catching diodes, would cause a frequency change of about ±10MHz. In practice, a maximum frequency change of ±2MHz is sufficient and this is the extent of control allowed by D₁₅ and D₁₆ which together with dividing resistors R₆₁, R₆₂ and R₁₀₁ restrict the applied a.f.c. voltage excursion to about ±0.1 volt. An inset drawing in Fig. 2 shows the alternative circuit which is necessary if a mechanically-controlled u.h.f. tuner is installed instead of the varicap one. In such an instance, a.f.c. sensitivity is much less, perhaps ±2MHz for ±4V, and for the same amount of control a larger voltage swing can be tolerated; the catching diodes used are the 3.3-volt zeners connected in series as shown.

Amplifier IC_{2a}, connected as shown in Fig. 2, has a gain of 6dB and produces the unit audio output at about 0.5 volt r.m.s. from a low-impedance source. The gain of this stage can be set to suit a

particular installation by changing the ratio of R_{63} to R_{59} .

A.G.C. circuit

A feed of positive-going composite video at 4 volts pk-pk is taken from Tr_5 in the main circuit, filtered by R_{27} and C_{62} , giving a 6dB/octave reduction for frequencies above 1MHz, and then applied to emitter-follower Tr_{13} . When properly set, the output from Tr_{13} has its blanking level at about +15 volts d.c. Clipping action at Tr_{13} emitter, controlled either by D_9 or by simple potential division from R_{67}/R_{73} according to the circuit fitted, causes this waveform to be sliced at a nominal 16 volts so that the remaining signal comprises negative-going mixed-sync pulses together with a volt or so of the picture component. The clipped signal then follows two paths; one goes directly to the f.e.t. sample switch, Tr_{16} , and the other to Tr_{14} which, acting as a sync-tip detector/amplifier, produces an output of 4-volt positive pulses labelled, logic-fashion, \overline{MS} .

The blanking-level sampling pulse is generated as follows. During each sync-pulse period, C_{64} charges to the full pulse amplitude taking current through Tr_{14} and the base-emitter junction of Tr_{15} . At the end of the pulse, this transistor is momentarily cut off as C_{64} discharges through R_{72} and the base potential of Tr_{15} then rises from about -3.5 volts to the on value of +0.7 volt; this takes about $3\mu s$.

While Tr_{15} is conducting, its collector holds the gate of Tr_{16} near to 0 volts. As Tr_{16} source is fed with the clipped video at an average potential of about +15 volts, the gate voltage is well below that required for pinch-off in this type of f.e.t. But, during the $3\mu s$ period that Tr_{15} is cut off, the gate voltage rises above this inhibiting value so that the f.e.t. conducts, and charges storage capacitor C_{65} to the Tr_{13} emitter blanking-level voltage present at that time.

Emitter bias of Tr_{17} is arranged so that conduction occurs for a base potential somewhere in the range +15 to +18 volts, the precise value being pre-set by adjustment of R_{78} . Having fixed the bias conditions in this way, conduction in this transistor then depends on the blanking-level samples stored in C_{65} . Suppose, for instance, the blanking-sample voltage moves negatively; the 'sense' of the MC1330 transfer characteristic is such that this indicates an increase in r.f. signal level. As a result, Tr_{17} begins to draw more current, the a.g.c. voltage fed from the junction of R_{80} and R_{81} to Tr_2 in the main circuit rises, and the i.f. gain is reduced. Hence, the signal level re-established at the MC1330 input is that pre-determined to give the required unit output; thus, R_{78} acts as a 'set output level' control.

Although the black-level sample-and-hold a.g.c. system requires some extra circuitry, it does offer at least two worthwhile advantages compared with the more usual methods. One is that it

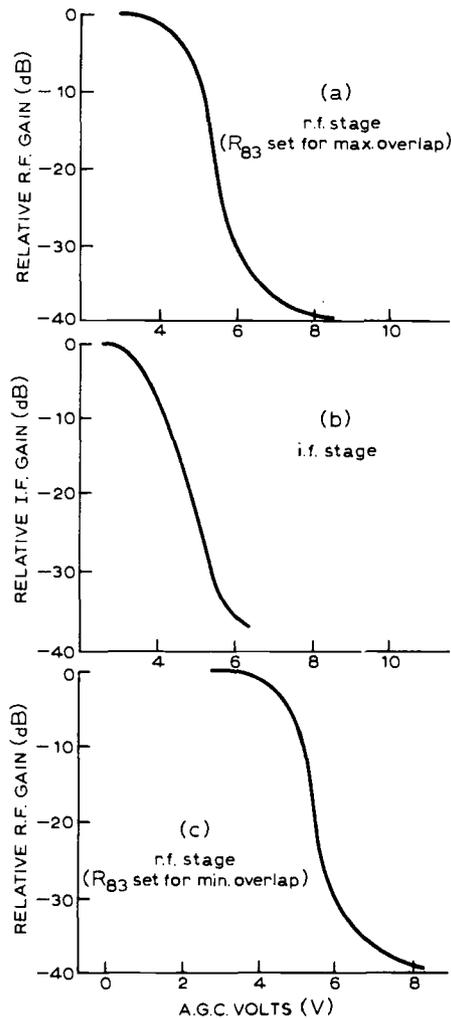


Fig. 13. Tuner a.g.c. characteristics (arranged to show the effect of crossover adjustment).

gives equal 'attack' and 'recovery' times for either sense of gain change, and therefore follows fast and repeated variations in incoming r.f. signal level (e.g. aircraft flutter) more faithfully. Second, it does not depend on the maintenance of a constant picture/sync ratio in the detected video signal.

The i.f. a.g.c. voltage produced as shown is also fed to the common-base stage Tr_{18} which is biased by the divider chain R_{82} to R_{84} so that a 'delayed' version of the control voltage is derived for application to the u.h.f. module. The amount of delay obtained depends on the setting of R_{83} which determines the positive value of emitter voltage required (i.e. the point on the i.f. gain-control range) necessary to cause conduction in Tr_{18} . For a continuing rise in this voltage, the current drawn by Tr_{18} then increases the p.d. across R_{86} which reduces the tuner r.f. gain.

Obviously, the overall tuner a.g.c. characteristic is governed by the degree of overlap between the i.f. and r.f. control ranges and hence depends largely on the setting of R_{83} . In practice, the crossover point is chosen to obtain the best compromise between conflicting requirements according to local reception conditions.

Figs. 13(a) and (b) illustrate the r.f. and i.f. a.g.c. characteristics separately.

Comparison between these two curves shows the relationship of their actions on the appropriate stage gain with R_{83} at its least positive setting i.e. for maximum overlap. Here, Tr_{18} is bottomed so that the two a.g.c. voltages are equal, tracking together and taking proportionate shares in the control of the overall gain. In this condition, the r.f. circuits tend to operate at relatively low gain and the noise they and the mixer produce is amplified by the i.f. circuits working at high gain so that the picture is thereby degraded.

The alternative limit condition, which obtains with R_{83} at its most positive setting for minimum overlap, is illustrated by comparing Fig. 13(b) with Fig. 13(c). The last-mentioned is simply the r.f. a.g.c. characteristic from (a) redrawn with a displaced horizontal (voltage) scale. Transistor Tr_{18} is now biased off until the i.f. a.g.c. reaches about 5.7 volts, i.e. reduction of r.f. gain is 'delayed' by this amount as indicated by the scale displacement. Over the same range of incoming signal levels as before, the r.f. circuits are at full gain and there is accordingly less i.f. amplification of r.f. stage and mixer noise. But the larger-voltage signals now acting in the r.f. stages may cause capacitance change in the varicap diodes, such changes being, of course, in sympathy with the a.m. vision carrier envelope. The resulting phase modulation of the outgoing i.f. signal has no effect on the video component, but the sound discriminator detects it as frequency modulation and hence produces a 'buzz' on the sound output. A secondary result of having excessive r.f. signal level is that there is then a danger of overloading the u.h.f. mixer stage with consequent intermodulation effects.

The choices open when setting up this section of the tuner can now be clearly seen. In those locations where all the stations which may be required for selection are received at low and constant level, the user will probably opt for high r.f. gain and so obtain the best possible noise performance. If, however, there is wide disparity in the received signal strength from different stations, or the signal from any one station is subject to large changes in level, then the alternative approach — that of keeping the r.f. gain as low as possible to prevent sound-carrier phase modulation occurring when the incoming level is high — may be preferable.

Printed circuit boards. *Wireless World* has arranged a supply of printed circuit boards for the tuner design. The board, which measures approximately 25 × 13cm, is a double-sided glass-fibre type and is supplied roller tinned and drilled with test points marked. One off price is £6 inclusive; make cheques or postal orders payable to M. R. Sagin at 11 Villiers Road, London NW2.

A kit of parts, including board, will be available from Magnum Electronics, 25 The Rise, Elstree, Herts, details of which will be given in part three of the article.

Crossover networks and phase response

A problem solved in loudspeaker design

by S. K. Pramanik

Bang & Olufsen, Denmark

Linearity of phase response has long been an aim of audio equipment designers, although its benefits to listening quality is a much debated subject. Whatever the *pros* and *cons* of the argument, it will be realised that to reproduce exactly through a speaker system (at least the direct sound) the wave form as received at the microphone, the two major influencing factors are the frequency and phase response of the chain. For example, to reproduce the steep wave front of a transient sound, not only must the harmonics be present in the same ratio as in the original sound, but their phase relationship must be equally correct. Other factors, such as harmonic distortion, etc., have a smaller visible effect when wave shapes are compared on an oscilloscope. This does not imply that there is any direct proportionality between the audible effect of any factor and its effect on visible wave shape. Phase distortion may therefore be regarded as wave shape distortion. Equally, it may be regarded as a frequency dependent delay in arrival times of different parts of the sound spectrum.

Square waves have long been used to give a quick and meaningful check on audio equipment, where by custom it is linked with transient performance. In fact it is a combined amplitude/frequency and phase/frequency response test, and gives little indication of harmonic or intermodulation distortion, or any of the other parameters considered relevant to audio equipment. It has, however, never been used to test speaker systems, as the reproduced wave has always been so far from the original that no conclusions have been possible. Generally it has been assumed that it was impossible to reproduce square waves on speaker systems, and, since the best designs sounded so good, that it was obviously unnecessary.

Ashley¹ showed that the problem of phase response lay more in the design of crossover networks than in the units themselves. In all multiway systems it is assumed that the sound from all the units is integrated in the air, by the time it reaches the listener. Therefore,

provided the vector sum of the sounds from each unit is, at all times, equal to the input to the speaker system, the wave form from the system will be the same as the input. The stress here is on the vector sum and therefore includes phase, rather than the amplitude sum and therefore amplitude/frequency response. Provided the units respond perfectly to the signal input applied to them with respect to both frequency and phase, the wave shape of the sound from the speaker system will be an exact replica of the wave shape of the input signal.

In practice, speaker units have a perfectly acceptable frequency and phase response over a limited bandwidth, usually of the order of four octaves. Also, technology exists today for units to be designed to cover a bandwidth of this order anywhere in the frequency spectrum. The problem therefore, is to ensure that the vector sum of the signals from the crossover network to the units exactly equals the input. Additionally, a sufficient number of units must be used to cover the audio spectrum, with adequate attenuation outside the useable bandwidth of each unit, for the quality level and the power handling capacity required.

Equal input-output crossover networks

The simplest form of crossover network is the first order filter, which operates at 6 dB/octave. Limiting the argument to two-way systems only (the mathematics is less straightforward but can be extended to multiway systems) for the sake of simplicity, the voltages received by the bass and treble units for unity voltage input to the crossover network* are

$$V_{\text{bass}} = \frac{1}{s+1} \quad V_{\text{treble}} = \frac{s}{s+1}$$

The attenuation curves for these functions are shown in Fig. 1. The vector sum of voltages to each unit is therefore

$$V_{\text{output}} = \frac{1}{s+1} + \frac{s}{s+1} = 1$$

showing that the output is identical to the input in amplitude and phase. A

speaker system therefore can be made to have linear phase response using crossovers of 6 dB/oct., with correct choice of crossover components. However, this will not solve any of the other problems associated with first order filters, such as the large overlap of four octaves for just 12 dB attenuation. These problems are so well known that they need not be restated. In fact first order filters are used today, almost exclusively for less expensive systems, designed for modest power handling applications.

Higher order crossover networks

For second and higher order crossover networks, the vector sum of the voltages will not be identical with the input. For example, for a second (12 dB/oct) order network, the voltages received by the bass and treble units for unity voltage input in the crossover network are

$$V_{\text{bass}} = \frac{1}{s^2 + \sqrt{2}s + 1}$$

$$V_{\text{treble}} = \frac{s^2}{s^2 + \sqrt{2}s + 1}$$

If the two units are connected in phase, the vector sum is

$$V_{\text{output}} = \frac{1+s^2}{s^2 + \sqrt{2}s + 1} \quad (1)$$

This gives attenuation curves for each unit and total amplitude/frequency characteristic shown in Fig. 2. It can be seen that the suckout at the crossover frequency will give audibly poor results, and to get around this most designers connect the two units in opposed phase. This gives the same attenuation char-

¹ For the mathematical models, voltage transfer functions are used, which include both amplitude and phase information. They are simplified by using the normalised frequency variable $s_R = s/\omega_0$, ω_0 being the nominal crossover frequency. In the text, however, " s_R " is replaced by " s " for the sake of clarity. The equations given are based on "maximally flat Butterworth filters", but the mathematics and results are valid for any other filter.

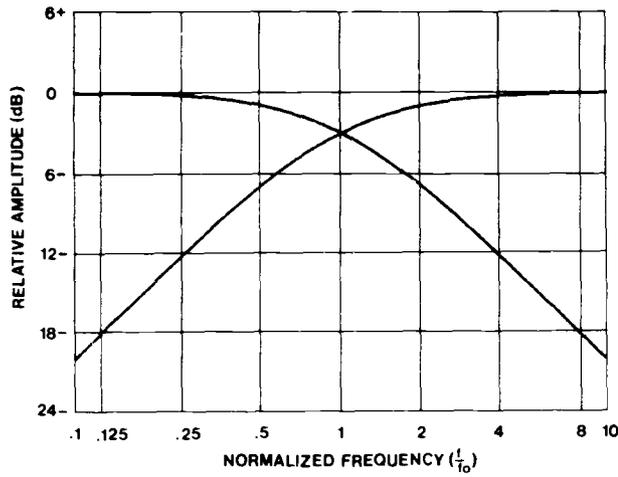


Fig. 1. Simple 6dB/octave crossover.

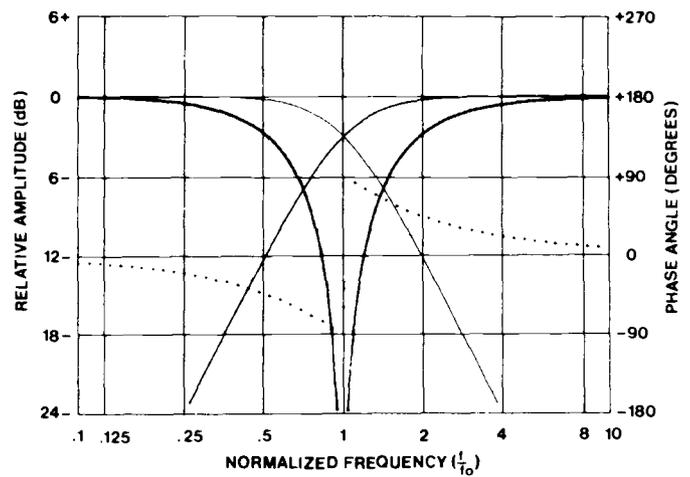


Fig. 2. Second order crossover network.

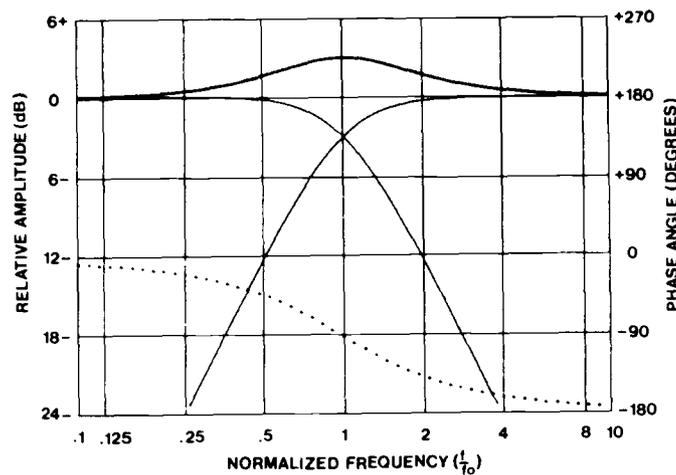


Fig. 3. As Fig. 2, but with tweeter phase reversed.

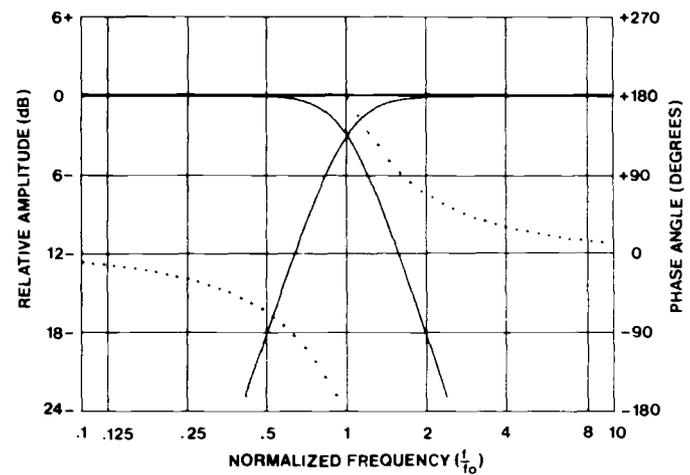


Fig. 4. Third-order crossover network.

acteristics for each unit, but the curve for the total amplitude/frequency characteristic (Fig. 3) shows a 3 dB rise at the crossover frequency. The vector sum of the voltages:

$$V_{\text{output}} = \frac{1+s^2}{s^2 + \sqrt{2}s + 1}$$

The dotted line in Figs. 2 and 3 shows the phase characteristics in the two cases, and it can be seen that in both cases a phase shift of 180° occurs in the crossover region. While the frequency response can be improved slightly by juggling with crossover components, the phase shift is an inherent property of the filters and cannot be altered.

In the case of a third order network (18 dB/oct) one gets a perfectly flat amplitude/frequency characteristic (Fig. 4). Phase, however, shifts 360° over a broad band centred on the crossover frequency, the vector sum being given by the expression

$$V_{\text{output}} = \frac{1+s^3}{1+2s+s^2+s^3}$$

As a third order crossover network has a large number of components it is basically expensive, but even more than this, components have to be matched to close tolerances, for the system to function as designed. Its application has

therefore been limited to speaker systems in the highest price bracket and even then generally limited to two-way systems.

Active crossover systems

To achieve linear phase response through the crossover network, Ashley¹ proposed a mathematical solution, which was later modified by Ashley and Kaminsky² and Small³. The basic idea behind these solutions is the same, together with their advantages and disadvantages. If we go back to the equation (1) for the second order filter, we find that the vector sum

$$V_{\text{output}} = \frac{1+s^2}{1+\sqrt{2}s+s^2}$$

This expression can be made unity, i.e. identical with the input, by adding the term $\sqrt{2}s$ to the numerator. In a practical case this term can be added to either the bass unit, the treble unit, or split between the two. For example, one could design a crossover network so that the voltages received by the bass and treble units were

$$V_{\text{bass}} = \frac{1+\sqrt{2}s}{1+\sqrt{2}s+s^2}$$

$$V_{\text{treble}} = \frac{s^2}{1+\sqrt{2}s+s^2}$$

This would give the attenuation characteristics shown in Fig. 5, and since their vector sum is unity, would result in flat amplitude/frequency and phase characteristics. This principle can be extended to higher order filters and an example of a proposed third order network by Small³ is shown in Fig. 6.

Systems such as these characteristically show a peak in the voltage to one or both units (depending on whether the crossover is designed to be asymmetric or symmetric), at a frequency near the crossover point. In passive crossover networks, power supplied by the amplifier will be referred to this peak and the required characteristic can only be obtained by dissipating power at all other frequencies in the crossover network. For a peak of 3 dB anywhere in the amplitude/frequency characteristics of either unit, therefore, virtually half the power supplied by the amplifier is dissipated before it reaches the units, rather than converted to acoustic energy.

The only practical answer for using this principle is to use a high impedance crossover network and individual amplifiers for each unit, the system being sometimes known as an active loudspeaker system. Even so, although

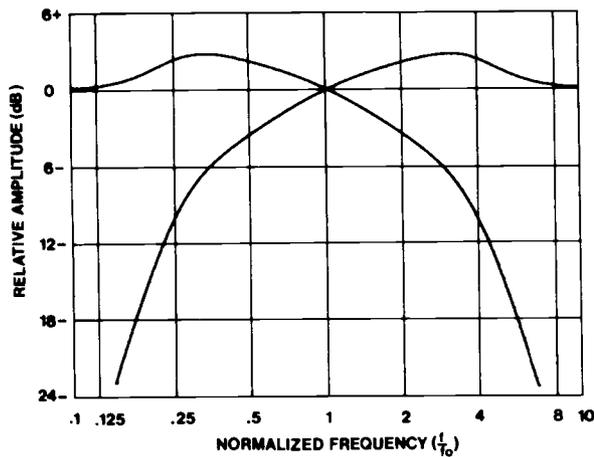


Fig. 5. Second order active crossover.

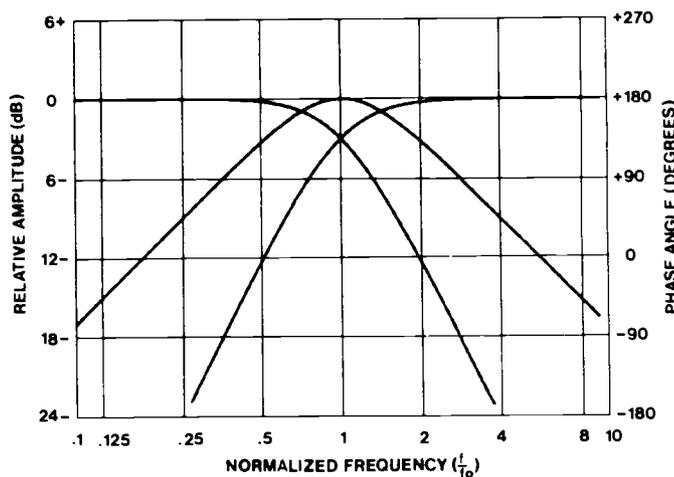


Fig. 7. Three-unit filler driver 2nd order system.

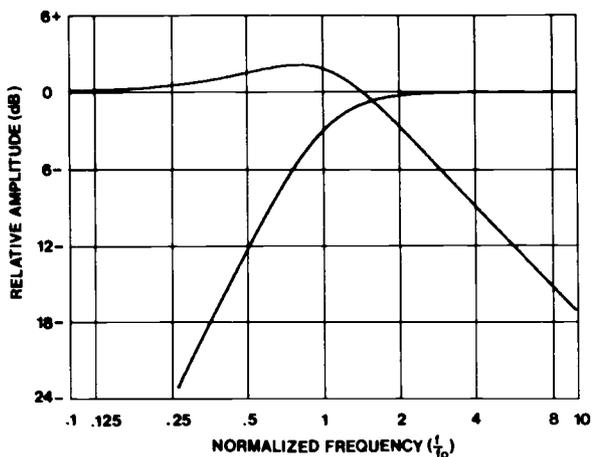


Fig. 6. Third order active network after Small.

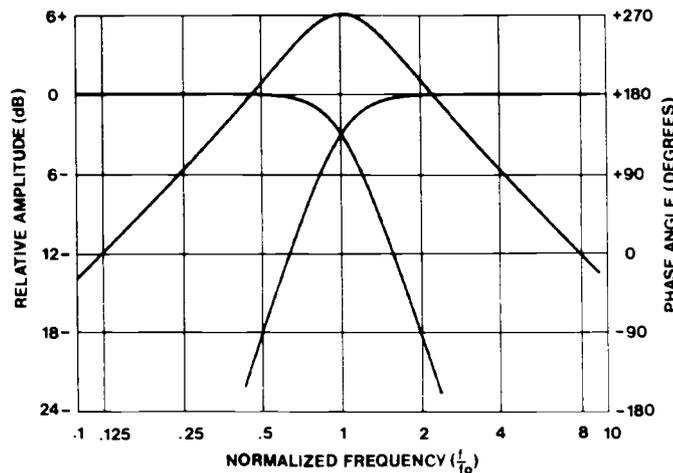


Fig. 8. Third-order filler driver system.

power is no longer dissipated in the crossover, amplifiers must be designed to supply power for the peak in the amplitude/frequency characteristic of each driver, although it is generally used at much lower levels for most of the frequency range.

Finally, perhaps the most significant drawback is that overlap at crossover frequency between the two units is appreciably increased. While the normal 2nd order network gives an overlap of two octaves for 12 dB attenuation, the modified network of Fig. 5 gives over 3.5 octaves. The third order network of Fig. 6 gives an even larger overlap of almost 4.5 octaves for the same attenuation. Compared to the 4 octaves of a first order network, which can also be designed to give a linear phase response, the performance gain is marginal for an enormous increase in cost.

The filler driver solution

Baekgaard⁴ suggested that the missing term in the numerator of equations (1) could be added as an extra, completely separate unit, instead of attempting to alter the attenuation curves for the existing units. This unit, which he called a filler driver, has the advantage that there is no alteration in the attenuation

characteristics of the normal bass and treble units, and therefore overlap is unaltered.

The calculated amplitude/frequency characteristic of the three units in what is still nominally a two-way system is shown in Fig. 7, for a second order (12 dB/oct) crossover network. The characteristics of the filler driver show a peak at the crossover frequency, with an attenuation of 6 dB/oct on both sides. It is therefore asked to handle only limited quantities of power, in a limited bandwidth centred on the crossover frequency.

The mathematical expressions for the attenuation characteristics are now

$$V_{\text{bass}} = \frac{1}{s^2 + \sqrt{2}s + 1}$$

$$V_{\text{filler}} = \frac{\sqrt{2}s}{s^2 + \sqrt{2}s + 1}$$

$$V_{\text{treble}} = \frac{s^2}{s^2 + \sqrt{2}s + 1}$$

The vector sum is unity, showing that both the frequency and phase responses are linear, and therefore the input and output wave shapes are identical.

A similar solution can be used for third order (18 dB/oct) filters, the attenuation characteristics being as

shown in Fig. 8. It will be noticed that the efficiency of the filler driver must be twice that of the basic units, a solution most easily realised by an active circuit. In passive crossover methods a special unit would have to be used, to obtain the required efficiency.

Listening for phase distortion

Whether phase distortion can be heard is a much debated subject, and the author does not wish to contribute to that debate in this article. A word of warning about the methods used may, however, be in order.

It is well known that no two speaker systems are identical, even when made under laboratory conditions using identical units and crossover networks. It is therefore imperative that the same cabinet and units are used for comparative tests.

Phase shift may be introduced electronically by coupling a phase shifting circuit at a high impedance stage in the amplifier. A circuit may be made up to give an unaltered amplitude/frequency characteristic, but with frequency dependent phase shift corresponding to the relevant crossover network. A circuit published by Russel⁵ corresponds to the phase shift of a third order filter. Such a test will, of course, be

relevant only if the basic speaker system has no more than modest phase shift over most of the audio spectrum.

Another test would be to start with a speaker system using a third order crossover network, which has a flat amplitude/frequency characteristic. The addition of a filler driver to such a system gives it, in addition, a flat phase characteristic. Provided switching the extra unit has no effect on the amplifier characteristics, or on the function of the crossover network, the effect of phase distortion can be estimated. This can again be done by using a high impedance "electronic" crossover network.

Testing with microphones in normal living rooms is largely irrelevant, because reflected sound has a very large influence on measurements. The ear, on the other hand, finds it very easy to distinguish between direct and reflected sound. If therefore in comparative tests, the ear is able to distinguish between loudspeakers having undistorted and distorted phase response, even on a few signals, the value of correctly designed loudspeaker systems will have been proved. We will then have to wait for signal sources with undistorted phase response from the software manufacturers, before the benefits of loudspeaker systems with linear phase response become fully apparent.

References

1. Ashley, J. Robert, On the transient response of ideal crossover networks, *J.A.E.S.*, July 1962.
2. Ashley, J. Robert & Kaminsky, Allan L. Active and passive filters as loudspeaker crossover networks, *J.A.E.S.*, June 1971.
3. Small, Richard H. Constant-voltage crossover network design, *J.A.E.S.*, January 1971.
4. Loudspeakers — the missing link. Paper of the 50th Convention of the A.E.S., London 1975.
5. Russel, Howard T. Design active filters with less effort, *Electronic Design*, January 1971.

The above article is based on a paper presented by Mr Pramanik at the Wireless World private conference on "linear phase" loudspeakers (see note in October 1975 issue, p. 482).

Electronic circuit calculations simplified. We regret that it has been necessary to postpone publication of Part 6 of this series, on LC circuits.

We also apologise that an error appeared in Part 4 on RC combinations in the September issue. The diagrams above the captions Fig. 6 (p.424) and Fig. 8 (p.425) should be transposed.

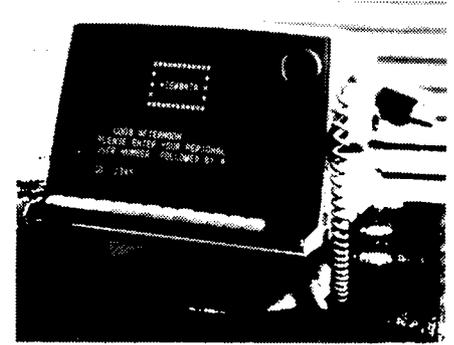
Viewdata on trial soon

In January 1976 the Post Office starts limited trials of Viewdata, its television-screen information service. Like Teletext (see first article in this issue), Viewdata presents "pages" of printed information on the home television set — but there are two differences. First, the information is not broadcast but sent into the home by data transmission over the existing domestic line. It comes from a central "data base" — a digital computer with magnetic disc storage. Secondly, Viewdata is "interactive" in that the subscriber, by pressing buttons on a keypad, can interrogate the data base to obtain increasingly detailed information. This is arranged on a "tree" selection basis. For example, starting from the general item "eating out" on the index page, the subscriber can obtain successively: classes of restaurants (e.g. Italian, Greek); names, addresses and telephone numbers of restaurants in a particular class; and finally menus.

Viewdata is intended to be complementary to Teletext and technically compatible with it, so that the same domestic television sets and decoders can be used for both services. The page and character formats (960 characters per page, 7 colours, characters on a 7 x 5 dot matrix) are identical. The Post Office has already had discussions with BREMA, the set makers' organization, to ensure that suitable domestic equipment can be provided.

A demonstration of how the system will work was given at a recent computer conference, Eurocomp, at the Heathrow Hotel in London. Standard commercial Teletext receivers made by GEC were used, and to these keypads were connected for selecting pages and interrogating the data base. Information in ASCII telegraph code was transmitted to and from the sets, via modems by the standard Post Office Datel 600 data transmission service — at a rate of 1200 bits/second for incoming information to the sets and 75 bits/second for outgoing information. The Datel 600 signals passed via the ordinary public telephone lines and exchanges to and from a data base consisting of a GEC type 4080 digital computer at the old Post Office Research Station at Dollis Hill, London. This machine has a magnetic disc cartridge store (capacity 2.4 megabytes) on which the pages are held in binary code. It is estimated that the computer system will give an enquiry response time of less than 2 seconds to 200 subscribers using it simultaneously. The machine will be moved to the new Post Office Research Station at Martlesham, Suffolk, for the start of the Viewdata trials, when initially it will be serving 20 to 50 home terminals.

Information for the service will be provided by outside organizations, and about 40 potential sources have already



Design for a purpose-made Viewdata terminal for business users. Home terminals will be domestic television sets.

been approached by the Post Office. Classified advertisements might be accepted.

A full public service could start in 1978-9, say the Post Office, if the trials show that Viewdata is commercially viable. Assessments have yet to be made of the range of information to be provided, the likely demand and the charges to be made for the service. A typical domestic installation would consist of an "interface" or adaptor unit, to which would be connected the telephone line, the telephone handset, the television set (with built-in decoder) and the controlling keypad. Cost of a home installation might be in the region £50-£100. In addition to the facilities mentioned above, it might be possible for subscribers to contact by telephone the providers of displayed information and to send their own messages — "electronic telegrams" — through the system.

Big demand for electronic watches

Production of electronic watch modules and the assembly of modules into cases will contribute over 30% of Hughes Microelectronics' turnover in 1976. This prediction was made by Dr Guy Barnes, the company's managing director who said that it was originally intended to develop production to 2,000 modules per month by August. This figure was rapidly lifted to 4,000 per month and the latest target is 6,000 modules per month. Plans are now advanced to include a two-button, five-function men's watch module and a ladies' module, and delivery will start later this year.

Optical sensor ignition system

Electronic switch replaces contact-breaker

by H. Maidment

A capacitive discharge (c.d.) system overcomes most of the problems inherent in the traditional Kettering system, and retains the option of reversion. The case for combining c.d. with a contactless timing source has been argued by J. R. Watkinson (WW July 74 and WW Annual 76), preferably with ignition advance determined by non-mechanical means. Although the last mentioned is desirable, it has not yet been proved to have superior reliability.

Having personally experienced timing drift, due to heel wear, with a contact-driven c.d. system and the longer term effects of cam-profile and distributor-shaft play on engine performance. I considered that a reliable contactless system, insensitive to the effects of shaft play, would be a worthwhile objective, provided that a roadside reversion was still possible.

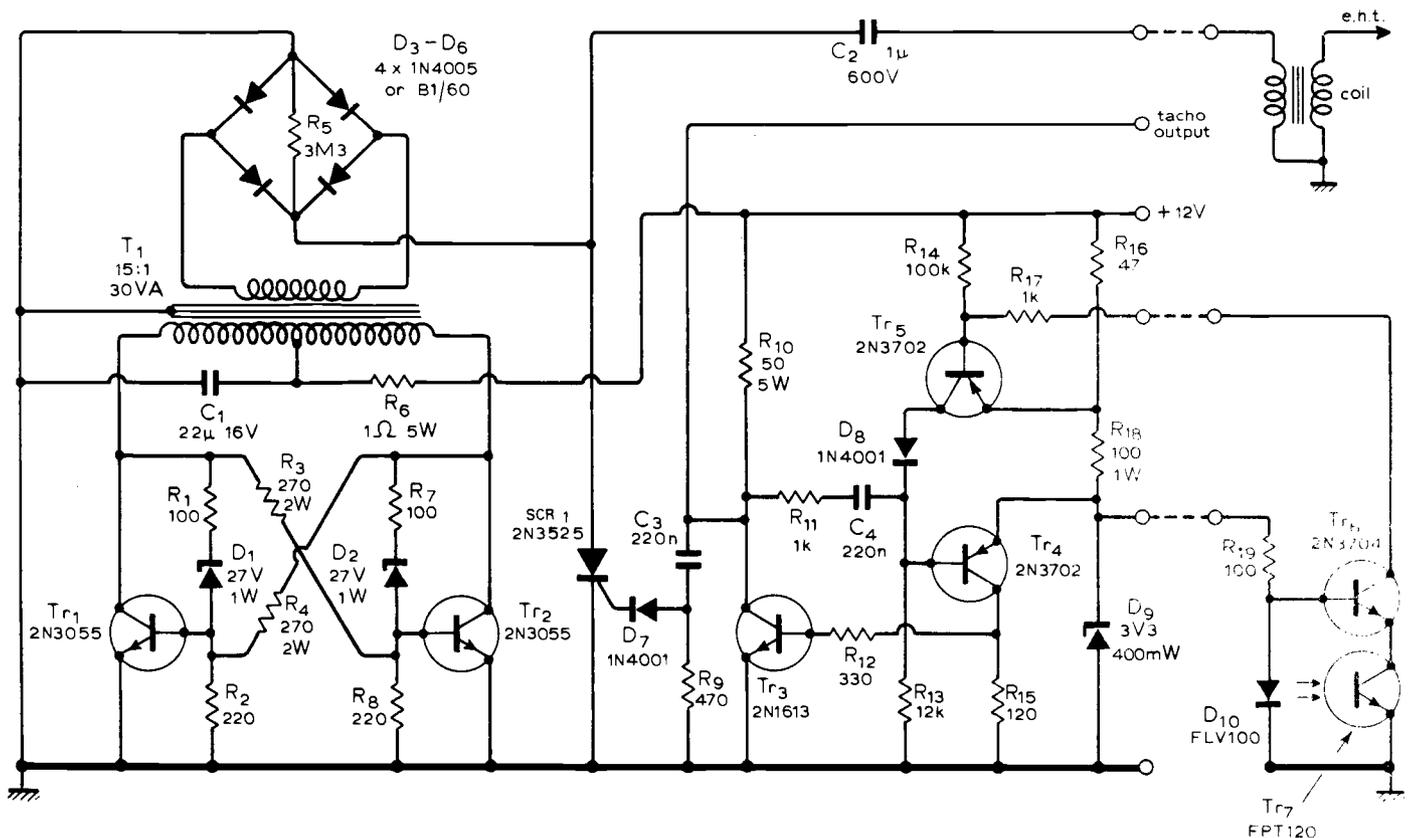
With the availability of relatively cheap point-source i.e.ds and high-sen-

This design combines the Marston capacitive discharge circuit with an optoelectronic switch to produce an ignition system which does not suffer from the timing drift or points-wear associated with a mechanical type.

sitivity planar phototransistors of matched spectral characteristics, an optical sensor was developed for use with the basic R. M. Marston c.d. ignition system (WW Jan 1970). The aim was to achieve a compact sensor head small enough to fit most distributors without disturbing the existing circuit-breaker assembly, and a design relatively immune to interference without the use of screened leads.

As shown in Fig. 1, the c.d. circuit follows the Marston design with the addition of C_1 , to overcome a tendency for false triggering, and the deletion of the bounce-suppression circuit. The last mentioned may be left in if existing units are being adapted, and C_1 need only be added if the complete unit self triggers while the light path is interrupted. The trigger circuit operates in the following manner; i.e.d. D_{10} is energized from D_9 via R_{19} . Transistor Tr_6 provides a low impedance load for

Fig. 1. Complete circuit diagram showing remote sensing head which is connected to the main circuit by unscreened leads.



phototransistor Tr_7 . These items form the remote sensing head in the distributor, connected by unscreened leads to the main unit. With an interrupted light path, $Tr_{5,6}$ and Tr_7 are cut off and Tr_3 and Tr_4 saturated. When light falls on Tr_7 and the voltage across R_{14} exceeds about 3V, a regenerative action follows, with Tr_5 conducting and Tr_4 being cut off, which causes the voltage across D_9 to rise by 0.5V, increasing the current in D_{10} . This ensures positive switching down to zero rev/min.

Transistors Tr_3 and Tr_4 are connected to form a complementary monostable which provides an output suitable for

triggering SCR_1 , to provide an average voltage proportional to engine speed, and an automatic engine speed limiter. It also provides a measure of false-trigger immunity. The time constants have been chosen for four cylinder engines to limit the speed to about 6,500; C_4 should be reduced to $0.15\mu F$ for six cylinder engines.

A double sided p.c.b. design is shown in Fig. 2. The earth or negative return area on the circuit side, and the heat-sink areas on the component side were covered with Fablon. The rest of the circuit was inked in with a resist pen before etching. The clearance areas in

the heat sinks were made after etching by lightly countersinking with a 3mm drill. If desired, a more compact assembly may be obtained by cutting the board at XX and mounting back to back as shown in Fig. 7. Readers wishing to adapt the trigger circuit for use with an existing Marston c.d. unit, may prepare a single-sided board as shown below the line YY, omitting D_7 , R_9 , C_3 and R_{10} . Note that $R_{3,4,6,10}$ and R_{18} are mounted clear of the board for better heat dissipation, and that C_2 is not mounted on the p.c.b.

Sensing-head design

The detail design of the shutter, sensing head and mounting bracket will depend on the type of distributor. Shown in Fig. 3 is a prototype assembly mounted on a Lucas distributor, with the optical axis vertical. This is the easier to construct, but to avoid the possibility of excessive dust on the phototransistor lens a horizontal optical axis is to be preferred. This type was used by the author on a Saab 99 employing a Delco-Remy distributor—Fig. 8.

The two types of shutter are shown in Figs. 4(a) and 4(b). The disc version can be fabricated from 18- or 20-gauge dural sheet, first scribing two lines accurately at right-angles for 4 cylinder engines, or three at 60° for 6 cylinder versions, and circles of radii to suit the distributor. The slots are only critical with respect to their leading edges, which should be filed accurately to the scribed lines and bevelled slightly on the underside, particularly the trailing edge. The bevelling eliminates stray reflections which can cause timing scatter.

An alternative approach, where facilities are available, is to black anodize the disc before attachment. The cylindrical type of shutter follows much the same principle except that it is more easily machined from dural stock in a lathe. To obtain the desired clearance between the lower edge of the shutter and the contact breaker, it is necessary to turn a shoulder on the rotor arm against which the inner diameter of the shutter locates. It is possible to hand file the slots to within 0.1mm of the scribed line using a suitable ward file. This represents about 0.5 crankshaft degrees error at 25mm radius, and compares well with the allowable cam lobe error, normally $\pm 2^\circ$. The width of slot is uncritical but less than 1mm will result in a loss of light and more than 3mm will increase the non-linearity of the tachometer output at low engine speed.

The two forms of sensing head are shown in Figs. 5(a) and 5(b). Both can be constructed from 6mm dural plate, although slightly thicker material would be an advantage when drilling the 5mm hole. This should be eased with a half round file and emery paper for a snug fit. The outer edges of each hole are rebated on one side to clear the device wires, which are bent at right-angles to align with the p.c.b. The height of the sensing head and form of

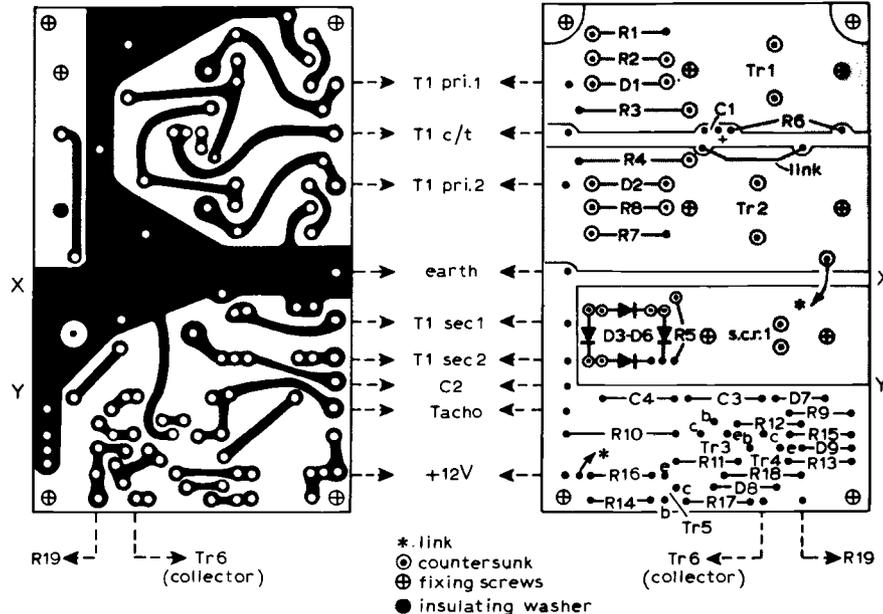
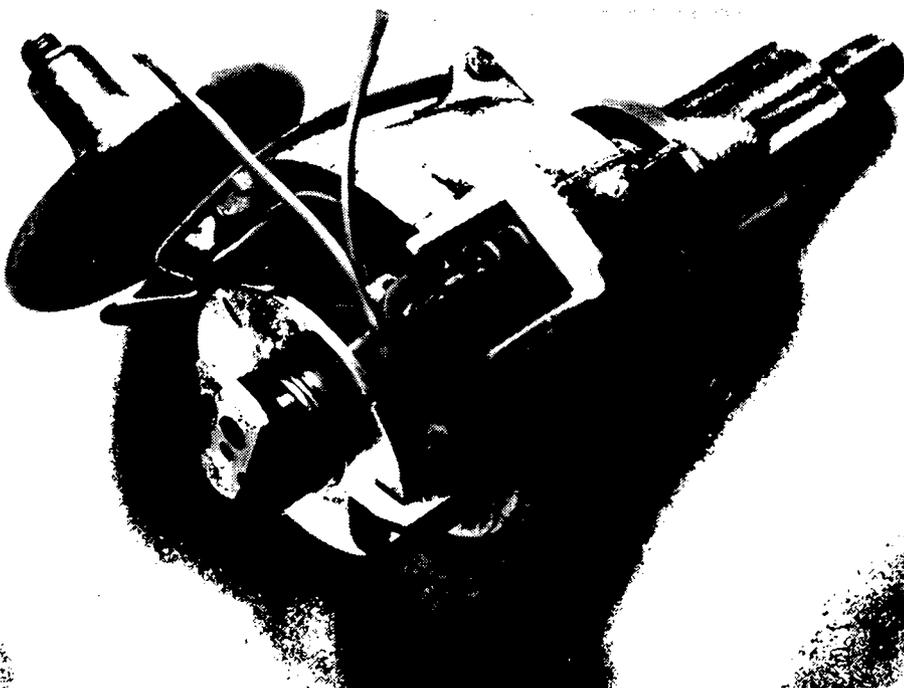
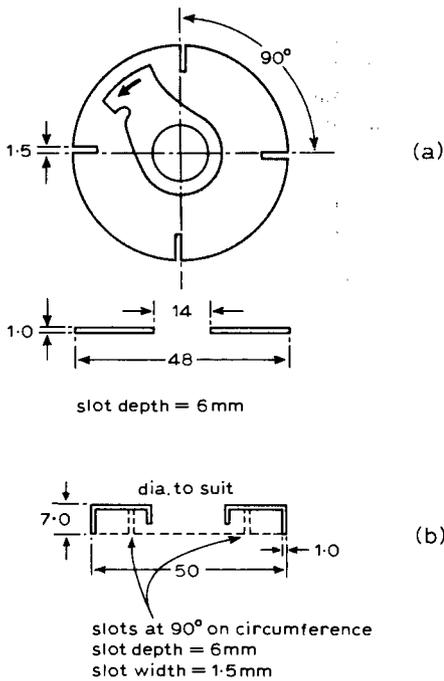


Fig. 2. Double sided p.c.b. layout measuring $2\frac{1}{2} \times 4$ in. This board can be cut across XX and the two halves mounted back to back. Alternatively, if the trigger circuit is to be used with an existing Marston c.d. unit the board below YY may be used.

Fig. 3. Vertical sensing head and shutter assembly mounted on a Lucas distributor.





all dimensions in mm
material 18 s.w.g. dural sheet

Fig. 4. Shutter design for vertical axis (a) and horizontal axis (b).

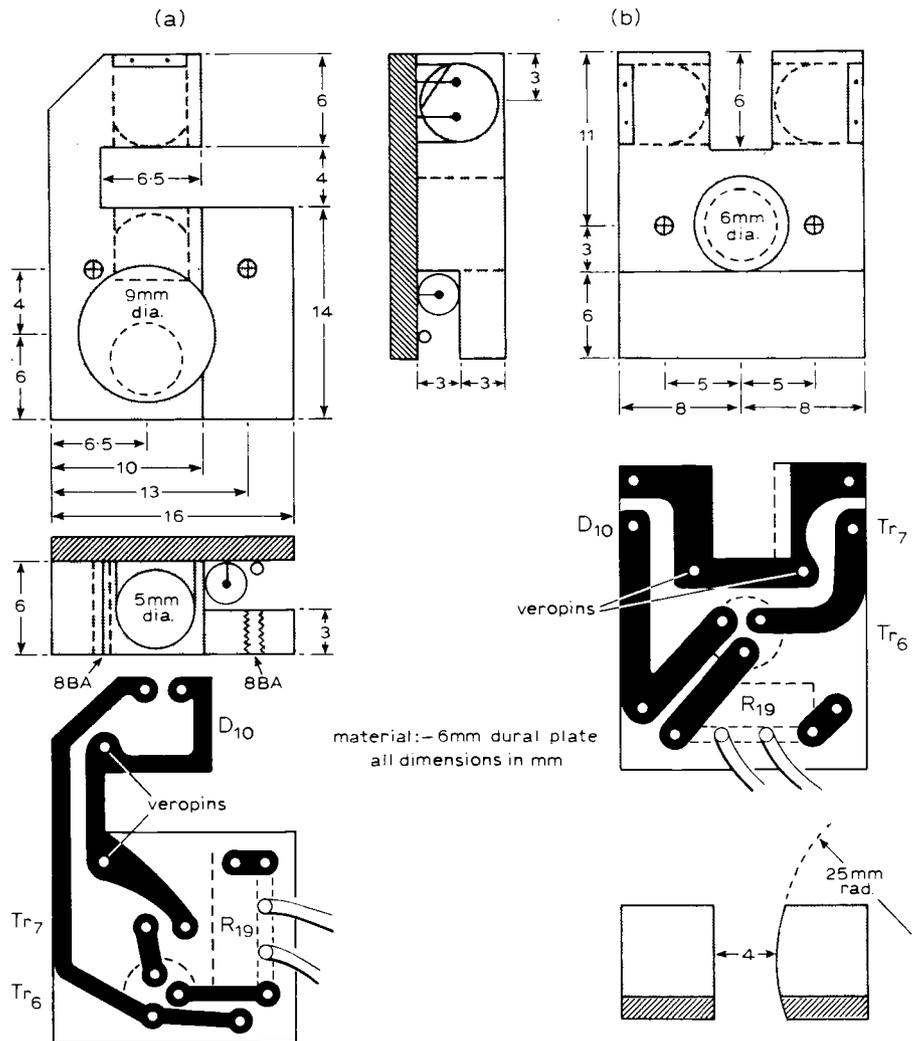


Fig. 5. Vertical and horizontal sensing-head details. The two Veropins in both types earth the circuit and act as locating dowels.

the mounting bracket will depend on the type of distributor used, but the arrangement shown using two 8 BA screws for attachment to a suitable mounting bracket should suffice for most types. The single sided p.c.b. was prepared and etched in the normal manner. In the case of the horizontal-axis sensor, the p.c.b. was first clamped to the body of the sensor after ensuring correct alignment, and two 1.0mm holes drilled, as indicated in Fig. 5, to receive a pair of 0.04in Veropins which serve to earth the circuit and act as locating dowels. At the same time the inner face of the slot is gently radiused to match the shutter curvature. A similar dowelling technique may be used for vertical sensors.

Before final assembly, Tr₆, R₁₉ and two fly leads are soldered in place. The fly leads should be thin instrument wires which are doubled back through clearance holes for mechanical strength. Diode D₁₀ and Tr₇ are positioned with their lenses 0.5mm behind the slot faces. Tr₇ occupies the inner or lower position with its base wire cut off flush. The p.c.b. is then aligned and soldered to the dowels, which have been force fitted to the block. The completed assembly is given a coat of polyurethane varnish which anchors the devices in place and

Components

Resistors

R ₁	100
R ₂	220
R ₃	270, 2W
R ₄	270, 2W
R ₅	3.3M
R ₆	1.0, 5W
R ₇	100
R ₈	220
R ₉	470
R ₁₀	50, 5W
R ₁₁	1k
R ₁₂	330
R ₁₃	12k
R ₁₄	100k
R ₁₅	120
R ₁₆	47
R ₁₇	1k
R ₁₈	100, 1W
R ₁₉	100

All resistors 1/2W unless otherwise stated

Capacitors

C ₁	22μ, 16V
C ₂	1.0μ, 600V
C _{3, C₄}	0.22μ, 250V (polyester)

Semiconductors

Tr ₁	2N3055
Tr ₂	2N3055
Tr ₃	2N1613, 2N3053 or BFY52
Tr ₄	2N3702, BC212 or ZTX500
Tr ₅	2N3702, BC212 or ZTX500
Tr ₆	2N3704, BC182(3), or ZTX300
Tr ₇	FPT120 (Fairchild)
SCR ₁	2N3525
D ₁	27V, 1W zener
D ₂	27V, 1W zener
D ₃₋₆	1N4005
D _{7, D₈}	1N4001
D ₉	3.3V, 400mW zener
D ₁₀	FLV100 l.e.d. (Fairchild)

T₁ 15:1 centre-tapped transformer rated at 30VA, A 1:1 or battery charger 240:16V type can be used. For details of modifying a transformer refer to WW Jan 70.

* Obtainable from Ambit International Ltd. 37a High Street, Brentwood, Essex CM14 4RH.

provides moisture protection. Care should be taken not to damage the lenses or contaminate them with varnish during construction.

Mounting

A suitable mounting bracket for the type of Lucas distributor shown in Fig. 3 is detailed in Fig. 6. This bracket is fitted in place of the capacitor whose original fixing screw provides a means for synchronizing the optical system to the contact breaker. Oversize holes in the vertical bracket and suitable washers behind the 8 BA screw heads holding the sensor permit adjustment of the shutter running-clearances. Brass was used as this allows the vertical bracket to be soldered in position on its base plate. Similar constructional methods may be adapted to suit most distributors.

The position of the sensor with respect to the rotor arm is uncritical except in the case of the vertical axis version, when it should not be in line at the triggering points. The orientation of the shutter with respect to the contact-breaker opening point, with the sensor bracket mid way in the angular range of adjustment, should be determined before Aralditing to the rotor arm. The disc shutter increases the height of the rotor arm; this should be checked by removing the brush from the distributor cap, and placing a knob of plasticine on top of the rotor arm before seating the distributor cap. If the clearance is less than 0.5mm, the base of the rotor arm should be carefully filed to suit. To maintain concentricity between the disc type shutter and rotor arm whilst Aralditing, a short length of split tube should be located through the shutter into the rotor arm and removed before the Araldite is fully cured.

In some distributors, significant angular backlash exists between the rotor arm and the shaft. This should be eliminated by shimming the clearance

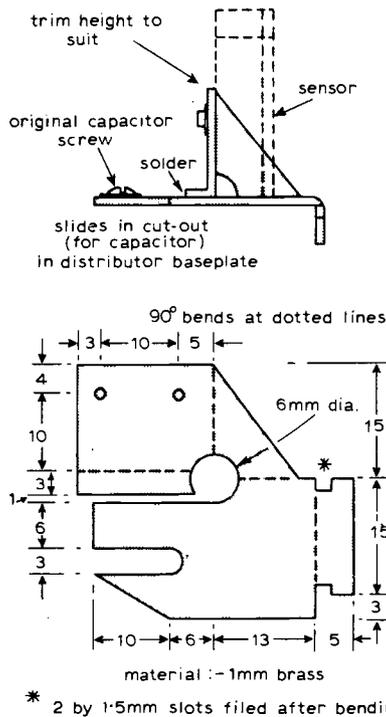


Fig. 6. Mounting bracket for use with a vertical sensing head in a Lucas distributor.

between the leading edge of the slot in the shaft and the key in the rotor arm. This may be achieved by forming a shim steel or beryllium copper strip in the shape of a question mark, the circular section fashioned to fit the hollow section of the shaft, and the tail bowed slightly, cut to suit the depth of the keyway, and located against the leading edge; thus taking up the backlash when the rotor arm is fitted. An alternative method is to oil the shaft spigot and coat the sides of the rotor arm with Araldite

Fig. 7. Main electronic unit showing the double sided p.c.b. cut in half and mounted back to back.

before locating on the shaft. The rotor should be gently eased off the shaft before the Araldite is fully cured.

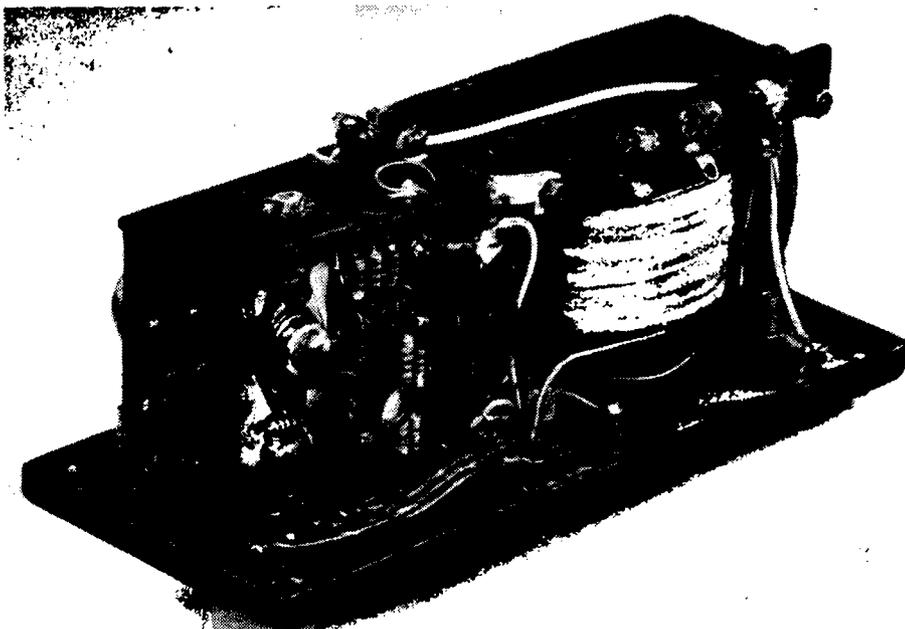
The construction of the main unit is left to the reader, following the general advice given by Marston. The optical trigger amplifier and sensor should be checked on the bench as follows. When the light path is uninterrupted; Tr₃ collector should be cut off, the current in R₁₉ about 22.5mA and the current in R₁₇ between 100 and 200µA. When the light path is interrupted; Tr₃ collector should not exceed 1V, the current in R₁₉ should drop to about 17.5mA, and in R₁₇ it should be less than 1µA provided that there is no background illumination. The circuit should change state cleanly when the current in R₁₇ exceeds about 30µA.

Installation

When installing the sensor and shutter, the mechanical clearances over the full rotation (taking account of distributor bearing play) should be carefully checked. Between the shutter edge and the base of the slot in the sensor there should be between 0.25 and 0.75mm clearance, and from 1.0 to 1.5mm on the sides. The fly leads should be wound into a four-turn helix around a 3mm drill shank and either taken through a grommet in the base of the distributor, or to a pair of feed through bushes; the fly leads must not foul or be strained over the range of vacuum advance travel. The capacitor from the distributor should be mounted alongside the coil and connected to the redundant contact breaker lead from which a lead may be taken to the c.b. connection of the coil as a "get you home" expedient. The contacts should be kept open with a slip of Tufnol to hold the heel clear of the cam when using the optical system.

The complete system should be monitored with a voltmeter at the tachometer output with the engine at tick-over — there should be no voltage kicks indicative of false triggering. If this is not the case, the supply line impedance may be the most likely cause, as in the case of the basic c.d. system (WW January 1970). Similar checks should be made when selecting each of the electrical services in turn. The most probable source of interference will be horns operated directly from the button; however, the horn is infrequently used and the effect on the engine is only slight.

Some problems were experienced from relay transients during the circuit development, and better noise immunity was achieved by adopting a 3V threshold for Tr₅ and transferring Tr₆ from the main unit to the sensing head. The timing delay introduced by the optical system was measured in a test rig where a second i.e.d., driven from the tachometer output (with C₄ disconnected) was mounted behind the shutter, 180° away from the sensor. The shutter, comprising two 0.5mm slots



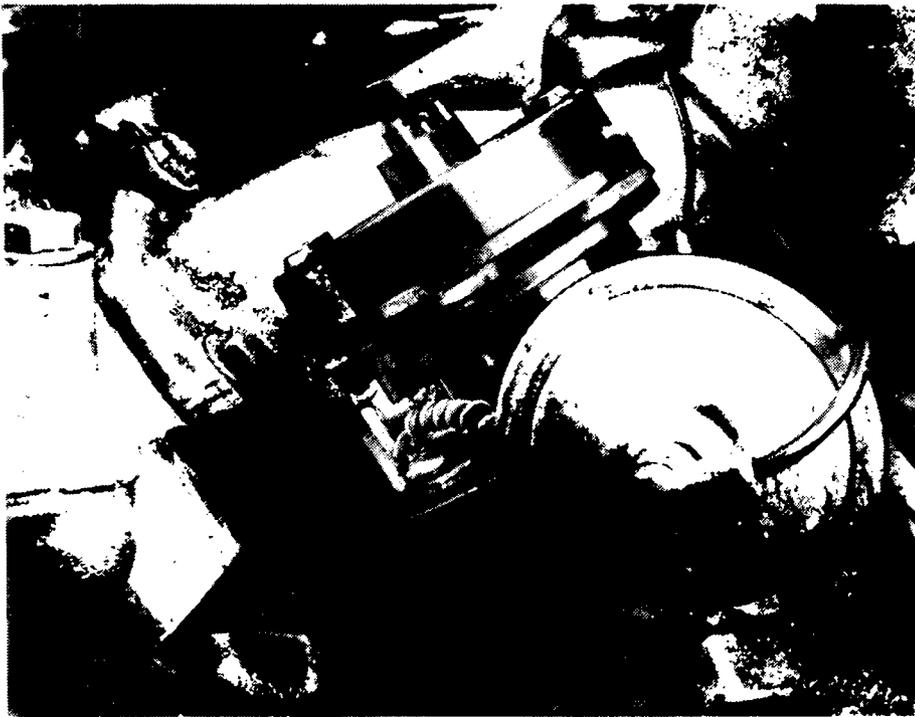


Fig. 8. Horizontal-axis sensor head mounted in a Delco Remy distributor on a Saab motor car.

diametrically opposed, was run at 3,000 r.p.m. (i.e. 6,000 crank r.p.m.) and the angular movement of the l.e.d. needed to restore full brilliance when viewed through the slot was less than 30 μ s. The low voltage start performance was

also simulated in powering the ignition from 6 V, and good starts from cold were achieved. This is a stringent test because under realistic conditions low voltages are only severe during the starter motor transient from rest.

The system described has operated with complete reliability and no timing drift for over 18 months in the author's car, as well as six months in a Singer Vogue. In the last-mentioned case, the electrical system used a positive earth, so a three-wire sensor was used with the main circuit wired upside down. Readers wishing to instal a permanent tachometer may use any suitable moving coil movement up to about 2mA f.s.d. The meter should be mechanically zeroed to offset the standing voltage present with the ignition on and the engine stationary. The desired f.s.d. may be set with an appropriate preset resistor. The linearity is good between 1,500 and 6,000 r.p.m., but will require calibration at a known road speed equivalent. As a guide, 9V is approximately equivalent to 5,000 r.p.m. on a four-cylinder engine. Although the trigger amplifier was specifically designed for use with the Marston c.d. unit, it should be readily adaptable to suit other designs in existence.

Literature Received

Four publications from Willsher and Quick describe their cases, racks and card frames now available. The 19-in Eurorac, Camac 19-in racks and the AEC-NIM range of crates and modules are described. Willsher & Quick Ltd, Walrow, Highbridge, Somerset TA9 4AQ WW401

A catalogue, detailing transformer assemblies for use in 5-1500VA applications, has been sent to us by Custom Transformers Ltd. Only the mechanical parts are offered. Custom Transformers Ltd, Bristol Road, Malmesbury, Wilts SN16 0DU WW402

The Ensign range of high-voltage, high-stability power supplies is described in a new leaflet sent to us by Brandenburg Ltd, High-voltage Engineering Division, 939 London Road, Thornton Heath, Surrey CR4 6JE WW403

We have received a leaflet from Hipotronics, which gives details of a range of dielectric and insulation testers, working at potentials up to 10kV a.c. and 25kV d.c. Leaflet HP7107 is obtainable from Hipotronics, Inc., Brewster, N.Y.10509, U.S.A. WW404

A new leaflet from BHS gives full constructional and technical data on the 2500VDC series of h.v. capacitors, which are epoxy-encapsulated and of polypropylene construction. The leaflet is available from BHS Electronics (Sales) Ltd, Bercourt House, York Road, Brentford, Middlesex WW405

Digital panel meters, with 200mV or 2V full-scale sensitivities, and 3½-digit l.e.d. displays, are described in publication D.1 from Farnell Instruments Ltd, Sandbeck Way, Wetherby, West Yorkshire LS22 4DH WW406

A pulse measuring system, counter and digital multimeter are combined in the Field Datameter DTM1000, described by Weir in a new leaflet. The instrument is for use with t.t.l. and m.o.s. logic and, in addition to voltage and resistance measurements, display of transition times, pulse width, duty cycle, time interval and pulse overlap is provided for. Weir instrumentation Ltd, Durban Road, Bognor Regis, Sussex WW407

The range of optoelectronic devices from Hewlett-Packard is fully covered in a new Designers Catalogue, which includes data on l.e.d.s, l.e.d. displays, isolators and detectors. The catalogue is obtainable free from GDS Sales Ltd, Michaelmas House, Salt Hill, Bath Road, Slough, Bucks WW408

Details of ITT power supplies, d.c.-to-d.c. converters and transformers, together with a number of reprinted articles, are published in a new catalogue from ITT Components Group Europe, Electrical Product Division, Edinburgh Way, Harlow, Essex WW409

Two brochures from Du Pont describe a range of conductive silver compositions, for use with various methods of application to the substrate and curing temperatures. The brochures can be obtained from Du Pont Electronic Materials Division, Maylands Avenue, Hemel Hempstead, Herts WW410

We have received from Ferranti a 40-page catalogue of application information and data on

T/R cells and duplexers. Ferranti Ltd, Professional Components Department, Dunsinane Avenue, Dundee DD2 3PN WW411

A brochure describing a buffered magnetic tape transport for minicomputer use is obtainable from Pertec International, Peripheral Equipment Division, 10 Portman Road, Reading, Berks. The system includes the buffered tape formatter and one of several transports, providing auto read and write for tape/buffer transfers, at up to 79kHz WW412

The 360-page Marconi Instruments catalogue for 1975/6 is now available, covering a wide range of measuring instruments for the communications and electronics industry. The catalogue is obtainable from Marconi Instruments Ltd, Longacres, St Albans, Herts.

Equipment for vacuum handling of small components and a range of de-soldering instruments is described in leaflets produced by Air-Vac Engineering of Connecticut, U.S.A. The leaflets can be obtained from Tony Chapman Electronics Ltd, 80a High Street, Epping, Essex CM16 4AE WW413

A leaflet describing the Mini-Therm range of temperature controllers is published by Solid State Controls. The units are either plug-in or panel-mounting types and can cover temperature ranges between -100°C to +1600°C, using either thermocouples or resistance bulbs. The leaflet can be obtained from the company at Brunel Road, Acton, London W.3 WW414

The Ariel group of companies have sent us a range of catalogues, describing electrical connectors, lampholders, fans, audio leads, tools and gauges. Available from Ariel Group of Companies Ltd, Wollaton Road, Beeston, Notts WW417

Research Notes

Black holes to solve the energy crisis?

Atom-sized black holes could spell the end of man's frantic search for energy, according to American physicist George Chapline of California University. Just before a black hole swallows matter, a pulse of radiation is emitted. This fact, coupled with the notion that there may be quite sizeable numbers of these minute black holes about the universe (10^{23} in our galaxy), prompted the suggestion that a captive hole could provide our energy needs for all time. As an added bonus its insatiable appetite for matter would neatly solve the problem of rubbish disposal. But where do you find a black hole, and perhaps more difficult still, how do you contain it when you've got it? One possibility would be to give it a charge and then suspend it in an electric field. Then simply add garbage (any old junk will do) and wait for a pulse of energy to emerge. So easy, but, maybe we'd better stick to nice safe plutonium reactors after all. Black holes, if they exist, are supposed to have a rather nasty habit of turning into white holes and then . . .

Come back, Geller, all is forgiven?

If the idea of generating power from black holes seems just a little on the dangerous side, then there may be a perfectly safe alternative. Indian research shows that when a metal rod is broken, electric and magnetic fields are produced around the fracture. In the experiment a test rod was placed near a small copper "aerial" connected to an oscilloscope and then stretched to the point of breaking. Although the effect only lasts for a few tenths of a second, a rod made from magnetic material does acquire a degree of permanent magnetism.

Just a second . . .

If you've built one of the recent designs for crystal-controlled digital clocks, you're probably congratulating yourself on how few seconds it gains or loses in a year. And indeed time and frequency are the most accurately measurable of all physical quantities. But oddly enough it appears that, even using atomic frequency generators, a perfectly standard second is a rather elusive commodity.

You probably recall an experiment a few years ago in which atomic clocks were synchronised and then flown around the world in opposite directions. The result, predicted by Special Relativity, was a discrepancy of several microseconds. This is the so-called Time Dilation Effect, and so paradoxically standard time must stand still!

Gravity is another factor affecting time, and indeed all the world's standard clocks are corrected according to their height above sea level. But even with this sort of precaution, standards labs still have to issue correction factors to bring themselves into line, and, until recently, for no obvious reason.

The solution, according to two Canadian physicists, may lie in the suggestion that we've all overlooked yet another aspect of relativity. Maybe the rotational acceleration of the earth needs to be taken into account, making time different in different latitudes. Curiously enough when the latitude correction was applied to data from all the world's time standards there was complete agreement, with however one exception — the Royal Greenwich Observatory. So maybe British Standard Time is quite unique after all!

Bat sonar is best

Bats can be trained to distinguish between targets which look the same on ordinary man-made sonars. Research in St Louis, Missouri, USA, used plastic objects of nearly identical size and shape. The only difference was that shallow depressions in the objects (square slabs of Perspex) differed in depth. The bats (rewarded by food when they responded to the correct target) learned to discriminate effectively between holes 7mm and 8mm in depth.

Sound waves to hold liquids in space lab?

One of the most striking demonstrations of standing waves is the generation of Chladni's figures. A vibrator, such as a square piece of metal sheet, suspended at its centre is set in harmonic motion by applying acoustic energy. Fine powder — traditionally lycopodium spores — sprinkled on the surface moves to the points of minimum

amplitude. The result is a visual standing wave display.

A three-dimensional acoustic standing wave in the air would show similar properties if gravity were absent. Solids or liquids placed in the sound field would be pushed to the points of minimum amplitude and held there.

It is proposed to use this effect in several crystal-growing experiments on board Spacelab, where ultrasonic standing waves will prevent alloys such as gold-germanium from coming in contact with any container. In this way it will be possible to achieve hitherto impossible standards of purity.

Meteorites: poor man's intelsat?

Those who can remember the good old days when wavelengths below 100m were "relegated" to amateurs will take pleasure in the belated arrival of the professional in yet another erstwhile amateur province; in this case meteor-scatter. Scientists at Lahore University in Pakistan are now exploring the possibility of using the ionisation trails left by meteors as a sort of cheap substitute for the communications satellite. Full of eastern promise you might think, but the snag, of course, is the unpredictability of the meteor trails. Undeterred by this the Pakistani scientists plan to record digital data and then fire it off at high speed whenever conditions are ripe. Quite obviously the wise men of old who followed the star in the east never guessed the habit would be catching!

Sixty Years Ago

The contents of our November 1915 issue must have been frustrating in the extreme for the thousands of amateurs who were forbidden even to possess "wireless" parts, be they for transmission or reception. The journal was full of the activities of military and marine operators, but the war had put paid to any participation by unofficial listeners or operators. The most tantalizing article was on the exposure of German neutrality violation at their station at Sayville in the USA. Apparently the Germans were using innocent-sounding commercial messages to convey military information from the US to German submarines, and an American experimenter, C. E. Apgar, had recorded the messages on wax cylinders. Sayville was promptly taken over by the US authorities.

The editorial of this issue contained what may have been one of the first references to a "black box." The writer of the editorial was promising a bumper Christmas issue and said "A notable feature will consist of a brightly written story covering the twenty years (more or less) which have elapsed since Senatore Marconi landed with his little black box on the shores of England."

More from the Berlin show

An improved model of the three-year-old Philips VCR video cassette recorder was introduced, model N1500 having sold an estimated 90,000 units. As well as the obvious areas of improvement, such as greater integration of components and re-styled appearance, stability has been improved, a "stop-motion" facility added and a greater bandwidth achieved — 3.1MHz for the luminance channel instead of 2.7MHz. Model N1460 also features the stop-motion and wider bandwidth, but is a playback-only unit. The new models sell for DM2750 (DM2450 for the N1500) and DM1980.

Sony gave the first European demonstration of their 305cm colour projection system, VPK1200E, using a specially-developed Trinitron tube. Sony's president, Akio Morita, said at a press conference that with tape recorders and colour television being the company's two main technologies, Sony saw their future in combining the two. He told *Wireless World* that in future colour tv sets would have a cassette system built in, especially as the choice of television broadcasts was small and receivers were in use for only a limited time. Units incorporating a 48cm colour receiver and Sony's new 1.3cm Betamax cassette system are being prepared for marketing in the US for \$2,295. The outstanding feature of the Betamax system is its very low tape consumption — lower in fact than BASF's LVR proposal. It achieves this by reversing colour phase polarity on alternate tracks, thus allowing guard bands between diagonal video tracks to be eliminated. A comb filter technique is used to deal with remaining crosstalk.

Because of the greater penetration of colour television receivers, and the joint venture with MCA, Philips plan to market their VLP video disc system first in the USA during the latter part of 1976. Marketing in Europe is planned for 1977, with "software" probably being mostly supplied by Polymedia, a 50:50 Philips and Siemens venture. There are hopes that the potentially competitive systems under investigation by Zenith and Thomson-CSF, will produce compatible discs — Zenith have now chosen an optical system and have demonstrated compatibility on a Philips player, and Thomson are reported to be thinking in terms of a reflective disc.

Since our last report on VLP players (pages 541/2, 1973), a further servo-controlled mirror has been added. The single pivoted mirror behind the objective lens and its control system allowed for radial tracking corrections due to eccentricity of the track. Though eccentricity of the hole and player combined is less than 50 μ m a longitudinal correction is needed to avoid timing errors, provided by a second orthogonal mirror and servo system. Other improvements have enabled a full composite video signal to be recorded

with a 5MHz bandwidth, instead of translating the colour subcarrier downward and limiting luminance bandwidth to 3MHz.

The Rabe MDR magnetic video disc recorder appears now to operate at 33 rev/min — when we first reported this development, speed was 156 rev/min (p.542, 1973), but the unit wasn't available at the time of our visit. The unit is expected to be available at the end of the year for DM2,000-2,300. The most likely problem this will meet is that due to dust on the disc surface — good head to disc contact being important to prevent dropout. Then there is the duplicating problem to be tackled.

Transcription units

A host of new cassette decks have the Dolby B system fitted (many being front-loading decks) — Akai, Braun, Elac, Grundig, ITT, Kenwood/Trio, NAD, Pioneer, Saba, Sanyo, Sharp, Tandberg, Telefunken, Uher and Wega (now owned by Sony). Some have both Dolby B and the Philips d.n.l. built in, such as the Braun TGC450, Elac CD520 and Philips N2520, while the Grundig CN700, Sanyo RD4050 and Saba CR833 have d.n.l. only. A new trend is the use of Dolby circuits in music centres, and according to Dolby Laboratories there are now 10 such models. There is still a lack of quality cassette machines with built-in power amplifiers.

Automatic arm lift-off is provided in the new Thorens TD145 turntable unit whilst leaving the pickup arm completely free of any mechanical attachment. A ferrite magnet is attached to a vertical spindle at the pickup arm centre of rotation, and a sensing coil energized by an h.f. oscillator is situated close to it. When the acceleration of the pickup arm in the run-out part of the disc groove is sensed the motor is switched off and the pickup arm lifted using the cueing lift.

The astonishing Technics SP-10 Mk2 professional direct-drive turntable was given its first European showing. Speed drift is held to within $\pm 0.002\%$ by a quartz-controlled oscillator, giving a playing time repeatable to within $\pm 0.036s$ for a 30 minute l.p. disc! It is insensitive to drag load, lkg not causing any change in speed. Full speed is achieved in 25 degrees of revolution (at 33 rev/min) and the 3kg platter can be stopped in 30 degrees. Speed change time from 33 to 45 rev/min is 0.1s. Needless to say wow and flutter are imperceptible. It includes a 78 rev/min speed, and the only slight disadvantage we could possibly pick out is the lack of a 16 $\frac{2}{3}$ rev/min speed which can sometimes be useful for pickup cartridge testing. But this is no loss for broadcasters, for whom the unit was intended. GBS.

Books Received

Principles and calculations for radio mechanics part 2 by R. A. Braney and A. P. Gilbert. This publication deals with subjects relative to the City & Guilds Radio Mechanics course 222 and is also suitable for courses 231 and 221. Price £1.90. Pp. 166. Newnes-Butterworth, Borough Green, Sevenoaks, Kent TN15 8PH.

Electronics Theoretical & Experimental is published monthly and contains a collection of papers by specialists in the electronics field. Most of the papers are theoretical with a full mathematical analysis making them suitable for knowledgeable engineers. Price (annual subscription) £50. Taylor & Francis Ltd, 10-14 Macklin Street, London WC2B 5NF.

SCR applications handbook edited by Dr Richard G. Haft is a very useful paperback devoted to thyristors and triacs. Thirteen chapters cover most aspects of s.c.r.s including series/parallel operation, a.c. phase control, and choppers, with the final sections dealing with protection, cooling, and testing of devices. Numerous circuits are given together with the waveforms produced for different modes of operation. Price £1.50. Pp.536, International Rectifier, Hurst Green, Oxted, Surrey.

Directional Broadcast Antennas by Jack Layton. This book deals with the practical aspects of installing, adjusting, and maintaining antennas using minimal theory and mathematics for explanation. Price \$12.95, pp.209. Tab Books, Blue Ridge Summit, Pa.17214, U.S.A.

The Use of Microphones by Alec Nisbett. This is a useful handbook for those wanting a working knowledge of microphones and recording techniques. The first chapter provides a crash course in sound and acoustics, with subsequent chapters covering speech, music balance, sound with picture techniques and the electronic control of sound. Price £1.75 (paperback), pp.168. Focal Press Ltd, 31 Fitzroy Square, London, W1.

International Handbook of Liquid Crystal Displays 1975-76 by Martin Tobias. At last! was the cry as I flicked through the pages, a book that will sort out one corner of the confused display market. After a general description of l.c. devices the chemistry of materials is discussed followed by the manufacture of displays. Subsequent chapters cover visual, optical and electro-optic characteristics of the devices with final sections describing drive systems, and lifetimes of l.c.s. The book also contains an international directory of the l.c. industry together with manufacturers of associated components. Ovum Ltd, 14 Penn Road, London N7 9RD.

Integrated Circuits vol. 1 analogue circuits, vol. 2 digital circuits, published by A. E. Kluwer. These two data books list details and characteristics of i.c.s sold with a PRO Electron classification. Price £6 and £7.50 respectively, available from The Technical Press Ltd, Freeland, Oxford OX7 2AP.

World of Amateur Radio

What goes wrong?

For several years the New Zealand Association of Radio Transmitters (NZART) has encouraged its branch groups to provide constructional kits for a variety of projects. For example, in 1970 the Otago branch provided 120 kits of parts for an s.s.b. exciter. P. W. Johnson, ZL4LV, who designed the equipment, has kept careful record of the problems that have arisen during the construction of 30 of these kits, amounting to some 70 faults. Of these, 15 were due to dry joints in soldering; there were 9 wrong parts used; 7 were errors in reading resistor colour codes; 11 parts had been omitted during construction; 2 diodes had been connected the wrong way round; but the most frequent faults, amounting to 20, arose in the winding and connection of the various inductors, in particular a trifilar-wound wide-band toroid output transformer, even though a special diagram had been provided to help constructors with this component. Of the actual components, only 4 were found to be faulty, less than 0.08 per cent of the total supplied.

From Australia comes the suggestion that cigarette smoking by amateurs may not only be a personal health hazard but can account for a significant number of equipment faults. Ron Fisher, VK3OM, claims that "having looked at dozens of receivers, transceivers and transmitters over the years, there is no doubt that a smoking amateur will have more trouble with his gear than his non-smoking compatriots. The by-product of cigarette smoke will firstly discolour the front panel, fog up the dial and meter faces, and finally work their way into valve sockets, relay contacts and even into the bearings of v.f.o. tuning capacitors. It forms a sticky coating over valves and, in conjunction with dust, forms a substance that will reduce the efficiency of a final stage to a marked extent."

Inflated awards?

A strong attack on the rapidly rising cost of amateur operating awards has been made by Jock White, ZL2GX, contest manager of the New Zealand

society. He suggests that amateurs are now being asked for excessive fees for some awards in what are "blatant money-making exercises" and believes that "the birth of the 'dollar per award'," derived from the "horrendous dollar per QSL" practice which grew rapidly about the time that specially mounted "DX-peditions" became popular.

Jock White accepts that return postage charges for QSL cards have risen alarmingly but considers these could be reduced by appointing accredited amateurs to check cards locally. He is particularly concerned at the recent imposition of the US\$10 charge for new applications for the DXCC (DX Century Club) and US\$20 for the five-band DXCC since these awards have become internationally accepted and recognised yardsticks of amateur radio operation.

But the cost of awards and certificates is only one aspect of the many problems that inflation and high postal rates are presenting to organised amateur radio operation. The R.S.G.B. has recently forecast "the worst financial result the Society has ever had in its history" which suggests that the deficit must be in the region of five figures. B.A.T.C. though still in surplus is urgently seeking ways of increasing revenue; many local societies are reducing the number of newsletters and other postal communications with members.

A. O. Milne, G2MI, who for over 30 years has been QSL Manager for the R.S.G.B., has urged amateurs to forget the old saying "the ultimate courtesy of a contact is a QSL card" pointing out that of the 1¼ million cards he receives each year some 600,000 are never claimed and have to be destroyed.

On the bands

After the summer doldrums, maximum usable frequencies for the h.f. bands rose steeply on September 5-6, bringing good long-distance openings back to 21 and 28 MHz. On September 5, the 21 MHz band remained open to the United States to beyond 2230 G.M.T. In view of recent suggestions that there may be a link between sunspot activity and earthquakes it may perhaps be significant that these high m.u.f.'s occurred at roughly the same time as the serious earthquakes in Turkey.

New Zealand amateurs believe they established a new world distance record for the 3.3 GHz band last February with a contact between Murray Willis, ZL2THW on Mount Murchison, 50 miles south of Nelson and Frances Brown-Douglas, ZL2TSM, on Mount Ruapehu, a distance of 238 miles. Height of the northern station was 5,650 ft. This follows an early 144-mile contact made with the same equipment (CV237 feeding a 3-ft dish aerial at both ends) to establish a Commonwealth record.

A recent "World Radio Club" visit to an RAF radio training centre near

Doncaster emphasised the continued importance (and problems) of h.f. radio and c.w. operation under difficult conditions. The 0815 G.M.T. transmission of this BBC World Service programme on Sunday mornings can now be heard on 1088 kHz medium-waves from the new external services transmitters in Suffolk.

Television topics

John L. Wood, G6AHT/T, in CQ-TV lists the following British amateur television stations as regularly active: G6ALT/T, Newcastle-upon-Tyne; G6ACK/T and G6AGC/T, Scarborough; G6AHW/T, Sheffield; G6AEP/T, Rotherham; G6MUR/T, Leicester; G6AHJ/T, Rugby; G6MXW/T, Warley; G6KQJ/T, Wolverhampton; G6ACH/T, Huntingdon; and also F6BQH/T, Calais, France.

Not all television and slow-scan television amateurs are happy with the latest IARU Region 1 band plans for 144 MHz and 432 MHz. M. T. Crampton, G6AHJ/T (G8DLX), urges that SSTV should use 144.23 MHz rather than the proposed 144.5 MHz which is not covered by a number of popular s.s.b. transceivers and which is used on Sundays for the R.S.G.B. news bulletins. B.A.T.C. is concerned that the proposed vision carrier frequency of 439.25 MHz is too close to the British band edge to permit use of 625-line vestigial-sideband transmissions to the System I used in the U.K. and appears to have been based on System G used in most of Europe.

In brief

The recent boom in the sale of Citizen's Band equipment in the United States may not be unconnected with a belief that many long-distance lorry-drivers and motorists are using the facilities to pass along thinly-disguised warnings of police speed traps. Recent F.C.C. decisions mean that CB radio can now legally be used "as a hobby or diversion", permit inter-state contacts, reduces the "silent period" between conversations and establishes Channel 11 as a national calling frequency. The demand for CB equipment has caused some manufacturers and distributors to reduce the amount of amateur radio equipment. . . . The Amateur Radio Retailers Association is holding its 4th amateur radio exhibition at the Granby Halls, Leicester, on October 30, 31 and November 1. . . . An R.S.G.B. evening symposium on "Amateur Radio Satellites" will be opened by Pat Gowen, G3IOR, and members of AMSAT-UK (IEE, Savoy Place, London WC2 at 6.30 pm. on November 4). . . . NZART are planning a Golden Jubilee conference in Auckland, New Zealand, from June 4 to 12, 1976 and have arranged group bookings with Air New Zealand.

PAT HAWKER, G3VA

Transmitter power amplifier design — 3

Practical considerations for a two-metre f.m. design using microstrip transmission line impedance matching

by W. P. O'Reilly, M.Sc., M.I.E.E.

The Plessey Company Ltd

The three stage amplifier to be described, which is intended for mobile use in the 144-146MHz amateur band, operates from a nominal 12-volt supply and provides an output of 20W for 150mW input. In order that the matching networks shall not be critically dependent upon capacitor tolerances, two section networks have been selected for all interstage matching and for the final output network. The resulting bandwidth of the amplifier is somewhat wider than the minimum required. If

greater miniaturisation is required higher Q single section networks could be used, but unless close tolerance capacitors are available trimmers would be necessary and these are both expensive and lossy at v.h.f.

The power transistors used are BLY34, 2N5990, and 2N5991 having output power and gain capabilities of 2.5W, 12dB; 10W, 7dB; and 25W, 4dB respectively when operated in Class C at 144MHz with a 12.5-volt supply. In this design the input stage is operated in

Class AB which provides a gain increase of about 2dB over Class C operation and provides a smoother increase in output power as the drive to the amplifier is increased.

From equation (1) in part 2 the output transistor requires a load resistance of 2.5Ω . The 50-ohms load is transformed to 2.5Ω by a two section matching network having an intermediate impedance of 12.5Ω . The parallel equivalent output capacitance of the 2N5991, which is typically 150pF and corresponds to a reactance of -7.5Ω at 144MHz, is tuned to resonance by a stripline collector choke.

The Smith chart of Fig. 1 illustrates the steps in designing the final stage output matching network: determine (e.g. from Fig. 5 in part 2) how many sections are required to achieve the required impedance ratio and bandwidth with an acceptable v.s.w.r. (note that more sections provide a lower loaded Q factor and hence smaller v.s.w.r., lower loss and less sensitivity to component tolerances). For this amplifier a two section network has been chosen.

Calculate intermediate impedance points at approximately equal geometric spacing. In this case 12.5Ω is selected as near to the geometric mean of 2.5 and 50.

Determine the stripline impedance to be used for the first section of the matching network. For maximum bandwidth the optimum impedance of

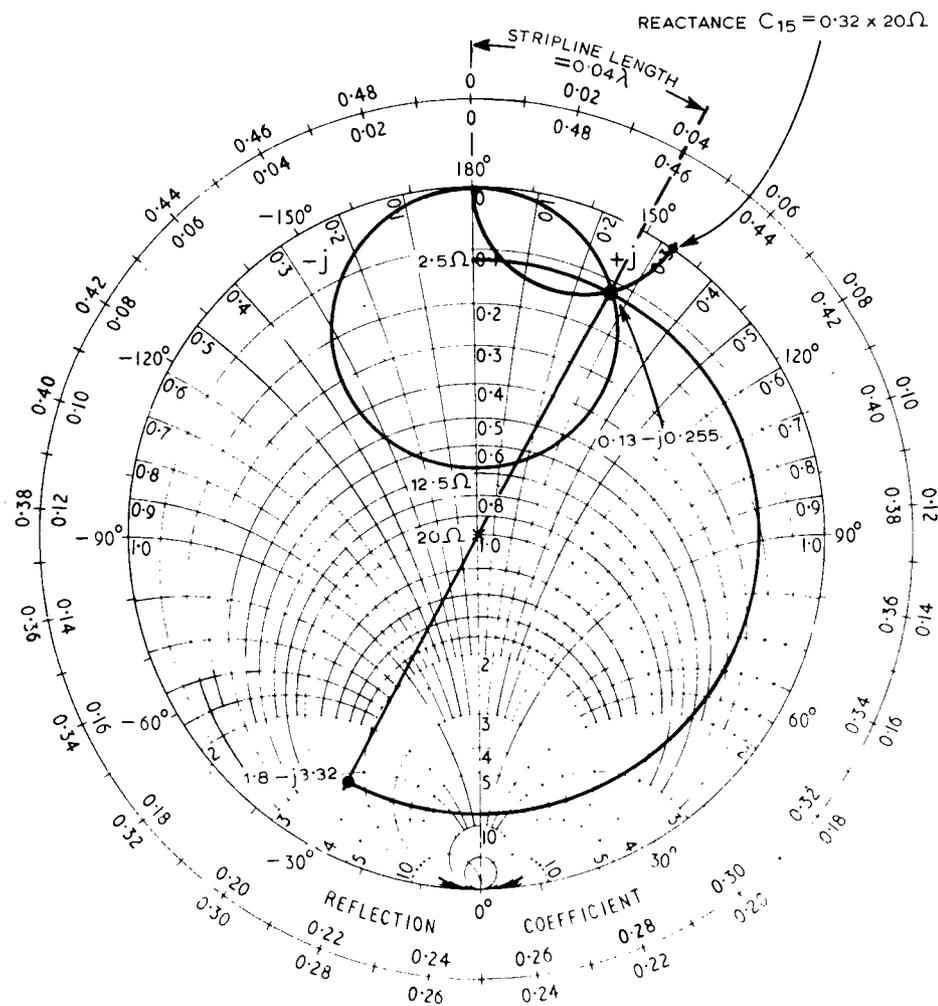


Fig. 1. Output matching network design using a Smith chart.

A member of the *Wireless World* staff has made available a printed circuit board for the strip line r.f. power amplifier. The board, which measures approximately 23×11 cm, is a double sided glass fibre type and is supplied roller-tinned and drilled. The one-off price is £4.50 inclusive. All cheques and postal orders should be made payable to M. R. Sagin and sent to 11 Villiers Road, London N.W.2.

A component layout diagram will be supplied with the board but will also be published in the final part of this series.

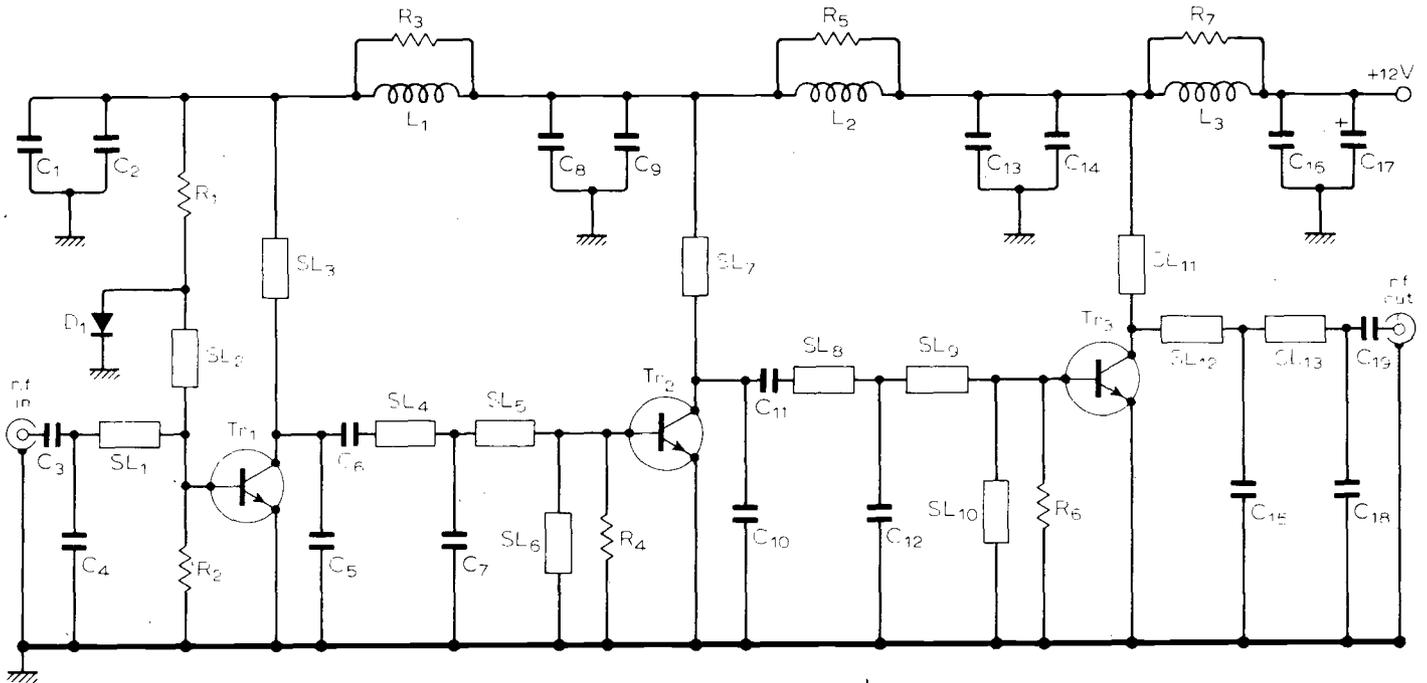


Fig. 2. Circuit diagram of the 20W v.h.f. power amplifier.

the line is $\sqrt{Z_1 Z_2}$, where Z_1 and Z_2 are the start and end impedances of the section, in which case a line length of $\lambda/4$ would be required. When a smaller bandwidth is acceptable a higher loaded Q factor is obtained using a shorter length of higher impedance line. In the present case a 20-ohm line is used giving a loaded Q of two. Use of a higher impedance line would result in further miniaturization but efficiency would be reduced and closer tolerance capacitors would be necessary.

On the Smith chart draw a circle with centre at $1 + j0$ — i.e. the centre of the chart — passing through the point $0.125 + j0$ corresponding to the required 2.5-ohm load resistance. At all points on the circumference of this circle the modulus of the voltage reflection coefficient, (ρ), is 0.78. Traversing the circumference clockwise from the point $0.125 + j0$ corresponds to the change in impedance when moving along the stripline from the 2.5-ohm point towards the load.

Draw a second circle centred on the $R_r(\rho) = -1$ line and passing through $0 + j0$ and $0.5 + j0$. The intersection between the two circles at the point $0.13 + j0.255$ corresponds to the junction of the stripline and the first shunt capacitor.

Draw a straight line from the centre of the chart passing through the point $0.13 + j0.255$. The required length of stripline is now read off from the calibrated scale around the chart. In this case a length of 0.04λ is indicated.

Calculate λ , the wavelength corresponding to 144MHz on the 20-ohm stripline. Due to the permeability of the dielectric, the wave travels at less than its free space velocity, and the guided wavelength is thus less than the free

space wavelength λ_0 . From Fig. 8 in part 2, $\lambda/\lambda_0 = 0.5$ for 20-ohm microstrip in a medium of $\epsilon_r = 5$, and the free space wavelength is $\lambda_0 = 3 \times 10^8 / \text{frequency} = 2.08\text{m}$. Thus $\lambda = 0.5 \times 2.08 = 1.04\text{m}$. The required length of line is thus $0.04\lambda = 4.16\text{cm}$.

In this amplifier the output capacitance of each of the transistors is tuned to resonance by a stripline collector supply choke. When maximum bandwidth is required the output capacitance and input inductance of the transistors can often be used as components of the matching network. The value of the base return chokes is not very critical but a low unloaded Q factor is required. In this design stripline chokes have been used and the Q factor is lowered by means of shunt resistors.

To ensure that any r.f. power on the supply line does not reach the early stages of the amplifier at a sufficient level to cause instability, very low Q factor inductors are used for supply line decoupling. The inductors are constructed by winding enamelled copper wire around the body of a metal oxide or carbon resistor and terminating the inductor so formed to either end of the resistor. Collector feed networks of this type ensure that the transistors operate into their correct impedances at the required working frequency and into near resistive low impedances at lower frequencies where, due to the increased internal gain of the transistors, the probability of destructive oscillations is much greater.

Printed circuit board

The striplines of the amplifier printed circuit board have been meandered to reduce the space which they occupy. A minimum meander spacing of twice the

conductor width is necessary to ensure that the characteristic impedance is not altered significantly. It is important to avoid running lines parallel to one another over distances approaching $\lambda/4$ since under these conditions quite strong coupling between the lines can occur. (This effect is made use of in directional couplers which will be discussed in the next article in this series.) Where a stripline abruptly changes direction a chamfer is used to reduce reflections caused by the discontinuity on the line. The p.c. board uses ordinary 1/16in epoxy-glass board with copper cladding of 1oz/sq. ft. on either side. It is essential to retain the copper on the reverse side of the board as this acts as an earth plane without which the striplines will not function correctly.

Components

Microstrip amplifiers contain only a minimum of discrete components. In this design apart from the power transistors the only unusual components are the capacitors used in the matching networks. Because of the very low impedances involved in v.h.f. solid state power amplifiers it is essential to use capacitors having very low internal inductance (e.g. at 144MHz only about 1nH inductance is required to create a 1-ohm reactance). Unencapsulated n-p 0 ceramic chip capacitors are ideal. Also suitable, but more expensive, are porcelain chips and uncased mica capacitors. To achieve reactances of 20 ohms or above, ceramic or mica capacitors with very short leads may be used, but it is advisable to connect several low value capacitors in parallel to achieve the required total capacitance.

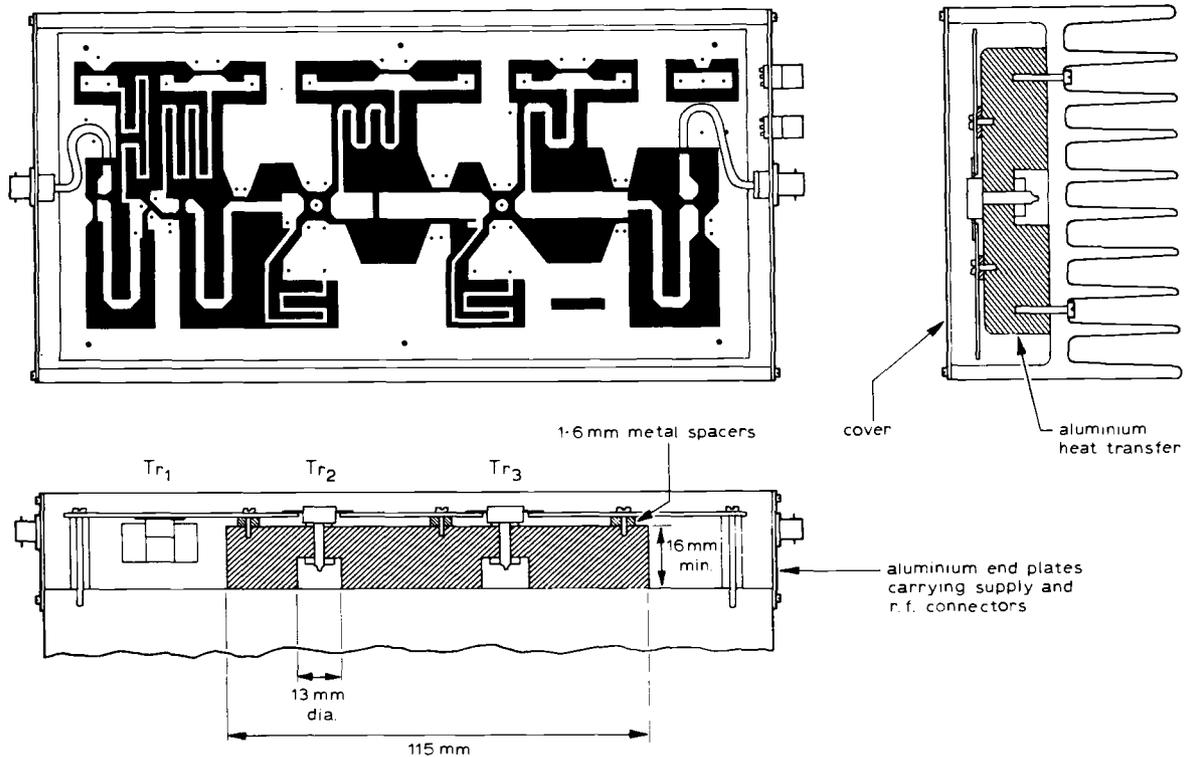


Fig. 3. Assembly of the power amplifier.

Construction

Fig. 3 shows a suggested method of constructing the power amplifier and the following notes should help in assembly.

- Select a heatsink having a thermal resistance to free air of $< 1^{\circ}\text{C}/\text{watt}$. This will permit safe continuous operation at ambient temperatures up to at least 50°C . If only intermittent operation is envisaged a less effective heatsink may be used, but the maximum duration of transmission must be restricted to avoid damaging the transistors.

- The input stage requires a $< 40^{\circ}\text{C}/\text{watt}$ heatsink and since the collector is connected to the case of Tr_1 an insulated heatsink of the clip-on type having low capacitance to ground is most suitable.

- Fig. 4 shows the method of connecting the components and coaxial cables to the microstrip lines. The power transistors must be bolted to the heatsink prior to soldering. The recommended stud torque for transistors of this type is 3.5 to 6.5 lb-in; excessive torque will result in damage to the threads of the copper stud. The surface of the heatsink should be smooth and flat with no burrs around the transistor mounting holes.

- If available, a smear of high thermal conductivity silicone compound such as Midland Silicones MS2623 should be used to improve the thermal contact between the transistors and their heatsink.

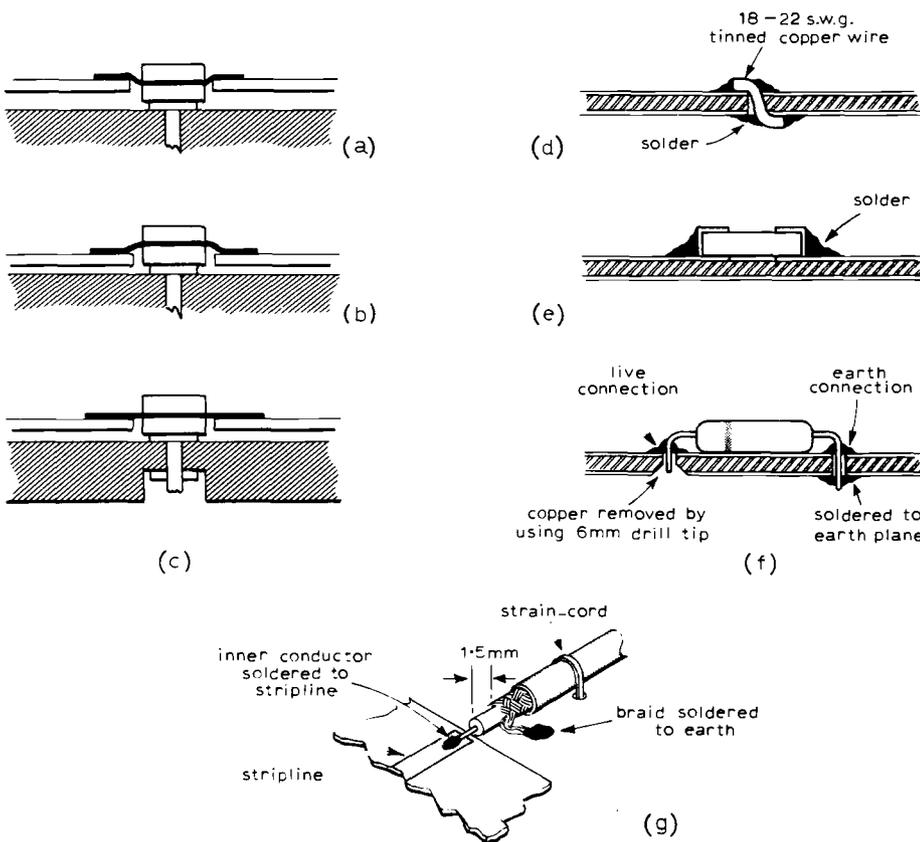


Fig. 4. Component mounting. In (a) and (b) spacers used in mounting a power transistor are not of the correct length, straining stripline leads and possibly causing fracture of package wall. In (c) the spacer is of the correct length. (d) through connection (e) chip capacitor mounting (f) typical resistor mounting (g) how low v.s.w.r. coaxial to stripline transition is made.

● **Caution.** Most stripline r.f. power transistors contain a layer of beryllium oxide between the silicon and the metal stud to provide high thermal conductivity and electrical insulation for the collector. This hard white material is extremely toxic and dust particles which result from fracturing the material must not be inhaled or allowed to enter the body via a cut or wound. Do not attempt to examine the interior of this type of transistor. In the event of damage faulty units should be returned to the manufacturer for disposal.

Testing

When a new power amplifier has been assembled there is always the possibility of a faulty component, badly soldered joints or an accidental short circuit and so it is essential that a careful initial testing procedure be carried out if the chance of an unexplained and expensive device failure is to be minimized. The following precautions, which are recommended for initial testing of the 2-metre mobile power amplifier, are generally applicable to the initial testing of solid state r.f. power amplifiers.

● Check that all components are correctly connected giving special attention to the orientation of stripline transistors. Ensure that the assembly is free from solder splashes and other foreign material.

● With the output of the amplifier correctly terminated, preferably via a wattmeter, and the input drive set to a very low level, monitor the supply current as the supply voltage is gradually increased to about 70% of nominal. The quiescent current for this amplifier should be less than 20mA at 8V supply. A power supply with a variable electronic current limit is ideal for initial testing. A heavy quiescent current is indicative of a faulty connection or component.

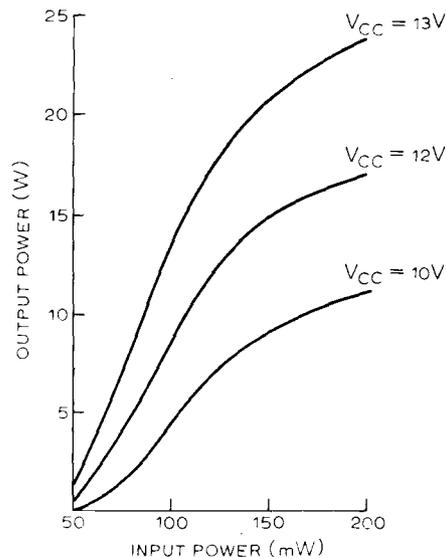


Fig. 5. Input/output characteristic of the amplifier over the 144-146MHz band.

● At the midband frequency gradually increase the drive to the amplifier. The output power and supply current should increase together. If they do not the current to each stage should be checked to determine the location of the fault. Any discontinuity in either output power or current consumption as drive is increased is an indication of instability and should be investigated and corrected before proceeding to test at full supply voltage when low frequency instability could result in destruction of the transistors.

● A spectrum analyser is extremely useful when the first prototype of a new design is being evaluated. The harmonic content of the output signal and any tendency for spurious or sub-harmonic instabilities under conditions of varying supply voltage, drive level or load mismatch may be monitored.

Matching network components

	Microstrip line				Capacitor		
	Circuit Ref.	Z ₀ (ohms)	Width (mm)	Fraction of wavelength	Length (mm)	Circuit Reference	Value (pF)
Input to Tr ₁ Single section 50 ohms to (12.5+j1) ohms	SL ₁	50	2.5	.073	79	C ₄	33.4
Interstage Tr ₁ to Tr ₂ 1st section 50 ohms to 12.5 ohms	SL ₄	50	2.5	.073	79	C ₅	33.4
2nd section 12.5 ohms to (3+j1) ohms	SL ₅	50	2.5	.014	15	C ₇	100
Interstage Tr ₂ to Tr ₃ 1st Section 10 ohms to 3 ohms	SL ₈	20	8	.037	38.5	C ₁₀	152
2nd Section 3 ohms to (1-j0.5) ohms	SL ₉	20	8	.015	15.6	C ₁₂	525
Tr ₃ to Load 1st Section 2.5 ohms to 12.5 ohms	SL ₁₂	20	8	.04	35.4	C ₁₅	172
2nd Section 12.5 ohms to 50 ohms	SL ₁₃	50	2.5	.073	79	C ₁₈	33.4

Components

Tr ₁	BLY33	Motorola, Ferranti
Tr ₂	2N5990	Motorola
Tr ₃	2N5991	Motorola

R ₁	1.5k
R ₂	82Ω
R ₃	15Ω
R ₄	2 x 15Ω
R ₅	15Ω
R ₆	2 x 15Ω
R ₇	15Ω

All resistors are ½W 10% carbon or metal oxide

L ₁	18-22 turns 30 s.w.g. wound on R ₃
L ₂	18-22 turns 30 s.w.g. wound on R ₅
L ₃	10-15 turns 26 s.w.g. wound on R ₇

C₁, C₈, C₁₃, C₁₆ 10nF ± 20%, 50V unencapsulated ceramic chip

C₂, C₉, C₁₄ 1000pF ± 20%

C₃, C₆, C₁₁, C₁₉ 33pF ± 5%, 50V
C₄, C₅, C₁₈ 150pF ± 5%, 50V
C₁₀ 2 x 150pF and 2 x 120pF each ± 5%, 50V n.p.o.

C₇ 100pF ± 5%, 50V n.p.o.

C₁₅ 100pF and 82pF n.p.o. each ± 5%, 50V

C₁₇ 22μF 15V electrolytic

Capacitors 2, 9, 14, 3, 6, 11, 19, 4, 5, 18, 10, 7, and 15 are all 50V n-p-o unencapsulated ceramic chip.

D₁ BAX12 or similar high conductance silicon diode

In this design, stability is ensured by careful supply line filter design and the use of low Q base return chokes. This ensures that a low source impedance is presented to the transistors at frequencies well below the operating band where the gain is much higher. Due to the inherent inductance of the low value resistors R₄ and R₆ very little gain at v.h.f. is sacrificed.

Fig 5 shows the input/output characteristic of the amplifier over the 144-146MHz band. A saturated output power approaching 25W is obtained for a total current consumption of 3.3A at 13.6V. This corresponds to an overall efficiency in excess of 50%. The collector efficiency of the output stage is over 75% when operating into a matched load.

(To be continued)

References

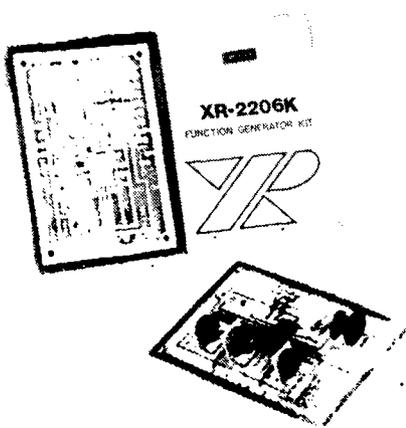
1. Jessop, G. R., A compact bandpass filter for 144MHz, *Radio Communication*, June 1971, Vol. 7, No. 6, p.390.

2. Matthaei, G. L., Young, L. and Jones, E. M. T., *Microwave filters impedance matching networks and coupling structures*, McGraw Hill, 1969.

New Products

Function generator kit

Two function generator kits based on the XR-2206 i.c. are now available from Rastra Electronics. Designated the XR-2206KA and KB both kits comprise a p.c.b., function generator i.c. and instruction manual but the last mentioned also contains the external components necessary for a complete circuit. The complete generator offers sine, triangle and square wave outputs with four overlapping frequency ranges which give an overall range from 1Hz to



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100kHz. Total harmonic distortion of the sine wave is typically 0.5%, and the sine/triangle output can be varied from 0 to 6V peak-to-peak from a 600Ω source. The square wave is available at a sync output terminal for oscilloscope synchronizing or driving logic circuits. The circuit also has a.m. and f.m. capabilities. Rastra Electronics Ltd, 275-281 King Street, Hammersmith, London W6 9NF.

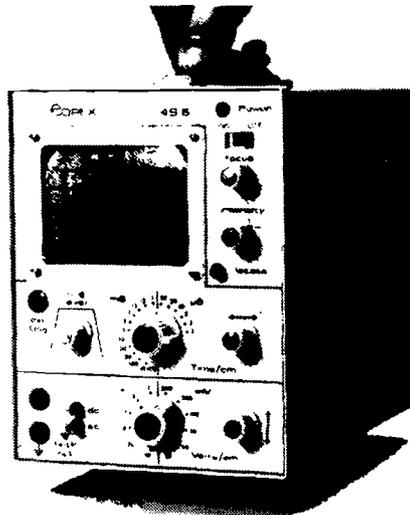
WW 301 for further details

Video tape printer

This is a half-inch video cartridge copier comprising two separate units, a master tape recorder and a tape "printer." The tape recorder will accept inputs from a variety of media, including colour or black and white television cameras, monitor receiver, record player or microphone and produces a 1/2in master tape. The tape so produced can then be loaded into the duplicator and up to 1,000 copies printed off.

Copying is at 10 times normal speed and operation is fully automatic. National Panasonic (UK) Ltd, Whitby Road, Slough, Bucks.

WW 302 for further details



WW 303 for further details

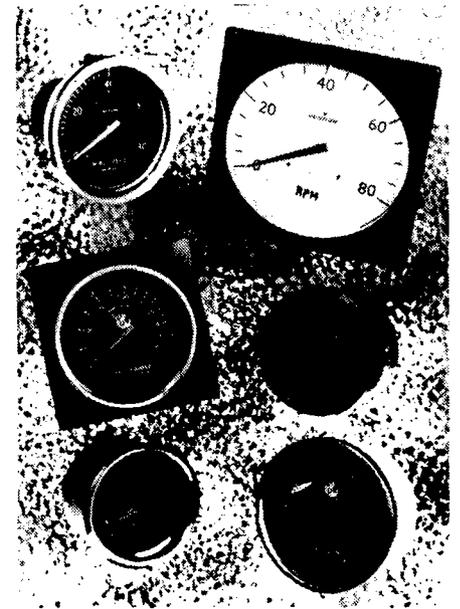
Low cost scope

Scopex have added the model 4S-6 oscilloscope to their range of instruments. This is a low-cost single-beam unit intended for educational and servicing applications. The instrument has a 6 × 8cm screen and offers a bandwidth of 0 to 6MHz, a sensitivity from 10mV to 50V/cm, a maximum sweep speed of 1μs/cm, and a maximum measurement error of 5%. The 4S-6 is priced at £88 and is available from Scopex Instruments Ltd, Pixmore Industrial Estate, Pixmore Avenue, Letchworth, Herts SG6 1JJ.

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Moving coil meters

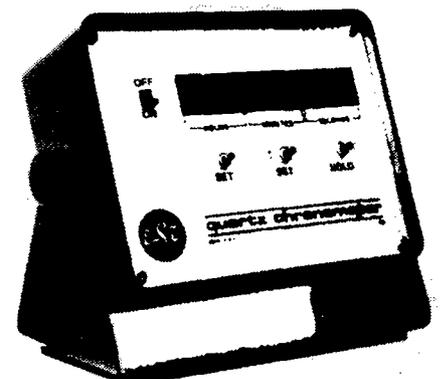
A range of 240° moving coil meters called Lincators will measure any parameter that can be represented by a change in direct current or voltage. The makers claim that these meters have a completely linear, or exactly repeatable non-linear, scale with an accuracy to within 1% which is achieved by a patented self-compensating design. A range of cases with diameters from 52 to 250mm is available and movements with sensitivities of greater than 1mA



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WW 306 for further details

f.s.d. Smiths Industries Ltd, Industrial Division, Waterloo Road, Cricklewood, London NW2 7UR.

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Power supply

Three types of laboratory bench power supply units are being offered by Gresham Lion. All have a maximum output voltage of 30V and two are dual output types. The GBS 30/25 is a single output, 0-2A, 0-30V unit; the GBS 30/1D is a dual output 0-30V, 0-1A unit and the GBS 30/2D is a dual output 0-30V, 0-2A unit.

Each of the units is fitted with a voltmeter and an ammeter, and has coarse and fine output voltage and current controls. Gresham Lion Electronics Ltd, Gresham House, Twickenham Rd, Feltham, Middx TW13 6HA.

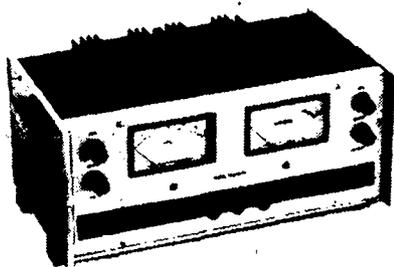
WW 305 for further details

Quartz chronometer

The model 401 is a solid state chronometer which uses a 3MHz crystal to achieve an accuracy to within one second per month at room temperature. The unit is powered from either the mains supply of a 12/24V external battery, with an optional self-contained nicke-cadmium battery.

Seven-segment l.e.d. displays are used in the chronometer which has four versions available either as ready built units or as kits. Electro Systems and Timing Co, 48 Robinson Road, Loudwater, High Wycombe, Bucks HP13 7BJ.

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WW 305 for further details



WW 309 for further details

Push button tuner

The CT9 is a novel, patented push-button selector system, coupled to a car radio tuner. Being extremely slim, the design can be combined with a car cassette player mechanism and still be mounted in the normal dash aperture. Autonnac Ltd, Tollesbury, Essex.

WW 307 for further details

Push-button switch

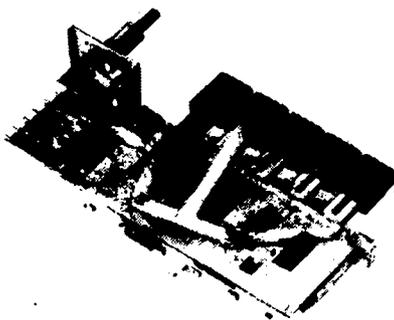
The DSR1066 is an addition to the Bulgin DS1000 series of push-button switches. Requiring only a simple push-fit to a panel, it can be illuminated if required, carry messages and is a push-on, push-off action.

The contacts are twin s.p.c.o. rated at 5A, 250V with the low voltage illumination being isolated from the switches. Available with five lens colours, the components can be assembled with other items from the DS1000 series, to extend the choice of panel presentation and switching configurations. Bulgin & Co. Ltd, Bye-pass Road, Barking, Essex IG11 0AZ.

WW 308 for further details

X-Y recorder

A potentiometric X-Y recorder, suitable for use with A4 standard size graph paper, has been introduced by S.E. Labs (EMI) Ltd. Known as the SM225 Mk II, it features electrostatic chart retention, a zero point which can be set in any



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position and a 'zero check' switch for instant zero indenting. Chart location is achieved using two points of light as a reference.

Two versions are available, either with 14 steps of sensitivity from 0.5mV/cm to 10V/cm with an interposed vernier adjustment, or with 16 steps between 0.05mV/cm to 5V/cm.

Additional options include a fixed range input for single function operation and a chart feed and winding adaptor for 180mm wide roll-chart application. SE Labs (EMI) Ltd, North Feltham Trading Estate, Feltham, Middlesex.

WW 309 for further details

Digital multimeter

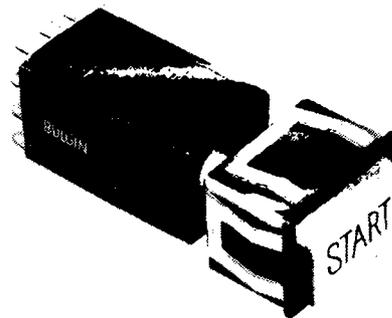
The TR-6656 is a digital multimeter with a d.c. voltage measurement accuracy of 0.01% of reading and a resistance accuracy of 0.015% of reading.

In addition to measuring a.c. and d.c. voltage, direct current, and resistance the unit also measures frequency, period, time interval and incorporates auto-ranging, start and stop inputs together with other separate inputs for the measurement of current, resistance and voltage. REL Equipment and Components Ltd, Croft House, Bancroft, Hitchin, Herts SG5 1BU.

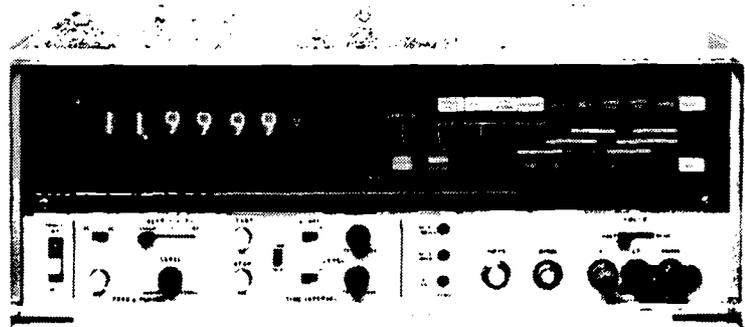
WW 310 for further details

Instrument cases

A range of p.v.c.-clad Colorcoat steel cases is being introduced by Vero and is to be called Veropak. Five sizes are



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offered with a fixed height of 158mm and depth of 220mm, these being in widths of 278mm, 316mm and 405mm. The 316mm wide case is also available in a 308mm high version and the 405mm case in an additional 114mm height.

Ventilation louvres are cut in the rear and base panels and the front panels are anodised. Vero Electronics Ltd, Industrial Estate, Chandler's Ford, Eastleigh, Hants.

WW 311 for further details

H.v. probe

A high-voltage probe with a meter mounted in the handle is being marketed by Precision Instrument Laboratories. The scale has an accuracy of 2% at 25kV and an f.s.d. of 40kV.

The probe tip is 13in long and capable of reading under the corona caps of most TV tubes. Price £22.00 plus VAT. Precision Instrument Laboratories, Instrument House, 212 Ilderton Rd, London SE15 INT.

WW 312 for further details

D.i.y. potentiometers

The MOD POT components are designed to permit design engineers to assemble prototype potentiometers in a wide variety of configurations. They consist of parts for the Allen-Bradley Series 70, $\frac{5}{8}$ in square potentiometers and can be offered in either hot-moulded carbon or cermet resistance elements and in single, dual, triple and quad control versions. In addition a variety of switch, drive, shaft, bushing lug and terminal arrangements are possible. Allen-Bradley Electronics Ltd, Pilgrimsway, Bede Industrial Estate, Jarrow, Tyne and Wear NE32 3EN.

WW 313 for further details

Tool cases

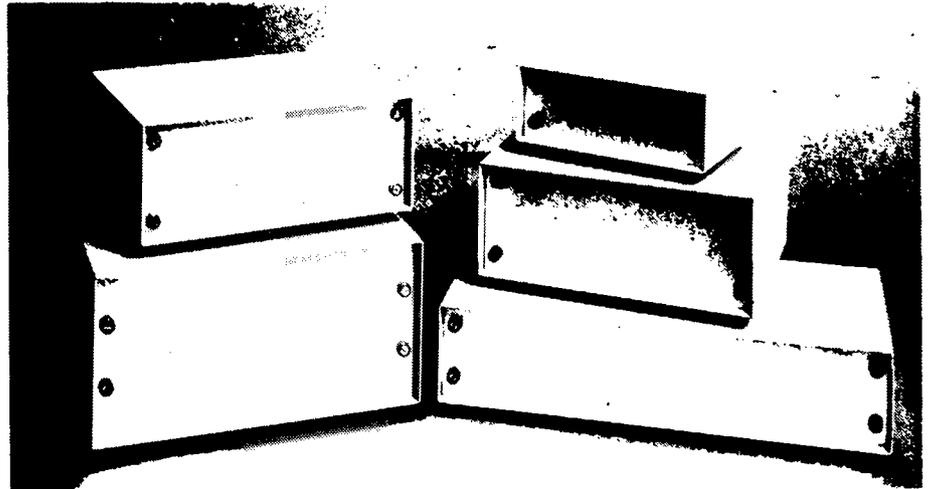
Topper are adding to their existing range of carrying and tool cases by offering specialist cases in sizes up to 30 x 15 x 7in. Suitable for use with audio-visual equipment, telecopiers and portable electronic units, they are designed to protect against a wide range of environmental hazards. Topper Cases Ltd, St. Peter's Hill, Huntingdon PE18 7ET.

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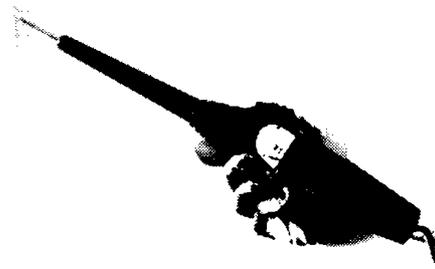
Resistance element

Suitable for measuring temperature on plane and slightly curved surfaces, the WF 60 resistance element can be used in the temperature range -250°C to $+600^{\circ}\text{C}$. Designed to withstand vibration and display long term stability with a high response rate. Degussa Public Relations Department, D6000 Frankfurt am Main 1, Postfach 2644, Germany.

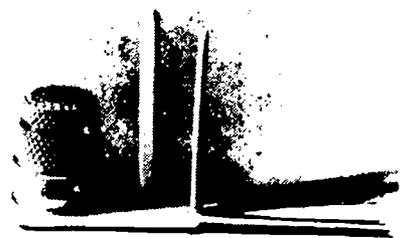
WW 315 for further details



WW 311 for further details



WW 312 for further details



WW 315 for further details



WW 314 for further details

P.c. connectors

A range of printed-circuit connectors are now available from Dieter Assmann Electronics, suitable for p.c.bs of thicknesses from 1.4mm to 2.54mm and having single or double sided contacts.

From six to 146 contacts per connector can be provided in the standard range or by using the modular connectors, series A2—MS or A3—MS a virtually unlimited number of contacts can be obtained.

Using appropriate end flanges, the connectors can be adapted for horizontal or vertical mounting, or used unmounted. Contacts are of gold or nickel plated phosphor bronze and can be supplied for 3A or 5A loads. Dieter Assmann Electronics Ltd, Victoria Works, Water Lane, Watford, Herts.

WW 316 for further details

Multi-turn trimmers

An addition to the capacitance range of p.t.f.e.-dielectric Tetfer trimmers has been announced by Jackson Brothers. It is called the 8mm, 20pF Tetfer Trimmer, Cat.No.6030 and is mounted on an 8mm diameter ceramic base. Tolerance at maximum 20pF is -0%, +30% in a temperature range from -55°C to +125°C.

The temperature coefficient is zero within $\pm 100\text{ppm}/^\circ\text{C}$, the power factor better than 0.001 at 1MHz and the tuning resolution, 18 turns from minimum settings to maximum. Jackson Brothers (London) Ltd, Kingsway, Waddon, Croydon, Surrey.

WW 317 for further details

Radiocom system

The SC905 is an addition to the SC900 series radio communications systems from Sonab. It consists of a simplex central processing unit, a u.h.f. transmitter operating on one channel in the 420-470MHz range and the option of a v.h.f. receiver providing duplex operation. Controlled by dial telephone, the c.p.u. converts the dial impulses to tones used to call the mobile stations.

These consist of pocket units, $53.5 \times 126 \times 19\text{mm}$, containing a receiver, an f.m. transmitter operating in the 160MHz band and a decoder for selective calling. The range of the base unit is claimed to be 5 miles. Sonab Communications Division, Sonab Ltd, P.O. Box No. 4, Oldfield Road, Hampton, Middx TW12 2HN.

WW 318 for further details

Laboratory power supply

Powerlab is a novel design of power supply from ITT. Unlike most of its competitors, it provides no panel meter. Selection of voltages is by push button.

A choice of three voltages, 5V, 10V or 15V, is offered from two isolated outputs, or a further three, 10V, 25V or 30V by connecting the outputs in series by pushbutton. The output voltage is variable by slide control over a range of $\pm 10\%$ but can be reset, on the 5V range, to within 20mV without reference to an external digital voltmeter.

An l.e.d. indicates constant current limiting, which is adjustable from 10% to 110% of full load current, which is 2A on the twin 5V range and the 10V series range and 1A on the remaining twin and series ranges. This can be doubled by selecting parallel arrangement of the outputs. ITT Components group Europe, STC Ltd, Edinburgh Way, Harlow, Essex.

WW 319 for further details

Solid State Devices

Names of suppliers of devices in this section are given in abbreviation after each entry and in full at the end of the section.

Transient spike suppressor

Two "transtectors" designed for protecting circuit assemblies from transients and noise can be used in parallel with standard scr "crowbar" units for fast acting (5ns) protection. They operate by clamping input and output lines to a specified voltage. Types V26 and V216 offer instantaneous clamping at 6.5V d.c. at 1A, and 16.5V d.c. at 400mA $\pm 5\%$ and peak pulse currents of 120A and 67A within an operating temperature range of -55°C to $+100^\circ\text{C}$.

WW 320 for further details Coutant

Video amplifier

The SL514 has an open loop gain of 70dB, temperature stable, giving a closed loop gain achievable using standard operational techniques. Slew rate is $175\text{V}/\mu\text{s}$ and a settling time of 50ns to 1%. The bandwidth is 0 to 100MHz at 20dB and the device is encapsulated in a 10-lead T0-5 package.

WW 321 for further details Plessey

C.m.o.s. phase-locked loop

The MC14046 contains two phase comparators, a v.c.o. and a zener diode regulated internal supply line. The v.c.o. operates at frequencies up to 1.4MHz with a supply voltage of 10V d.c. Power dissipation is of the order of microwatts.

WW 322 for further details Motorola

Dual transistor

The 2N5902 series of monolithic j.f.e.t.s. have a diode-isolated substrate designed to reduce leakage current to 0.1pA over input voltage swings up to 30V. Common mode rejection is typically better than 120dB and the transistors can be matched to within 5mV and drift to within $5\mu\text{V}/^\circ\text{C}$. The devices are offered in 8-pin, TO-99 cans.

National Semiconductor

WW 323 for further details

R.a.m.

The S1103X, is a dynamic 1024-bit r.a.m. with a data access time of 120ns. It has a read-write cycle time of 270ns and is available in an 18-pin d.i.p.

WW 324 for further details AMI

D.c. — d.c. converter

A thick-film d.c.—d.c. converter, model TG311 has been designed to handle input voltages of 0.8 to 1.6V and to give up to 15V d.c. output. The efficiency is claimed to be 50% or greater over the operating temperature range and the circuit occupies approximately one cubic centimetre.

WW 325 for further details Redac

Schottky clock

The CO-238 is a 14-pin, d.i.p. crystal oscillator available at frequencies up to 1000MHz to drive Schottky t.t.l. Power supply is 5V d.c. and the oscillator will fan out into 10 loads. Stability is claimed as $\pm 0.0025\%$ over the range 0-70°C.

WW 326 for further details Lyons

Suppliers

Coutant Electronics Ltd, 3 Trafford Rd, Reading RG1 8JR.

Plessey Semiconductors, Cheney Manor, Swindon, Wiltshire SN2 2QW.

Motorola Inc, Semiconductor Products Division, York House, Empire Way, Wembley, Middx.

National Semiconductor UK Ltd, The Precinct, Broxbourne, Herts EN10 7HY.

AMI Microsystems Ltd, 108A Commercial Rd, Swindon, Wilts.

Redac Software Ltd, Newtown, Tewkesbury, Gloucestershire GL20 8HE.

Lyons Instruments Ltd, Hoddesdon, Herts.

LOW COST VOLTMETERS



LEVELL

PORTABLE INSTRUMENTS

These highly accurate instruments incorporate many useful features, including long battery life. All A type models have 3½" scale meters, and case sizes 5" x 7" x 5". B types have 5" mirror scale meters and case sizes 7" x 10" x 6".



A.C. MICROVOLTMETERS

VOLTAGE & dB RANGES: 15µV, 50µV, 150µV... 500V f.s.d.
Acc. ± 1% ± 1% f.s.d. ± 1µV at 1 kHz. - 100, - 90... + 50dB.
scale - 20dB/+ 6dB rel. to 1mW/600Ω.
RESPONSE: ± 3dB from 1 Hz to 3MHz, ± 0.3dB
from 4Hz to 1MHz above 500µV. Type TM3B can be
set to a restricted B.W. of 10Hz to 10 kHz or 100 kHz.
INPUT IMPEDANCE: Above 50mV : > 4.3MΩ < 20pf.
On 50µV to 50mV : > 5MΩ < 50pf.
AMPLIFIER OUTPUT: 150mV at f.s.d.

type **£73** type **£88**
TM3A TM3B



BROADBAND VOLTMETERS

H.F. VOLTAGE & dB RANGES: 1mV, 3mV, 10mV... 3V f.s.d.
Acc. ± 4% ± 1% of f.s.d. at 30MHz. - 50dB, - 40dB, - 30dB
to + 20dB. Scale - 10dB/+ 3dB rel. to 1mW/50Ω. ± 0.7dB
from 1MHz to 50MHz. ± 3dB from 300kHz to 400MHz.
L.F. RANGES: As TM3 except for the omission of 15µV and 150µV.
AMPLIFIER OUTPUT: Square wave at 20Hz on H.F. with
amplitude proportional to square of input. As TM3 on L.F.

type **£120** type **£135**
TM6A TM6B



D.C. MICROVOLTMETERS

VOLTAGE RANGES: 30µV, 100µV, 300µV... 300V.
Acc. ± 1%, ± 2% f.s.d., ± 1µV. CZ scale.
CURRENT RANGES: 30 pA, 100 pA, 300 pA, 300 mA.
Acc. ± 2%, ± 2% f.s.d., ± 2 pA. CZ scale.
LOGARITHMIC RANGE:
± 5µV at ± 10% f.s.d., ± 5 mV at ± 50% f.s.d., ± 500 mV at f.s.d.
RECORDER OUTPUT: ± 1V at f.s.d. into > 1kΩ

type **£73**
TM10



D.C. MULTIMETERS

VOLTAGE RANGES: 3µV, 10µV, 30µV... 1kV.
Acc. ± 1% ± 1% f.s.d. ± 0.1µV. LZ & CZ scales.
CURRENT RANGES: 3pA, 10pA, 30pA... 1 mA (1A for TM9BP)
Acc. ± 2% ± 1% f.s.d. ± 0.3pA. LZ & CZ scales.
RESISTANCE RANGES: 3 Ω, 10 Ω, 30 Ω... 1kΩ linear.
Acc. ± 1%, ± 1% f.s.d. up to 100M Ω.
RECORDER OUTPUT: 1V at f.s.d. into > 1kΩ on LZ ranges.

type **£105** type **£125**
TM9A TM9BP

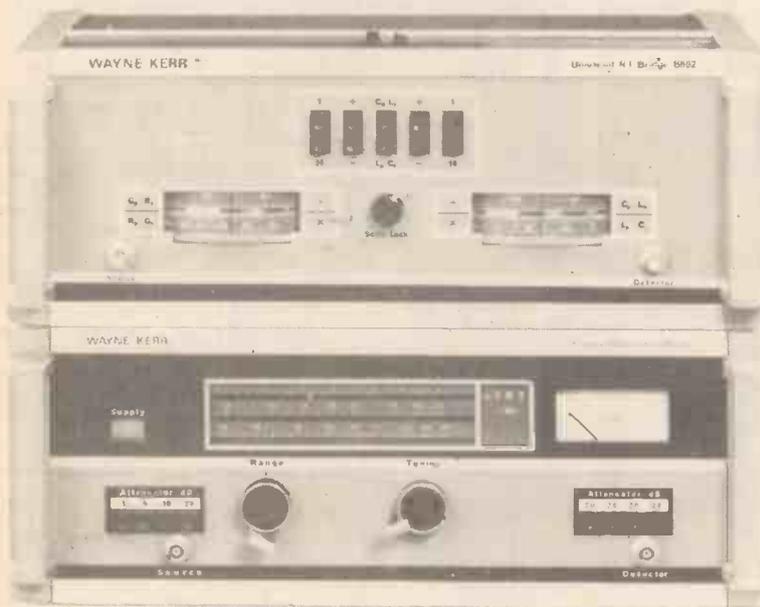
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Wide-range universal bridge **B602** 0.1-100MHz source/detector **SR268** from Wayne Kerr



SPECIFICATION

B602

Frequency range: 100kHz to 10MHz
Accuracy: 1% up to 3MHz, 1pF to 10nF
10 Ω to 100k Ω
1 μ H to 10mH

Overall impedance range: 1fF to 1mF
100 $\mu\Omega$ to 100M Ω (10n Ω to 10k Ω)
10pH to 10H

SR268

Frequency Range: 100kHz to 100MHz in 9 bands
(SR268L 46.5kHz to 46.5MHz)
2-3% according to band used.

Frequency accuracy: 0.01%
Short Term Frequency Stability: 0.5-2.0V according to band used.
Output level: 3, 6, 10, 20 dB additive steps, 75 Ω
Output attenuator:
Input sensitivity for 10% meter deflection: 1 to 30 μ V according to frequency setting
Input attenuator: 4 steps of 20 dB, 75 Ω
Detector bandwidth: 2-3% according to band used

For more information, either phone Bognor Regis (02433) 25811 or write to the address below:

WAYNE KERR

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Telex: 86120. Cables: Waynkerr, Bognor

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The B602 transformer ratio arm bridge measures impedance in all four quadrants of the complex plane over the frequency range 100kHz to 10MHz. Because of novel features incorporated in the design, values from virtually a short circuit to an open circuit can be measured. This bridge has established a standard of performance and flexibility which is unobtainable from any other radio frequency bridge.

A standard inductor is included in the bridge network in addition to standards of capacitance and resistance enabling a periodic calibration of the scales which are correct at any frequency between 100kHz and 10MHz.

There are only two balance controls. One is direct reading in resistance and conductance, the other in capacitance and inductance and there is no interaction between them.

The stability realised allows a discrimination of 0.1% to be obtained for all types of measurement with a general accuracy of 1% over most of the impedance and frequency range.

The bridge is shown together with the SR268 Source and Detector which can also be used with other bridges in the Wayne Kerr range over the frequency band 100kHz to 100MHz. Nine frequency ranges are provided by this instrument and a single tuning control adjusts both source and detector to the exact frequency required.

Meticulous screening between the two sections provides freedom from bridge measurement errors due to leakage of the source signal into the detector. Common mode rejection transformers are incorporated in the input and output networks to reduce interference from unwanted signals, and push button attenuators are included to assist the logarithmic detector circuit to indicate approach of the bridge balance point.

MEET OUR SCIENTISTS

Q1 1420 — SENIOR



- Automatic selection of correct notation for result display (scientific or floating point)
- Dome keyboard for excellent response and preventing double entry input
- Algebraic mode operation
- Chain operations
- Change sign operation
- Three memories
- Display and memory exchangeable
- Trigonometric functions (sin, cos, tan)
- Inverse-trigonometric functions (\sin^{-1} , \cos^{-1} , \tan^{-1})
- Radian or degree selectable
- π constant
- Logarithms (ln, log)
- Anti-logarithms (e^x , 10^x)
- Combinatorial functions (n!, $\binom{n}{r}$, (h),)
- Normal distribution function (Pr(x))
- Gamma function ($\Gamma(x)$)
- Group operations ($\Sigma \pm$, \bar{O} , \bar{X} , $\|x\|$)
- Group controls (K \uparrow , K \downarrow , $\Sigma \uparrow$, $\Sigma \downarrow$ CL_{GRP})
- Power function (y^x)
- Reciprocal (1/x)
- Square root (\sqrt{x})
- Square (x^2)
- Sum of squares (Σx^2)
- Summation (ΣX)
- Item count (n)
- Mean value (\bar{X})
- Mixed chain operations with parentheses approach (up to two levels)

- 14-digit LED display
- 10-digit mantissa with sign and 2-digit exponent with sign for data entry or results (10^{-99} ~ 10^{99})

PRICE: £61.55 (Excluding VAT)

Q1 1421 — PROGRAMMABLE



- Reverse polish notation
- Display and Y-register exchangeable
- One accumulating memory (Memory store, Memory recall, M + X, M - X and M + X²)
- Trigonometric functions (sin, cos, tan)
- Inverse-trigonometric functions (\sin^{-1} , \cos^{-1} , \tan^{-1})
- Radians and degrees exchangeable
- π constant
- Logarithms (ln, log)
- Anti-logarithms (e^x)
- Power function (y^x)
- Reciprocal (1/x)
- Square root (\sqrt{x})
- Square (X^2)

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- 8 digits capacity for data entry or results (10^{-9} ~ 10^9)
- Full floating point
- Automatic display blanking
- Three-register operational stack
- Change sign operation

PRICE: £45.97 (Excluding VAT)

Q1 1439—FINANCIAL



SPECIFICATION

- 9-digit green tube display
- 8 digits capacity for data entry or results (10^{-10} ~ 10^9)
- Fixed point (0, 1, 2, ..., 7 places) or full floating point selectable
- Dome keyboard for excellent response and preventing double entry input

BASIC FUNCTION (+, -, x, %) AND MEMORY

- Algebraic mode operation
- Constant operations
- Repeat operations

- Chain operations
- Percentage with automatic add on and discount
- Change sign operation
- Four memories

SPECIAL FUNCTION

- Financial operations
- Cost, sell, margin operations
- Trend line operations
- Delta percentage operations
- Item count (n)
- Mean value (\bar{X})
- Square root (\sqrt{x})
- Summation (ΣX)
- Sum of squares (ΣX^2)

PRICE: £24.63 (Excluding VAT)

Q1 1419 — ADVANCED (Q1 1449R)



SPECIFICATION

- 14 digit LED display
- 10 digit mantissa with sign and 2-digit exponent with sign for data entry or results (10^{-99} ~ 10^{99})
- Automatic selection of correct notation for result display (scientific or floating point)
- Dome keyboard for excellent response and preventing double entry input

BASIC FUNCTION (+, -, x, %) AND MEMORY

- Algebraic mode operation
- Constant operations
- Repeat operations
- Chain operations
- Change sign operation

- Display and Y-register exchangeable
- One accumulating memory
- Display and memory exchangeable

SPECIAL FUNCTION

- Trigonometric functions (sin, cos, tan)
- Inverse trigonometric functions (\sin^{-1} , \cos^{-1} , \tan^{-1})
- Hyperbolic functions (sinh, cosh, tanh)
- Inverse hyperbolic functions (\sinh^{-1} , \cosh^{-1} , \tanh^{-1})
- Radian or degree selectable
- π constant
- Logarithms (ln, log)
- Anti logarithms (e^x , 10^x)
- Power function (y^x)
- Reciprocal (1/x)
- Square root (\sqrt{x})

PRICE: £31.25 (Excluding VAT)

Q1 1444 — SLIDE RULE



SPECIFICATION

- 9-digit green tube display
- 8 digits capacity for data entry or results (10^{-10} ~ 10^9)
- Full floating point
- Floating negative sign
- Dome keyboard for excellent response and preventing double-entry input
- Automatic display blanking

BASIC FUNCTION (+, -, x, %) AND MEMORY

- Algebraic mode operation
- Constant operations
- Repeat operations
- Chain operations
- Percentage with automatic add on and discount
- Change sign operation
- Display and Y register exchangeable
- One accumulating memory

SPECIAL FUNCTION

- Reciprocal (1/x)
- Square root (\sqrt{x})
- Square (x^2)

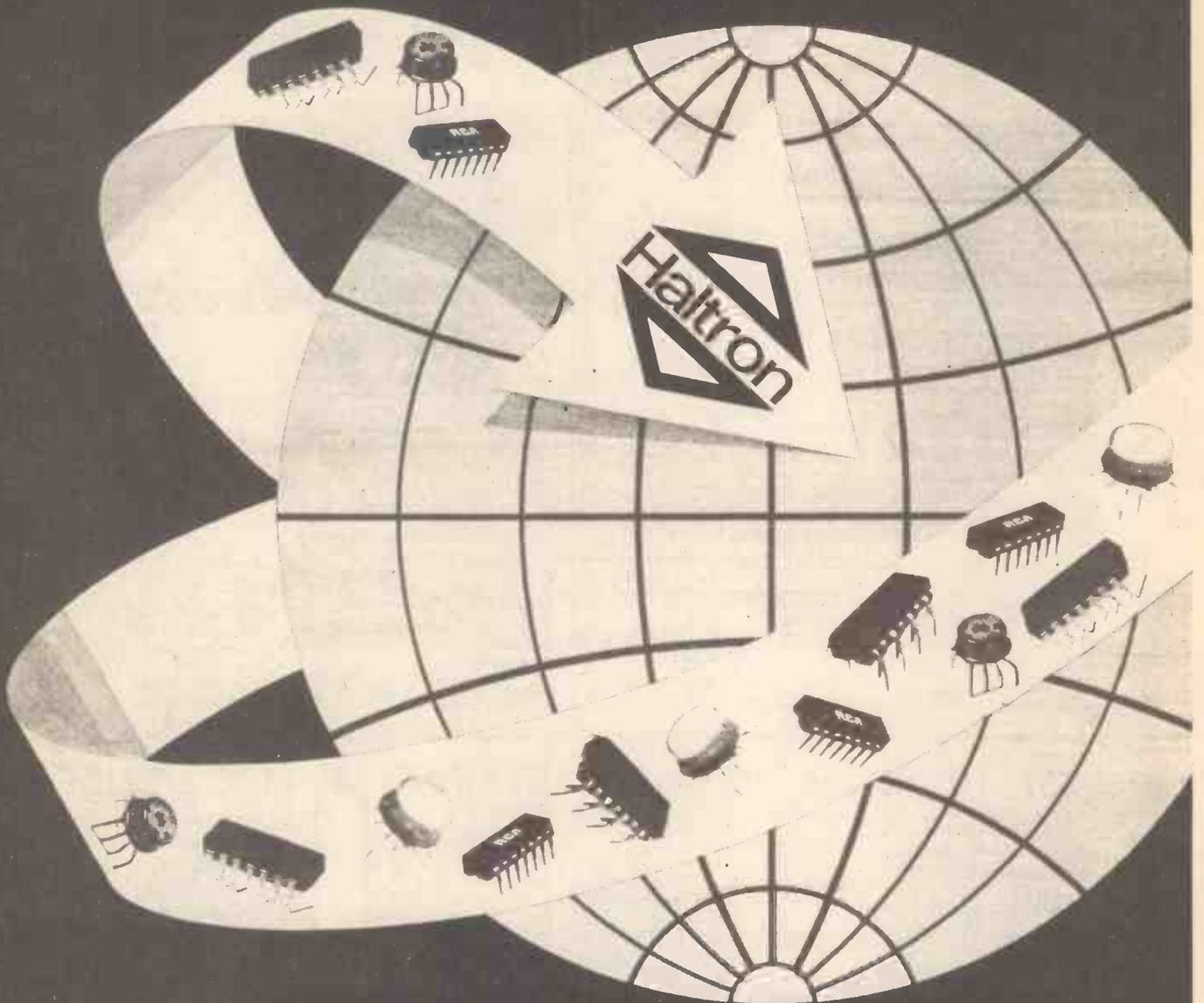
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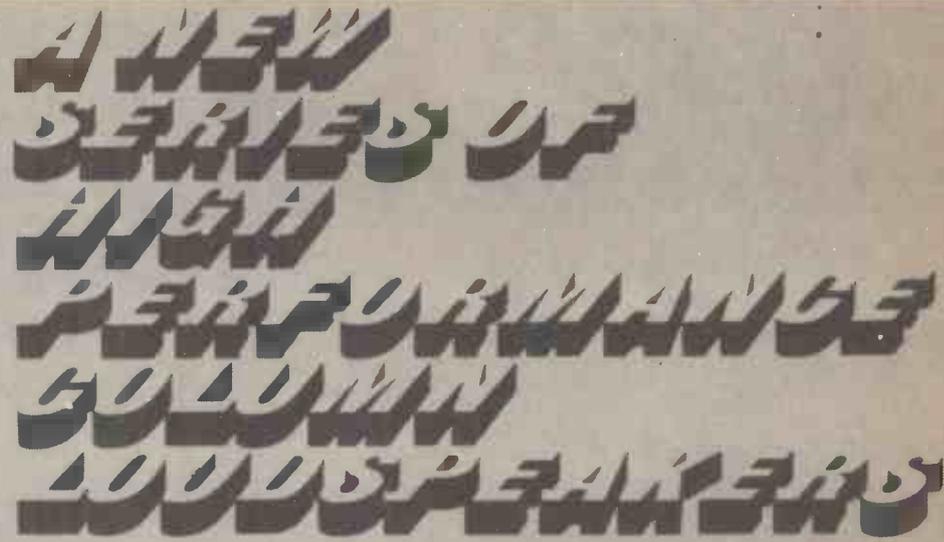


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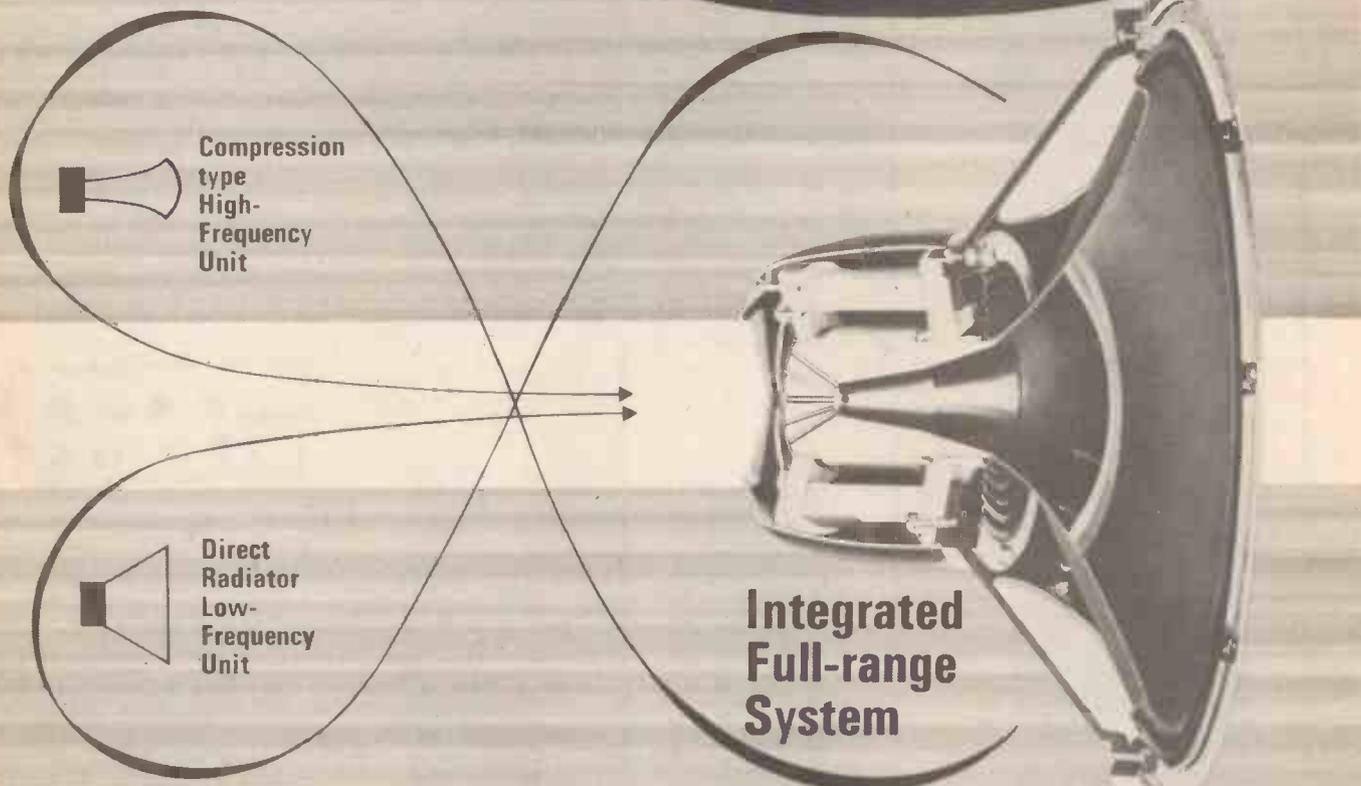
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THE *New* TANNOY

Monitor HIGH PERFORMANCE DUAL



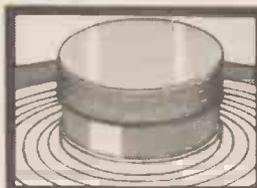
The Monitor H.P.D. represents a further outstanding improvement of a loudspeaker system which has become regarded as a quality standard over the last 25 years by Recording Studios throughout the world. There is a very good chance that your favourite records and tapes were monitored on Tannoy Dual Concentric loudspeakers, and to select these superbly engineered, individually hand-assembled speakers for your music system assures you of the same professional performance.

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Power Handling Capacity*	50W	60W	85W
Frequency Response	27-20,000 HZ	25-20,000 HZ	23-20,000 HZ
Intermodulation Products	less than 2%	less than 2%	less than 2%
Impedance via Crossover network	8 ohms (5 ohms min.)	8 ohms (5 ohms min.)	8 ohms (5 ohms min.)

*INTEGRATED PROGRAMME MATERIAL



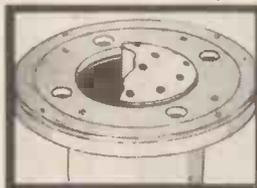
The Girdacoustic Cone improves frequency and transient response, gives much increased power handling capacity and greater mechanical stability.



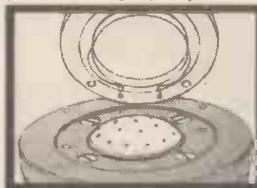
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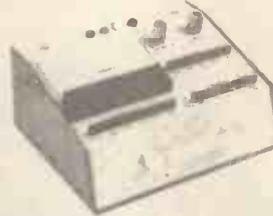
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And its sine and square wave outputs are available simultaneously. With less than 0.1% sine wave distortion. And less than 50 ns square wave rise time.

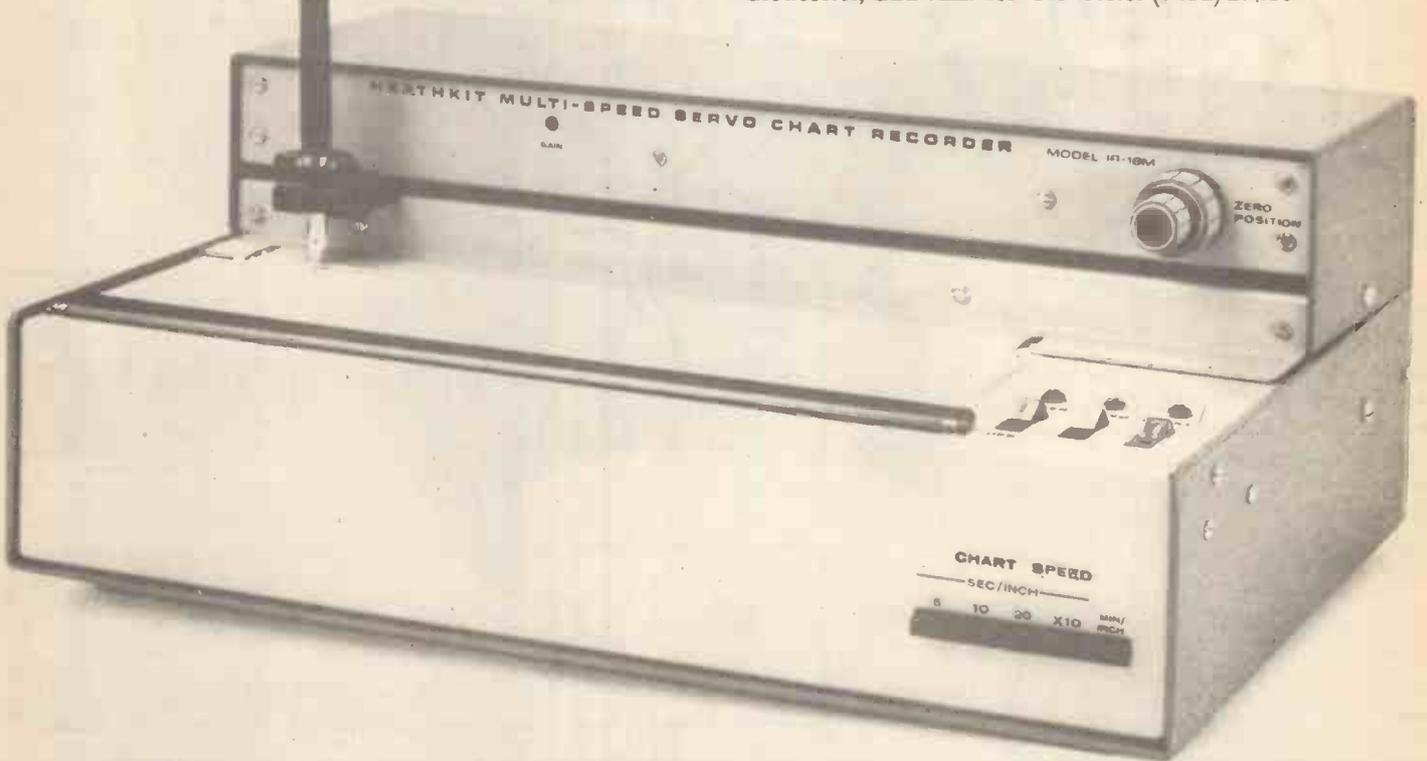
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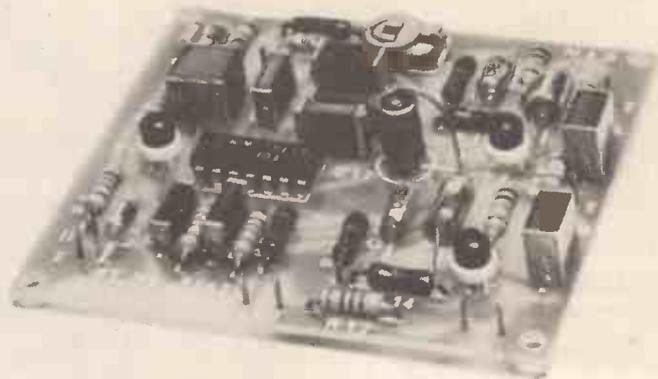
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THE INSIDE STORY—2

SUPERB STEREO

Illustrated here is the stereo decoder sub-system board as used in our high quality F.M. tuner. This tuner has been setting new standards of performance on stereo, giving clear clean sound, in addition to its well thought out controls and operating system. Placed side by side with most top performance tuners, particularly in bad reception areas, the Icon Design tuner gives better and cleaner stereo sound with greatly reduced 'birdies' and other spurious sounds.



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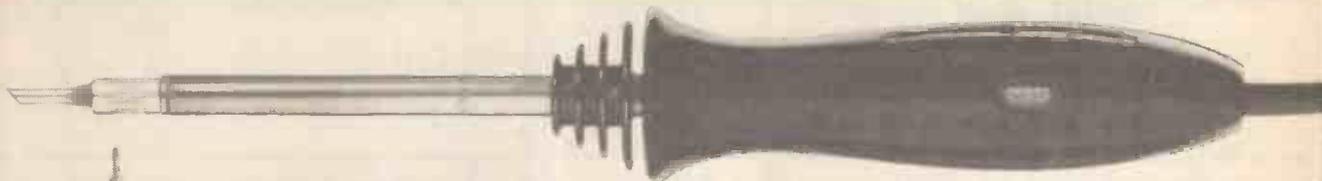
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Icon Design

33 RESTROP VIEW, PURTON, WILTS SN5 9DG

The Greenwood guide to professional soldering.

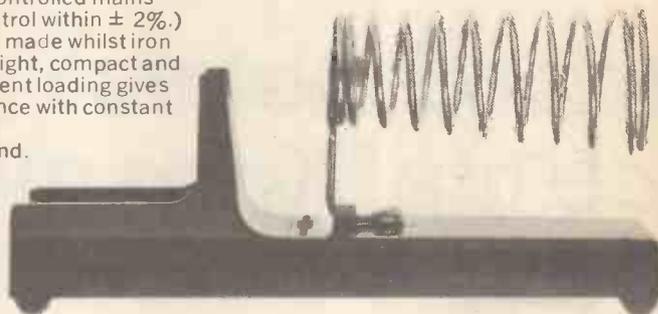


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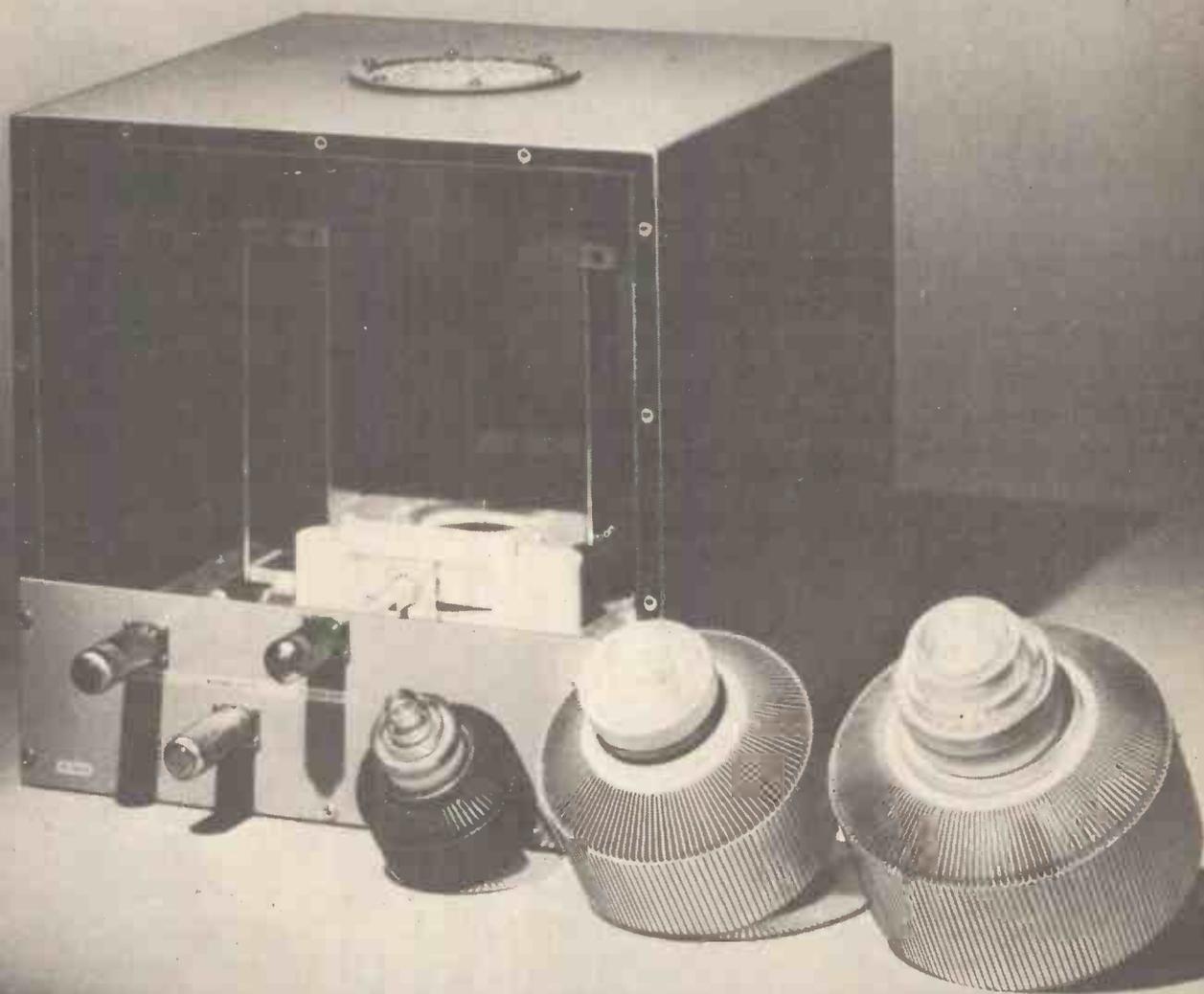
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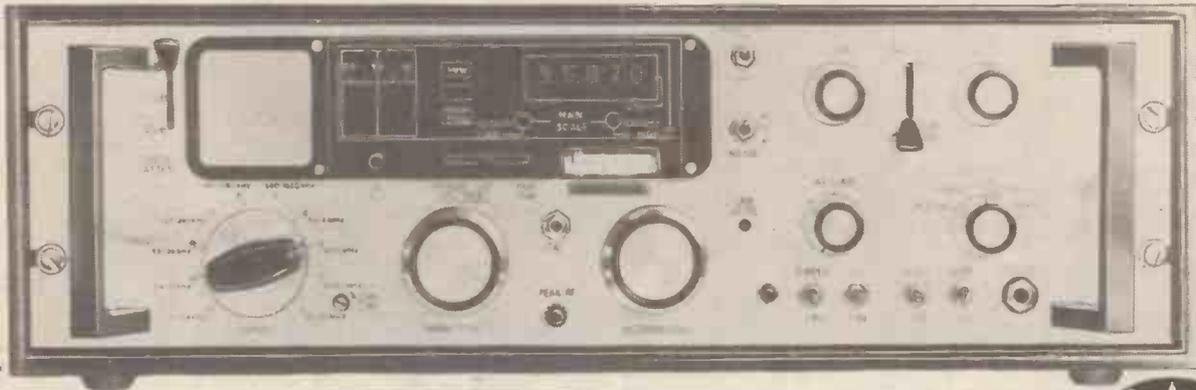
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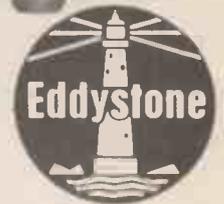
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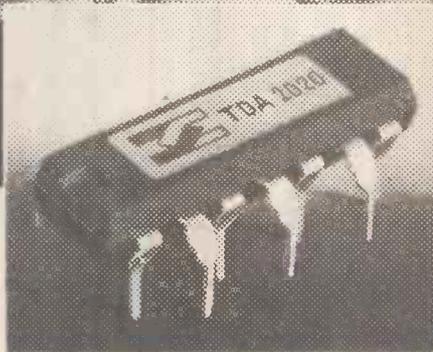
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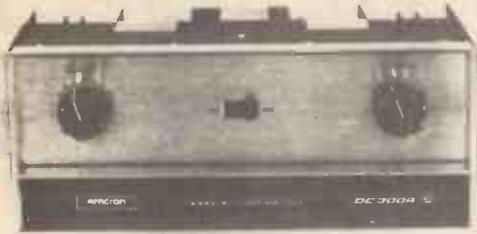
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Power Bandwidth	DC-20kHz @ 150 watts + 1db, - 0db.	Slewing Rate	8 volts per microsecond
Power at clip point (1 chan)	500 watts rms into 2.5 ohms	Load impedance	1 ohm to infinity
Phase Response	+0, -15° DC to 20kHz, 1 watt 8Ω	Input sensitivity	1.75 V for 150 watts into 8Ω
Harmonic Distortion	Below 0.05% DC to 20kHz	Input Impedance	10K ohms to 100K ohms
Intermod. Distortion	Below 0.05% 0.01 watt to 150 watts	Protection	Short, mismatch & open cct. protection
Damping Factor	Greater than 200 DC to 1kHz at 8Ω	Power supply	120-256V, 50-400Hz
Hum & Noise (20-20kHz)	At least 110db below 150 watts	Dimensions	19" Rackmount, 7" High, 9 1/4" Deep
Other models in the range: D60 — 60 watts per channel		D150 — 150 watts per channel	

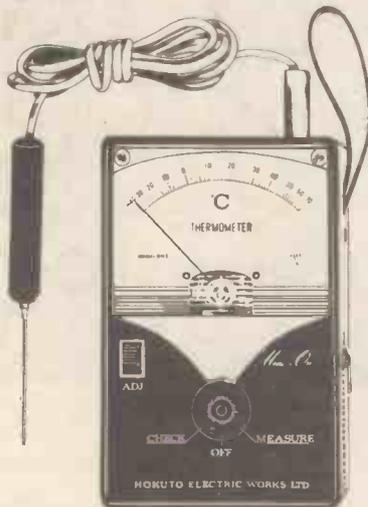


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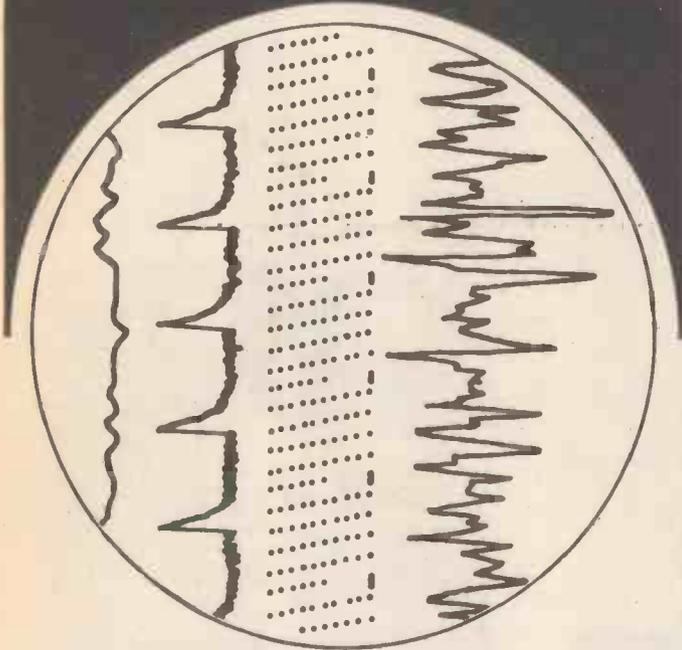
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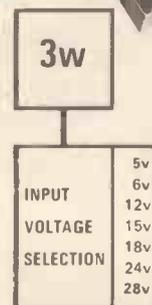
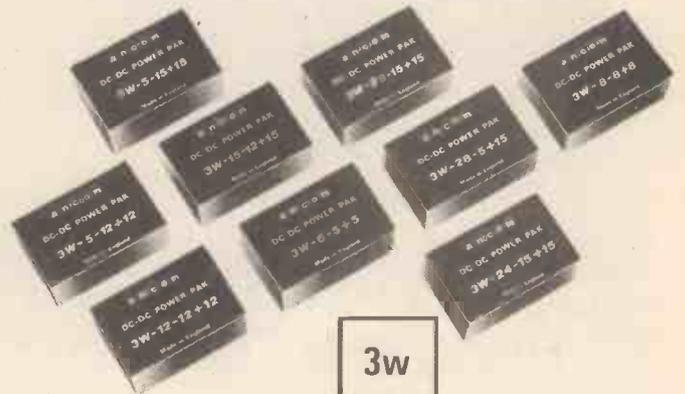
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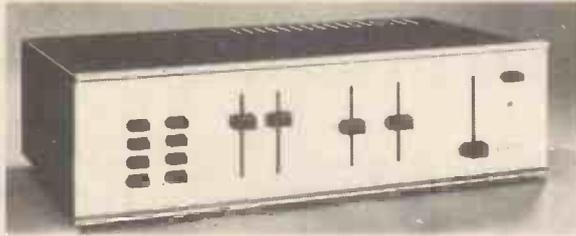
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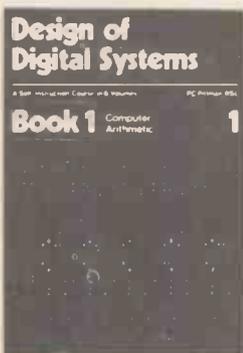
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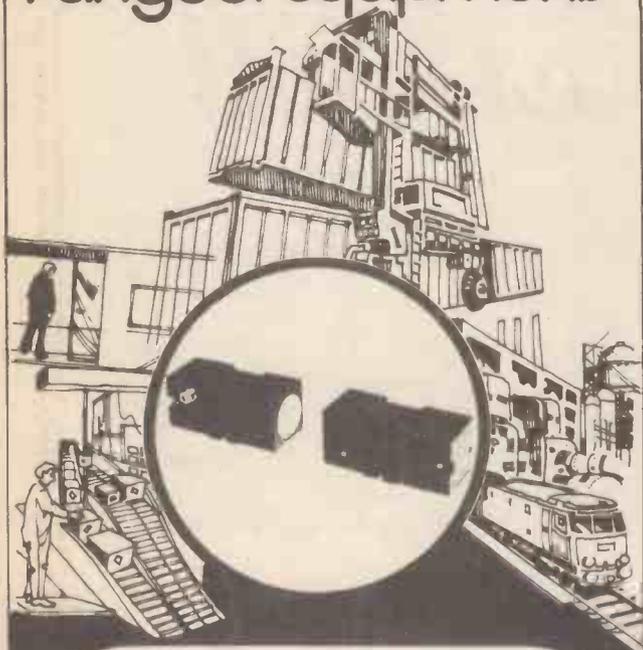
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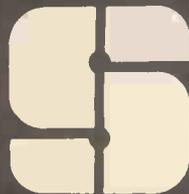


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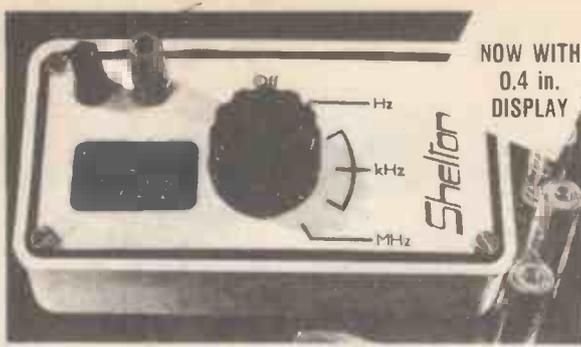
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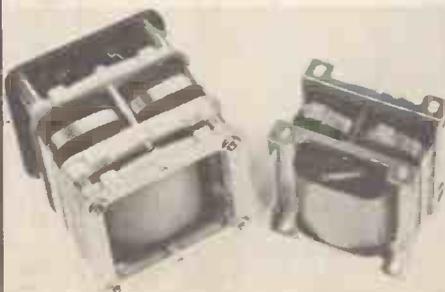
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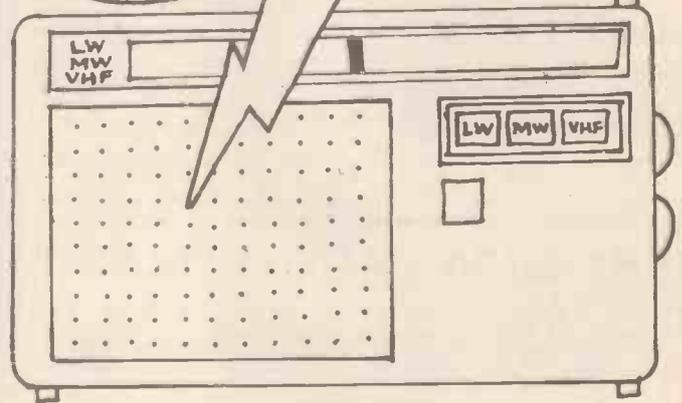
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FERRANTI semiconductors

FE.468

WW—074 FOR FURTHER DETAILS

The SC6010 is the most advanced scientific and statistical calculator in its price range

THE POWER HOUSE

- 10 ADDRESSABLE MEMORIES
- 50 FUNCTIONS
- 60 KEYBOARD COMMANDS

THE SC6010 WILL SOLVE YOUR PROBLEMS AT A PRICE THAT ISN'T A PROBLEM

£62
+ VAT £4.96
Total £66.96



Size: 17cm x 9cm x 3cm.



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There are so many we can list only some of them: 50 functions and 66 keyboard commands. Includes: 10 digits plus scientific notation, Algebraic logic with two parenthesis levels, Sin, Cos, Tan (plus inverse, 1/n, Log 10^x, e^x, pi, y^x, √x, x², 1/x, x^{-y}, and x^{-m} exchange, sign change, nl, low battery indicator, automatic battery saving circuit (display blanking), satonal and many other features.

Advanced Functions

Combinatorial functions and binomial co-efficients, combinations, permutations, normal probability functions Pr(z), Gamma function Γ(n), statistical functions: arithmetic mean, standard deviation σ, variance σ², sq. rt. of sum of squares 1/x11. Memory: 10 operator accessible memories with protected group memory which includes: Sum memory sum of squares memory, index memory, plus much more.

Whatever your problem, engineering or statistical, the SC6010 is your answer.

Accessories include:

NiCd rechargeable batteries charging time 4-5 hours, A/C adaptor/charger, leatherette carry case, instructions, one year parts and labour warranty, U.K. service station

ALSO AVAILABLE

SC60. As SC6010 but 2 fully addressable memories, 1 sum to memory, 1 index memory.

Price £50 + £4.00 VAT

Please send me SC6010 at £66.96 or SC60 at £54.

Name

Address

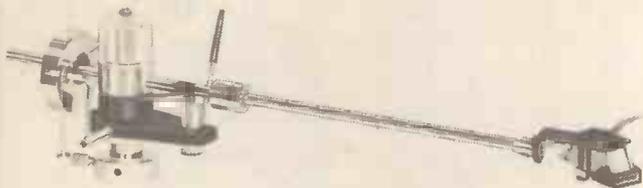
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Formula 4

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Pivot friction below
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Effective mass
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745 COUNTER TIMER

Measures frequency, period, time and totalises
32 MHz frequency range (DC coupled)
5-digit .3" LED display
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Measures frequency, period and time
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643 FUNCTION GENERATOR

£86 + £1.50 p.&p. + VAT

Accurate, digital frequency setting
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TWO TONE BLUE CASE

£370 **520** MHz

Sensitivity 10mV. Stability 5 parts 10¹⁰

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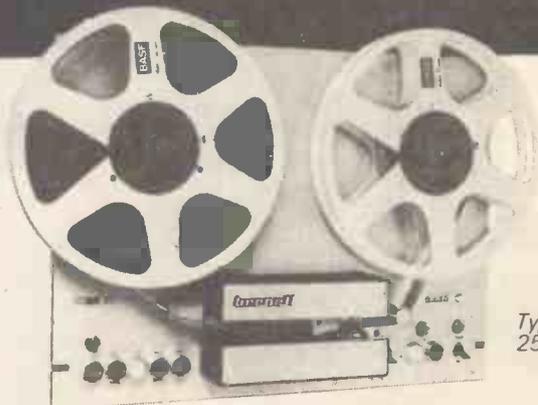
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TAPE TRANSPORTS**
and multi-channel electronics
for studio and industrial use



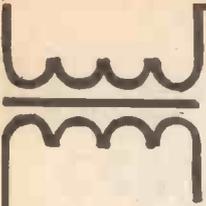
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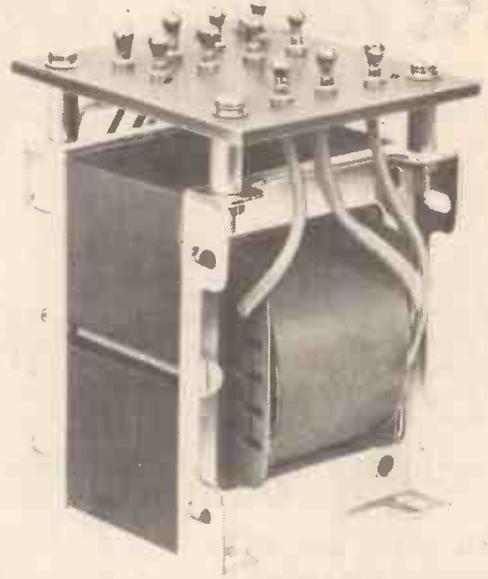
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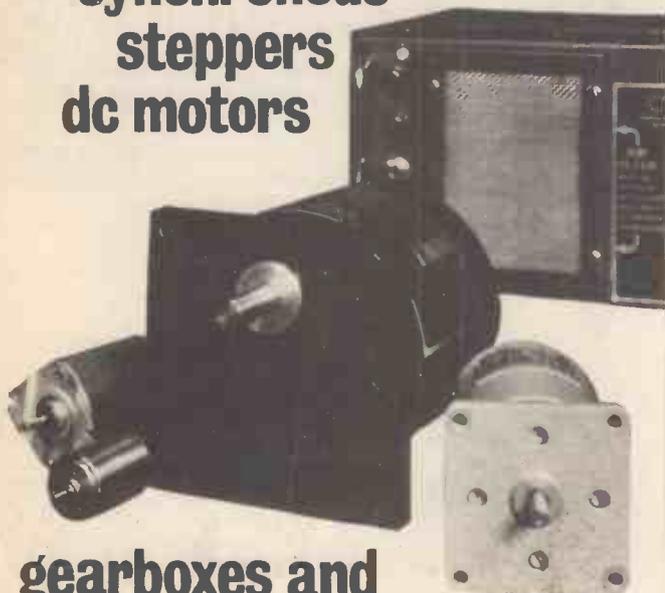
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In damaged goods. In doubled delivery charges. It need not cost you a penny. Because it needn't happen. **PROTECTOMUFFS** are tough, padded, weather-proof, dustproof. They are tailored to fit your product. Slipped on in seconds by unskilled staff, they provide all the packing required. And because they are re-useable again and again and again, packing costs become a non-recurring item. Be like Hoover, Ferranti, Rediffusion — use Protectomuffs and show your customers your care.



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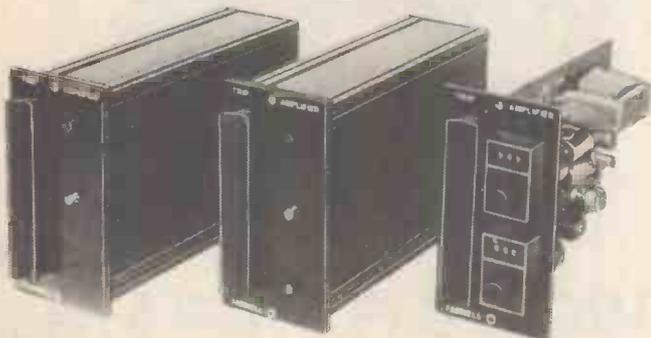
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W.W.11

Trip Amplifiers



SET-POINT CONTROL OF VOLTAGE, CURRENT & TEMPERATURE

When input signals derived from voltage, current or temperature sources, fall outside pre-determined limits, relay changeover contacts (rated at 30V d.c. 5A) operate within this unit to control peripheral equipment.

Single or twin trip levels are available set by lockable 3 digit dials or alternatively by multi-turn screwdriver operated controls. Units are ready for panel mounting or can be supplied to fit a standard I.S.E.P. rack. Both versions incorporate a regulated power supply. A compatible range of Alarm Annunciators and Digital Panel Meters is available.



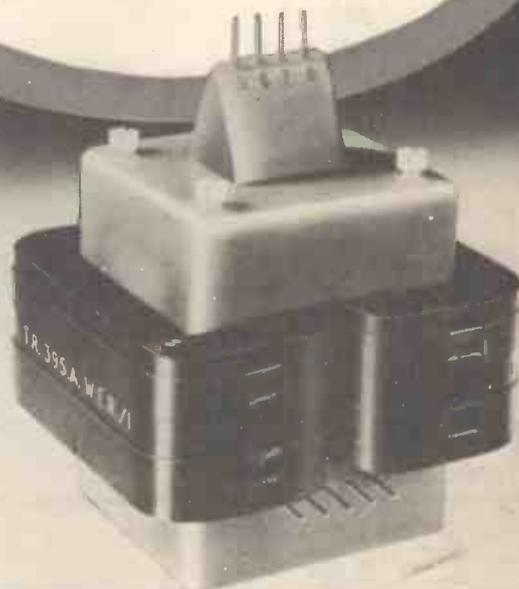
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“They want safety isolation for their voice band circuits”



One more request item. We met it with a neat little transformer. Now, in two versions, it joins the list of useful Whiteley products, and everyone involved in communications system design will be interested in the protection they provide. Inserted in voice band circuits, they effectively isolate equipment from the hazards of adjacent high voltage power circuits on the 'line' side. High isolation level between line and equipment windings gives protection against voltage surges, lightning strikes and fault conditions. One version is designed for 17Hz signalling circuits, the other with several voltage ratios also suits a 50Hz ringing circuit. All are Post Office and C.E.G.B. approved, and the second version is also approved with extra protection diodes added. Requests for data sheets welcome. Or if you want to request a product spec of your own — we're always interested!

Surprising how often you'll find

Whiteley make it.

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WW-059 FOR FURTHER DETAILS

FAST RESPONSE STRIP CHART RECORDERS

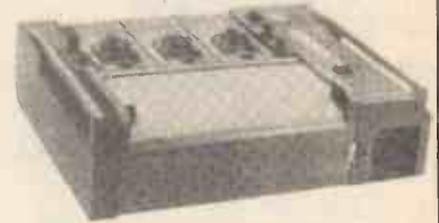
Made in USSR



Type H3020-1
Single pen

Specification

Basic error.....2.5%
Sensitivity.....8mA F.S.D.
Response.....0.2 sec.
Width of each channel.....80mm
Chart speeds, selected by
push buttons.....0.1-0.2-0.5-1-2.5-
-5-12.5-25mm/sec.
Chart drive.....200-250v 50Hz



Type H3020-3
Three-pen

Recording:

Syphon pen directly attached to moving coil frame, curvilinear co-ordinates

Equipment:

Marker pen, Timerpen, Paper footage indicator, 10 rolls of paper, connectors, etc.

Dimensions:

H320-1: 285x384x16.5mm
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PRICE: H320-1 £80.00
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Available for immediate delivery

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ANADEX CF-700

1 GHz COUNTER FOR £475



Features include:—

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- ★ 8 digit 'SPERRY' display

Also: Model CF-710 giving 0.001Hz resolution up to 10k Hz

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WW-042 FOR FURTHER DETAILS



*** The new Rank**

WOW & FLUTTER Meter Type 1742

Fully transistorised for high reliability

Versatile

Meets in every respect all current specifications for measurement of Wow, Flutter and Drift on Optical and Magnetic sound recording/reproduction equipment using film, tape or disc

High accuracy

with crystal controlled oscillator

Simple to use

accepts wide range of input signals with no manual tuning or adjustment

Two models available:

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CCIR 409-2 Specifications
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RANK FILM EQUIPMENT

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AUDIO TEST EQUIPMENT

A comprehensive, versatile range of test equipment primarily designed for the measurement of high quality audio equipment but with additional applications in the electronics industry in general. The equipment is of particular interest to the professional audio engineer, recording studios, broadcasting authorities and educational establishments.



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PS1A. Regulated Mains Power Supply. **Selling Price: £22.50 + VAT.**



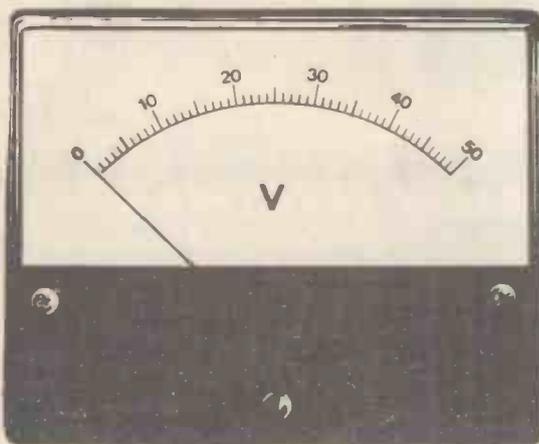
Model 'A' Noise Generator. A portable battery operated unit designed for carrying out listening tests on loudspeakers. 'Pink' or 'White' noise can be selected and output can be continuous or burst. Output is continuously variable. **Selling Price: £47.50 + VAT.**

Full Colour Literature describing the complete range may be had on request

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METER PROBLEMS?



137 Standard Ranges in a variety of sizes and stylings available for 10-14 days delivery. Other Ranges and special scales can be made to order.

Full Information from:

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WW-016 FOR FURTHER DETAILS

1 to 50 microns

*...that's OCLI's
I.R. Filter capability.*

OCLI manufacture a wide variety of Infrared Filters which fully cover the 1 to 50 micron spectral region.

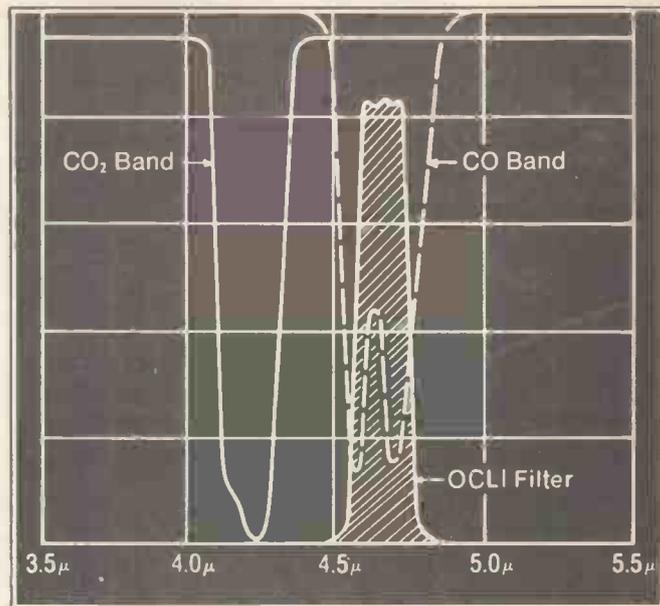
Strict quality control and inspection ensure that all

OCLI I.R. Filters possess superior performance coupled with the highest degree of environmental

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The range available includes SQUARE BAND, WIDE BAND, and LONG & SHORT WAVELENGTH PASS Filters.

Typical performance characteristics of an OCLI I.R. Square Band Filter used to isolate the CO band in a pollution detection application are shown below.



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OCLI
(European Manufacturing
Division)

OCLI Optical Coatings Ltd.,
Hillend Industrial Estate,
Dunfermline, Fife, Scotland KY11 5JE.
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Telex. 72307.

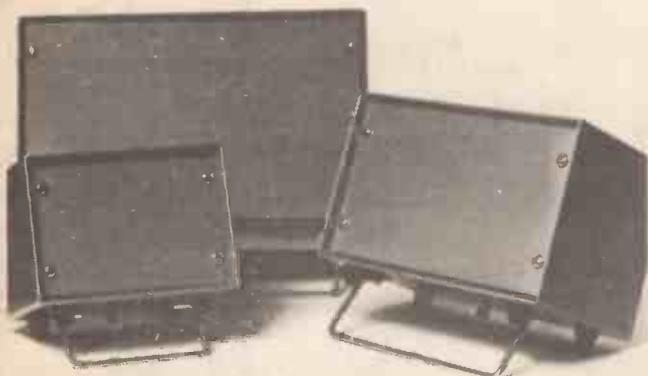
OC-52B

SPANNING EUROPE

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OLSON

MINICASES



Standard minicases are made from 20g. mild steel sheets zinc-coated and finished in silver grey hammer-tone stove enamel. Front panels made from 18g. steel, finished in light grey high gloss enamel.

Type	Overall Dimension			Case no vents	Case with vents	Chrome leg
	Width	Height	Depth			
21	6 1/2"	4 1/2"	4 1/2"	—	3.92	0.90
22	8 1/2"	5 1/2"	5 1/2"	—	4.40	0.90
23	10 1/2"	6 1/2"	6 1/2"	—	5.25	0.95
24	12 1/2"	7 1/2"	7 1/2"	—	5.74	0.95
25A	6 1/2"	4 1/2"	4 1/2"	3.80	4.28	0.90
25B	6 1/2"	4 1/2"	6 1/4"	4.00	4.48	0.90
26A	8 3/4"	5 3/4"	6 1/4"	5.37	5.85	0.95
26B	8 3/4"	5 3/4"	8 1/4"	5.62	6.10	0.95
27A	12 1/4"	7 1/2"	5 1/2"	5.75	6.35	0.95
27B	12 1/4"	7 1/2"	8"	6.35	6.95	0.95
28A	14"	10 1/2"	6 1/2"	6.95	7.55	—
28B	14"	10 1/2"	8 1/2"	7.55	8.15	—
29A	10"	4"	6"	4.85	5.33	0.95
29B	10"	4"	8"	5.15	5.63	0.95
30A	12"	5"	6"	5.25	5.85	0.95
30B	12"	5"	8"	5.56	6.16	0.95
31A	14"	6"	6"	5.75	6.35	0.95
31B	14"	6"	8"	6.05	6.65	0.95
61	15 1/2"	7 1/2"	9 1/2"	—	8.75	—
62	17 1/2"	8 1/2"	9 1/2"	—	10.15	—
63	16 1/2"	9 1/2"	9 1/2"	—	10.15	—
64	15 1/2"	7 1/2"	12 1/2"	—	10.15	—
65	17 1/2"	8 1/2"	12 1/2"	—	11.60	—
66	16 1/2"	9 1/2"	12 1/2"	—	11.60	—

Types 21, 22, 23 and 24 are finished in olive green hammer-tone with front panels in light straw gloss enamel. Fitted with ventilated rear panels only. No louvres in the base.

PORTABLE POWER DISTRIBUTION



COMPLETE WITH 6FT CABLE AND 13AMP PLUG

4 SOCKETS 13A.	£8.80
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Please add for postage and packing and VAT @ 8%.
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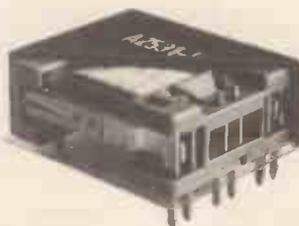
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TEL: 01-739 2343

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Producing 30 basic types of relay and 15,000 variants with regard to contact stacks, terminals, energizing current and contact material, Zettler is among the largest manufacturers of electro-mechanical components.

Our product range comprises:
Low profile (platform) · Timing · Miniature · Low contact capacity · Hermetically sealed · Stepping · Mains switching · Latching Contact stacks · Solenoids



Platform Relay AZ 531
for universal application with control circuits, i.e. for black and white operation. 2 independent changeover contacts. Contact material: Fine silver, silver · cadmium oxide, fine silver with hard gold flashing.
Printed circuit-mounting (27.5 x 22.6 x 11 mm).
Coil voltages: 6 to 110 VDC.
Contact rating:
110 VDC/125 VAC max.,
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We resolve your switching problems rapidly and expertly. Please contact us for further details.

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Please look us up at the Electrical Engineering Exhibition, Manchester. 10-14 November, 1975.
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USED THROUGHOUT THE WORLD, SANWA'S EXPERIENCE OF 30 YEARS ENSURES ACCURACY, RELIABILITY, VERSATILITY. UNSURPASSED TESTER PERFORMANCE. COMES WITH EVERY SANWA.

6 Months' Guarantee	£11.75	MODEL F80TRD	Excellent Repair Service	£26.40
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MODEL K30 THD				

MODEL U-50DX

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Cases extra, available for most meters, but not sold separately

Please write for illustrated leaflet of these and other specialised Sanwa meters

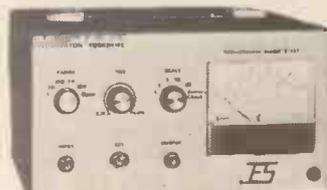
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Distortion Measuring Unit.
15 Hz — 20 KHz — .01%

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Low distortion Oscillator.
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Larsholt 7252 tuner set. 1uV for 26dB S/N. Scan, AFC, AGC, muting, dual MOSFET input 4 twin varicap tuned stages. A complete 88-108MHz receiver system for HiFi/Monitor uses. Built and tested .. £24.00

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All the above are varicap tuned

MT3302 FM tuner with AM gang capacitor and 3:1 drive (3 stage FM tuning) .. £5.00

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Wireless system components.

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WS150: 150mm WW slider pot for direct scale readout. £3.00.

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Edgewise meters for frequency, tuning, sig.strength. £2.50 ea. (Includes 12v bulb at 50mA).

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MVAM1 3x300pF varicap diode. £2.75, or MVAM2 2 diode version £1.05. (2% match).

All prices exclude VAT. PP is 20p per order. Minimum invoice £7.50, min. cwo £2.

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Up-to-the-minute design. All five of our range of frequency-period-ratio counters are **directly gated**. For best resolution - FAST.

Stability. Electronic controlled crystal oven 3 parts 10⁻⁶

Bright. .63" character height display. (All Nine)

CHOICE. Filament or LED with Polaroid Filter.

All counters have suppressed leading zeros and auto decimal point positioning for easy positive readings. The memory is also standard.

Suffix F— Filament

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Type DG110L
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Sensitivity 10mV
Frequency 100 Mhz
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WW-027 for further details

THE CINTEC SINUSOIDAL FREQUENCY and voltage STABILIZER



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★ SINUSOIDAL ★ 500 WATTS ★ SINGLE PHASE

The rapid growth in the use of Video Tape Recorders and other types of equipment which are extremely sensitive to electrical supply frequency variations, has increased the problems for recording engineers, particularly when operating mobile or in areas where no stable electricity supply is available.

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Just switch on and you have 230 volts 50Hz with a stability of better than 0.01% in frequency and 1% in voltage. Even if the electrical supply is fluctuating wildly between 200-255 volts and 40-60Hz the output remains rock steady from no load up to a full load of 500 watts. The harmonic distortion of the sinusoidal waveform is less than 2%.

Specification:

Input: 200-255 volts 40-60Hz Direct.
Output: 230 volts ± 1% No load to 500 watts. (60 Hz output on request)
50Hz ± 0.01%
Waveform: Sinusoidal.
Distortion: 2% Max.
Duty: Continuous.
Efficiency: 60% at full load.
Dimensions: 413(W) x 203(H) x 540mm(D) (16 1/4" x 8" x 21 1/4")
Weight: .33Kg (72lbs)
Construction: Cabinet or 19" rack.
Termination: Input-Cannon EP-3-14.
Output-Cannon EP-4-13

An Inverter for 24v DC input, with similar output specification, available shortly.

Certificate of Calibration

The Stabilizer has been tested in accordance with National Standards by Bradley Services of London (Certification No. K5149/5832)

Full specification and performance figures available.

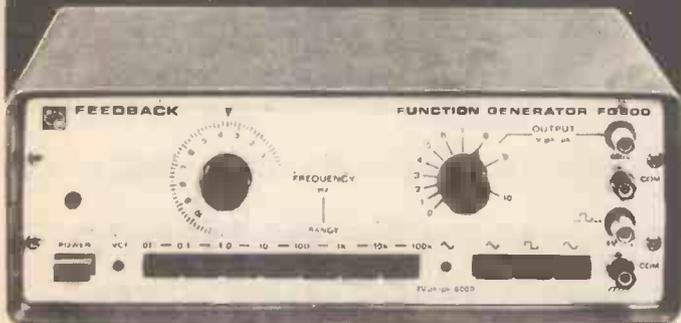
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Telephone: 01-640-2241

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the triangle and
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- * Output level continuously variable up to 10V pk-pk from 600Ω. TTL square wave at 5V fixed amplitude.
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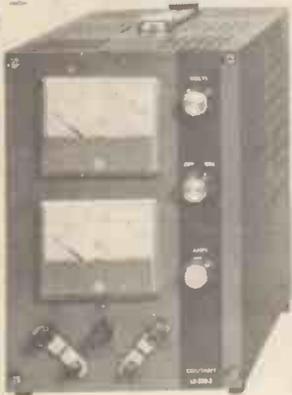
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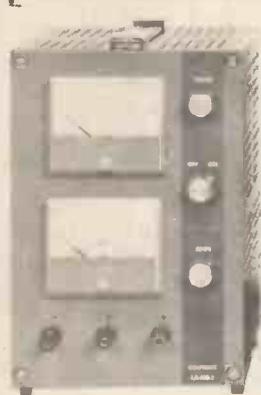
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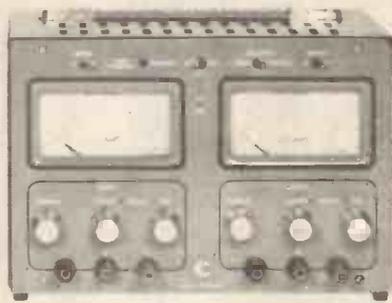
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WW-032 FOR FURTHER DETAILS

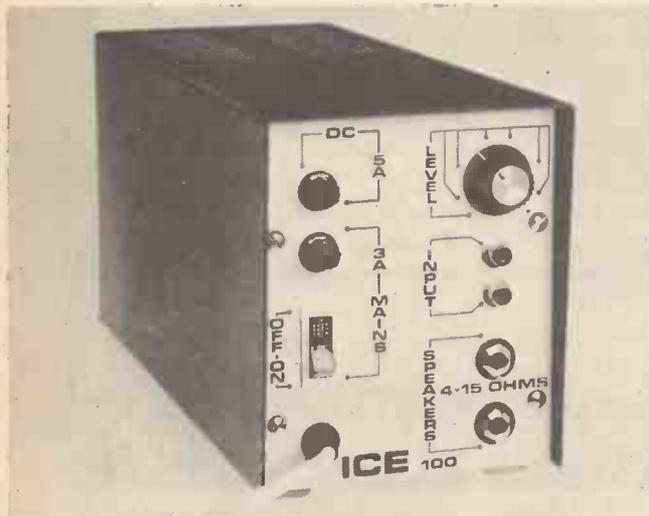


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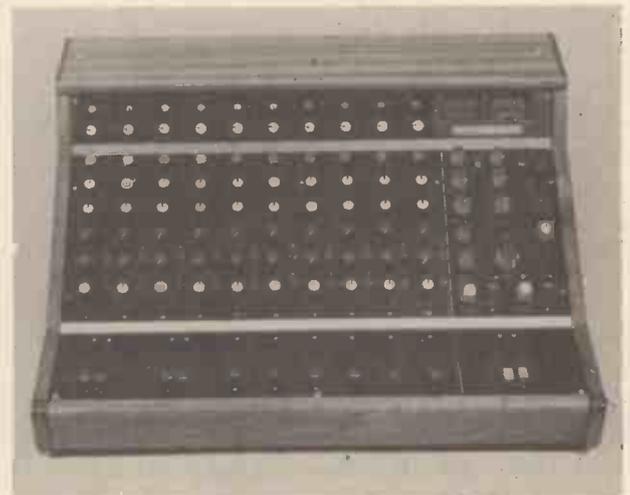


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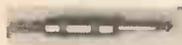
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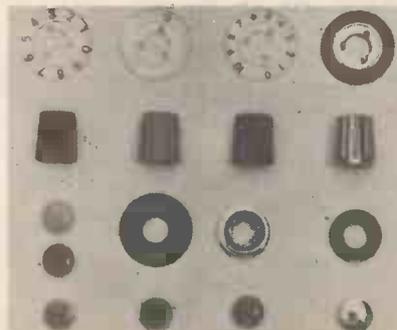


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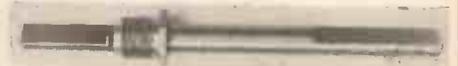
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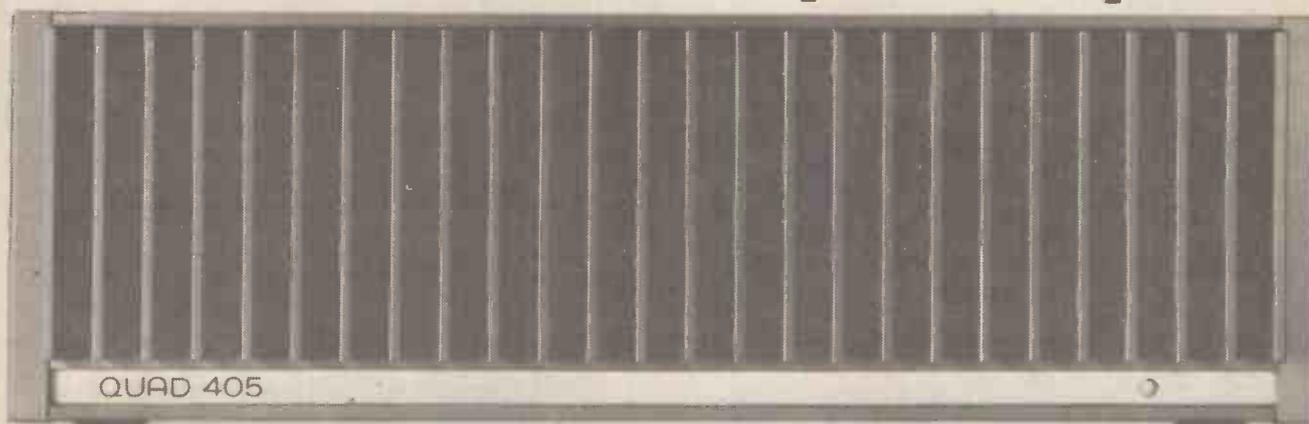
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WW-084 FOR FURTHER DETAILS

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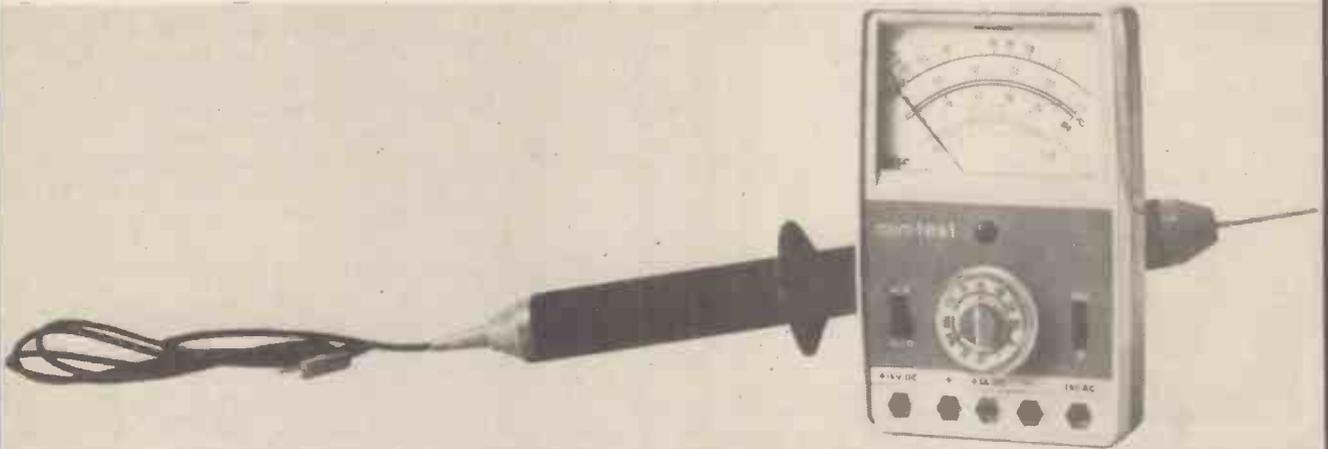
First, the appearance. Diminutive, neat, wipe-clean plastic cover with pressed steel case.

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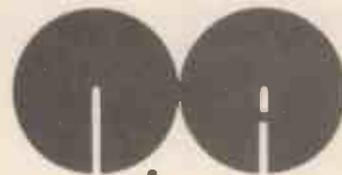
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naim audio the power amplifier

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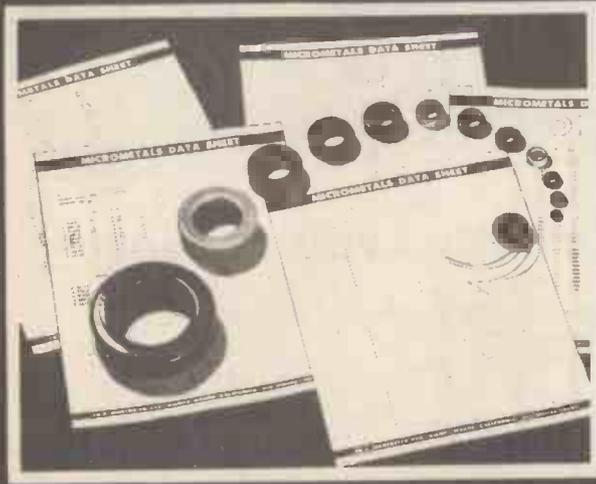
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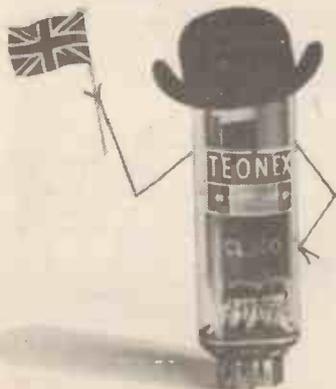


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		Volts	Amps	LINE	LOAD
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NV7308	5	180	0.05	2.5	2.5
NV7312	12	5	1.00	.005	.024
NV7314	12	2x 5	1.00	.005	.024
NV7317	12	6	1.00	.009	.021
NV7319	12	2x 6	1.00	.009	.023
NV7323	12	2x12	0.50	.014	.011
NV7328	12	2x15	0.50	.019	.011
NV7336	12	24	0.5	.07	.09
NV7342	24	5	1.00	.004	.024
NV7344	24	2x 5	1.00	.004	.024
NV7349	24	2x 6	1.00	.008	.023
NV7353	24	2x12	0.50	.010	.012
NV7357	24	15	1.00	.024	.021
NV7358	24	2x15	0.50	.015	.012
NV7366	24	24	0.5	.07	.09
NV7368	24	50	0.25	.3	.2
NV7372	50	5	1.00	.002	.024
NV7383	50	2x12	0.50	.007	.011
NV7388	50	2x15	0.50	.010	.012
NV7396	50	24	0.5	.07	.09
NV7398	50	50	0.25	.3	.2

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 * modules facilitating polarity changes

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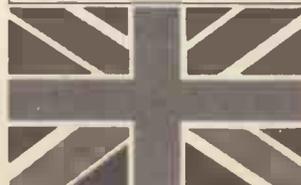
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	Voltage	Amps		
PU01	5	0.5	370	0.3
PU02	5	1.0	770	0.5
PU03	15-0-15	0.10	37	0.1
PU04	15-0-15	0.20	84	0.1
PU05	12-0-12	0.12	45	0.1
PU06	12-0-12	0.24	120	0.2
PU11	18-0-18	0.15	50	0.1
PU10	15	0.10	37	0.1
PU12	12	0.10	45	0.1
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7405	0.13	7445	0.70	7491	0.71	74162	0.85
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7407	0.24	7447	0.75	7493	0.39	74164	0.25
7408	0.12	7448	0.69	7494	0.42	74165	1.25
7409	0.12	7450	0.11	7495	0.51	74166	1.15
7410	0.11	7451	0.12	7496	0.55	74170	1.65
7411	0.16	7453	0.12	74100	1.25	74175	0.85
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4010	0.49	4024	0.85	4069	0.29		
4011	0.21	4025	0.21	4071	0.29		
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304	TD100	0.50	550	A DIP	0.55	748	V DIP	0.25
305	TO99	0.60	555	V DIP	0.45	5556 (1456)	V DIP	0.65
307	V DIP	0.38	556	B DIP	0.75	5558 (1458)	V DIP	0.65
	TO99	0.45	560	B DIP	2.55	ULN 2111	A DIP	0.95
308	A DIP	0.65	561	B DIP	2.55	LM3900	A DIP	0.35
	TO99	0.90	562	B DIP	2.55	75450	V DIP	0.45
309K	TO3	1.45	565	A DIP	1.45	75451	V DIP	0.45
311	V DIP	0.90	566	V DIP	1.50	75452	V DIP	0.45
320K	TO 3 NEG	5.2, 12, 15	567	V DIP	1.60	75453	V DIP	0.45
		1.25	709	A DIP	0.22	75454	V DIP	0.45
324	A DIP	1.07	710	A DIP	0.25			
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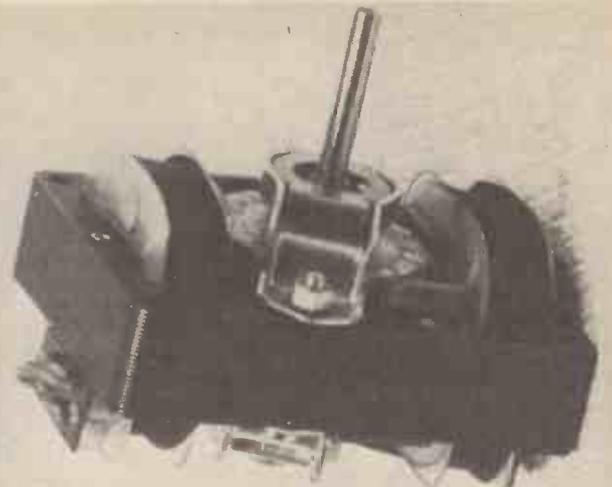
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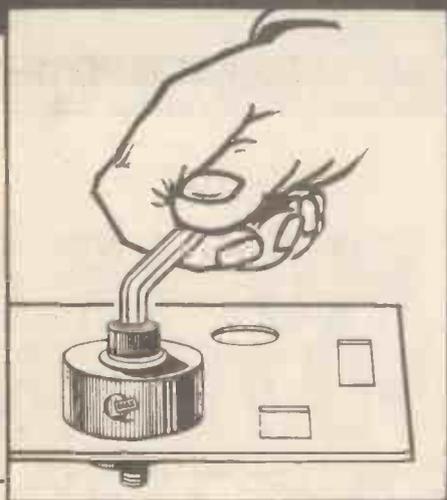
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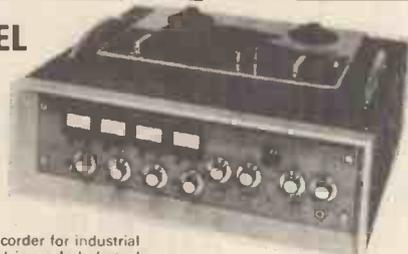
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Mumetal Plus	89 000	300 000	0.77	0.37	0.8	1.3	350	
Supermumetal	127 000	350 000	0.77	0.4	0.55	0.9	350	
Orthomumetal			0.8		2.4	7.5	350	
Salmumetal	65 000	240 000	1.5	0.7	2.0	12	500	
Radiometal 50	5 000	30 000	1.6	1.0	8.0	40	525	
Super Radiometal	15 000	100 000	1.6	1.1	3.2	20	525	
Radiometal 36	3 000	20 000	1.2	0.5	16.0	76	275	
Hyho Radiometal	3 500	60 000	1.4	1.0	8.0	45	525	
Hyvem Radiometal		70 000	1.5	1.35	8.0	50	525	
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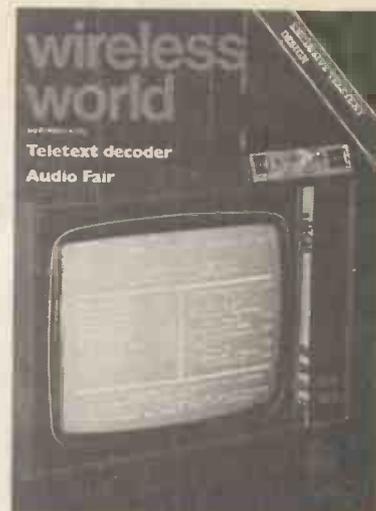
wireless world

Electronics, Television, Radio, Audio

NOVEMBER 1975 Vol 81 No 1479

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This month's front cover shows a colour TV receiver displaying a Teletext page, processed by the Wireless World Teletext decoder seen on top of the set (see page 498). (Receiver lent by Thorn Television Rentals)

IN OUR NEXT ISSUE

Microprocessors for computer control. What they are and how they work, with a table of types on the market

New audio amplifier design uses "current dumping" output transistors and feedforward distortion correction

Interference from pocket calculators can cause trouble. Measurements of electromagnetic radiation from three named calculators

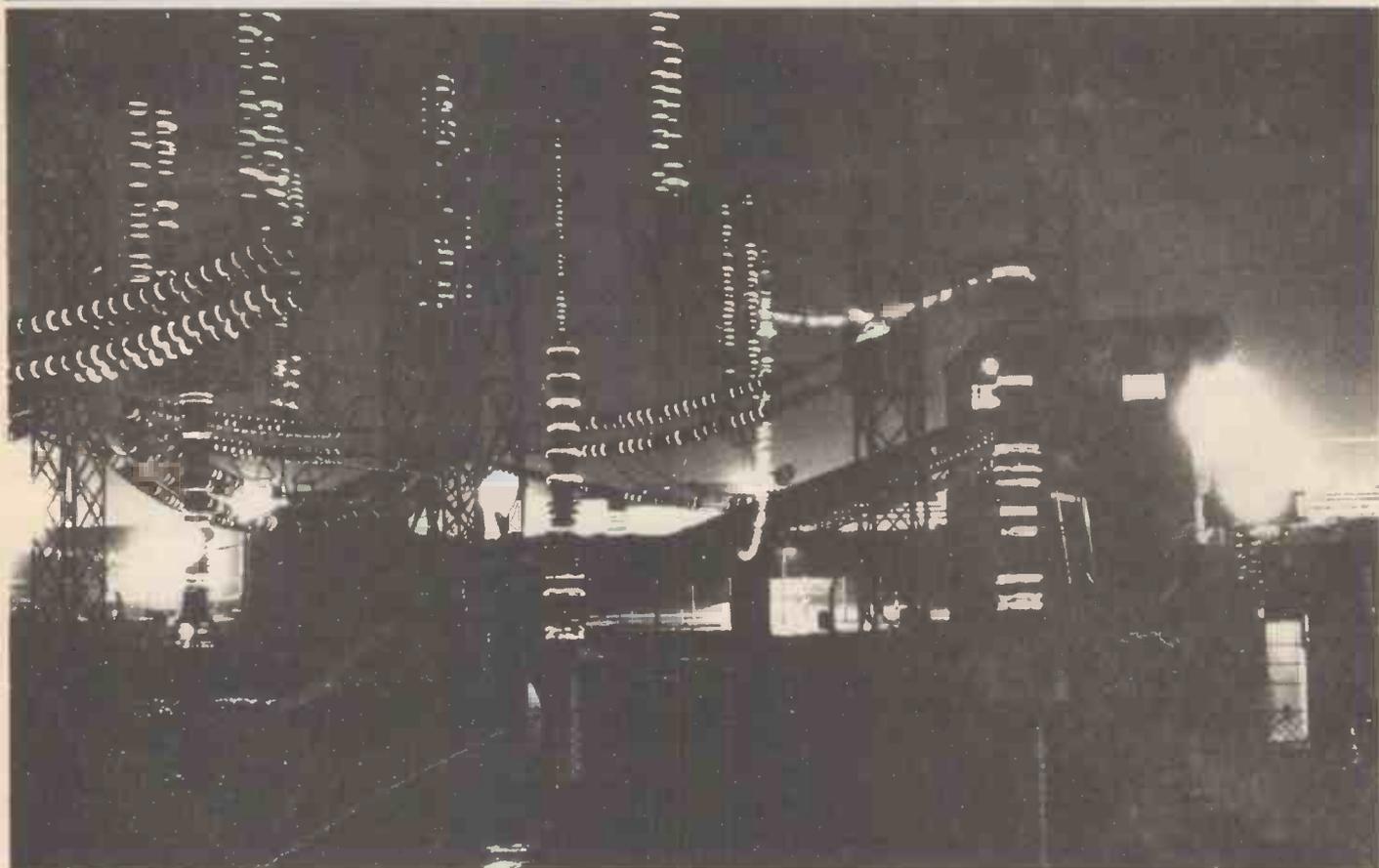
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LAP 93

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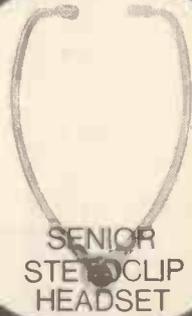
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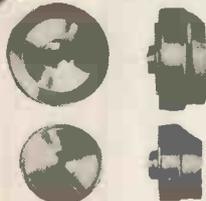
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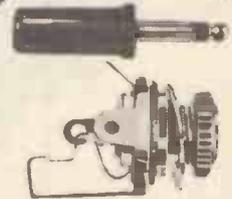
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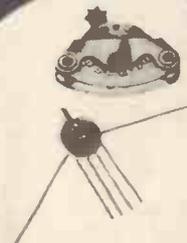
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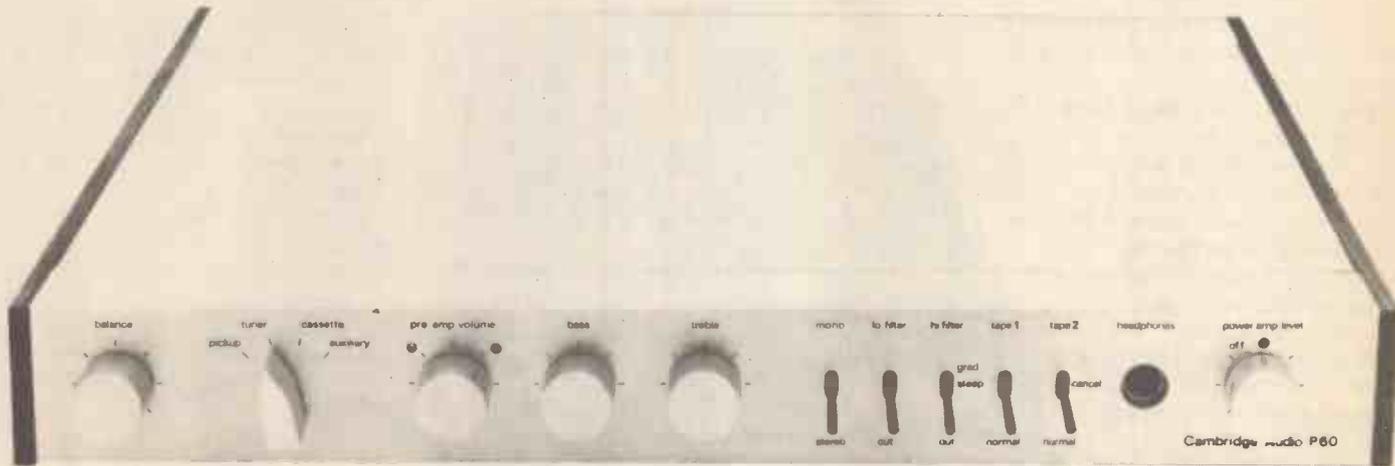
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WW 25

Programmable calculator

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They were expensive.

But they were infinitely faster and normally more accurate than slide rules or tables.

Programmable calculators—unlimited power

Personal scientific calculators had limitations: the number of functions was determined by the number of keys that could be crammed onto a keyboard; and every extra function meant extra cost.

Programmability overcomes both limitations—and makes a calculator vastly more powerful. With a programmable calculator, the number of functions which can be performed is unlimited.

It becomes a true miniature computer.

Sinclair Scientific Programmable: fastest, cheapest, most convenient

The two or three personal scientific programmable calculators on the market so far have cost hundreds of pounds.

The Sinclair Scientific Programmable is a technological breakthrough.

As a straightforward scientific calculator, it's remarkable. It gives access to the full range of scientific and mathematical functions. It uses true scientific notation. And it's the fastest personal scientific machine on the market—all functions are to all intents and purposes instantaneous.

It has an exceptionally convenient 19-key keyboard.

It's completely self-contained—even program-entry takes place through the keyboard.

And it costs only £29.95!



Functions and features of the Scientific Programmable

Keyboard-entry programmability

Programs up to 24 steps entered simply by keying in a sequence equivalent to calculation. No program takes longer than 30 seconds to enter.

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Full scientific notation, with floating-point entry option. Post-fixed operators (reverse Polish) for convenience in handling complex calculations. Exponent range: 10^{-99} to 10^{99} .

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\sqrt{x} , $\frac{1}{x}$, x^2 , sign change.

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Store, recall, exchange.

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Over 400 standard programs.

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Sinclair Scientific Programmable—a personal computer for under £30

The Sinclair Scientific Programmable is startlingly good value.

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The unique single Sinclair chip means that the Scientific Programmable—the fastest personal scientific calculator in the world—can be sold for £29.95 including VAT.

10-day no-oh

There's a lot more to this remarkable machine—far more than one advertisement can describe.

You need to see it and handle it... to program it yourself in a few seconds to save you hours... to check its performance against tables and graphs... to see the full range of standard programs.

It's not everybody's calculator—and as yet, it's not in the shops.

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dramatic breakthrough!

programmable. For under £30!

Programmability—what it is... what it offers

Any calculation consists of a series of operations performed on constant or variable numbers.

With a non-programmable calculator, every step demands at least one key-stroke.

With a programmable calculator, constants and operations can be stored in the right sequence in the calculator, ready to operate on the variables as they are entered. (The calculator becomes a miniature computer.)

The task of the operator is reduced to entering the appropriate variables at the appropriate points.

Programs may be taken from the program library or devised by the operator. Either way, they are entered simply by keying in a sequence equivalent to the calculation.

This means

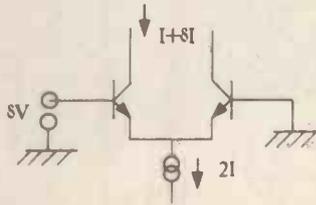
1. *unlimited power*—any function can be entered as a program;
2. *enormous time-saving*—for repetitive or iterative calculations *only* the variables need be entered;
3. *consistent accuracy*—eliminates risk of operator error during program execution;
4. *flexibility*. The Sinclair Scientific Programmable offers the choice of mains or battery operation—and once programmed can even be given to an operator who does not understand the program.

How the Scientific Programmable saves you time

This is most evident in repetitive calculations and in iterative procedures like the Newton-Raphson method of successive approximation.

Typical examples of repetitive calculations

1. An electronics engineer needs to plot the theoretical output waveform of a long tailed pair with current source tail for a sine wave input of peak value V_{pk} .



The change of output current is described by the formula:

$$\frac{\Delta I}{I} = \frac{(10^{\frac{sV}{60}} - 1)}{(10^{\frac{sV}{60}} + 1)}$$

where sV is in mV

By storing a 24-step program, from the program library, he can rapidly construct a plot of the output waveform by entering V_{pk} plus a series of linear steps corresponding to the time axis of the graph.

With no further instructions, the machine calculates the sinusoidal input waveform, applies it to the transfer function given, and displays the normalised change in output current.

If the calculation had to be performed step by step each time, graphing any substantial number of values could take hours. With the Scientific Programmable, each plot is instantaneous.

2. An accountant raising a loan may have a number of quotations giving different repayment terms and interest rates. He can enter a standard program from the program library to calculate annual repayments for any number of combinations in a matter of minutes.

Typical example of iterative process

Solve the equation $\tan x = 1 + x$.

By storing as a program the formula for solution by successive approximation, the solution can be obtained with high accuracy in a matter of seconds.

Over 400 standard programs

The procedures above are derived from some of over 400 standard programs in the Sinclair program library. Other programs include:

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Reactance frequency chart	Moments of inertia of square section torroids
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Determination of values for ladder attenuators	Heat conduction shape factor of a cylinder
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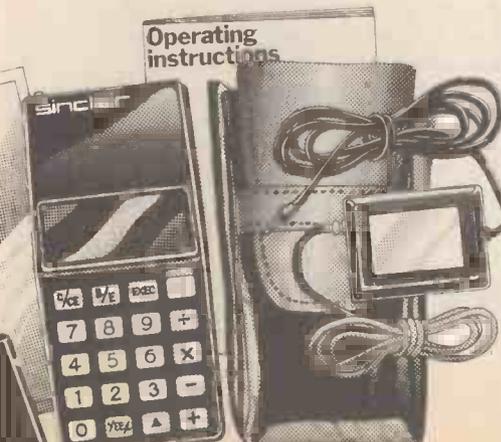
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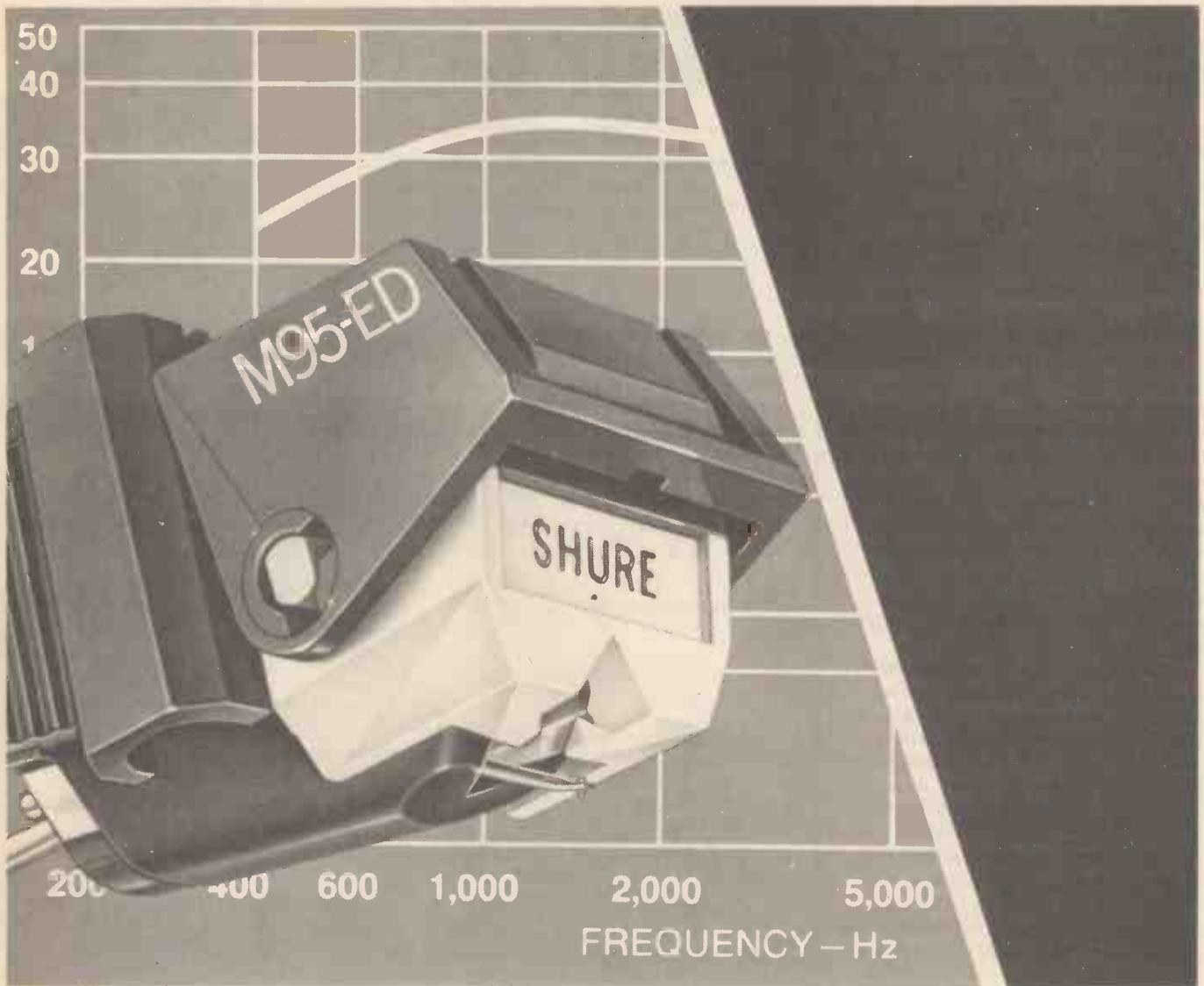
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M95ED: A Significant Technological Innovation

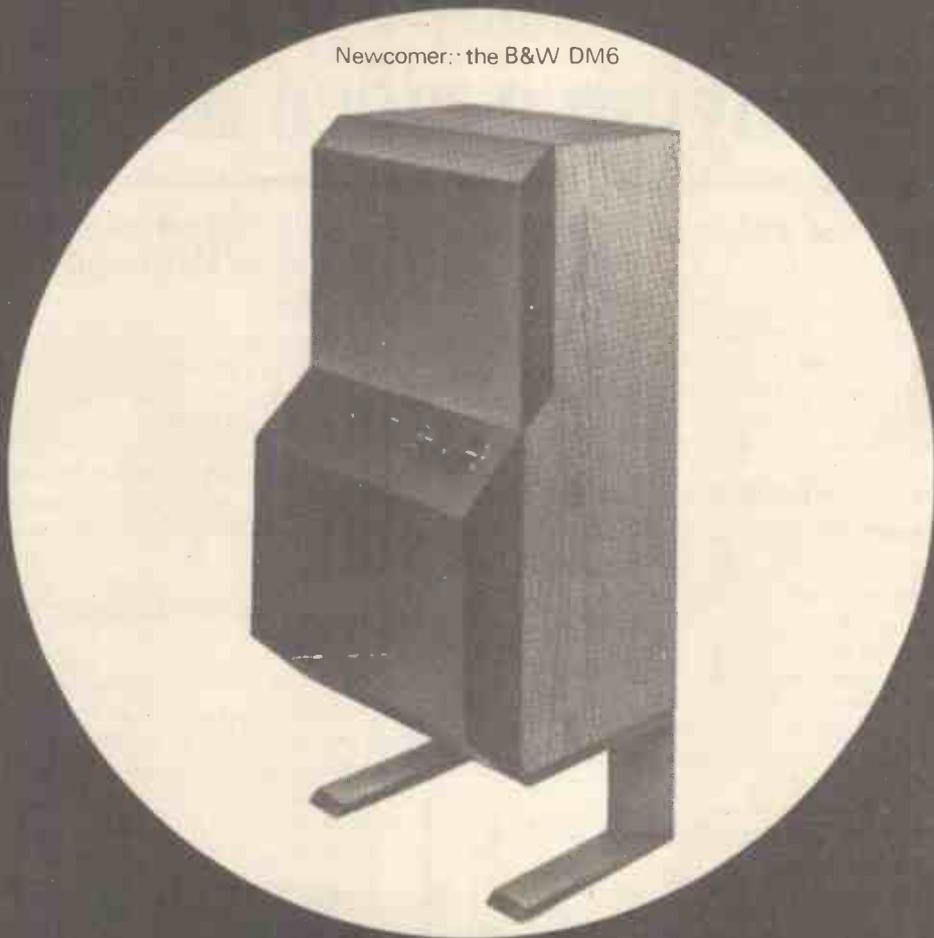


Shure now introduces a superb, moderately priced pick-up cartridge with a performance second only to the renowned V-15 Type III. The technologically advanced electromagnetic structure with a newly designed pole-piece virtually eliminates hysteresis loss. The frequency response from 20 to 20,000 Hz remains essentially flat. Operating at extremely light tracking forces of between $\frac{3}{4}$ and $1\frac{1}{2}$ grams, the exceptional trackability of the M95ED enables it to trace the very high recorded velocities encountered on many modern recordings with the result that in addition to providing faithful reproduction of the recorded sound, stylus and record wear are reduced to minimum proportions. The M95ED: A notable addition to the Shure range with a performance never before available at such a competitive price.

Shure Electronics Limited
Eccleston Road, Maidstone ME15 6AU
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Newcomer: the B&W DM6



It's easy to understand

... why B&W invested more than two years' design and development work in producing this addition to their range of monitor loudspeakers. Easy that is, when you hear, and see, the result—the B&W DM6.

but it's difficult to explain

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So, if you want to hear and see this new loudspeaker, contact your B & W Authorised Dealer. If you would like to receive literature explaining the principles and complexities of the DM6, drop a line to us.



B&W Loudspeakers

B & W Loudspeakers Ltd (Room 6) Meadow Road Worthing West Sussex BN13 10A

Tel. (0903) 205611

B & W DM is the registered trade mark of B & W Loudspeakers Ltd

WW—124 FOR FURTHER DETAILS

From Canada's largest manufacturer of video monitors, Bell & Howell present the extensive Electrohome range.

Questions to ask before buying a video monitor

It's an impressive number of models but what about the performance?

The performance/price ratio is equally impressive – perhaps the best in the CCTV business. More than 80% of the screen has a resolution capability greater than 1,000 lines and on the large monitors the minimum brightness in the white area is 130ft lamberts (under accepted test conditions). Other features include high video input impedance and external sync input.

I need a large screen. For what application has Electrohome's 23 in monitor been designed?

The long-term reliability of the EVM23 and EVM23AG make either ideal for surveillance systems in banks, factories and department stores. They are equally at home in the message centres of the world's airports, in schools and broadcast studios. Both models have a durable outer casing and the EVM23AG has a special tube face to reduce reflections – important where lights or windows may reflect on to the screen. Lockable front panels make them ideal for unattended locations.

What about mounting? I need the utmost flexibility.

There is no problem. Electrohome have wall and ceiling mount assemblies that allow a monitor to be swivelled or tilted about its centre of gravity. For mobile work like presentations and exhibitions there is an adjustable stand to support the EVM23 at four different heights – 63in, 55½in, 54in, and 46½in. If your requirement is for rack mounting versions, all sizes below 23in are available in rack mount options.

How do I decide the screen size to suit my application and do Electrohome have a complete range?

Screen size depends largely on viewing distance and available space. If the minimum viewing distance is 10ft then you should use a large monitor – 17in or above. At closer distances or where space is limited a 9in or 11in screen may be more suitable. If you intend TV to teach or persuade, avoid the mistake of sacrificing visual impact for the sake of economy. Electrohome's range is one of the most comprehensive available with seven different sizes from 9in to 25in (two in colour).

What facilities do Electrohome's small screen monitors offer?

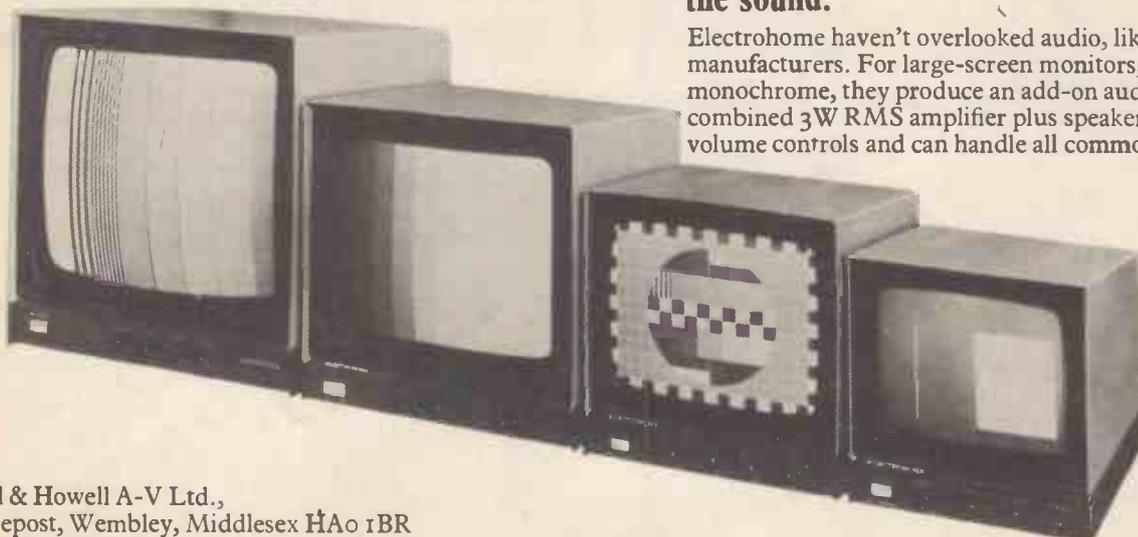
To complement this outstanding specification we have not forgotten the importance of switchable A-B inputs, switchable underscan, DC restoration and good geometry. Also the wide input sensitivity range and the input ground (which can be 'floated') will look after less favourable operating conditions. Input power requirement is also tolerant within 95–130V/185–265V, 50/60Hz.

When should I use a colour monitor?

We'll ask a question which will help you decide. Everything you show on TV will be shown with a purpose. Will colour help to achieve that purpose? If so, use colour – and choose an Electrohome colour monitor because, simply, you cannot make a better choice. (This is only part of the answer to a complex question which we would enjoy discussing with you in proper depth.)

What about audio? You have convinced me that the video signal is first-class, but I need to hear the sound.

Electrohome haven't overlooked audio, like some manufacturers. For large-screen monitors, both colour and monochrome, they produce an add-on audio pod with a combined 3W RMS amplifier plus speaker unit. It has tone and volume controls and can handle all common audio inputs.



Bell & Howell A-V Ltd.,
Freeport, Wembley, Middlesex HA0 1BR
(no stamp required).

 **BELL & HOWELL**

More questions? Write to us for the address of your nearest Bell & Howell Video Centre. You'll get the answers in the most convincing way possible – by seeing and hearing how Electrohome's monitors perform.

Specifications: the Electrohome monitor range from Bell & Howell

Models	Screen size	Specification	Individual features	
EVM-910 (freestanding) EVM-910R (rack mounted) EVM-910R2 (double rack mounted)	9in (21.7cm) 38in ² (245cm ²)	Input sensitivity 0.35V - 2V pp composite or separate sync. signal (sync. negative). Resolution in excess of 1,000 lines in central 80% of display area at 5ft lamberts; more than 860 lines at 30ft lamberts brightness; capability 55ft lamberts in white area of test pattern (23in monitor 150ft lamberts). EHT regulation, switchable scan size, DC restoration and 15Mhz bandwidth ± 3 dB.	2 video inputs or 1 video blanked input plus sync.	
EVM-1110 (free standing) EVM-1110R (rack mounted)	11in (26.3cm) 61in ² (393.5cm ²)			
EVM-1410 (free standing) EVM-1410R (rack mounted)	14in (32.2cm) 82in ² (529cm ²)			
EVM-1710 (free standing) EVM-1710R (rack mounted)	17in (41.3cm) 149in ² (961cm ²)			
EVM-23	23in (57.5cm) 282in ² (1819.3cm ²)			Lockable control cover
EVM-23AG	23in (57.5cm) 282in ² (1819.4cm ²)			Special tube face to reduce reflections. Lockable control cover
ECV-19P (colour)	19in (48.26cm) 185in ² (1193.25cm ²)	Input sensitivity 0.5V - 2V pp composite or separate sync. signal (sync. negative). D.C. restoration: keyed clamp back porch maintains black level shift to less than 2% of peak luminance from 10% to 90% APL. Colour temperature: 6500°K. Continuously adjustable to 9300°K.	Lockable control cover	
ECV-25P (colour)	25in (62.5cm) 315cm ² (2032cm ²)			
Accessories				
ECM-2	Ceiling mount			
EWM-1	Wall mount			
EVSA-2	Speaker/amplifier pod. 3W RMS amplifier available for large monochrome and colour monitors.			
EPC-1	Pulse-Cross kit. Allows VTR users to optimise tracking and tape tension (EVM-23 only).			


BELL & HOWELL

all the 'scope you need... with Dynamco's new 7500

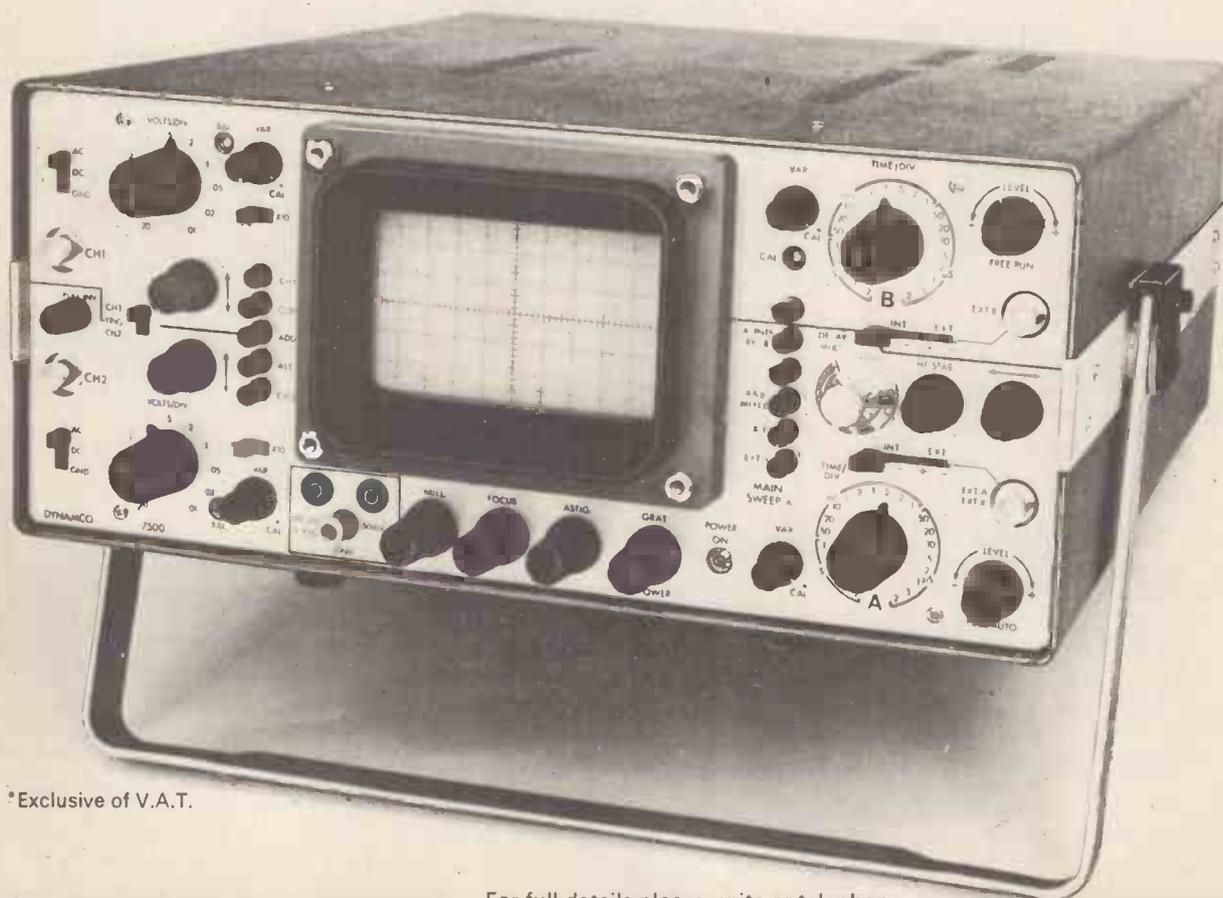
Designed to meet the increasing demand for low cost 40MHz oscilloscopes, Dynamco's new 7500 offers outstanding value when compared with instruments of similar specification.

Some of its many features are :-

- * 40 MHz band width at 10mV/div sensitivity
- * Dual trace * Mixed sweep * Calibrated sweep delay * Gated trigger * 3% accuracy * Small size - lightweight and the option to operate from external DC supplies or clip-on battery pack.

Provisional price £470.00*

With todays demand for first class equipment at sensible prices Dynamco's 7500 fits the bill.



*Exclusive of V.A.T.

DOT DYNAMCO

For full details please write or telephone

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WW-115 FOR FURTHER DETAILS

CHROMASONIC electronics

Dept. 5, 56, Fortis Green Road,
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C - MOS

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PHOTO-DARLINGTON



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7427	27p	22p	18p
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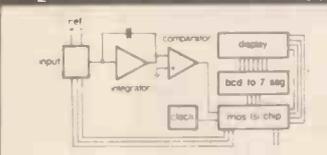
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3 1/2 DECADE DVM I.C.



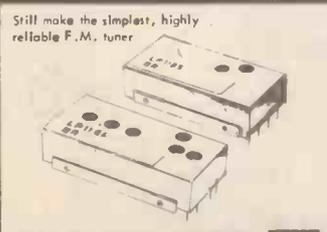
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AC117	0.24	BC125	0.29	BD124	0.80	BF336	0.35	C111E	0.56	ZTX313	0.12	2N3794	0.20
AC126	0.25	BC126	0.20	BD131	0.45	BF459	0.63	CRS3/40	0.75	ZTX500	0.17	2N3819	0.35
AC127	0.25	BC132	0.15	BD132	0.50	BF596	0.70	D40N1	0.45	ZTX504	0.12	2N3820	0.49
AC128	0.25	BC134	0.20	BD145	0.40	BF597	0.15	E5024	0.20	ZTX504	0.17	2N3823	1.45
AC141	0.26	BC135	0.19	BD136	0.46	BF839	0.24	E6001	0.18	ZTX602	0.24	2N3866	1.70
AC141K	0.27	BC136	0.20	BD137	0.30	BF841	0.30	E6002	0.17	ZTX602	0.24	2N3867	0.25
AC142K	0.19	BC137	0.20	BD138	0.56	BF861	0.35	E6001	0.18	ZTX602	0.24	2N3867	0.25
AC153K	0.28	BC138	0.20	BD139	0.55	BF879	0.24	E6001	0.18	ZTX602	0.24	2N3867	0.25
AC154	0.20	BC142	0.30	BD140	0.62	BF743	0.55	E6001	0.18	ZTX602	0.24	2N3867	0.25
AC176	0.26	BC143	0.35	BD144	2.19	BFW10	0.55	E6001	0.18	ZTX602	0.24	2N3867	0.25
AC178	0.27	BC147B	0.13	BD145	0.75	BFW11	0.55	E6001	0.18	ZTX602	0.24	2N3867	0.25
AC179	0.27	BC148	0.12	BD163	0.67	BFW16A	1.70	E6001	0.18	ZTX602	0.24	2N3867	0.25
AC187	0.25	BC149	0.14	BD183	0.38	BFX30	1.38	E6001	0.18	ZTX602	0.24	2N3867	0.25
AC187K	0.26	BC149B	0.15	BD234	0.75	BFW59	0.19	E6001	0.18	ZTX602	0.24	2N3867	0.25
AC188	0.25	BC152	0.25	BD519	0.76	BFW60	0.20	E6001	0.18	ZTX602	0.24	2N3867	0.25
AC188K	0.26	BC153	0.20	BD520	0.76	BFW90	0.28	E6001	0.18	ZTX602	0.24	2N3867	0.25
AC193K	0.30	BC154	0.20	BDX18	1.45	BFX16	2.55	E6001	0.18	ZTX602	0.24	2N3867	0.25
AC194K	0.32	BC157	0.15	BDX32	2.55	BFX29	0.30	E6001	0.18	ZTX602	0.24	2N3867	0.25
ACV258	0.25	BC158	0.13	BDY15A	0.38	BFX30	0.35	E6001	0.18	ZTX602	0.24	2N3867	0.25
ACV30	0.68	BC159	0.15	BDY18	1.78	BFX84	0.25	E6001	0.18	ZTX602	0.24	2N3867	0.25
AD140	0.59	BC161	0.48	BDY20	0.99	BFX85	0.26	E6001	0.18	ZTX602	0.24	2N3867	0.25
AD142	0.52	BC167B	0.15	BF115	0.20	BFX86	0.26	E6001	0.18	ZTX602	0.24	2N3867	0.25
AD143	0.51	BC168B	0.13	BF117	0.45	BFX87	0.28	E6001	0.18	ZTX602	0.24	2N3867	0.25
AD149	0.48	BC169C	0.13	BF120	0.55	BFX88	0.24	E6001	0.18	ZTX602	0.24	2N3867	0.25
AD161	0.48	BC170	0.15	BF121	0.25	BFY18	0.53	E6001	0.18	ZTX602	0.24	2N3867	0.25
AD162	0.48	BC171A	0.15	BF123	0.45	BFY40	0.40	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF114	0.25	BC172	0.14	BF125	0.25	BFY41	0.43	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF115	0.25	BC173	0.20	BF127	0.30	BFY50	0.45	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF116	0.25	BC176	0.22	BF158	0.25	BFY51	0.23	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF117	0.20	BC177	0.20	BF159	0.27	BFY52	0.23	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF118	0.50	BC178	0.22	BF160	0.22	BFY57	0.32	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF121	0.32	BC178B	0.22	BF161	0.45	BFY64	0.42	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF124	0.29	BC179	0.20	BF162	0.45	BFY72	0.31	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF125	0.25	BC179B	0.21	BF163	0.45	BFY90	0.70	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF126	0.25	BC182L	0.11	BF167	0.25	BFY15A	0.79	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF127	0.25	BC183	0.11	BF173	0.25	BPX25	1.90	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF139	0.35	BC183K	0.12	BF177	0.30	BPX29	1.70	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF147	0.32	BC183L	0.11	BF178	0.33	BPX52	1.90	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF149	0.35	BC184L	0.13	BF179	0.33	BRCA443	0.68	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF178	0.55	BC186	0.25	BF180	0.35	BRV39	0.47	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF179	0.60	BC187	0.27	BF181	0.33	BRV56	0.40	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF180	0.55	BC208	0.12	BF182	0.44	BR101	0.47	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF181	0.50	BC212L	0.12	BF183	0.44	BSW64	0.35	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF186	0.40	BC213L	0.12	BF184	0.26	BSX19	0.13	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF239	0.40	BC214L	0.15	BF185	0.26	BSX20	0.19	E6001	0.18	ZTX602	0.24	2N3867	0.25
AF279	0.84	BC238	0.12	BF194	0.15	BSX76	0.15	E6001	0.18	ZTX602	0.24	2N3867	0.25
AL100	1.10	BC261A	0.28	BF195	0.15	BSX82	0.52	E6001	0.18	ZTX602	0.24	2N3867	0.25
AL102	1.10	BC262A	0.28	BF196	0.15	BSY19	0.52	E6001	0.18	ZTX602	0.24	2N3867	0.25
AL103	1.10	BC263B	0.15	BF197	0.17	BSY41	0.22	E6001	0.18	ZTX602	0.24	2N3867	0.25
AL113	0.95	BC271L	0.12	BF198	0.20	BSY52	0.45	E6001	0.18	ZTX602	0.24	2N3867	0.25
AU103	2.10	BC268C	0.14	BF199	0.25	BSY54	0.50	E6001	0.18	ZTX602	0.24	2N3867	0.25
AU110	1.90	BC294	0.37	BF200	0.35	BSY56	0.80	E6001	0.18	ZTX602	0.24	2N3867	0.25
AU113	2.40	BC300	0.60	BF218	0.35	BSY65	0.15	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC107	0.12	BC1301	0.35	BF222	1.08	BSY78	0.40	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC107B	0.40	BC303	0.60	BF224J	0.15	BSY91	0.28	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC108	0.12	BC307	0.12	BF240	0.20	BT106	1.24	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC108A	0.12	BC308A	0.10	BF241	0.22	BT116	1.20	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC108B	0.13	BC309	0.15	BF244	0.18	BU105/021.95	0.15	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC108C	0.14	BC323	0.68	BF254	0.45	BU108	3.25	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC109	0.13	BC377	0.22	BF255	0.45	BU126	2.89	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC109C	0.14	BC441	1.10	BF256	0.45	BU204	1.98	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC113	0.13	BC461	1.58	BF257	0.49	BU205	1.98	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC114	0.20	BCY42	0.16	BF258	0.66	BU207	3.00	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC115	0.20	BCY71	0.22	BF259	0.93	BU208	3.15	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC116	0.20	BCY87	4.65	BF262	0.70	BU209	2.55	E6001	0.18	ZTX602	0.24	2N3867	0.25
BC117	0.20	BCY88	2.42	BF263	0.70	BUY77	2.80	E6001	0.18	ZTX602	0.24	2N3867	0.25

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Notes: All prices are in pence per unit. First price in each group is thyristor, second is triac, third is triac with trigger. Encapsulation depends on current rating and device type. Connection data supplied with each device. Quantity enquiries welcomed.

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Type	Price (p)	Type	Price (p)
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CA3065	1.90	£15/100	
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MC1310P	2.94	25k lin pots—short spindle	
MC1327PQ		5p each	
		£4.20/100	
		£35/1000	
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TBA120S	0.99		
TBA240A	2.97		
TBA480Q	1.90		
TBA500	1.99		
TBA550Q	2.00		
TBA510	1.99		
TBA520Q	3.34		
TBA530	2.71		
TBA5300	2.71		
TBA540	3.21		
TBA5400	3.21		
TBA550Q	4.10		
TBA560C	4.09		
TBA560C	4.10		
TBA570	4.10		
TBA641	2.30		
TBA673	2.28		
TBA700	2.45		
TBA7500	2.33		
TBA800	1.75		
TBA810AS	1.75		
TAA300	1.		

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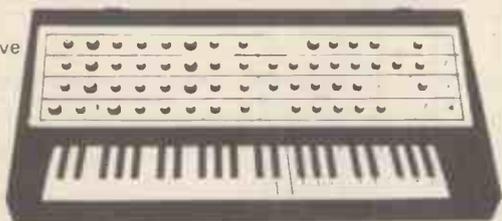
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The 3600 SYNTHESISER

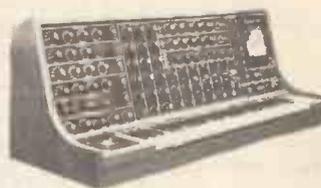
The 3600 synthesiser includes the most popular features of the 4600 model, but is simpler. Faster to operate, it has a switch patching system rather than the matrix patchboard of the larger unit and is particularly suitable for live performance and portable use.



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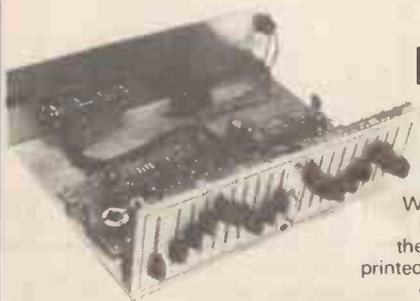
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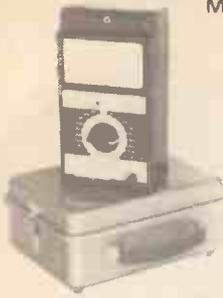
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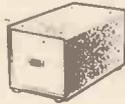
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VA (WATTS)	REF No.	PRICE Cased £	PRICE Plugs 2 Pin + 1 Earth £	PRICE Open £	Post £
60	149	8.60	0.88	4.37	0.56
100	150	9.40	0.88	4.90	0.54
200	151	11.70	0.88	8.14	0.80
250	152	13.15	0.88	9.80	0.88
350	153	15.75	0.88	11.88	0.95
500	154	12.50	0.88	13.62	1.13
750	155	27.35	1.10	20.59	0.81
1000	156	35.65	1.10	29.15	0.81
1500	157	42.25	1.10	33.37	0.81
2000	158	49.95	2.64	37.10	0.81
3000	159	73.50	2.64	58.55	0.81

MINIATURE & EQUIPMENT

VOLTS		MILLIAMPS		TYPE	PRICE £	Post £
Sec. 1	Sec. 2	Sec. 1	Sec. 2	No.	£	£
3-0-3	—	200	—	238	1.50	0.25
0-6	—	500	—	234	1.38	0.25
0-6	—	1000	—	212	1.90	0.47
9-0-9	—	100	—	13	1.40	0.25
0-9	—	330	—	235	1.50	0.25
0-9-9	—	500	—	207	1.93	0.34
0-9-9	—	1000	—	208	2.75	0.47
15-0-15	—	40	—	240	1.35	0.25
0-15	—	200	—	236	1.38	0.25
20-0-20	—	30	—	241	1.35	0.25
0-20	—	150	—	237	1.38	0.25
0-15-20	—	500	—	205	2.73	0.56
0-20	—	300	—	214	1.93	0.47
0-20	—	3500	—	1116	3.30	0.64
12-20	—	700	—	221	2.20	0.47
0-15-20	—	1000	—	206	3.50	0.56
0-15-27	—	500	—	203	3.00	0.56
0-15-27	—	1000	—	204	3.85	0.56

12 and 24 VOLTS PRIMARY 200-240 Volts

VA (Watts)	Ref No.	PRICE Cased £	PRICE Plugs 2 & 3 pin £	PRICE Open £	Post £
12V	24V				
0.3	0.15	242	1.58	0.34	
0.5	0.25	111	1.78	0.34	
1	0.5	213	1.38	0.47	
2	1	71	2.30	0.47	
4	2	18	2.96	0.56	
6	3	70	4.18	0.56	
8	4	108	4.56	0.64	
10	5	72	5.20	0.72	
12	6	116	5.51	0.72	
16	8	17	7.00	0.80	
20	10	115	10.42	0.88	
30	15	187	13.25	1.01	
40	20	232	14.85	0.81	
60	30	226	16.83	0.81	

30 VOLTS

AMPS	Ref.	Price	Post
0.5	112	1.90	0.47
1	179	2.40	0.56
2	3	3.50	0.56
3	20	4.50	0.64
4	21	5.15	0.72
5	51	6.40	0.72
6	117	7.16	0.88
8	88	9.55	0.95
10	89	9.67	0.95

50 VOLTS

AMPS	Ref.	Price	Post
0.5	102	2.58	0.57
1	103	3.48	0.56
2	104	5.03	0.64
3	105	5.81	0.72
4	106	7.58	0.88
6	107	12.30	0.95
8	118	13.20	1.13
10	119	17.02	0.81

60 VOLTS

AMPS	Ref.	Price	Post
0.5	124	2.30	0.56
1	126	3.41	0.56
2	127	5.09	0.72
3	125	7.52	0.80
4	123	8.75	0.95
5	40	9.75	0.95
6	120	11.20	1.01
8	121	15.00	1.19
10	122	18.20	0.81
12	189	18.50	0.81

AUTO TRANSFORMERS

VA (Watts)	Ref No.	PRICE Cased £	PRICE Plugs 2 & 3 pin £	PRICE Open £	Post £
Tapped at 115, 220, 240 Volts					
20	113	3.10	0.20	1.74	0.47
Tapped at 115, 200, 220, 240 Volts					
150	4	6.65	0.20	4.12	0.56
200	65	7.30	0.20	4.95	0.64
300	66	8.25	0.20	5.81	0.72
500	67	11.25	0.20	8.85	0.88
750	63	14.10	0.85	10.80	0.95
1000	84	17.50	0.85	13.68	1.13
1500	93	22.15	0.85	18.31	0.81
2000	95	33.40	1.60	24.25	0.81
3000	73	48.20	2.10	36.10	0.81

BRIDGE RECTIFIERS

ONE AMP	Price
50 P.I.V.	0.20
100 P.I.V.	0.26
200 P.I.V.	0.30
600 P.I.V.	0.30

FOUR AMP	Price
100 P.I.V.	0.55
200 P.I.V.	0.59
400 P.I.V.	0.65
600 P.I.V.	0.75

TWO AMP	Price
50 P.I.V.	0.35
100 P.I.V.	0.40
200 P.I.V.	0.45
400 P.I.V.	0.50

SIX AMP	Price
50 P.I.V.	0.65
100 P.I.V.	0.70
200 P.I.V.	0.78
400 P.I.V.	0.90

POWER UNIT TYPE CC12-05 British Made



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Housed in smart steel case, finished in hard epoxy coating. Screened for safety.
Output switched 3, 4.5, 6, 7.5, 9 and 12 Volts at 500 mA D.C. Operates from 240 V mains, suitable for Radios, Tape Recorders, Record Players, etc. Size 7.5 x 5.0 x 14.0 cm. Price £4.05 Post 30p.

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SIZE: 60mm Wide x 45mm High x 40mm Deep	L.R. Movement	SIZE: 110mm Wide x 82mm High x 43mm Deep	L.R. Movement
0-50 micro A	1250	0-50 micro A	1400
0-100 micro A	580	0-100 micro A	730
0-500 Micro A	170	0-500 micro A	200
0-1 mA	170	0-1 mA	200
0-5 mA	170	0-5 mA	200
0-10 mA	6	0-10 mA	6
0-50 mA	0.5	0-50 mA	0.5
0-100 mA	0.5	0-100 mA	0.5
0-500 mA	0.5	0-500 mA	0.5
0-1 AMP	0.5	0-1 AMP	0.5
0-2 AMP	0.5	0-2 AMP	0.5
0-25 Volt	15K	0-25 Volt	15K
0-50 Volt	50K	0-50 Volt	50K
0-300 Volt	300K	0-300 Volt	300K
"V" Meter	170	"V" Meter	200
VU Meter	9250	VU Meter	5250

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DC Volts 0-1 50 250 1000 Volts
DC Current 0-1 mA 0-100 mA
Resistance 0-150K ohms
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MINIATURE NEONS

6mm dia., 12mm length leads length approx. 20mm. Recommended ballast resistor. 150K ohms for 240 Volt operation. Price: Packet of 10 for 60p. Postage 15p

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Pack	Price
1 Fibreglass printed circuit board for front end, IF strip, demodulator, AFC and mute circuits	£2.15
2 Set of metal oxide resistors, thermistor, capacitors, cermet preset for mounting on pack 1	£4.80
3 Set of transistors, diodes, LED, integrated circuits for mounting on pack 1	£6.25
4 Pre-aligned front end module, coil assembly, three-section ceramic filter	£8.80
5 Fibreglass printed circuit board for stereo decoder	£1.10
6 Set of metal oxide resistors, capacitors, cermet preset for decoder	£2.60
7 Set of transistors LED, integrated circuit for decoder	£3.45
8 Set of components for channel selector switch module including fibreglass printed circuit board, push-button switches, knobs, LEDs preset adjusters, etc.	£8.30

Pack	Price
9 Function switch, 10 turn tuning potentiometer, knobs	£5.30
10 Frequency meter, meter drive components, fibreglass printed circuit board	£8.60
11 Toroidal transformer with electrostatic screen. Primary: 0-117V-234V	£4.45
12 Set of capacitors, rectifiers, voltage regulator for power supply	£2.95
13 Set of miscellaneous parts, including sockets, fuse holder, fuses, inter-connecting wire, etc.	£1.50
14 Set of metal work parts including silk screen printed fascia panel, acrylic silk screen printed tuning indicator panel insert, internal screen, fixing parts, etc.	£6.50
15 Construction notes (free with complete kit)	£0.25
16 Teak cabinet	£9.85
One each of packs 1-16 inclusive are required for complete stereo FM tuner.	
Total cost of individually purchased packs	£76.85

NOVEL STEREO FM TUNER

In the April and May issues of *Wireless World* there was published a novel design for an f.m. tuner which combines consistent high performance with the elimination of the critical setting-up procedure required by too many earlier tuners. This original circuit has been developed further and is used as the basis for our new slimline unit. The front end is a ready built pre-aligned module which then feeds an amplifier driven screened three section ceramic filter leading to an integrated circuit five-stage limiting amplifier providing excellent a.m. rejection. This is followed by a single coil integrated balanced demodulator from which the audio output may be taken. Temperature compensated varicap tuning allows stations to be selected either by a ten-turn tuning potentiometer or by a choice of six preset push-button controls. Each of the preset controls can be adjusted on the front panel with the settings being indicated by six LED lamps behind an acrylic silk screen printed fascia panel insert. Additional circuitry includes temperature compensated AFC restricted to less than station spacing, inter-station muting, a single-lamp LED tuning indicator and a linear scale frequency meter. The stereo decoder, built on a separate board, is based on a well proven integrated circuit phase-locked-loop to which has been added active filters to remove sub-carrier harmonics and 'birdies'. The power supply, to ensure station holding stability, uses an integrated circuit voltage regulator which is powered via a low-hum field specially designed TOROIDAL TRANSFORMER.

STYLED TO COMPLEMENT THE WORLD-WIDE ACCLAIMED LINSLEY-HOOD 75W AMPLIFIER



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MORE ON NEXT PAGE!

DESIGNER APPROVED KIT

In *Hi-Fi News* there was published by Mr Linsley-Hood a series of four articles (November 1972-February 1973) and a subsequent follow-up article (April 1974) on a design for an amplifier of exceptional performance which has as its principal feature an ability to supply from a direct coupled fully protected output stage, power in excess of 75 watts whilst maintaining distortion at less than 0.01% even at very low power levels. The power amplifier is complemented by a pre-amplifier based on a discrete component operational amplifier referred to as the Liniac which is employed in the two most critical points of the system, namely the equalization stage and tone control stage, positions where most conventional designs run out of gain at the extremes of the frequency spectrum. Unusual features of the design are the variable transition frequencies of the tone controls and the variable slope of the scratch filter. There is a choice of four inputs, two equalized and two linear, each having independently adjustable signal level. The attractive slimline unit pictured has been made practical by highly compact PCBs and a specially designed Toroidal transformer.

Hi-Fi News Linsley-Hood 75W/Channel Amplifier Mk III Version (modifications as per *Hi-Fi News* April 1974)



Full circuit description in handbook (pack 15—price 30p)

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Pack	Price
1 Fibreglass printed-circuit board for power amp.	£0.85
2 Set of resistors, capacitors, pre-sets for power amp.	£1.70
3 Set of semiconductors for power amp. (now using BDY56, BD529, BD530)	£6.50
4 Pair of 2 drilled, finned heat sinks	£0.80
5 Fibreglass printed-circuit board for pre-amp.	£1.30
6 Set of low noise resistors, capacitors, pre-sets for pre-amp.	£2.70
7 Set of low noise, high gain semiconductors for pre-amp.	£2.40
8 Set of potentiometers (including mains switch)	£2.05
9 Set of 4 push-button switches, rotary mode switch	£3.70
10 Toroidal transformer complete with magnetic screen/housing primary: 0-117-234 V, secondaries: 33-0-33 v, 25-0-25 V.	£9.15

Pack	Price
11 Fibreglass printed-circuit board for power supply	£0.65
12 Set of resistors, capacitors, secondary fuses, semiconductors for power supply	£3.50
13 Set of miscellaneous parts including DIN akts, mains input skt, fuse holder, inter-connecting cable, control knobs	£4.25
14 Set of metalwork parts including silk screen printed fascia panel and all brackets, fixing parts, etc.	£6.30
15 Handbook	£0.30
16 Teak cabinet	£9.85
2 each of packs 1-7 inclusive are required for complete stereo system	
Total cost of individually purchased packs	£72.25

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Component packs for a choice of three outstanding amplifiers are stocked together with packs for a regulated power supply suitable for use with a pair of any of them. Also stocked are packs for a very well-established pre-amplifier—the Bailey-Burrows design which features six inputs, a scratch and rumble filter and wide range tone controls which may be either rotary or slider operating.

30W BAILEY

Pk. 1 F/Glass PCB	£0.80
Pk. 2 Resistors, capacitors, pots	£1.75
Pk. 3 Semiconductor set	£4.70

20W LINSLEY-HOOD

Pk. 1 F/Glass PCB	£0.85
Pk. 2 Resistors, capacitors, pots	£2.40
Pk. 3 Semiconductor set	£3.35

60V REGULATED POWER SUPPLY

Pk. 1 F/Glass PCB	£0.75
Pk. 2 Resistors, capacitors, pots	£1.40
Pk. 3 Semiconductor set	£3.10

BAILEY-BURROWS PRE-AMP

Pk. 1 F/Glass PCB	£2.05
Pk. 2 Resistors, capacitors, pre-sets, transistors	£4.95

Pk. 3R Rotary potentiometer set £1.60

Pk. 3S Slider potentiometer set (with knobs) £2.70

STUART TAPE RECORDER

A set of three printed-circuit boards has been prepared for the stereo integrated circuit version of this high-performance *Wireless World* published design.

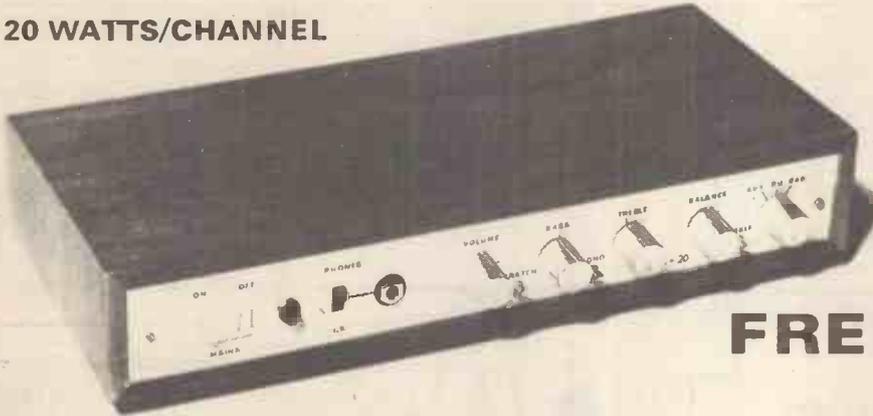
TRRP Pk. 1 Reply amplifier F/Glass PCB £0.90

TRRC Pk. 1 Record amp./meter drive cct. F/Glass PCB £1.40

TROS Pk. 1 Bias/erase/stabilizer cct. F/Glass PCB £1.00

For details of component packs for this design please write for free list.

20 WATTS/CHANNEL



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Pack	Price
1 Set of all low noise resistors	£0.95
2 Set of all small capacitors	£1.50
3 Set of 4 power supply capacitors	£1.40
4 Set of miscellaneous parts including DIN sockets, fuses, fuse holders, control knobs, etc.	£1.90
5 Set of slide and push-button switches	£1.20
6 Set of potentiometers and selector switch	£2.00
7 Set of all semiconductors	£7.25
8 Special Toroidal Transformer	£4.95
9 Fibreglass PC Panel	£2.50
10 Complete chassis work, hardware and brackets	£4.20
11 Preformed cable/leads	£0.40
12 Handbook	£0.25
13 Teak Cabinet	£4.50

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2N1711 £0.25	40362 £0.45	BD529 £0.85	MJE521 £0.60	TIP30A £0.60
2N2926G £0.10	BC107 £0.10	BD530 £0.85	MPSA05 £0.25	TIP29C £0.71
2N3055 £0.45	BC108 £0.10	BDY56 £1.60	MPSA12 £0.55	TIP30C £0.78
2N3442 £1.20	BC109 £0.10	BF257 £0.40	MPSA14 £0.35	TIP41A £0.74
2N3711 £0.09	BC109C £0.12	BF259 £0.47	MPSA55 £0.25	TIP42A £0.90
2N3904 £0.17	BC125 £0.15	BFR39 £0.25	MPSA65 £0.35	TIP 41B £0.82
2N3906 £0.20	BC126 £0.15	BFR79 £0.25	MPSA66 £0.40	TIP 42B £0.98
2N4062 £0.11	BC182 £0.10	BFY51 £0.20	MPSU05 £0.60	1N914 £0.07
2N4302 £0.60	BC212 £0.12	BFY52 £0.20	MPSU55 £0.70	1N916 £0.07
2N5087 £0.42	BC182K £0.10	CA3046 £0.70	SBA750A £2.50	1S920 £0.10
2N5210 £0.54	BC212K £0.12	LP1186 £5.50	SL301 £1.30	5B05 £1.20
2N5457 £0.45	BC182L £0.10	MC1310 £2.90	SL3045 £1.60	FILTERS
2N5459 £0.45	BC184L £0.11	MC1351 £1.05	SN72741P £0.40	FM4 £0.80
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ACTIVE FILTER CROSSOVER

An essential and critical component in a high-quality speaker system is the crossover unit conventionally comprising of a series of passive networks which unfortunately, though introducing reactive impedances between the amplifier and the speakers, result in the loss of the advantage of high amplifier damping factor and renders the speakers prone to overshoots and resonances. An elegant solution to this problem, described by D. C. Read in *Wireless World*, involves the use of a series of active filters splitting the output of the pre-amplifier into three channels, of closely defined bandwidth, each of which is fed to the appropriate speaker by its own power amplifier. A design for a suitable 20-watt amplifier, based on a proven Texas circuit, was also described by Mr Read. The printed-circuit board for this has been designed such that three amplifiers may be stacked and mounted together on a common heat sink to achieve a conveniently compact module.

ACTIVE FILTER

Pack	Price
1 Fibreglass PCB (accommodates all filters for one channel)	£1.05
2 Set of pre-sets, solid tantalum capacitors, 2% metal oxide resistors, 2% polystyrene capacitors	£4.20
3 Set of semiconductors	£2.65
2 off each pack required for stereo system	

READ/TEXAS 20w amp.

Pack	Price
1 Fibreglass PCB	£0.70
2 Set of resistors, capacitors pre-sets (not including O/P coupling capacitors)	£1.10
3 Sets of semiconductors	£2.40
6 off each pack required for stereo system	
4 Special heat sink assembly for set of 3 amplifiers	£0.85
5 Set of 3 O/P coupling capacitors	£1.00
2 off packs 4, 5 required for stereo system	

POWER SUPPLY

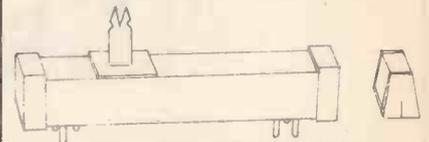
Pack	Price
1 Fibreglass PCB	£0.50
2 Set of rectifiers, zener diode, capacitors, fuses, fuse holders	£2.60
3 Toroidal transformer	£4.95

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MORE KITS ON PAGE 61

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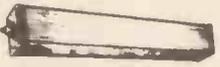
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BC182/3/4&4L10p	1N4148 & 914 4p
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As can be seen from the photograph the tone control unit is very slim (only 1 1/4" from front to back) and may therefore be used in many other applications than our Bailey metalwork which it is designed to fit.

METALWORK AND WOODEN CASES These have been under review for some time: please send for latest information.

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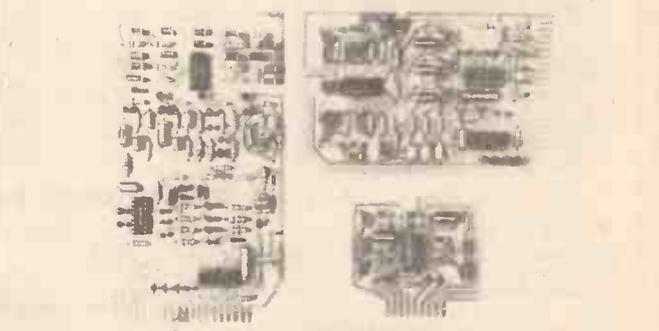
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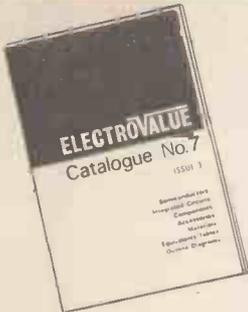
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207	500.500	0-8-9-0-8-9	1.92	30
208	1A 1A	0-8-9-0-8-9	3.30	38
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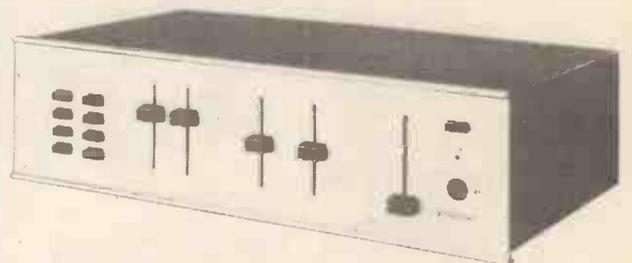
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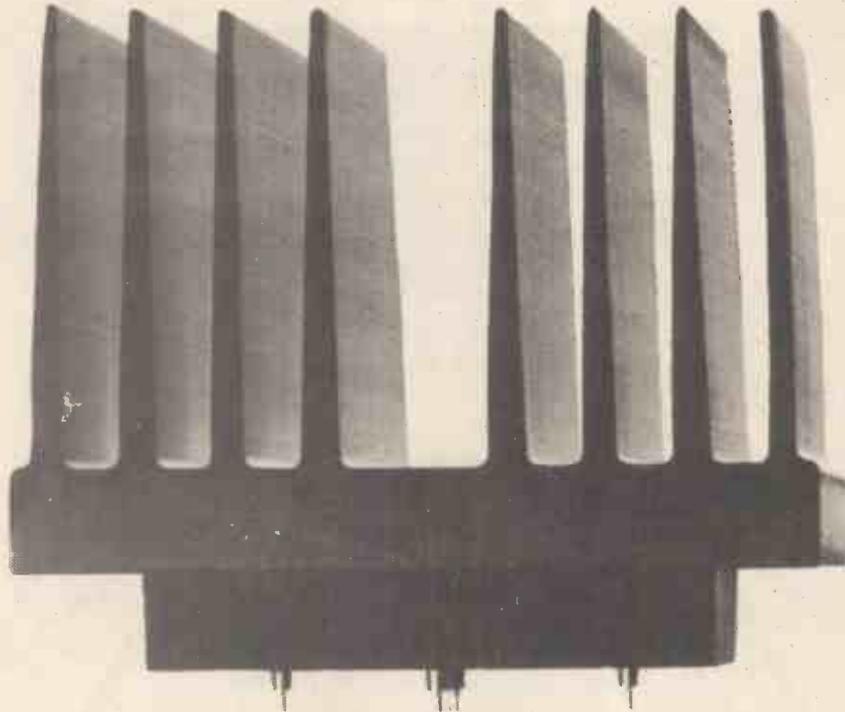
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082 0.45	688G 0.35	6L1 2.34	12AX7 0.39	30P4MR	AC/PEN(7)	EBC90 0.53	MUI2/14	PL508 1.10	UR1C 1.00	XSG15 1.17	AF114 0.33	BYZ11 0.33	OA211 0.88
024 0.55	68A6 0.41	6L18GC 0.88	12AX7 0.94	30P12 1.05	AC/TH1 1.00	EBC91 0.53	PL509 1.65	UR15 1.17	XSG15 1.17	AF115 0.25	BYZ12 0.33	OA212 1.63	OC19 1.63
1A3 0.85	68B2 0.90	6L17M 0.59	12B6 0.53	30P18 0.80	AL60 1.17	EBC92 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF116 0.25	BYZ13 0.33	OC22 0.49	OC23 0.49
1ASGT 0.50	68G6G 0.41	6L12 0.45	12BH7 0.59	30P19/18	ARP3 0.80	EBC93 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF117 0.25	BYZ15 2.26	OC23 0.49	OC24 0.49
1A7GT 0.50	68H6 0.73	6L18 0.84	12BY7 0.59	30P4	ATP4 0.50	EBC94 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF118 0.25	CG12E 0.26	OC24 0.49	OC25 0.49
1B3GT 0.50	68H6 0.73	6L19 2.00	12BY7 0.59	30P16 0.43	AZ1 0.50	EBC95 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF119 0.25	CG64H 0.26	OC25 0.49	OC26 0.49
IC2 1.15	68J6 0.64	6LD12 0.45	12E1 3.51	30P18 0.50	AZ1 0.50	EBC96 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF120 0.25	FSY11A 0.29	OC28 0.77	OC29 0.81
IG6 1.15	68K7A 0.85	6LD20 0.78	12J5GT 0.39	30P18 0.50	AZ1 0.50	EBC97 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF121 0.25	FSY11A 0.29	OC29 0.81	OC30 0.85
1HG7 0.50	68K5 0.36	6N7GT 0.70	12K7G 0.70	30P11 1.00	AZ1 0.50	EBC98 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF122 0.25	FSY11A 0.29	OC34 0.13	OC35 0.14
1L4 0.25	68Q7A 0.64	6PL12 0.45	12K7G 1.17	30P12 0.45	AZ1 0.50	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF123 0.25	FSY11A 0.29	OC36 0.14	OC37 0.14
1LD5 0.70	68R7 1.20	6P15 0.36	12K7GT 0.50	30P13 1.20	CL33 1.85	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF124 0.25	FSY11A 0.29	OC38 0.55	OC41 0.64
1LN5 0.70	68R8 1.25	6Q7G 0.50	12K8 0.85	30P14 1.29	CV6 0.62	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF125 0.25	FSY11A 0.29	OC42 0.81	OC43 1.52
1NSGT 0.76	68S7 1.64	6Q7GT 0.60	12Q7GT 0.50	30P15 0.90	CV63 1.00	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF126 0.25	FSY11A 0.29	OC44 0.13	OC45 0.14
1R5 0.50	68W6 1.00	6Q7M 0.60	12S7GT 0.70	35A3 0.76	CV988 2.29	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF127 0.25	FSY11A 0.29	OC46 0.20	OC47 0.20
1S4 0.29	68W7 0.65	6R7G 0.70	12S7GT 0.70	35C5 0.85	CV988 2.29	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF128 0.25	FSY11A 0.29	OC48 0.20	OC49 0.20
1S5 0.40	68X8 0.30	6R7M 0.88	12S7GT 0.70	35D5 0.90	CV988 2.29	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF129 0.25	FSY11A 0.29	OC50 0.20	OC51 0.20
1T4 0.30	68Y7 0.40	6S47 0.55	12S7GT 0.70	35E5 0.90	CV988 2.29	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF130 0.25	FSY11A 0.29	OC52 0.20	OC53 0.20
1U4 0.70	68Z6 0.57	6S7GT 0.50	12S7GT 0.70	35F4 0.60	CV988 2.29	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF131 0.25	FSY11A 0.29	OC54 0.20	OC55 0.20
1U5 0.88	6C4 0.47	6S7GT 0.50	12S7GT 0.70	35Z3 0.88	DAF91 0.40	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF132 0.25	FSY11A 0.29	OC56 0.20	OC57 0.20
2D21 0.60	6C5G 0.59	6S7GT 0.50	12S7GT 0.70	35Z4GT 0.82	DAF96 0.60	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF133 0.25	FSY11A 0.29	OC58 0.20	OC59 0.20
2GK5 0.75	6C8 0.47	6S7GT 0.50	12S7GT 0.70	35Z5GT 0.90	DC90 0.70	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF134 0.25	FSY11A 0.29	OC60 0.20	OC61 0.20
2X2 0.70	6C9 2.90	6S7GT 0.50	12S7GT 0.70	42 4.2	DD4 0.80	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF135 0.25	FSY11A 0.29	OC62 0.20	OC63 0.20
3A4 0.60	6C10 0.80	6S7GT 0.50	12S7GT 0.70	50B5 1.00	DF33 0.76	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF136 0.25	FSY11A 0.29	OC64 0.20	OC65 0.20
3B7 0.53	6CB6A 0.47	6U4GT 0.82	12S7GT 0.70	50C5 0.70	DF91 0.31	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF137 0.25	FSY11A 0.29	OC66 0.20	OC67 0.20
3B28 4.50	6C12 0.40	6U7G 0.55	12S7GT 0.70	50C6G 1.46	DF96 0.65	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF138 0.25	FSY11A 0.29	OC68 0.20	OC69 0.20
3D6 4.70	6C17 2.34	6V6G 0.30	14H7 0.64	50E5 0.88	DH63 0.50	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF139 0.25	FSY11A 0.29	OC70 0.20	OC71 0.20
3Q4 0.85	6C18 0.30	6V6GT 0.55	14S7 1.10	50F6GT 1.00	DH76 0.50	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF140 0.25	FSY11A 0.29	OC72 0.20	OC73 0.20
3Q5GT 0.70	6C18 0.30	6V6GT 0.55	14S7 1.10	50F6GT 1.00	DH76 0.50	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF141 0.25	FSY11A 0.29	OC74 0.20	OC75 0.20
3S4 0.47	6C16 0.76	6X5GT 0.50	19AQ5 0.65	77 0.70	DH81 0.88	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF142 0.25	FSY11A 0.29	OC76 0.20	OC77 0.20
3V4 0.82	6C18A 0.94	6Y6G 0.94	19B6G 0.88	85A2 0.75	DK32 0.60	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF143 0.25	FSY11A 0.29	OC78 0.20	OC79 0.20
4CB6 0.75	6CM7 0.88	6Y7G 1.17	19G6 7.00	90A3 0.75	DK40 0.82	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF144 0.25	FSY11A 0.29	OC80 0.20	OC81 0.20
5C68 0.75	6C15 0.88	7A7 1.00	19G6 7.00	90A3 0.75	DK91 0.50	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF145 0.25	FSY11A 0.29	OC82 0.20	OC83 0.20
5R4GY 0.84	6C14 0.75	7B8 0.88	19H1 4.00	90C3 2.81	DK92 1.15	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF146 0.25	FSY11A 0.29	OC84 0.20	OC85 0.20
5T4 0.47	6D3 0.75	7B7 0.82	20D1 0.80	90C4 2.81	DK96 0.70	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF147 0.25	FSY11A 0.29	OC86 0.20	OC87 0.20
5U4G 0.50	6D7 0.88	7F8 1.76	20D4 2.34	90C1 0.88	DL92 0.47	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF148 0.25	FSY11A 0.29	OC88 0.20	OC89 0.20
5V4G 0.59	6D76A 0.88	7H7 0.88	20F2 0.88	150E2 1.00	DL94 0.82	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF149 0.25	FSY11A 0.29	OC90 0.20	OC91 0.20
5Y3GT 0.55	6E16 0.88	7V7 1.76	20L1 1.29	21S5G 0.59	DL96 0.84	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF150 0.25	FSY11A 0.29	OC92 0.20	OC93 0.20
5Z3 0.88	6E5 1.17	7Y4 0.80	20P1 0.64	301 1.17	DM70 0.80	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF151 0.25	FSY11A 0.29	OC94 0.20	OC95 0.20
5Z4G 0.55	6F1 0.80	7Z4 0.88	20P3 0.84	302 1.17	DM71 0.76	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF152 0.25	FSY11A 0.29	OC96 0.20	OC97 0.20
5Z4GT 0.80	6F6G 0.90	9BW6 0.88	20P4 1.17	303 1.17	DW4/350	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF153 0.25	FSY11A 0.29	OC98 0.20	OC99 0.20
630L2 0.80	6F12 0.50	9D7 0.70	20P5 1.50	305 1.17	DW4/350	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF154 0.25	FSY11A 0.29	OC100 0.20	OC101 0.20
6A8G 1.46	6F13 0.90	10C2 0.76	25A6G 0.70	807 1.17	DY87/6 0.41	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF155 0.25	FSY11A 0.29	OC102 0.20	OC103 0.20
6A7 0.60	6F14 0.88	10D1 0.82	25L6G 0.70	956 0.60	DY802 0.47	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF156 0.25	FSY11A 0.29	OC104 0.20	OC105 0.20
6A6G 0.35	6F15 0.76	10DE7 0.88	25Y5 0.80	1821 1.17	E90CC 2.57	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF157 0.25	FSY11A 0.29	OC106 0.20	OC107 0.20
6A5H 0.80	6F18 0.64	10F1 0.88	25Y5G 0.80	4033X 7.61	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF158 0.25	FSY11A 0.29	OC108 0.20	OC109 0.20
6A15 0.76	6F23 0.80	10F3 1.17	25Z4G 0.80	3703 1.20	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF159 0.25	FSY11A 0.29	OC110 0.20	OC111 0.20
6A18 0.40	6F25 1.10	10F9 0.70	25Z5 0.75	833 0.76	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF160 0.25	FSY11A 0.29	OC112 0.20	OC113 0.20
6A15 0.47	6F25 1.10	10F9 0.70	25Z5 0.75	833 0.76	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF161 0.25	FSY11A 0.29	OC114 0.20	OC115 0.20
6A16 0.40	6F25 1.10	10F9 0.70	25Z5 0.75	833 0.76	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF162 0.25	FSY11A 0.29	OC116 0.20	OC117 0.20
6A16 0.40	6F25 1.10	10F9 0.70	25Z5 0.75	833 0.76	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF163 0.25	FSY11A 0.29	OC118 0.20	OC119 0.20
6A16 0.40	6F25 1.10	10F9 0.70	25Z5 0.75	833 0.76	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF164 0.25	FSY11A 0.29	OC120 0.20	OC121 0.20
6A16 0.40	6F25 1.10	10F9 0.70	25Z5 0.75	833 0.76	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF165 0.25	FSY11A 0.29	OC122 0.20	OC123 0.20
6A16 0.40	6F25 1.10	10F9 0.70	25Z5 0.75	833 0.76	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF166 0.25	FSY11A 0.29	OC124 0.20	OC125 0.20
6A16 0.40	6F25 1.10	10F9 0.70	25Z5 0.75	833 0.76	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF167 0.25	FSY11A 0.29	OC126 0.20	OC127 0.20
6A16 0.40	6F25 1.10	10F9 0.70	25Z5 0.75	833 0.76	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF168 0.25	FSY11A 0.29	OC128 0.20	OC129 0.20
6A16 0.40	6F25 1.10	10F9 0.70	25Z5 0.75	833 0.76	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF169 0.25	FSY11A 0.29	OC130 0.20	OC131 0.20
6A16 0.40	6F25 1.10	10F9 0.70	25Z5 0.75	833 0.76	E90F 2.20	EBC99 0.50	PL509 1.65	UR15 1.17	XSG15 1.17	AF170 0.25	FSY11A 0.29	OC132 0.20	OC133 0.20
6A16 0.40	6F25 1.10	1											

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1N283	2	2N3808	5	BC121	4	B0597	3	HS7027	3
1N629	2	2N3824	5	BC125A	2	B0598	3	ITT44	15
1N935	2	2N3906	8	BC131	4	B0607	2	MC1312P	1
1N938A	1	2N4059	1	BC136	3	B0608	2	MC1314P	1
1N3323RB	1	2N5089	5	BC137	3	BF121	4	MC1315P	1
1N3595	3	2N5128	5	BC153	6	BF125	4	MC1357P	1
1N4392	3	2N5447	10	BC157	8	BF153	8	ME0411	2
1N5398	15	2N5485	2	BC170A	3	BF160	3	ME0414	10
2N1304	3	2N5691	1	BC171	3	BF222	4	ME0462	2
2N2223	2	3N174	5	BC181A	2	BF251	3	ME0492	3
2N2726	2	AC122	3	BC208A	6	BF395C	8	ME1002	1
2N2905A	3	AC175K	2	BC214K	6	BF395D	8	ME1002-22	4
2N2907	2	AC193K	1	BC261	5	BFX37	2	ME1002	3
2N2926	1	AC194K	1	BC261A	4	BFY57	4	ME1104	11
2N3053	5	AF239	3	BC268A	8	BU105	1	ME6101	4
2N3252	5	BA163	1	BCY21	8	BUY24	1	ME6102	4
2N3508	3	BC113	6	BD117	2	CA3029	1	ME8001	5
2N3549	3	BC115	4	B0361	3	DM7474	1	ME8003	4
2N3638	5	BC116A	5	BD362	3	FD300	3	MEF104	2

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S-2020TA STEREO TUNER/AMPLIFIER KIT

NEW PRODUCT

A high-quality push-button FM Varicap Stereo Tuner combined with a 20W r.m.s. per channel Stereo Amplifier.

Brief Spec. Amplifier: Low field Toroidal transformer, Mag. input, Tape In/Out facility (for noise reduction unit, etc), THD less than 0.1% at 20W into 8 ohms. All sockets, fuses, etc, are PC mounted for ease of assembly. Tuner section: uses Mullard LP1186 module requiring no RF alignment, ceramic IF, INTERSTATION MUTE, and phase-locked IC stereo decoder. LED tuning and stereo indicators. Tuning range 88–104MHz. 30dB mono S/N @ 1.8µV. THD typ. 0.4%.

PRICE: £47.95 + 99p p&p + VAT.



**SOLID
MAHOGANY
CABINET**



A very high performance tuner with dual gate MOSFET RF and Mixer front end, triple gang varicap tuning, and dual ceramic filter/dual IC IF amp.

Brief Spec. Tuning range 88–104MHz. 20dB mono quieting @ 0.75µV. Image rejection—70dB. IF rejection—85dB. THD typically 0.4%. IC stabilized PSU and LED tuning indicators. Push-button tuning and AFC unit. Choice of either mono or stereo with a choice of stereo decoders.

**PRICE: Mono £25.46 + 85p p&p + VAT;
With Portus-Haywood Decoder £31.96 + 85p p&p + VAT;
With ICPL Decoder £29.73 + 85p p&p + VAT.**

NELSON-JONES STEREO FM TUNER

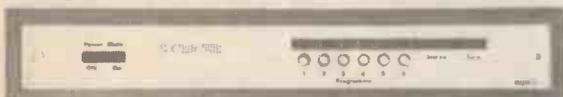
NEW PRODUCT

S-2020A AMPLIFIER KIT

Developed in our laboratories from the highly successful "TEXAN" design. PC mounting potentiometers, switches, sockets and fuses are used for ease of assembly and to minimize wiring.

Typ. Spec. 20+20W r.m.s. into 8-ohm load at less than 0.1% THD. Mag. PU input S/N 60dB. Radio input S/N 72dB. Head-phone output. Tape In/Out facility (for noise reduction unit, etc). Toroidal mains transformer.

PRICE: £29.95 + 99p p&p + VAT.



STEREO MODULE TUNER

A low-cost Stereo Tuner based on the Mullard LP1186 RF module requiring no alignment. The IF comprises a ceramic filter and high-performance IC. Variable INTERSTATION MUTE. PLL stereo decoder IC.

Typ. Spec. Sens. 30dB S/N mono @ 1.8µV. Tuning range 88–104MHz. LED sig. strength indicator. LED Stereo indicator. THD typically 0.4%.

PRICE: Stereo £26.32 + 85p p&p + VAT. Mono £22.40 + 85p p&p + VAT.

ALL THE ABOVE KITS ARE SUPPLIED COMPLETE WITH ALL METALWORK, SOCKETS, FUSES, NUTS AND BOLTS, KNOBS, FRONT PANELS, SOLID MAHOGANY CABINETS AND COMPREHENSIVE INSTRUCTIONS.

SUB ASSEMBLIES

BASIC NELSON-JONES TUNER

Supplied as a printed circuit board with all components and screening box to build a varicap tuner module. Performance spec as above for complete N-J Tuner. For suitable stereo decoders see below. (Illustrated without screening box.)

PRICE: £12.88 + 25p p&p + VAT.

BASIC MODULE TUNER

Supplied as a printed circuit board with all components and screened Mullard LP1186, to build a mono or stereo tuner module. Performance spec as above for Stereo Module Tuner complete kit.

PRICE: Mono £11.11 + 25p p&p + VAT; Stereo £13.89 + 25p p&p + VAT.

PORTUS-HAYWOOD PHASE-LOCKED STEREO DECODER

Mk II version of this design (WW Sept. 1970). The lowest distortion phase-locked stereo decoder kit available (Typ. 0.05% @ N-J Tuner O/P level). Separation 40dB up to 15KHz. Complete kit comprises PCB and all components, inc. stereo LED.

PRICE: £7.68 + 25p p&p + VAT.

PHASE-LOCKED IC DECODER

Integrated circuit phase-locked stereo decoder based on the MC1310. THD typically 0.3%. Separation 40dB @ 1KHz.

PRICE: £4.27 + 20p p&p + VAT.

PUSH-BUTTON UNIT

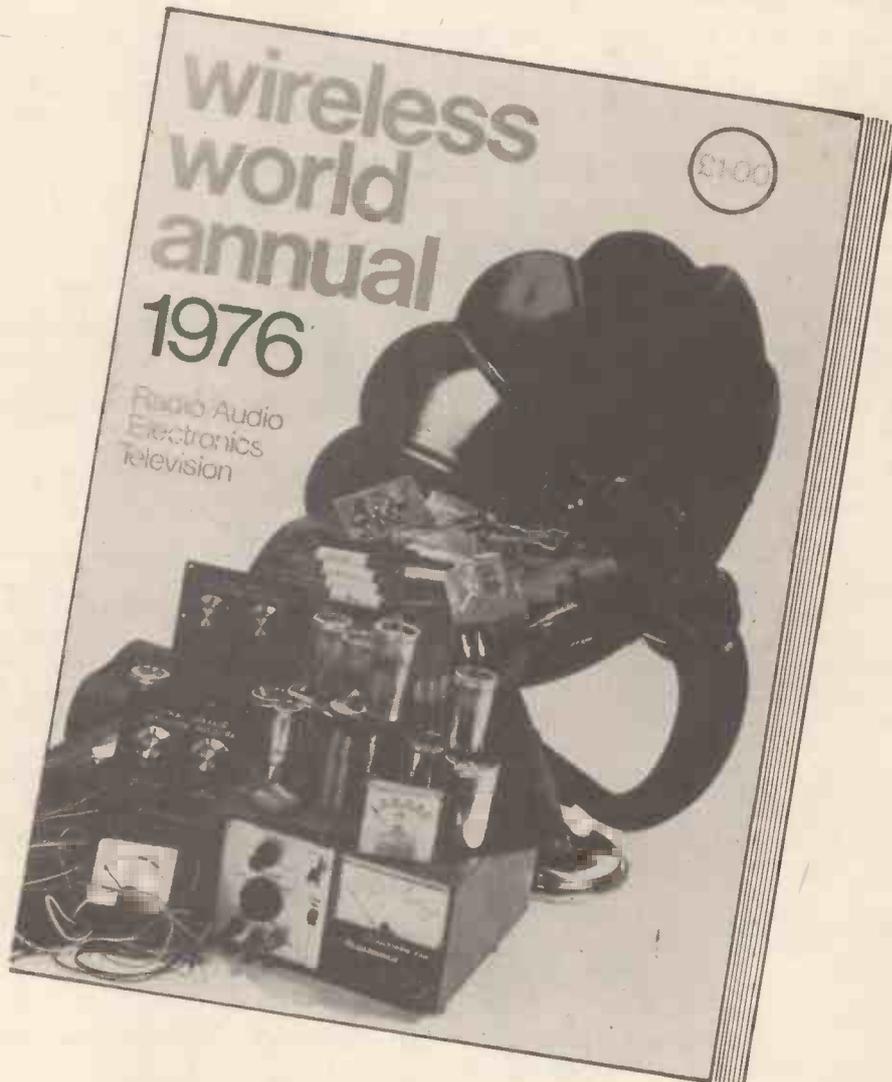
The six-position push-button unit used in our tuners and tuner/amp. Each track has the required diode law for stability of tuning. There are approx. 40 turns on each button and there are six separate moving pointers. An AFC disable switch is incorporated with each button. The unit is finished in black with red pointers.

PRICE: £3.00 + 20p p&p + VAT.

Please send SAE for complete lists and specifications.

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ARR	0.50	ECL83	0.70	KT66	2.50	PY80	0.40
ATP4	0.50	ECL86	0.50	KT88	3.85	PY81	0.40
B12H	3.00	EF36	0.65	MH4	0.75	PY82	0.40
CY31	0.50	EF37A	1.20	ML6	0.65	PY83	0.40
DAF96	0.85	EF40	0.75	OA2	0.45	PY88	0.45
DF96	0.55	EF41	0.65	OZ2	0.45	PY80	0.40
DK96	0.70	EF80	0.30	PAB80	0.40	PY800	0.45
DL92	0.40	EF83	1.25	PC97	0.50	PY801	0.80
DL96	0.60	EF85	0.35	PC900	0.50	QV03-10	1.40
DY86/87	0.40	EF86	0.35	PC94	0.40	QV06-40A	8.00
DY802	0.65	EF89	0.30	PC95	0.40	R19	0.75
EB8CC/01	1.20	EF92	0.50	PC99	0.50	SCI/400	3.00
E180CC	0.70	EF95	0.40	PC8189	0.60	SCI/600	6.00
E182CC	1.25	EF183	0.35	PCF80	0.40	SC1	0.75
EA50	0.40	EF184	0.35	PCF82	0.40	SP61	0.75
EABC80	0.40	FL200	0.75	PCF84	0.60	TT21	5.00
EA472	0.75	EL34	0.70	PCF86	0.60	TT2	5.00
EB91	0.30	EL36	0.60	PCF200	0.75	U25	0.85
EB33	1.00	EL37	1.80	PCF201	0.75	U26	0.75
EB41	0.75	EL41	0.80	PCF801	0.55	U27	0.85
EBF80	0.40	EL81	0.60	PCF802	0.50	U191	0.75
EBF83	0.50	EL82	0.55	PCF805	0.90	U801	0.75
EBF89	0.40	EL84	0.30	PCF806	0.75	UAEBC80	0.40
EC52	0.35	EL85	0.65	PCF808	0.90	UAF42	0.60
EC81	0.40	EL86	0.45	PCF200	0.80	UBC41	0.60
EC82	0.35	EL90	0.45	PCL81	0.55	UBF80	0.40
EC83	0.35	EL504	0.80	PCL82	0.40	UBF89	0.40
EC84	0.35	EM31	0.60	PCL83	0.65	UL1	1.00
EC85	0.40	EM80	0.85	PCL84	0.45	UBL21	0.70
EC86	0.90	EM84	0.60	PCF808	0.90	UCB85	0.45
EC88	0.50	EM87	1.00	PCL805	0.60	UCF80	0.75
EC8189	0.70	EY51	0.45	PFL200	0.70	UCH42	0.75
EC80	0.40	EY81	0.45	PL36	0.60	UCH81	0.45
ECF82	0.40	EY86	0.60	PL81	0.50	UCL82	0.45
ECF801	0.75	EY88	0.50	PL82	0.45	UCL83	0.65
ECM35	1.40	EZ40	0.70	PL83	0.45	UF41	0.70
ECM42	0.80	EZ41	0.75	PL84	0.45	UF80	0.35
ECM81	0.35	EZ80	0.30	PL504	0.80	UF85	0.45
ECM83	0.45	EZ81	0.30	PL508	1.00	UF89	0.80
ECM84	0.45	EY501	0.75	PL509	1.35	UL1	1.75
ECL80	0.65	GZ34	0.70	PL802	1.75		

UL84	0.40	3A4	0.60	6AL5	0.30	6AX5GT	1.00	6C6	0.50	6J7G	0.40
UY41	0.45	3BP1	7.00	6AL5W	0.55	6B7	0.70	6C8	0.50	6K6GT	0.80
VR105/300.45	3D6	0.40	6AM6	0.60	6B8	0.35	6C6H	1.45	6K7	0.55	
VR150/300.45	3S4	0.40	6AN8	0.45	6BE6	0.40	6CL6	0.75	6K7G	0.30	
X61M	1.40	3V4	0.85				6D6	0.55	6K8GT	0.50	
X66	0.65	5B/254M	4.50				6E8A	0.85	8K25	1.00	
Z800U	2.70	5B255M	4.50				6F1	1.10	6L6	1.90	
Z900T	1.20	5U4G	0.50				6F8G	0.75	6L6G	0.60	
1A3	0.55	5V4G	0.55				6F23	0.90	6L7G	0.40	
1L4	0.25	5Y3GT	0.60				6F32	0.75	6SA7	0.50	
1R5	0.40	5Z3	0.80				6F33	3.50	6SA7GT	0.40	
1S4	0.30	5Z4GT	0.85	6AQ5	0.45	6BG6G	0.90	6H6	0.40	6SC7GT	0.40
1T4	0.30	6AB7	0.60	6ASW	0.70	6B15	0.65	6J4WA	1.25	6S7	0.50
1X2A	0.75	6AC7	0.60	6AS6	0.80	6B7A	0.60	6J5	0.65	6S7J	0.55
1X2B	0.75	6AH6	0.70	6AT6	0.60	6B87	1.20	6J6	0.50	6S7JGT	0.35
2D21	0.80	6AK5	0.40	6AU6	0.40	6B86W	1.00	6J6GT	0.50	6SK7	0.55
2K25	9.00	6AK8	0.40	6AV6	0.45	6B87	1.00	6J6	0.30	6SK7	0.55
				6AX4GT	0.75	6C4	0.40	6J7	0.60	6SL7GT	0.50

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AC127	AF239	BY216	OC25	ZR11	2N3391
AC128	AF212	CRS1/10	OC26	ZR21	2N3638A
AC176	ASV26	CRS1/20	OC28	1N23A	2N3730
AC178	ASV27	CRS1/30	OC29	1N25	2N3819
AC179	ASV28	CRS1/40	OC35	1N32A	2N4038
AC190	BC108	CRS3/10	OC36	1N38A	2N4058
AC193	BC118	CRS3/20	OC42	1N43	2N4061
AC194	BC119	CRS3/30	OC44	1N70	2N4785
AD149	BC136	CRS3/40	OC45	1N277	2N5295
AD161	BC137	CRS25/25	OC70	1N415C	3N125
AD162	BC148A	GET115	OC73	1N4148	3N154
AD211	BC172	GET116	OC78	2N456A	3N159
AD212	BC172A	GEK66	OC78D	2N708	2S303
AF114	BC212A	NAK222	OC81	2N918	20R2
AF115	BCY31	OAS	OC82	2N1304	40250
AF116	BCY33	OA47	OC82D	2N1305	40251
AF117	BCY72	OA70	OC82DM	2N1307	40310
AF118	BF115	OA71	OC83	2N1309	40668
AF124	BF167	OA73	OC139	2N2062	
AF125	BF185	OA79	OC140	2N2147	
AF126	BFY51	OA91	OC170	2N2411	
AF127	BFY52	OA200	OC172	2N2589	
AF139	BSY27	OA202	OC200	2N3053	

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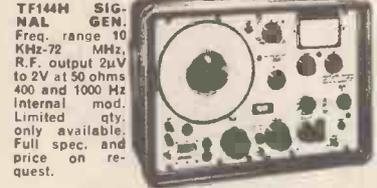
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BOONTON FM/AM SIGNAL GENERATOR TYPES 202E & 202H. 54-216 MHz in two ranges, complete with separate power supply unit £275.

EHV POWER SUPPLY 115V input 100KV at 5mA output £150.

SOLARTRON
CD 1400 Oscilloscope.
Few left, only £110.

Open 9-12.30, 1.30-5.30 p.m. except Thursday 9-1 p.m.



TF 526B OSCILLATOR AND DETECTOR UNIT £50.00.

TF 1226B, TF1225A, TF 577A. WHITE NOISE TEST SET £185.00. Full spec. on request.

TF 1400S DOUBLE PULSE GENERATOR WITH TM 6000'S SECONDARY PULSE UNIT. For testing radar, nucleonics, scopes, counters, filters etc. SPEC. TF 1400S. Rep. freq. 10Hz to 100kHz, pulse width 0.1 to 100µ sec., delay -1.5 to +3000µ sec., rise time 30N sec. SPEC. TM 6000'S. As for TF1400S except pulse width 0.5 to 25µ sec., delay 0 to +300µ sec. £175.

TF 893 AUDIO OUTPUT METERS £55.

NOISE GENERATOR TF1053 (CT207). Range 100-600MHz. Noise factor up to 150 (21.7db) at 75 ohms. Audio power up to 500MW. £95.
MARCONI TF893 AUDIO OUTPUT METERS. Price on application.

MARCONI HR23 TRIPLE DIVERSITY IS RECEIVERS. Freq 3-27.5 MHz. VFO or 6xtal positions. Reception of independent, single or double-side band transmissions. Full specification and price on application.

HEWLETT - PACKARD

175A OSCILLOSCOPE with 1750A dual trace vert plug-in and 1781B delay time base plug-in, 50MHz minimum bandwidth at 50mV/cm. 7B modes; main, main single, mixed, main delayed, delaying. Full Spec. & P.O.A.
540B TRANSFER OSCILLATOR. Measures frequency up to 12.4GHz. May be used on its own or with freq. counter. P.O.A.

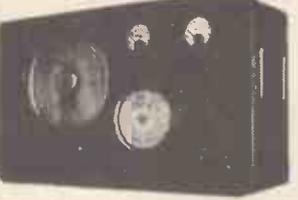
200AB AUDIO OSCILLATOR 19kHz, 600ohm balanced or unbalanced, small size. £25.
300A HARMONIC WAVE ANALYSER Freq. 0-16kHz. Full spec & P.O.A.

MULLARD

PRECISION VARIABLE CAPACITOR TYPE F.2. 15pF to 336pF. Supplied with individual calibration certificate. Brand new in original packing. £12. Carriage £1.

MS 111D DANISH PRODUCTION SIGNAL GENERATOR 10Kc - 110Mc £150.

BEST PRICES PAID FOR TEST AND COMMUNICATION EQUIPMENT. Single items or quantities. Private or Industrial.



RF 801D/S SIGNAL GENERATOR. Range 10-485 MHz in five ranges. R.F. output 0.1 uV-IV source e.m.f. Dial calibrated in volts, decibels and power relative to thermal noise. Piston type attenuator. 50Ω output impedance. Internal modulation at 1 kHz at up to 90% depth, also external sine and pulse modulation. Built-in 5MHz crystal calibrator. Separate R.F. and mod. meters. P.O.A.

TF801B/2. Spec as for TF801D but minor circuit differences. Working order. £95.

TF 1370 R.C. OSCILLATOR sine/square wave 10Hz to 10MHz £140.

TF995 A/1 or A/2 or A/2M SIGNAL GENERATORS. AM/FM freq. 1.5-250MHz. Prices on application.

TF 934 DEVIATION METER 250MHz/FM £55.

TM 8517 VIDEO AMPLIFIER £60.

ROHDE & SCHWARZ

Z-g DIAGRAPH TYPE ZDU. 30-420 MHz, 500. Directly measures multi-terminal networks, phase shift, phase angle etc. with complementary POWER SIGNAL GENERATOR TYPE SMLM High Freq. resolution, internal/external mod. up to 3V out. P.O.A.

VHF WATTMETER & MATCHING INDICATOR 30/80W. 230MHz, 75Ω. P.O.A.
VHF VOLTMETER TYPE UDDN P.O.A.

MICROWAVE POWER METER TYPE NRD. 0-3200MHz at 500. 0-200mW in 4 ranges, built-in calibration check with measuring head £125.

FREQUENCY SYNTHESIZER TYPE XUA. 30Hz-30MHz with FREQUENCY INDICATOR TYPE FKM, 15-30MHz; 30-100MHz. P.O.A.

AVO

CT 537 Transistor / Diode test set £50.
CT 160 Valve Characteristic meter £55.
CT410 Noise Generator £30.

RACAL UNIVERSAL COUNTER/TIMER SA550 (CT488)



8 digit in-line read-out. Full title a include: direct frequency measurement up to 100MHz; pulse, period, ratio, time interval and totalising measurements. Input sensitivity variable from 300MV to 9V, three independent inputs, self-check etc. Full spec. on request. £145.

500/250W MEDIUM WAVE BROADCAST TRANSMITTERS. Price and details on application.

PLEASE NOTE Unless offered as "as seen" ALL EQUIPMENT

ordered from us is completely overhauled mechanically and electrically in our own laboratories

FOR EXPORT ONLY TRANSMITTERS:

BC 610 Hallicrafters.
RCA ET 4336 also modified version of increased output to 700W.
COLLINS TYPE 231D 45kw, 10 channel, autotune and manual tuning. All above complete installation and spare parts.

TRANSCIVERS

C-13 TRANSMITTERS
RACAL COMMUNICATIONS EQUIPMENT

We are able to offer a comprehensive selection from the range of this modern high class equipment including, receivers, L.F. Converters, SSB adaptors, panoramic adaptors, diversity switches, transmitter driver units, linear amplifiers can be built to customers' requirements. Please send us your enquiries.

AR9 SPARES. We hold the largest stock in U.K. Write for list.

R.F. METER 0-8 amp. 2 1/2" (U.S.A.) £1-80 P. & P. 15p.

TELEPHONE TYPE "J" (Tropicalised) 10 line MAGNETO TELEPHONE SWITCHBOARD

50 line AUTOMATIC PRIVATE TELEPHONE SWITCHBOARD

Price of each of the above on application.

TEST EQUIPMENT

for direct line for all enquiries regarding test equipment only, phone 01-748 6496.

PLEASE ADD 25% VAT

COLOMOR (ELECTRONICS) LTD.
170 Goldhawk Rd., London, W.12
Tel. 01 - 743 0899

RECORD PLAYBACK TAPE HEADS

Individual prices of these are: 2 track record playback heads 75p each. 4 track record playback heads £1.10 each. Erase heads are also available separately - 2 track 50p - 4 track 85p. MV metal mounting shields 60p each. 2 track heads already fixed on heavy mounting plate with shield £1.85. ALL PLUS 25% VAT.



DRILL CONTROLLER

New 1KW MODEL Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions, £2.50 plus 45p post & VAT. Made up model also available, £3.50 plus 55p post & VAT.



NEED A SPECIAL SWITCH

Double Leaf Contact. Very slight pressure closes both contacts, 12p each. Plastic pushrod suitable for operating, 10p each, 10 for 68p.

1 R.P.M. MOTOR + GEAR BOX

Made by the famous Chamberlain & Hookham Ltd. These could be made to drive clock or similar. Really robust, reliable unit. Price £1.50 + 30p post & VAT.



MULTI-SPEED MOTOR

Six speeds are available 500, 850 and 1,100 r.p.m. and 8,000, 12,000 and 15,600 r.p.m. Shaft is 1/4 in. diameter and approximately 1 in. long. 230/240V. Its speed may be further controlled with the use of a thyristor controller. Very powerful and useful motor, size approx. 2 in. dia. x 5 in. long. Price £1.40 + 45p post & VAT.

SLIDE SWITCHES

Slide Switch. 2-pole changeover panel mounting by two 68 A. screws. Size approx. 1 in. x 1/4 in. rated 250V lamp, 15p + 7p post & VAT. Sub Miniature Slide Switch, DPDT 19mm (4 in. approx.) between fixing centres, 28p each + 9p post & VAT or 10 for £1.90. SP Change over spring return 250V 1 amp. 25p + 8p post & VAT.

PRESSURE SWITCH

Containing a 15 amp change over switch operated by a diaphragm which in turn is operated by air pressure through a small metal tube. The operating pressure is adjustable but is set to operate in approx. 10 in. of water. These are quite low pressure devices and can in fact be operated simply by blowing into the inlet tube. Original use was for washing machines to turn off water when tub has reached correct level, but no doubt has many other applications. £2.10 each + 25p post & VAT.

LIGHT DIMMER KIT

For dimming up to 250w without heat sink or 750w with heat sink. This comprises quadric variable control potentiometer, condenser, resistors, tag strip for mounting and data. Price £1.95 + 30p post & VAT.

SWITCH TRIGGER MATS

So thin is undetectable under carpet but will switch on with slight pressure. For burglar alarms, shop doors, etc. 24in x 18in. £1.90, post & VAT 30p. 13in. x 10in. £1.50, post & VAT 25p.

SMITHS CENTRAL HEATING CONTROLLER

Push button gives 10 variations as follows: (1) continuous hot water and continuous central heating (2) continuous hot water but central heating off at night (3) continuous hot water but central heating on only for 2 periods during the day (4) hot water and central heating both on but day time only (5) hot water all day but central heating only for 2 periods during the day (6) hot water and central heating on for 2 periods during the day time only - then for summer time use with central heating off (7) hot water continuous (8) hot water day time only (9) hot water twice daily (10) everything off. A handsome looking unit with 24 hour movement and the switches and other parts necessary to select the desired program of heating. Supplied complete with wiring diagram. Originally sold, we believe, at over £15 - we offer these, white stocks last at £6.95 each, VAT & Postage 85p each.

AUDIO AMPLIFIER

Part of the famous RedTune background music system, secondhand, but believed in good order. However, no guarantee; we are selling for spare value only. These are 6 valve amplifiers, the output valves are 2 x EL 84 in push/pull, complete with mains transformer, rectifier and ample smoothing equipment. The mains transformer alone, today would cost at least £4. Size is 9 1/2" x 5 1/2" x 4 1/2". Price only £2.00 + postage & VAT £1.50.

15A ELECTRICAL PROGRAMMER

Learn in your sleep! Have radio playing and kettle boiling as you awake - switch on lights to ward off intruders - have a warm house to come home to. All these and many other things you can do if you invest in an electrical programmer. Clock by famous maker with 15 amp. on/off switch. Switch-on time can be set anywhere to stay on up to 6 hours. Independent 60 minute memory jogger. A beautiful unit. Price £2.45, VAT & Postage 80p, or with glass front, chrome bezel, £1.50 extra.

THIS MONTH'S SNIP Smiths 24 hr. timer heart, really the "Autoset" without its plastic case. This is a 24 hr. twice on, twice off, clock switch which will repeat until re-programmed. Switches rated at 15 amps. Limited supplies - £3.95 each + VAT & post 55p.

12 VOLT 1 1/2 AMP POWER PACK

This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mfd smoothing. Price £3.75 plus VAT & post £1. Heavy Duty Mains Power Pack. Output voltage adjustable from 15-40V in steps - maximum load 250W - that is from 6 amp at 10V to 15 amp at 18V. This really is a high power heavy duty unit with dozens of workshop uses. Output voltage is very quick - simply interchange push on leads. Silicon rectifiers and smoothing by 3,000mF. Price £10.50 plus £1.25 VAT & post.

TANGENTIAL HEATER UNIT

This heater unit is most efficient and quiet running. As fitted in Hoover and blower heaters costing £15 and more. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW, and with thermal safety cut-out. Can be fitted into any metal line case or cabinet. Only needs control switch, £5.82 plus post & VAT £1. 2kW Model as above except 2kW £4.25 plus VAT & post 75p. Don't miss this. Control Switch 44p. P & P 40p.

INSTANT START FLUORESCENT LIGHTING BARGAINS

Startersless control gear, complete with tube ends and tube clips for window lighting, signs, fascias, etc. 4ft. 40w. £1.90; 5ft. 65w. £2.00; 5ft. 80w. £2.20; 6ft. 80w. £2.45; and for pairs as follows - twin 2ft. 20w. £2.55; twin 3ft. 30w. £3.55; twin 4ft. 40w. £3.25; twin 5ft. 65w. £3.25; twin 6ft. 80w. £3.95; twin 8ft. 125w. £5.75. These are about one half of maker's current prices and can't be repeated once stocks are cleared. Please add 30p per piece to cover postage or carriage and 8% VAT.

J. BULL (ELECTRICAL) LTD. (Dept. W.W.), 103 TAMWORTH ROAD CROYDON CRO IXX

MAINS TRANSFORMERS

Table listing various mains transformer models and their prices in pounds and pence.

Charger Transformers 2 amp £1.50, 5 amp £2.25, 6 amp £2.25, 10 amp £3.50. Add 30p per piece to cover postage and VAT 25%.

RELAY BARGAIN

Type 600 relay, 2 changeover one open and one closed contact. Twin 500 ohm coils make this suitable for closing off DC 6v, DC 12v, DC 24v or AC mains using resistor and rectifier, 40p each. Resistor and rectifier 20p extra. Post and VAT 20p.

BLACK LIGHT

As used in discotheques and for stage effects, etc. Virtually no white light appears until the rays impinge on luminous paint or white shirts, etc. We offer 9" 6w tubes complete with starter, choke, lamp-holder and starter-holder. Price £2.75 + 30p post. Tubes only £2. Post & VAT 50p.

MULLARD AUDIO AMPLIFIERS

All in module form, each ready built complete with heat sinks and connection tags, data supplied. Model 1153 500mW power output, £1.10 + 40p post & VAT. Model 1172 1w power output, £1.35 + 45p post & VAT. Model EP9000 4 watt power output, £2.40 + 50p post & VAT. EP 9001 twin channel or stereo pre-amp, £2.50 + 50p post & VAT.

MAINS TRANSISTOR PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6v, 9v, 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9 and others. Kit comprises: main transformer rectifier, smoothing and load resistor, condensers and instructions. Real snip at only £1.50, VAT & Postage 60p.

Advertisement for J.B. Bull (Electrical) Ltd. featuring various electronic components like capacitors, resistors, and potentiometers with prices and specifications.

Advertisement for J.B. Bull (Electrical) Ltd. featuring various electronic components like resistors, capacitors, and potentiometers with prices and specifications.

Advertisement for J.B. Bull (Electrical) Ltd. featuring various electronic components like multimeters and potentiometers with prices and specifications.

B. H. COMPONENT FACTORS LTD.

Large advertisement for B.H. Component Factors Ltd. featuring a wide range of electronic components, including capacitors, resistors, potentiometers, and multimeters, with detailed specifications and prices.

SERVICE TRADING CO

RELAYS				SIEMENS PLESSEY, etc. MINIATURE RELAYS			
1	2	3	4	1	2	3	4
52	4-8	2c/o	75p	700	16-24	4 M2B	85p
58	5-9	6c/o	85p	700	16-24	4c/o	85p
185	8-12	6M	65p	1250	18-36	2 c/o	65p
230	9-18	2c/oHD	75p	2500	36-45	6M	85p
430	15-24	4 c/o	85p	2500	31-43	2 c/oHD	65p
700	12-24	2 c/o	85p	9000	40-70	2 c/o	65p
				15k	85-110	6M	85p

(1) Coil ohms; (2) Working d.c. volts; (3) Contacts; (4) Price HD=Heavy Duty. All Post Paid. (*Including Base)

OPEN TYPE RELAYS
6 VOLT D.C. 1 make con. 35p. Post 15p.
9 VOLT D.C. RELAY
 3 c/o 5 amp contacts. 70 ohm coil 75p. Post 15p.
12 VOLT D.C. RELAY
 3 c/o 5 amp contacts. 120 ohm coil 75p. Post 15p.
24 VOLT D.C. 3 c/o 600 ohm coil 75p. Post 15p.
 2 HD c/o 700 ohm coil 75p. Post 15p.
 4 c/o 300 ohm coil 85p. Post 15p.

ENCLOSED TYPE RELAYS
24V D.C. 3 c/o 75p. Post 20p. Base 15p.

24 VOLT A.C. M.f.g. ITT 3 h.d. c/o contacts 55p. Post 20p. Base 15p extra.

55 VOLT A.C.
 3 heavy duty c/o contacts. Price 55p. Post 20p. Base 15p.

100 VOLT A.C.
 2 c/o sealed type, octal base 75p. Post 20p. Base 15p.

240 VOLT A.C. RELAY
 240V. A.C. heavy duty 3 c/o contacts. Price 75p. Post 20p. Octal base 15p extra.

220/240 VOLT AC RELAY
 3 c/o 5 amp cont. Sealed M.f.g. ISKRA. £1.25. Post 20p. Base 15p extra.

ARROW 230/240V AC 2 c/o 15 amp contacts. Amp connectors. £1.00. Post 20p.

110 VOLT A.C. 2 c/o. 20 amp. £1.25. Post 15p.

CLARE-ELLIOT TYPE RP 7641 G8
 Miniature relay. 675 ohm coil. 24 volt D.C. 2 c/o. 70p. P.P.

MANY OTHERS FROM STOCK, PHONE FOR DETAILS

VARIABLE VOLTAGE TRANSFORMERS
 INPUT 230 v. A.C. 50/60
 OUTPUT VARIABLE 0/260 v. A.C.
BRAND NEW. All types.
200W (1 Amp) £10.00
0.5 KVA (Max. 2 1/2 Amp) £11.50
1 KVA (Max. 5 Amp) £16.50
2 KVA (Max. 10 Amp) £30.00
3 KVA (Max. 15 Amp) £33.00
4 KVA (Max. 20 Amp) £60.00
 (max. 37.5 Amp) £102.50
1 amp OPEN TYPE (Panel Mounting) £10.00

LT TRANSFORMERS
 0, 6, 12 volt @ 10 amp. £5.60 Post 70p
 0, 10, 17, 18 volt @ 10 amp. £7.90 Post £1.00
 0, 6, 12 volt @ 20 amp. £9.00 Post £1.00
 0, 12, 24 volt @ 10 amp. £9.20 Post £1.00
 0, 4, 6, 24, 32 volt @ 12 amp. £9.80 Post £1.00
 0, 6, 12, 17, 18, 20 volt @ 20 amp. £10.40 Post £1.00
 Other types to order at short notice—Phone your enquiries.

AUTO TRANSFORMERS
Step up step down 0-115/200/220/240 volts.
 At 75 watt £2.64 Post 40p. 150 watt £3.50 Post 50p. 300 watt £6.20 Post 60p. 500 watt £9.20 Post 75p. 1000 watt £12.00 Post 90p.

STROBE! STROBE! STROBE!

★ FOUR EASY TO BUILD KITS USING XENON WHITE LIGHT FLASH TUBES, SOLID STATE TIMING + TRIGGERING CIRCUITS, PROVISION FOR EXTERNAL TRIGGERING. 230-250v. A.C. OPERATION.

★ HY-LITE STROBE Mk IV
 Designed for use in large rooms, halls and utilizes a silica tube, printed circuit. Speed adjustable 1-20 f.p.s. Light output greater than many (so called 4 Joule) strobes. Price £14.00. Post 75p.

★ RANGE OF THREE OTHER STROBE KITS FROM STOCK. FROM £6.30 to £22.00 S.A.E. (Foolscap) for details.

★ **BIG BLACK LIGHT**
 400 Watt. Mercury vapour ultra violet lamp. Extremely compact and powerful source of u.v. Innumerable industrial applications also ideal for stage, display, discos etc. P.F. ballast is essential with these bulbs. Price of matched ballast and bulb £21.00. Post £1.50. Spare bulb £8.00. Post 65p.

★ **BLACK LIGHT FLUORESCENT U.V. TUBES**
 4ft. 40 watt £5.50 (callers only). 2ft. 20 watt £4.25. Post 60p. (for use in stan bi-pin fittings). MINI 12in. 8 watt £1.60. Post 25p. 9in. 5 watt £1.30. Post 25p. Complete ballast unit and holders for either 9" or 12" tube. £1.70. Post 30p (9" x 12" measures approx.).

U.D.I. SINGLE CHANNEL. 750 watt MANUAL/AUTO DIMMER

750W Solid State Fader, with three functions. Manual fade; Auto fade-up; Auto fade-down. Automatic cycling up and down. Functions selected with 'three position' rocker switch. Two ranges of cycling for 'Flashing' or 'Slow blending'. Ready built module 6" x 3" glass fibre board incorporating 10 amp TRIAC. Two or more modules for top quality colour blending and flashing effects. PRICE £15.00. Post 65p.

SQUAD LIGHT

A new conception in light control: Four channels each capable of handling 750 watts of spotlights, floodlights, or dozens of small mains lamps. Seven programs all speed controlled plus flash modulation, effectively giving 14 different displays. Makes sound-to-light obsolete. Completely electrically and mechanically noise free. Can be used on same circuit as radio mikes or sensitive amplifiers. A whole new range of lighting effects possible with astounding results. Already in use in London's foremost theatres, night clubs and discos. Conforms to all R.F.I. tests, including Common Market regulations. Supplied in tough, well designed case with embossed front panel. Price only £60.00. Post 75p. S.A.E. (Foolscap) for further details.

WHY PAY MORE?!

MULTI RANGE METER. A.C. volts 2.5-500, D.C. volts 2.5-500 (Sensitivity 200 μ /V DC & AC). DC current 0/1/10/100 mA, Ohms range. Sturdy compact moving coil instrument with 21 ranges, dimensions 120x 80x 44mm. Weight 0.32 kg. SERVICE TRADING CO. Price £5.00. Post 50p. (Total price inc. VAT & Post £5.84).

METERS NEW

90mm Diameter.
 Type 65C5. 2A D.C. M/C; 5A D.C. M/C; 10A D.C. M/C; 1 20A D.C. M/C; 50A D.C. M/C
 Type 62T2. 1A A.C. M/I; 20A A.C. M/I; 300V A.C. M/I; ALL ABOVE £2.50. Post 30p.
 Type 65L5. 300V A.C. R/M/C; £2.75. Post 30p.

VAT VAT AT 8% MUST BE ADDED TO ALL ORDERS
 FOR THE TOTAL VALUE OF GOODS INCLUDING POSTAGE UNLESS OTHERWISE STATED

GEARED MOTOR
 230/240 volt A.C., smooth, powerful, continuously rated.
 Two types: 32 r.p.m. or 110 r.p.m.
 Either type £4.75. Post 50p.

REVERSIBLE MOTOR
 General Electric. 230V A.C. 1.600 r.p.m. 0.25 amp. Complete with anti-vibration mounting bracket and capacitor. O/A size 10mm x 95mm. Spindle 5/16" dia. 20mm long. Ex-equipment tested. £3.00. Post 50p.

20 r.p.m. GEARED MOTOR
 230/240 volt 20 r.p.m. motor. £1.00. Post 20p.

BODINE TYPE N.C.I. GEARED MOTOR
 (Type 1) 71 r.p.m. torque 10 lb. in. Reversible 1/70th h.p. cycle 38 amp. (Type 2) 28 r.p.m. torque 20 lb. in. Reversible 1/80th h.p. 50 cycle 28 amp. The above two precision made U.S.A. motors are offered in as new condition. Input voltage of motor 115V A.C. Supplied complete with transformer for 230/240V A.C. input. Price, either type £6.25. Post 75p or less transformer £3.75. Post 65p.

These motors are ideal for rotating aerials, drawing curtains, display stands, vending machines, etc.

BENDIX MAGNETIC CLUTCH
 A superb example of Electro-mechanics! The main body is in two sections. The coil section is fixed and has a 3/8in. sleeve. The drive section rotating on the outer perimeters. The uniting plate has 3/8in. ID bearing concentric with main section and 18-tooth cog wheel. When energized transmission is extremely powerful. 24V d.c. at 240 MA. OUR PRICE JUST £2.50. Post 45p.

ROTARY VACUUM AIR COMPRESSOR AND PUMP
 Carbon vane, oil-less. 100/115V A.C. 1/12 h.p. motor. 50/60 cycle. 2875/3450 r.p.m. 20" vacuum. 1.25 c.i.m., 10 p.s.i. (approx. figures). New unused surplus stock, with elect. connection data. Fraction of maker's price. £12.00. Post £1.00. Suitable transformer £3.50. Post 50p.

UNISELECTOR SWITCHES - NEW
4 BANK 25 WAY FULL WIPER 25 ohm coil, 24v. D.C. operation £6.90. Post 50p.
6 BANK 25 WAY FULL WIPER 25 ohm coil, 24 v. D.C. £7.90. Post 50p.
8 BANK 25 WAY FULL WIPER 24 v. D.C. operation £9.50. Post 65p.

TIME SWITCH
 'Horsmann' Type V Mk II Time Switch. 200/250 volt A.C. Two on two off every 24 hours, at any manually pre-set time. 30 amp contacts. 36-hour spring reserve in case of power failure. Day omitting device. Fitted in heavy high impact case, with glass observation window. Built to highest Electricity Board spec. individually tested. Price £7.75. Post 50p. (Total inc. VAT £8.91).

A.C. MAINS TIMER UNIT
 Based on an electric clock, with 25 amp, single-pole switch, which can be preset for any period up to 12 hrs. ahead to switch on for any length of time, from 10 mins. to 6 hrs. then switch off. An additional 60 min. audible timer is also incorporated. Ideal for Tape Recorders, Lights, Electric Blankets, etc. Attractive satin copper finish. Size 135 mm X 130 mm X 60 mm. Price £2.25. Post 40p. (Total inc. VAT & Post £2.67.)

PROGRAMME TIMERS
 230/240 Volt A.C. 15 RPM Motors. Each can operate a c/o micro switch. Ideal for lighting effects, animated displays etc. Ex equipment tested, similar to illustration.
 2 cam model 15 r.p.m. £2.00 post 35p
 4 cam model 15 r.p.m. £2.50 post 40p
 8 cam model 20 r.p.m. £4.75 post 60p
 8 cam model, each cam fully adjustable. 6 r.p.m. M.f.g. by Magnetic Devices. £7.50. Post 60p.

POWER RHEOSTATS
 New ceramic construction, vitreous enamel embedded winding, heavy duty brush assembly, continuously rated.
 25 WATT 10, 25, 100, 150, 250, 500, 1k, 1.5k, 2.5k ohm. £1.70. Post 20p. 50 WATT 1, 5, 10, 25, 50, 100, 500, 1k ohm £2.10. Post 25p. 100 WATT 1/10/25/50/100/250/500/1k/1.5k/2.5k/5k ohm. £3.30. Post 35p.
 Black Silver Skirted knob calibrated in Nos. 1-9. 1 1/2 in. dia brass bush. Ideal for above Rheostats, 22p ea.

'GENTS' 6" ALARM BELL
 200/250 volt AC/DC. Brand New. Price: £5.00. Post 75p (illus.). VAT 25%.

'STC' 6" RED ALARM BELL
 Brand New. Price: £4.00. Post 50p. 24/48V DC. VAT 25%

INSULATION TESTERS (NEW)
 Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L. 8 in., W. 4 in., H. 6 in., weight 6 lb.
 500 VOLTS. 500 megohms £30.00. Post 80p.
 1000 VOLTS 1000 megohms £36.00. Post 80p.

PRECISION CENTRIGUGAL BLOWERS
 Mfg. by Smiths Industries. Miniature model. Series SF7200. Size 95mm x 82mm x 82mm. Aperture 38mm x 31mm. 12 c.f.m. £2.75. Post 50p.

Mfg. by Airflow Developments Ltd.
 Precision made, continuously rated, smooth running. 230/240v A.C. motor 80c.f.m. As illustrated but with round aperture. £6.50. Post 75p.

Mfg. by Woods
 Extremely powerful. 220/250v A.C. 0.3 amp. 2,700 r.p.m. continuously rated. Capacitor start. Cast construction. Aperture 66mm x 50mm. O/A 200mm. £12.00. Post £1.00.

230 VOLT FAN ASSEMBLY
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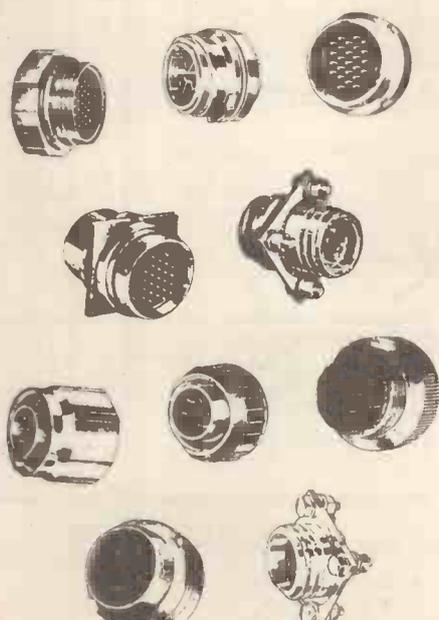
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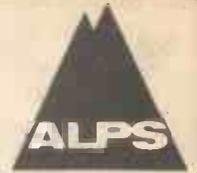
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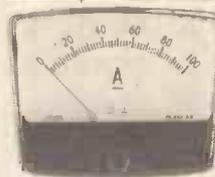
Ohms	48	66	85	118	150
in	2	2	2	2	2
mm	42	50	70	106	110
50 µA	£3.63	£3.81	£4.00	£4.90	£5.46
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TYPE SA

Ohms	43	51	61	82
in	2	2	2	2
mm	43	51	61	78
50 µA	£3.52	£3.59	£3.87	£4.12
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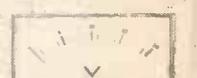
Ohms	73	78	92
in	2	2	2
mm	56	63	72
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1mA	£3.48	£3.73	£3.98
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300vAC	£3.73	£3.87	£4.22

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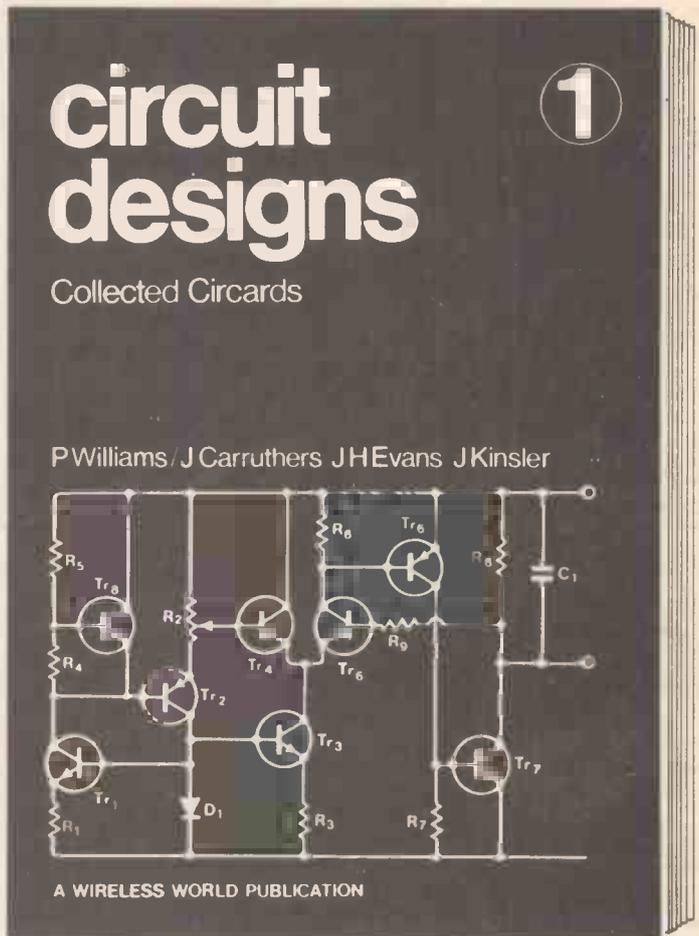
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Dorset House, Stamford Street, London SE1 9LU.

BI-PAK SEMICONDUCTOR

COMPONENTS

CARBON RESISTOR PAKS
These Paks contain a range of Carbon Resistors, assorted into the following groups:-

R1	50	Mixed	100 ohms	0.60
			820 ohms 1/8th W.	
			8.2Kohms 1/8th W.	
R2	50	Mixed	1K ohms	0.60
			8.2Kohms 1/8th W.	
			82Kohms 1/8th W.	
R3	50	Mixed	10K ohms	0.60
			82Kohms 1/8th W.	
			820Kohms 1/8th W.	
R4	50	Mixed	100K ohms	0.60
			820Kohms 1/8th W.	
			8.2Kohms 1/8th W.	
R5	30	Mixed	100 ohms	0.60
			820 ohms 1/8th W.	
			8.2Kohms 1/8th W.	
R6	30	Mixed	1K ohms	0.60
			8.2Kohms 1/8th W.	
			82Kohms 1/8th W.	
R7	30	Mixed	10K ohms	0.60
			82Kohms 1/8th W.	
			820Kohms 1/8th W.	
R8	30	Mixed	100K ohms	0.60
			820Kohms 1/8th W.	

These are unbeatable prices.

LOW COST CAPACITORS

500	µF	50V	Elect	0.09	each
0.1	µF	400V		0.03	each

REPANCO CHOKES & COILS

RF Chokes	CHI	2.5mH	0.27
	CH3	7.5mH	0.29
	CH5	1.5mH	0.26
	CH4	5.0mH	0.28
	CH2	10mH	0.31
COILS	DRX1	Crystal set	0.29
	DRR2	Dual range	0.42

CARBON POTENTIOMETERS

Log and Lin 4.7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M.

VC1	Single Less Switch	0.14
VC2	Single D.P. Switch	0.26
VC3	Tandem Less Switch	0.43
VC4	1K Lin Less Switch	0.14
VC5	100K Log anti-Log	0.43

HORIZONTAL CARBON PRESETS

0.1 Watt 0.06 each
100, 220, 470, 1K, 2.2K, 4.7K, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M, 4.7M.

REPANCO TRANSFORMERS

240V. Primary. Secondary voltages available from selected tappings 4V, 7V, 8V, 10V, 40V, 50V and 25V-0-25V.

Type	amps	Price	P&P
MT50/1/2	1/2	£1.79	0.45p
MT50/1	1	£2.24	0.48p
MT50/2	2	£3.06	0.60p

COIL FORMERS & CORES

NORMAN 1/4" Cores & Formers 0.07p
3/4" Cores & Formers 0.09p

SWITCHES

DP/DT Toggle 0.28p
SP/ST Toggle 0.22p

FUSES

1 1/2" and 20mm, 100mA, 200mA, 250mA, 500mA, 1A, 1.5A, 2A QUICK BLOW 0.5p each
Anti-surge 20mm only 0.8p each

VEROBOARDS

VB1 containing approx. 50 sq. ins. various sizes all 0.1 matrix 0.60p
VB2 containing approx. 50 sq. ins. various sizes all 0.15 matrix 0.60p

DECON-DALO 33PC Marker

Etch resistant printed circuit marker pen. Full instructions supplied with each pen 0.92p

BATTERY HOLDERS

Takes 6 H.P. 7s complete with terminal clip and lead 0.31p each

CABLES

CF1	Single lapped screen	Per Metre	0.08
CF2	Twin Common Screen		0.11
CF3	Three Screened		0.12
CF4	Four Core Common Screen		0.21
CF5	Four Core Individually screened		0.28
CF6	Microphone Fully Braided Cable		0.11
CF7	Three Core Mains Cable		0.08
CF8	Twin Oval Mains Cable		0.06
CF9	Speaker Cable		0.14
CF10	Low Loss Co-Axial		0.14

SEE OUR COMPLETE RANGE IN

PRACTICAL ELECTRONICS, PRACTICAL WIRELESS, RADIO CONSTRUCTOR, EVERYDAY ELECTRONICS, WIRELESS WORLD
OR SEND 5p FOR THE FULL LIST OF ALL BI-PAK PRODUCTS

INSTRUMENT CASES



(In 2 sections, Black Vinyl covered top and sides and bezel)

No.	Length	Width	Height	Price
BV1	8" x	5 1/4" x	2"	*£1.25
BV2	11" x	6" x	3"	*£1.62
BV3	6" x	4 1/4" x	1 1/4"	* 0.92
BV4	9" x	5 1/4" x	2 1/4"	*£1.39

ALUMINIUM BOXES

No.	Length	Width	Height	Price
BA1	5 1/4" x	2 1/4" x	1 1/4"	*0.45
BA2	4" x	4" x	1 1/4"	*0.45
BA3	4" x	2 1/4" x	1 1/4"	*0.45
BA4	5 1/4" x	4" x	1 1/4"	*0.54
BA5	4" x	2 1/4" x	2"	*0.45
BA6	3" x	2" x	1"	*0.39
BA7	7" x	5" x	2 1/4"	*0.79
BA8	8" x	6" x	3"	*£1.02
BA9	6" x	4" x	2"	*0.65

(each complete with 1/2" deep lids & screws)
PLEASE ADD 20p POSTAGE AND PACKING FOR EACH BOX

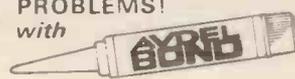
COMPONENT PAKS

Pak No.	Description	Price
CI 200	Resistors mixed values approx. count by weight	.60
C2 150	Capacitors mixed values approx. count by weight	.60
C3 50	Single Resistors mixed values	.60
C4 75	1/8th width Resistors mixed preferred values	.60
C5 5	Pieces assorted Ferrite Rods	.60
C6 2	Tuning Gangs. MW/LW VHF	.60
C7 1	Pak Wire 50 metres assorted colours	.60
C8 10	Reed Switches	.60
C9 3	Micro Switches	.60
C10 15	Assorted Pots & Pre-Sets	.60
C11 5	Jack Sockets 3 x 3.5m, 2 x standard Switch Type	.60
C12 30	Paper Condensers preferred types mixed values	.60
C13 20	Electrolytics Trans. types	.60
C14 1	Pack assorted Hardware - Nuts/Bolts, Grommets, etc.	.60
C15 5	Mains Slide Switches, 2 Amp	.60
C16 20	Assorted Tag Strips & Panels	.60
C17 10	Assorted Control Knobs	.60
C18 4	Rotary Wave Change Switches	.60
	2 Relays 6-24V Operating Sheets Copper Laminate. approx. 200 sq. ins.	.60

Please add 20p post and packing on all component packs, plus a further 10p on pack nos. CI, C2, C19 & C20.

AVDEL BOND

SOLVE THOSE STICKY PROBLEMS!



CYANOACRYLATE C2 ADHESIVE
The wonder bond which works in seconds - bond plastic, rubber transistors, components permanently, immediately!

OUR PRICE ONLY 60p for 2gm phial

BIB HI-FI ACCESSORIES

REF	DESCRIPTION	PRICE
B	Stylus and turntable cleaning kit	*31p
J	Tape head cleaning kit	*68p
P	Hi-Fi cleaner	*30p
9	Wire stripper/Cutter	*94p
31	Cassette head cleaner	*58p
32	Tape editing kit	*£1.64
32A	Stylus balance	*£1.24
36A	Record stylus cleaning kit	*32p
42	De Luxe Groov-Kleem	*£1.84
43	Record care kit	*£2.68
45	Auto changer groove cleaner	*98p
46	Spirit level	*68p
56	Hi-Fi stereo hints & tips	*38p
60	Chrome finish as above	*£1.72

ANTEX EQUIPMENT

SOLDERING IRONS		
x25. 25 watt		*£2.45
Model G. 18 watt		*£2.70
CCN 240. 15 watt		*£2.90
SK2. Soldering Kit		*£3.90

BITS AND ELEMENTS

Bit No.	Model	Price
102	for model CN240	3/32" *42p
104	for model CCN240	3/16" *42p
1100	for model CCN240	3/32" *42p
1101	for model CCN240	3/8" *42p
1102	for model CCN240	1/2" *42p
1020	for model G240	3/32" *42p
1021	for model G240	1/8" *42p
1022	for model X25	3/32" *42p
50	for model X25	3/32" *44p
51	for model X25	1/8" *44p
52	for model X25	3/16" *44p

ELEMENTS

Model ECN 240	£1.10*
Model EG 240	£1.35*
Model ECCN 240	£1.55*
Model EX 25	£1.20*

SOLDERING IRON STAND

ST3 Suitable for all models Antex heat shunt *£1.10 *10p

PLUGS

PS	Description	PRICE
PS1	D.I.N. 2 Pin (Speaker)	0.10
PS2	D.I.N. 3 Pin	0.11
PS3	D.I.N. 4 Pin	0.14
PS4	D.I.N. 5 Pin 180°	0.15
PS5	D.I.N. 5 Pin 240°	0.15
PS6	D.I.N. 6 Pin	0.16
PS7	D.I.N. 7 Pin	0.17
PS8	Jack 2.5mm Screened	0.17
PS9	Jack 3.5mm Plastic	0.11
PS10	Jack 3.5mm Screened	0.17
PS11	Jack 1/4" Plastic	0.14
PS12	Jack 1/4" Screened	0.20
PS13	Jack Stereo Screened	0.33
PS14	Phono	0.09
PS15	Car Aerial	0.14
PS16	Co-Axial	0.14

INLINE SOCKETS

PS 21	D.I.N. 2 Pin (Speaker)	0.13
PS 22	D.I.N. 3 Pin	0.19
PS 23	D.I.N. 5 Pin 180°	0.19
PS 24	D.I.N. 5 Pin 240°	0.19
PS 25	Jack 2.5mm Plastic	0.15
PS 26	Jack 3.5mm Plastic	0.15
PS 27	Jack 1/4" Plastic	0.28
PS 28	Jack 1/4" Screened	0.32
PS 29	Jack Stereo Plastic	0.28
PS 30	Jack Stereo Screened	0.35
PS 31	Phono Screened	0.17
PS 32	Car Aerial	0.20
PS 33	Co-Axial	0.20

SOCKETS

PS 35	D.I.N. 2 Pin (Speaker)	0.07
PS 36	D.I.N. 3 Pin	0.09
PS 37	D.I.N. 5 Pin 180°	0.09
PS 38	D.I.N. 5 Pin 240°	0.10
PS 39	Jack 2.5mm Switched	0.11
PS 40	Jack 3.5mm Switched	0.11
PS 41	Jack 1/4" Switched	0.18
PS 42	Jack Stereo Switched	0.29
PS 43	Phono Single	0.07
PS 44	Phono Double	0.09
PS 46	Co-Axial Surface	0.09
PS 47	Co-Axial Flush	0.19

P.C.B. KITS & PENS

PROFESSIONAL D.I.Y. PRINTED CIRCUIT KIT

Containing 6 sheets of 6" x 4" single sided laminate, a generous supply of etchant powder, etching dish, etchant measure, tweezers, etch resistant marking pen, high quality pump drill with spares, cutting knife with spare blades, 6" metal ruler, plus full easy to follow instructions. *£7.80 per kit Spare container of etchant for above, complete with instructions *60p

P.C.B. MARKING PENS

2 x quality market pens, specifically designed for drawing fine etchant resistant circuits on copper laminate. Complete with full instructions *£1.53 per pair

LOW-NOISE CASSETTES

C60	*33p
C90	*44p
C120	*56p

SLIDER PAK

Containing a range of slider pots.
SP1 6 mixed values sliders 0.60
SP2 6 470R Lin. sliders 0.60
SP3 6 10K Lin. sliders 0.60
SP4 6 22K Lin. sliders 0.60
SP5 6 47K log. sliders 0.60
SP6 6 47K Lin. sliders 0.60

AUDIO LEADS

S221	5 pin DIN plug to 4 phono plugs length 1.5m	£1.08
S222	5 pin DIN plug to 5 pin DIN socket length 1.5m	0.8p
S237	5 pin DIN plug to 5 pin DIN plug mirror image length 1.5m	£1.20
S238	2 pin DIN plug to 2 pin DIN socket length 5m	0.68p
S268	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5 length 1.5m	£1.00
S270	2 pin DIN plug to 2 pin DIN socket length 10m	0.80p
S271	5 pin DIN plug to 2 phono plugs, connected to pins 3 & 5 length 1.5m	0.70p
S275	5 pin DIN plug to 2 phono sockets connected to pins 3 & 5 length 23cm	0.8p
S318	5 pin DIN socket to 2 phono plugs connected to pin 3 & 5 length 23cm	0.8p
S404	Coiled stereo headphones extension cord extends to 7m	£1.40
S217	3 pin DIN plug to 3 pin DIN plug length 1.5m	0.80p
S219	5 pin DIN plug to 5 pin DIN plug length 1.5m	0.80p
S474	3.5mm Jack to 3.5mm Jack length 1.5m	0.8p
S600	5 pin DIN plug to 3.5mm Jack connected to pins 3 & 5 length 1.5m	0.80p
S700	5 pin DIN plug to 3.5 Jack connected to pins 1 & 4 length 1.5m	0.80p

CROSSOVER NETWORK

K4007 1/P Impedance 8 ohms. (2-way) Insertion Loss 3dB. Crossover Frequency 3 KHz. PRICE £1.12

3-WAY-STEREO H/PHONE JUNCT BOX

H1012 Enables change-over from loudspeaker to headphone listening. Also has a centre position for both outputs. PRICE £1.73

HANDBOOKS

TRANSISTOR DATA BOOK, DTE 2
227 Pages packed with information on European Transistors. Full specification including outlines. Price *£2.95 each
TRANSISTOR EQUIVALENT BOOK
BPE 75 256 Pages of cross references and equivalents for European, American and Japanese Transistors. This is the most comprehensive equivalents book on the market today and has an Introduction in 13 languages. Price *£2.68 each
DIODE EQUIVALENT BOOK DE 74
144 Pages of cross references and equivalents for European, American and Japanese Diodes, Zeners, Thyristors, Triacs, Diacs and L.E.D.'s. Price *£1.98 each
MULLARD DATA BOOK 1974/75 MDB 74
The latest edition of this popular handbook contains information on Semiconductors, Integrated Circuits, Television Picture Tubes, Valves, Capacitors and Resistors. Included in the 161 informative pages are 21 pages on Semiconductor Comparables. Price *£0.40 each
TTL DATA BOOK DIC 75
Now complete Data book of 74 series TTL (7400-74132).

PO BOX 6 WARE HERTS

AL 60

ONLY £3.95

50w. PEAK (25w. R.M.S.)

- Max Heat Sink temp 90°C
- Frequency Response 20Hz to 100K Hz
- Distortion better than 0.1 at 1KHz
- Supply voltage 15-50 volts
- Thermal Feedback
- Latest Design Improvements
- Load — 3, 4, 5 or 16 ohms
- Signal to noise ratio 80dB
- Overall size 63mm x 105mm x 13mm. Especially designed to a strict specification. Only the finest components have been used and the latest solid state circuitry incorporated in this powerful little amplifier which should satisfy the most critical A.F. enthusiast.



STABILISED POWER MODULE SPM80

SPM80 is especially designed to power 2 of the AL60 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 BMT80, the unit will provide outputs of up to 1.5 amps at 35 volts. Size: 63mm x 105mm x 30mm.

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.

TRANSFORMER BMT80 £2.60

PRICE £3.00

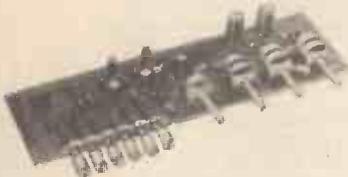


STEREO PRE-AMPLIFIER TYPE PA100

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.

£13.20



MK 60 AUDIO KIT

Comprising: 2 x AL60, 1 x SPM80, 1 x BTM80, 1 x PA100, 1 front panel, 1 kit of parts to include on-off switch, neon indicator, stereo headphone sockets plus instruction booklets.

COMPLETE PRICE: £27.55 plus 45p postage.

TEAK 60 AUDIO KIT

Comprising: Teak veneered cabinet size 16 1/2" x 11 1/2" x 3 1/4", other parts include aluminium chassis, heatsink and front panel bracket, plus back panel and appropriate sockets, etc.

KIT PRICE: £9.20 plus 45p postage.

STEREO 30 COMPLETE AUDIO CHASSIS

7 + 7 WATTS R.M.S.

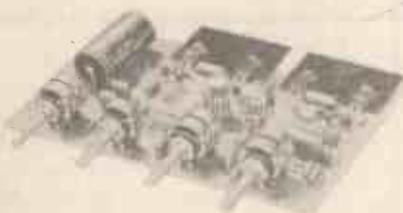
The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This with only the addition of a transformer or overwind, will produce a high quality audio unit suitable for use with a wide range of inputs, i.e. high quality ceramic pickup, stereo tuner, stereo tape deck, etc.

Simple to install, capable of producing really first-class results, this unit is supplied with full instructions, black front panel, knobs, mains switch, fuse & fuse holder and universal mounting bracket, enabling it to be installed in a record plinth, cabinets of your own construction or the cabinet available.

Ideal for the beginner or advanced constructor who requires Hi-Fi performance with a minimum of installation difficulty. Can be installed in 30 mins.

PRICE £15.75 plus 45p postage & packing.

TRANSFORMER £2.45 plus 45p postage & packing **TEAK CASE £3.65** plus 45p postage & packing.



PLEASE ADD V.A.T.

AT 25% TO ALL ITEMS EXCEPT

* ADD 8%
NO V.A.T.

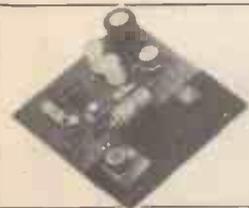
GIRO NUMBER
388-7006

AL 10/AL 20/AL 30

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.

AL10 £2.30, AL20 £2.65, AL30 £2.95



SPEAKERS

E.M.I. LEK 350 Loudspeakers Enclosure kit in teak veneer, including speakers. Rec. retail price £4.50 per pair.

OUR SPECIAL PRICE
ONLY £27.75 per pair P&P £3
WHILE STOCKS LAST!

HEADPHONES

4-16 ohms Impedanced frequency response 20 to 20,000 Hz stereo/mono switch and Volume Control £4.55

FRONT PANEL

FOR PA100, Attractive matt silver. Finish with black trim and lettering. Adds that professional touch. £1.10 only.

M.P.A.30

Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the new Bi-Pak M.P.A.30 which is a high quality pre-amplifier exist for the use of ceramic cartridges only.

Used in the construction are 4 low noise, high gain, silicon transistors and it is provided with a standard DIN input socket for ease of connection.

Supplied with full, easy to follow instructions.

PRICE £2.65

STORAGE-CARRY CASES

RECORD CASES
7 in E.P. 18 3/8th in. x 7 in x 8 in (50 records) *£2.48
12 in L.P. 13 1/2 in x 7 3/8th in x 12 1/2 in (50 records) *£3.30

CASSETTE CASES
Holds 15. 10 in x 3 1/4 in x 5 in. Lock and handle *£1.50

8-TRACK CARTRIDGE CASES
Holds 14. 13 in x 5 in x 6 in. Lock and handle *£2.20
Holds 24. 13 3/8th in x 8 in x 5 3/8th in Lock and handle *£3.20

CARTRIDGES

ACOS GP91-1SC	200mV at 1.2cms/sec	£1.11
GP93-1	280mV at 1cm/sec	£1.43
GP96-1	100mV at 1cm/sec	£2.31
TTC J-2005	Crystal/Hi Output	£0.97
J-2010C	Crystal/Hi Output Compatible	£1.11
J-2006S	Stereo/Hi Output	£1.52
J-2105	Ceramic/Med Output	£1.81
J-2203	Magnetic 5mV/5cm/sec including stylus	£4.78
J-2203B	Replacement stylus for above	£2.88
AT-55	Audio-technica magnetic cartridge 4mV/6cm/sec	£3.06

DYNAMIC MICROPHONE

TYPE B1223 200 ohms impedance. Complete with stand, on/off switch and 2.5mm and 3.5mm plugs. Suitable for cassette tape recorders. **PRICE £1.67**

JUST OUT!

STEREO FM TUNER

WRITE NOW FOR FULL DETAILS

The SECOND-USER Computer Specialists

COMPUTER SALES AND SERVICES Peripherals and Systems for Data Processing Systems, Equipment and Components

Mini-Computer Exchange

Our Mini Computer Exchange has systems for immediate delivery at greatly reduced prices. A few examples of our stock include:

- PDP8L 8K Processor
- PC8I Reader Punch & Control
- PDP8E 8K Processor + ASR33
- PDP 8E 32K Processor + ASR33
- PDP8M 8K Processor + LA30
- PDP11/15 4K Processor
- PDP11/15 16K Processor
- DEC 6ft. Cabinets
- DEC Modules — send for list

Ring now for prices. Other models becoming available all the time — let us know your requirements.



Add 8% VAT to all prices shown. Carriage extra — details on request.

Callers welcome — Monday to Friday 9 a.m. to 5 p.m.

COMPUTER SALES & SERVICES (EQUIPMENT) LIMITED
 49/53 Pancras Road, London NW1 2QB. Tel. 01-278 5571

PAPER TAPE PUNCHES & READERS



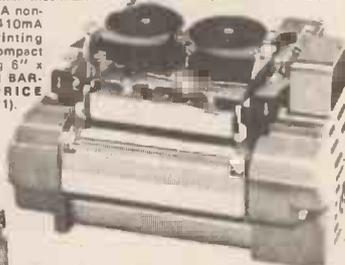
TELETYPE BRPE 110 cps Synchronous Punch 5/7/8 channel. Self-contained, mains-operated unit consisting of punch unit, base, motor and tape supply spool. Price £145.00. Sound-reducing cabinet available at £25.00.

INVAC P135 solenoid-actuated punch, 35 cps, 5/6/7/8 channel. Compact unit 7 1/4" x 6 1/4" x 5". Power requirements: Tape transport solenoids 26V DC 2A, Punch solenoids 26V 4.5A, Punch return solenoids 26V 2A. Minimum pulse width 16 millisecc. Price £69.50.

DATA DYNAMICS 1114 Rack-mounted 110 cps Punch, as new. Mounted in sound-reducing rack cabinet and complete with control and interface electronics and power supply unit with short circuit and overload protection. Asynchronous operation up to 110 cps. Our special price £580.

DIGITAL PRINTING MECHANISM TYPE EP101

Capacity 21 columns, 16 print positions (0-9 + — L S). Parallel data entry. Column spacing 3.5mm. Line spacing 5.1mm. Character Dimensions 1.8mm wide x 2.9mm high. Power requirements: 15V DC. Current 150mA non-printing up to 410mA maximum printing load. Very compact unit measuring 6" x 5" x 4". **OUR BARGAIN PRICE £49.00 (P&P £1).**



JUST ARRIVED — SPECIAL PURCHASE OF DISK STORAGE DRIVES BY CDC WILL ACCEPT 6-SPEED DISK-PACKS AVAILABLE EITHER 2 OR 4 MEG CAPACITY. NEVER OFFERED BEFORE. PRICES FROM £480.00

Keyboards

NEW REED-SWITCH KEYBOARDS BY CLARE-PENDAR WITH

READ ONLY MEMORY ASCII-CODED OUTPUT

Ideal for communications equipment, VDU's, prototype designs, etc. 68-key positions plus 11 instruction keys. Positive logic. Input voltage -12V DC + 5V.

OUR INCREDIBLE PRICE (DUE TO SPECIAL PURCHASE) £29.50

+ £1.00 P&P

ELECTRO-MECHANICAL NUMERIC KEYBOARDS originally designed for 80-column card punch and verifier machines. Numeric with 12 character keys and 8 instruction keys. Alpha-numeric with 47 character keys and 8 instruction keys. Price: Numeric £4.50 + £1.00 P&P. Alpha-numeric £15 + £3.00 P&P.



4 BANK HONEYWELL ALPHANUMERIC KEYBOARD — BRAND NEW Mounted on printed circuit board (non-coded). 53 character keys + 10 instruction keys and 2 space bars. Layout can be re-arranged as required. Ideal for prototypes and special applications. Half-effect switches. Power requirement + 5V 420 mA. Price £20.00 (P&P £1).

REED-SWITCH 4-BANK ALPHA-NUMERIC KEYBOARD mounted on printed circuit board with ASCII coded output, 43 character keys + 2 shift keys and 12 instructional keys. Ideal for data displays, computer programming, etc. (a) Ex-equipment, housed in metal case: £30.00 + £3.00 P&P. (b) Brand new, mounted on PC board only: £30.00 + £1.00 P&P.

TERMINALS

ASR35 Heavy-duty console-mounted version of ASR33. Designed for continuous running with minimum maintenance. £950.00.

KSR35 Input/Output Console (hard copy only) £375.00.

COSSOR DIDS SERIES 402.2 and 402.2A Visual Display Units. Provide high-speed visual access from computer or other information sources. Data transfer rate 120 cps. The model 402.2 displays 13 lines of 40 characters with a viewing surface of 8" x 4 1/2", while the 402.2A displays 13 lines of 80 characters with a viewing surface of 8" x 6". 64 character alphanumeric keyboard. Prices from £325.00.

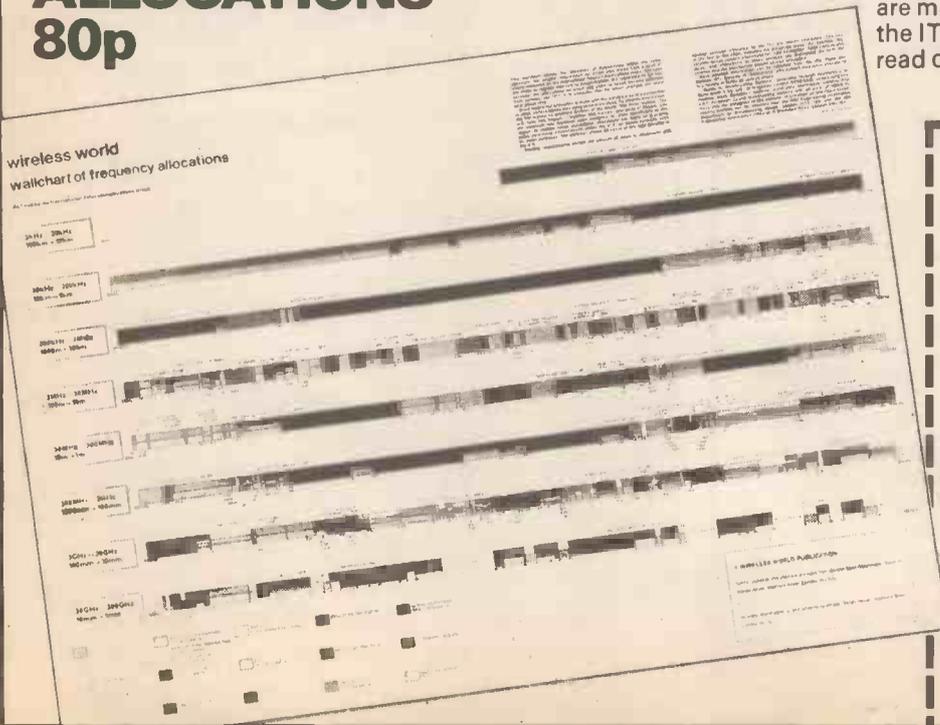
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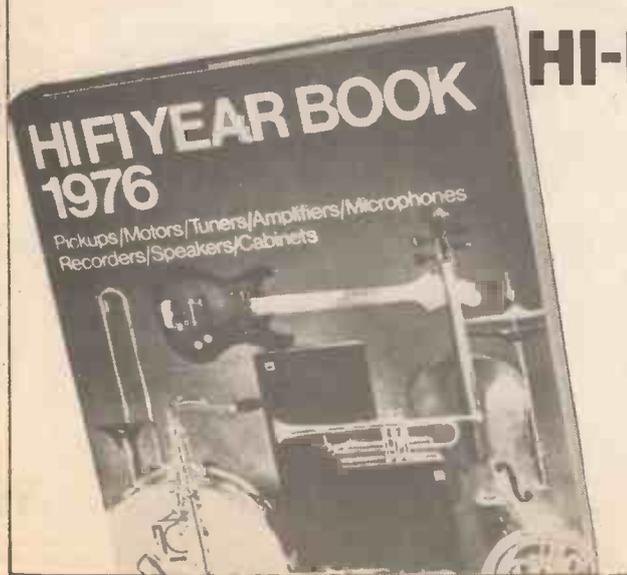
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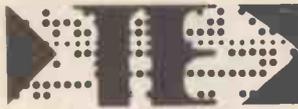
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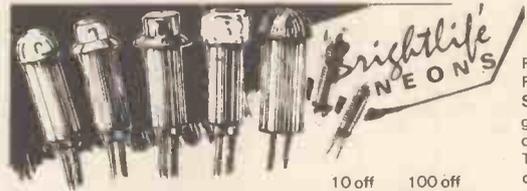
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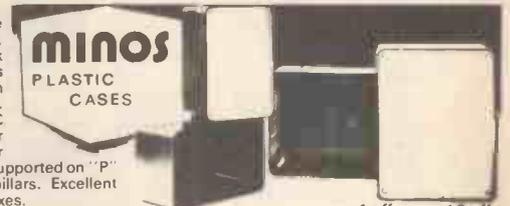


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Q type	none	110 or 160—260	£2.319 ea.	£2.297 ea.
S type	none		£2.53 ea.	£2.31 ea.

Add 8% VAT. Min. quantity each type 10 off. Prices correct Oct. 1975.

A smart miniature case in tough, rigid, high-gloss black ABS. Front panels in either aluminium or white PVC/Steel. Built-in slots for PC cards, dividers, or screens. Chassis or PC boards can be supported on "P" clips for internal pillars. Excellent as encapsulation boxes.

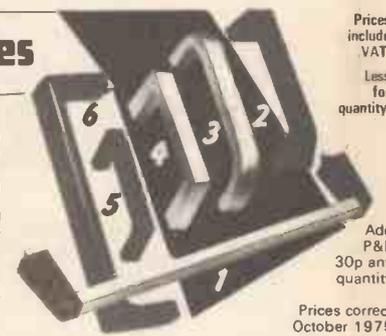


M2 65mm X 100mm X 50mm 2 1/2" X 3 3/4" X 2"	1 off	59p	10 off	50p
M3 100mm X 130mm X 50mm 3 1/4" X 5 1/8" X 2"		75p		65p

Less for quantities.
 Also available without panel and screws. Prices correct October, 1975.

CONTIL handles

- (1) No. 265.55. Anodised aluminium centre bar. Black plastic brackets with moulded-in core. 77mm @ £1.31. Five more sizes up to 254mm.
- (2) No. 281. 1 Nylon 112mm. Load 50Kg @ 59p.
- (3) No. 277. Ali. ground polished anodised 88mm. @ £1.27. 120mm. @ £1.43.
- (4) No. 268. Satin ali. 57.5mm. £1.27; 102mm. @ £1.37; 146.5mm @ £1.57.
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Prices include VAT.
 Less for quantity.

Add P&P 30p any quantity

Prices correct October 1975



The design of these cases permits the instrument to be built or serviced within their external panels. 48 shapes. Low cost. Blue PVC/steel with grey PVC-coated aluminium panels.

Width	Height	Depth	1 off	Width	Height	Depth	1 off
A 4.5"	3"	6.5"	£5.14	M 4.5"	3"	13"	£6.05
B 4.5"	7"	6.5"	£6.06	N 4.5"	7"	13"	£8.08
C 4.5"	10"	6.5"	£7.35	O 4.5"	10"	13"	£10.67
D 9"	3"	6.5"	£7.35	P 9"	3"	13"	£8.08
E 9"	7"	6.5"	£8.08	Q 9"	7"	13"	£10.67
F 9"	10"	6.5"	£9.53	R 9"	10"	13"	£13.11
G 13"	3"	6.5"	£8.08	S 13"	3"	13"	£10.67
H 13"	7"	6.5"	£9.53	T 13"	7"	13"	£13.11
I 13"	10"	6.5"	£10.67	U 13"	10"	13"	£16.17
J 18"	3"	6.5"	£9.53	V 18"	3"	13"	£13.11
K 18"	7"	6.5"	£13.11	W 18"	7"	13"	£16.17
L 18"	10"	6.5"	£16.17	X 18"	10"	13"	£19.11

Mod-2 in Woodgrain finish or Black, in sizes A, B, C, D, E, N, G, F, H, J, I, K & L. Prices as for one price up on Mod-2, e.g. Mod 2A Woodgrain or black is £6.05. Prices include screws, rubber feet, one or two chassis according to size. P&P and 8% VAT. Write or phone for our latest catalogue. Prices correct October, 1975. NEW POSTAL INCREASES NOT INCLUDED

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Signal Generator D1 £39
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A.F. Signal Generator J.2B £45
A.F. Signal Generator J.2 £35

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Signal Generator 702 30Hz-30KHz in 3 bands £60
Signal Generator 701 £60
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MARCONI INTS.



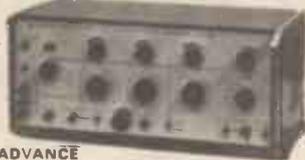
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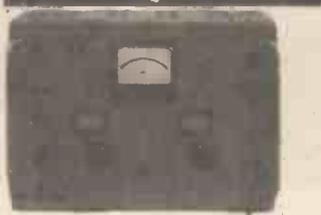
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Relcon	0705/05/F11	5	200 ohm	£1.7
Beckman	7246/5019	10	50 ohm	£2.0
Bourns	35005-2-500	10	50 ohm	£1.9
Bourns	35005	10	1K	£2.0
Beckman	A/S303	10	5K	£1.0
Beckman	72212/5	10	10K	£2.0
Relcon	0710-1-1-001A	10	10K	£2.0
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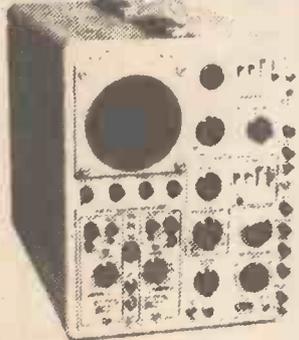
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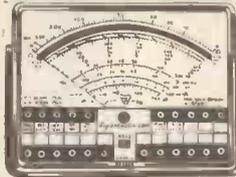
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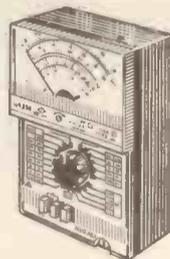
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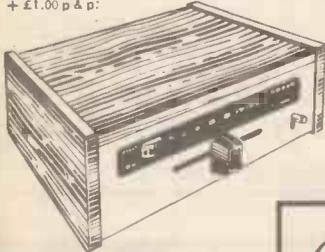
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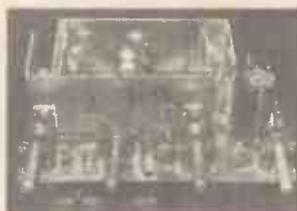
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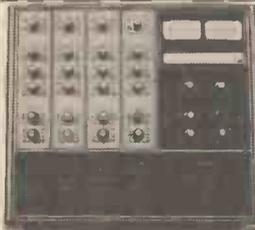
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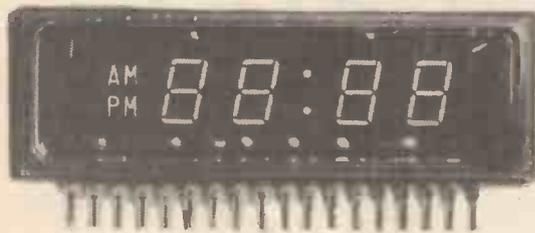
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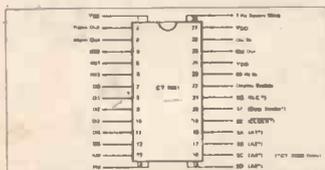
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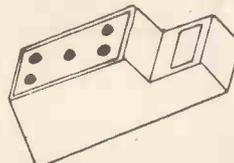
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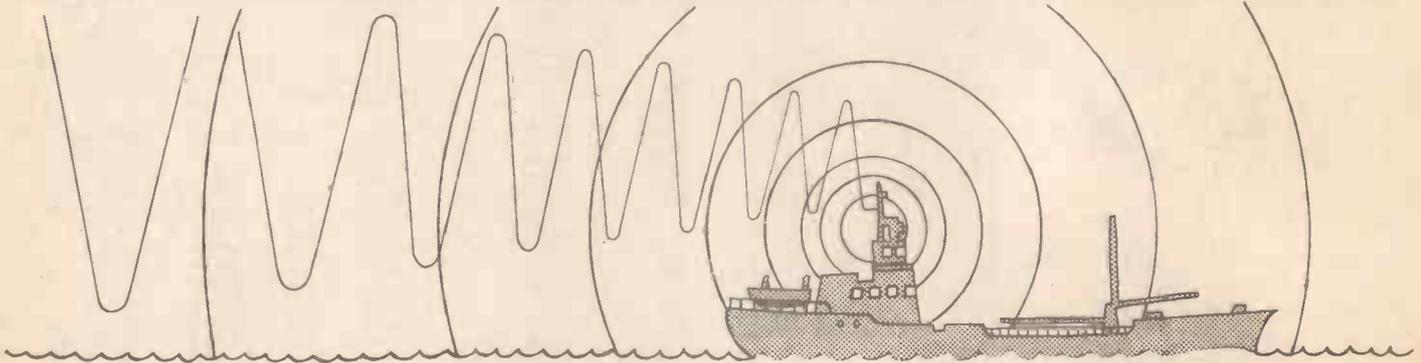
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Salary Scales: Grade II £3558-£4581 per annum plus London Weighting.

Applicants should have obtained ONC, HNC, HND or an appropriate science degree with the relevant technical experience.

Application forms from the Area Personnel Officer, 106-114 London Road, Kingston Upon Thames, Surrey. Tel: 01-546 2181, Ext. 264.

Closing date: 24th October, 1975.

4504



TEST AND COMMISSIONING ENGINEER

Servotest Limited, leading manufacturers of electro-hydraulic servo equipment, have vacancies for competent engineers to work in testing, commissioning and servicing.

Some travel is involved, both in the U.K. and abroad. The successful candidates will have a sound practical and theoretical electronics background with a knowledge of several of the following:

Analogue circuits using integrated and discrete components; operational amplifiers, simple digital circuits, servo systems, hydraulics.

Appropriate qualifications would be HNC, C&G Radio and Television, etc. The ability to work without supervision and to deal with customers at all levels is essential. Applicants must hold a current driving licence. Salary around £3,500 p.a.

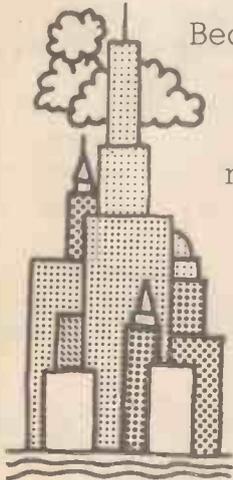
Telephone for interview.

Servotest Limited
Sarsfield Road, Perivale
Middlesex UB6 7AA
Tel. No. 01-998 1552

4510

RADIO OFFICERS

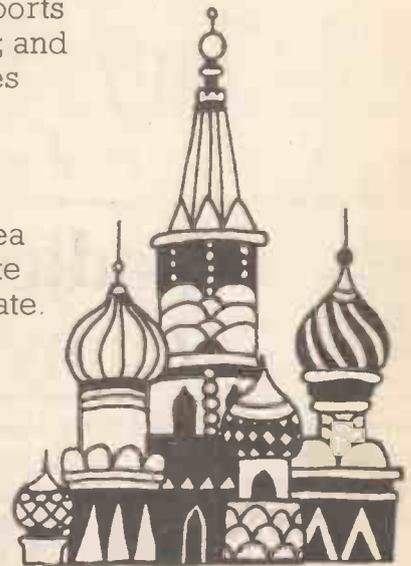
See a different world with us.



Because our job is to keep the ships of the Royal Navy supplied with fuel, stores and equipment wherever they happen to be, RFA ships tend to operate off the beaten track of commercial shipping lanes. As a Radio Officer on one of our ships you will visit ports rarely frequented by other merchant fleets; and you'll enjoy the social and sporting facilities laid on for RN Officers. Yet you remain firmly civilian.

You need a 1st Class P.M.G. or M.P.T. General Certificate or (with previous sea experience) 2nd Class P.M.G. Certificate and D.O.T. Radar Maintenance Certificate.

You'll find that service with us offers considerable technical challenge, as our ships have a more extensive communications fit than is usually found in commercial vessels.



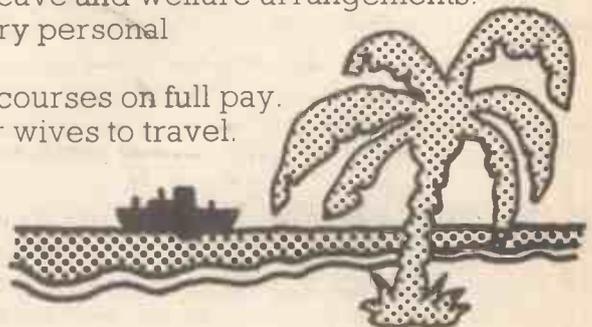
Basic pay: at least £3,370 for less than 6 months sea service, at least £3,921 for more than 6 months sea service, depending on qualifications and experience.

Regular increases thereafter. Promotion can lead to salaries of £7,000 and more.

- * Leave: 183 days per annum served.
- * Study leave on full pay.
- * Generous sick leave and welfare arrangements.
- * Non-contributory personal pension scheme.
- * Special training courses on full pay.
- * Opportunities for wives to travel.



For further details write to:
The Careers Office, Royal Fleet Auxiliary,
Empress State Building, London SW6 1TR.
Or telephone 01-385 1244 Ext. 2192.



ROYAL FLEET AUXILIARY

RFA

VHF/UHF TELEVISION INSTALLATION ENGINEERS

(Spain)

Well qualified and/or highly experienced INSTALLATION ENGINEERS are invited to apply immediately for INTERVIEWS IN ENGLAND to fill THREE IMPORTANT VACANCIES leading to senior positions in Spain.

The posts are based in Madrid but knowledge of Spanish, though desirable, is not essential because the equipment being installed is of an international nature.

Please write today to:
CARLOS SYMMES, Engineering Manager
29 The Rookery, Balsham
CAMBRIDGE CB1 6EU, England.

and send brief summary of experience and qualifications.



NORTRON of Spain
Designers and Manufacturers of TV and FM
Broadcast Equipment

(4923)

MUSIC RECORDING ENGINEER

A major overseas studio has a vacancy for a Chief Recording Engineer.

The successful applicant will take charge of a studio complex fitted with the world's latest and most sophisticated equipment for the multi-track recording and mixing of Pop Music. He will have had at least 5 years' experience in professional Music Recording Studios, of which at least two years will have been spent as a balance and mixdown engineer. A knowledge of Electronics and maintenance techniques, although not essential, will be an advantage.

This is a Senior position and carries a top salary plus exceptional fringe benefits, therefore only top people in this field need apply.

For further particulars apply to Box WW 4986.

REPRESENTATIVE REQUIRED

One time opportunity exists for a suitable candidate for this excellent job offered by a leading West German Manufacturer of Electronic Components.

Applicant must be able to prove some technical qualifications, should have good connections into Radio, Television and Electronic Industry and be willing to call on customers in any part of UK.

As this appointment carries with it a directorship at a later date in an already well-established agency, he must also be capable of working entirely on his own initiative and look after the administrative side of the Company.

German an advantage but not a necessity.
Salary and other remunerations subject to negotiation.

Write to Box No. WW 4974.

G. R. INTERNATIONAL ELECTRONICS LTD.

is seeking

ELECTRONICS ENGINEERS

These positions are as members of a busy Engineering Department engaged on a variety of projects, but with particular emphasis on audio and audio-visual consumer items. Duties will encompass design and the control of build and commissioning of in-house test equipment for sub-assemblies and finished products, with prospects of increasing involvement in product design work.

Applicants should ideally be qualified to H.N.C. standard or better, but this requirement might be waived for anyone able to offer a sufficient degree of practical experience coupled with enthusiasm and integrity. There are good prospects of advancement for hard-working and ambitious engineers who would like the opportunity to aid the successful growth of new product activities.

The Company is currently 300 strong, embarked on a major programme of expansion, and based in one of the most attractive parts of Central Scotland. The social and sporting amenities and general living environment of Perth are outstanding and assistance is offered with re-housing and removal costs.

Good salaries will be offered, consistent with age and experience.

Please apply in writing for interview, giving details of age, marital status, qualifications (if any), experience and current salary, to:

Mr. J. Bandon, Executive Director Administration
GR INTERNATIONAL ELECTRONICS LTD.
Almondbank, Perthshire PH1 3NQ

Interview expenses would be fully reimbursed.

4508

HER MAJESTY'S GOVERNMENT COMMUNICATIONS CENTRE

HANSLOPE PARK, MILTON KEYNES MK19 7BH

has vacancies in the following fields of R & D work:

- (a) VHF/UHF COMMUNICATIONS EQUIPMENT DESIGN
- (b) ACOUSTICS
- (c) MICROWAVE COMMUNICATION SYSTEMS
- (d) GENERAL CIRCUIT DESIGN — ANALOGUE, DIGITAL
- (e) STATISTICS/OPERATIONAL ANALYSIS
- (f) RELIABILITY — FROM COMPONENTS TO OVERALL SYSTEMS
- (g) SMALL SCALE MECHANICAL ENGINEERING — HYDRAULICS/SMALL MECHANISMS

Post (e) will be in London and will attract London allowance of £410 p.a. Appointments will be made within the grades of:

Scientific Officer

£2149-£3527 (Candidates under age 27)

- Qualifications:-
- (a) Scientific or Engineering Degree
 - or (b) Degree standard membership of a Professional Institution
 - or (c) HNC or HND in a scientific or engineering subject or equivalent qualification.

Higher Scientific Officer

£3254-£4454 (Candidates under age 30)

Qualifications: As for Scientific Officer, with the following experience since qualifying:

- (a) Candidates with 1st or 2nd class honours degree or equivalent qualifications — at least 2 years post graduate experience.
- or
- (b) Other Candidates — at least 5 years of appropriate experience.

Senior Scientific Officer

£4185-£5778 (Candidates at least age 25 and under age 32)

Posts (c) and (e) only.

Qualifications: 1st or 2nd class honours degree in a scientific subject and a minimum of 4 years appropriate post-graduate experience.

For further details and application form please write to:

Administration Officer
 HM Government Communications Centre
 Hanslope Park
 Hanslope
 MILTON KEYNES MK19 7BH

*Looking
 for
 a
 new
 job?*

Perhaps we can help!

We have regular contact with hundreds of electronics and electrical companies needing qualified electronics engineers and technicians and TV service engineers.

We can, therefore, help you to find an interesting and well paid job. All you need to do is to return the coupon below or give us a ring. Our service is confidential and costs you nothing.

**TJB Technical Services Bureau,
 3A South Bar,
 Banbury, Oxfordshire.
 Banbury (0295) 53529**



Technical Services Bureau is a division of Technical & Executive Personnel Ltd and is solely concerned with job placement in the Electronics and Electrical Industries

Please send me an "Application for Registration" form

NAME

ADDRESS

.....

..... (4519)

C.A.T.V. Television Communal Aerial Systems

We are acquiring an increasing volume of business in this field including many very long term contracts, and we are seeking to expand the range of our activities. Consequently, we have immediate requirements in London, Leeds and Birmingham for engineers with good practical experience and ability in any of the following aspects of the work:—

**System Design
Planning and Estimating
Project Control
Installation Supervision
Test and Commissioning**

Duties are varied and interesting, with frequent opportunities for travel, and for acquiring experience in new fields. Enquiries and application for interviews will be treated in strict confidence, and should be sent to:—

BRITISH RELAY TV

The General Manager,
British Relay
(Electronics) Limited,
41 Streatham High Road,
London SW16 1EP.
Tel. 01-677 9681.

4990

Northampton Borough Council

ENGINEERING DEPARTMENT

Area Traffic Control

A comprehensive Area Traffic Control scheme is being installed in the expanding town of Northampton and is due to be commissioned in Summer 1976. The system will comprise a dual computer system connected by data transmission links to on-street traffic signal; pelican crossing and flow detector equipment, together with closed circuit television for surveillance purposes. The following specialist post is to be filled on the Council's permanent establishment:—

Engineering Assistant

(Systems-Hardware)

£2922-£4095 p.a.

For the implementation of contracts for the provision of computer equipment, CCTV and traffic signals, the day-to-day running of the ATC system and design of hardware for future extensions to the system. Applicants should have a degree in electrical engineering or a directly relevant discipline and have at least one year's experience in an appropriate field.

The successful applicant will join an enthusiastic team who are at present working on all aspects of the installation and commissioning of the Area Traffic Control system and associated traffic signals; and must be prepared to assist in associated fields as the workload demands.

Starting salary will be commensurate with experience and qualifications. Assistance with housing and removal expenses, temporary lodging or travelling allowance in approved cases.

Further details and application forms from the Chief Executive (Personnel), Northampton Borough Council, 61 Derrigate, Northampton NN1 1UU. Telephone: Northampton (0604) 34881 ext. 583.

Closing date for applications: 31st October, 1975.

We know some of the best jobs in the £2000-£5000 p.a. bracket. But do we know about you?

Unless you fill in this coupon and post it off to us, there are hundreds of rewarding jobs you'll never get to hear about. You'll either miss them reading your paper or they just won't be advertised. And all you needed to do to be considered as a candidate was to have your name entered on our register. It costs you nothing but a 7p stamp and could make all the difference to your future. What are you waiting for?

lansdowne Appointments Register

Find out more by writing to Stuart Tait, Lansdowne Appointments Register, Design House, The Mall, London W5 5LS. Tel: 01-579 6585 (any time—24 hour answering service).

Please send me a full explanation of your free service.

Name _____

Address _____

WW 15/10

UNIVERSITY OF LONDON INSTITUTE OF
EDUCATION

ELECTRONICS

TECHNICIAN — GRADE 5

The Department of Child Development and Educational Psychology seeks a second technician to set up and run a modern electronics workshop in the Institute's new building; pleasant working conditions. Experience in maintaining psychological and/or physiological equipment and in general workshop practice desirable, together with some ability to advise on and construct special purpose equipment as needed. The appointment is to commence as soon as possible. Salary £2849-£3305, including London Allowance.

Further details and application forms from The Secretary, University of London Institute of Education, Malet Street, London WC1E 7HS, quoting ref. Tech/CDEP. Completed applications required by 30 October.

(4517)

Technical Officer

Telegraph Engineering

There is a vacancy in the Telegraph Services Department of British Airways for someone with extensive experience in modern telegraph engineering. The chief responsibility is with the development of new projects. Thus there is involvement at all stages from initial assessment of a user's technical requirements, through systems planning, development and progress chasing, up to acceptance testing and hand-over. Associated with this is the drawing-up of technical specifications, writing of documentation, and staff training where necessary.

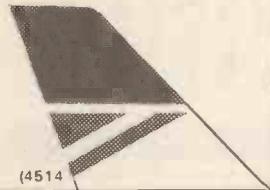
Useful experience would therefore include traffic evaluation, written specifications, instructions and reports, and the drawing of circuit diagrams. There is considerable liaison with both user and communications departments within British Airways, and certain organisations outside, which involves some travelling, normally within the United Kingdom.

Applicants should be qualified to City and Guilds Intermediate Certificate at least, or its equivalent in relevant subjects. They should be familiar with telegraph engineering practices, message-switching networks and line disciplines, with experience on modern mechanical/electronic telegraph and teleprinter equipment and semi-intelligent video terminals.

The post is based at Heathrow Airport and carries a starting salary of £3483 per annum including London Allowance. Other benefits include a contributory pension scheme, sports and social facilities and opportunities for concessional holiday air travel worldwide.

Please write or phone 897 5602 or 5329 for an application form, quoting reference 509/ /MA to: **Manager Selection Services, British Airways, PO Box 10, Heathrow Airport - London, Hounslow, Middlesex TW6 2JA.**

**British
airways**



(4514)

**UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG**
**BERNARD PRICE INSTITUTE OF
GEOPHYSICAL RESEARCH**

RESEARCH OFFICER (SEISMOLOGY)

Applications are invited for appointment to the above post for 3 years in the first instance.

Experienced science or engineering graduate is required for crustal structure investigations, based mainly on explosive energy sources including the initial planning, execution and analysis of data from refraction and reflection profiles. Results obtained may be used for a higher degree. Starting salary on the scale R6300 x 360 — R9180 according to qualifications and experience.

The University offers an annual vacation savings bonus, pension and medical aid facilities.

The policy of the University is not to discriminate in the appointment of staff or the selection of students on the grounds of sex, religion, race, colour or national origin. Applications giving full personal and career details, including the name and addresses of 3 persons who may be called upon to act as referees, should reach the Registrar, University of the Witwatersrand, Jan Smuts Avenue, Johannesburg, not later than 19th November, 1975.

University of Birmingham

ELECTRONICS TECHNICIAN

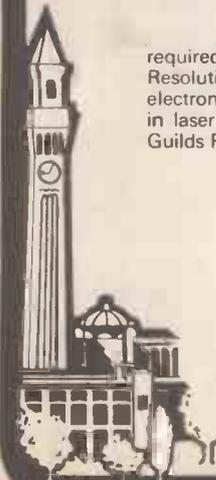
required for Department of Physics, to work with the High Resolution Spectroscopy Group, constructing and maintaining electronic instruments. The group is carrying out research work in laser spectroscopy and solar physics. O.N.C. or City and Guilds Final in electronics preferred with some experience.

Salary on scale £2013 to £2343 p.a.

Ref: 113/C/876

Apply

Assistant Secretary
Personnel Office
University of Birmingham
P.O. Box 363
Birmingham B15 2TT



4970

Telecommunications Technician

IBM Information Services Limited at Havant, Hampshire, is responsible for the installation and maintenance of the Company's internal telecommunications network. It provides international access to the USA, Europe and Middle East for a complex network of voice, telegraph and on-line data systems.

A vacancy exists for a Telecommunications Technician to work on the operational installation and maintenance of this network. The job is Havant based with occasional international travel when on-site support of our overseas installations is necessary. Applicants should have experience or knowledge of FDM, TDM or Datel techniques and of telegraphic and data transmission systems from 50 baud upwards. They should be educated to HNC, City and Guilds or equivalent standard and be prepared to work a rotating shift covering the hours between 7.00 a.m. and midnight. We offer good starting salaries plus a premium for working shifts, a comprehensive employee benefits scheme, generous assistance with removal expenses and an opportunity to live in one of the most pleasant parts of the south coast.

Please send details of age, experience and qualifications to Mrs. Jill Christison, Personnel Officer, IBM Information Services Limited, P.O. Box 11, Langstone Road, Havant, Hampshire PO9 1RQ.
Quoting Ref: WW/92485.

IBM

4997

Avery-Hardoll

Manufacturers of Meter Pumps for Petrol and Fuelling Equipment for Aircraft, require a

TECHNICAL SERVICE ENGINEER

to reside in South East of England (South of Thames and East of Bournemouth) the successful applicant, who has reached ONC in electrics or electronics and preferably has had experience in electro-mechanical servicing.

The duties are concerned with the commissioning, diagnosis of faults, and rectification of electronic equipment associated with liquid flow measuring devices, mainly on readout and control.

Permanent staff position with a Company car, four weeks' holiday after one year of service, contributory pension scheme, etc.

Please write with brief details of experience to date to:

Personnel Manager
Avery-Hardoll Ltd.
Downley Road
Havant,
Hants. PO9 2NW



A member of the Avery Group

4513

ELECTRONIC ENGINEERS

Design, R & D and Technical Authors permanent and contract. Always required.



Technical Reserves
362 Euston Road
London, NW1
Tel: 388 1609

(4518)

THE POLYTECHNIC OF CENTRAL LONDON
SCHOOL OF ENGINEERING AND SCIENCE
DIVISION OF ENGINEERING

TECHNICIAN

Grade 3

£2424-£2754

to join a small team investigating digital navigation receivers. The applicant should have some experience with digital integrated circuits for this expanding research programme. Apply to The Establishment Officer, PCL, 309 Regent Street, London W1R 8AL. 01-580 2020 Ext. 212.

(4972)

Technician

£2,737 - £3,382

The Independent Broadcasting Authority, which is responsible for independent television and independent local radio requires a technician who will operate and maintain a wide range of broadcast television equipment and arrange viewing sessions for internal departments. Other duties include driving, rigging and operating equipment aboard the mobile video tape recorder vehicle for lecture and exhibition support.

You should have some relevant experience and may currently be studying for a recognized electronics engineering qualification to ONC or HNC level. The post will provide an excellent opportunity to acquire knowledge of television and radio equipment in studio techniques.

Starting salary will be within the above range according to experience and qualifications.

The post is based at our modern offices in London - opposite Knightsbridge Underground Station but visits to the Authority's technical centre near Winchester and to Programme Company studio centres to assist in code of practice measurements will also be required.



INDEPENDENT
BROADCASTING
AUTHORITY

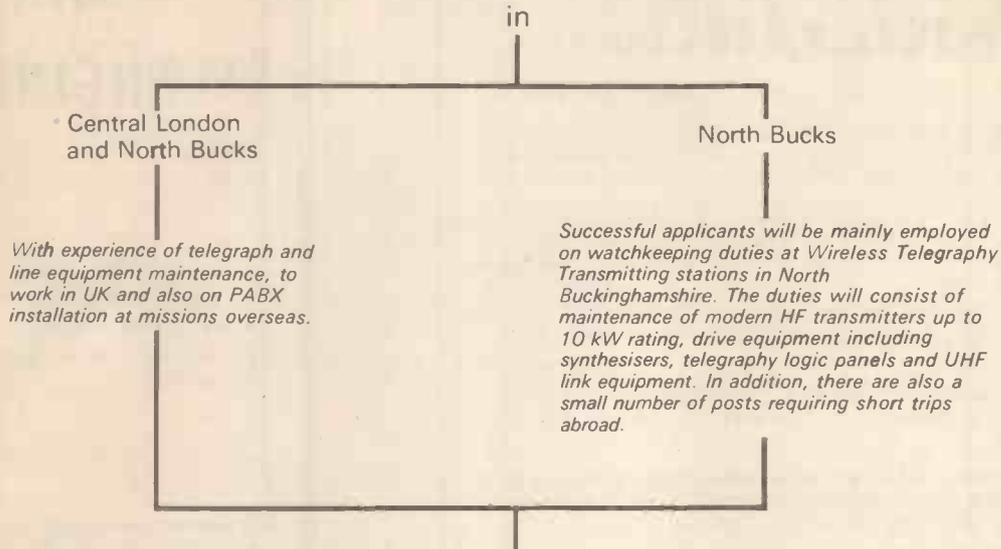
Please apply for an application form either by telephoning 01-584 7011 extension 390 or, if you prefer, by writing to:
The Establishments Officer,
Independent Broadcasting Authority,
70 Brompton Road, London, SW3 1EY.

4978

**FOREIGN AND COMMONWEALTH OFFICE
COMMUNICATIONS DIVISION**

has vacancies for

Communications Technicians



Minimum qualifications required: City and Guilds Intermediate Certificate in Telecommunications or its equivalent.

SALARY is according to age, e.g. £2450 per annum at age 21; £2675 at age 23; £2905 at age 25 (or over on entry), rising by annual increments to a maximum of £3385 per annum. The appointments attract 4 weeks' paid holiday and prospects of pensionable employment.

For further details and application form write to:

Recruitment Section, Foreign and Commonwealth Office, Hanslope Park, Hanslope, Milton Keynes MK19 7BH.

4973



**CAPITAL
APPOINTMENTS LTD**

FIELD SERVICE ENGINEERS (ELECTRONICS)

If you're not earning over £3,500 p.a. plus a car — then you had better contact us! 4507

34 Percy Street, London, W.1
01-636 9659 (day) or
550 0836 (evg.)

SERVICE ENGINEER

NUCLEAR AND CLINICAL

An additional engineer is required to join our present enthusiastic team in this expanding field. A thorough knowledge of digital electronics is essential and experience in the Nuclear counting field would be desirable. The successful applicant could expect not less than £3000 p.a. plus Company VOLVO car. 4 weeks' holiday profit sharing bonus scheme. Applicants must be resident within 20 miles Greater London or prepared to move.

Application forms from Service Manager.

L.K.B. Instruments Ltd.
232 Addington Road
Selsdon, South Croydon
Tel: 01-657 8822

(4984)

Opportunities for Electronics Engineers

To change to wider fields of electronics
— join the EMI Service Team at Hayes.

Vacancies exist on repair and calibration of a wide range of electronic test gear including oscilloscopes, DVMs, pulse generators, power supplies etc.

Also

Servicing and commissioning closed circuit television equipment including cameras, VTRs, Monitors etc.

Applicants should have at least 5 years practical experience.

These positions offer varied and interesting work. Attractive starting salaries, subsidised lunches, 4 weeks holiday and excellent sick pay and pension schemes.

For further details telephone or write to :- M. Ford, 01-573 3888, Ext. 2167, EMI Service, 254 Blyth Road, Hayes, Middlesex.



The international music, electronics and leisure Group.

(4926)

SENIOR TELEVISION TECHNICIAN

For Educational Television Unit at Guildford County College of Technology.

The Unit operates a well-equipped closed-circuit television studio and mobile system producing and distributing educational material for use within the College and elsewhere in the County.

To be responsible to the Senior Lecturer in Charge for the daily operation and maintenance of black and white television equipment, including cameras, monitors, vision and sound mixers, video tape recorders, etc.

Candidates should preferably have had practical experience with vidicon cameras and helical-scan recorders. An interest in photography is desirable, but not essential.

Salary £2307-£2709 or £2709-£3033 (inclusive) depending on qualifications and experience plus a qualification allowance where appropriate.

Application form and further particulars obtaining on receipt of S.A.E. from the Vice Principal, Guildford County College of Technology, Stoke Park, Guildford, Surrey.



SURREY
COUNTY COUNCIL

(4509)

PAE PARK AIR ELECTRONICS

RF DESIGN ENGINEER

Our planned Company expansion has created an opportunity to join our team engaged on the design of VHF Transmitters and Receivers for use in the Airports of the World.

The man we are looking for must be keen to work as a member of this specialist team and be prepared to take the responsibility of working on the project as a whole. He will be formally qualified and will have had really relevant experience in our field. Reporting to the Development Manager he will be keen to progress his career in the expansion phase the Company is entering at the moment.

Salary will be in line with the job responsibility. There is an excellent contributory pension scheme, World Wide Air Fare rebates for holiday travel, and relocation assistance will be given.

If you would like to work for a small company which offers career prospects and big company benefits in this pleasant rural area, please contact Clive Picking at:

PAE PARK AIR ELECTRONICS LIMITED

Ryhall Road, Stamford, Lincolnshire, England
Telephone: Stamford 2187
Member of the International Aeradio Group

PAE

4975

Well-organised German enterprise working on the sector of loudspeaker chassis and accessories is looking for an

ACTIVE REPRESENTATIVE

with good contacts to manufacturers and relevant quarters of special commerce.

We supply loudspeaker chassis for all applications such as Hi-Fi, Ela, bass guitars, autocars, frequency converters; also fabrics for loudspeakers.

Please contact us quoting Box No. WW 4915.



Opportunities in the ELECTRONICS FIELD

Men with analogue or digital qualifications / experience seeking higher paid posts in: TEST - SERVICE - DESIGN - SALES.

Phone: Mike Gernat, Ref. W.W.

NEWMAN APPOINTMENTS
360 Oxford Street, W.1,
01-629 0501 (94)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

BERNARD PRICE INSTITUTE OF GEOPHYSICAL RESEARCH

ELECTRONICS ENGINEER OR TECHNICIAN SEISMOLOGY

The successful applicant will be expected to maintain and take responsibility for the Institute's sophisticated system for replay and digitising of seismic tapes. Furthermore he will be responsible for the mobile seismic replay laboratory during field programmes. Salary scale will be R6300 x360 - R8100.

The University offers an annual vacation savings bonus, pension and medical aid facilities.

The policy of the university is not to discriminate in the appointment of staff or the selection of students on the grounds of sex, religion, race, colour or national origin. Applications giving full personal and career details, including the name and addresses of 3 persons who may be called upon to act as referees, should reach the Registrar, University of the Witwatersrand, Jan Smuts Avenue, Johannesburg, not later than 19th November, 1975.

4987

ELECTRONIC & MECHANICAL TECHNICIANS

**(PERMANENT
NIGHT WORK)**

Phonodisc Limited, part of the International Polygram Group of Companies, manufactures and distributes records and pre-recorded tapes for the Marketing Companies whose labels include Philips, Polydor, DGG, Contour and many others.

We are in urgent need of an **ELECTRONIC TECHNICIAN** to join a busy team of technicians engaged in the servicing of professional high speed tape duplicating, disc cutting and ancillary equipment, incorporating NOBIT and TTL logic.

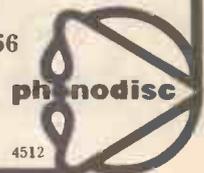
A City and Guilds qualification (or equivalent) is desirable and experience in the Hi-Fi field meeting industrial professional standards is an advantage.

We also need a **MECHANICAL TECHNICIAN** who has served a five year apprenticeship as an instrument maker and has five years' experience servicing and maintaining complex light production machinery. Preference will be given to technicians with some electrical knowledge and experience with electro-mechanical devices.

The wage for both positions is £82.76 per five night week with the prospect of extra after a satisfactory probationary period. Benefits of service include an annual bonus, staff discount shop, 4 weeks holiday, subsidised canteen, a sick pay and pension scheme.

For further details and an immediate interview please write or telephone:

Peter Garfield, Record Works, Phonodisc Limited
Walthamstow Avenue, London, E.4. Tel: 01-527 2256



4512

OPENINGS IN

ELECTRONICS TO £5000

Experienced Personnel urgently required for a variety of current vacancies, ring now for confidential free service.

TUDOR APPOINTMENTS

11 Muswell Hill
London N10 3TH
Tel: 01-444 9121

4501

SUNDERLAND POLYTECHNIC FACULTY OF ENGINEERING

RESEARCH ASSOCIATE

(Salary scale: £2,591 x £126 (2) —
£2,843)

Applicants should be good honours graduates in Electrical Engineering Computer Systems or an allied field. The research, which is in the area of image analysis by mini-computer, is jointly sponsored by the Polytechnic and Joyce Loebel Ltd.

The appointment is for three years, subject to satisfactory progress, and candidates will be expected to register for a higher degree. A range of computers will be available for the project.

An application form may be obtained from the Personnel Officer, Sunderland Polytechnic, Chester Road, Sunderland SR1 3SD, and should be returned as soon as possible.

4994

TELECOMMUNICATIONS ENGINEERS

**Going to the Middle East
with IAL/Lockheed makes a
lot of sense right now**

Here's why. £6,500 p.a., free of local tax for a start. £2,000 bonus at the end of your 2½ year contract is another happy thought. Free accommodation, free life & medical insurance and generous home leave make the actual take-home pay a very warming prospect. Especially with things as they are at home.

One of our contracts in the Middle East needs degree, or equivalent, standard engineers with relevant experience in telecommunications. They will analyse the various performance characteristics of both radio and wire

communications equipment and systems, and submit reports and recommendations. Equipment training will be given where necessary.

Apart from the money it's invaluable experience in a tough environment which will say a lot in your favour when you get back.

If you'd like to make a profitable decision about the next 2½ years, please contact John Davies now at

International Aeradio
Limited, Aeradio House,
Hayes Road, Southall,
Middlesex.
Tel No:
01-571 1808.



4971

APPOINTMENTS

TECHNICAL WRITER

If you are an electronic engineer or technician with an interest in writing on electronics, you may be the man we are looking for to join the editorial team of *Wireless World*. We have a vacancy for someone with an industrial background and practical experience of amateur radio communication. A wide interest in radio and electronics is essential, as is the ability to write good English quickly. Preferred age is around 25.

Please write briefly in first instance to:

wireless world

The Editor
Wireless World
Dorset House
Stamford Street
London SE1 9LU

(4922)

ARTICLES FOR SALE

Economise on Semiconductors

All prices include VAT

- ★ Low Price CMOS
- ★ Low price DIL sockets
- ★ Lower Price 741C
- ★ Plastic 3 terminal Regulators

	1+	10+	25+		1+	25+		1+	25+
709C + data 8 pin DIL	38	36	34	7400	14	12	4000	18	17
723C + data 14 pin DIL	70	68	64	7402	14	12	4001	18	17
741C + data 8 pin DIL	26	25	24	7403	14	12	4002	18	17
748C + data 8 pin DIL	39	37	35	7404	16	13	4006	102	95
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							4028	78	71
							4030	50	43
							4040	93	84
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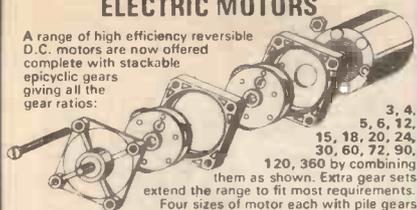
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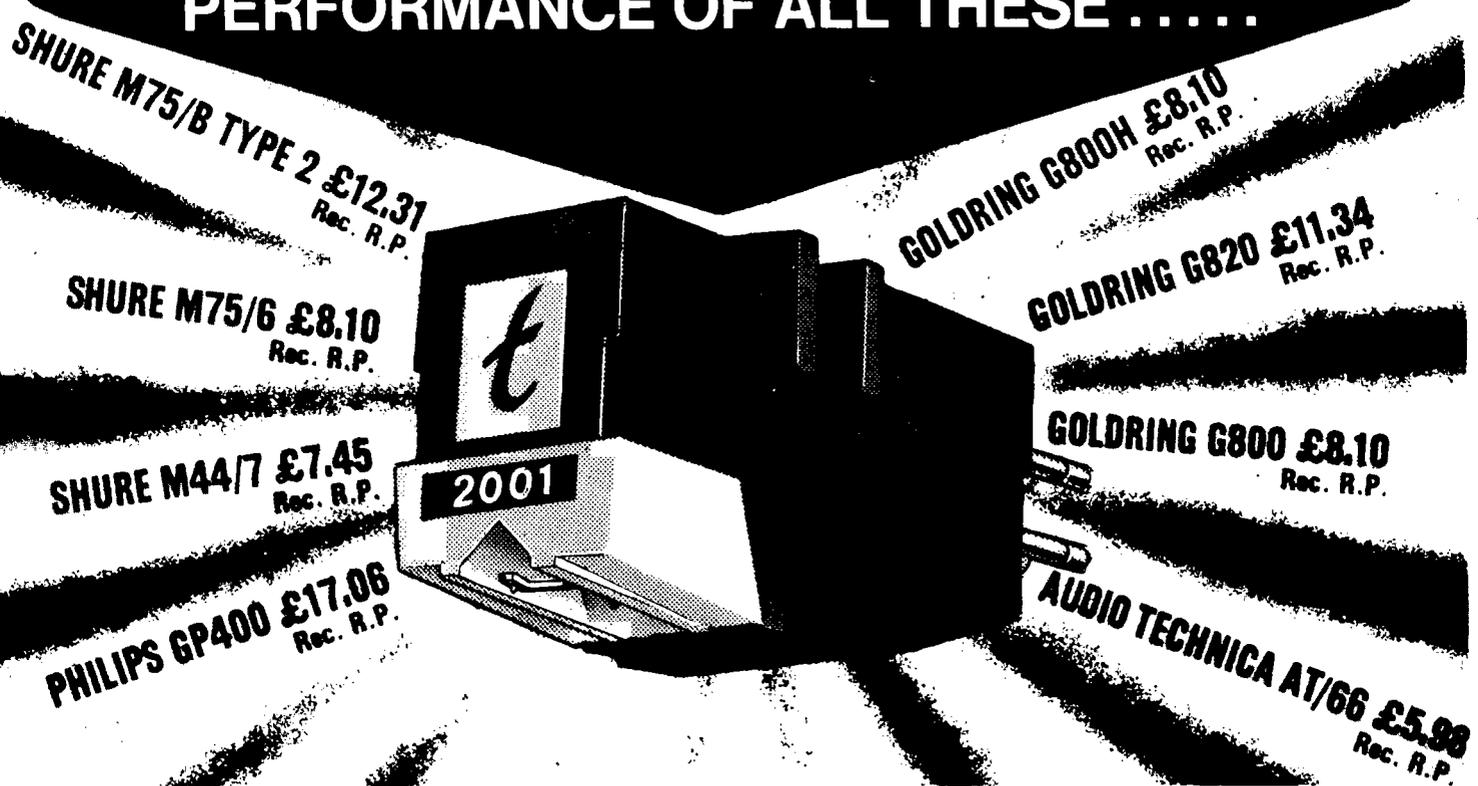
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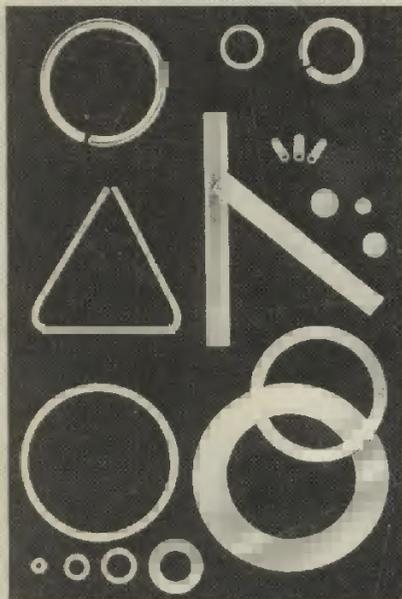
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