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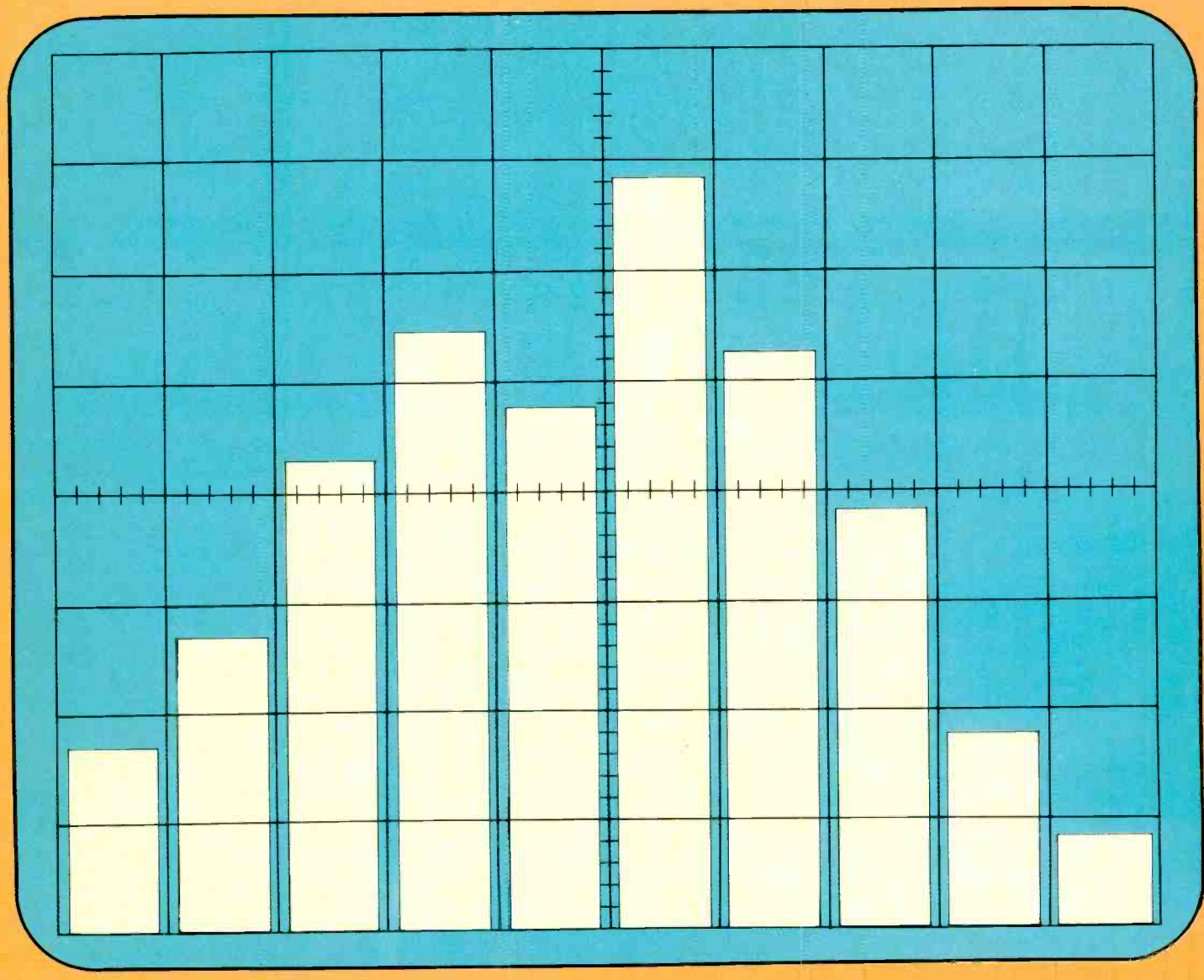
JUNE 1978



Real-Time Audio Analyser

Review of the Fluke 8020A Digital Multimeter

Catalogue Survey

Projects

Ultrasonic Switch

Phone Bell Extender

DIODES/ZENERS

1N914	100v	10mA	.05
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
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1N5244B	14v	z	.25
1N5245B	15v	z	.25

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4015	.90
4016	.35
4017	1.10
4018	1.10
4019	.50
4020	.85
4021	1.00
4022	.85
4023	.25
4024	.75
4025	.30
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.50
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	.95
4044	.95
4046	1.75
4049	.45
4050	.45
4066	.95
4069	.40
4071	.35
4081	.70
4082	.45
MC 14409	14.50
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7400	.15	7473	.25	74176	1.25	74H72	.45
7401	.15	7474	.30	74180	.75	74H101	.75
7402	.20	7475	.35	74181	2.25	74H103	.75
7403	.20	7476	.40	74182	.95	74H106	.95
7404	.15	7480	.55	74190	1.75		
7405	.25	7481	.75	74191	1.05	74L00	.25
7406	.35	7483	.95	74192	.75	74L02	.25
7407	.55	7485	.75	74193	.85	74L03	.30
7408	.25	7486	.25	74194	1.25	74L04	.30
7409	.15	7489	1.35	74195	.95	74L10	.30
7410	.10	7490	.55	74196	1.25	74L20	.35
7411	.25	7491	.95	74197	1.25	74L30	.45
7412	.30	7492	.95	74198	2.35	74L47	1.95
7413	.35	7493	.35	74221	1.00	74L51	.45
7414	1.10	7494	.75	74367	.85	74L55	.65
7416	.25	7495	.60			74L72	.45
7417	.40	7496	.80	75108A	.35	74L73	.40
7420	.15	74100	1.15	75110	.35	74L74	.45
7426	.30	74107	.35	75491	.50	74L75	.55
7427	.45	74121	.35	75492	.50	74L93	.55
7430	.15	74122	.55			74L123	.85
7432	.30	74123	.55	74H00	.15		
7437	.30	74125	.45	74H01	.25	74S00	.35
7438	.35	74126	.35	74H04	.20	74S02	.35
7440	.25	74132	1.35	74H05	.20	74S03	.30
7441	1.15	74141	.90	74H08	.35	74S04	.30
7442	.45	74150	.85	74H10	.35	74S05	.35
7443	.65	74151	.65	74H11	.35	74S08	.35
7444	.45	74153	.75	74H15	.45	74S10	.35
7445	.65	74154	.95	74H20	.30	74S11	.35
7446	.95	74156	.95	74H21	.25	74S20	.35
7447	.95	74157	.65	74H22	.40	74S40	.20
7448	.65	74161	.85	74H30	.20	74S50	.20
7450	.25	74163	.85	74H40	.25	74S51	.25
7451	.25	74164	.60	74H50	.25	74S64	.20
7453	.20	74165	1.50	74H51	.25	74S74	.35
7454	.25	74166	1.35	74H52	.15	74S112	.60
7460	.40	74175	.80	74H53J	.25	74S114	.65
7470	.45			74H55	.20		
7472	.40						

74S133	.40
74S140	.55
74S151	.30
74S153	.35
74S157	.75
74S158	.30
74S194	1.05
74S257 (8123)	1.05
74LS00	.25
74LS01	.35
74LS02	.35
74LS04	.30
74LS05	.45
74LS08	.25
74LS09	.35
74LS10	.35
74LS11	.35
74LS20	.25
74LS21	.25
74LS22	.25
74LS32	.40
74LS37	.35
74LS40	.45
74LS42	1.10
74LS51	.50
74LS74	.65
74LS86	.65
74LS90	.95
74LS93	.95
74LS107	.85
74LS123	1.00
74LS151	.95
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74LS157	.85
74LS164	1.90
74LS367	.75
74LS368	.75
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LM320T12	1.65
LM320T15	1.65
LM324N	.95
LM339	.95
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LM340T15	1.00
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LM340K15	1.25
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78L12	.75
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CANADA'S ELECTRONICS MAGAZINE

PROJECTS

FEATURES

NEWS & INFORMATION

NEWS DIGEST

Portable CB Analyzer

Sencore has begun the marketing of a new portable CB analyzer.

The CB49 weighs 10 pounds, and operates from batteries or AC. The tester is completely automatic, with all tests shown as good or bad on an analogue meter. This feature enables non-technical dealers to check out CB radios to be sure they are defective before sending them to a service center.

Every test is completely automatic: SWR, RF watts, percent modulation, distortion, or percent off channel, for the transmitter section. The receiver is checked in the same automatic way. The CB49 is the first CB analyzer to make the receiver sensitivity checks automatically, as an internal device samples and compares signal to noise ratio and does the calculations.

The CB49 is equipped with the standard 8 ohm loudspeakers load, plus a special 3.2 ohm load for in-dash checks of the new radios that Motorola is gearing up to build for Ford this year. A DC voltage jack is provided to test the battery voltage in the automobile dash built-in relative field strength meter checks that the CB is working correctly and that the antenna has been installed properly.

The US price is $695. Canadian representatives are Superior Electronics Inc., 1330 Trans Canada Highway South, Montreal, Quebec H9P 1H8.

EICO Move

EICO (Canada) Limited have moved to PO Box 268, Richmond Hill, Ontario, L4C 4Y6. (Phone 883-9900.)

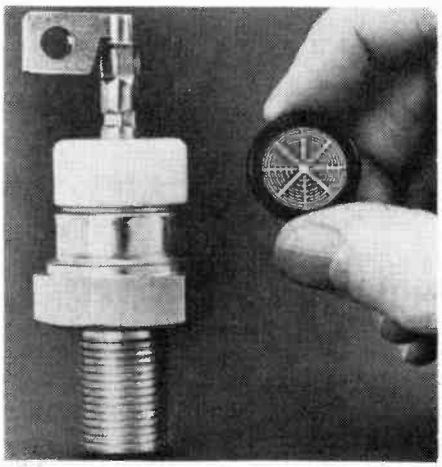
ACA Catalogue

The 16-page ACA Electronic Centres catalogue came into the office recently. Contents are: digital multimeters, voltmeter accessories, digital thermometers, power supplies, oscilloscopes, counters, generators, and two pages of demos and specials. Available free from your ACA Electronics Centre — in Vancouver, Calgary, Montreal or Toronto.

Rub-Down Resist

Ceres Electronics of Toronto announce a new material which should come as a godsend to everyone interested in making PCBs. Known as 'Ceresist', the product consists of 'rub down' dry transfers in typical PC patterns. (eg, IC pads, transistor pads, lines, etc.) These can be easily applied to PCBs, which are then ready for etching since the material has excellent resist properties. Ceresist can also be applied to paper for artwork masters that can be photographed for both photo-etch and silk screen processes — in fact, the material takes well on almost any surface, including clear film. Easy to apply, the product gives highly professional-looking results, is erasible, and costs less than many comparable products. Ceresist is stocked by Dominion Radio in Toronto and is also available by mail from Ceres (see ad in this issue), who will be glad to send further information.

Ceres, 53 Burnett Ave., Willowdale, Ontario M2N 1U2.



Largest Transistor

A new high-current, high-voltage and fast-switching power transistor, with turn-on and turn-off times less than 0.5 us, is available from the Westinghouse Semiconductor Division. This large switching transistor, is particularly applicable to high frequency inverters, switching power supplies, power amplifiers, induction motor control, and chopper controls for vehicle drives.

Rated at 200 amps peak current, 450-550 volts, the D60T transistor has a gain of 10 at 50 amps. Its high power dissipation and low saturation voltage enables it to switch high-power loads at high frequencies. Fast switching speed allows reduced size of magnetic components and more efficient energy use.

The transistor's simple turn-off eliminates the complicated commutating circuitry required with SCRs. An extensive safe operating area is provided for high-energy switching circuits.

For more information about the new D60T high-speed switching power transistor write to Semiconductor Division, Westinghouse Canada Limited, PO Box 510, Hamilton, Ont. L8N 3K2 or call (416) 528-8811.

NEWS DIGEST

Ford of Canada will introduce next fall two factory-installed options designed to improve the quality of their car stereos — a fully electronic radio and a high fidelity sound system.

The radio is combined with a quadrasonic 8-track tape player, and uses electronic memory for storage of favourite station frequencies. Touchbuttons are used to recall the frequencies, which are displayed digitally.

Production of the new radio at the Don Mills, Ont., plant of Philco-Ford of Canada has resulted in a $6 million expansion program and the creation of 300 new jobs. In contrast to the current top-of-the-line AM/FM stereo radio with quad tape (top), the new radio eliminates the slide-rule dial and projecting knobs and buttons.

The 300 new jobs bring employment in Ford operations in Canada to more than 20,800 — up 2,100 in the past 12 months and the highest level since Ford was established in Canada in 1904.

Digital S. Meter

The 'Signal-Hunter' digital S-meter has a three-digit LED display which reads to a tenth of an S unit. Signals over S9 are displayed directly in dB. The unit also works in the transmit mode to display relative power.

The photo-drawing illustrates two features not mentioned in the text of the Press Release we received: the display works with the unit switched off and there's an LED display with a special segment for the downstroke of "7". For more information contact: DIGI-COMM, Suite 110, 720 Ste-Catherine St. West, Montreal, PQ H3B 1B9. (514) 871-9433.

50 MHz Pulse Generator

A new 50 MHz pulse generator, the Wavetek 802, is now available in Canada from Allan Crawford Associates Ltd.

This new generator features variable pulse width and delay over the 5 Hz to 50 MHz operating range. Continuous, triggered, gated and external width operation are selectable with single, double or complement pulse outputs.

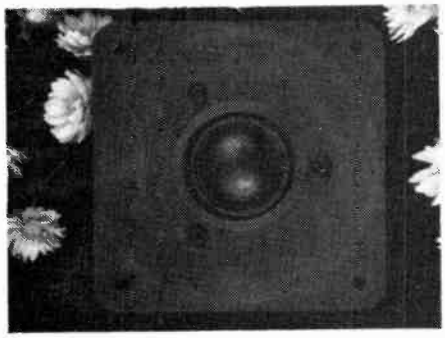
Four simultaneously available outputs further enhance the utility of the generator: the +/- 10 volt variable output, a fixed TTL output, a fixed TTL complement output and a TTL compatible sync output. The variable amplitude output features independantly adjustable upper and lower pulse voltage levels.

For optimum loading, internal 50 ohm termination at the source, at the load, or both, gives additional versatility in minimizing signal reflections.

For more information contact Allan Crawford Associates Ltd., 6503 Northam Drive, Mississauga, Ontario L4V 1J2 (416) 678-1500.

Dome Tweeter

The Electron Devices Division of Philips has just added the AD01600T8 tweeter to their DeForest Loudspeaker series for the home constructor of high quality enclosures.



This new square-frame model features a forward mounted textile — material dome radiator. Initially available in 8 ohm version, 4 ohm and 15 ohm versions will follow shortly. The tweeters meet DIN 45500 (specification for low distortion), feature very wide dispersion pattern and are ideal for use singly or in multiple arrays. The power rating is 40 watts RMS (system) per tweeter when crossed-over at 4 kHz or above.

The response extends to over 22 kHz and the (maximum) suggested resale price is $27.50 each.

This 320 pound RCA vacuum switch tube is the world's most powerful of its kind and will be used in tests to prove feasibility of making electricity from nuclear fusion. The tube handles 25 million watts. Twelve similar tubes will be used in a nuclear fusion reactor being constructed at the Plasma Physics Laboratory of Princeton University.

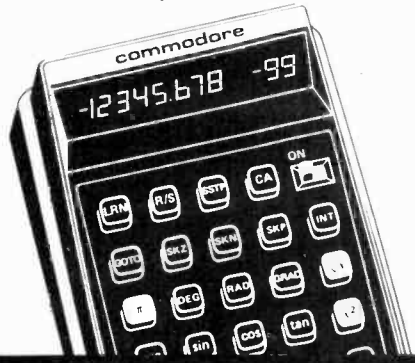
PETs Are Here (At last)

While CSA approval is still pending on Commodore PETs, Rick Denda of Marketron is importing them directly from the States and having them approved by Ontario Hydro. As far as we know these are the first PETs to be actually *sold* in Canada.

New Calcs From Commodore

The P50 is a new single-chip programmable from Commodore due to be delivered mid-May. For $32.95 you get 24 steps, allowing conditional branching, skip, and single-step operation. The usual scientific functions and memory are available. The display can show an 8-digit mantissa and the obvious 2-digit exponent. Power is from a common 9V battery.

Also new is Commodore's SR4912 scientific calculator for $22.95. Fifty key functions, including memory, and an 8+2 ('12' character) display. Power is from a 9V battery.



NEWS DIGEST

New Hammond Power Supplies

A wide range of open frame series regulated power supplies are now available off the shelf from the Hammond Manufacturing Company through leading Hammond distributors. The array of single output ranges from 5 to 250 V DC with currents ranging from 100 mA to 30 amps. There are dual, triple and quadruple output supplies for digital and microprocessor applications. Characteristic regulation is +0.05% line and +0.1% load.

Hammond extend a full two year warranty. Hammond Manufacturing Company Limited, 394 Edinburgh Road North, Guelph, Ontario N1H 1E5 (519) 822-2960.

TV Production Workshops and Colour TV Courses

Sony Of Canada Ltd. will sponsor an "Advanced Television Production Workshop" in the following locations during 1978: Montreal, May 8-12 and November 27-December 1; Vancouver, June 12-16; Edmonton, October 16-20; Toronto September 18-22.

Sony will also sponsor a "Basic Colour Television System" course as follows: Toronto, June 6-8 and October 3-5; Vancouver, September 12-14; Montreal, December 13-15.

Biomed Course

Fanshawe College, through its Faculty of Technology offers a two year post-graduate Biomedical Electronics program for electronics technicians. Entrance requirements are graduation from an electronics engineering technician program from a community college or equivalent.

The 52 week co-operative program is designed for the graduate Electronics Technician who wishes to prepare himself for a career in a health care environment. A technical report on the work experience is required for graduation. Fanshawe College, P.O. Box 4005, Terminal C, London, Ontario N5W 5H1 Telephone (519) 452-4191.

microfile

Two-Sided Floppies

Micropolis Corporation has extended the capacity of its 5¼-inch floppy disk subsystems with the first double-sided models with formatted file storage of up to near million bytes.

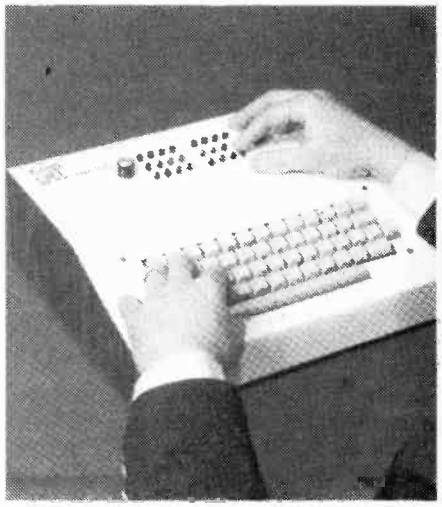
Micropolis Corporation, 7959 Deering Avenue, Canoga Park, California 91304 (213) 703-1121.

RCA SOS 8085

RCA Corporation and Intel Corporation have signed an agreement whereby RCA will design high-density SOS (silicon-on-sapphire) versions of the Intel 8085 and 8048 microprocessors. Conversely, Intel will receive information which will allow it to manufacture CMOS SOS versions of these components.

CREI Micro Programme

Programme P680 is a new CREI course teaching minicomputer and microprocessor technology. The fifty assignments include four lab units and the student develops his own 6802-based microcomputer (but no video interface included), and gets a free TI-30 calculator. The course costs $1600. More details from McGraw-Hill Continuing Education Centre, 330 Progress Avenue, Scarborough, Ontario, M1P 2Z5. Phone (416) 293-1911.



EXORciser II

The capabilities needed to design and develop high performance microcomputer systems based on Motorola's M68BXX series of 2 MHz chips are now offered in the EXORciser II, an extended version of the widely-used EXORciser Development System. EXORciser II also directly supports designs based on the M68AXX (1.5 MHz) and M6800 (1.0 MHz) series. Optional modules are also available to configure EXORciser II for development of systems based on all other microprocessor and microprogrammable families offered by Motorola. These include the MC3870 Microcontroller, the MC141000 Microcomputer, and the MC2900 (TTL) and MC10800 (MECL) 4-bit slices.

EXORciser II features what Motorola call Dual Memory Map Mode which lowers development time and cost by allowing full use of the complete microprocessor addressing map, regardless of the addressing requirements of the EXORciser II and its system peripherals. With the dual mode feature, a more complete emulation and debugging of the user's system can be achieved since memory in the user's 65 kbyte map need not be allocated to the new EXbug program which can now reside in its own 65 kbyte map. If desired, EXbug 2 may reside in the user's memory map as before.

EXORciser II is available now from Motorola sales offices and authorized distributors. Part numbers for the four configurations of EXORciser II are given below, and US prices: M68SDT1-2S"X", EXORciser II with 32K Static RAM, 110V, $7850. M68SDT2-2S"X", EXORciser II with 32K Static RAM, 220V, $7900. M68SDT1-2D"X", EXORciser II with 32 Dynamic RAM, 110V, $7250. M68SDT2-2D"X", EXORciser II with 32 Dynamic RAM, 220V, $7300. ("X" = A, B, or M for cassette, tape, or MDOS version of Assembler/Editor program)

NEWS DIGEST

Four-disk system from Processor Technology

An integrated small computer system with four full-size floppy disks on-line has been introduced by Processor Technology Corporation. The new system, Sol System IV, includes the company's Sol-20 mainframe with 50, 176 8-bit words of RAM memory, a Helios II Model 4 Disk Memory System, PTDOS Disk Operating System, Extended Disk BASIC, a video monitor and complete documentation. Total mass storage capability on four formatted disks is 1.5 million bytes.

The PTDOS Disk Operating System offers advanced functions including complex editors, assembler, device-independent files, and random indexed files. Extended Disk BASIC was designed to obtain maximum performance from Sol/Helios hardware. The video display can be addressed randomly to any position on the screen so one can easily write powerful forms control procedures. Extended BASIC includes string and advanced file functions, timed input, complete matrix algebra, base 10 and natural logarithms, trigonometric functions, exponential numbers and 8-digit precision.

In addition to Extended BASIC, Processor Technology offers disk fortran and disk pilot languages as low cost options.

Suggested US price for Sol System IV fully assembled and factory tested is $7995. Delivery from Sol computer dealers throughout the United States, Canada and internationally is stock to 90 days.

For complete information, please address Processor Technology Corporation, 7100 Johnson Industrial Drive, Pleasanton, CA 94566.

Micros for Scientists and Engineers

There still might be time to register for the American Institute of Professional Education's 'Microprocessing Fundamentals' courses in five Canadian cities this May and June. AIPE is a non-profit organization, but the course still costs $695. You get a KIM-1 and manual — to keep. Dates: Calgary, 23-25 May; Ottawa, 31 May-2 June; Edmonton, 6-8 June; Montreal, 13-15 June; Toronto, 20-22 June. More details: The American Institute for Professional Education, Brentwood Management Ltd., 212 Queen St., East Brampton, Ontario. Or phone 201-377-7400.

Catalogue From E&L

A sixteen page microcomputer products catalogue containing complete descriptions and detailed specifications of the MMD-1 Mini-Micro Designer and many other microcomputer products is available free from E&L Instruments, Inc. The 8080A based MMD-1, available in kit or fully assembled form, is part of an integrated educational and development system that includes the famous Bugbooks, and many other useful accessories.

E&L microcomputer products include many practical accessories for users of S-100 compatible systems. E&L Instruments, Inc., 61 First St., Derby, CT 06418 USA.

Logic Analyzer Literature

The employment of general purpose logic analyzers to solve microprocessor problems is the topic of a new application note from the Biomation division of Gould, Inc. The brochure presents a practical approach to troubleshooting microprocessor-based systems utilizing the company's 1650-D logic analyzer, 116 display control accessory and two 10-TC probe pods. The application note uses detailed diagrams and scope CRT photos to help the reader easily step through the program execution. To get your copy of this application note, contact Bob Lorentzen, Applications Engineer, Digital Instruments, Gould-Biomation, 4660 Old Ironsides Drive, Santa Clara, CA 95050.

Audio Today

Developments in audio reviewed by Wally Parsons

SHURE BROS. has recently launched an advertising campaign which emphasises the point (if you'll forgive the pun) that there is a lot more to a good pickup than the stylus and its shape and other characteristics. This is one of those obvious things which most of us take for granted. After all, we no longer use thorn needles held in place by a set screw. However, it is only natural that a manufacturer should lay emphasis on some particular aspect of design which distinguishes a new product from others, and at the present time this happens to be stylus shape.

But it is equally true to say that there is more to a pickup than the pickup; there is its termination, which is also the interface with a pre-amplifier. All too often the only aspect of pickup termination considered is the load resistance. Since this has been essentially standardized for stereo pickups at 47k, it is no longer something with which we need concern ourselves. Figure 1 shows the equivalent circuit of a magnetic pickup including its load and the preamp. Coil inductance L and load capacitance (including cable, preamp and strays) constitute a resonant circuit whose circuit is controlled by the internal resistance Rs and load resistance R_L (including preamp input resistance).

COMPLIMENTARY CHARACTERISTICS

All too often it's assumed that the recommended load capacitance for a pickup is a maximum figure, and it doesn't matter what actual value is used as long as it does not exceed this figure, and that too much capacitance will reduce high frequency response. Nothing could be further from the truth.

The moving system of any pickup has a natural resonant period which results from the effective mass of the moving system referred to the tip, and the compliance of its suspension. This produces a resonant peak which may be damped to a greater or lesser degree. This results in a particular response curve due to the mechanical system. In order to achieve a flat response to a constant velocity, the electrical circuit must have a response which is complementary, and this response is shaped by the circuit elements shown in Fig. 1. In order to achieve specified performance then, we *must* provide the specified loading conditions.

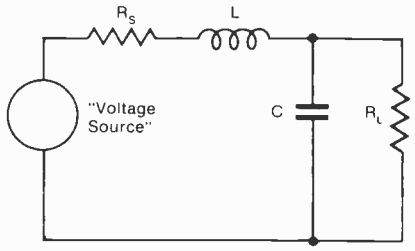
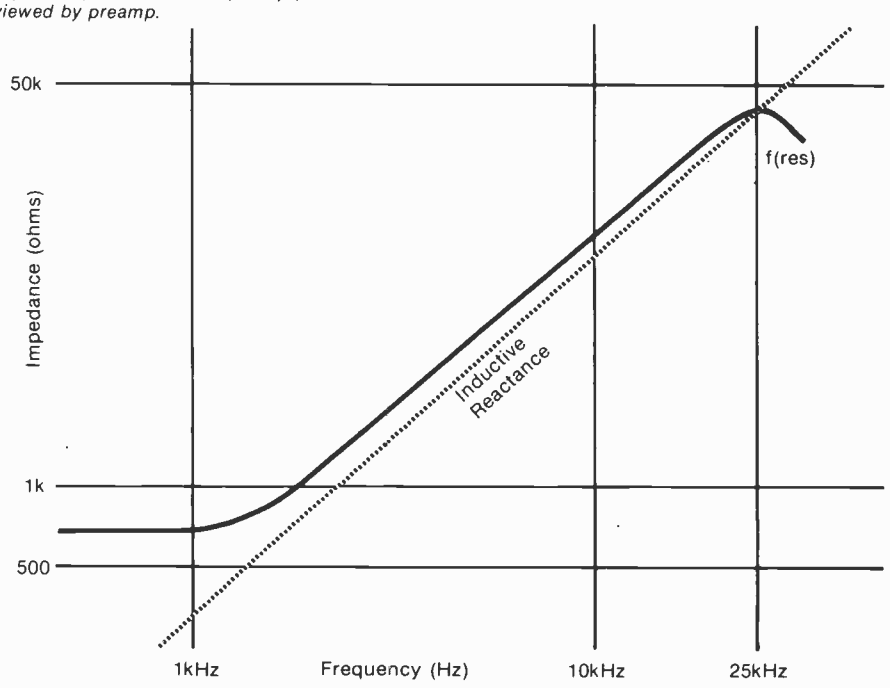


Fig. 1. Equivalent circuit of a magnetic pick up including load and preamp.

Fig. 2. Impedance vs. frequency plot of source viewed by preamp.



NOTHING IS EVER SIMPLE

Since R_L includes the preamp's input resistance, including it in the calculations of fixed resistance is simple, provided either that R_{in} is very high, or is a constant value. But this is seldom the case, especially when feedback is applied to the input stage, and is further complicated when equalization is incorporated in the feedback loop. Feedback alters the amplifier input impedance, and a feedback equalizer introduces a feedback factor which is frequency dependent, therefore, the input impedance is frequency dependent. It is important therefore that the preamp be designed in such a way as to ensure that its input impedance makes a negligible contribution to the pickup load. With commercially built equipment we rarely have any control over these characteristics, and in any case manufacturers seldom supply such information.

Is it any wonder then that a pickup may deliver outstanding performance with one preamp and prove quite disappointing with another of similar, or even better quality. It's worth noting that moving coil pickups when matched to a pre-preamp are less subject to these conditions, and the pre-preamp's output being resistive is affected less by the preamp-equalizer's input characteristics, as compared to other magnetic types, and this may be a major factor in the audibly superior quality of such units. It also goes a long way toward explaining the fact that many radio stations achieve excellent sound considering that pickups used are chosen with ruggedness in mind and frequently will deliver unacceptable performance in a home system.

LOOKING FROM THE OTHER DIRECTION

The circuit shown in Fig. 1 provides the source impedance for the preamp, and this impedance may look something like Fig. 2. This is quite a bit different from the simple resistance often assumed when designing a preamp. Since most preamps in use today use series summing (a later article will cover this subject) the feedback factor is modified by this impedance characteristic, and equalization accuracy is impaired. In addition, a complex and often unpredictable phase characteristic is introduced to affect the stability margin.

One solution is to use a differential input, but this is a noisier configuration. However, since the final noise figure is influenced by the source impedance this may not always be a problem. In other words, the noise figure which results from the variable source impedance may be sufficiently higher than the theoretical minimum that in reality we end up with the same noise figure no matter which circuit is used.

Another solution for use with preamps which already exist is the addition of series resistance to the input (Figure 3a). although one would at first expect this to increase noise level, the more nearly constant source impedance allows input stage current to be optimized for the series resistance itself, with the additional benefit of allowing a better match to a wider variety of pickups. It can also be helpful in reducing rf pick-up, especially if circuit layout permits insertion directly at the base lead of the input stage. It also means that pickup load capacitance can be provided exclusively by the connecting cables and fixed capacitors. A suitable value for this resistance would be around 15k for most pickups, and should, if possible, be connected after the 47k load resistor, otherwise an additional load of 200k will be required, as in Fig. 3c.

If a pickup-preamp combination does not perform as well as the quality of each component suggests it should, there is a good chance of the kind of hidden mismatch which many people seem to think is mysterious. It isn't really, it's just a matter of looking at all the facts, and considering the interaction of all circuit elements.

Fig. 3a. Prefered method of "swamping" cartridge inductance by adding series resistance Rs.

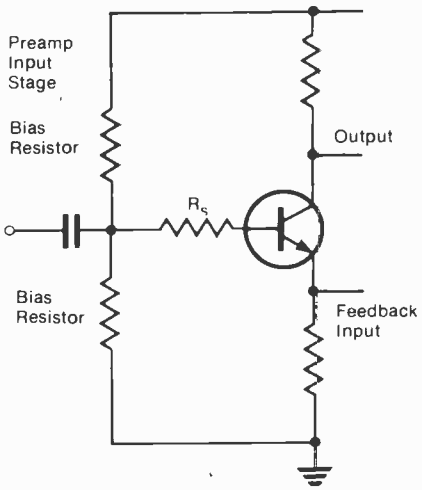
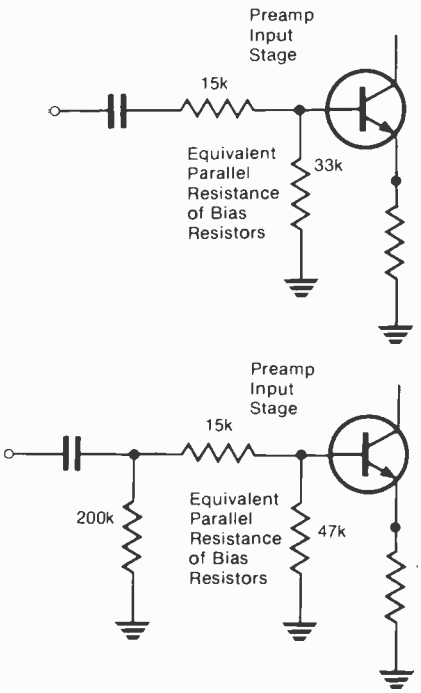


Fig. 3b,c. Two alternative modifications to existing preamp input stages depending on bias resistor arrangement.



Audio Today

CONNOISSEUR BD103/A

This is probably the lowest priced D.C. Servo Motor turntable on the market. Belt driven, and with 3 speeds and arm and Auto lift off, it comes complete with cover and base at $299.50. Without the arm it's designated as the BD103 at $239.50.

Connoisseur has been known since the year one for excellent performance at a low price, and although not designed to take abuse, their products have generally been very reliable. They also make what to my knowledge is the only turntable in kit form, the **Model BD-1,** at $69.50.

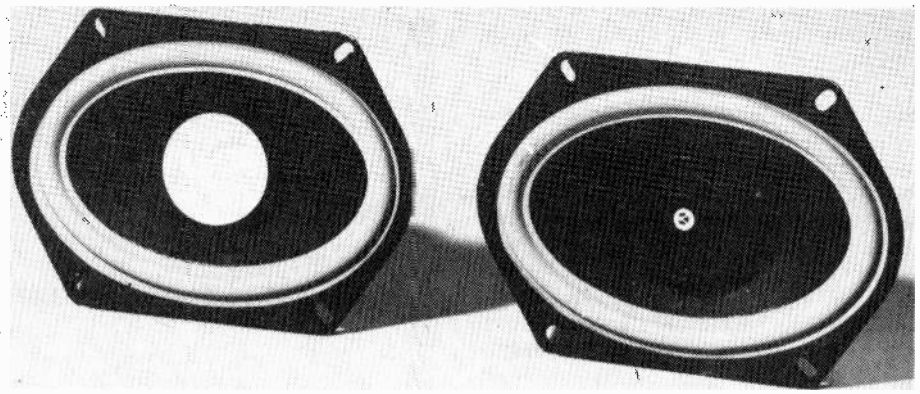
Connoisseur is manufactured in England by A.R. Sugden, and distributed in Canada by Rocelco Inc., 160 Ronald Dr, Montreal P.Q. Postal Code H4X 1M8.

Connoisseur Transcription turntable BD103/A.

PHILLIPS WOOFER

PHILIPS AD4050W Woofer is now being stocked. A 4" unit in the De Forest series, it features a 3 ounce Ticonal magnet, 1" voice coil and a 60 Hz resonant frequency, and is suitable for automotive use as well as small bass reflex systems. The magnet system is said to have a low external field.

For further information please contact Philips Electronics Ltd., 601 Milner Ave., Scarborough Ont M1B-1M8.

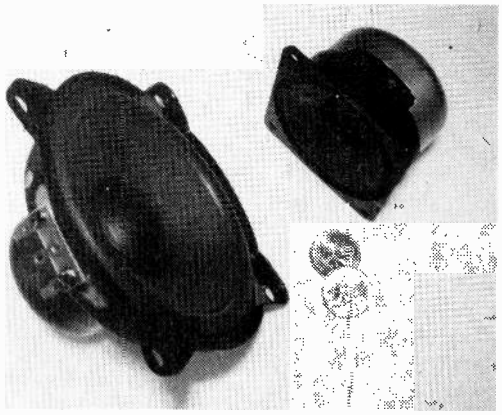


Automotive speakers from Acoustic Fibre Sound The Kriket Klassic 2731 and 2732

KRIKET SPEAKERS

KRIKET KLASSIC speakers manufactured by Acoustic Fibre Sound Systems of Indianapolis, U.S.A. are now marketing a line of automotive speakers, both co-axial and dual range, in 5"x7" and 4"x10" sizes at prices ranging from $17.50 to $24.95. All types feature 10 oz ceramic magnet and 1" voice coils and claim a power handling capability of 25 W.

Canadian distribution is handled by Allcan Communications Ltd., 3335 North Service Rd., Yorkbury Sq., Burlington Ont., L7R-3Y7.



A couple of De Forest products from Philips.

TELEDAPTER

Television sound really is a lot better than your receiver would have you believe. TELEDAPTER manufactures the model TE-300 and the rack-mounted TE-300R TV Audio tuner to prove it. It is installed and used in the same way as an FM tuner except that it uses VHF/UHF channel selectors and is tuned like a TV set, completely bypassing the usually poor to atrocious sound system incorporated in most TV sets. In addition the unit features a simulated stereo output and will be convertible to true stereo when such transmissions are authorized. U.S. prices are $169.95 for the TE-300 and $249.95 for the TE-300R.

The company also manufactures a model TE-200 which produces a stereo simulation from any mono source including TV (which is taken from the speaker terminals) at $19.95, U.S.

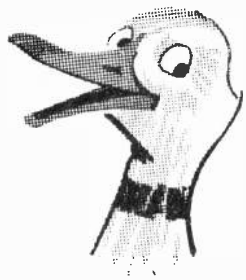
Write to Rhoades National Corp. Box 817, Hendersonville, Tennessee, 37075, U.S.A. Sorry, but I don't have a Canadian rep. listed.

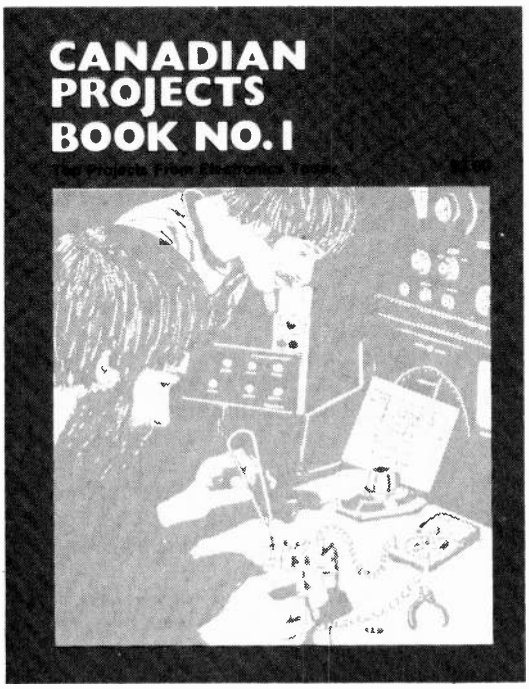
When writing to manufacturers and distributors, please mention ETI. I thank you, Steve thanks you, and Caesar the cat thanks you.

COMING SOON

Jensen 566 Triaxial speakers, and the new Stanton 881S pickup.

I know where to find 6 projects never published in ETI-Canada!





HEART-RATE MONITOR

By clipping an illuminated bulb to one side of your ear-lobe and clipping an LDR to the other side, you can monitor the changing translucency of the tissue as blood spurts through the blood vessels. The signal from the ear-lobe detector is cleaned up and squared off and then fed to a frequency-to-voltage convertor which, after buffering, drives an analogue meter. this project is not meant for use as a serious diagnostic instrument. It can be used by those experimenting in biofeedback or by sportsmen in training.

DOUBLE DICE

A project to get you started in CMOS digital electronics. A decade counter is made to divide the output from an oscillator by six. The dice rolls while a button is pressed and continues to roll (now slowly) for a short while after release. Consumption from the battery is so low that we use no on-off switch. The results are truly random.

TOUCH ORGAN

What's so neat about this project is that it is all on one PCB. Twenty-seven touch-switches are laid out on the copper side of the board to give a full two-octave keyboard and tremolo switch. There ae two voices available, and a volume control. The project is easy to build, uses 12 ICs and runs from a 9V battery.

PHASER

The effect of the phaser or phlanger will be well-known to readers who are interested in popular music. The ETI phaser achieves the desired effect by splitting an audio signal into two paths and re-mixing the components after one has undergone a phase change. This change takes place in six RC networks, each capable of 180° shift at high frequencies. This gives a comb-shaped response (3 minima) for the unit as a whole. The characteristic whooshing sound occurs when we change the resistive elements of each RC section (using a 4049 as six sets of complementary FETs) under voltage control from a triangle-wave oscillator.

AUDIO LIMITER

This stereo device uses a 4049 CMOS hex-inverter IC to provide enhancement-mode FETs for use in a voltage-controlled attenuator circuit. The project can be used to limit audio peaks to prevent amplifier clipping, to reduce the dynamic range of a signal for recording, or as a voltage-controlled volume control for remote or automatic operation.

SOUND-LIGHT FLASH

This project senses a change in light or sound and, after a predetermined delay, operates a photographic flash unit. You can photograph glass shattering, any violent impact splash, clap, explosion, etc.

They're in our "Canadian Projects Book No. 1", now available for $3 a copy.

If you want to checkout the other projects in this book see the early issues of ETI Canada:

5W Stereo: Feb. 77
Overled: July 77
Bass Enhancer: Aug. 77
Disco Modules: Mar. 77 & Apr. 77
Metal Locater: March 77
GSR Monitor: June 77
Fuzz Box: May 77
Mastermind: July 77
Reaction Tester: Feb. 77
Burglar Alarm: May 77
Injector-Tracer: June 77
Digital Voltmeter: July 77

Please clip the coupon below and send to: **ETI Magazine**
Unit 6, 25 Overlea Blvd., Toronto, Ontario, M4H 1B1

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Audio Today Letters

Audio developments reviewed by ETI's Contributing Audio Editor Wally Parsons

Audio Today is ETI's new regular section dealing with news and views on topics ranging from loudspeaker design to audio circuits, from auditory perception to concerthall acoustics, from microphone techniques to designing domestic listening rooms.

If you want to express your views or report on news write to Audio Today, ETI Magazine, Unit Six, 25 Overlea Blvd, Toronto Ont. M4H 1B1.

Recalcitrant Recorder

While visiting England last year, I purchased a combination AM/FM/Cassette player. I replaced the 250 V transformer with a 120 V unit. The frequency difference doesn't seem to affect its operation (it also runs on 6 V batteries).

But recently after obtaining a (5 pin) DIN patch cord to connect the recorder to my stereo (both of which accept the plug), I was unable to record directly from the amp to the recorder via the patch cord. The problem is a high-frequency sound (pulsating) which sounds like a chirping bird, and is generated only when recording from a phono input. The sound diminishes when I tape from the tuner (radio) input, or reel to reel tape.

Can you help? I don't want my recorder to be a synthesizer.

M.W., Scarborough Ont.

It would help greatly if readers with problems supply as much information as possible, e.g. circuit diagrams, make and model of equipment, etc. Often the problem is due to some specific characteristic of the equipment, and with limited information I can only be of limited help. This is a good case in point. Ordinarily I should have thought that the problem would be most pronounced on FM external input. I suspect, though that there is output/input coupling within the DIN connector and/or bias signal on the line. Also, many recorders do not parallel the jack input and the DIN input, but each one operates at a different sensitivity and impedance. Some phono preamps become unstable when terminated in a load of too low a resistance and/or excessive capacitance. In that case your best bet is either to increase the input resistance of the recorder with fixed resistors, or go to the separate line input jack (if there is one). If neither of these remedies is available, you may have to build a buffer which may consist of a 741 or similar type I C connected as a voltage follower. Have you tried driving the recorder from some other amplifier, and using the amplifier to drive another recorder? In the first case don't go through the switching system built into your present unit, but connect directly.

Compander Level

I am interested in building the ETI (Jan. 78) Compander but am not sure if it will work properly with my pre-amplifier. The compressor input seems to be specified at 1 volt. However, my pre-amp tape out only puts out 150 mV (max. pre-amp out only 550 mV) of signal. For optimum results does the compressor input have to be 1 V? If so could you supply me with a diagram of a simple low distortion pre-amp to run off the Compander power supply to raise my 150 mV to the required level. How much expander input voltage is needed?

B.F., Abbotsford B.C.

The specifications show the MAXIMUM input voltage as 1 Volt. 150 mV will not overload the unit, and this is what counts. In any case, I doubt very much that this output figure for your pre-amp is anything other than a "nominal" figure based on some "nominal" input. After all, it's not like a power line which is fixed.

Hot Letter

I would like to say that I am enjoying ETI very much. I just can't seem to keep up with all the wonderful circuits being published. Please keep it up. I have a couple of suggestions:

1) More information on thermistors in general as I have experienced difficulty in finding any. Also what type of thermistor would be used in conjunction with the ETI Freezer Alarm project? The article omitted this. The LM3911 said little other than the sensor was built into the chip. No mention as to what one should hook up to the sensor from the freezer.

2) I have some rather good old tube type recording equipment. The heat of course is rather high as is the current consumption. I would like to up-date the gear without the expense of losing my tape deck to the scrap heap. How about getting the back room boys designing a good transistor playback-record amplifier, and maybe some info on tape heads.

Keep up the good work. I feel ETI is just about nicely balanced between practical and theoretical.

R.W., Mississauga Ont.

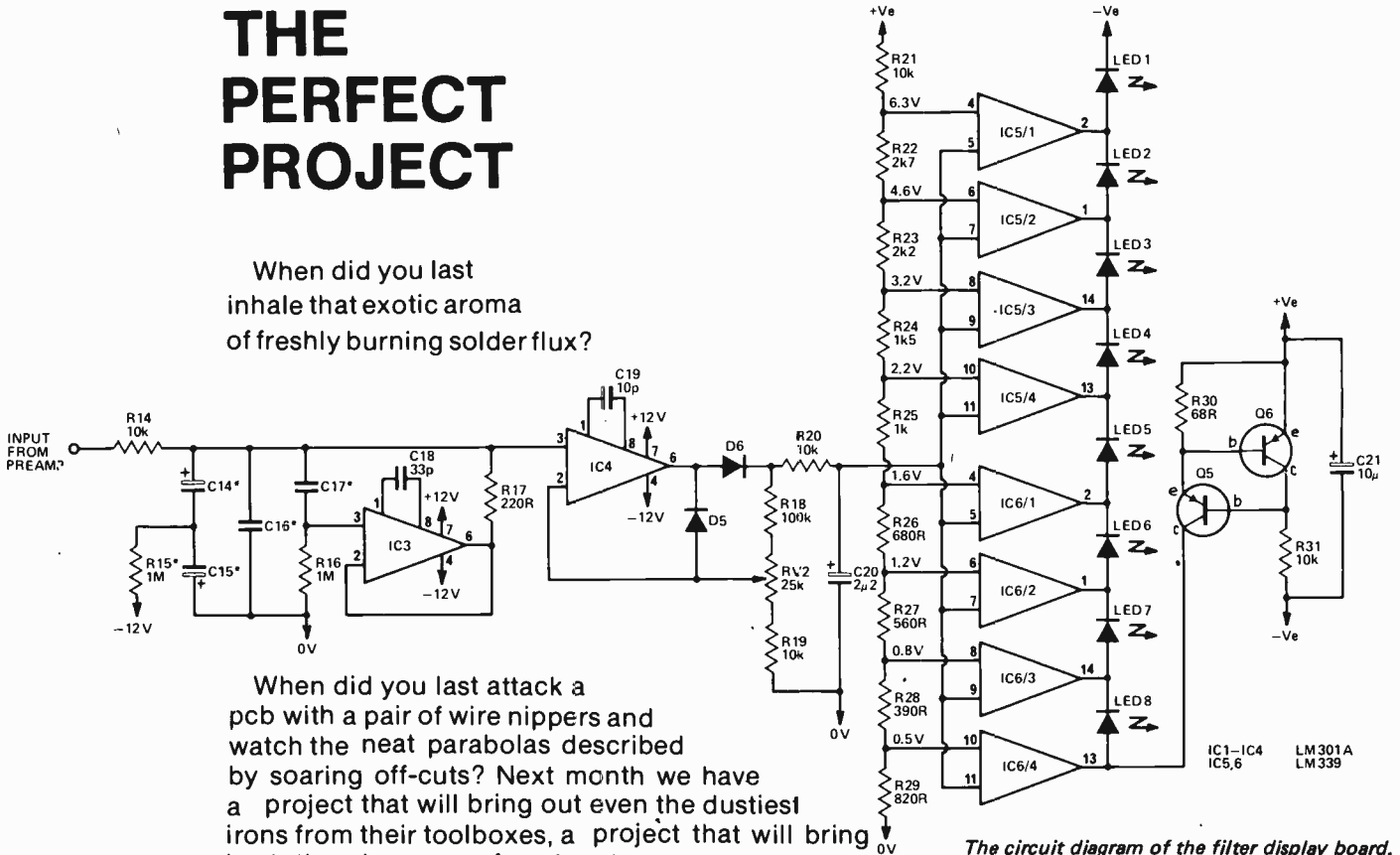
Many thanks for the compliments; hope you like the new "Audio Today" feature. It's especially nice to hear from a fellow tube nut.

As it happens, I have two such recorders myself for which I plan to build new electronics in the future. If enough readers express interest it would be worthwhile developing a unit whose characteristics can be adjusted to match a wide variety of heads. To facilitate this I'd be happy to hear from readers with such equipment. Let me know what you have (make and model, and either age, or serial No. to help identify, if possible). The purpose here is to gain some idea as to how versatile such a project must be to be useful.

Howard W Sams publishes "ABC s of Thermistors", by Rufus P Turner, (20765) which you might find informative. Possibly we can do something on thermistors at a future date. As to the Freezer Alarm, I would suggest re-reading the data sheet in October 77 ETI. The LM3911 is a temperature controller with built-in sensor, and comparator input for operation from an external reference. The article omitted reference to a thermistor because it does not use one. You stick the whole LM3911 into the freezer and run a cable to the PCB as shown.

THE PERFECT PROJECT

When did you last inhale that exotic aroma of freshly burning solder flux?



The circuit diagram of the filter display board.

When did you last attack a pcb with a pair of wire nippers and watch the neat parabolas described by soaring off-cuts? Next month we have a project that will bring out even the dustiest irons from their toolboxes, a project that will bring back the pleasures of project-building to many lapsing enthusiasts, a perfect project.

You start with a hand-sized printed-circuit board and solder in two LM301 ICs and two LM339s. Using two transistors you make a constant-current source to limit the current through a chain of eight LEDs to 10mA. The 339 ICs (each a four-unit voltage comparator) are used to switch on the LEDs to give a bar-graph display analogous to the control voltage. This is simple stuff — easily within the scope of any ETI reader.

The finished board is to be used in the project to display the power content of an audio signal at a specific frequency. The two LM301s are used to (i) filter the audio, and (ii) rectify the audio and process the voltage to be fed to the comparators. The first IC is used as a gyrator which replaces the traditional inductor in a band-pass filter circuit. Here you brush-up your knowledge of filters and learn how to custom-design your own.

When you have got this board working and have experimented with the basic parameters (for fun) you can design another nine boards to monitor set frequencies across the spectrum. Then you can see how we did it and build up the extra boards. Add a board to handle buffering and noise generation, the simplest (isolated!) power supply ever and you have a space-age gadget for your hifi or a serious test instrument for your lab.

This project is required-building for all our readers.

Other projects in June ETI will be (if present plans are fulfilled): An accentuated-beat metronome. A proximity switch. An electronic race-track game.

The feature articles planned include the inside story on amateur radio, a survey of digital multimeters available in Canada, another of Wally Parson's technology-explained articles (this time he looks at 'Feedback' in electronic circuits), and possibly a look at Heathkit's pinball machine.

Catalogue Survey

Here are some of the catalogues you should have to order electronic components through the mail.

Here we go again, telling you what you should have to be a good electronics enthusiast. A library of catalogues is essential to all project builders who want to do more than just put together kits. All catalogues are useful for finding sources of any parts you need, but generally much more is offered. Many catalogues provide data and specs for devices you might be having trouble with, and there is a lot you can learn (often you discover parts you never knew existed) by just reading through a catalogue.

Here we list some of the catalogues we use in ETI's editorial office, starting with the Fat Cats.

ELECTRO SONIC

Eleven - hundred - and - sixty - odd pages qualifies Electro Sonic for the ETI King Katalog award. There's lots of photos and drawings and specs for all kinds of electronic stuff from micros to wire. The ICs come with data and applications circuits and the transistors have package drawings and basic specs. After the first 160 pages of semiconductors and 80 pages of passive components, the more boring (from the bedtime-reading viewpoint) hardware coverage starts. First there's 125 pages of Hammond products, a quarter of which is useful to people who have trouble finding transformers for projects. Then there's all the tools we told you about last month and a whole heap of equipment, switches, pcb making materials, TV antennas, books (18 pages worth), you-name-it . . .

The catch is you have to pay $10 for the catalogue, but it is worth it. Published 1978.

Electro Sonic Inc, 1100 Gordon Baker Road, Willowdale, Ontario, M2H 3B3.

SAYNOR

Fat Cat number two comes from Saynor: 928 pages, but amazingly this one is free. At least it **was** free — Saynor might have to reprint if they get 25000 orders from ETI readers. To send the catalogue parcel post to BC costs $1.75 for postage alone, so make suitable allowances if you want to order by mail. Published 1976.

There are no ICs listed, nine pages of transistors with brief specs, lots of SCRs, Triacs and rectifiers, the usual reams on switches, transformers, wire, hardware, plugs, sockets and terminals, and so on. For the tools coverage see ETI May 78.

Saynor Electronics Ltd, 99 Scarsdale Rd, Don Mills, Ontario, M3B 2R4.

CESCO

The last of the big cats is from Cesco. Published in 1977. Three dollars (inc postage) gives you 352 pages of products available from their centres in Quebec, Montreal, Ottawa and Toronto. The contents page reads like the other catalogues: first half of the book deals with the common components from semiconductors through to capacitors, and the second half is connectors, wire, switches, hardware, tools and books. Data is included for semiconductors — a useful reference — and the coverage of industrial products is extensive.

Cesco, 4050 Jean Talon Street, West, Montreal. Cesco, 24 Martin Ross Avenue, Toronto. Cesco, 1300 Carling Ave, Ottawa. Cesco, 98 Ouest St Vallier, Quebec.

FUTURE

Future are planning a 1978 catalogue but at the moment the 1977 edition is current. You get 64 (about half ETI-sized) pages for $1. Two-thirds of the line is semiconductors, with single-line descriptions. Lots of TTL, CMOS, linear ICs, and memories from 28 different companies. There's a limited range of passive components plus a line of RF wattmeters and accessories from Dielectric Communications.

Future Electronics Corp, 5647 Ferrier Street, Montreal, Quebec, H4P 2K5. Future Electronics Corp, 44 Fasken Drive, Unit 24, Rexdale, Ontario. (Note the phone number for the Toronto office is 675-7820; there is a misprint on the catalogue.)

J & J

The 1978 J&J catalogue contains 64 full-sized pages of components for hobbyists or professionals. The speciality is semiconductors and surplus components (new and unused), from 20¢ 'disposable' transistors to microprocessor chips. There's reference data on transistors and 12 pages of 'kits' for projects (not ETI projects, and no cabinets included). Seven pages list Vero products and pcb materials. The quality of production and layout is first-class.

J&J also send out flyers every 6 to 8 weeks to advertise their bargains — the 'surplus' semiconductors, etc.

J&J Electronics Ltd, PO Box 1437, Winnipeg, Manitoba, R3C 2Z4.

DOMINION

The latest Dominion catalogue was published inside last month's ETI so most readers will have a copy. The main catalogue was published in ETI last September and the next should appear this September. The catalogue is available from Dominion for 50¢; ETI back-issues cost $2. Dominion handle lines from SGS Ates, SSS, Micro Electronics, Nissei, Elna, Philips, Injectorall, Ungar, Tenco, Jana, RSC, Marsland, Vista, Leader, and many more. Good for many components for the audio project builder, but poor coverage of ICs.

Dominion Radio and Electronics, 535 Yonge St, Toronto, Ontario, M4Y 1Y5

SUPREME

In last year's catalogue survey the Supreme catalogue was a 60 page pocket-sized job. This year the catalogue is 252 pages, and full-size pages at that. Almost in our Fat Cat bracket.

The catalogue is very good as a reference for data and specs (that's all it is really — the price list is separate). In fact, we can vouch for the accuracy of some of the data — that which was ripped off from ETI.

The coverage is comprehensive: semiconductors, capacitors, hardware, tools (Alpha, Armaco, Lenline, Panavise . . . accidentally not mentioned as a supplier in last month's tools survey), etc. My only criticism is that the cheap paper used has a musty smell, probably because it's recycled paper.

The catalogue costs $3, which is redeemable if you ask for it. (Unfortuntely the wrong price is printed on the cover.)

Supreme Electronics Inc, PO Box 58276, Postal Station L, Vancouver, BC V6P 6E3.

RADIO SHACK

The 1978 Radio Shack catalogue is available free from your local outlet. Components take 16 of the 164 pages, there's 3 pages of books, a couple of meters and power supplies, and 4 on electronic tools. A handy catalogue to have, because you don't have to order through the mail: just lock your workshop door, jump into the car, and wiz down to your local Shack. 'New for 78' includes a DIP switch, a right-angle LED socket, a DIP header, an 8080A, a wire-wrap tool, and some small components. PCB supplies, tubes, and antenna mounting hardware are other useful products.

Radio Shack have 640 stores across Canada.

ETCO

Our latest ETCO catalogue is the November 77 edition but it's possible there's a more recent one out by now. The catalogue is a 32-pager, on newsprint, and, filled with 'scoop'/'hot buys'/'incredible'/'wow'/'value'/'while they last'/'Compare! Save!' Surplus bargains. It is not much help to a project builder who is looking for a component, but the interesting bargains are sure to give him ideas for new projects. For the hifi, CB, or amateur radio enthusiast it is worth a look through to see if anything grabs your fancy.

Etco Electronics, 183 Hymns Blvd, Point-Claire, PQ, H9R 1E9.

CORONET

The 1978 catalogue from Coronet is 52 pages (unstapled) of semiconductors (mainly) and a few other components, like switches, plugs and sockets and PCB materials. Apart from the single-line descriptions there are a few pin-out diagrams: otherwise no data. No contents list either.

The influence of ETI is apparent — the only original circuits published are **our** copyright, copied from our Feb/77 issue. It would be nice if companies credited the magazine when they rip-off our material — by rights they should pay for it in the first place.

Coronet Electronics, 649A Notre Dame St West, Montreal, Quebec, H3C 1H8.

SUPERIOR

Superior are a big company with no general catalogue. They do not sell direct to the public from their Montreal HQ. One of the four main divisions sells (and makes) electronic components and test equipment (Sencore). They have several catalogues of interest to TV service people. There is a booklet explaining the range of Tech-Spray chemicals (like the chiller spray — which finds thermally intermittent components and cracked pcbs). Catalogue SP1178 covers chemicals and TV connectors, fuses, etc. There's catalogues for B&W and colour picture tubes, TV antennas and rotors.

Superior (Components Division), 1330 Trans Canada Highway, Montreal, PQ H9P 1H8.

ARKON

Not so much a catalogue, more a flyer, we received from Arkon an eleven-page bulletin listing kits, surplus equipment, computer accessories, and a few components.

Arkon Electronics Ltd, 91 Queen Street East, Toronto, Ontario M5C 1S1.

TENCO/GLADSTONE/ EDMUND

These catalogues are of interest to ETI readers but do not fall into the 'components' category. The Tenco catalogue has switches and cabinets, test gear, audio accessories, and auto accessories.

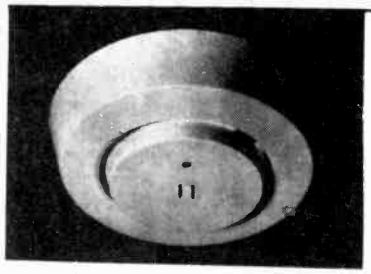
The Gladstone catalogue covers hifi (mainly), test equipment, and some bits and pieces.

The Edmund Scientific catalogue (sells for $1) specialises in astronomy, optics, weather, biofeedback, and photography.

Tenco Electronics Ltd, 196 West 6th Ave, Vancouver, BC, V5Y 1K6. Tenco Electronics Ltd, 75 Denison Street, Markham, Ontario, L3R 1B5.

Gladstone Electronics, 1736 Avenue Road, Toronto, Ontario M5M 3Y7.

Edmund Scientific Products, 3500 Bathurst St, Toronto, Ontario, M6A 2C6.



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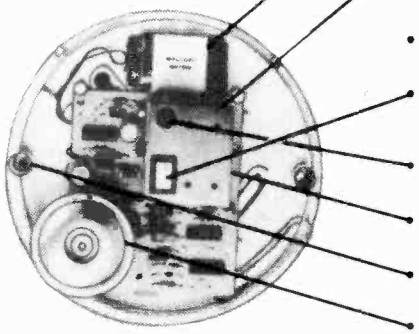

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A Lumberjack, But We're Not Okay

John Cox looks at the sociological and political explanations of why Canada doesn't have a thriving electronics industry, and offers some encouragement.

You might not expect 'politics' to be discussed in electronics magazines, but one of the functions of a magazine is to cast a look around at things which concern us generally, and, with a federal election in the offing, now seems a good time to tune in to what's going on (or isn't going on) in Ottawa. 'Parasitic oscillations' and 'spurious tweets' seem to describe things, though it would indeed be hard to fault the government's 'slew rate'...

As we all know, North America as a whole is in economic trouble, and this is due to changes which are really global in scope. While we obviously cannot blame the Canadian government for the entire situation, we can and should question whether we, as a nation with vast and relatively untapped resources, should turn out to be as vulnerable as we are.

There are signs that some politicians have come to realize that one major factor in our difficulties is our lack of secondary industries. We hew wood and fetch water admirably (this includes, of course, mining, growing wheat and chopping down trees), but when did you last see an IC with 'made in Canada' written on it? In the past, we paid for our imports of 'secondary' products with our exports of 'primary' ones, but in the present this does not work. Perhaps it is ironic that, at a period in history when people are seriously worried about natural resources running out, the world markets are saturated with raw materials and we actually have difficulty selling them, but this is the position. (The president of one of our pulp and paper products companies recently noted that, were it not for the devaluation of the Canadian dollar, we would be exporting even less than we do!)

This is not the whole story, however, for even though our exports of raw materials provide most of our 'spending' money, they provide employment for relatively few people. Most of our population lives in a handful of cities strung out along the border, striving to make a living out of entrepreneurial and bureaucratic rather than productive skills.

As noted earlier, some politicians are beginning to see these aspects of the problem, but so far discussion of it has been on very general lines. This is where readers of this magazine come in, because any number of connections can be made between the overall situation and our field of electronics in particular.

You get an idea of the problem every time you build yourself an ETI project. About 90% of the components you use are imported from some other country. This means that you have a fork out an additional 11½% (or more) in excise tax, plus a considerable amount in overheads incurred by the extra work importing entails — while at the same time you are supporting foreign, rather than Canadian, labour! (While this is being written, a cut in provincial sales taxes is being announced. This may stimulate the economy slightly, but its effect in terms of job creation is limited, because a large part of the spending dollar will go for imports.)

If you are hoping to make your career in electronics, you are directly involved whether you want to be or not. Without an electronics industry to speak of there simply are no openings for the majority of you — and such openings as there are exist mainly in the servicing and entrepeneurial side of the nearly non-existent industry. A while back, Mr Trudeau told an audience of arts students that if they couldn't find jobs in Canada, perhaps they should look elsewhere, and it would seem that the same advice applies to you! (Actually, the Prime Minister used the words, "if they don't like Canada...' It seems to me that this added insult to injury, and as far as inferences concerning patriotism were concerned, the boot should have been on the other side's collective foot. Perhaps it will prove to be so in the present election!)

Beyond all this is the consideration that electronics is a vital industry today. Government, business and finance are already so thoroughly computerised that we literally depend on imported technology to run the country. One could go on and on, but it is abundantly clear that if lack of secondary industries in general is a major factor in our depressed economy, then the absence of 'made in Canada' electronics is an outstanding example. (Indeed, one might be bold enough to suggest that, in a technological age, electronics is 'primary' rather than secondary. In which case, the situation has the

makings of a calamity!)

As was stated above, traditionally we have paid for manufactured imports with raw materials exports. This was the line of least resistance — a line, it may be said, which seems to have a strong appeal to politicians. Now that we are beginning to hear mumblings about the need for secondary industry we realise that so far these mumblings are exceedingly vague, for the simple reason that politicians have never really focussed on the national needs in this direction before. Federal politics, in Canada, has always been a matter of going to Ottawa to plead for money for one's particular bailiwick. It is true that efforts have been made at the provincial level to promote industry, but again the lack of hard-nosed approach has been evident all too often (the ill-fated Bricklin car is an example of how politicians may be well intentioned, but impractical). It is strange, perhaps, that our latest Prime Minister considers himself a 'technocrat,' yet seems to have very little feeling for technology; at the same time, no one on the other side has either, so this remark is not intended to be partisan.

Similarly, because of our traditional role as hewers of wood and fetchers of water, we seem to have developed an inferiority complex in regard to technology. Politicians are not the only people who (seem to) have the innate feeling that certain things 'cannot be done' successfully in Canada. For instance, if you suggested that someone should start up a 'New Brunswick Instruments' or 'Newfoundland Semiconductor', you would be greeted with gales of laughter (check?) — yet such enterprises are just what Canada, to say nothing of New Brunswick and Newfoundland, needs!

Another 'psychological' complex is the idea that we can only build 'large' things, such as tractors, and that 'small' ones, such as microcircuits, are completely beyond us. This seems to derive from our self-image as a nation of lumberjacks, according to which the manufacture of transistors is tantamount to pressing wild flowers. Well, we're a lumberjack, but we're not okay. . .Finally, we have a fixation that we are a small nation in terms of population, and therefore can't do anything. This is certainly irrational in view of the present situation, where we have a very large number of people not doing anything because the economy gives them nothing to do.

From all this, it is clear that we have to change our thinking — and the politicians have to bring their heads down out of the clouds and start paying much more attention to the real world, in very specific detail. Changing the economic structure of Canada will undoubtedly be difficult, but it is not a question of whether it can be done — it **must** be done!

For encouragement, we might take time out to look at some other countries for examples of how it can be. Holland, for instance, with 13M people yet boasts the mighty Philips organisation; W. Germany, France and Italy, all with more people than their natural resources can support and therefore engaged in constant struggle to survive, nevertheless have considerable 'home-grown' electronics industries. And while the UK isn't perhaps an example of 100% economic health, it does give us some object lessons. For instance, a commission was set up to decide which industries were most vital to the country, and electronics was high on the list of twenty which came out of this. As a result, government policies were instituted which gave priority to electronics, including massive support — and this explains why the UK is now contributing significantly to advances in the field, and indeed has companies which are rapidly expanding into the US manufacturing sector! If you sat down to build an ETI project in any of the common market countries, you'd be using components made (and very likely designed) right at home.

Canada will not change its situation without very considerable government support. As far as this writer is concerned, none of the political parties has come to grips with things, and for as long as they fail to do so our economic situation will grow worse, while the longer changes are postponed the more difficult it will be to make them. There are a number of steps the new government can take without taking an interminable length of time to indulge in theoretical claptrap. One would be to insist that multinational firms operating here should do a significant amount of research and development in Canada too. Another is that, since a great deal of electronics consists of manufacturing components into industrial and consumer devices, ways must be found to encourage component manufacture at home — at the same time as not penalising those who must import components not made here with heavy customs duties. These are just two examples of the kind of policies which must be developed immediately, and which can only come about on the federal level.

It would be a truism to say that government should give leadership, but it appears from the record that somehow or other it is the people who have to lead the government right now. Of course, some of us have more clout than others — for instance, I've personally met at least two millionaires in the electronics business. (I don't know if they read ETI but I hope so!) But we all have **some** influence, and since our future depends on the electronics industry, we'd better find ways to make it felt, at all levels.

As an afterthought, electronics is a field which offers considerable and viable opportunities for relatively small businesses. If you can't get a job, maybe you can make one by starting a business yourself. This gives you a strong personal motivation for raising money and support, and automatically you will find yourself a 'campaigner.' But don't just leave it to 'big brother.' Get after him every way you can, and don't let up! Even if you feel you can't reach many people actively, you still have a chance to make your ideas felt at the ballot box, and if you sometimes wonder which side you ought to support, then ask yourself the question, 'Which side is supporting **me**?' (That's not selfishness — that's democracy!) If, in the final analysis, you can't find any evidence that either side intends to do anything for you, then take time out to go to a political meeting or talk to your MP, and ask him point blank what his policy is with regard to electronics. Sure, he'll probably reply that he doesn't condone 'bugging,' or expose that he's clueless — but that's your cue to wise him up as to just how important the issue is.

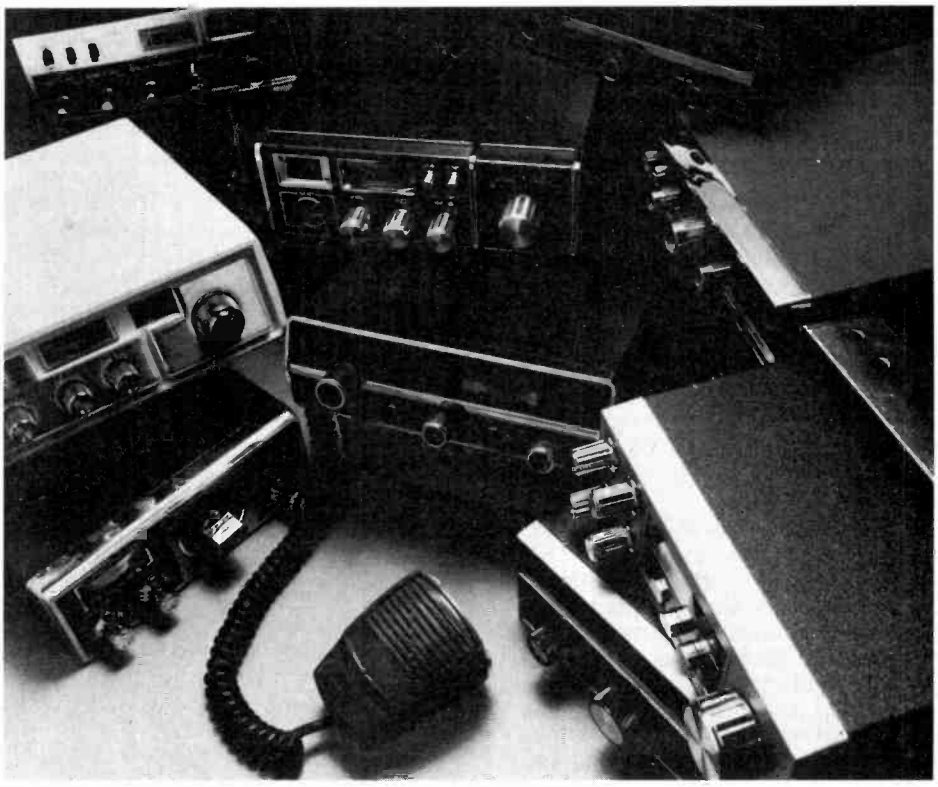
MAKING WAVES

John Cox suggested 'Making Waves' as a name for a regular column in ETI and sent us this piece to get it started. If you have any personal views (they don't have to concern electronics directly — but I have to be satisfied they are of interest to ETI's readers) you don't mind typing up (double spacing please), send them to Making Waves, ETI magazine, 25 Overlea Blvd., Toronto, Ontario M4H 1B1.

You might like to write in and say articles of this type have no place in an electronics magazine. . .

Steve Braidwood.

25 million reasons why you should look into NRI training in CB and Communications Servicing.



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There are more than 25 million CB radios out there, millions more two-way radios, walkie-talkies, scanners, and other communications apparatus in use by business and industry, government, police and fire departments. And all of this equipment demands qualified technicians to install, maintain, and repair it. The man with the right skills can practically pick his job, even start a business of his own.

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Delhi Success

Jim Essex reports the success of one Canadian company in a competitive field.

When it comes to TV antennas, Delhi Metal Products have succeeded by the simple expedient of "watching your neighbour's antenna".

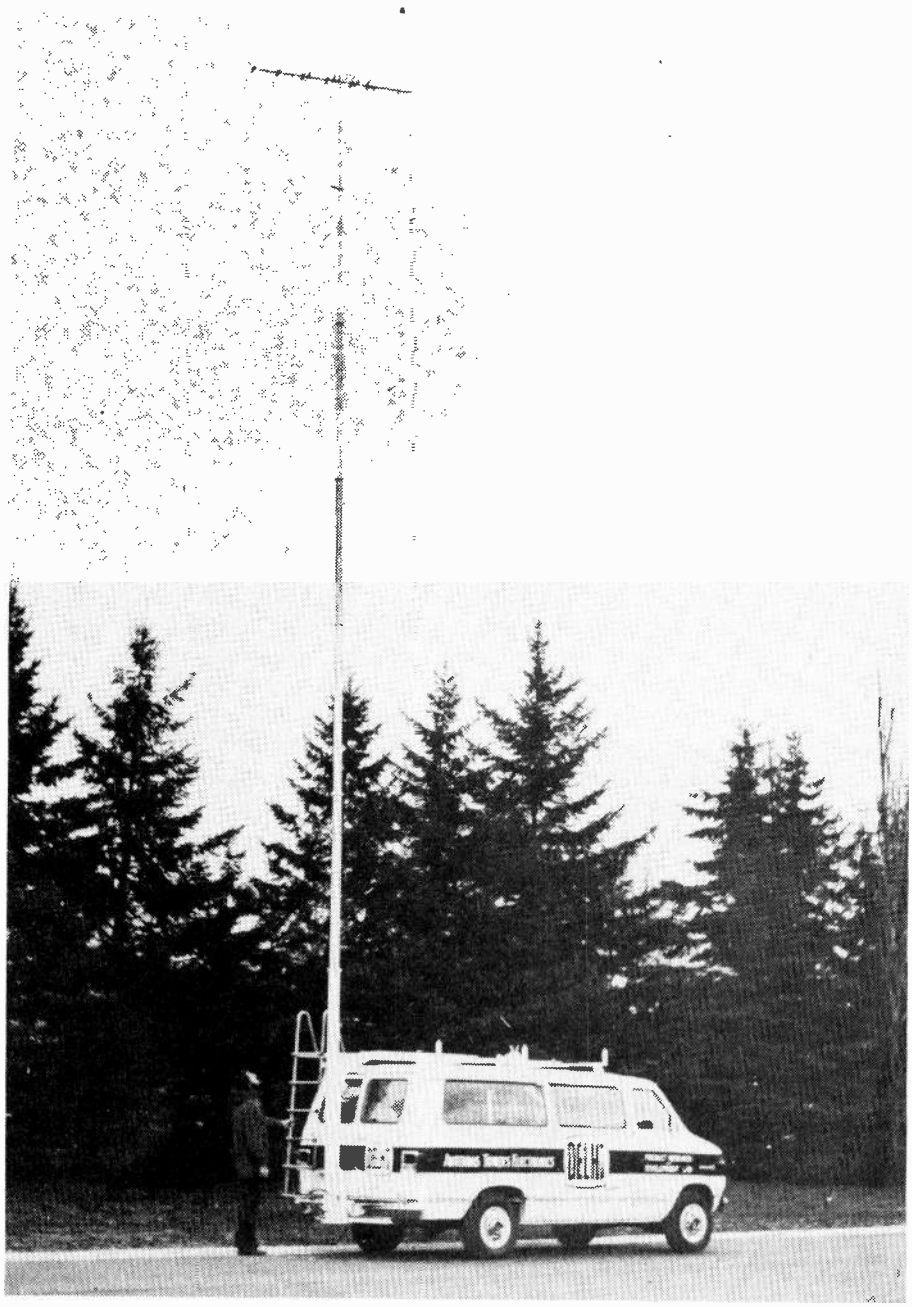
In the early 50s, when black & white TV came over the horizon faster than tomorrow's rising sun, Canadians were literally caught with their aerials down. Consequently, we had to rely on American antennas to satisfy our sudden TV demand.

But in the little town of Delhi, Ontario — perhaps better known for the tobacco industry which flourishes there — Mr. Ken Soul decided there must be a better way. He started putting together what he believed an antenna better suited to Canada's sparse transmitters and greater distances between cities. High gain antennas became his forte. A continually expanding line of antennas followed, which, according to Ed Laevens, Marketing Manager, has now resulted in a variety of designs to suit nearly every Canadian condition from metropolitan use to outer fringe. When all seemed fine, the blow fell.

THE CHALLENGE FROM CABLE

The inevitable cable TV came with the 60s, and the fight was on, first, Delhi realized vast improvements would be needed if they were to wean cable TVers away from what amounted to 'spoon-feeding'. The docile environment bred by cable was bound to break, and they had to be ready. Besides, Canadians still like a bargain, and the continually rising cost for cable not to mention the installation charges, have made most of us pause.

How did they do it? Ed Adams, formerly of Sinclair Radio Labs, approached the problem from an unusual angle. After all, the empirical method had served this far, — why not continue using cut-and-try methods?"



The Delhi Mobile Lab.

Indeed the task of adjusting "theory to the practical" began really two decades before. The result? A mobile van with a 40 foot telescopic antenna. (see photo) Ed set about watching the neighbours antenna to see if he could do better. He did.

He not only evaluated, on-the-spot, antenna patterns, he put them on polar graphs and brought them into the lab and proved them.

In the field, he'd evaluate a particular area for best signal. Bracketing three categories — from say, lowest, to middle, and exceptional — three antennas could be selected, not only for best pix but best price as well.

THE "QUEBECOIS"

An example of how this works is the story of the "Quebecois", a multi-element device sold in Quebec City and within a radius of 100 miles. It is designed specifically for channels 4, 5, and 11.

Prior to 1964, the independent Channel 4 was broadcasting in French. Ch. 5 broadcast in English as the CBC service network. In addition to the dual-channel yagi antenna ("yagi" from wartime fame when Canadian warships used this Japanese invented antenna to serve our radar), already providing adequate TV reception in the metro and fringe areas, Delhi covered a third channel. This was provided by 5 element single channel Ch 11 yagi.

Knowing the gains of the two, and combining this with the third, provided the basis for the performance of the "Quebecois". Thus, a unique Canadian flavor has not been left out — providing extreme gain for those out-of-the-way places, — not just in Quebec.

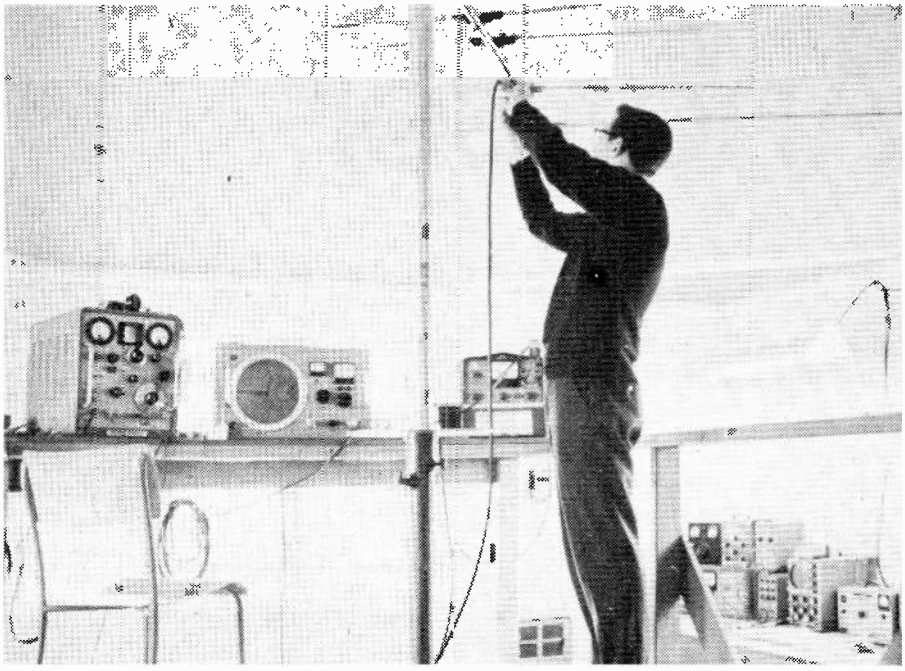
UHF COVERAGE

Cable companies, of course, make much of their extra channels — which, effectively cover the UHF band. But Delhi combat this with their UHF SFA 1483 which goes from 14, clear to 83. This is a "Yagi" type that has no objection to being connected to a VHF antenna — without a coupler. All they ask is that it be three feet away from your VHF antenna. It is ideal for fringe areas — something Canada has a lot of.

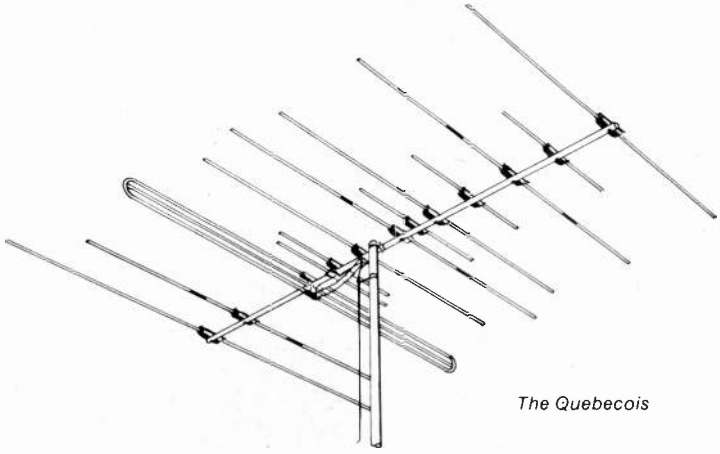
If you want to experiment, you can break off (or clip) the director tips on certain of the directors that'll raise the gain another 5 dB between chs 71-83. This will lower the gain 3 dB between 53 and 60, but if this is comptable with your particular area, you're home free! Watch your neighbour's antenna!

All Delhi's antennas have an anodised finish to withstand the Canadian climate. Along with double-dipped welded galvanized steel masts, the installations, are all-Canadian.

It may be over-simplifying the case to say all this came "from watching the other guy's antenna," but, — in simple truth, — how better can you judge what the competition's doing?



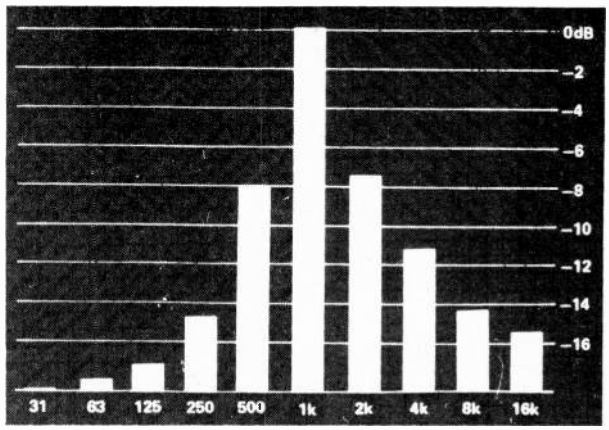
Inside the Delhi Lab.



The Quebecois

Audio Spectrum Analyser

Equalise systems for room acoustics accurately using this neat piece of 'test' gear.



AUDIO SPECTRUM ANALYSERS can be a valuable tool used in the setting up of a room acoustically with a graphic equalizer such as the ETI 487; to monitor program material or just as a gimmick to please yourself and friends.

Because this is such a nifty instrument, we have not one, but two Analyser projects. ETI 487 is a box which feeds an oscilloscope as the display, plans this month. Next month we've got an LED column display unit, ETI 489. ETI 487 is the more sophisticated, while 489 uses simplicity and modularity to provide non-scope-owners with similar capabilities.

When setting up rooms pink noise is pumped into the room using an amplifier. A microphone is then used to monitor the sound and its output is the input to the analyser. Now by adjusting the graphic equalizer a flat response can (hopefully) be obtained.

DESIGN FEATURES

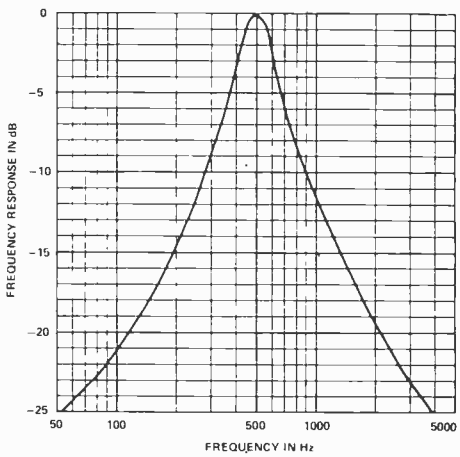
Spectrum analysis can be done by two main methods. The first is to have a tuneable filter which is swept across the band of interest. The output of the filter, when displayed on an oscilloscope, will be a frequency/amplitude graph of the input. While this gives a well-formatted and accurate display it is not "real time" in that if an event occurs at one frequency while the filter is sweeping elsewhere it will not be recorded. For this reason this method is used normally where the spectral content is constant and the sweep is only over a small percentage of total frequency (such as the output of a radio transmitter).

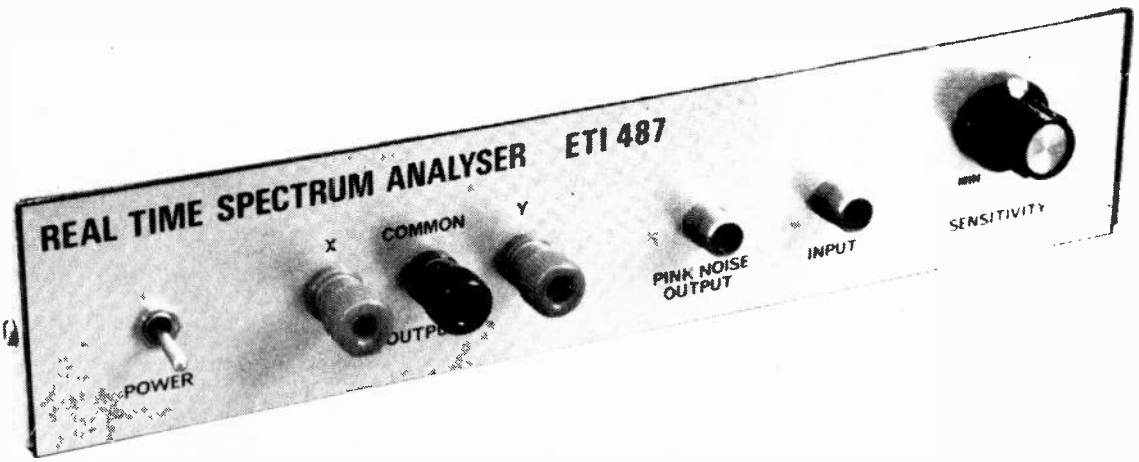
For real time analysis the frequency spectrum is broken into bands using bandpass filters and the output of each rectified. The output from these rectifiers can be displayed on an oscilloscope as in this project or by columns of LEDs or similar methods. The number of bands and the dynamic range required determine the filters used. In this project where only about 20dB is required a single LC network is sufficient. Another unit we have built (not for a project) uses a 6 pole high pass filter followed by a 6 pole low pass one. This gives a flat response (± 1dB) over ± ½ octave and is 36dB down 1 octave away. However, it uses 6 op amps and 2% capacitors and resistors in each filter. *Text continues on P52.*

SPECIFICATIONS

No. of bands	10
Frequencies	31, 63, 125, 250, 500, 1k, 2k, 4k, 8k, 16k
Filter characteristics	−12dB, one octave from nominal centre frequency
Display	CRO in XY mode
Input level	50mV – 10V
Input impedance	200k
Pink noise output	200mV
X output	± 4V approx
Y output	0V to 10V

Fig. 1. The frequency response of the 500Hz filter. All other filters follow a similar curve.





HOW IT WORKS

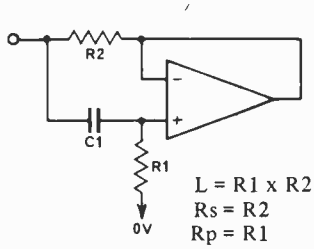
The unit can be broken into eight sections to help the explanation of how it works.

(a) Input amplifier
(b) Ten individual filters and rectifiers.
(c) Ten way analogue switch with decade counter.
(d) Staircase generator controlled by "c". (X output).
(e) Log converter.
(f) Ramp generator and comparator. (Y output)
(g) A pink noise generator.
(h) Power supply.

(a) The input amplifier has an input impedance of 220 k (set by R1) and a gain of 101 ((R3 + R2)/R2). The output of the amplifier drives all ten filters and Q1 and Q2 are used to buffer IC1 to give the drive capability required.

(b) The ten filter-rectifiers are identical except for component values and a bias resistor in the three lowest frequency filters, where tantalum capacitors are used in series. The filter is a parallel LC network which, with a series resistor, gives a band-pass filter.

As large value inductors are expensive we have used an active one using an operational amplifier, two resistors and a capacitor. The value of such a network is as follows:



$L = R1 \times R2 \times C1$ H
$Rs = R2$
$Rp = R1$

The frequency response of the networks is given in fig. 1.

The rectifier is a half wave type where the gain is variable from about 4 to 12. A diode from the output back to pin 2 keeps the op-amp in the linear region on the negative half cycle allowing operation up to the 16kHz of the top filter.

(c) The analogue switches IC23/1 – IC25/2 are controlled by IC22. This is a decade counter with 10 decoded outputs, each of which is high only for one clock period. As the analogue switches need a high to switch them on, only one will be selected at any one time.

(d) The output of the decade counter also controls the staircase generator IC28 with the weighting networks R58 – R72 giving equal steps of about 0.9 volts. Resistor R89 provides a bias current and the output of IC28 starts at about +4 volts and steps down in 0.9V steps to about -4.2 volts when the output switches back to +4 volts. This is used to drive the X input of the CRO. To add some width to the vertical lines, IC29/1 and IC29/2 form an oscillator of about 300 kHz and after filtering by R90 and C69 is coupled into the input of IC28 by R91.

(e) The output of the analogue switch is fed to the diode-resistor network (D21 - D26, R73 - R77) which gives a simple log conversion. This method is simple, needs no adjustments and is adequate for the purpose. As there is some loss in this network IC26 is used to provide a gain of three to recover this loss.

(f) The ramp generator is formed by the constant current (12μA) source and capacitor C71. The capacitor can be discharged by IC25/4 and the current source is controlled by IC25/3. The voltage out of the log converter (IC26) can vary between zero and +10 volts and this is compared to the ramp voltage by IC30. The output of IC30 controls the oscillator formed by IC29/3 and IC29/4. When the ramp voltage exceeds the voltage from IC26 the output of IC30 goes high allowing the oscillator to start. This immediately discharges C71 and switches off the current source which causes the output of IC30 to go low again after only about 2μs. Diode D27 ensures however that the oscillator acts as a monostable giving an output of about 6μs to ensure the capacitor C71 is completely discharged. The output of IC29/4 also clocks IC22 which selects the next input. If the input from IC26 is ever negative and C71 cannot be discharged to less than this voltage, IC29/3 and IC29/4 will oscillate continuously at about 100kHz clocking IC22 until it finds an input higher. This prevents possibility of lockup if the offset voltages of the op-amps all go the wrong way.

(g) White noise is generated by the zener action of Q3 which is reversed biased. It is amplified by Q4 to give 200 mV of white noise on its collector. White noise however has equal energy per unit bandwidth and what we need is pink noise which has equal energy per percentage bandwidth (i.e., equal energy per octave). To convert white to pink we need a filter at 3 db/octave. This is performed by IC27 with the RC networks providing the necessary curve.

(h) The power supply is a simple rectifier type with IC regulators to give stable supply voltages.

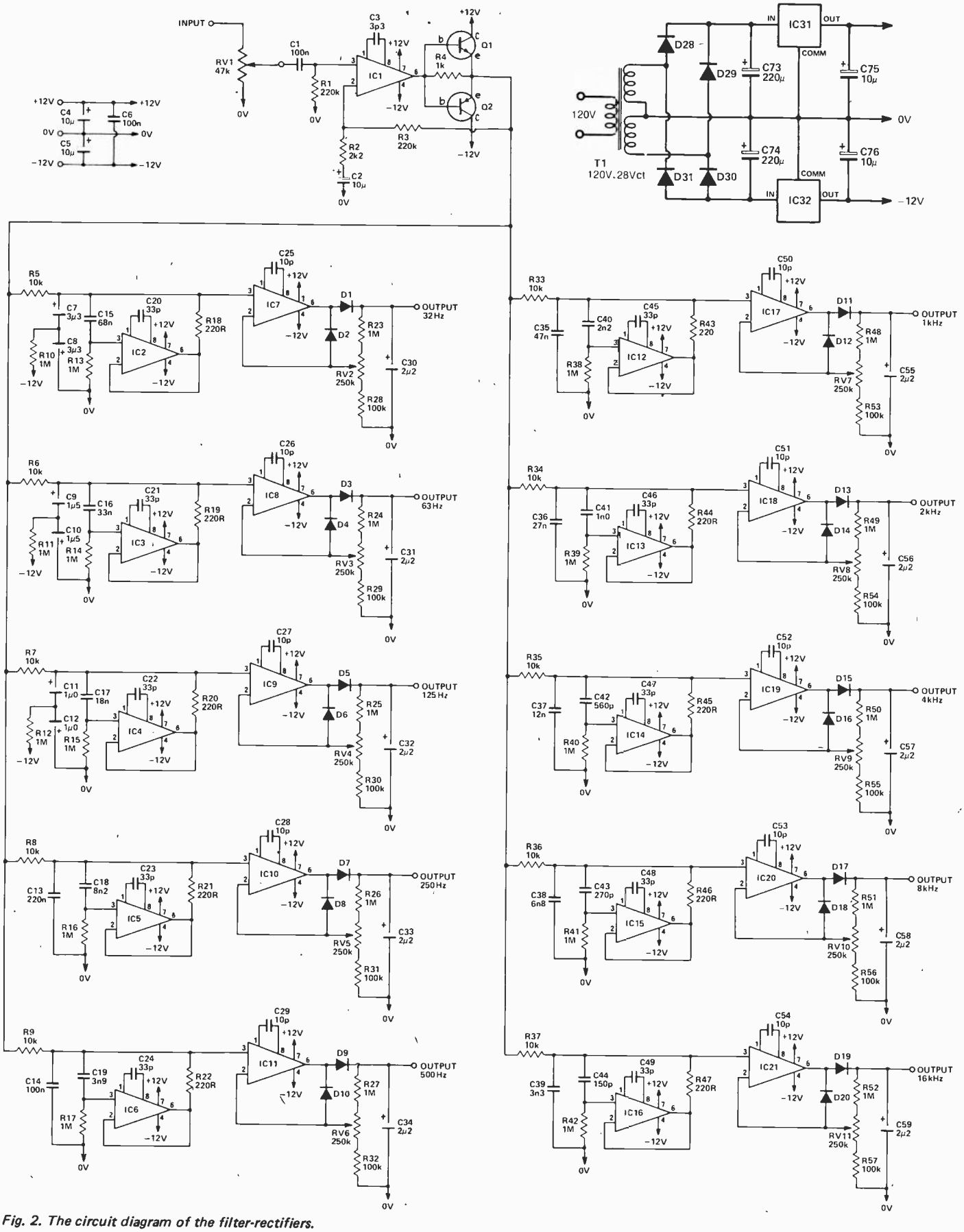
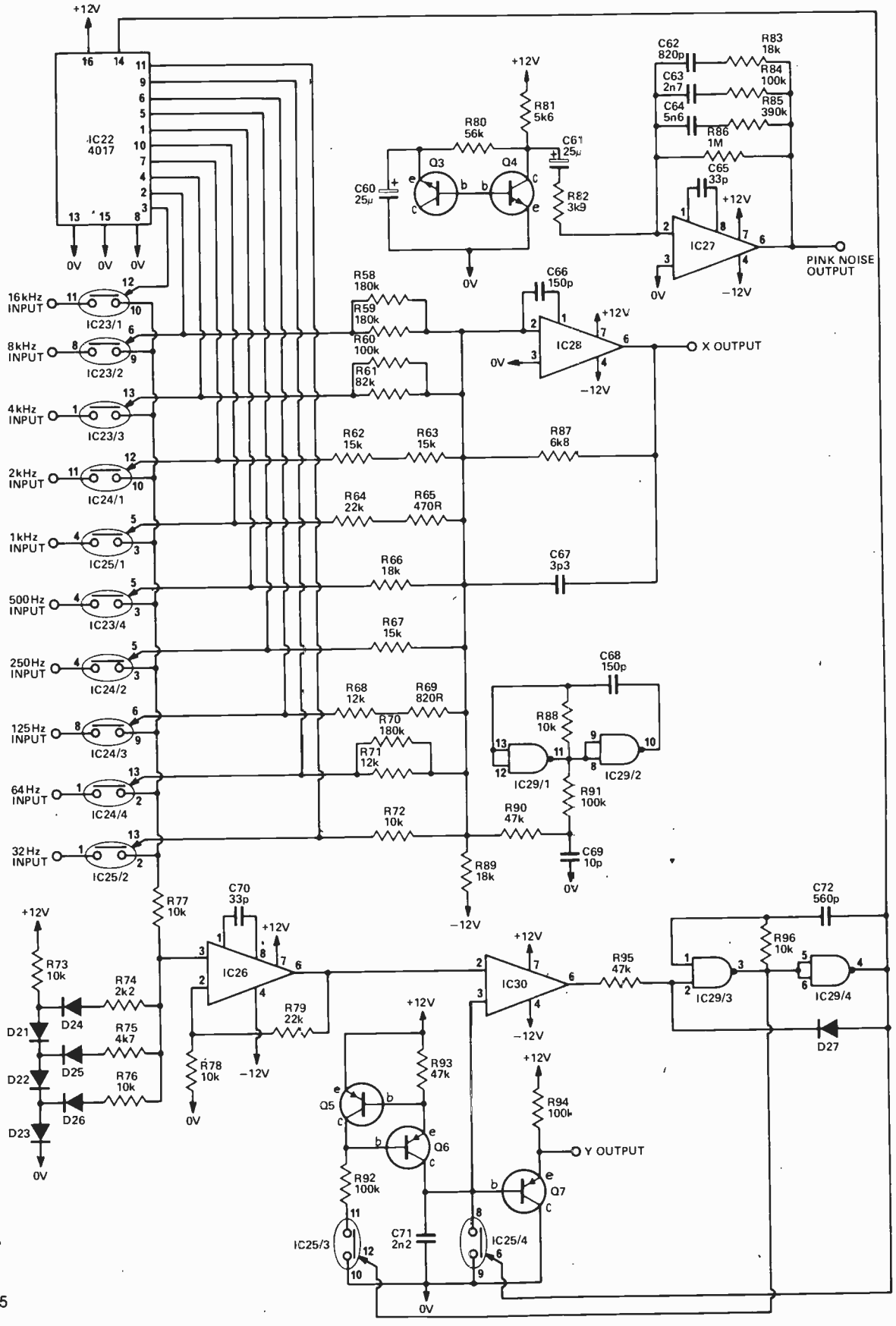
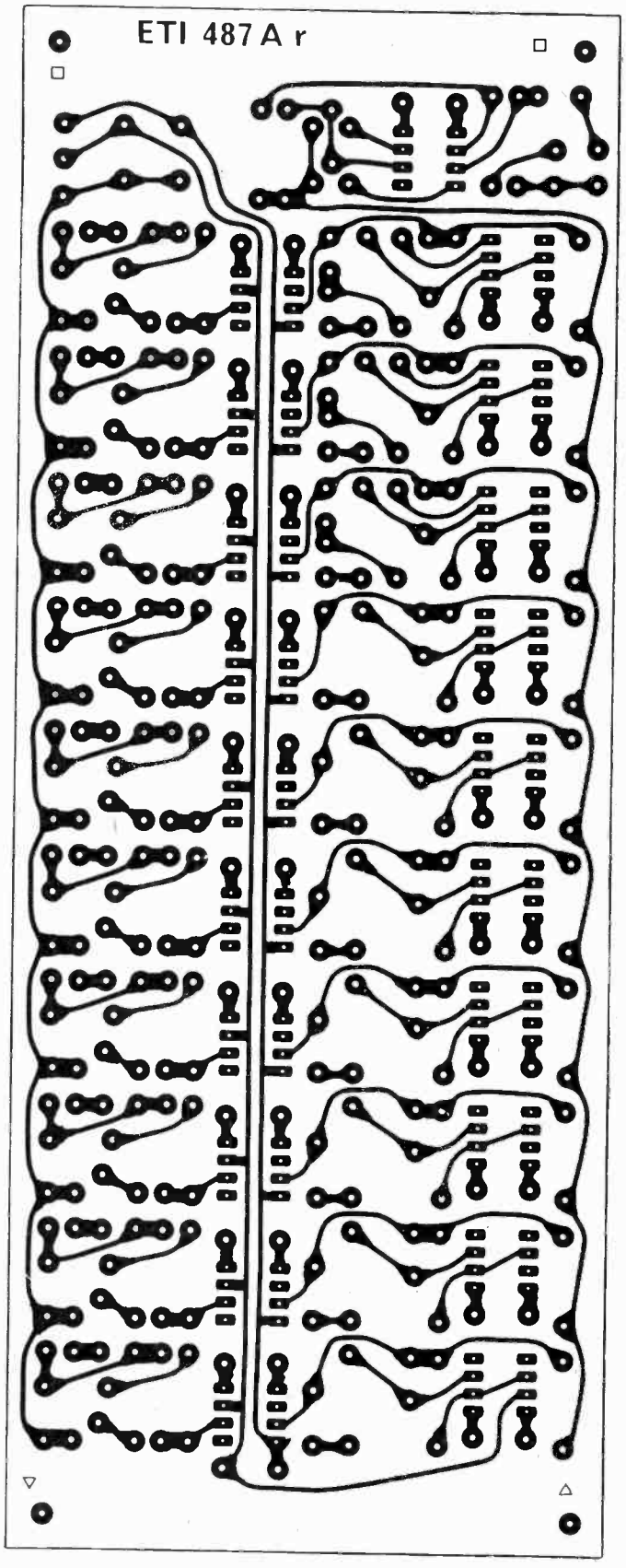


Fig. 2. The circuit diagram of the filter-rectifiers.



NOTES:
IC22 IS A 4017
IC23–IC25 ARE 4016
IC26–IC28 ARE 301A
IC29 IS A 4011B
IC30 IS A 301A
D21–D27 ARE 1N914
Q3, 4 ARE 2N3904
Q5–Q7 ARE 2N3905

Fig. 3. The circuit diagram of the logic circuitry.



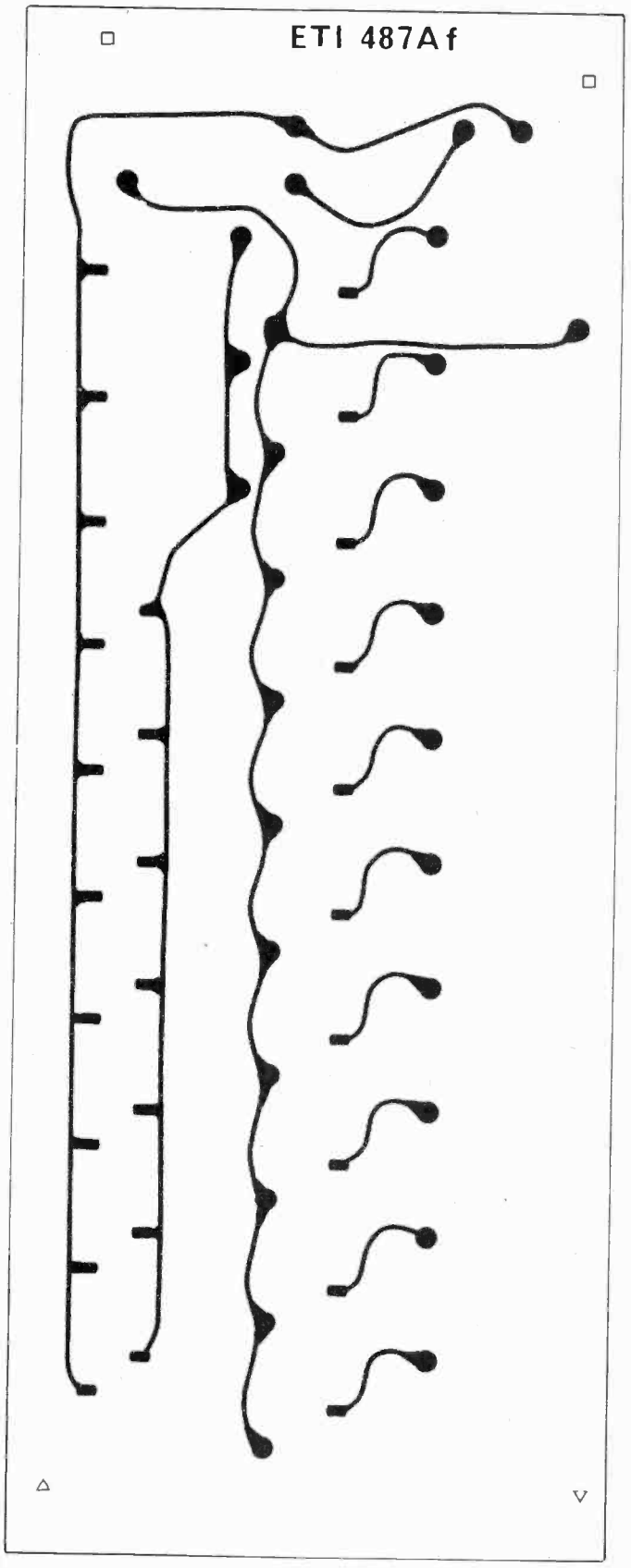


Fig. 4. Both sides of the ETI 487A board shown full size.

Number One ETI CIRCUITS

The first in a new series of 'ideas books' for the experimenter

Contents

Ultrasonic Switch

Two-board design forms basis for a wide range of applications from door-bells to alarms, even data transmission!

THE USE OF an invisible beam to transmit information or to act as an alarm system has always been fascinating. We have described light operated systems of the infra-red (invisible), normal light and laser beam types. We have also published a radar alarm system. This unit uses a high frequency acoustical beam, well above the range of human hearing, which can be used simply as a door monitor, i.e. to give an alarm if the beam is broken, or can be modulated at up to several hundred Hz. This will allow information to be transmitted

CONSTRUCTION

The construction of the units is not critical – any method may be used although the PC boards are recommended. We didn't mount the relay on the PCB as it can vary in size and if the unit is later used with a modulated beam, the relay will not be needed.

The only adjustment on the unit is the sensitivity control and this should be set to give reliable operation. The transmitter needs a supply voltage of 8 V to 20 V at about 5 mA. This could come from the regulated supply on the receiver board.

If it is required to extend the effect of a quick break in the beam or a quick burst from the transmitter, the resistor R9 can be replaced by C4 and this will give a minimum operation time of about 1 second.

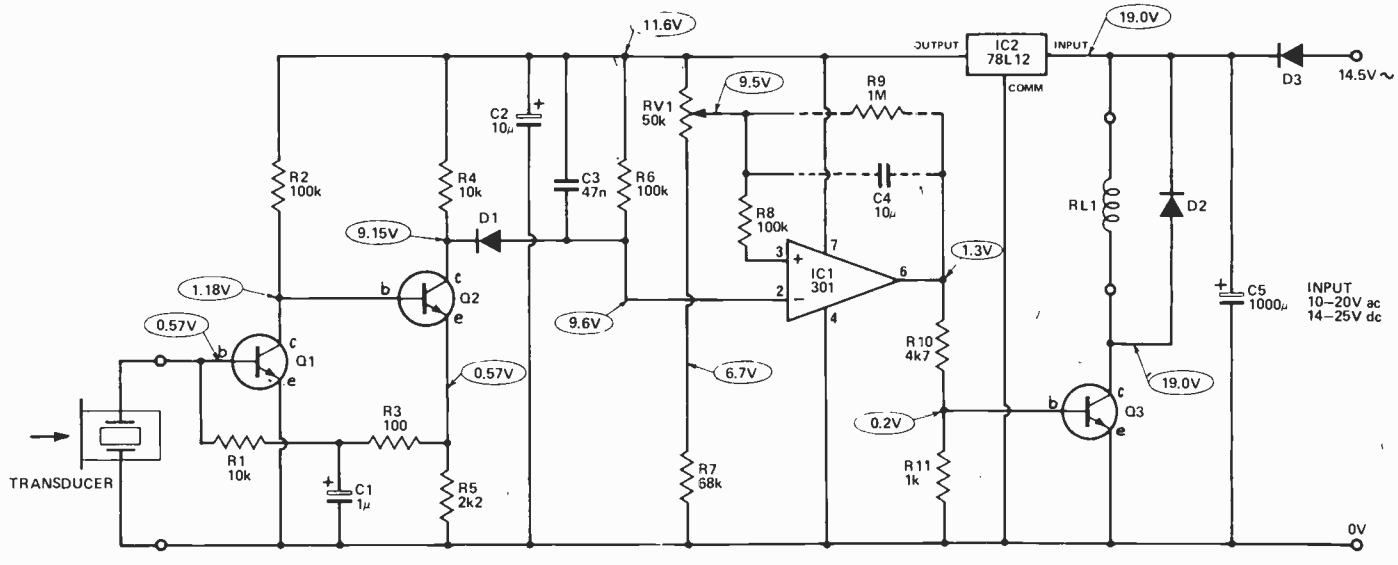


Fig. 1. Circuit diagram of the receiver.

NOTES:
VOLTAGES MEASURED WITH NO INPUT SIGNAL USING A VOLTMETER WITH 10 MEG OHM INPUT IMPEDANCE.
Q1–Q3 ARE 2N3904
D1 IS 1N914
D2,D3 ARE 1N4001
C4 IS USED INSTEAD OF R9 IF A MONOSTABLE ACTION IS REQUIRED.

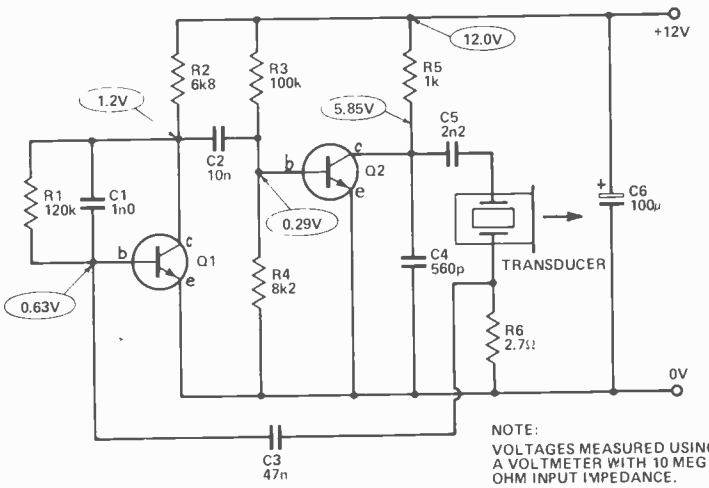


Fig. 2. Circuit diagram of the transmitter.

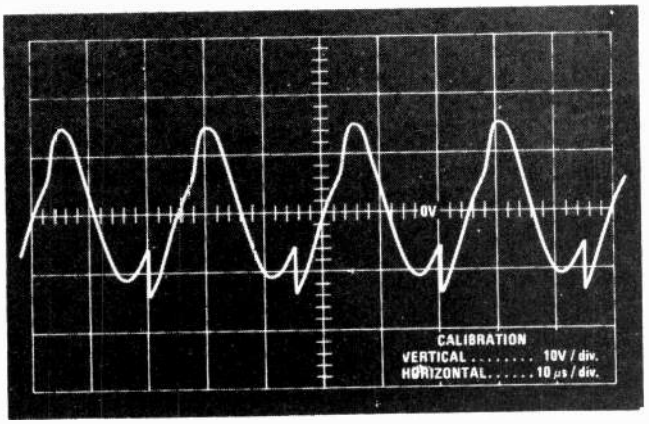


Fig. 3a. Waveform across the transducer on the transmitter.

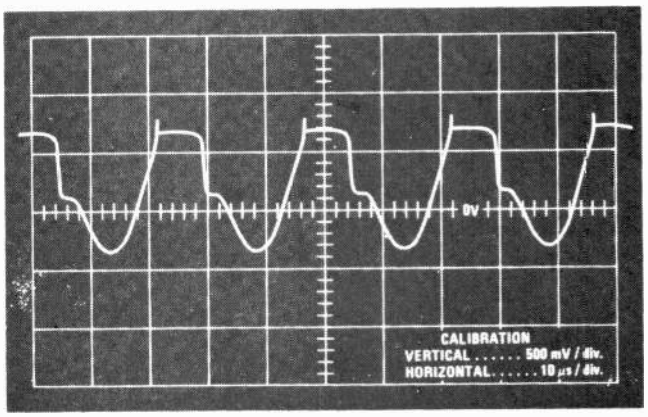


Fig. 3b. Voltage on the base of Q2 in the transmitter.

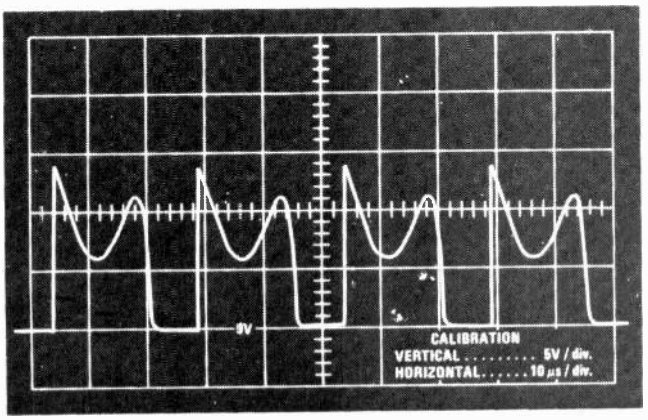


Fig. 3c. Voltage on the collector of Q2.

HOW IT WORKS

TRANSMITTER

This is an oscillator the frequency of which is determined by the transducer characteristics. The impedance curve of the transducer is similar to that of a crystal with a minimum (series resonance) at 39.8 kHz followed by a maximum (parallel resonance) just above it at 41.5 kHz.

In the circuit the two transistors are used to form a non-inverting amplifier and positive feedback is supplied via the transducer, R6 and C3. At the series resonant frequency this feedback is strong enough to cause oscillation.

Capacitors C1 and C4 are used to prevent the circuit oscillating at the third harmonic or similar overtones while C5 is used to shift the series resonant point up about 500 Hz to better match the receiver.

RECEIVER

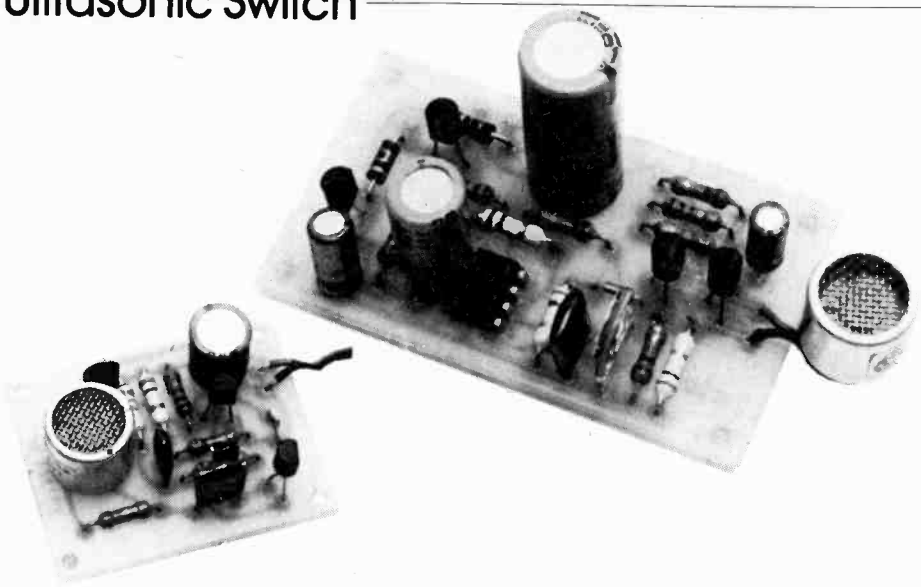
The output from the transducer is an a.c. voltage proportional to the signal being detected (40 kHz only). As it is only a very small level it is amplified by about 70 dB in Q1 and Q2. D C stabilization of this stage is set by R1 and R3 while C1 closes this feedback path to the 40 kHz a.c. signal.

The output of Q2 is rectified by D1 and the voltage on pin 2 of IC1 will go more negative as the input signal increases. If the input signal is strong the amplifier will simply clip the output, which on very strong signals will be a square wave swinging between the supply rails.

IC1 is used as a comparator and checks the voltage on pin 2, i.e. the sound level, to that on pin 3 which is the reference level. If pin 2 is at a lower voltage than pin 3, i.e. a signal is present, the output of IC1 will be high (about 10.5 volts) and this will turn on Q3 which will close the relay. The converse occurs if pin 2 is at a higher voltage than pin 3.

A small amount of positive feedback is provided by R9 to give some hysteresis to prevent relay chatter. If R9 is replaced by the capacitor C4 the IC becomes a monostable and if the signal is lost for only a short time the relay will drop out for about 1 second. If the signal is lost for more than 1 s the relay will be open for the duration of the loss of signal.

We used a voltage regulator to prevent supply voltage fluctuations triggering the unit. The relay was not included on the regulated supply, allowing a cheaper regulator to be used.



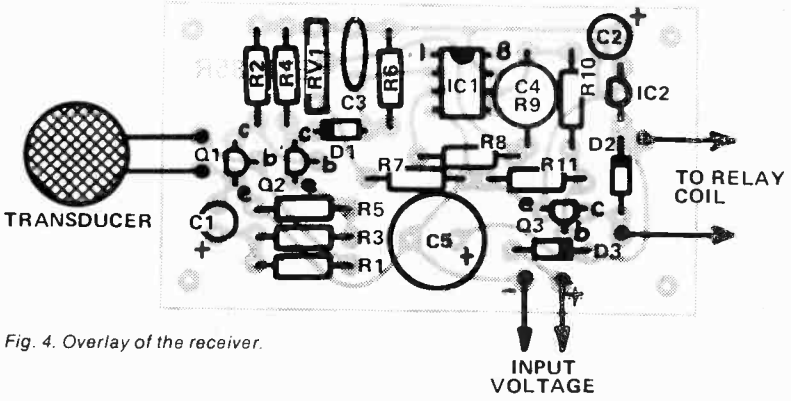


Fig. 4. Overlay of the receiver.

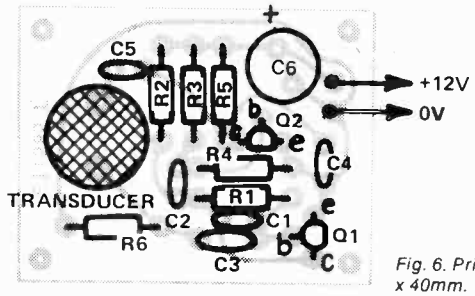


Fig. 5. Overlay of the transmitter.

Fig. 6. Printed circuit board of receiver. Full size 70 x 40mm.

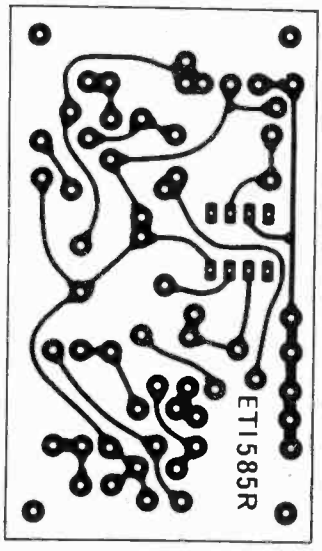
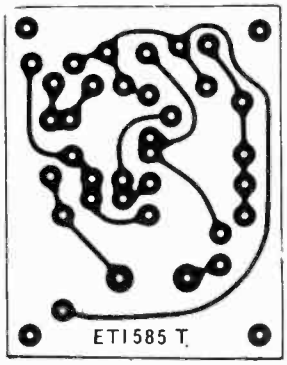


Fig. 7. Printed circuit board of transmitter. Full size 46 x 36mm.



RECEIVER

RESISTORS all ½ W 5%

R1,4	10k
R2,6,8	100k
R3	100R
R5	2k2
R7	68k
R9	1M
R10	4k7
R11	1k

POTENTIOMETER

RV1	50k preset

CAPACITORS

C1	1u 25 V electrolytic
C2	10u 25 V electrolytic
C3	47n polyester
C4	10u tantalum
C5	1000u 16 V electrolytic

SEMICONDUCTORS

Q1–Q3	2N3904
IC1	LM301A
IC2	78L12
D1	1N914
D2,3	1N4001

MISCELLANEOUS

PCB as pattern, 40 kHz receiver, 12 V relay, case to suit

TRANSMITTER

RESISTORS all ½ W 5%

R1	120k
R2	6k8
R3	100k
R4	8k2
R5	1k
R6	2R7

CAPACITORS

C1	1n polyester
C2	10n polyester
C3	47n polyester
C4	560p
C5	2n2 polyester
C6	100u 25 V electrolytic

TRANSISTORS

Q1,2	2N3904

MISCELLANEOUS

PCB as pattern, 40 kHz transmitter, case to suit.

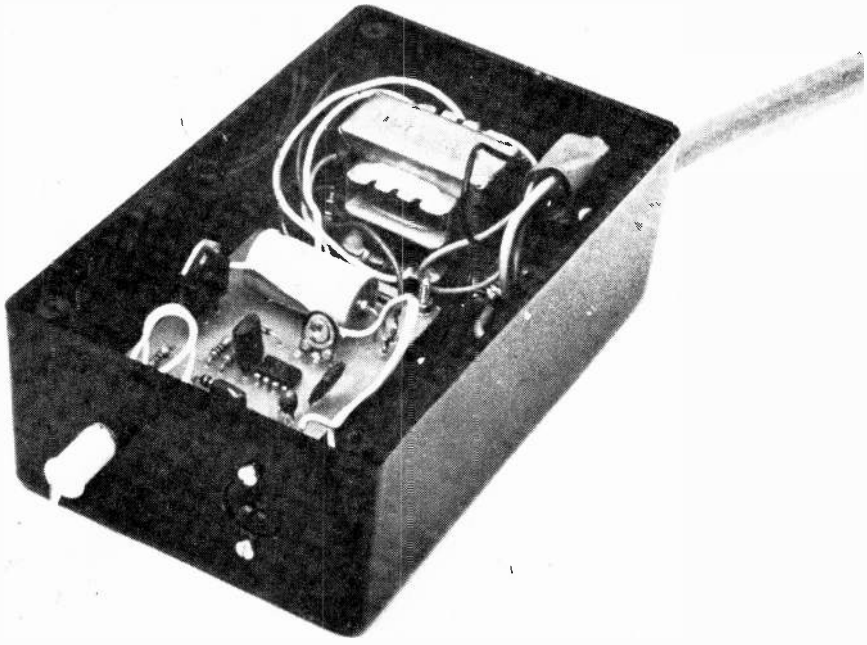
Kits and parts (including transducers) for this project are available from Dominion, see their ad in this issue.

SPECIFICATIONS

FREQUENCY	40 kHz
RANGE	5 metres
MAXIMUM MODULATION FREQUENCY (NOT WITH RELAY OUTPUT)	250 Hz
OUTPUT	relay, closed when beam is made
POWER SUPPLY	
TRANSMITTER	14–25 V DC 10–20 V DC
RECEIVER	8–20 V DC, 4 mA

Telephone Bell Extender

This simple project allows you to leave the phone unattended as you move about the house.



MANY TIMES WHILE you're working in the garden the phone may ring and by the time it is heard, if it is at all, it is often too late to reach the phone.

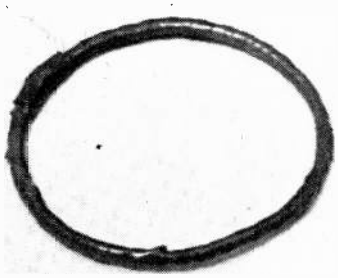
This bell extender will allow you to add, without touching the phone, an external bell, buzzer or speaker anywhere it is desired. When using a horn loaded speaker the sound level is high enough to be heard over high ambient noise making it ideal for the industrial environment.

ADJUSTMENT

There are two controls to be set, these being sensitivity and volume. The volume can be set first by rotating RV1 until the tone starts then adjusting RV2 to give the desired volume. To adjust the sensitivity first tape the sensor coil to the underside of the phone and then adjust RV1 until the sound stops. Note however that it should be rotated slowly as C3 gives a delay on switch off. Check that picking up and replacing the phone does not operate the alarm then have someone phone you to check that the phone signal does. It may be necessary to experiment with the position of the pickup coil to get the best results.

CONSTRUCTION

While any construction method could be used we recommend that the PC board be used and the overlay in Fig.3 be followed. The pickup coil was made out of 0.125 mm enamelled wire, although the gauge is not important,



with about 200 turns wound in a circle about 50 mm diameter. The wires can then be terminated to some thin plastic insulated wires (twin "speaker" wire is ideal) and then the complete coil wrapped with plastic insulation tape.

We built our unit into a small plastic box using an external speaker. The unit can be mounted anywhere suitable, taking care however with the 120V wiring. The speaker used will depend on the volume required with a large speaker producing more sound. If a horn speaker is used a very high sound level can be produced.

If it is required only to operate a buzzer the second IC can be altered to be an on-off device by deleting C5, R5, R6, D2 and RV2 and placing a jumper where C5 was.

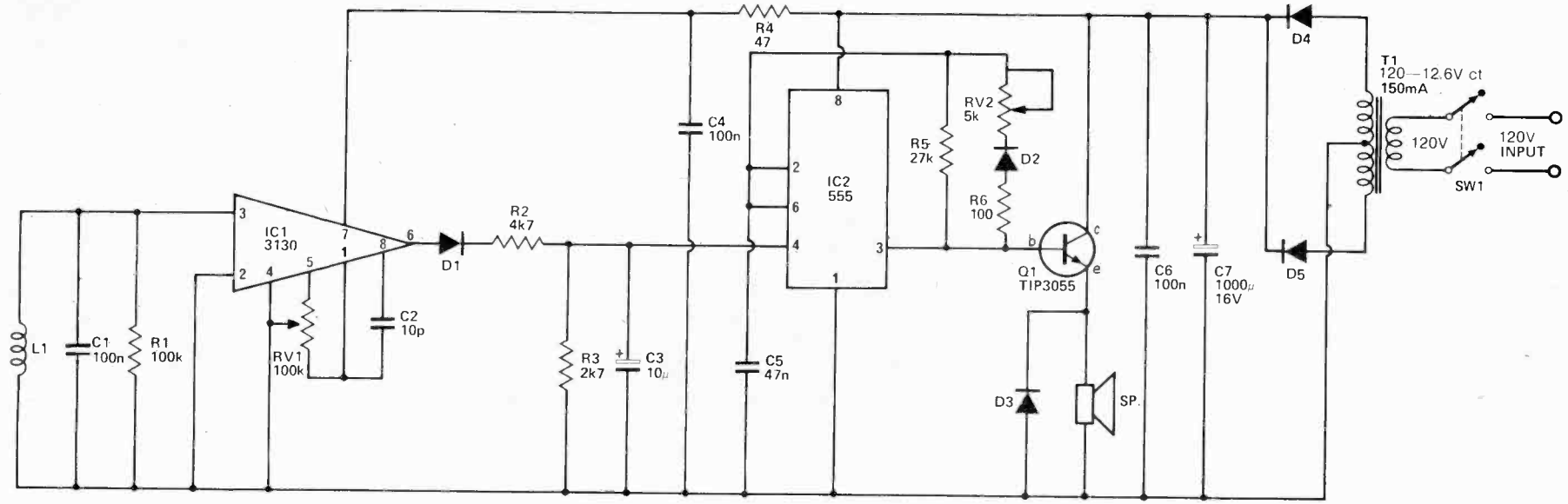


Fig. 1. Circuit diagram of the bell extender.

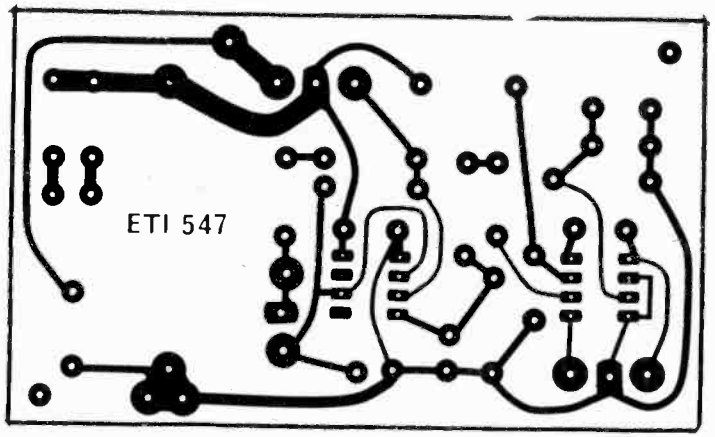


Fig. 2. Printed circuit layout.
Full size 91 x 53 mm.

HOW IT WORKS

Inside the telephone there is a solenoid which operates a striker which hits a pair of bells to give the ring tone. When it operates there is a high magnetic field generated and we detect this field to give the indication that the bell is ringing. To do this we use a wire coil under the telephone and use an IC to detect the presence of a signal. IC1 has its offset voltage adjusted by RV1 such that a slight positive voltage is needed to make the output go high. It is used in the open loop mode as a comparator only. The capacitor C1 is used to remove the unwanted higher frequency signals.

The oscillator used to operate the speaker is simply a 555 timer with a TIP3055 to buffer the output. The frequency is determined by C5 and the volume by RV2. Changing the volume does change the frequency slightly. Oscillation can however only occur if the voltage at pin 4 is greater than 0.6V. If the output of IC1 is low, R3 ensures that pin 4 is less than this voltage. However when the bell rings the output of IC1 oscillates high and low in time with the ring tone of the bell. This lifts pin 4 high, allowing IC2 to oscillate and C3 holds pin 4 for a short time to prevent the oscillator turning on and off at the ring tone frequency.

The power supply is a simple full wave rectifier with no regulation with IC1 being decoupled further by R4 and C4. Batteries could be used but the drain is reasonably high.

PARTS LIST

Resistors all ½W 5%
R1 100k
R2 4k7
R3 2k7
R4 47
R5 27k
R6 100

Potentiometers
RV1 100k trim
RV2 5k trim

Capacitors
C1 100n polyester
C2 10p ceramic
C3 10µ 16V electro
C4 100n ceramic
C5 47n polyester
C6 100n ceramic
C7 1000 µ 16V electro

Semiconductors
IC1 CA3130
IC2 NE555
Q1 TIP 3055
D1-D5 1N4001

Miscellaneous
PC board
Transformer 120V — 12.6 V ct
On/off switch, line cord
Box, speaker, pickup coil

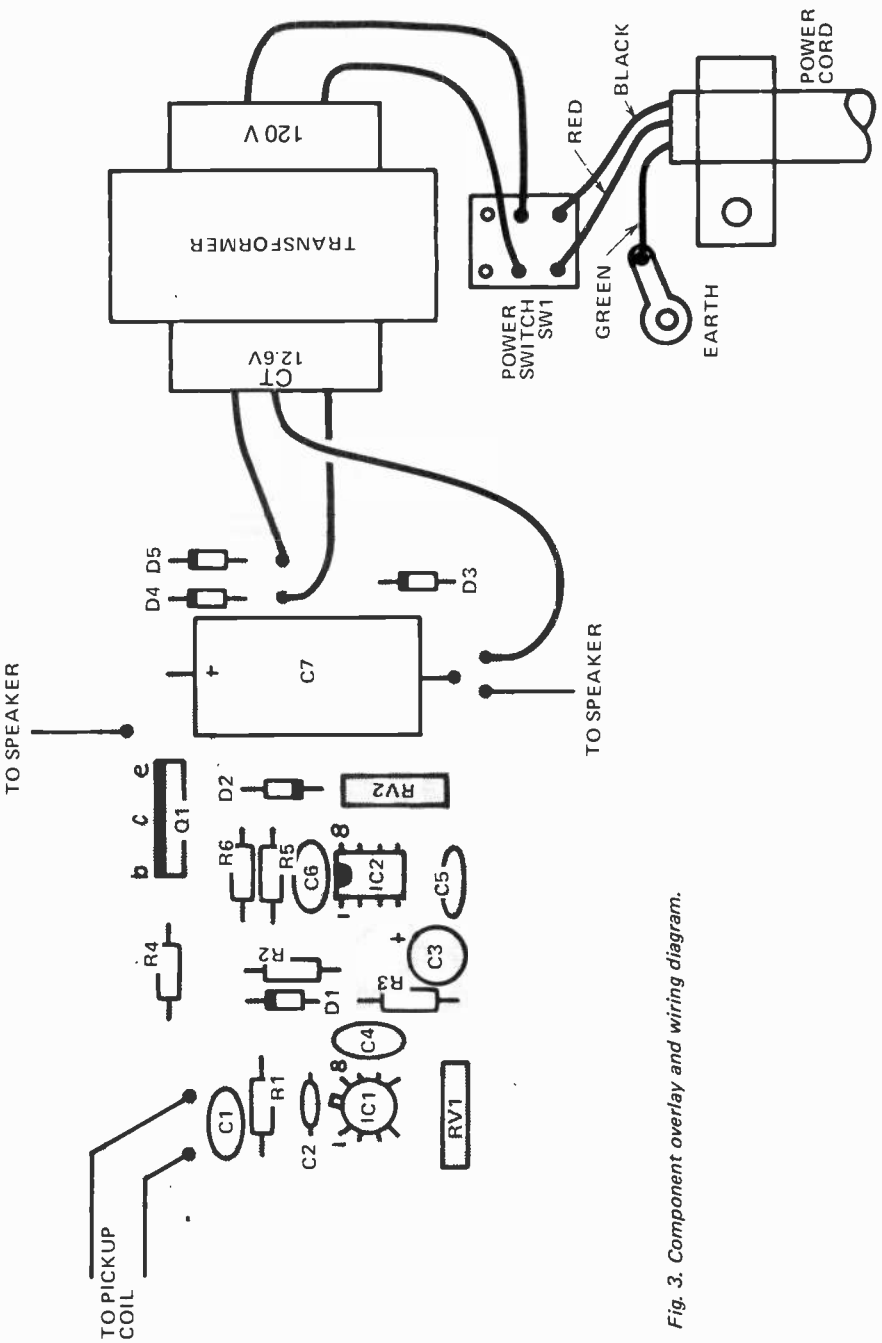


Fig. 3. Component overlay and wiring diagram.

ER, IT'S GOT A SLIPPED DISK ...

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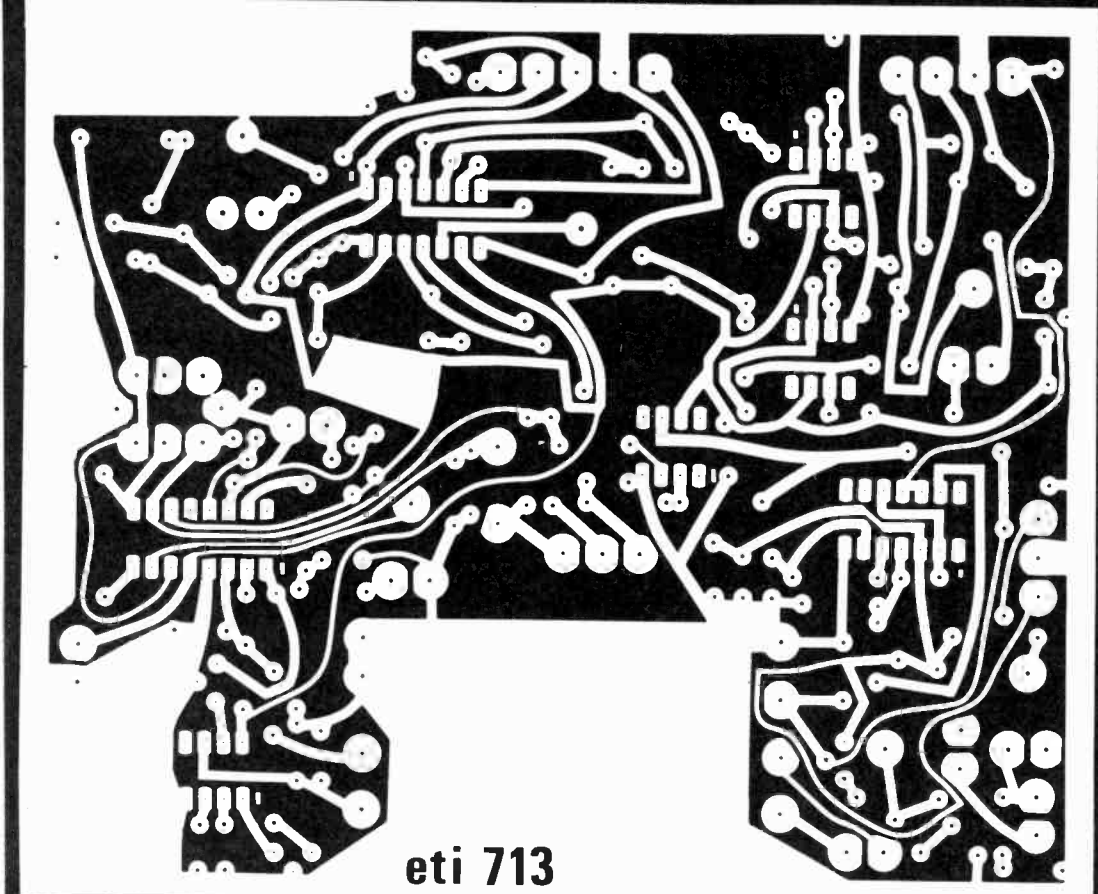

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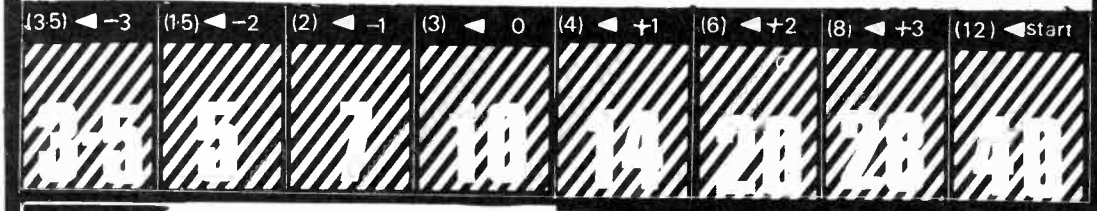
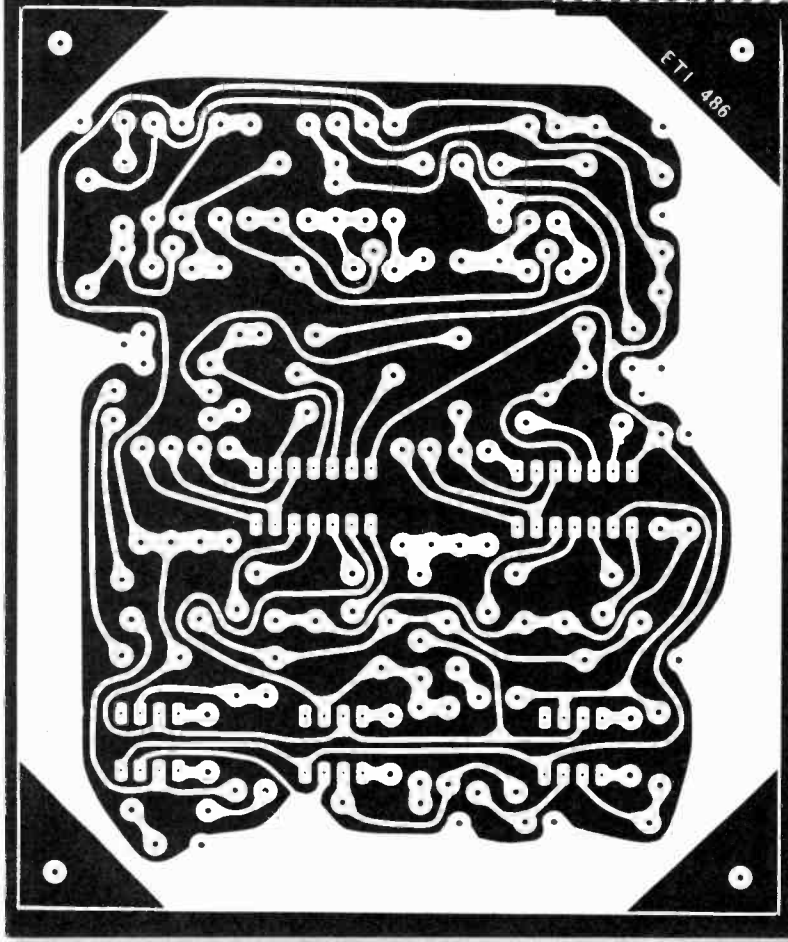
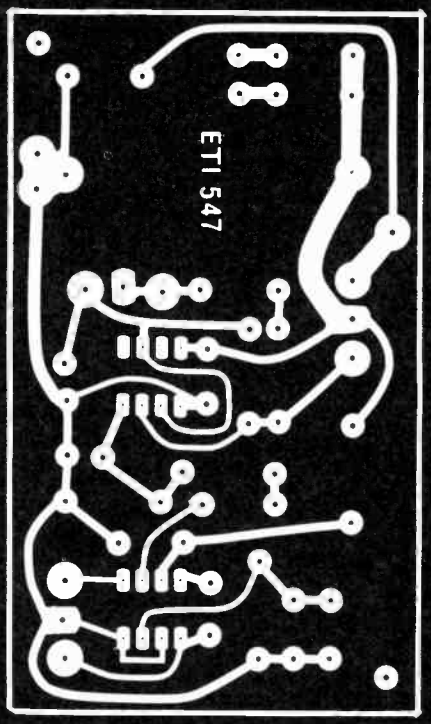
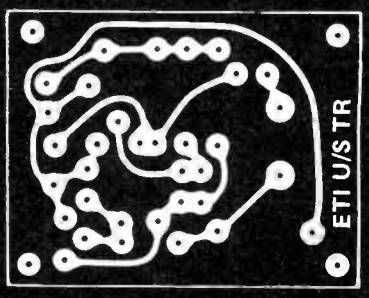
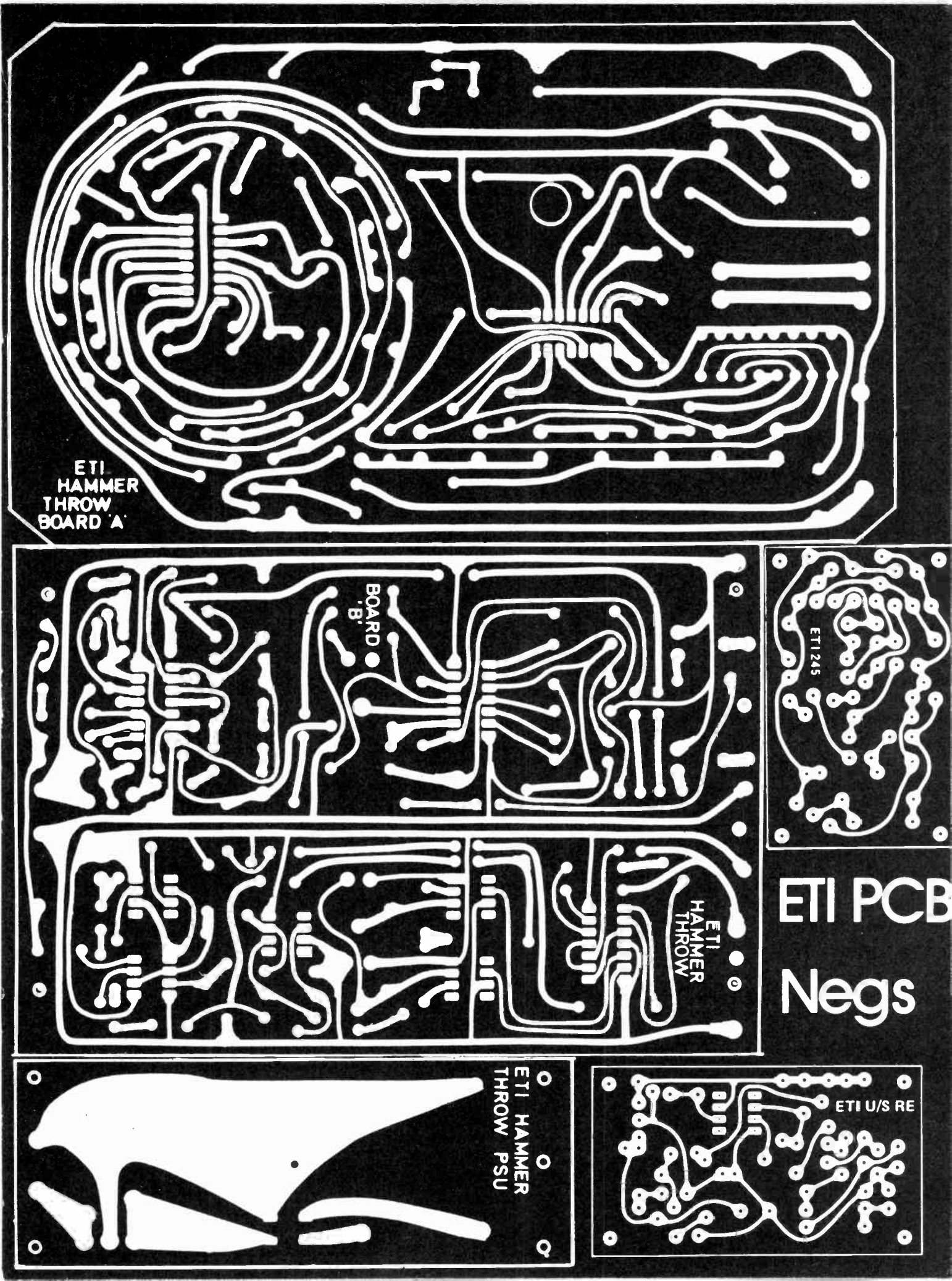








HERE WE present negatives for May and June issues, plus Hammerthrow from March, minus the Audio Spectrum Analyser. We didn't feel tht the double sided Analyser boards are really suited to this method of production. These negs can be used with presensitized boards (eg. Injectoral). Typical exposure times under a No. 2 photoflood bulb with reflector at ten inches we expect to be around 20 minutes. Use test strip to make test exposures to find optimum exposure for your setup. Full details were given in Jan. 78 ETI.


ETI HAMMER THROW BOARD 'A'
BOARD 'B'
ETI HAMMER THROW
ETI 245
ETI HAMMER THROW PSU
ETI U/S RE

ETI PCB Negs

Fluke 8020A: Meter for People

ETI staff were very pleased with this digital multimeter.

THE TRADITIONAL moving coil analogue scale multimeter which has served as prime tool for just about everyone involved with electricity is losing ground rapidly to comparatively new digital instruments. A widely held and generally valid, belief is that the reduction of moving parts from equipment and their replacement with electronics will result in improvement in performance and a quantum jump in reliability.

Early digital voltmeters were rather large, to say the least but of course we have all seen the effects of Large Scale Integration over the last few years. The 8020A Digital Multimeter from the John Fluke Manufacturing Co. takes advantage of the benefits of LSI to produce a good quality and very functional multimeter which will fit in a pocket. (Well, a large pocket.)

The 8020A is designed to meet the demands placed on a portable digital multimeter used in the field: it must be reliable, unaffected by rough handling, easy to use, must be small and light, run from batteries, stay calibrated over long periods, and must be cheap. To fit this bill, the 8020A's designers chose to use CMOS LSI for the circuitry, coupled with a liquid crystal display in a tough plastic moulded case. In fact, the single chip in the meter is made by Intersil and is very similar to the 7107 described in ETI Canada in February 78; this approach means a low component count, hence reduced costs.

Model 8020A features a total of 26 measurement ranges of six quantities. These quantities are AC and DC voltage, AC and DC current, resistance and conductance. Figure 1 shows how the user selects each function and range.

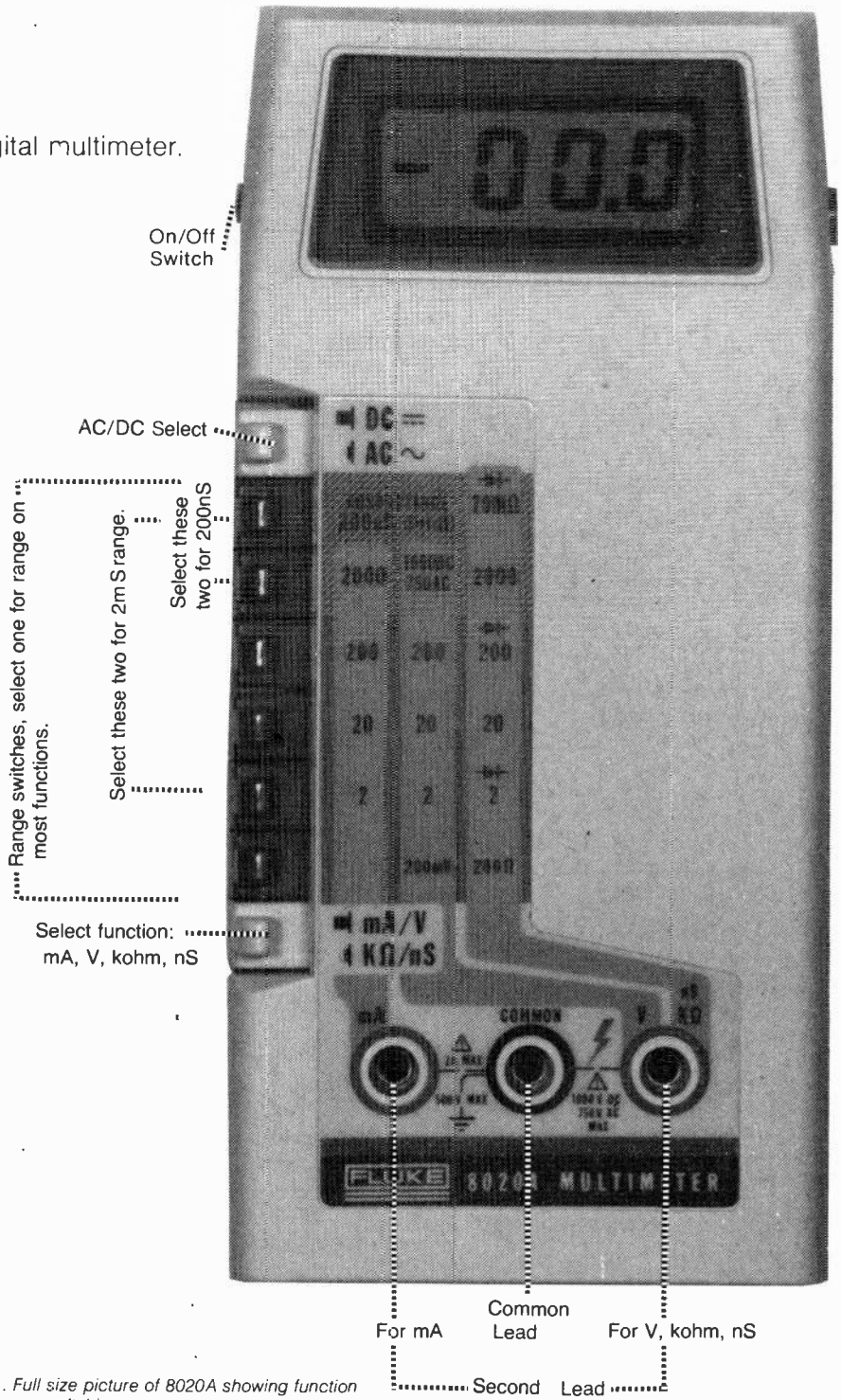


Fig. 1. Full size picture of 8020A showing function and range switching.

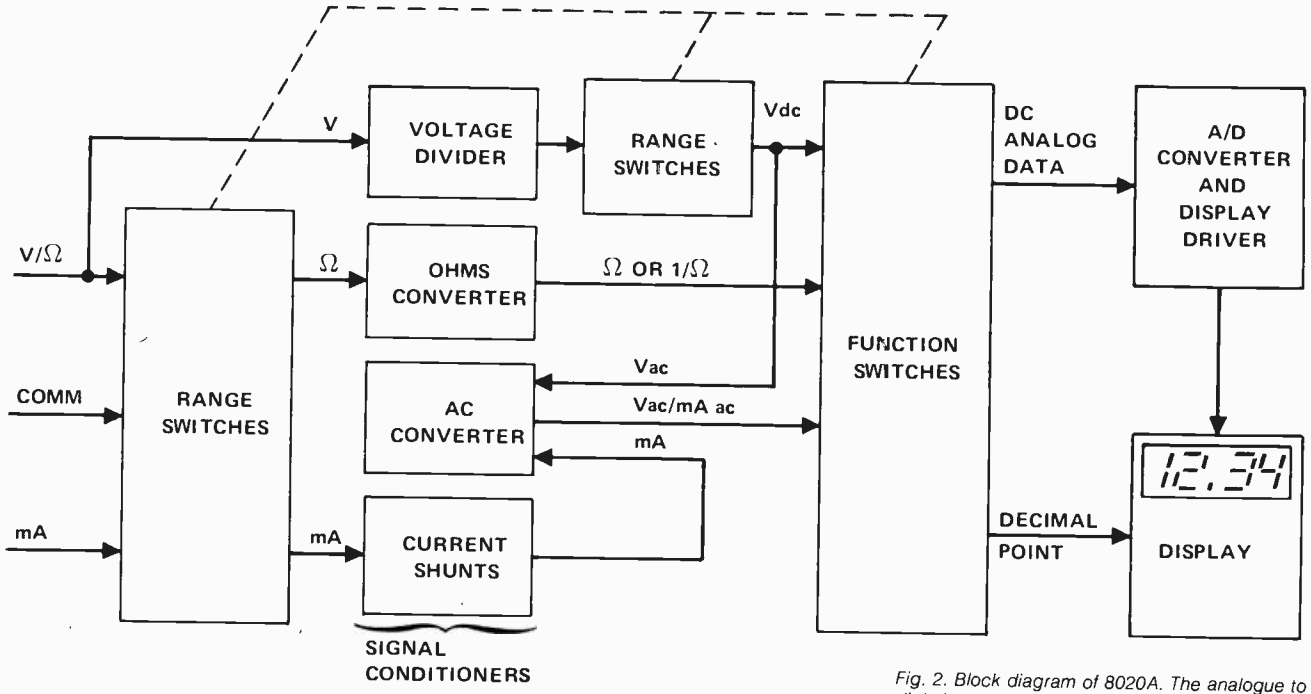


Fig. 2. Block diagram of 8020A. The analogue to digital convertor is the main intelligence block.

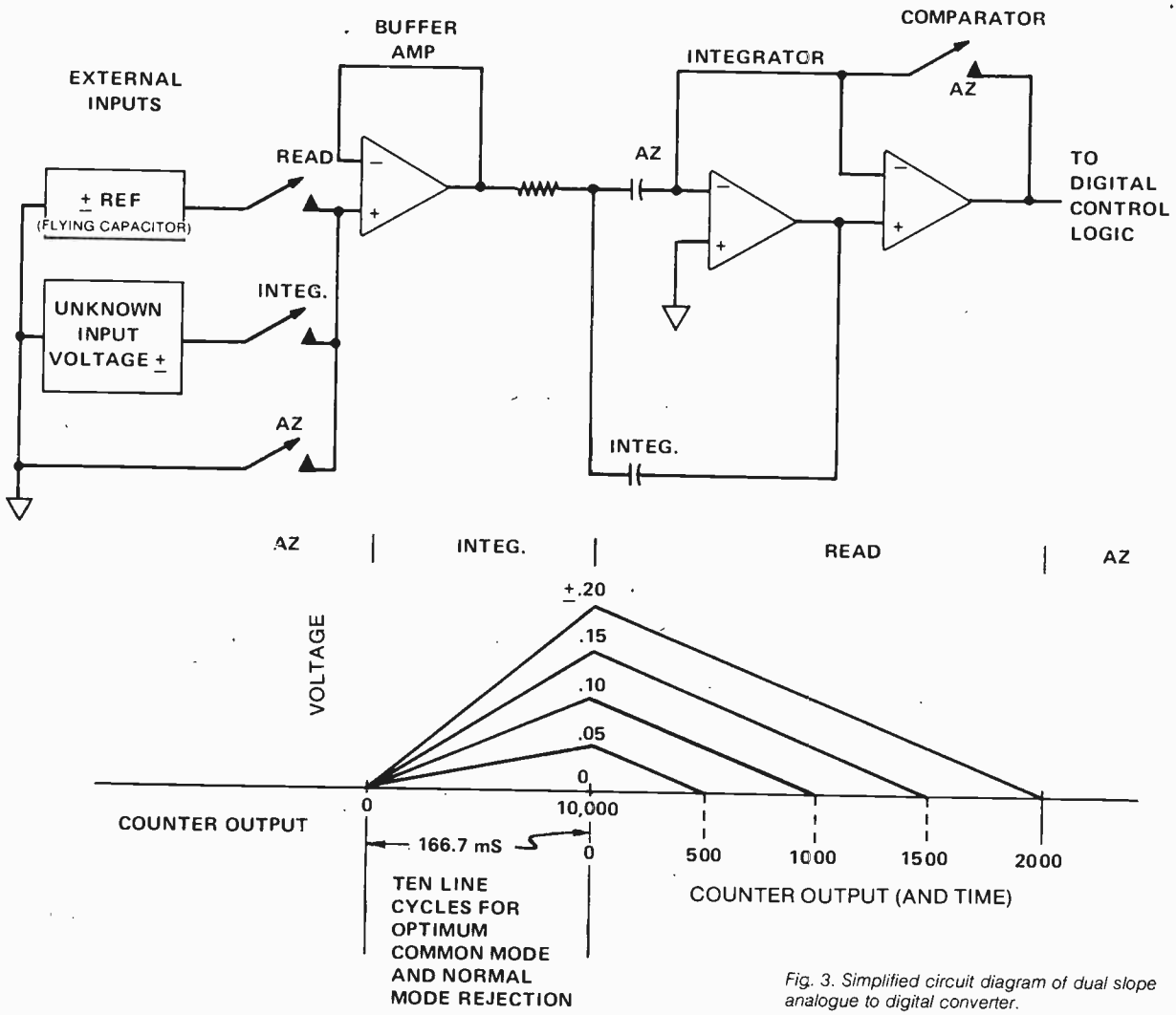
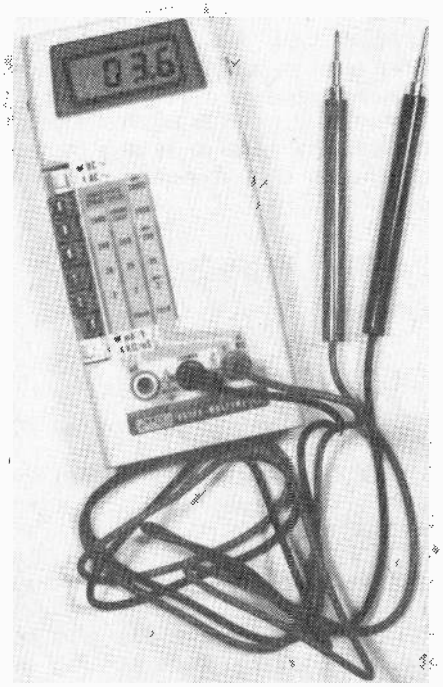


Fig. 3. Simplified circuit diagram of dual slope analogue to digital converter.



INTERNALS

A block diagram of the whole meter system is shown in Fig. 2. The purpose of the entire "front end", switches and "signal conditioners" is to convert the input signal be it voltage, current etc. to a voltage in a suitable range for feeding the analogue to digital converter chip.

A/D AND DISPLAY

A special chip was developed by Intersil in conjunction with Fluke to handle the functions of converting the analogue signal to digital form, displaying the result on a liquid crystal readout, plus taking care of autopolarity and overflow etc.

The basic functions of the convertor itself are shown in Fig. 3. The well known "dual slope" method is employed.

At the start of a measurement cycle the entire circuit is "zeroed". Then the integrator "ramps up", integrating the unknown (in this example positive) input voltage for 10,000 counts of the crystal controlled 3.84 MHz clock. At the end of this period a set of counters start counting while the integrator ramps down integrating a (in this case negative) reference voltage. When the integrator reaches zero the count is latched into the display section of the chip, and the cycle starts afresh.

The main advantages of the dual slope method itself are two fold. First, both unknown and reference voltages are fed through the same circuit, so any offset cancels. Secondly, the output is a convenient numerical format.

In the 8020 in particular a number of nice features are incorporated. The clock frequency was chosen so that an exact number of AC line cycles (60Hz) would be contained in the measurement period. Thus any 60Hz AC "hum" in a DC measurement will cancel. The integration period may be 1000 or 10,000 cycles, to give the flexibility of either +/-0.2V or +/-2.0V ranges into the A/D converter. Finally, in order to measure conductance (inverse of resistance) a special switching arrangement allows interchanging the unknown input and reference voltages.

The 8020A gave us the impression it was very professionally human-engineered. Even the feel was right, you get the idea that by pushing the right buttons you could get Scotty to beam down onto your workbench.

Having become accustomed to the convenience and accuracy of digital meters in general, the addition of battery powered portability is a big improvement, not only where AC power is not available (in the car, boat, cottage, etc) but even on the bench it makes the meter easy to move around. In the middle of a complicated test sequence when the test prods won't quite reach you don't have to spend 10 minutes figuring out which five pieces of equipment would be easiest to move over. The 9V battery, by the way, lasts for 100 to 150 hours for a regular type or 200 hours for alkaline. The meter will work down to a battery voltage of 6V, and gives you a low battery indication warning you when you are into the last few hours of operation.

The display visibility is impressive, in fact Fluke went to some pains to maximize the contrast of the 3½ digit LCD readout. In addition the case is designed so that the display is tilted for better readability. On the back of the case is a flip out stand for even more angle, which may also be used for hanging the meter up, which can be very convenient.

Operation of the selector switches is straight forward after initially learning what they all do, and the meter may be operated and held with one hand.

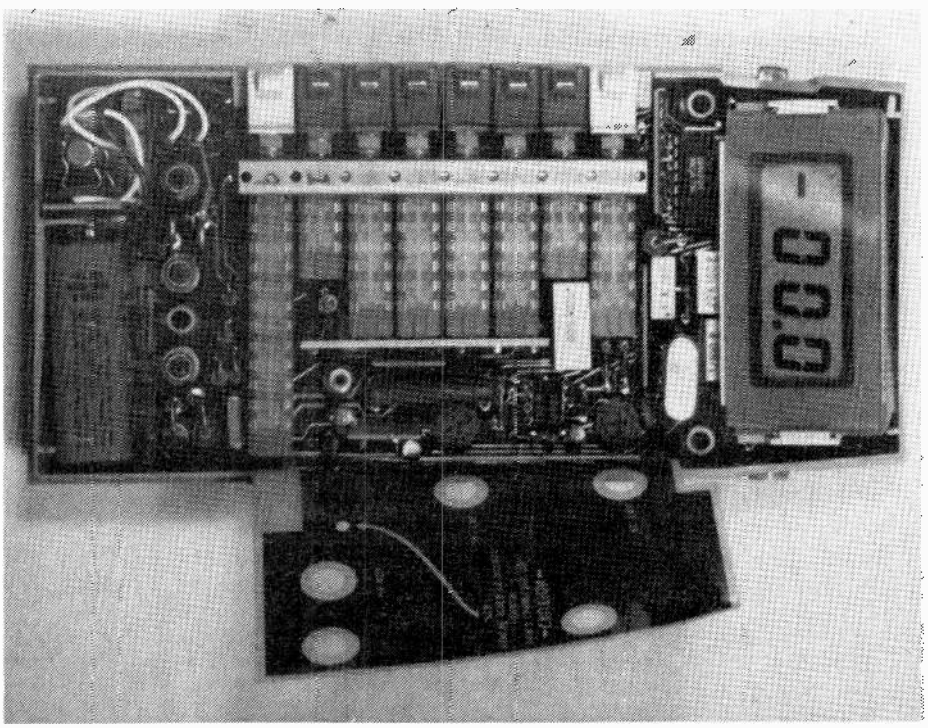
A useful assortment of probe tips is available. (Fig. 5).

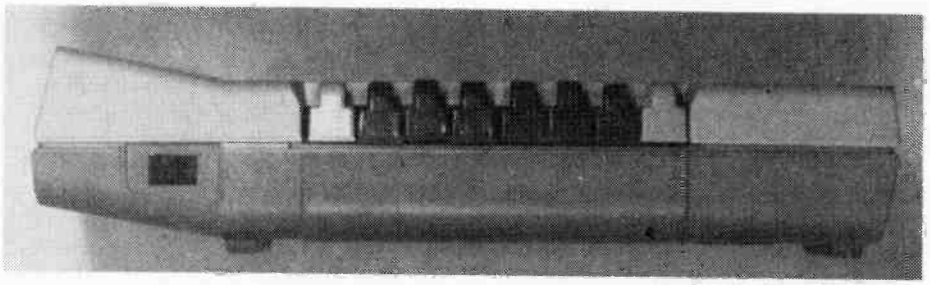
A calculator-style carrying case is handy to get and an AC adapter is available along with other accessories.

SPECIAL ABILITIES

Aside from the "ordinary" measurements this meter can perform, it does a number of handy things not at first evident. When testing resistance in circuits involving transistors and diodes, one can either select the ranges with the diode symbol, or those without. In the ranges with, the voltage applied to the circuit by the meter is large enough to forward bias and turn on diodes and transistors,

Fig. 4. Inside the meter is a compact PCB with all parts mounted upon it.





whereas in the "without" ranges, the diodes and transistors remain off.

In order to measure large values of resistance (above 20M) two conductance ranges have been included. Conductance being the inverse of resistance is measured in units of 1/ohm, formerly called "mho", now known as seimens of S. 1S is of course 1 amp per volt. Using the conductance range, and conversion chart supplied, resistances up to 10,000 M may be measured, without the usual noise problems associated with high resistance measurement. The conductance ranges are useful for measuring capacitor and semiconductor leakage, and of particular note, transistor beta may be read off directly (see below).

On the AC functions it is worthwhile noting that this meter measures accurately up to 5kHz on some ranges.

SUPER PROTECTION

As noted on the case of the meter, a very good protection circuit is incorporated. This allows up to 1000V DC or 750V RMS AC to be applied to the input terminals on voltage scales, 300V DC or RMS on resistance and conductance scales, with a 2A fuse for current range protection.

In addition the meter can handle at least 500V DC or RMS common mode, that is with respect to real ground. This enables the user to safely measure the voltage between two points which are at say 470.000V and 470.234V.

MANUAL

The manual provided with the 8020A adds to the impression that the Fluke people really want to help you measure, not just sell you a meter. The booklet starts with a "let's get to know your meter" introduction. Then follows very comprehensive information on using each measurement function, such as different factors for different AC waveforms, and any effects that the meter has on the circuit under test. It was most impressive to see the manual give complete instructions on constructing and using a tester attachment to determine type, collector-emitter leakage, and gain of a transistor, instead of trying to sell the tester as an accessory. (One resistor, one switch, one socket and one dual banana plug are all that's needed).

There are also chapters on the theory of operation, maintenance, testing, calibration, circuitry and information on accessories.

OVERALL IMPRESSION

Impressed.

SPECIFICATIONS

Some representative specs are given below.

DC VOLTS: Ranges +/- 200mV to +/- 1000V; Accuracy .25%; Input Impedance 10M.

AC VOLTS: Ranges 200mV to 750 RMS; Accuracy .75% to 5% according to frequency;

RESISTANCE: Ranges 200 to 20M; Accuracy .2% to 2% according to range.

CONDUCTANCE: Ranges 2mS, 200nS; Accuracy .3%, 2%.

DC CURRENT: Ranges +/-2mA to +/-2A; Accuracy .75%.

AC CURRENT: Ranges 2mA to 2A; Accuracy 1.5% to 2%.

Fluke products are available from: Allan Crawford Associates, with retail outlets in Toronto, Calgary, Vancouver and Montreal.

Fig. 5. Handy probe tips are available as accessories.

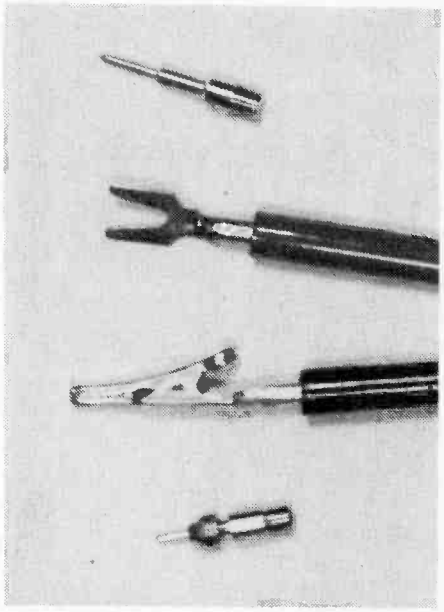
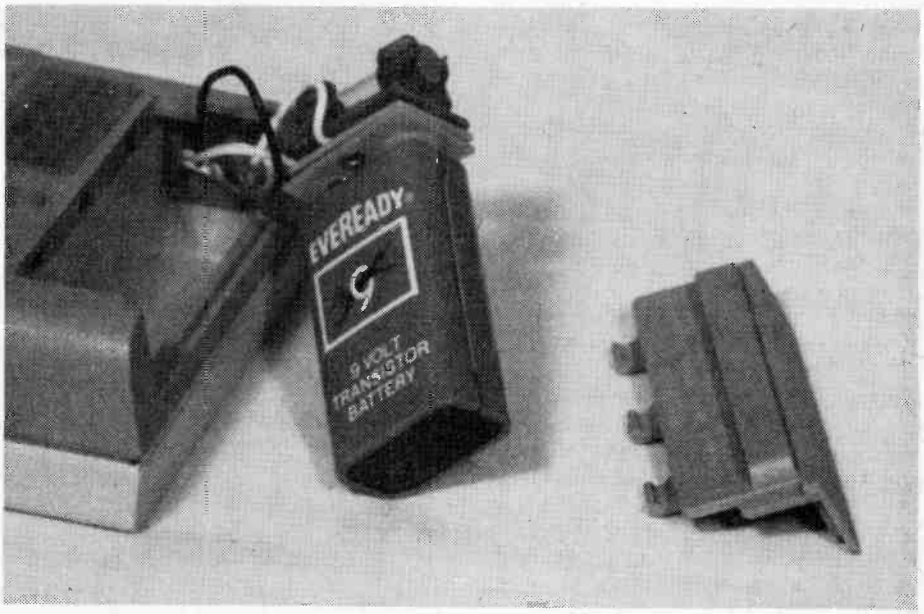


*Fig. **6.** This is about the only fault we can find in this product. The battery and fuse connector arrangement is a little messy, not up to the "niceness" of the rest of the meter but quite useable.*



LOOK WHAT YOU'VE BEEN MISSING

Since we started publishing ETI in Canada the circulation growth has been dramatic. That means that there's thousands of our readers who have missed some terrific issues. The issues we can't supply are March 77, April 77 and August 77.

The chart shows just the main features and projects in the various issues we have available, but for some months we are selling out fast so you'd better hurry and get your copies now. Just send us $2 (not cash) for each issue you require, to ETI BACK-NUMBERS, Unit 6, 25 Overlea Blvd., Toronto, Ontario M4H 1B1.

TGS812/813 Gas Sensors

Here's what you need to know about those nifty Figaro gas sensors.

THE TGS 812/813 are semiconductor gas sensors suitable for general purpose combustible gas detection. They are manufactured by Figaro Engineering.

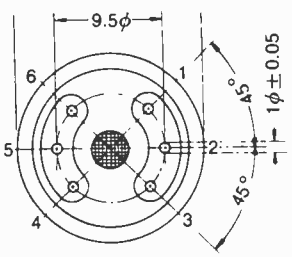
The sensor consists of a ceramic tube onto which is deposited a layer of the semiconductor (mainly tin dioxide) and the electrodes.

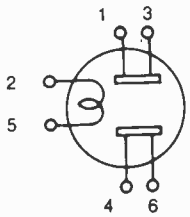
In fresh air the resistance of the semiconductor is constant, but as the concentration of the detectable gases increases and comes into contact with the sensor's surface, the resistance of the semiconductor changes.

In order to increase the response time of the device, the sensor is heated to a temperature between 200 and 400°C by a heated coil in the ceramic tube.

The sensitivity characteristics of the TGS sensors are altered by changes in atmospheric temperature and humidity. The detection principle of the sensor is based on chemical absorption and desorption of gases on the sensor's surface, and because these reactions are temperature dependent and water vapour can be considered a gas, the effects of temperature and humidity changes cannot be eliminated from the sensor. These effects can, however, be reduced by suitable circuit design (see Fig 7).

Livingstone Electronics has some Figaro sensors available (see their advertisement for address). Figaro Engineering Inc., has an office in the States their address is; 3303 Harbor Boulevard, Suite D-8, Costa Mesa, California 92626 U.S.A.





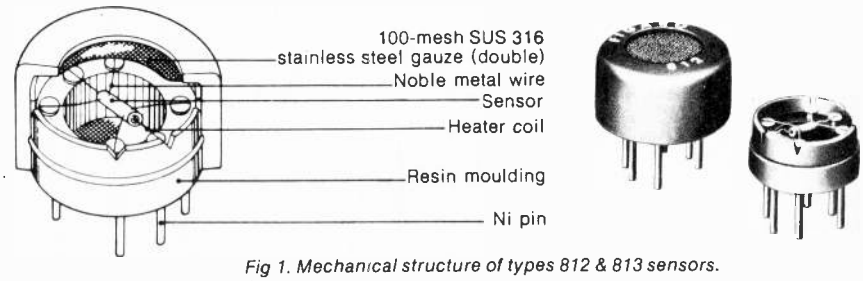


Fig 1. Mechanical structure of types 812 & 813 sensors.

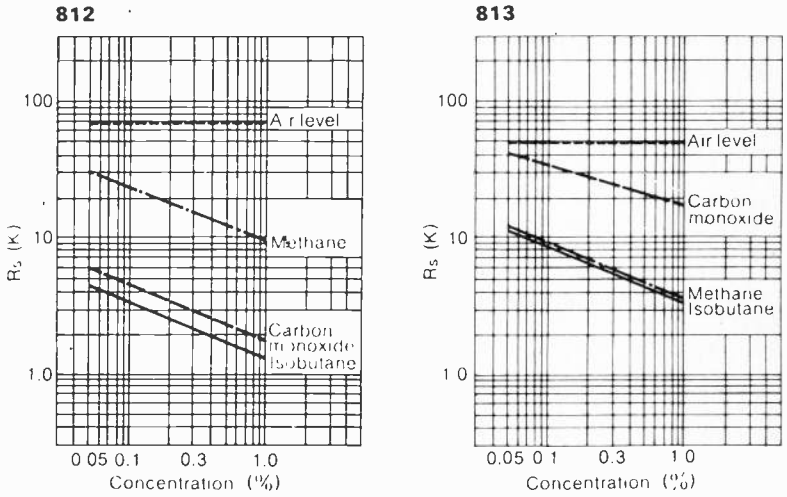


Fig 2. Sensor resistance (Rs) changes with different concentrations of gas.

TYPE NO.	TGS 812/813
TEST CONDITION	
(A) Circuit Voltage (VC)	10V (A.C. or D.C.)
(B) Heater Voltage (VH)	5.0V (A.C. or D.C.)
Heater Power Dissipation (PH)	Approx. 650mW.
(C) Load Resistance (RL)	4K
WARM-UP TIME	Approx. 2 min.
HEATER RESISTANCE (RH)	38±3
SENSOR RESISTANCE (RS)	1 — 10K in Isobutance 1000ppm/air

Fig 3. Sensor characteristics.

Sensor type	Electrical ratings	Applications and Features
812	Vc: (Max.)24V Vh: 5.0V	General purpose combustible gas detection. Carbon Monoxide detection. High CO sensitivity enables most types of smoke to be detected.
813	Vc: (Max.)24V Vh: 5.0V	General purpose combustible gas detection. Methane detection. High CH sensitivity makes it suitable for Natural Gas detectors.

Fig 4. Differences in sensitivities between 812 & 813.

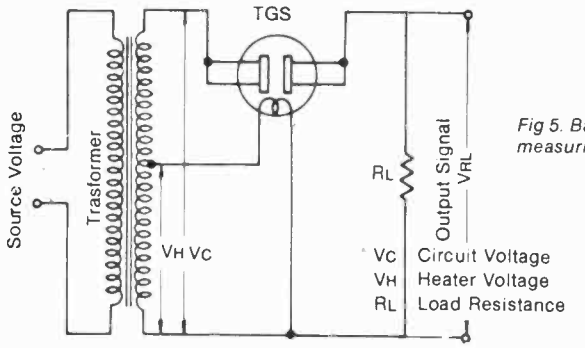


Fig 5. Basic test and measuring circuit.

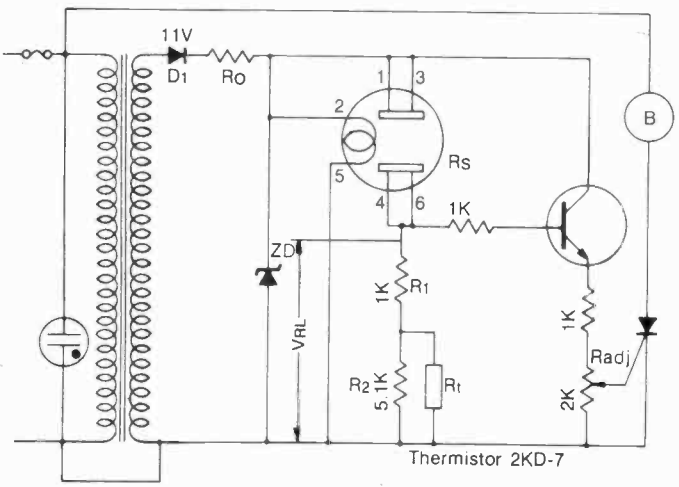


Fig 6. Circuit for use as a gas leak detector.

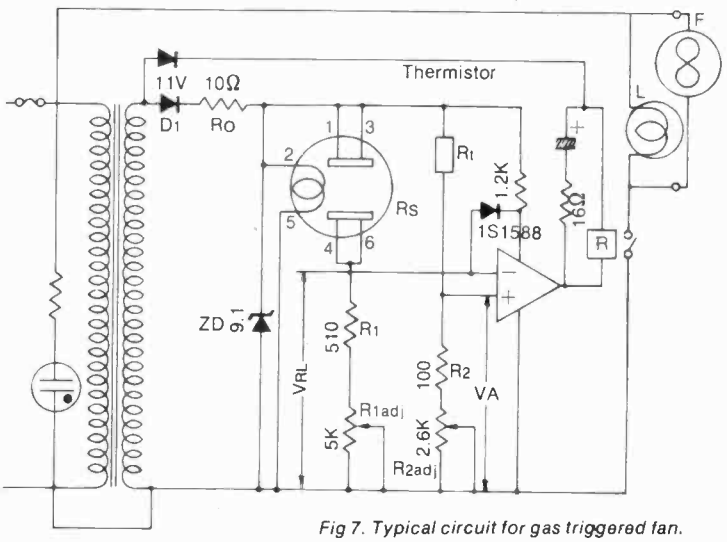


Fig 7. Typical circuit for gas triggered fan.

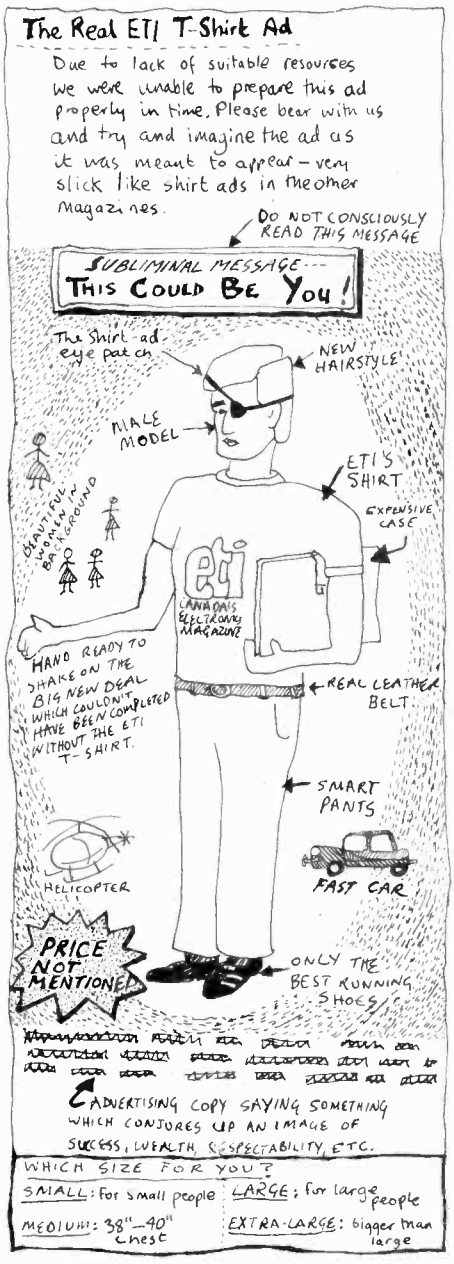
ETI T-SHIRTS

Just the thing to wear for your next job interview, for meeting the girlfriends' parents, seeing your bank manager, anytime you want to impress. Wear it now and order these quality Canadian-made products, made from fine-weave polyester-cotton. The shirts are coloured light blue with "ETI — Canada's Electronics Magazine" printed in navy blue.

To order your shirt just send $5.50 and size required to ETI T-Shirts, Unit Six, 25 Overlea Blvd, Toronto, Ont M4H 1B1. Do not send cash, and remember to include your name and address.

Special price for double orders: if you order two T-shirts you need only send $10. Prices include postage and handling.

Ontario residents add 4% PST.



Your Personal R2D2

The special effects used in Star Wars have amazed millions. Brian Matthews was inspired enough to build his own version of R2D2. Wally Parsons investigates.

"HOW TO LIVE WITH A ROBOT AND ENJOY IT"

THROUGHOUT THE HISTORY of humanity, one of man's major preoccupations, aside from murder, has been what might be called self replication. Statues and other figures, sometimes in the form of gods also created in man's image have always been with us, but especially fascinating has been the idea of creating life, or at least an imitation of it in human form, more or less. There is some reference to mechanical creatures in the Arabian Nights, although performance is attributed to magic, but the modern concept of a self-contained non-biological creature able to move about like a human being waited for the Industrial revolution and the development of science and engineering.

The word is really a Czech word meaning "worker" and first appeared in the English language in a play by Karel Kapec entitled "R.U.R." (short for "Rossum's Universal Robots"), in the mid-1930's. Since then, robots have been staples of science fiction where they have done everything from running complete space stations to playing winning baseball. Movies and television, leading from the rear, as usual, have finally caught on, giving us such things as a space Robinson Crusoe in which the most interesting character was a Robot, a six-million dollar robot, and even a robot cop (which is only reasonable, I guess).

And then "Star Wars". Even people who haven't seen the film know about the robots, just as a decade ago they knew about HAL, the computer of '2001: A Space Odyssey" whose functions made him, in a sense. But where HAL was awesome, R2D2 of "Star Wars" is positively cute and even cuddly. Even to the point where already an active market is developing for R2D2 dolls.

But what if a doll is not good enough. Maybe you'd like the real thing, or at least something pretty close to it. No problem. Just build you own. That's what Brian Matthews did, and the results can be seen in the pictures on these pages.

A MATTER OF PROPORTION

Wait a minute! It's all very well to say "build your own" but everyone knows that the original R2D2 carried a hefty five-figure price tag and was built with the resources of a large studio's full special effects department. But engineers design while inventors invent, and many an amateur has accomplished the impossible because he didn't know it couldn't be done.

Now, Brian has been fooling with radio controlled models for several years, and although he has no real knowledge of electronics and only a high school knowledge of mechanical engineering, he has learned how to make things work. Combine this with amateur boat building, and a sharp eye for detail, along with about a thousand dollars and another R2D2 is born.

A CASE OF ARTIFICIAL SYNTHETICS

When I fist saw Brian's creation on television I assumed that a lot of metal-working and plastics fabrication had gone into his construction. Imagine my surprise when I looked inside to discover *plywood*. And the surprise was magnified by the fact that in person R2D2 seemed to be a work of metal and plastic, even to a domed head looking for all the world like anodized aluminum. But this is where the boat builder's skill came into play. The basic body is in the form of a barrel, fabricated from cedar strips glued together to form the barrel shape. Internal components are mounted on a wooden frame which also provide re-inforcement for the body.

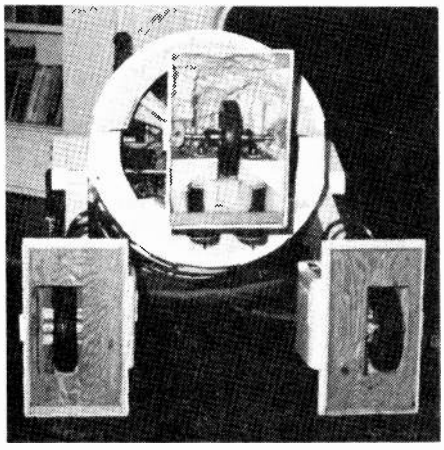
The dome head is the only real departure from the wooden construction, consisting of a single plexiglass dome ⅛" thick fitted to a plywood platform in the centre of which is the coupling which fits into a motor at the top of the body, and allowing the head to rotate. Fitted within the head are various lights, pulsating and otherwise.

R2D2

Sounds are produced by a means so simple as to be positively elegant: a cassette recorder fitted with a continuous loop tape and remotely activated. No synthesizers, no radio sound transmissions, just a recorder.

As for the locomotion, here some major departures are made from the original R2D2. While the latter used drive wheels in the base of each of the rear (side?) legs, and steered by rotating the front wheeled leg, Brian's version uses a front-wheel-drive system, although retaining the same steering system. Power is applied via 36:1 step-down gears from each of two 6 Volt motors mounted in the foot. These motors operate in forward or reverse, with two speeds available. The two side legs have wheels which are free-wheeling, and all have feet internally damped with expanded rigid styrofoam to provide sound deadening.

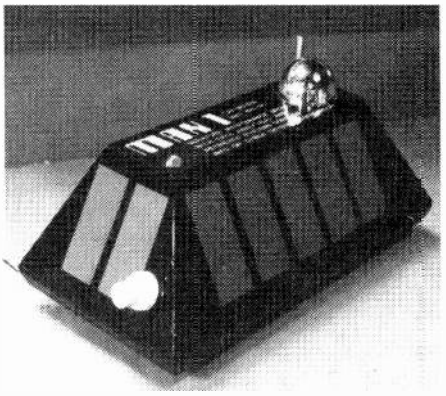
The two side legs are not articulated, that is to say they don't actually do anything except support the rest of the structure. The reason for this is quite simple: much of the design was dictated by parts availability.

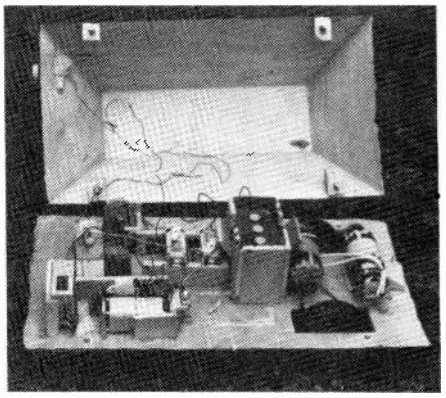


A rather "personal" view of Brian's R2D2.

WHAT YOU HAVE IS WHAT YOU GET

These conditions also dictated much of the rest of the design. Hobby shops, radio-control dealers, and the like, were the source of many of the component parts, and as many of ETI's readers in smaller towns are aware, you can't always get what you want, so you make do with what you have and what you *can* get. For example, since many of the controls were from radio control sources, this meant a 6 V supply, thus locking the builder into 6 V operation.





Max 1, the Box relative, inside and out.

Two power systems are used, one is a 6V 14 AH lead acide battery to provide power for the motors, lights, tape machine, and the other is a NiCd system for the radio control equipment. These are the familiar servo systems and are operated via two RC receivers.

The radio control system consists of two Kraft transmitters and receivers, each of which provides up to five channels, for a total capability of ten channels. Seven channels are used in this version, and they handle the following functions: Sound, Head Turning, Spot Light, Light, Speed, Forward-reverse, and Steering.

R2D2 (Brian's version) stands 3.5 feet high, weighs 43 pounds with batteries, and will run for 2.4 hours on a single battery charge. Finish is enamel, plus silver laquer (mostly for the dome). He (it? she?) was built over a three month period, with 300 hours actual construction time, and was completed on December 23, 1977.

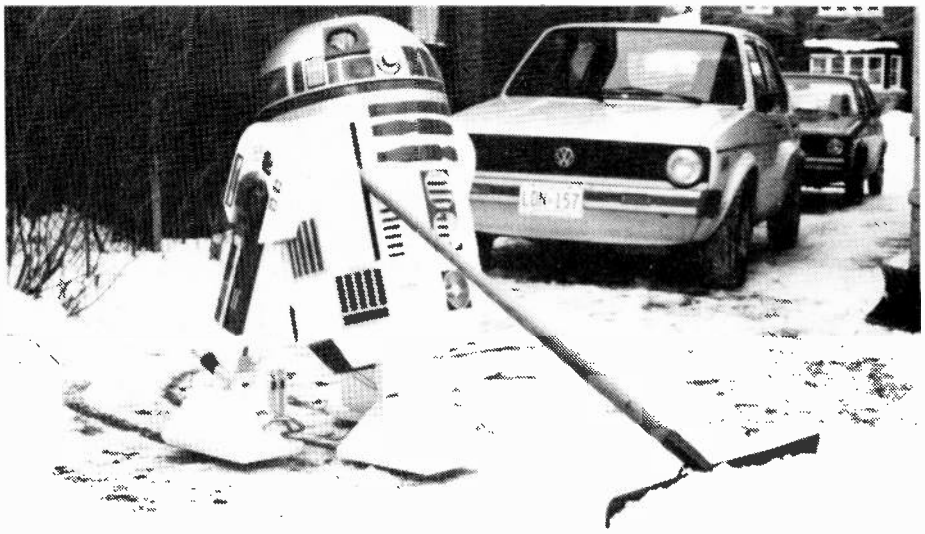
The little fellow seen in some of the pictures is named "Max" and was built by Matthew Brigden, a friend of Brian's and with whom he shares his RC hobby. Now Max is not exactly a "Star Wars" character, but was inspired by the Box robot that runs around the Imperial Death Star. When I first saw Max I immediately thought of one of those little dogs, all hair hanging down to the floor, and a little red tongue sticking out. He makes a great pet, and was built along the same general principles as R2D2. Actually, Max was patterned along the lines of general impressions gleaned from the movie.

How about R2D2, where did his plans come from? Oh, he was designed from magazine photos.

Readers wishing to meet Brian Matthews and his robot, may from time to time encounter them (closely?) in the observation deck and the restaurant atop the CN Tower where they've been well received by visitors and staff alike. As for Brian's family's reaction, R2D2 occupies an honoured position in the living room.

Meanwhile, Brian's working on a new robot.

Imagine what fun magazine writers have thinking up captions for pictures like this!



The Real R2D2

Here's the inside story on the real (?) R2D2 built by mechanical wizard John Stears.

TWO VERSIONS of R2-D2 were made, one for Kenny Baker to fit inside and the three-legged radio controlled version. Our interest is centred on the radio controlled version.

R2 D2 has three forward speeds, but no reverse, and is steerable. Provision is made for the change from two legs to three legs by radio control, also when tilted the third leg drops automatically. The reason for this is that R2 would fall over if left on only two legs.

MECHANICAL

In order to achieve forward motion, the two rear legs have individual traction motors which drive twin inline wheels. Steering is via the front drop leg, with a proportional self centring servo unit. The twin wheels in the steering foot remain parallel to the other wheels during turns.

The front leg and foot can be retracted inside the body. When the front leg drops it is held at the correct distance by wires, R2-D2 can then move off at full speed.

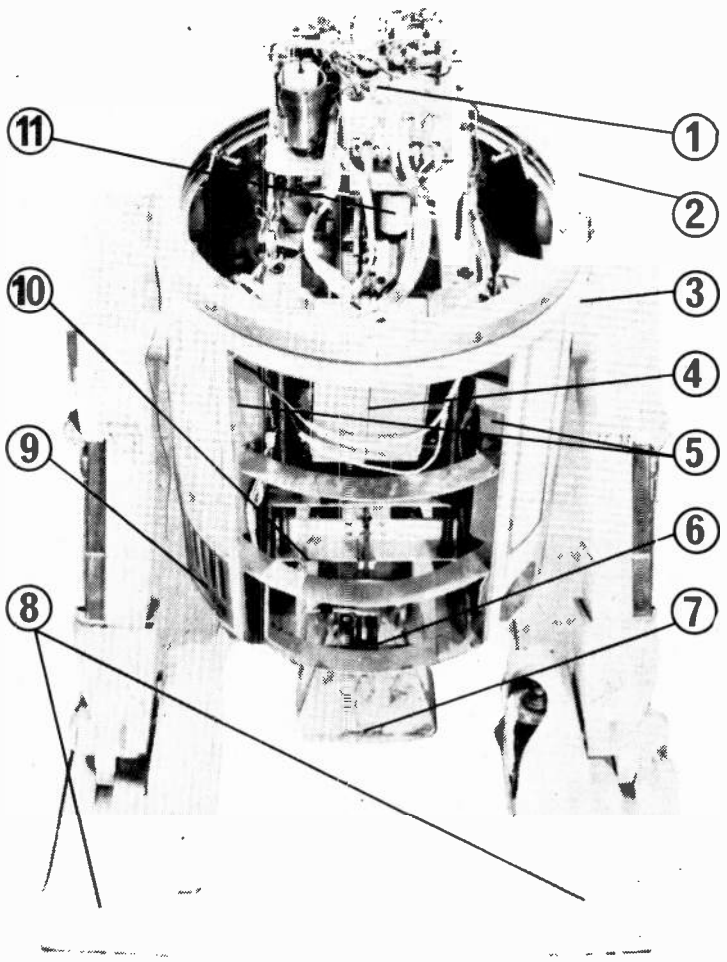
The casings for all the R2s were specially made by a company called Petric Engineering for the modest sum of $35,000, which may seem a trifle high — but they were precision pieces of engineering to the highest standard, in fact John Stears says they were excellent value.

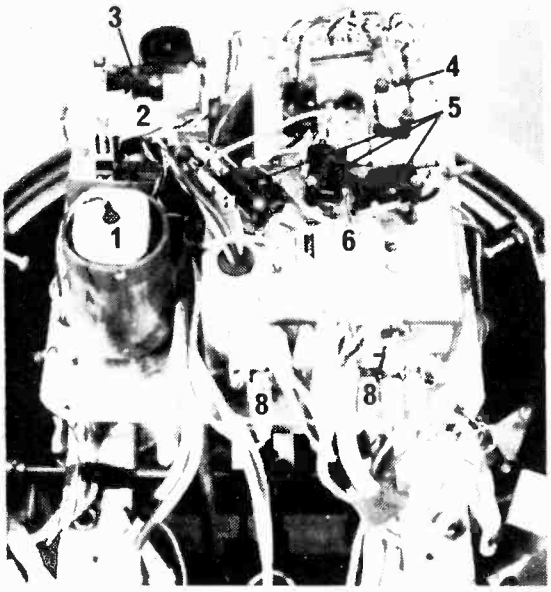
CLEANING UP

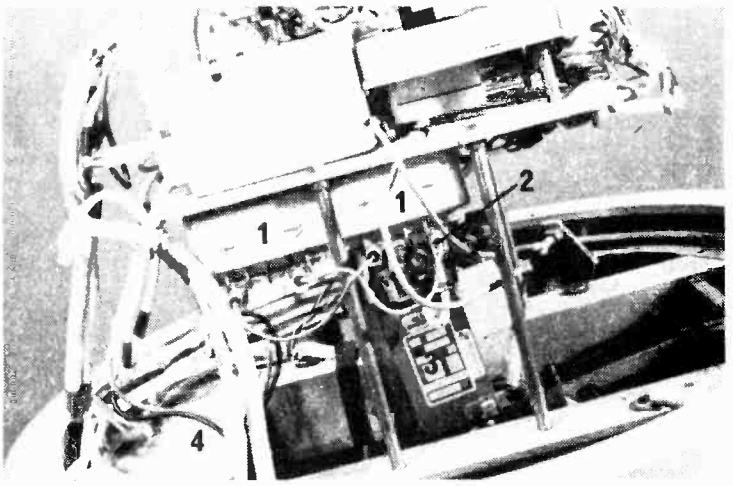
For several of the scenes R2-D2 was made to appear thoroughly blasted, or covered in grime. The only way was to virtually blast it in real life, and then clean up for the next shot. While in the Tunisian desert John Stears was also continuously cleaning real dirt and sand from R2, it got in everywhere!

GENERAL

1. *Radio control gear*
2. *Head Ring*
3. *Shoulder bearing*
4. *Two 6V batteries for lights and steering (removable)*
5. *Six 6V batteries for traction (not removable)*
6. *Headlight switch*
7. *Front foot (steering)*
8. *Rear feet (traction)*
9. *Radio on off switch*
10. *Leg drop (mechanical)*
11. *Leg drop (electrical)*





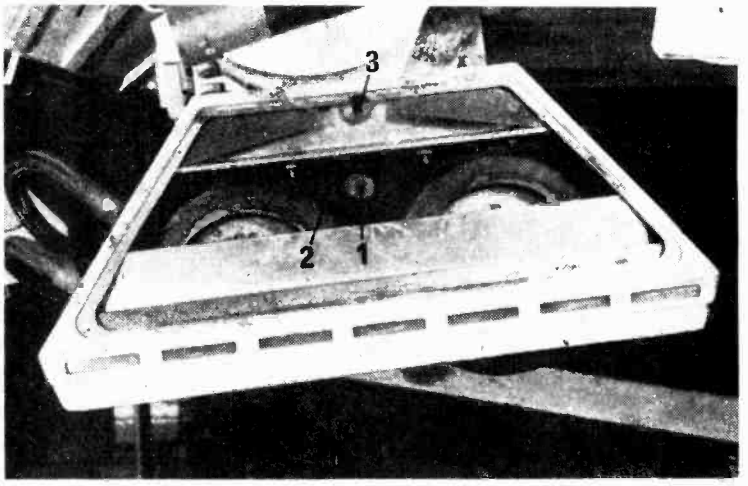


PULSATING LIGHT DRIVES

1. *Pulsating light control box*
2. *Pulsating light connections*
3. *Leg drop solenoid*
4. *Light and steering batteries*

RADIO CONTROL GEAR

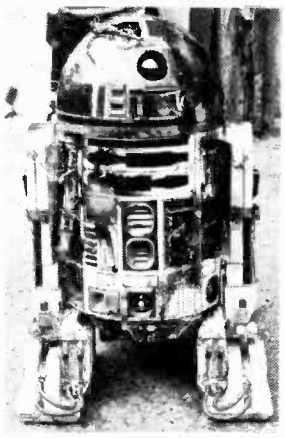
1. *Deac*
2. *Main receiver*
3. *Leg drop servo and microswitches*
4. *Steering servo and microswitches*
5. *Speed control microswitches*
6. *Speed control servo*
7. *Traction motor connections*
8. *Traction batteries charge terminals*

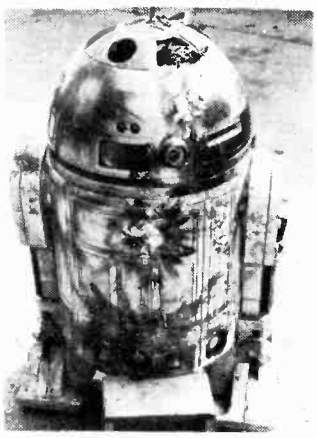


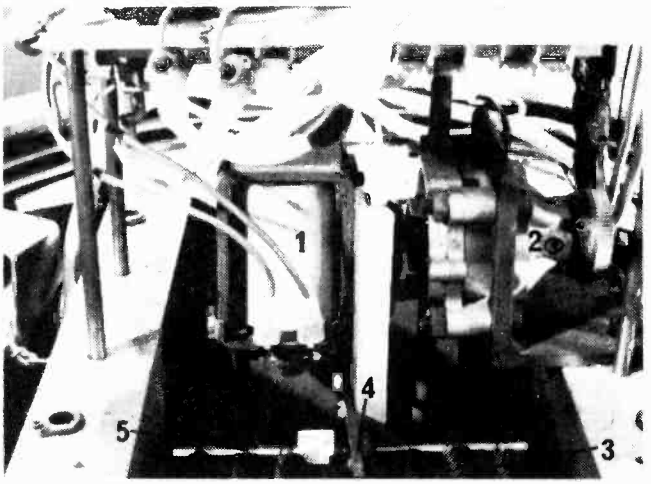
DRIVING FOOT

1. *Drive front gear box*
2. *Chain sprocket, both wheels in each foot driven by single chain*
3. *Foot retaining pin*

What a heartbreaking task - blasting such a beautiful piece of equipment!







LEG DROP

1. *Leg drop solenoid*
2. *Damper*
3. *Body tilt tension springs*
4. *Leg drop locking arm*
5. *Leg drop locking rod*

Air-Sea Battle

This challenging calculator game comes from "Calculatorist" Ken Wood of Goderich, Ontario.

MANY CALCULATOR games involve shooting at a target which may move in a variety of different ways. The fun in designing such a game lies in trying to simulate the movement and projectile characteristics of a real life situation. In this game Ken has included several features contributing to the skill needed and uncertainty encountered when ship and plane are engaged in "Air-Sea Battle". Ken describes his program.

Recently I purchased a Texas Instruments Model 59 magnetic card programmable calculator. Upon receipt of my machine I spent the whole day and most of the night poring over the 320 or so pages of documentation that are provided with the calculator. The following day I wrote the program which appears here in its revised form (each time I worked out a bug I discovered something I could add to make the game more interesting).

This program is based on a similar game program which was written in RPN for an HP-25 calculator. As a matter of fact, I first tried to translate the program directly from RPN to TI's algebraic notation. However, after puzzling over various unknown (to me) functions of the HP-25, not to mention the strange order that the recognizable ones were in, I decided to start from scratch. This turned out to be much to my advantage as far as ease of programming is concerned. Also, in writing the program specifically for the TI-59, I was able to add several distinctive features to the game which were not included in the original version of the game.

The set-up of the game is this: you are in a ship at sea, and there is an enemy dive bomber spotted at a preset distance (I use 1000 metres). The object of the game is for you to shoot down the plane before it gets a chance to drop a bomb on your ship. You "shoot" at the aircraft once every second (not real time, of course) by entering a range estimate in metres. The plane's speed is known to be between 100 and 200 m/s and therefore, if you used 1000 m as the initial range, your first range estimate would be somewhere between 800 and 900 m. After you have entered your range estimate one of the following things will occur:

1. If your range estimate is +/- 5 m of the actual range, you score a direct hit and ten '1's will flash in the display indicating that you have won the game.

2. If your range estimate is +/- 10 m of the actual range, you score a near hit and a single digit will flash in the display. This digit is the number of near hits you have scored during the course of the game. If you get five near hits before the plane's range reaches zero, that is the equivalent of a direct hit and ten '1's will flash in the display once again to indicate that you were victorious.

An interesting feature added to the game is the fact that each near hit you get slows the enemy plane down by 7 m/s. This must be taken into consideration if accuracy is to be maintained.

3. If the range reaches zero and you have not yet destroyed the plane, it will release its bomb. I have arranged it so that when this occurs there is a 90% chance that the bomb will hit and destroy your ship. This is indicated by a row of flashing '9's and means that you have lost the game. However, 10% of the time the gods will take pity on you and the bomb will miss the ship and land in the sea. When this occurs a single zero will flash in the display indicating that neither your ship nor the enemy plane was destroyed.

4. If your range estimate is off by more than 10 m and the range has not yet reached zero, then the calculator will display the approximate range error. The display will read 25, 50, 75, or 100. A display of 25 means that your estimate was off by between 10 and 25 m. A display of 75 means that your estimate was off by between 50 and 75 m, and so on. Any range error over 75 m causes a display of 100.

Originally my approximate range error was much more exact than this and also indicated whether the shot was

ETI Softspot

too far or too close. However, this made the game very easy as it took away the element of luck and so I altered it to the above. Now, no matter how meticulous you are in your calculations you can still end up treading water in the middle of the ocean, much to the delight of the enemy pilot.

Figure 1 shows a diagram of the main logic flow of my program. Using this as a guide it should be fairly simple to write a version of this game in the language of your particular calculator. The program for TI-58 or TI-59 is listed in Fig. 2.

Figure 3 is a copy of the User Instructions for the Air/Sea Battle program. This can serve as a guide for playing the first couple of games until you get used to the playing sequence. The numbers in brackets are the values I use for the various factors but it would be a good idea to experiment with different values until you find those which suit you best. When you have done this you might want to enter them directly into the program in place of the storage locations that I have assigned to them. This would eliminate the bother of having to enter the factors each time the calculator is used for the game.

In any case, I hope you will enjoy trying to annihilate the ominous enemy bomber before it succeeds in its attempt to convey your ship to the bottom of the sea. Bombs away!

SOFTSPOT is ETI's programmable calculator software department. We know there are many of you who have gone to a lot of effort to write routines for your machines — how about sharing the fun. Send us a copy of your pet program, preferably with flow chart. To make things interesting we will restrict our choices to only those programs making use of loops or conditionals.

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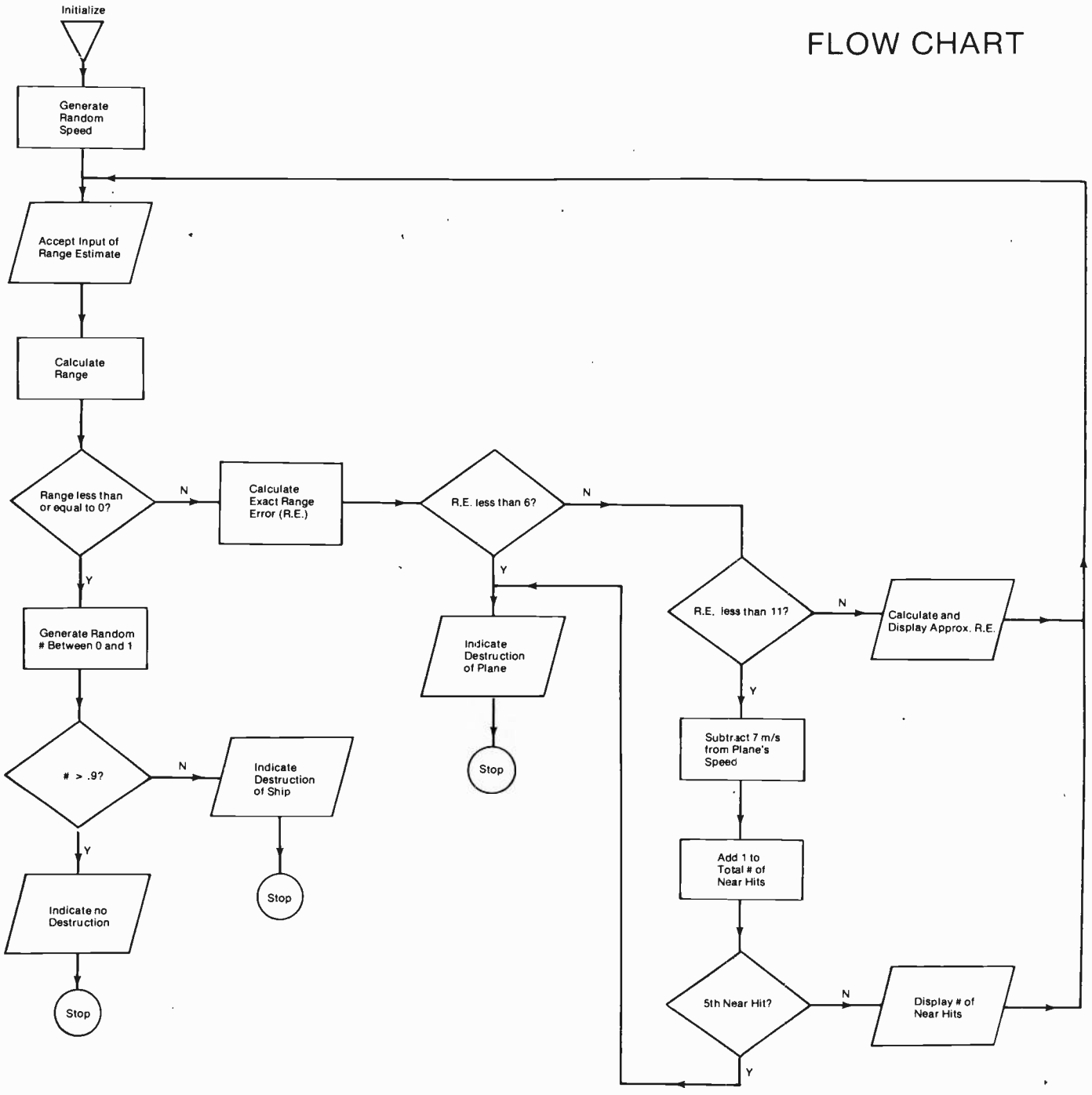
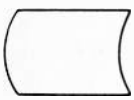
TORONTO, Ontario
M4H 1B1

Don't forget to mention what kind of calculator you use — and we'd also be interested to know where you bought it.

FLOW CHART

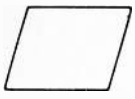


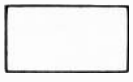
FLOW CHART SYMBOLS


Information Output


Branch


Program Entry Point


Data to be Input


Operations


End

PROGRAM

00	43	RCL	
	04	04	
	42	STO	
	03	03	
	00	0	
	42	STO	
	08	08	
	36	2nd Pgm	
	15	15	
	71	SBR	
10	88	2nd DMS	
	53	(	
	24	CE	
	65	x	
	01	1	
	00	0	
	00	0	
	85	+	
	01	1	
	00	0	
20	00	0	
	54	)	
	59	2nd Int	
	42	STO	
	01	01	
	25	CLR	Initalize
	16	2nd A'	
	76	2nd Lbl	
	11	A	
	42	STO	Store Range
30	02	02	Estimate
	53	(	
	43	RCL	
	03	03	
	75	−	
	43	RCL	
	01	01	Calculate
	54	)	and store
	42	STO	present
	03	03	range
40	01	1	
	32	x ↔ t	
	43	RCL	
	03	03	
	22	INV	
	77	2nd x ≥ t	Range ≤ 0?
	12	B	
	53	(	
	43	RCL	
	02	02	
50	75	−	
	43	RCL	
	03	03	Calculate
	54	)	Exact Range
	50	2nd I x I	error (RE)
	42	STO	
	05	05	
	43	RCL	
	06	06	
	32	x ↔ t	
60	43	RCL	
	05	05	
	22	INV	
	77	2nd x ≥ t	RE < 6?
	13	C	
	43	RCL	
	00	00	
	32	x ↔ t	
	43	RCL	
	05	05	
70	22	INV	
	77	2nd x ≥ t	RE<11?
	14	D	
	43	RCL	
	05	05	
	32	x ↔ t	
	02	2	
	05	5	
	77	2nd x ≥ t	
	19	2nd D'	
80	05	5	
	00	0	
	77	2nd x ≥ t	
	19	2nd D'	
	07	7	
	05	5	
	77	2nd x ≥ t	
	19	2nd D'	
	01	1	
	00	0	
90	00	0	
	77	2nd x ≥ t	
	19	2nd D'	
	76	2nd Lbl	Calculate
	19	2nd D'	& Display
	95	=	Approx. RE
	76	2nd Lbl	
	16	2nd A'	
	91	R/S	
	11	A	
100	76	2nd Lbl	
	12	B	Drop bomb
	36	2nd Pgm	
	15	15	
	71	SBR	
	88	2nd DMS	
	32	x ↔ t	
	93	•	
	09	9	
	77	2nd x ≥ t	Bomb hit?
110	15	E	
	00	0	
	85	+	
	85	+	
	91	R/S	
	81	RST	
	76	2nd Lbl	
	15	E	
	00	0	
	35	I/x	Display
120	91	R/S	Loss
	81	RST	
	76	2nd Lbl	
	13	C	
	01	1	
	01	1	
	01	1	
	01	1	
	01	1	
	01	1	
	01	1	
130	01	1	
	01	1	
	01	1	
	01	1	
	85	+	
	85	+	Display
	91	R/S	Win
	81	RST	
	76	2nd Lbl	
	14	D	
140	07	7	
	22	INV	
	44	SUM	
	01	1	
	01	1	
	44	SUM	
	08	08	
	43	RCL	
	12	12	
	32	x ↔ t	
150	43	RCL	
	08	08	
	77	2nd x ≥ t	
	13	C	
	43	RCL	
	08	08	
	85	+	
	85	+	Display #
	91	R/S	near hits
	11	A	

EXECUTION

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1:	Enter Learn mode — Key in program — exit L.M.			
2:	Enter seed # for Pgm 15 of Library Module		2nd Pgm 15	0
	(any # between 0 and 199 017)	Seed #	E	Seed #
3:	Store Initial Range (1000)	I.R. (1000)	Sto 0 4	I.R. (1000)
4:	Store definition of direct hit (6)	DODH (6)	Sto 0 6	DODH (6)
5:	Store definition of near hit (11)	DONH (11)	Sto 0 0	DONH (11)
6:	Store # of near hits needed to destroy plane	NONHTDP (5)	Sto 1 2	NONHTDP (5)
7:	Initialize		Rst R/S	0
8:	Enter Range Estimate	Range Est.	R/S	(see above)
9:	Repeat Step #8 until a final result is obtained.			

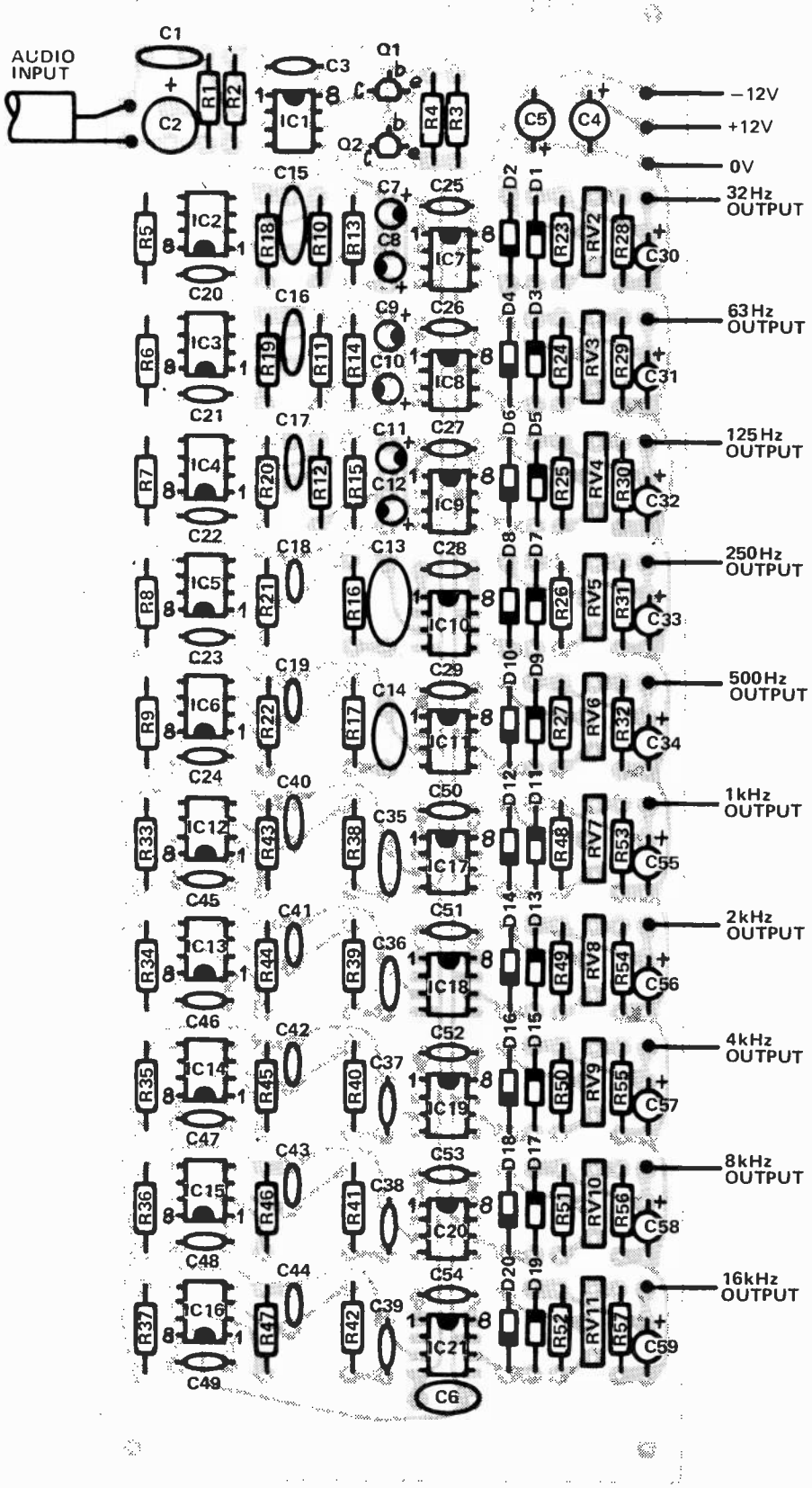


Fig. 5. The component overlay of the filter-rectifier board.

PARTS LIST

RESISTORS all ½W 5%

R1	220k
R2	2k2
R3	220k
R4	1k
R5–R9	10k
R10–R17	1M
R18–R22	220R
R23–R27	1M
R28–R32	100k
R33–R37	10k
R38–R42	1M
R43–R47	220R
R48–R52	1M
R53–R57	100k
R58,59	180k
R60	100k
R61	82k
R62,63	15k
R64	22k
R65	470R
R66	18k
R67	15k
R68	12k
R69	820R
R70	180k
R71	12k
R72,73	10k
R74	2k2
R75	4k7
R76–R78	10k
R79	22k
R80	56k
R81	5k6
R82	3k9
R83	18k
R84	100k
R85	390k
R86	1M
R87	6k8
R88	10k
R89	18k
R90	47k
R91,92	100k
R93	47k
R94	100k
R95	47k
R96	10k

POTENTIOMETERS

RV1	47k log rotary
RV2–RV11	250k trim

CAPACITORS

C1	100n polyester
C2	10µ 25V electro
C3	3p3 ceramic
C4,5	10µ 25V electro
C6	100n polyester
C7,8	3µ3 16V tantalum
C9,10	1µ5 16V "
C11,12	1µ0 16V "

CONSTRUCTION

Due to the complexity of the unit it is recommended that PC boards are used. These boards are assembled as per the overlay diagrams. Watch the orientation of all the ICs, diodes, capacitors, etc., when installing them. Note that if the board is not a plated through type that the tracks on the top side of the board must also be soldered to the

CAPACITORS

C13	220n polyester
C14	100n "
C15	68n "
C16	33n "
C17	18n "
C18	8n2 "
C19	3n9 "
C20–C24	33p ceramic
C25–C29	10p "
C30–C34	2μ2 25 V electro
C35	47n polyester
C36	27n "
C37	12n "
C38	6n8 "
C39	3n3 "
C40	2n2 "
C41	1n0 "
C42	560p ceramic
C43	270p "
C44	150p "
C45–C49	33p "
C50–C54	10p "
C55–C59	2μ2 16 V electro
C60,61	25μ 16 V "
C62	820p ceramic
C63	2n7 polyester
C64	5n6 "
C65	33p ceramic
C66	150p "
C67	3p3 "
C68	150p "
C69	10p "
C70	33p "
C71	2n2 polyester
C72	560p ceramic
C73,74	220μ 25 V electro
C75,76	10μ 25 V "

SEMICONDUCTORS

IC1–IC21	LM301A
IC22	4017 (CMOS)
IC23–IC25	4016 (CMOS)
IC26–IC28	LM301A
IC29	4011B (CMOS)
IC30	LM301A
IC31	7812
IC32	7912
Q1	2N3904
Q2	2N3905
Q3,4	2N3904
Q5–Q7	2N3905
D1–D27	1N914
D28–D31	1N4001

MISCELLANEOUS

PC boards ETI 487A, 487B
Transformer 120V/28V @ A
Case to suit
3 wire line cord
120V power switch
Input / output terminals to suit

components. This prevents the use of sockets for the ICs but they are not really worth the cost for low priced ICs as used. Molex pins could be used if desired.

Note that a surplus Japanese transformer was used in our model, and the pcb designed for it. Either ensure that your type will fit, or redesign or eliminate the end of the 487B board.

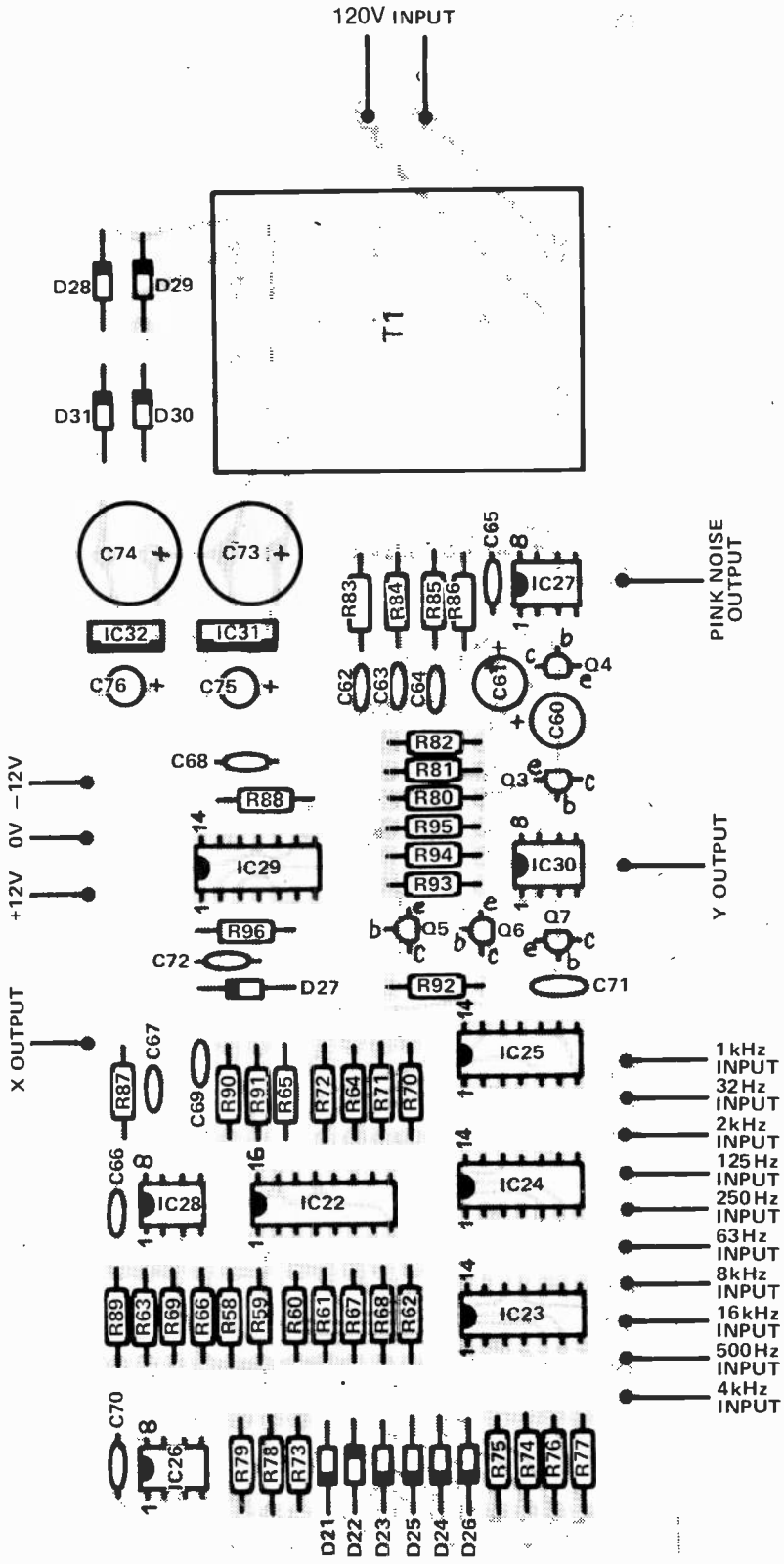


Fig. 6. The component overlay of the logic-power supply board.

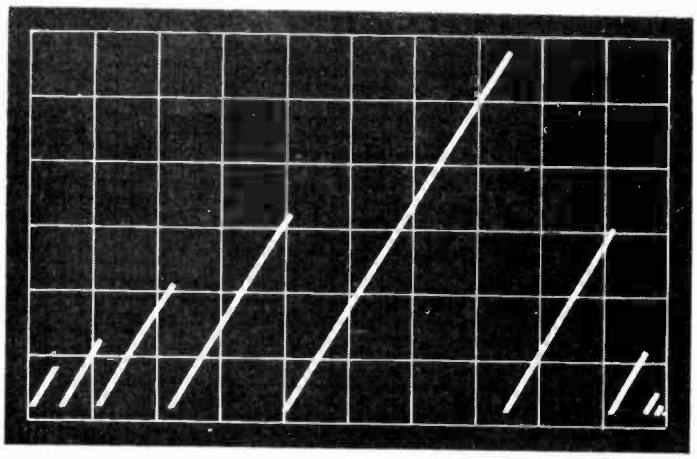


Fig. 7. The waveform on the Y output (vertical) with a 1kHz tone input. Note that the time between cycles varies with the height.

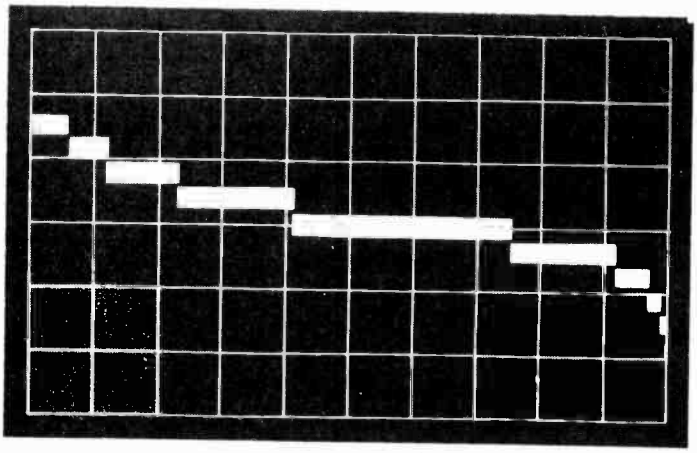


Fig. 8. The waveform on the X (horizontal) output. As this starts at +4 V which is the right hand side of the screen, the 16kHz output is sampled first. Note that the time between steps corresponds to that in fig. 7.

ALIGNMENT

This can be done using the pink noise generator or preferably with a sine wave oscillator.

Connect the unit to the oscilloscope switched into the X Y mode. With the unit switched on and a signal connected, adjust the X gain and shift to obtain a series of ten vertical bars across the screen. Increase the input signal until the columns will not get any higher. Adjust the Y gain and shift until the column is the height of the screen. Note that the scope should be dc coupled.

Now by sweeping the oscillator frequency it will be found that each column will come up in sequence. Adjust the frequency to peak the 16 kHz column. Now adjust RV11 to about 75% of its travel (wiper towards RV10) and then adjust the overall sensitivity control to give a column height of about 80%.

Now using the same amplitude adjust the signal generator frequency until the 8kHz column peaks and adjust RV10 to give the same height. Each of the filters should be adjusted in the same way. Note that due to component variations the actual peak of a filter may not exactly coincide with its nominal frequency. Also the 16kHz filter has the greatest loss which is the reason for starting with it near its maximum gain.

By taking the pink noise output to the input each column should be approximately the same height. Due to the nature of noise the top of the columns will jump up and down a little and this should be averaged out by the eye.

If an oscillator is not available the noise generator can be used and the potentiometers adjusted to give an even response. Also, if desired, a vertical dB scale can be made.

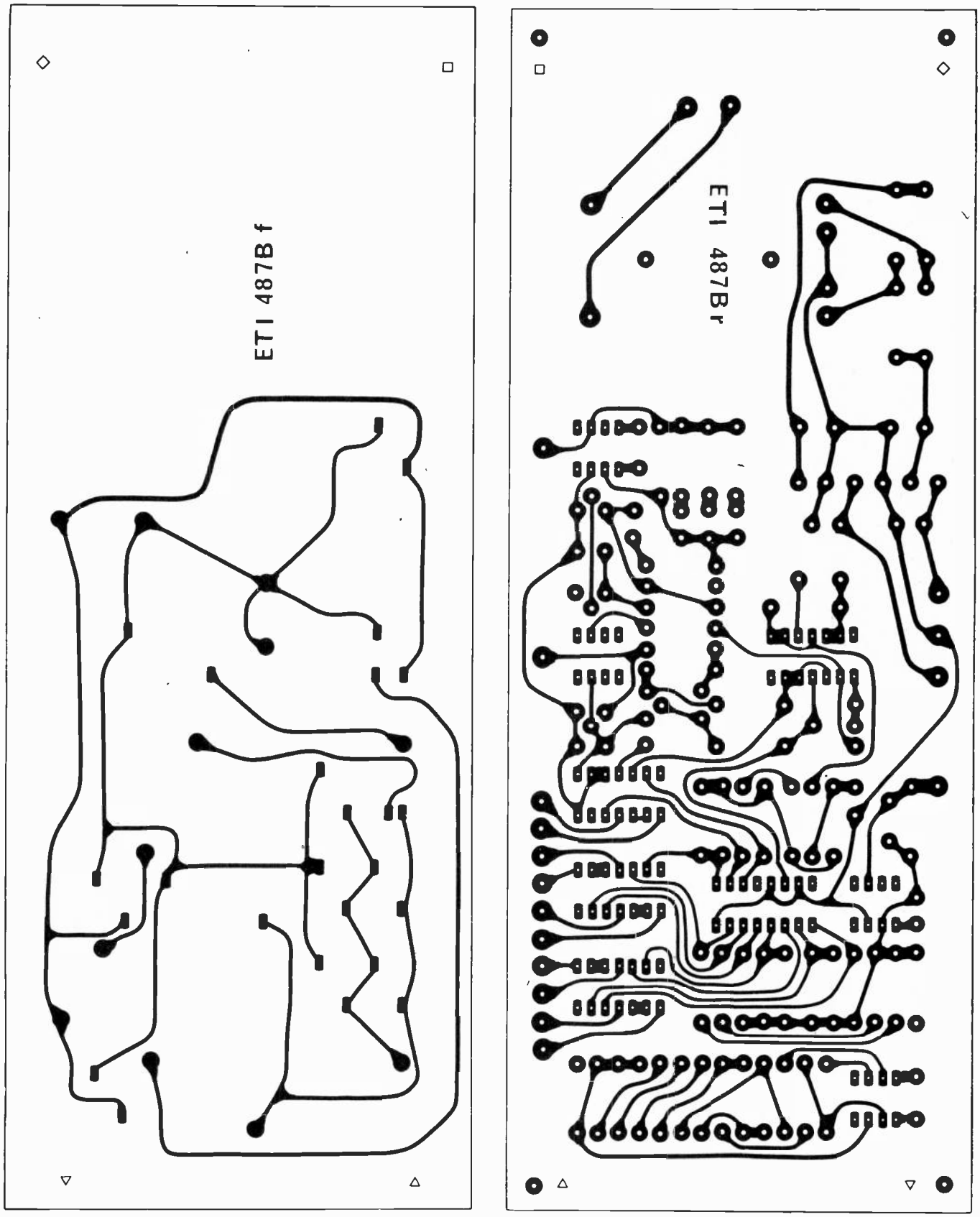


Fig. 9. Both sides of the ETI 487B board shown full size.

Tech Tips

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PROPER IDENTIFICATION FOR T.V. GAME CHIP

E. Parr

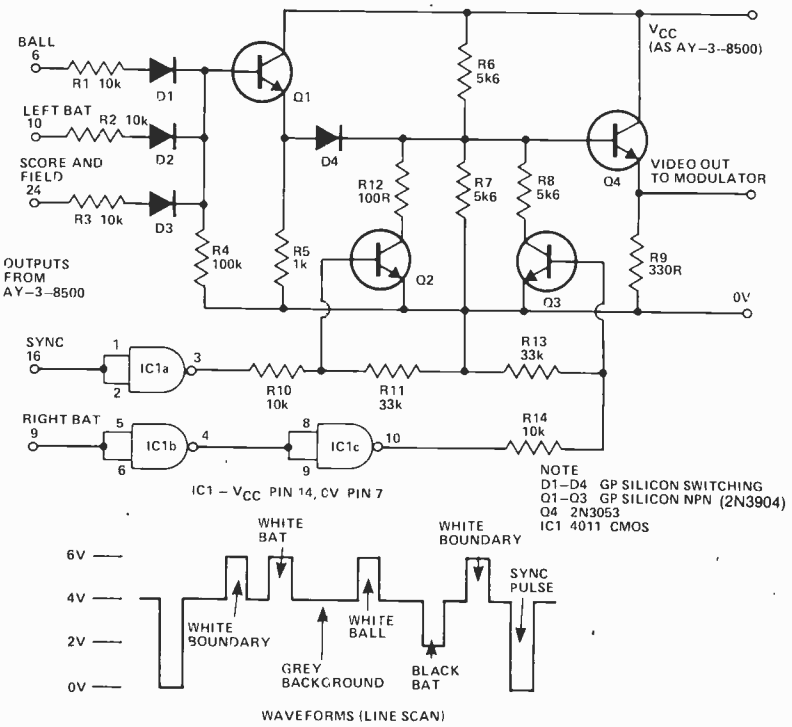
Many of the T.V. game circuits, whether ready built or as a magazine project, use the popular GI 8500 chip. The standard circuit gives white players, ball and court on a black background. The circuit described below gives a grey background, one white and one black player and a white ball and court. This is aesthetically more pleasing and has the advantage of making the squash game less confusing.

The modifications are shown below. The output on Q2 emitter spends the majority of the time at a "grey" level, and this "grey" voltage is defined at the junction of R6 and R7.

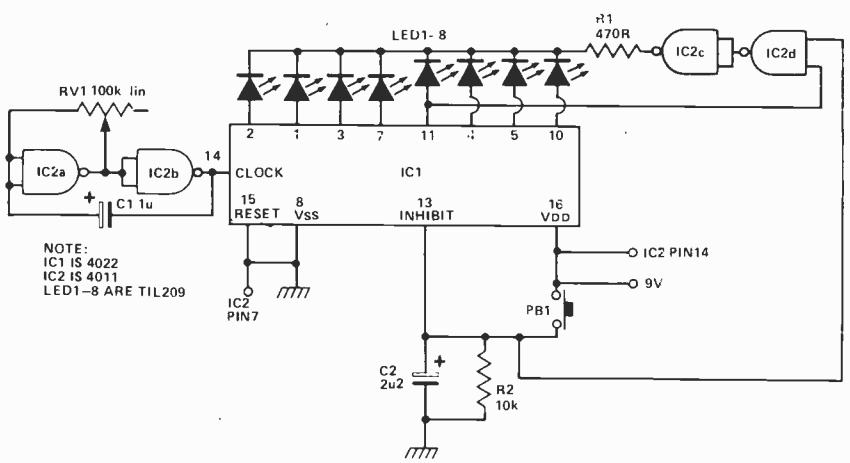
The three signals from the 8500 requiring a white output are Ball (pin 6), left player (pin 10) and the score and field (pin 24). These are "Or'ed" together by Q1 to produce a white level defined by the ratio of R1-R3 and R4. The white level on Q1 takes the output on Q1 to white via diode D4.

The one black signal is the right bat (pin 9). This is buffered by two stages of a CMOS 4011 chip, and turns on Q4. This takes the output to a black voltage defined by R6, R7, R8. If a white and black signal occur together (as happens when the bats cross in squash) the white from Q1 will predominate.

The sync output from pin 16 is inverted and turns on Q3 pulling the output down to sync level, OV.



With the values shown and a supply of 9V the open circuit output voltages are White 6V, Grey 4V, Black 2V and sync bottom 0V. The output is positive going video.



POT SHOT

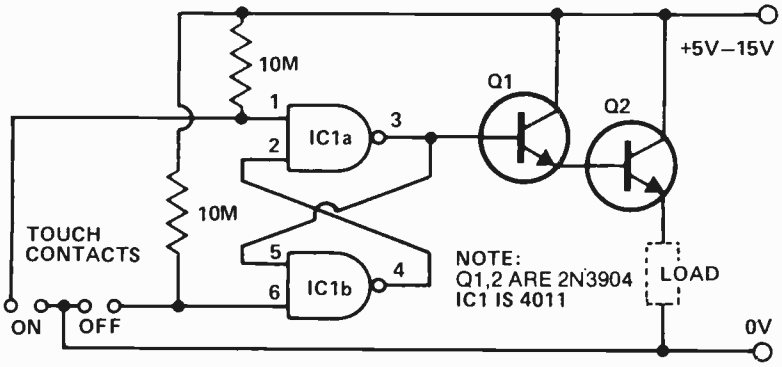
A. Kenny

This is a circuit for a game of the shooting gallery variety. IC2a and b form an astable multivibrator clocking IC1 which causes LEDs 1-8 to flash in turn LED 5 is the "target" LED and the object of the game is to depress PB1 just as LED 5 comes on. If this is done, the whole display is blanked for a few seconds signifying a hit. Otherwise, the LED which was lit remains lit. When the push button is released, C2 discharges through R2 taking 8 pin 13 low again and the LEDs will start to flash again.

ETI Tech Tips

LOW CURRENT TOUCH SWITCH

D. Ian



The cost of many CMOS ICs is now lower than a mechanical on/off switch. Using only one half of a 4011, plus a couple of general purpose transistors, a touch operated switch can be constructed which is ideal for many battery powered projects.

Assuming that the inputs to the remaining half of the 4011 are tied low, the current drawn in the off state is almost negligible and battery life is hardly affected.

Touching the 'on' contacts with a finger brings pin 3 high, turning on the darlington pair and supplying power to the load (transistor radio etc). Q1 must be a high gain transistor, and Q2 chosen for the current required by the load circuit.

INCREASING REGULATOR OUTPUTS

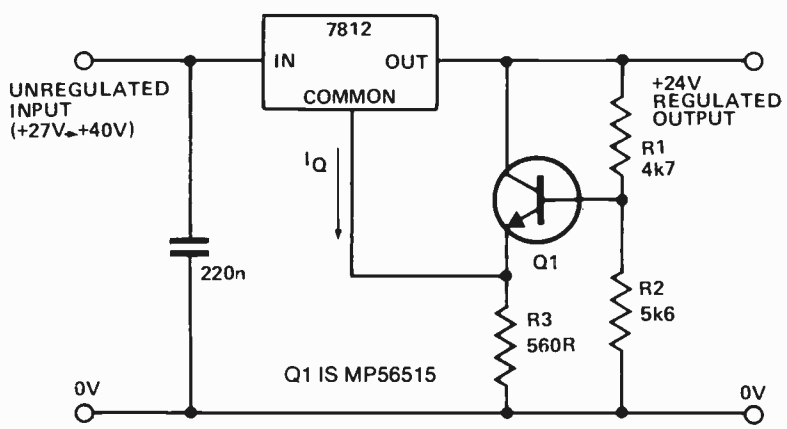
D. Self

It is often necessary to arrange an integrated circuit 3-terminal voltage regulator to give a higher output voltage than that set by the regulator alone. The normal way of doing this is to connect the "common" terminal to the mid-point of a potential divider hung between the regulated output and ground. The regulator voltage now appears across the top divider resistor; hence, if for example equal divider resistors are used, the output voltage is twice that maintained by the regulator between its common terminal and output.

The problem with this method is that most IC regulators (eg the 78-series) have a small quiescent current (approx 10mA) flowing out of the common terminal to ground. The magnitude of this current is not closely controlled, and hence the total output voltage becomes somewhat unpredictable due to this extra current flowing in the bottom half of the divider. Low divider resistor values help, but there are likely to be the complications of heat dissipation and inefficiency.

The circuit above avoids the problem by using transistor Q1 to generate a low impedence at the regulator common terminal by emitter-follower action, while transferring the voltage derived from a relatively high-resistance divider network. The value of R3 is not critical, but must be low enough to accept the highest likely quiescent current without causing Q1 to turn off.

The circuit shows a practical 24 Volt supply using a 7812 regulator.



ETI Tech Tips

GATED 123 OSCILLATORS

M. James.

The action of two distinct types of gated oscillator is shown in Fig 1. Type A stops immediately the inhibit signal goes low, and starts immediately it goes high. (Hence fractional output pulses may be produced).

Type B finishes its current pulse before stopping when the inhibit signal goes low and like A starts immediately it goes high.

A is used when an oscillator has to be synchronized using pulses shorter than the output pulse and B is used when a number of whole pulses are required (the inhibit signal is obtained from the output of a counter).

It can be quite difficult to achieve a type A oscillator that starts up without jitter using TTL. The circuit of Fig 2 shows how an SN74123 may be used to construct both types. A type A oscillator is obtained if the dotted connections are left out. The times t_1 and t_2 are set by the usual timing components see Fig 3 — the diode is needed if $C_{ext} > 1000p$ (across P_A — M_A and P_B — M_B respectively). The times may be calculated using:—

$t = 0.32 R_T C_{ext} (1 + 0.7/R_T)$

if the diode is not required and

$t = 0.28 R_T C_{ext} (1 + 0.7/R_T)$

otherwise.

R_T is in kilo-ohms, C_{ext} is in picofarads, t is in nanoseconds and the max value of R_T is 20k.

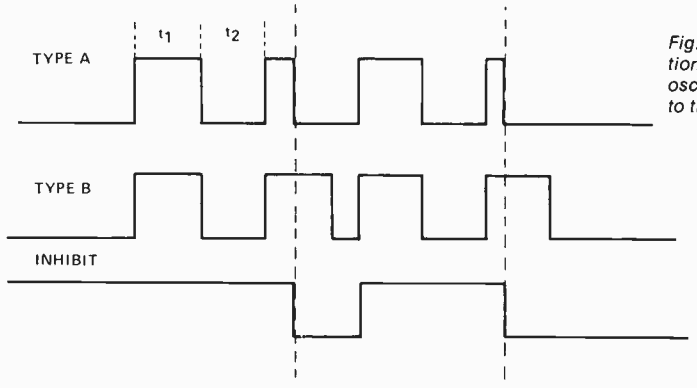


Fig. 1. Left — operation of the two types of oscillator with respect to the inhibit signal.

Fig. 2. Right — connection to a 74123 to obtain both type of gated oscillator.

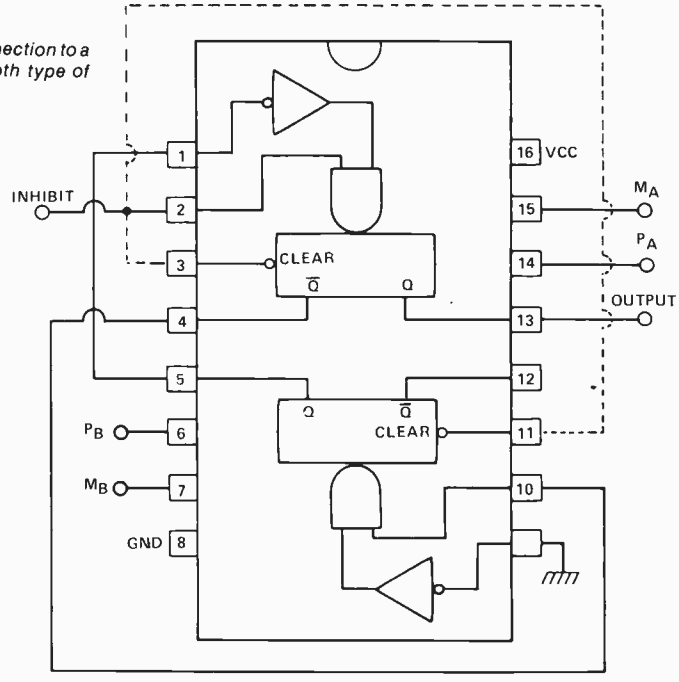
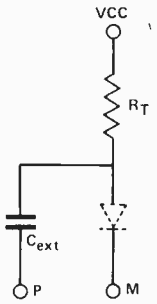


Fig. 3. Below — arrangement of the timing components.



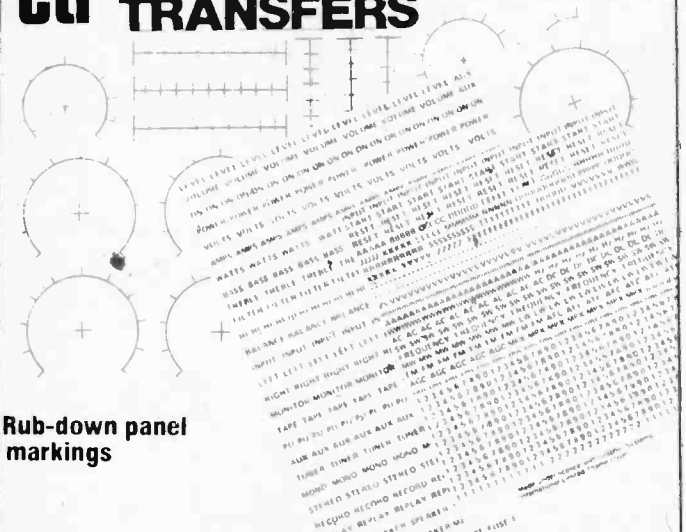
All in ETI's 741 Cookbook:

- Differential voltage comparator
- Open-loop inverting DC amplifier
- Closed-loop inverting DC amplifier
- Non-inverting DC amplifier
- Unity-gain DC voltage follower
- X100 inverting DC amplifier
- Variable gain inverting DC amplifier
- High impedance x100 inverting DC amplifier
- X100 inverting AC amplifier
- Non-inverting x100 DC amplifier
- Non-inverting variable-gain DC amplifier
- High input impedance, non-inv, x100 AC amplifier
- Non-inverting x100 AC amplifier
- DC voltage follower
- AC voltage follower
- Very high input impedance voltage follower
- Unidirectional DC v-follower, boosted output
- Bidirectional DC v-follower, boosted output
- Unity-gain inverting DC adder (audio mixer)
- Unity-gain balanced DC phase splitter
- Unity-gain differential DC amplifier (subtractor)
- Semi-log AC voltage amplifier
- Constant-volume amplifier
- 1kHz tuned amplifier (twin-T, acceptor)
- 1kHz notch filter
- Variable low-pass filter
- Variable high-pass filter
- Variable-voltage supply
- Stabilised power supply
- Stabilised power supply with overload protection
- Precision half-wave rectifier
- Precision half-wave AC/DC convertor
- DC voltmeter converter
- DC voltage or current meter
- Precision DC millivoltmeter
- Precision AC millivoltmeter
- Linear-scale ohmmeter
- Audio Wien-bridge oscillator
- Square-wave generator
- Precision temperature switch

Available from ETI for $2 (includes postage). Just order our May 1977 issue from ETI Back Issues Dept, Unit Six, 25 Overlea Blvd, Toronto, M4H 1B1.

Rapitype ✱ **New from ETI**

eti PANEL TRANSFERS no 1



Rub-down panel markings

A really high quality system for finishing off your projects. The sheets include a mass of lettering and control scales for both rotary and linear pots.

The lettering is transferred simply by laying on to the panel and rubbing down — it's strong and permanent.

The markings are on two sheets (a full-sized one cut in half for easy postage) and contain sufficient lettering for dozens of projects.

Send $3.50 (including postage) to ETI PANEL TRANSFERS, Unit Six, 25 Overlea Blvd., Toronto, Ontario, M4H 1B1. Ontario Residents add 7% PST.

THIS IS NO ORDINARY BATTERY

CGE BRINGS YOU A BATTERY YOU MAY NEVER HAVE TO REPLACE

The distinctive "Plug" logo tells the story . . . "A battery that delivers portable power as reliable and continuous as your household outlet. That means always having fresh fully charged batteries on hand when you need them. No more forgetting to go to the store to replace work-out zinc carbon or alkaline batteries.

Ordinary 'throwaway' batteries get lazy from the first moment they are used — their power output declines steadily until finally you have to 'throw them away' not so with CGE batteries — they deliver a constant power output — which means you get constant bright light from your photoflash & clear constant sound reproduction from your cassette recorder.

"In terms of cost per hour of use . . . (the GE Nicad Battery) . . . is *by far* the most economical system available today"
ELECTRONICS TODAY — DECEMBER 1977

One CGE Battery costs a bit more than one ordinary 'throwaway' battery but then one GE (Nicad) Battery* will outlast 100 alkaline batteries and over 200-300 zinc carbon batteries.

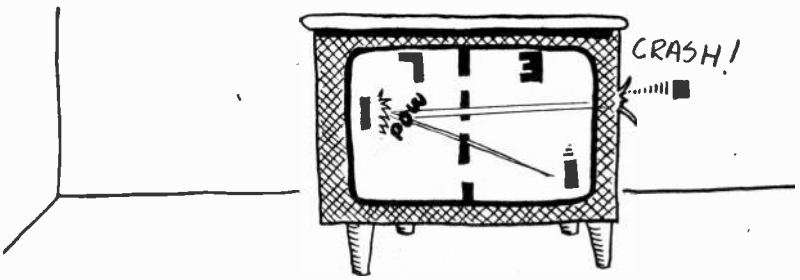
WARRANTY
All CGE Batteries and Accessories are warranted for a period of one year against defects in materials and workmanship.

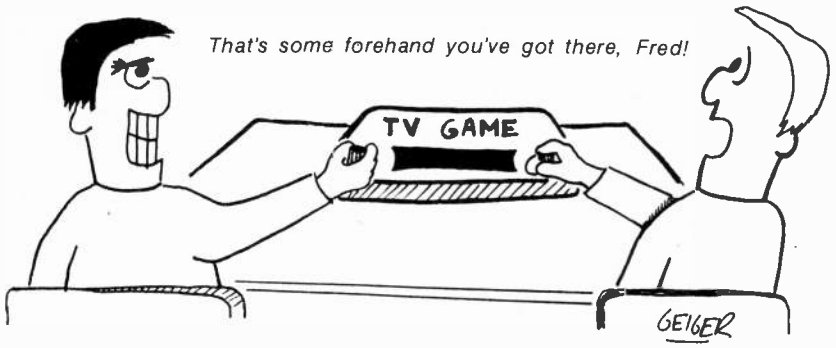
Ask your Representative about the new Rechargeable 6 Volt Lantern Batteries

Available from CGE Electronic Distributors, Department and Camera Stores coast to coast.

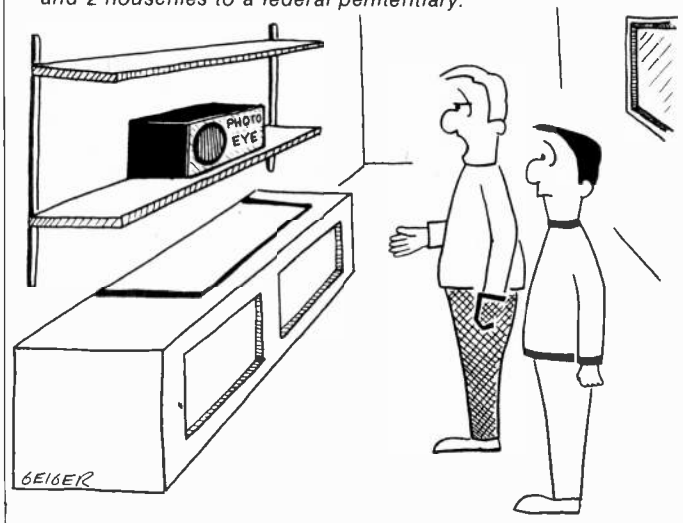
Canadian General Electric | ELECTRONIC COMPONENTS OPERATION
189 DUFFERIN STREET, TORONTO
(416) 537-4481 MONTREAL (514) 733-9911
Test Data available on request

The Fun of Electronics



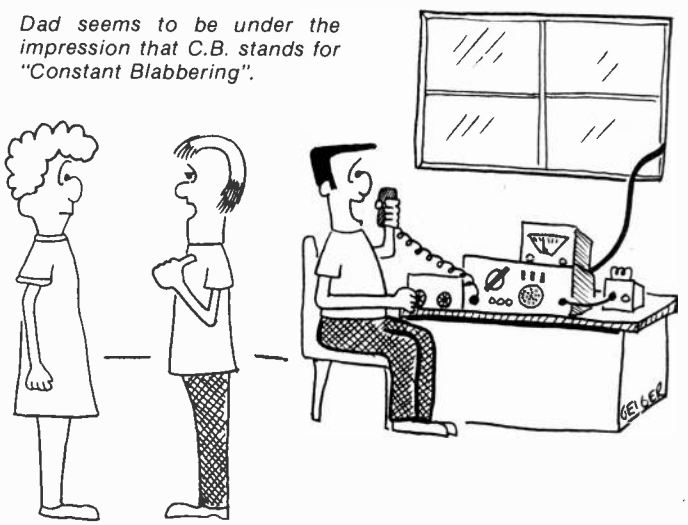


A few weeks ago, I installed this burglar alarm. It sounds a horn whenever it detects the slightest motion anywhere in the room. So far, it's been responsible for sending 4 mosquitoes and 2 houseflies to a federal penitentiary.



. . . and this is our very latest model; the moment it detects fire, it detaches itself from your ceiling and runs out of your house screaming hysterically.

Dad seems to be under the impression that C.B. stands for "Constant Blabbering".



You know you've become an advanced experimenter when you can build things that you can't spell.

Club Call

LARCRSO Convention

October 13th, 14th and 15th will be Red Letter Days for London's Amateur Radio Club. The industrious committees are firming up their programmes, which now, more than ever, include "something for everyone" . . . YLs and the Harmonics too!

A Friday night, "Oktoberfest-type" Eyeball, promises to be a gala affair and admission is free to all registrants and their spouses.

Saturday's program for the hams will include a vertitable smorgasbord of topics: contesting, antennas, dxing. Modes such as FM, RTTY, ATV, SSB and CW will all have special prominence, as well as technical topics such as computers and AMSET. Of course there will be the forums for RSO, CARF, CRRL, and a DOC discussion will be on deck. Continuous movies on our hobby will be presented in another area of the huge, new, Downtown Holiday Inn.

At the Saturday night banquet, more prizes will be awarded and then comes dancing to the music of The Big Band Sounds provided by our full orchestra.

Sunday is Flea Market Day — the likes of which will boggle the imagination! If all this sounds exciting — IT IS!

See you there.

Lloyd Wright, VE3CRF
Convention Promotional Chairman
London Amateur Radio Club Inc.,
Convention Committee,
P.O. Box 82, London, Ontario N6A 4V3

Fort George ARC

Members: 41.
Associate members: 11.
President — Frank Vander Zande VE7AV.
Secretary - Dick Blokland VE7DUV
Treasurer — Ernie McDonald VE7BCD.
Meetings — 1st Tuesday of the month. at 7:30 p.m. at Boy Scout Hall (behind City Hall).
Newsletter — Monthly (except during summer).
Repeaters — 146.34 — 146.94
146.28 — 146.88
147.33 simplex.
Net — Sundays at 10 a.m. on 146.34-146.94 — informal, swap'n'shop, club business.

Diana Vander Zande,
VE7DTO

PEE GEE AWARD

Sponsored by the Prince George Chamber of Commerce and the Fort George Amateur Radio Club

REQUIREMENTS

1. Work 5 (five) amateur radio statins located in the city of Prince George. Also available to SWLs on a "heard" basis.
2. Phone, CW or mixed contacts permitted.
3. QSLs not required. Send log data only.
4. No charge for certificate.
5. Send your application to

Fort George Amateur Radio Club
Box 835
Prince George, BC,
V2L 4T7.

4 ETI Publications

Projects Books 3 & 4 now sold out.

Canadian Projects Book No. 1 — $3.00

Top projects from the early issues of ETI's Canadian edition, plus some of the projects from the UK edition's issues which were distributed in Canada in 1976. All projects use parts available in Canada. Those projects from UK edition have been completely re-worked in Canada for Canadian constructors. Includes a series of modular disco projects, plus games, biofeedback, metal locator, etc.

Circuits No. 1 — $5.00

A brand new concept from the house of ETI. More than 100 pages packed with a wide range of experimenters circuits. Based on the 'Tech Tips' section carried in the overseas editions of ETI, Circuits 1 is the first of a series of specials — produced for the enthusiasts who know what they want, but not where to get it! Circuits 1 will also act as a catalyst for further development of ideas, ideal for the experimenter. The collection of more than 200 circuits is complemented by a comprehensive index, making searches for a particular circuit quick and simple. Also, similar circuits can be compared easily, due to the logical layout and grouping used throughout. Last and by no means least, Circuits 1 has no distracting advertisements in the main section!

Electronics — it's easy Volume 1 — $3.50*

The best introductory series to electronics ever published in a magazine. Volume three completing the series, will be available in a few months. Volume One introduces electronics to the beginner by going through the systems approach, basic concepts, meters and measurements, frequency and wavelengths, electronics and communication, capacitance and inductance, capacitive and inductive reactance, resistance, capacitance and inductance in combination, detection and amplification, elements of transistor amplifiers, emitter followers and DC amplifiers, and basic operational amplifiers.

Electronics — it's easy Volume 2 — $3.50*

Volume Two introduces the sources of power, simple power supplies, how regulated power supplies work, general purpose supplies, generating signal waveforms, generating non-sinusoidal waveforms, all about electronic filters, more about filters, introducing digital systems, the algebra of logic, integrated circuit forms of logic functions, digital sub-systems, counters and shift registers.

$6.00 For Both*

Send your order, with payment (not cash), to **ETI PUBLICATIONS**, Electronics Today International
Unit Six
25 Overlea Boulevard
Toronto, Ontario
M4H 1B1

Please specify which publications you require,
and print your name and address clearly.

BINDERS

In response to many requests from our readers we have arranged for binders to be made so that you can keep ETI's first Canadian volume together and protected from damage. The binders are covered in attractive leather-look black plastic and are designed to hold twelve issues. The ETI design is printed in gold letters on the spine.

The binders cost $5.00 each, which includes postage and packaging. Do not send cash — you can pay by cheque, Mastercharge, or Chargex. Credit card orders must include your account number, the expiry date, and your signature. In all cases allow six weeks for delivery. Send your order to ETI Binders, Unit 6, 25 Overlea Blvd., Toronto, Ontario M4H 1B1. Don't forget to include your name and address. Ontario residents add 7% PST.

CLASSIFIED

ETI Project File

Updates, news, information, ETI gives you project support

HOW'S YOUR EQUIPMENT?

We feel strongly that if you have a desire to be involved with practical electronics you should make things easy and satisfying for yourself by having the right tools. This includes "constructing" tools which we surveyed last month. More importantly (and generally more expensively too!), tools include those instruments which enable you to "see" into a circuit and observe exactly what's going on with the signals. Meters and oscilloscopes are without doubt the most helpful pieces of electronic equipment you can invest in.

To get our readers interested we are working on a series of features on meters and scopes, starting this month with a look at what to expect on a digital multimeter, using the Fluke 8020A as an example. Next month there will be a survey of digital meters available in Canada, and where to get them. In August we'll take a look at an example of today's oscilloscopes, followed up in September with another survey, this time on the Canadian scope market. We hope you enjoy the series and that you too can be enthusiastic about electronics. John Cox says we need you. (See P17).

EQUALISER KITS COMING!

Word from Livingstone Electronics is that they're working on a kit of the ETI Graphic Equaliser, which should be ready in the near future. So for all readers who have written to ask us where they can get one . . . stay tuned!

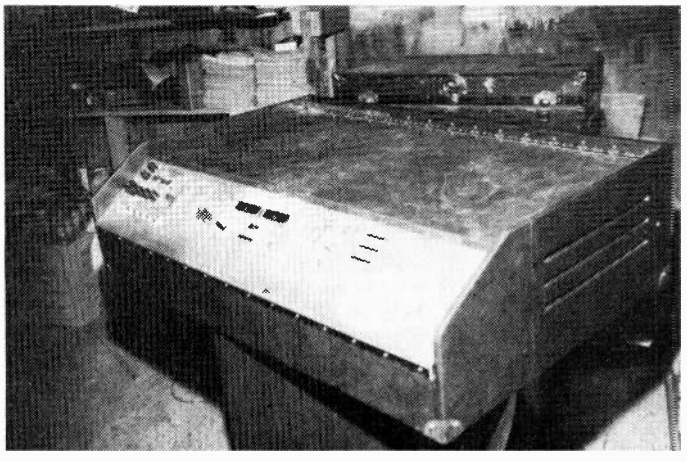
READER'S PROJECT

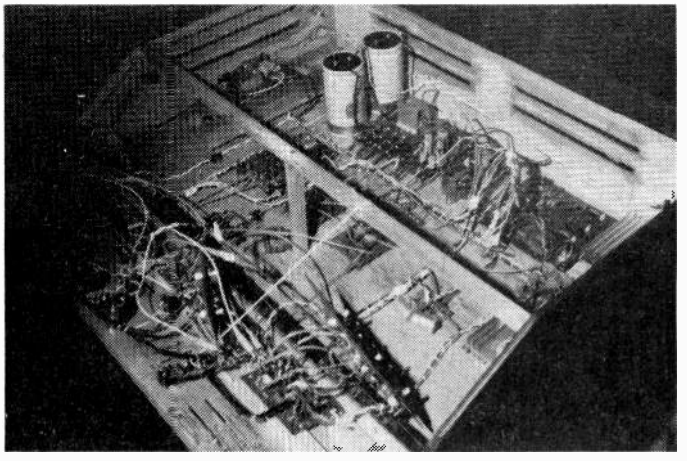
Mr. G. Hallee of Montreal wrote to us late last year describing the ETI Disco set-up he was constructing. This project was published in the March 77 issue, and was reprinted in Canadian Projects No. 1. Mr. Hallee included pictures of the project, which as you can see was in an advanced stage of construction.

PARTS PARTS PARTS

We are continually beseiged with letters from readers asking where they can get parts in their area. Since we can't take a country-wide tour to check where all the elctronics parts-places are, how about sending us a note on any stores you have found useful, what they are good for (if you own the place you can contribute too!) and so on. At some time in the future we would like to help out the "lost" readers by publishing a rundown of where to get what.

ETI Disco project under construction by reader Mr. G. Hallee.





PROJECT FILE is our department dealing with information regarding ETI Projects. Each month we will publish the Project Chart, any Project Notes which arise, general Project Constructor's Information, and some Reader's Letters and Questions relating to projects.

PROJECT CHART

This chart is an index to all information available relating to each project we have published in the preceding year. It guides you to where you will find the article itself, and keeps you informed on any notes that come up on a particular project you are interested in. It also gives you an idea of the importance of the notes, in case you do not have the issue refered to on hand.

Every few months we print a pull out section in the magazine which may be used as a photographic negative for making printed circuit boards (as described in our January 78 issue). Each edition of this sheet contains projects from the preceding few issues. Information on where to find which negative is included in the chart.

PROJECT NOTES

Since this magazine is largely put together by humans, the occasional error manages to slip by us into print. In addition variations in component characteristics and availability occur, and many readers write to us about their experiences in building our projects. This gives us information which could be helpful to other readers. Such information will be published in Project File under Project Notes. (Prior to May 78 it was to be found at the end of News Digest.)

Should you find that there are notes you wish to read for which you do not have the issue, you may obtain them in one of two ways. You can buy the back issue from us (refer to Project Chart for date of issue and see also Reader Service Information on ordering). Alternatively you may obtain a photocopy of the note free of charge, so long as your request includes a self addressed stamped envelope for us to mail it back to you. Requests without SASE will not be answered.

PROJECT CONSTRUCTOR'S INFORMATION

Useful information on the terminology and notation will be published each month in Project File.

READER'S LETTERS AND QUESTIONS

Many readers write to us concerning their projects, bringing to our attention ambiguities in articles and difficulties which might be faced by many in some phase of obtaining pars in construction or trouble-shooting. Where a letter is of such general interest we may publish it, along with solutions or suggestions.

We like to see any comments from readers on projects they've built, modifications or success stories, and pictures too.

We obviously cannot troubleshoot the individual reader's projects, by letter or in person, so if you have a query we can only answer it to the extent of clearing up ambiguities, and providing Project Notes where appropriate. If you desire a reply to your letter it must be accompanied by a self addressed stamped envelope.

Write to: Project File
Electronics Today International
Unit 6, 25 Overlea Blvd.,
TORONTO, Ontario
M4H 1B1

Component Notations and Units

We normally specify components using an international standard. Many readers will be unfamiliar with this but it's simple, less likely to lead to error and will be widely used sooner or later. ETI has opted for sooner!

Firstly decimal points are dropped and substituted with the multiplier, thus 4.7uF is written 4u7. Capacitors also use the multiplier nano (one nanofarad is 1000pF). Thus 0.1uF is 100n, 5600pF is 5n6. Other examples are 5.6pF = 5p6, 0.5pF = 0p5.

Resistors are treated similarly: 1.8M ohms is 1M8, 56k ohms is 56k, 4.7k ohms is 4k7, 100 ohms is 100F, 5.6 ohms is 5R6.

Kits, PCBs, and Parts

We do not supply parts for our projects, these must be obtained from component suppliers. However, in order to make things easier we co-operate with various companies to enable them to promptly supply kits, printed circuit boards and unusual or hard-to-find parts. Prospective builders should consult the advertisements in ETI for suppliers for current and past projects.

Any company interested in participating in the supply of kits, pcbs or parts should write to us on their letterhead for complete information.

ETI Project Chart June 77 to June 78

ISSUE DATE	ARTICLE
June 77	GSR Monitor
Aug 77	Note: O
June 77	Tape Slide Sync
June 77	Injector Tracer
June 77	Metronome
June 77	Drill Controller
July 77	Mastermind
Oct 77	Note: O
July 77	Digital Voltmeter
Sept 77 or CPB1	Note: N
July 77	Overled
July 77	Turn Indicator Canceller
Aug 77	Skeet
Nov 77	Notes: C, D,
Aug 77	Dig. Freq. Meter
Aug 77	Bass Enhancer
Aug 77	Tachometer
Sept 77	Audio Sweep Osc.
Sept 77	Microamp
Sept 77	Bongos
Sept 77	Alarm Alarm
Oct 77	Graphic Equaliser
Feb 78	Note: D
Oct 77	Loud Hailer
Oct 77	Continuity Tester
Oct 77	Stereo Simulator
Nov 77	Digital Thermometer
Jan 78	Note: C, T, S,
Jan 78	Neg.
Feb 78	Note: S
Nov 77	3-Channel Tone Control
Jan 78	Neg.
Nov 77	Watchdog
Jan 78	Neg.
Dec 77	50D50 Amplifier
Jan 78	Neg.
Feb 78	Note: T
Dec 77	Spirit Level
Jan 78	Neg.
Dec 77	Egg Timer
Jan 78	Neg.
Jan 78	Option Clock & Neg.
Jan 78	LED Pendant
May 78	Note: C
Jan 78	Compander & Neg.
Feb 78	Tachomonitor
Apr 78	Neg
Feb 78	LCD Panel Meter
Apr 78	Note: C
Apr 78	Neg.
Feb 78	CB Power Supply
Apr 78	Neg
May 78	Note: N
Feb 78	Freezer Alarm
Apr 78	Neg
Mar 78	Hammer Throw
June 78	Neg
Apr 78	Computer PSU & Neg.
Apr 78	Audio Delay Line & Neg
Mar 78	True RMS Meter
Apr 78	Neg
Mar 78	Home Burglar Alarm
Apr 78	Gas Alarm & Neg.
May 78	White Line Follower
June 78	Neg
May 78	Acoustic Feedback Eliminator
June 78	Neg
May 78	Add-on FM Tuner
June 78	Neg
June 78	Audio Analyser
June 78	Ultrasonic Switch & Neg
June 78	Phone Bell Extender & Neg

Canadian Projects Book

Audio Limiter	Metal Locator
5W Stereo	Heart-Rate Monitor
Overled	GSR Monitor
Bass Enhancer	Phaser
Modular Disco	Fuzz Box
G P Preamp	Touch Organ
Bal. Mic. Preamp	Mastermind
Ceramic Cartridge Preamp	Double Dice
Mixer & PSU	Reaction Tester
VU Meter Circuit	Sound-Light Flash
Headphone Amp	Burglar Alarm
50W-100W Amp	Injector-Tracer
Note: N Apr. 78	Digital Voltmeter

Key to Project Notes
C:- PCB or component layout
D:- Circuit diagram
N:- Parts Numbers, Specs
Neg:- Negative of PCB pattern printed
O:- Other
S:- Parts Supply
T:- Text
U:- Update, Improvement, Mods
***:- Notes for this project of complicated nature write for details (enclose S.A.S.E., see text)

Reader Service Information

Editorial Queries

Written queries can only be answered when accompanied by a self-addressed, stamped enveloped, and the reply can take up to three weeks. These must relate to recent articles and not involve ETI staff in any research. Mark your letter ETI Query.

Projects, Components, Notation

For information on these subjects please see our Project File section.

Sell ETI

ETI is available for resale by component stores. We can offer a good discount and quite a big bonus, the chances are customers buying the magazine will come back to you to buy their components. Readers having trouble getting their copy of ETI could suggest to their component store manager that he should stock the magazine.

Back Issues and Photocopies

Previous issues of ETI-Canada are available direct from our office for $2.00 each. Please specify issue by the month, not by the features you require. The following back issues are still available for sale.

1977	1978
February	January
[redacted]	February
[redacted]	March
May	April
June	May
July	June
[redacted]	
September	
October	
November	
December	

We can supply photocopies of any article published in ETI-Canada, for which the charge is $1.00 per article, regardless of length. Please specify issue and article. (A special consideration applies to errata for projects, see Project File.)

ETI MARKET PLACE

FREE ADVERTISING

We will allow you up to twenty-five words to advertise items you want to buy or sell, or to publicise meetings of clubs, etc. Advertising will be accepted at our discretion — we will not accept commercial or any form of company advertising. For more insertions mail in again.

PLEASE SEND IN YOUR ADVERTISEMENT IN THIS FORM. USE AN EMPTY SEALED ENVELOPE, WITH YOUR MESSAGE ON THE BACK.

ETI MARKETPLACE
UNIT 6, 25 OVERLEA BLVD,
TORONTO, ONTARIO.
M4H 1B1

FOR SALE ETI REACTION TESTER, $30.95, ALLOW SIX MONTHS DELIVERY. ALSO MODERN CATS-WHISKER WIRELESS, $11.49. J.J. FLASH APT. 1105, EARTH BLVD, VANCOUVER V3J 7K6.

SELL LAVOIE SPECTRUM ANALYZER-SORNSEN 1KW 117 VOLT CONSTANT VOLTAGE SUPPLY-48 VOLT 200 AMP DC SUPPLY-MAX POWELL JR., BOX 500, CARBONEAR, NFLD.

FOR SALE:8 RCA STEREO AMP. BOARDS. JUST ADD 42N3055'S FOR A 25W/CH AMP LOW THD. $30 EACH. 494-8694 D DEDERER, 7 QUINCY CRES., WILLOWDALE, ONT. M2J 1C5.

FOR SALE: UNUSED HEATHKIT **SELF-INSTRUCTIONAL COURSES.** INCLUDES CASSETTES AND PARTS. 1) DC ELECTRONICS: 2) AC ELECTRONICS: 3) SEMICONDUCTOR DEVICES VALUE: $200 SELL: $50 EACH OR $140 COMPLETE. 921-0033 OR 534-1797, TED DAVIS, 29 ELGAR AVE., SCARBOROUGH, ONT. M1J 1M3.

FOR SALE 3" COMPUTER **VIDEO DISPLAY** IN GOOD WORKING ORDER WITH SERVICING MANUAL. $90.00 (INCLUDE SHIPPING) R. CHARRON, R.R. #3, ST-JEROME, QUEBEC J7Z 5T5.

WANTED OUT OF PRINT RCC TELEVISION **SERVICE MANUALS.** WILL PAY REGULAR PRICE J. GRENIER BOX 638, RR 2, GREELY, ONT. K0A 1Z0.

WANTED SCHEMATIC DIAGRAM FOR **RBM-3 RECEIVER** MODEL CCT-46076 J. S. ZYLA, BOX 100, MINTON, SASK.

NEEDED: ANY INFORMATION (ALIGNMENT INFO., SCHEMATIC, ETC.) ON THE **XONEX TA-808.** PLEASE SNED TO KEN MACDONALD, 815 NADINE AVE., LONDON, ONTARIO, N6C 4R8.

JADE

ONT STOP MAILORDER SHOPPING AT LOW PRICES

21L02 (450ns) Static Rams 100 @ $1.10 ea.	1702A E—PROM 8 @ $3.75 ea.	6502 Microprocessor 5 @ $11.00 ea.	2708 (450ns) E—PROM 8 @ $11.00 ea.	21L02 (250ns) Static Rams 100 @ $1.36 ea.	Z—80A Microprocessor 5 @ $25.00 ea.	8212 8 Bit I/O Port 25 @ $3.00 ea.	4116 (200ns) 16K Dyn. Ram 16 @ $24.00 ea.
Z-80 Microprocessor 5 @ $20.00 ea.	8224-4 Clk.Gen.&Dvr. 25 @ $8.75ea.	4108 (200ns) Static Ram 100 @ $8.75ea.	4096 Dynamic Ram 100 @ $3.50 ea.	4200A (200ns) Static Rams 25 @ $10.00 ea.	74LS367 Hex Buffer 100 @ .70¢ ea.	74LS368 Hex Inverter 100 @ .70¢ ea.	2513 (5v) Character Gen. 5 @ $9.00 ea.

MICROCOMPUTER COMPONENTS

MICROPROCESSOR'S

F8	16.95
Z80	12.00
Z80A	28.00
CDP1802CD	19.95
2650	24.95
AM2901	22.95
6502	11.95
6800	18.95
6802	25.00
8008-1	9.95
8035	22.00
8080A	11.95
8085	27.00
TMS9900TL	75.00

8080A SUPPORT DEVICES

8212	3.50
8214	9.00
8216	3.75
8224	3.50
8224-4	9.95
8226	3.95
8228	7.95
8238	7.50
8251	9.95
8253	21.95
8255	21.95
8257	21.95
8259	21.95
8275	75.00
8279	20.00

FLOPPY DISC CONTROLLER

1771B	55.95
1771B-01	57.95

KEYBOARD CHIPS

AY5—2376	13.75
AY5—3600	13.75

PROM'S

1702A	4.00
2704	15.00
2708	12.00
2716	30.00
2716 Intl	38.00
2758	26.60
D3601	4.50
D3604	13.00
5203AQ	5.00
5204AQ	7.50
6834	17.50
6834-1	14.95
82S23B	4.00
82S129B	4.25
8223B	3.50

6800 SUPPORT

6810P	4.95
68B10P	6.00
6820P	7.50
6821P	7.50
6828P	11.25
6834P	16.95
6850P	9.75
6852P	11.75
6860P	10.00
6862P	14.50
6871P	28.00
6875P	8.75
6880P	2.50

Z80 SUPPORT DEVICES

3881	12.95
3882	12.95

STATIC RAMS

21L02	1.50	1.24	1.18
21L02 (350)	1.60	1.35	1.25
21L02 (250)	1.75	1.50	1.50
4108	10.75	10.00	9.25
1101A	1.00	.90	.80
2101-1	2.95	2.75	2.60
2102	1.25	1.15	1.00
2111-1	3.95	3.50	3.25
2112-1	2.95	2.80	2.65
2114-3	11.00	10.00	9.25
2125L	11.10	9.00	8.30
2147	37.50		
31L01	2.50	2.35	2.00
3106	3.95	3.70	3.25
3107	3.95	3.70	3.25
TMS-4044	9.95	9.00	8.95
4200A	12.95		
TMS-4045	11.00	10.00	9.25
5101	8.30	7.40	7.25
74C89	3.25	3.05	2.85
7489	2.25	2.10	1.90
74S201	4.50	4.00	3.75
P8101	4.20	3.40	2.80
P8155	17.00	14.00	
P8156	21.00	18.00	
8599	1.88	1.75	1.60
9102BPC	1.65	1.45	1.30

CHARACTER GENERATORS

2513	6.75
2513 5v upper	9.75
2513 5v lower	10.95
2516	10.95
MCM6571	10.95
MCM6571A	10.95
MCM6574	13.25
MCM6575	13.25

WAVEFORM GENERATOR

8038	3.50
MC4024	2.25
S66	1.50

DYNAMIC RAMS

416D/4116	32.00
1103	1.00
2104	4.00
2107B	4.25
2107B-4	3.95
TMS4050	4.00
TMS4060	4.50
TMS4070-2	32.00
4096	4.00
4116/416D	32.00
MMS270	4.50
MCM6605	5.00

USRT

S2350	10.75

UART'S

AY5-1013A	5.25
AY5-1014A	8.25
TR1602B	5.25
TMS6011	5.95
IM6402	10.80
IM6403	10.80

MISC. OTHER COMPONENTS

N8T20	3.39
N8T26	2.10
N8T95	1.35
N8T96	1.35
N8T97	1.35
N8T98	1.35
81LS95	2.00
81LS97	2.00
1488	1.75
1489	1.75
D3205	4.00
D3207A	4.55
D3208A	14.20
D3211	10.00
B3222	9.75
B3242	10.15
D3245	5.60
C3404	6.75
P3408A	12.00
P4201A	5.20
MM5320	7.50
MM5369	1.90
TMS5501	24.95
DM8130	2.90
DM8131	2.75
DM8833	2.50
DM8835	2.50
DM8837	1.75
MK50240	20.00
MK50250	15.00

JADE 8080A KIT
$100.00 KIT
BARE BOARD **$30.00**

E—PROM BOARDS

MR 8 (8K uses 2708) with 1K RAM	KIT	$99.50
MR 16T (16K uses 2716) with 1K RAM	KIT	$99.50
MM 16 (16K uses 2708) RAM/N/ROM (16K uses any E PROM)	KIT	$99.00
JG 8/16 (uses 2708 or 2716)	KIT	$117.00
BARE BOARD		$59.95 $30.00

TV-1

Convert T.V. set to Video Monitor.
KIT $8.95

STATIC RAM BOARDS

8K

250ns	ASSEMBLED & TESTED	$189.95
450ns	ASSEMBLED & TESTED	$149.75
250ns	KIT	$169.95
450ns	KIT	$125.00
BARE BOARD		25.00

6800 ADAPTER to S-100 System
KIT $12.95

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450ns	ASSEMBLED & TESTED	$380.00
450ns	KIT	$335.00

32K

250ns	ASSEMBLED & TESTED	$850.00
450ns	ASSEMBLED & TESTED	$775.00
450ns	KIT	$675.00

DYNAMIC RAM BOARDS

On board Refresh power is provided with no wait states or cycle stealing required.
+8VDC 400MA DC +18VDC 400MA DC and 18VDC 30MA DC

EXPANDABLE 32K

8K	(375ns)	KIT	$151.00
16K	(375ns)	KIT	$259.00
24K	(375ns)	KIT	$367.00
32K	(375ns)	KIT	$425.00

EXPANDABLE 64K

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32K	(375ns)	KIT	$519.00
48K	(375ns)	KIT	$757.00
64K	(375ns)	KIT	$995.00

MOTHER BOARD's — S-100 Style

13 slot — w/front panel slot
BARE BOARD $35.00
KIT $95.00

22 slot $149.95
ASSEMBLED & TESTED

THE PROM SETTER

WRITE & READ EPROM
1702A — 2708 — 2716
5204 — 6834

- Plugs directly into your ALTAIR IMSAI Computer
- Includes Main Module Board and External EPROM Socket Unit
- The EPROM Socket Unit is connected to the Computer through a 25 pin connector
- Programming is accomplished by the Computer
- Just read in the Program to be Written on the EPROM into your Processor and let the Computer do the rest
- Use Socket Unit to Read EPROM's Contents into your Computer
- Software included
- No external power supplies. Your computer does it all
- Doubles as an Eight Bit Parallel I/O
- Manual included

KIT $210.00
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KIM—1

ASSEMBLED & TESTED $245.00

MEMORY PLUS

for KIM—1
8K RAM (21L02)
8K EPROM
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—with PROVISIONS for ONBOARD 2708 and POWER ON JUMP

$135.00 EA. (2MHZ)
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Change your JADE 2MHz Z80 to a 4MHz version with this simple kit:

only $17.95 with trade
$49.95 purchase.

To trade, you must give us your 2MHz Z80 chip and 8224 clock driver

The "UPGRADE KIT" includes:
Z80A chip, 1.8K resistor
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COMPU/TIME CT 100

S100 BUS COMPATIBLE

TIME & CALENDAR

Microprocessors need the power that a real-time clock can offer. Date and time becomes instantly available. **COMPU/TIME** does not have to be initialized every time the system is powered up. It possesses a crystal-controlled time base to obtain superior accuracy and has two setable coincidence counters. Time, date, and counters are set via software.

COMPUTATIONAL FUNCTION

Microprocessors need to be complimented by hardware arithmetics to free up memory pages dedicated to floating point routines and mathmatical software. **COMPU/TIME** provides a 40 function calculator array so that algebraic, trigonometric, basic arithmetic problems can be solved without the need of developing sophisticated software.

Buy It Your Way

COMPU/TIME	CT100	$199 KIT	$245	Assembled
COMPU only	C101	$149 KIT	$189	Assembled
TIME only	T101	$165 KIT	$205	Assembled
COMPU/TIME	PC Board only	$80		

JADE VIDEO INTERFACE KIT

FEATURES **$99.95**

S-100 Bus Compatible
32 or 64 Characters per line
16 lines
Graphics (128 x 48 matrix)
Parallel & Compositive video
On board low-power memory

Powerful software included for cursor, home, EOL, Scroll Graphics/ Character, etc.
Upper case, lower case & Greek
Black-on-white & white-on-black

full ASCII PROFESSIONAL KEYBOARDS

- Full 128 Character ASCII
- Tri-Mode MOS Encoding!
- MOS DTL TTL Compatable Output
- Two-key Rollover!
- Level and Pulse Strobe!
- Shift and Alpha Lock!
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- Positive or Negative Logic!

MODEL 756 (56 keys)

PRICING INFORMATION

Model 756 (assembled)	$75.95
Model 756K (kit)	64.95
Model 702 Enclosure	29.95
Model 710 Numeric Pad	9.95
Model 756MF Mtg. Frame	8.95

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DB — 25P	$3.00
DB — 25S	$4.00
COVER	$1.50
44 Pin — PC & EYE	$1.95
44 Pin — WW	$2.50
86 Pin — (6800) PC	$5.00
86 Pin — (COSMAC ELF) PC	$5.00
100 Pin — (Altair) PC	$4.50
100 Pin — (Imsai) PC	$3.75
100 Pin — (Imsai) WW	$4.25

We accept master charge THE INTERBANK CARD

JADE

REAL TIME CLOCK FOR S-100 BUS

1 MHZ Crystal Oscillator
Two independent interrupts
One interrupt uses 16 bit counter in 10 USEC steps
Other interrupt is in decade steps from 100 USEC to 10 sec.
Both software programmable
Board can be selected by 128 device code pairs.
Complete documentation includes software to display time of day
Double sided solder mask
Silk screen parts layout

JG—RT ASSEMBLED & TESTED $179.95
JG—RT KIT $124.95
BARE BOARD with Manual $30.00

TARBELL CASSETTE INTERFACE

- Plugs directly into your IMSAI or ALTAIR*
- Fastest transfer rate: 187 (standard) to 540 bytes/second
- Extremely Reliable — Phase encoded (self-clocking)
- 4 Extra Status Lines, 4 Extra Control Lines
- 37-page manual included
- Device Code Selectable by DIP-switch
- Capable of Generating Kansas City tapes also
- No modification required on audio cassette recorder

JADE KIT* $99.95 ASSEMBLED $175.00
*(6 month warranty from JADE) MANUAL $4.00

JADE PARALLEL/SERIAL INTERFACE KIT

S-100 **$124.95** KIT
2 Serial Interfaces with RS232 interfaces or 1 Kansas City cassette interface.
Serial interfaces are crystal controlled.
Selectable baud rates.
Cassette works up to 1200 baud.
1 parallel port.

DATA COMMUNICATIONS ADAPTER

80-103A Serial I/O and FSK modem for professional and hobby communications.

- Completely compatible with your IMSAI, ALTAIR* SOL** or other S-100 microcomputers
  *Trademarks of *MITS, **Processor Technology
- Designed for use on the dial telephone or TWIX networks, or 2-wire dedicated lines, meets all FCC regulations when used with a CBT coupler.
- All digital modulation and demodulation with on board crystal clock and precision filter mean that NO ADJUSTMENTS ARE REQUIRED
  - Bell 103 standard frequencies
  - Automated dial (pulsed) and answer
  - Originate and answer mode
  - 110 or 300 BPS speed select
  - Complete self test capability
  - Character length, stop bit, and parity
  - 90 day warranty and full documentation

PRICES: BARE BOARD and Manual $49.95
Assembled (48 hr. burn in) $279.95
JG—DCA KIT $159.95

NUMBER CRUNCHER

The CT200 is a number-oriented microprocessor intended for use in those applications that require fast versatile mathematical solutions.
THIS IS NOT A CALCULATOR CHIP. THERE ARE NO KEY DELAYS.
The CT200 has a unique architecture that is designed to be a TASK processing system within a system. This unique architecture will allow the CT200 to work and run with ANY S100 BUS microprocessor system. It is completely compatible with Z80, 4MHZ version also, 8080, 8800, 6502 microprocessor. A micro incoded instruction set allows programming in a calculator like language. The instruction set includes a full set of test and branch instructions. All decoding of S100 bus signals (for select or control functions) is performed with strobed latches to eliminate the possibility of glitches.

PRICE: $249.00
Includes Manual, ASSEMBLED & TESTED.

JADE

Discounts available at OEM quantities. All prices above are quoted in US$ F.O.B. Lawndale, Calif. USA. To expedite shipments please include international money order or bankers check payable against any USA bank in US$, or affiliated credit cards of Bank America or Master Charge welcome (include card No., expiration date and signature). Add 10% of total order for postage. For orders less than $10 add $1.50 service charge. New catalog now available.

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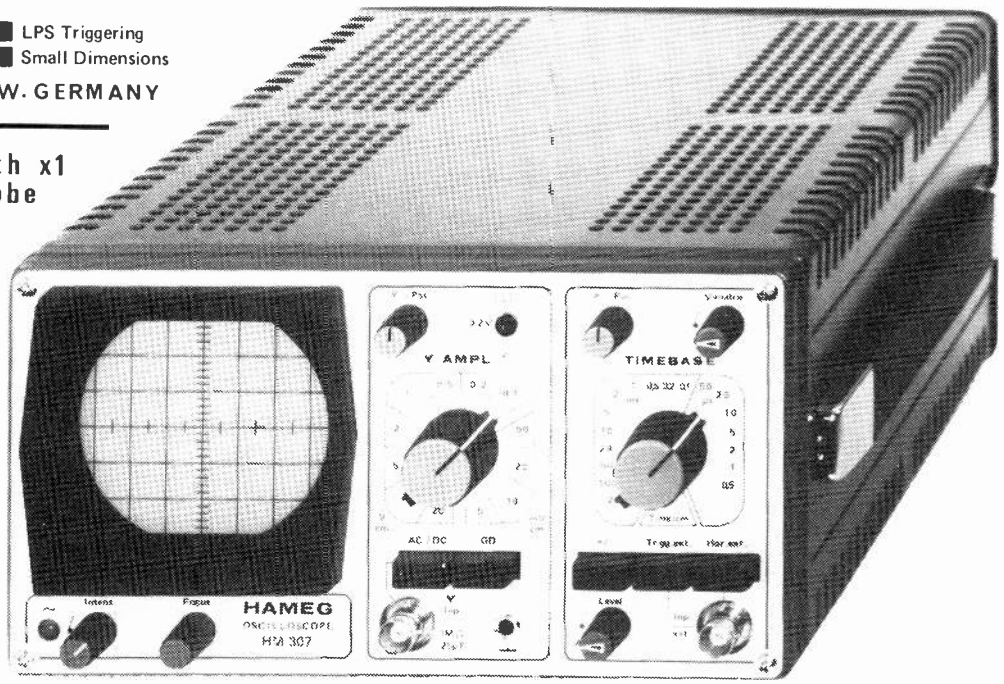
OSCILLOSCOPE HM 307

- Bandwidth DC - 10MHz
- Screen 7cm Ø
- LPS Triggering
- Small Dimensions

MANUFACTURED IN W. GERMANY

NEW with x1 probe



Specifications

Vertical Amplifier Y

Frequency range 0 10MHz (-3dB)
Risetime approx 35ns
Overshoot maximum 1%
Sensitivity 5mVpp/cm 20Vpp/cm
Input attenuator with 12 positions (1-2-5 sequence)
Deflection factor accuracy ± 5%
Input impedance 1MOhm//25pF
Input switchable DC-AC-GD
Max admissible input voltage 500V DC
Linearity error max 2%

Timebase

Sweep range 0,2s/cm 0,5µs/cm, with fine control 1 2,5 down to 0,2µs/cm (18 positions with 1-2-5 sequence)
Sweep accuracy ± 5%
Triggering: int or ext, pos or neg, automatic or with adjustable level
Trigger frequency range 1Hz - 25MHz
Trigger threshold max 3mm

Horizontal Amplifier X

Frequency range 3Hz 1MHz (-3dB)
Sensitivity approx 0,75Vpp/cm
Input impedance approx 1MOhm//25pF

Semiconductor Component Parts

6 IC, 30 transistors, 21 diodes, 5 silicon rectifiers

Miscellaneous

Cathode-ray tube 3RP1A with 7cm Ø
Built-in square-wave generator 1kHz for probe adjustment (0,2Vpp)
Electronic stabilization for all supply voltages incl. high voltage
Mains supply 110, 127, 220, 237V AC
Admissible mains fluctuations ± 10%, 50 60Hz
Power consumption approx 24W
Weight approx 4,5kg
Case 212x114x265mm, anthracite, with handle and tilt stirrup

Subject to change

14 Day money back guarantee »»

Purchase the model *HM 307* on a 14 day full money back guaranty. If for any reason you are disatisfied or that it does not meet specifications; then return the unit along with proof of purchase and receive your full refund or credit.(Offer not valid where unit has been damaged or misused.)

This small trigger oscilloscope with 7cm screen is especially designed for electronic service and advanced amateurs. Despite its simplicity it has many qualities of bigger oscilloscopes. The sensitivity of the measuring amplifier is sufficient to display also signals of a few mV without problems. The time deflection works with the new LPS trigger technique, developed by HAMEG. Signals of higher repetition frequency are also triggered absolutely jitter-free. All supply voltages are stabilized.
The operating elements are clearly arranged just as is known from HAMEG instruments. A solid mechanical construction and optimum design of all technical details testify to the good value of this oscilloscope.

$449.95 LIST

Available Accessories

10:1 and 100:1 probe, demodulating probe, various test leads, pre-amplifier, dual-trace adapter, viewing hood, carrying case, recording camera and instrument cart.

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