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MAY 1978

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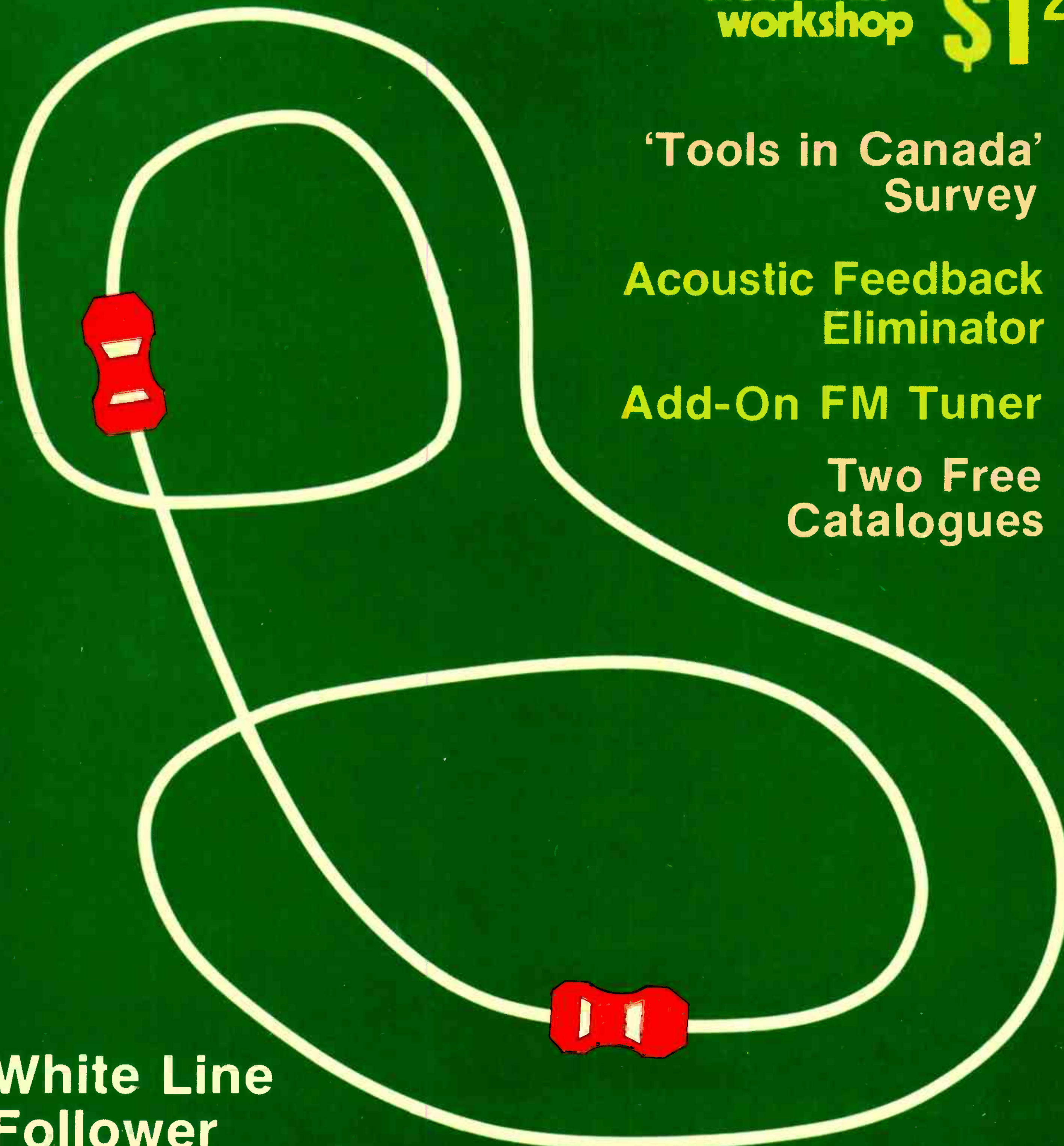

'Tools in Canada' Survey

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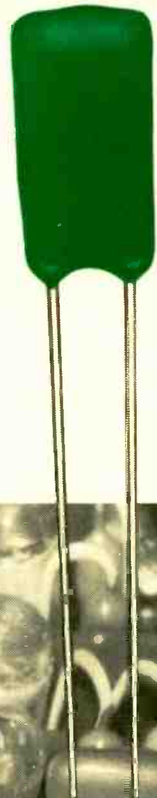

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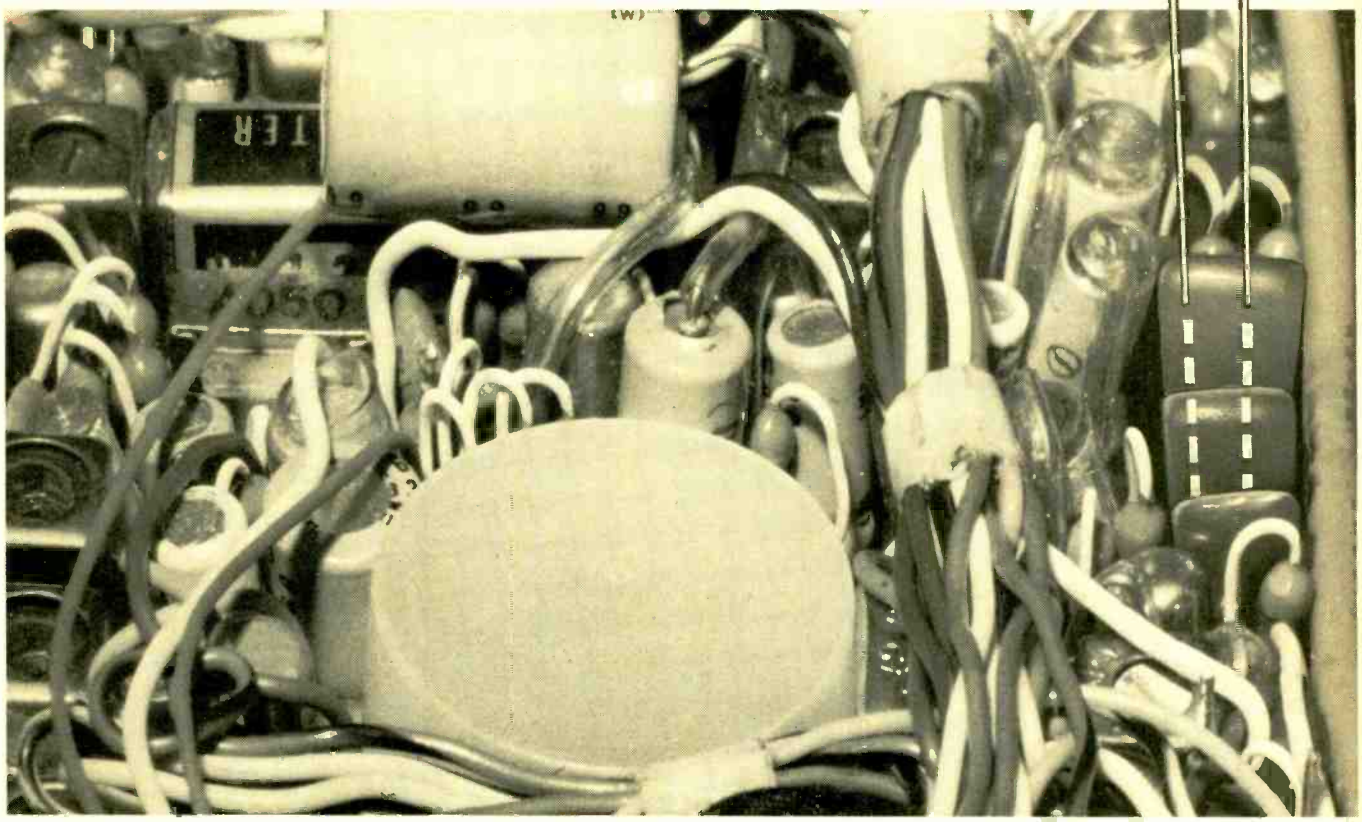

Low-cost Verti-Film★ epoxy-coated polyester-film capacitors help you beat the cost/space squeeze when servicing CB radios and other entertainment electronic equipment, letting you make exact replacements on crowded PWBs quickly and easily. Their single-ended design permits vertical installation in far less space than required by conventional axial- or radial-lead film capacitors.

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VOL. 2 NO. 5
MAY 1978

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Published by Electronics Today International (Canada) Ltd.

EDITORIAL AND ADVERTISING OFFICES
Unit 6, 25 Overlea Boulevard, Toronto, Ontario, M4H 1B1
Telephone (416) 423-3262

Printed by Livingstone Printing Ltd.

News Stand Distribution Gordon & Gotch, Toronto.

Subscription Rates $12.00 per year, $20.00 for two years. Send to Subscription Dept., ETI Magazine, Unit 6, 25 Overlea Blvd., Toronto, Ontario, M4H 1B1.

INTERNATIONAL EDITIONS
Electronics Today International
25-27 Oxford St., London W1R 1RF, UK.
Editor Halvor Moorshead.

Electronics Today International,
Ryrie House, 15 Boundary St.,
Rushcutters Bay, Sydney, Australia.
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Electronica Top Internationaal,
Postbus 260, Emmen, Holland.
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electronics today international

CANADA'S OWN ELECTRONICS MAGAZINE

PROJECTS

FEATURES

NEWS & INFORMATION

Second Class Mail registration number 3955. Return postage guaranteed. Post Office returns to Unit 6, 25 Overlea Boulevard, Toronto, Ontario, M4H 1B1.

NEWS DIGEST

Japanese Explorers Use Canadian Radios

Early in March, two separate attempts were made by Japanese nationals to reach the North Pole following Admiral Peary's historic route from Cape Columbia. During their eight to ten week outward and return journey over the treacherous polar ice cap, they will be in regular communication with their respective base camps, charter aircraft support and the outside world by means of compact portable signal sideband radio transceivers manufactured in Vancouver by the specialized communications equipment firm of Spilsbury & Tindall Ltd.

The 4-channel battery-operated units weigh eight pounds and have an effective two-way voice range in excess of 600 miles. Spilsbury & Tindall Ltd., 120 East Cordova St., Vancouver, B.C.

Computer Video Game Chips

Signetic Corp. has announced a set of new ICs for video games based on its 2650 microprocessor. The ICs are the 2636 PVI (Programmable Video Interface), the 2622 TV sync unit, the NE549 colour generator, a cartridge ROM and the 2650. The projected price for high-volume buyers is under $30.

The PVI chip can generate up to 80 images in up to 16 colours. It has built-in scoring facility, eight-colour background choice, and 255-frequency (over 3 octaves) programmable music output. The PVI displays 200 lines of video with 280 ns resolution.

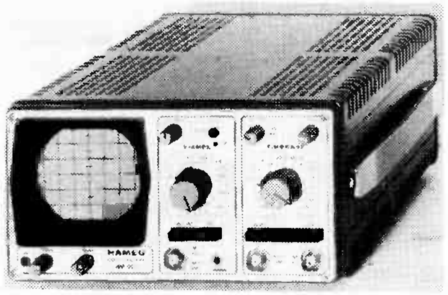
Straight-Line Communication Across the Globe!

Imagine telecommunications from Canada to India in a straight-line — through the solid mass of the earth. Such a system is under study at the US Naval Research Lab in Washington. The technique is to use a collimated beam of neutrinos directed at a receiver anywhere on earth. The neutrinos can pass through our planet without significant attenuation, and the techniques of detection, collimation and generation of the beams have already been demonstrated in various research labs.

Affordable DC - 10MHZ

This small trigger oscilloscope with 7 cm screen is 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 signals of a few mV without problems. The time deflection works with the new LPS trigger technique, developed by HAMEG. Signals of high repetition frequency trigger jitter-free. All supply voltages are stabilized.

The technical side of the HM 307 is based on a mixed application of integrated circuits and semiconductors. A flat design was chosen for the case, which is more suitable for portable operation than the upright size. The usable screen size is approx. 6 x 7 cm, divided into cm. For the display of very slow processes the HM 307 can also be delivered with a tube with long persistence time.



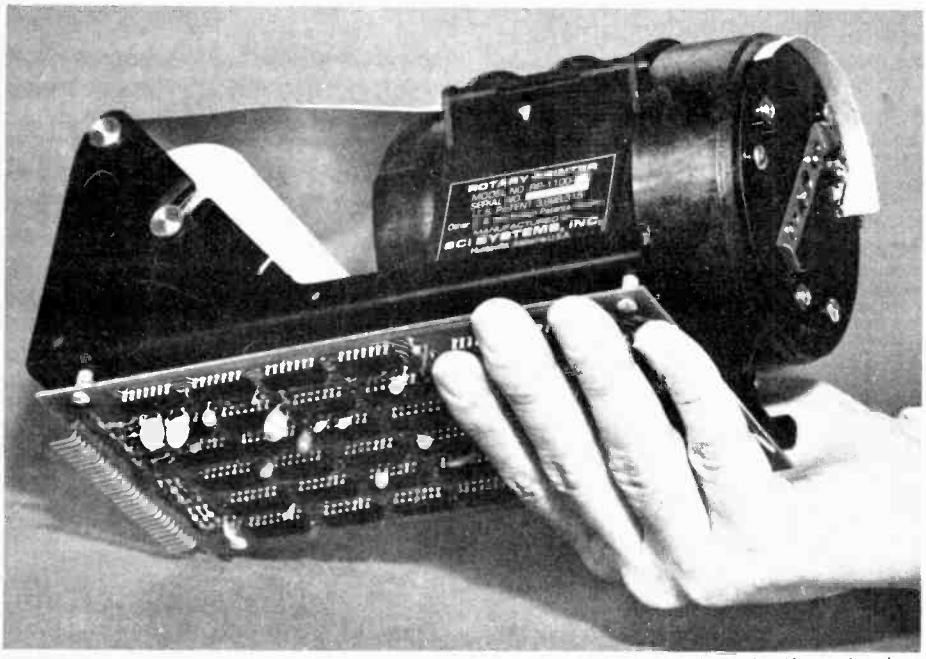
The measuring amplifier of the HM 307 has a diode-protected FET input. The measuring amplitude can be determined by means of the 12-position frequency-compensated input attenuator.

Triggering and time deflection of the HM 307 both work with the LPS technique. The essential feature is logic control of charging circuit. CRT unblanking and the trigger unblocking. In position "AT" of the level control (automatic triggering), a timebase line is always displayed even when there is no signal. The unblanking of the cathode-ray tube is controlled via an opto-coupler.

A square-wave generator of 1kHz is built-in for probe adjustment and calibration of the Y-amplifier. When using a 10:1 probe, the displayed signal will be 4 cm high at a sensitivity of 5mVpp/cm. This and other Hameg scopes are available from BCS Electronics Ltd., 980 Alness St., Unit 35, Downsview, Ont. M3J 2S2. They also supply Coline scope probes and coax connectors.

Multi-Plane Matrix Boards

Available with up to 10 planes of diversification, "Controlox" multi-plane matrix plug boards feature a current rating of 5 amps. For further information contact GEC (Canada) Ltd., 766 King Street West, Toronto, Ontario M5V 1N7.



Printer for Radio Shack TRS 80

The Series 1100 Rotary Printer prints 2,200 characters per second. The SCI Systems Inc. unit can print the King James Version of the Bible in 22 minutes.

One of the major advantages of the SCI Rotary Printer is its economy. The Rotary Printer will not normally require the service contract expense associated with conventional printers. The reliability of the Rotary Printer is largely due to its simplicity. Estimated life of the drive unit is in excess of 8 billion characters. (It is limited only by the life of the motor's brushes.) Low power consumption further enhances its reliability.

The Rotary Printer is "almost" maintenance free. The replaceable element is the print head. It will print at least 25 million characters. When replacement is required a new head can be snapped into place in 10 seconds.

The printer which is 4 by 5 by 9 inches weighs only 3 pounds.

The rotary printer has only three primary elements; the drive unit, the print head, and the paper itself.

A central shaft supports a code wheel at the rear of the drive unit and the print head at the front. The shaft is belt driven by a small D.C. motor. A single paper feed roller is driven from the central shaft through a worm gear arrangement. Thus, a single motor directly drives all elements of the printer and synchronization is inherent.

The print head contains three multiwire stylus assemblies. These are mounted 120° apart on a plastic rotor and are protected by a molded cover. A slip ring dis is the rear structure of the print head and is connected through flexible etched cables to the styli themselves. The cover photograph shows the contact bruches which connect the print head to the drive electronics.

Paper is inserted through the writing platen and formed into a 120° arc by a snap down top cover. In operation the drive roller pushes the paper through the unit continuously. Centrifugal force extends the stylus wires through slots in the print head cover and into contact with the platen and paper as the head rotates.

The Rotary Printer uses moderately priced electrosensitive paper. The base paper is coated with a black pigment. A micro-thin layer of aluminum is then vacuum deposited on the surface. As the print styli move across the paper, electrical pulses are applied through them to the paper. Each pulse removes the surface layer and exposes the undercoating — thus forming a black dot on the paper. Characters are formed by closely spaced combinations of dots. This printing process is a non-impact one which requires no chemicals, inks, or toners. The printed record is permanent and does not deteriorate with time.

Dot-Matrix Printers

Motorola Microsystems has announced four new dot-matrix printers to complement its microcomputer development systems. The line offers 80 and 132 column formats and 60, 120 and 180 characters per second, using bidirectional and logic-seeking print heads. The printers are mechanically identical to Centronix products with the same model numbers: 779, 781, 702, 703.

Personal Computing Festival

The 1978 National Computer Conference, which will be held in the Anaheim Convention Center, June 5-8, will include a full-scale, three-day Personal Computing Festival in the nearby Disneyland Hotel. The Festival will include paper, panel and tutorial sessions; a contest for microprocessor systems and applications; and a commercial exhibit of personal computing products and services. For information write, National Computer Conference, c/o AFIPS, 210 Summit Avenue, Montvale, NJ 07465; 201/391-9810.

Array Processor

The first Array Processor offered by a minicomputer manufacturer was recently announced by Data General (Canada) Limited. The Eclipse AP/130 combines a powerful central processor and a floating-point array processor.

Array processing, digital signal processing and transform processing all involve rigorous, highly computational mathematical operations on structured data. The AP/130's array processor is an integral high speed special-purpose floating-point computing unit that can perform the Fast Fourier Transform (FFT) of a 1024-element complex number array 200 times faster than a modern scientific minicomputer. Data General (Canada) Limited, 415 Horner Avenue, Toronto, Ontario M8W 4W3.

First 12-Bit Monolithic CMOS DAC

Claimed to be the industru's first true 12-bit monolithic CMOS digital/analog converter, the AD7541 has been introduced by Analog Devices. In Canada contact Tracan Electronics Corporation, 558 Champagne Drive, Downsview, Ontario, M3J 2T9.

NEWS DIGEST

Amateur Experimenter Certificate

Here, in full, is a notice sent out by the DoC inviting comment on the plans for introducing an Amateur Experimenter Certificate. This will be of interest to many of ETI's readers — anyone who is interested in computers or radio. Note you have send off your comments before the end of May.

SCHEDULE

1. Section 46 of the General Radio Regulations, Part II, is amended by adding immediately after subsection (4) the following subsection:

"(4.1) The frequency bands and types of emission set forth in Schedule VII may be used by a licensee who is the holder of an Experimenter Amateur Radio Operator's Certificate;"

2. Section 49 of the said Regulations is amended by deleting "or" at the end of paragraph (e) thereof by adding the word "or" at the end of paragraph (f) thereof and by adding thereto the following paragraph:

"(g) an Experimenter Amateur Radio Operator's Certificate";

3. The said Regulations are amended by adding immediately after section 97 the following heading and section:

"Experimenter Amateur Radio Operator's Certificate

97.1 The holder of an Experimenter Amateur Radio Operator's Certificate may operate the radio apparatus installed in a station performing an Amateur Experimental Service in accordance with the privileges specified in section 46;"

4. The said Regulations are amended by adding immediately after subsection 111(2) the following heading and section:

"Experimenter Amateur Radio Operator's Certificate

111.1 Candidates for examination for an Experimenter Amateur Radio Operator's Certificate shall be required

(a) to answer, in a written examination, questions on

(i) theory of communications, computing, analog and digital transmissions, queuing theory, packet radio, micro-processors, error detection schemes and reliability;

(ii) the installation, operation and maintenance of transmitters, receivers and computing equipment, and

(iii) regulations under the Radio Act applicable to the establishment and operation of stations performing an Amateur Experimental Service.

5. (1) Schedule II of the said Regulations is revoked and the following substituted therefor:

"SCHEDULE II

Item	Column I Frequency Bands		Column II Types of Emission
1	1.8000 -	2.000 MHz	A1, A3, F3
2	3.500 -	3.725 MHz	A1, F1
3	3.725 -	4.000 MHz	A1, A3, F3
4	7.000 -	7.150 MHz	A1, F1
5	7.150 -	7.300 MHz	A1, A3, F3
6	14.000 -	14.100 MHz	A1, F1
7	14.100 -	14.350 MHz	A1, A3, F3
8	21.000 -	21.100 MHz	A1, F1
9	21.000 -	21.450 MHz	A1, A3, F3
10	28.000 -	28.100 MHz	A1, F1
11	28.100 -	29.700 MHz	A1, A3, F3
12	50.000 -	50.050 MHz	A1,
13	50.050 -	51.000 MHz	A1, A2, A3, F1, F2, F3
14	51.000 -	54.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4
15	144.000 -	144.100 MHz	A1,
16	144.100 -	148.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4,
17	220.000 -	225.000 MHz	**Packet radio transmissions
18	*420.000 -	450.000 MHz	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4,
19	*1 215.000 -	1 300.000 MHz	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4,
20	*2 300.000 -	2 450.000 MHz	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4,
21	*3 300.000 -	3 500.000 MHz	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4,
22	*5 650.000 -	5 925.000 MHz	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4,
23	*10 000.000 -	10 500.000 MHz	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4,
24	24 000.000 -	24 050.000 MHz	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4,
25	*24 050.000 -	24 250.000 MHz	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4."

(2) Schedule IV of the said Regulations is revoked and the following substituted therefor:

"SCHEDULE IV

Item	Column I Frequency Bands		Column II Types of Emission
1	1.800 -	2.000 MHz	A1,
2	3.500 -	4.000 MHz	A1,
3	7.000 -	7.300 MHz	A1,
4	14.000 -	14.350 MHz	A1,
5	21.000 -	21.450 MHz	A1,
6	28.000 -	29.700 MHz	A1,
7	50.000 -	50.050 MHz	A1,
8	50.050 -	51.000 MHz	A1, A2, A3, F1, F2, F3,
9	51.000 -	54.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4,
10	144.000 -	144.100 MHz	A1,
11	144.100 -	148.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4,
12	220.000 -	225.000 MHz	**Packet radio transmissions
13	*420.000 -	450.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4,
14	*1 215.000 -	1 300.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4
15	*2 300.000 -	2 450.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4,
16	*3 300.000 -	3 500.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4,
17	*5 650.000 -	5 925.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4,
18	*10 000.000 -	10 500.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4
19	24 000.000 -	24 050.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4,
20	*24 050.000 -	24 250.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4."

(3) The following Schedule is added immediately after Schedule VI

"SCHEDULE VII

Item	Column I Frequency Bands		Column II Types of Emission
1	144.000 -	144.100 MHz	A1,
2	144.100 -	148.000 MHz	A0, A1, A2, A3, A4, F1, F2, F3, F4, P0, P1, P5, P9,
3	220.000 -	225.000 MHz	**Packet radio transmissions
4	*420.000 -	450.000 MHz	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4, F5, P0, P1, P2, P3, P4, P5, P9
5	*1 215.000 -	1 300.000 MHz	A0, A1, A2, A3, A4, A5, F1, F2, F3, F4, F5, P0, P1, P2, P3, P4, P5, P9."

** Packet Radio Transmission in the 220 MHz to 225 MHz Band

This band should be used for any packet radio transmission up to the maximum data rate that this band can support, provided that individual packets of data do not exceed 500 characters in length and the effective radiated power does not exceed 15 watts. Any transmission in this band should not produce out-of-band interference.

1. Packet Radio Transmission: refers to a communications technique where packets of data are 'broadcast' over a communications channel which is shared by a number of users.
2. Packet of Data: consists of a header and a header parity check word, followed by up to 400 characters (bytes) of data and a data parity check word. A full packet of data including overhead shall not exceed 500 characters (bytes).
3. Packet length: refers to the amount of data and overhead characters (bytes) that make up a given packet.

NEWS DIGEST

Department of Communications

Radio Act

Notice No. DGTR -001-78

The Department of Communications wishes to encourage Canadians to become proficient in communications and computing technologies and, in particular, in the organization of radio and computing equipment for accomplishing resource sharing in man to machine and machine to machine networks.

The Department therefore plans to introduce a new class of amateur licence, called the Amateur Experimenter Certificate to further the above-mentioned objective. The attached schedule delineates the proposed terms and conditions of this certificate.

Comments on this proposal are invited from all interested parties. All communications should be addressed to the Director, Operations Branch, 300 Slater Street, Ottawa, K1A 0C8, and should be postmarked not later than 90 days from the date of this notice.

Comments received in response to this Notice will be made available for public inspection, unless confidentiallity is specifically requested, at the Department of Communications Library, 300 Slater Street, Ottawa, K1A 0C8, and at Regional Offices of the Department in Vancouver, Winnipeg, Toronto, Montreal and Moncton. Those wishing to respond to such comments may do so in writing within a further 30-day period.

Dated at Ottawa this 1st day of March 1978.

Dr. John deMercado,
Director General,
Telecommunication
Regulatory Service.

Multiplier Application Guide

This guide shows many ideas on using multipliers, dividers, squarers and square rooters to solve analog problems with simplicity and low cost. In addition to over 30 applications, the book includes a section on theory and bibliography. Examples of applications are: increased accuracy with multiplying DACS; audio power booster; bridge linearization; automatic level control; flowmeter; acoustic thermometer; and high-performance rms-to-dc conversion circuit. The book is authored by the Analog Devices' engineering staff and edited by Daniel H. Sheingold. For a free copy of the 40-page Multiplierf Application Guide, please contact Analog Devices, Inc., PO Box 280, Norwood, MA 02062. USA.

New Capacitors

CGE "TE" series epoxy-dipped solid tantalum capacitors offer a wide range of features and options. Such as: Operating temperative of -55°C to -85°C; working voltage of 3 VDC to 50 VDC; capacitance range from 0.10 uF to 680 uF; case sizes from 1 through 11; and tolerances from -20% to -10%.

Available from: Canadian General Electric Co. Limited, Electronic Components, 189 Dufferin Street, Toronto, Ontario M6K 1Y9.

JFET-Input Op-Amps

The internally compensated LF155 series from Motorola incorporates matched junction FET devices on the same substrate as bipolar IC elements, producing input characteristic enhancement of more than an order of magnitude over conventional amplifiers.

Extremely low input bias and offset currents combine with very high input impedance, and characteristic low FET noise levels, making the series especially useful in sample and hold circuits, high impedance buffers, fast D/A and A/D converters, precision high speed integrators, and wideband, low-noise, low-drift applications.

The Longest Large-Capacity Digital Radio Route in the World

The first major contracts for large capacity digital radio in Canada have been awarded to Norhtern Telecom Canada Limited by three western Canadian telephone companies. The contracts cover a 1100-mile system running from the Manitoba-Ontario border to Calgary, Alberta.

When completed and in service in late 1979 the system will link up with another in Ontario to form part of the longest large capacity digital radio route in the world, stretching 2,300 miles from Toronto to Calgary and Edmonton. This route in turn will be linked to the LD-4 high capacity coaxial cable digital system that runs between Toronto, Ottawa and Montreal.

The DRS-8 system, developed and designed in Canada will use existing microwave route facilities that include buildings, towers and antennas. There are 40 such locations over the route in the prairies.

The system, being digital, can handle voice or data traffic up to the equivalent of 1,344 telephone conversations simultaneously per radio channel. There are 11 operating radio channels in the frequency band.

NEWS DIGEST

LCD Digital Panel Meter

Texmate's new liquid crystal display DPM, model PM-35X, provides a 3½ digit display with ½" character height. The voltage range is from 3.5 to 7.5 VDC and 8.5 to 15 VDC, unregulated. There is also a model to operate from 120 VAC. Input voltage ranges are 200 mV, 2V, 20 V, 200 V and 1200 VDC. It offers 8 programmable function descriptors, providing multimeter capability. The price of the PM-35X is $79.00 (Canadian) in single unit quantities with delivery from stock. For a free technical data sheet contact Metermaster, 214 Dolomite Drive, Downsview, Ontario, M3J 2P8.

Errata/Project File

Project errata, addenda and notes will in future appear in our new reference section, Project File. This new item starts this issue, on pages 68 and 69.

Project File is intended to provide project support to readers building projects published in the last year's issues of ETI-Canada.

It includes a chart cross-referencing all information published with respect to each project.

UW Datapac

The University of Waterloo's Honeywell computer, on the third floor of the mathematics and computer building, is now hooked up to Bell Canada's Datapac computer network. This makes it possible for anyone who knows how, to make use of the Honeywell from any of seventy-two Datapac-served cities in Canada. And about as easily and cheaply as one could work with it from a terminal in an office anywhere else in the math building. "I am sure it is going to have a very great impact," predicts Dr. Morven Gentleman, computer science professor and a member of UW's computer communications network group. "What it will mean is that people who aren't even connected with the university . . . people who may live perhaps thousands of miles away . . . will use our computer when it is to their advantage to do so. Say for instance when there is some program or data in our file system that would be helpful to them; they now have easy and inexpensive access to it." Another important feature of the Datapac system, he feels, is that it will be possible to use it as a form of electronic mail.

"It won't be at all like the post office, the telephone or even Telex," he says. "As a user you'll have to work out a system for exchanging messages with the other party or parties but once you have established a system you will be able to send messages to others, or just call in and ask if there are any messages for you. The communication is almost instantaneous and it won't be costly. This is something I am personally very enthusiastic about."

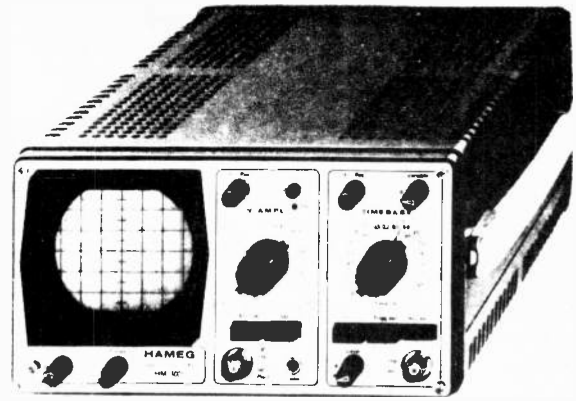
Miniature Matrix

The AMX-1010 matrix selector is a 100 station cross-bar programming pin board. This miniature assembly is 1.4 inches square and has a 0.34 inch profile. The pin sockets and the shouting pins (ten supplied) are gold plated. The precision machined four-leaf pin sockets assure positive retention of pins even at high levels of shock and vibration. For further information contact: Canadian General Electric Company Limited, Electronic Components, 189 Duffering Street, Toronto, Ont., M6K 1Y9.

HAMEG

OSCILLOSCOPE HM 307

Special offer 14 day money back guarantee



10MHz
(-3 dB)

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

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
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Power consumption approx 24W
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Case 212 x 114 x 265mm, anthracite, with handle and tilt stirrup.

INCLUDES X1 PROBE

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Purchase the model HM307 on a 14 day money back guaranty If for any reason you are dissatisfied or the instrument does not meet specifications Return it with proof of purchase. Your money will be then refunded immediately

Art Baier
President

The HM 307 is characterized by modern semiconductor circuitry. The new generation design from HAMEG is also representative of high performance standards in spite moderate technical expenses. It is ideally suited to the technician or the service engineer as its light weight and small size allows it to be taken anywhere.

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$449.95
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Audio Today

Developments in audio reviewed by Wally Parsons

IN ANY FIELD of endeavour based on sophisticated technology it's very easy to become so wrapped up in the technology itself as to lose sight of one's purpose, the end to which this technology is directed. This is especially true in a field such as audio which is not only in a state of rapid evolution but is also heavily consumer oriented. Thus we find hardware promoted for applications which are, at best, questionable, and at worst, quite impossible. Thus, persons may want to use graphic equalizers to correct frequency response irregularities caused by improper component mating (e.g. impedance mismatch), or simply bad design of a particular component, such as a speaker, or failure to deal with strong standing waves in the listening room.

Or perhaps we attempt to add "ambience" or equalization in a misguided effort to restore proper balance, without having the slightest idea of what the "proper" balance is. We want to obtain a reproduction which is "accurate", whatever that's supposed to mean, and faithful to the original, even though the original may never have existed, that is, the performance was created on the recording.

Now it is not my intention to knock progress. On the contrary; so many advances over the years have produced the capability of recording and broadcasting with a degree of fidelity inconceiveable not too many years ago. But much of this technology is wasted if we forget basics and lose sight of our aims. This may be why it's taken 70 years for American and Canadian pressers to figure out how to put the centre hole in the centre of the record, and London has forgotten how.

LISTENING

In these pages "Audio" is presumed to refer to those areas of sound reproduction which aim at a high level of performance quality. In establishing performance criteria attention must first be paid to the type of programme material to be reproduced most of the time. The classical music concert goer is especially likely to be a purist. His reference standard is live music, heard with some frequency. This might give the impression of being a pretty tough act to follow, yet this is the audiophile most likely to be fooled into accepting reproduction which deviates grossly from his intended ideal. The reason is quite simple; human memory seems to be quite unreliable where sensory information is involved. If you go to a concert it's usually in the evening. Chances are you won't be operating your sound system before the next day, at least at concert hall levels. By that time your memory of last night's performance will have become less clear and unless your system has some gross obvious faults, it will sound pretty good. If the low bass is missing, your mind fills it in, or if a voice is projected a little too forward, your mind pushes it back. And then, if you can only get Gallery seats and a recording was made with an up front perspective you no longer have a reasonable reference. This points to a need for considerable listening experience and helps explain the difficulty of becoming a first rate sound man at an early age.

Then too, it's so easy to be impressed by the extremely wide stage reproduced by two speakers and forget that at the live performance the stage angle was so much narrower that if you closed your eyes you really wouldn't know the exact location of the oboe and the trumpet. As for front to back depth, there really isn't much of that either.

Remember that speaker which reproduced such silky smooth string tones? Surprise: massed strings often have an edge to them which verges on the wiry. And why not; sound is produced by drawing a bow across stretched wire. And many a great speaker has been criticized because cellos and basses have a resonant and woody quality often attributed to cabinet resonance. Well, it's resonance all right, the resonance of the belly of the instrument. Tympani really do sound hollow and a concert bass drum really is boomy. A good speaker does not reproduce its sound as a "Wump".

PRODUCTION

The collector of predominantly rock music is in a different position. The technical key to such production is the multi-channel recording chain, which, when used creatively, permits sonic effects which are quite impossible to produce by any other means, but which all too often makes possible the production of tracks by musically illiterate dullards who wouldn't be able to play the same tune together using conventional means. Unfortunately they are often put together by producers and engineers of similar mentality, who frequently exercise their toys on real music. With good material, engineered with taste, imagination, and good judgement, the result can often be magnificent. Obviously, the legitimate aim in reproduction is to realize the sonic image heard by the producer. In other words, to achieve what he wanted the listener to hear. The catch is, that you don't know what he wanted you to hear. So you may not be able to achieve it without duplicating the exact conditions which existed during the final mixdown. However, taste and judgement often prove to be a good guide here.

Where it becomes a little sticky is in the realm of more traditional popular music and some jazz forms in which these techniques have been used. Here we have at least the possibility of finding a live performance for comparison. With multi-track what we usually end up with is two channel monophonic sound which has been highly processed to produce an artificial stereo image. How successful these efforts are may be judged by the increasing number of equalizers, noise-reduction units, time delay devices and other signal processors commercially marketed and the demand for construction articles by readers of ETI.

AN ART

I've long felt that most of the art produced in any time to be worthless and is generally forgotten with time. Perhaps in the area of music recording we must view software engineering from the same point of view. Like the discriminating music lover, then, we must establish clear values in our own minds as to what we are trying to accomplish, and evaluate new developments, equipment and concepts from this point of view.

I expect to get back to more specific aspects of this theme from time to time, but in the meantime, consider the virtue of the word "why".

PRODUCTS AND DEVELOPMENTS

Basically there is little difference between the shape of the groove cut on the early Berliner disc and that of a modern stereo LP. Both are cut with a modified V-groove with some rounding at the bottom, and with each modulation occurs on both groove walls. The only real differences have been in dimensions, included angle, and modulation angles.

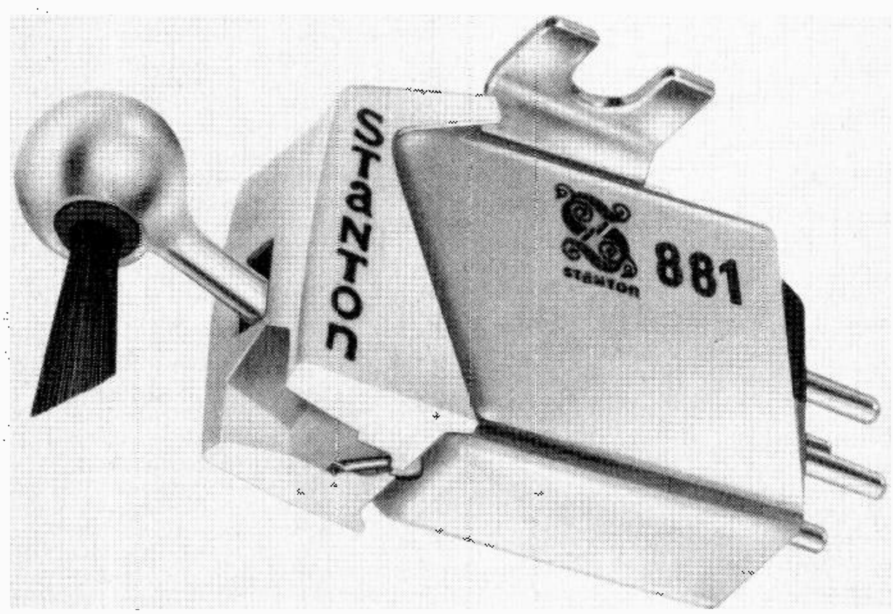
Playback styli, too, have evolved from steel ploughs to precision instruments as more was learned about the dynamic relationship between stylus and groove wall. Generally, though, styli have been conically shaped with the tip ground to a spherical arc, and later an elliptical cross-section with bi-radial tip. This latter was developed mainly to improve the stylus' ability to trace high frequency modulations in the stereo groove. But even this proved inadequate to handle the very high frequencies (up to 45 kHz) involved in CD-4 recordings. Consequently other shapes were developed most notably the complex Shibata and other types. With luck, most of the various four-channel systems will hibernate for awhile, while we figure out what we really want to do with all these channels, but in the meantime some of the things learned have spun off and been applied to conventional two-channel stereo recording and playback.

QUADRAHEDRAL

One of these was Stanton's "Quadrahedral™" stylus configuration, basically a stylus of elliptical cross-section with a very wide ratio of lateral to transverse dimension. Now, ordinarily this would result in a very small contact area and a consequently high unit contact pressure when used at any realistic tracking force. However, by forming the stylus into a hyperbolic shape, when viewed from the front, a larger area is placed in contact with the groove walls. The result is low unit pressure, and because this extended contact is along the vertical reduced tip mass developed for CD-4 means smoother more extended high frequency response, with better tracing at high frequencies, aided by the improved groove wall contact.

In optimizing for CD-4 performance some sacrifice was made in tracing ability and transient response when playing stereo discs, with the result that Stanton's 780/4 DQ pickup lacked the presence and impact which characterized the 681 series. Even so, the new stylus shape combined with a redesigned pole structure in the pickup body did produce a certain smoothness and cleanness.

An outgrowth of this experience is the "Stereohedron™" stylus similar to the CD-4 unit but optimized for stereo use and available in the 681 EEE/S and the new Calibration Standard 881S. I've had the opportunity to use the EEE/S version for several months, and it seems to be an effective and worthwhile development which, if not in its present form, at least in some other variant, is likely to become as commonplace as the elliptical tip is now. So far I haven't found anything which it will not trace including some pretty heavily equalized sibilants. Probably because of the different mating surface involved, recordings which showed signs of damage due to mistracking on previous plays either were cleaned up, or the noise component seemed to dissociate itself from the signal, thus reducing its obtrusiveness. The same is true of surface imperfections which appear as separate signals. The effect is



something like noises which may come from an audience, one is aware of them, but they can be tuned out. Bright instruments like brasses and cymbals sound bright, yet there is no artificial effect added. Stereo imaging is wide, and solid, with a lovely but not exaggerated presence on voices and solo instruments, and a clean separation of individual voices on choral music.

Now for the kicker. Stanton advises that the assembly be used **only** in the 681 EEE body. Well, I've got news; I'm using it in both the older 681 EE and the 780 Bodies. In the latter it performs to spec, although it requires a load of 27k and 100pF capacitance, while with the former it provided a significant upgrading in performance, and in both cases at considerably less cost than a complete 681 EEES. The different loading requirements are due to the different inductances used in each body. Now, Stanton has always designed their pickups for operation into a much lower capacitive load than most other manufacturers, using higher inductance coils to achieve reasonable output. This may account for the variable reports on performance. They tend to be a little tricky to install, and one would be well advised to use very low capacitance cables even if it means adding lump capacitance to bring it up to the specified value.

On the other hand, none of the products exhibit the excessive compliance which has become a fashionable design characteristic in recent years, so they can be used in arms of moderate mass.

MOVING MAGNET

The 881S represents a return to the moving magnet system, unlike Stanton's other products which use a moving iron principle. Therefore, its stylus cannot be used in the other bodies. They claim to have achieved a lower effective tip mass by using a very high energy magnet material and reducing its mass.

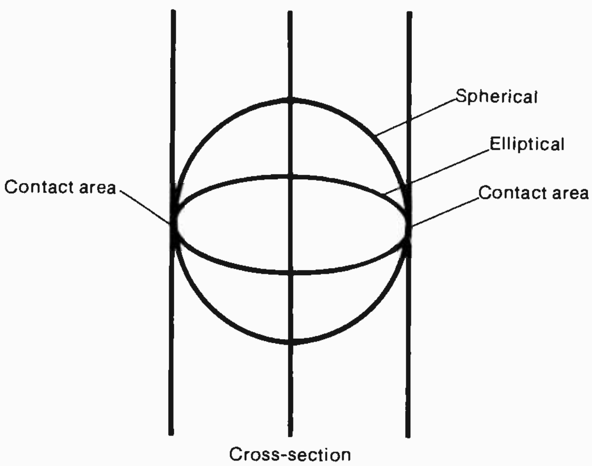
If you're using one of the earlier Stanton models this is a good way to upgrade. If not, but have considered using a professional pickup, the 681 EEE/S or the 881S would be worth considering. And incidentally, because of the close relationship between the companies many of the Stanton and Pickering styli and bodies are interchangeable. Thus, the Pickering 4500Q appears similar to the Stanton 780/4DQ, while XSV/3000 claims the same magnet system and stylus as the Stanton 881S. I'm not suggesting that you purposely mix and match bodies and styli, but if you already have the body, you might want to give it a new pointy head.

Stanton is distributed by Tri-Tel Associates, 105 Sparks Ave., Willowdale, Ont. M2H-2S5.

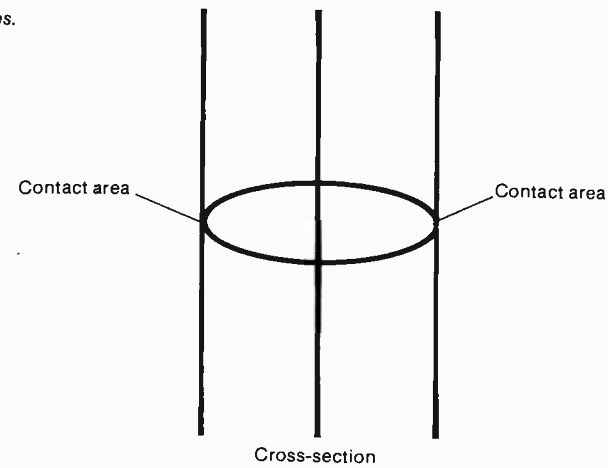
NOTED IN PASSING

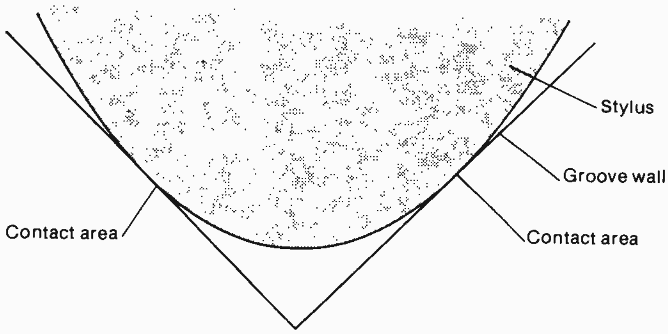
PRO SOUND, 13717 S. Normandie Ave., Gardena CA., USA has a LOUDSPEAKER PHASE AND IMPEDANCE TESTER, which is said to allow experimentation with varied amplifier-speaker combinations without risk of amplifier damage.

NATIONAL SEMICONDUCTOR has introduced the LM391 audio power drive IC for use in 10 to 75 watt amplifiers. Distortion claims are 10 times lower than earlier drivers and slew rate is said to be 20 V/us. As soon as I get the data sheets I'll have more to say about this device.

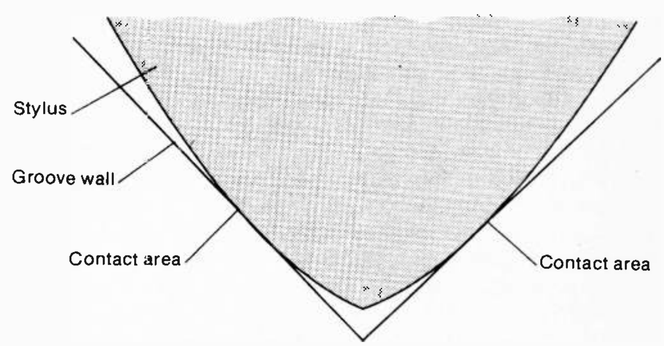


Diagrams of stylus types.





Elliptical and spherical styli.



CD-4 derived stylus (typical).

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.

Parts Problems

I am a monthly reader of your magazine and find great interest in them being an electronics technician. Recently I have been seriously considering building one of your many fine projects found in your magazine but I have found a problem. I am not able to locate one of your parts needed to complete this project. I was hoping you might be able to assist me.

A.J., Yarmouth Co., N.S.

This might be a good point to mention the subject of distributors' catalogues. In general, they provide an excellent source of information as to availability of parts and in many cases are extensive enough to include fairly comprehensive technical data. Frequently I refer to Electrosonic and I realize that Electrosonic needs a free plug from me about as much as Eaton's does but as it happens their catalogue is one of the most comprehensive available both in terms of the variety and quantity of components shown and in the amount of technical data included. Electrosonic charges $10 for their catalogue; in my opinion it is $10 well spent if only for the technical information. Other suppliers may or may not charge for their catalogue. ETI published a comprehensive survey of distributors' catalogues last summer and we're in the process of assembling material for another such article in the near future. Readers seriously interested in constructing ETI projects are urged to try to obtain such catalogues an even if money has to be spent for them, it will be money well spent.

I suggest also contacting other suppliers who have advertised availability of parts for several of ETI projects. And if any other suppliers wish to make available parts for ETI projects just drop us a line on your letterhead and we'll be quite glad to offer whatever co-operation we can.

Light Organs

Please send to me all the information you have on 5 channel colour organs.

B.F.H., Britt, Ontario

A complete answer to such a question would really require volumes and volumes of information. This, coupled with the brevity of your letter and a lack of knowledge as to your degree of expertise makes it very difficult to determine just how much information and explanation to supply, but we'll give it a try anyway.

Basically, a colour organ is an elaborate light dimmer. Now, light dimmers ordinarily use thyristors in appropriate circuits to control the portion of the AC cycle which is used to power a lamp. In colour organ application the thyristor is controlled by the audio signal in one or more of several ways. In general, the signal is usually divided up into a variety of band-passes, three is the usual minimum, sometimes five, even more. The signal is then rectified and the rectified signal becomes the control voltage for the thyristor. Of course, band-pass need not be the only means of differentiating the characteristics of each channel. For example, we could base the control voltage on a phase relationship between two stereo channels. We could have a circuit which would respond logarithmically or in some other non-linear fashion, but in general the principle remains the same: The audio signal is rectified with the appropriate characteristics and this is used to control the light intensity from several channels. Ordinarily, each channel has a light of a different colour or it may even be used to operate a strobe.

At this point perhaps it would be best to recommend several books to you. At the beginning level, I might suggest Sam's Publication THE ABC'S OF SILICON CONTROLLED RECTIFIERS, Sam's number 20124. Also, from RCA, THE THYRISTOR AND RECTIFIER MANUAL No. TRM445; the RCA SILICON CONTROLLED RECTIFIER EXPERIMENTERS' MANUAL No. KM71. On a more advanced level, RCA has a SOLID STATE POWER CIRCUIT DESIGNERS' MANUAL No. SP52. Now these generally will not cover colour organs as such but they will give some information of thyristors and you can take it from there.

Watts

In your December issue of ETI you described the construction of a 50W per side amplifier.

I am interested in building this amplifier, however, I would like to clear up a few points. What is 1) input sensitivity, 2) frequency response, 3) signal to noise ratio, 4) output impedance.

G.V., Toronto, Ontario

Input sensitivity will depend on the impedance of the speaker being used but as indicated in the text the voltage gain is 30. The output voltage for 50W to the speakers, across 8 ohms will be 20 volts, and across 4 ohms 14 volts. The input voltage then for 50W into 8 ohm speakers will be 0.66 V and for 4 ohm about 0.5 V.

Frequency response at the top end is

limited primarily by the compensating capacitor and would limit response to about 40 kHz. At the bottom end it is limited by the coupling capacitor to the speaker. The smaller the capacitor the higher the cutoff frequency and the cutoff frequency may be calculated by means of the formula: Xc + 2 FC, where Xc is the capacitor's reactance in ohms, F is frequency in Hz, and C is capacitance in farads. Response will be down 3dB at the frequency at which Xc + the impedance of the loudspeaker.

Similarly, output impedance will also be largely dependent on the capacitor. I presume that you are concerned largely with the damping factors at low frequencies and with this type of circuit then the output impedance is essentially the reactance of the capacitor at the frequency in question.

The signal to noise ratio is largely dependant on component quality. On an amplifier of this type the signal to noise ratio should be at least 80dB below full output, more than adequate for most applications.

More Watts

I am writing to find out if you would have a diagram on how to build a (100-150W) power amp for a guitar amp to be hooked up between the preamp and the cabinet or if you have any knowledge of where I could get one. This would be much appreciated.

D.S., Gananoque, Ontario

An excellent amplifier in the 100W range appears in Canadian Projects No. 1, which is available from ETI. (See also the note on this project last issue.) If you're using it as a power amp for a guitar you might also look into the possibility of using power modules such as the RCA HC2000 or perhaps one of the very high power ILP types which have been advertised in earlier issues of ETI. They are capable of power outputs in excess of 100W and in the case of one of the ILP's, 240W into a 4 ohm load. Also the RCA POWER CIRCUIT DESIGNERS' MANUAL referred to earlier has fairly comprehensive notes on the applications of the HC2000 and HC2500. In addition, Motorola has an application note AN485 for a series of amplifiers of various power ratings up to 100W. This design is not the most recent but has demonstrated a high degree of reliability over the years and is particularly notable for effective load fault protection circuitry. It's available from Motorola Semiconductor products, 490 Norfinch Drive, Toronto.

If you're not planning to use this for a bass guitar I think that 100W should be plenty of power, especially in view of the fact that most speakers used in such applications are pretty efficient anyway.

What to Look for in June's ETI:

Real-Time Audio Analyser

Use your scope to display the content of an audio waveform as a bar-graph, amplitude vs. frequency. Use for setting up room equalization, etc.

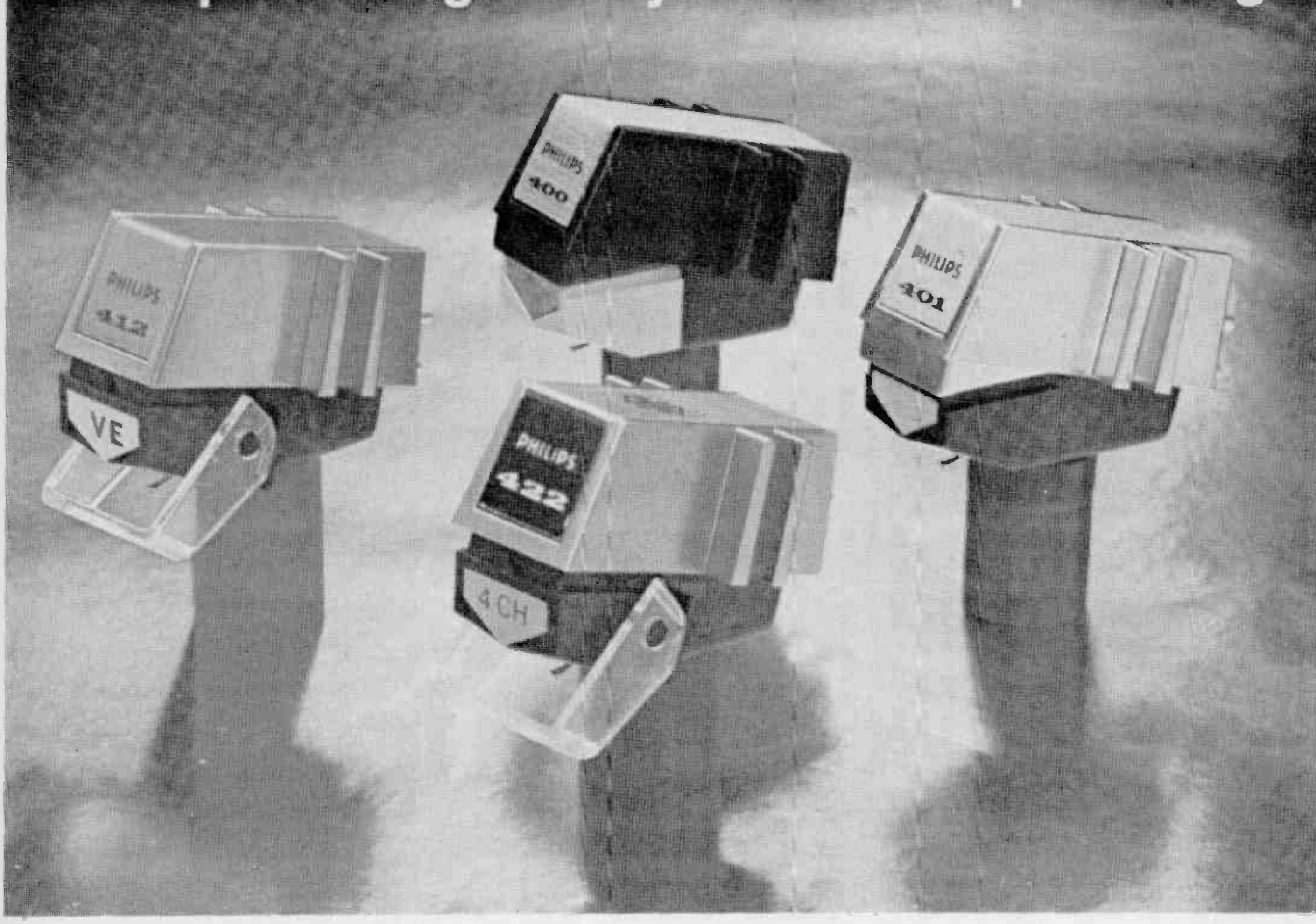
Ultrasonic Switch

This two-board project (transmitter and receiver) can be used in a wide range of applications from doorbells to data transmission.

Phone Bell Extender

Place a pick-up coil near your telephone (or other bell) and this project will sense the electromagnetic disturbance when the bell rings and sound an alarm in a remote place.

HiFi Super-M Magneto-Dynamic Pick-Up Cartridges



HI-FI MAGNETO-DYNAMIC PICK-UP CARTRIDGES SUPER-M MARK II — FEATURES

Super-M magneto-dynamic pick-up cartridges with diamond stylus, for brilliant high-fidelity reproduction. Remarkable characteristics due to application of a very small magnet of high energy Super-M magnet steel. High compliance, low dynamic mass, perfect resonance damping, and extremely low frequency intermodulation distortion. High sensitivity and excellent, smooth response over a wide frequency range. ½" Retma mounting distance for use with pick-up arms provided with universal shell. Convenient transparent hinged needle protector.

ADDITIONAL FEATURES FOR GP 422

Special shaped "S.S.T." (Super Sonic Tracking— tri-radial stylus, suitable for all types of quadraphonic records

Extended frequency spectrum, well over 50 kHz, for discrete quadraphonic systems such as CD-4

"S.S.T." stylus, finished to high precision and positioned with high accuracy, for perfect tracking of record grooves with high frequencies such as CD-4 system

Application of special shaped "S.S.T. stylus substantially reduces tracking distortion at low stylus forces and record wear

Important improvement in reproduction of stereo records

TECHNICAL DATA	GP400 II	GP401 II	GP412II	GP422 II
Frequency response (Hz)	20-20,000 ± 2 dB	20-20,000 ± 2 dB	20-25,000 ± 2 dB	20-50,000 20-20,000 ± 2 dB
Sensitivity (mV/cm/sec) at 1 kHz	1.3	1.3	1.5	1.1
Output asymmetry at 1 kHz	< 2 dB	< 2 dB	< 1 dB	< 1 dB
Channel separation at 1 kHz	> 29 dB	> 29 dB	> 30 dB	> 30 dB
Frequency intermodulation distortion (at recommended stylus force)	< 0.9%	< 0.8%	< 0.7%	< 0.6%
Stylus tip (diamond)	spher. 15 μm	ell. 7 x 18 μm	ell. 7 x 18 μm	S.S.T. 7 x 18 x 25 μm
Stylus shaft material	stainless steel	stainless steel	titanium	(no shaft)
Stylus mass (mg)	0.2	0.2	0.1	0.035
Stylus force (gf)	1.5—3	1.5—2.5	0.75—1.5	0.75—1.5
Recommended stylus force (gf)	2	1.7	1.2	1.2
Compliance (mm/N)				
static — lateral	> 32	> 32	> 40	> 40
— vertical	> 17	> 17	> 30	> 30
dynamic — lateral	> 20	> 20	> 30	> 30
— vertical	> 16	> 16	> 20	> 20
Recomm. load impedance (kΩ)	≥ 47	≥ 47	≥ 47	≥ 47 (stereo)

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PHILIPS ServiceServiceService **PHILIPS**

ETI Tools Catalogue

Where to get electronics tools in Canada

Everyone has a local Canadian Tire, hardware shop, Woolco, etc, where they can buy the usual screwdrivers, socket sets, pliers, etc. But there are special tools for the electronics technician that you can't buy locally. Here we list the Canadian companies that supply tools for the electronics industry, and we show you the tools in the many product lines they handle.

The prices in the ETI Tools Catalogue are not precise, they are for guidance only. Some include tax, some don't. Many prices are direct from the 1977 catalogues (when that was the latest one we could find) and have not been checked with the company.

Make sure you have the right tool for the job

SUPPLIERS/DISTRIBUTERS/MANUFACTURERS

CESCO, 4050 Jean Talon St. W., Montreal & 24 Martin Ross Ave., Toronto & 1300 Carling Ave., Ottawa.

EFSTONLINE, 3500 Bathurst St., Toronto, Ont. M6A 2C6.

ELDON, 50 Prince Andrew Place, Don Mills, Ont. M3C 2Y7.

ELECTRO SONIC, 1100 Gordon Baker Rd., Willowdale, Ont. M2H 3B3.

LEN FINKLER, 25 Toro Rd., Downsview, Ont. M3J 2A6.

G E IRVING, PO Box 311, Clarkson PO, Mississauga, Ont. L5J 3Y2.

RADIO SHACK, 214 Bayview Drive, Barrie, Ont. L4M 4W5.

SAYNOR, 99 Scarsdale Rd., Don Mills, Ont. M3B 2R4.

Plus your local electronics shop. See also next month's ETI for the survey of mail-order catalogues.

WHERE TO FIND THE TOOL YOU WANT

The numbers here are ETI's reference numbers

Cutters
Wire strippers; 38/3, 0307, 0401, 1001, 2004, 2208, 2401, 2501
Shears; 0306, 2208
Diagonal cutters; 0310, 0801, 1401, 1901, 2302, 2303
Side cutters; 1402, 2301
Head cutters; 0311, 0803, 1403, 1902, 2304

Pliers
0312, 0601, 0802, 0804, 1404, 1903, 2305, 2306, 2307, 2308, 3101, 3814
Tweezers & Forceps; 0605, 1904, 1905, 2210, 2701
Lead Bending Tool; 0305
Wire bending jigs; 2403
Lead cleaner; 1103

Soldering
Irons; 0302, 0303, 0304, 0501, 3401, 3402, 3403, 3404, 3405, 3702, 2701
Cordless irons; 3401, 3601
Temp. controlled irons; 0301, 1804, 3406
Guns; 3701
Stations; 0503, 3703
Aids; 0308, 1101, 1102, 2209, 3103
Stands/Cleaners; 0502, 3407, 3704
Desoldering tools; 0309, 1801, 1802, 1803, 3407, 3704
IC Insertion & Extraction Tools; 0101, 0701, 2207, 3407, 3704, 2403

Wire-Wrap
Power tools; 1201, 2801, 3501
Hand Tools; 2801, 3502

Screwdrivers
General, Special; 1304, 2201, 2402, 3001, 3806
Slot; 3301, 1301, 3001, 3801, 3802
Phillips; 1302, 3803
Robertson; 1303, 3805
Allen (Hex), Spline; 2002, 2205, 3804, 3811
Interchangeable blade/handle; 0206, 2202, 1305, 3808, 3812
Kits - screwdrivers; 0201, 0205, 1906, 2601, 3102
Kits - drivers & wrenches; 0201, 0204, 0602, 0604, 2204, 3809, 3810, 3102

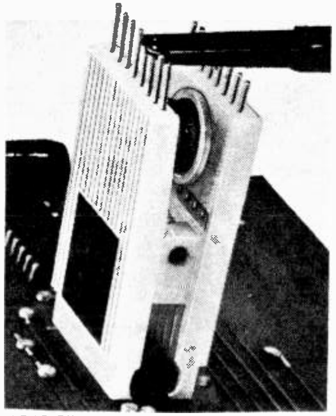
Nut drivers
Fractional; 2203, 2402, 2601, 3807, 3811
Metric; 2203, 3807, 3811
Wrenches; 0603, 2005, 2308, 2402
Adjustable wrenches; 1405, 2308, 2701

Scribers *1702, 2602*

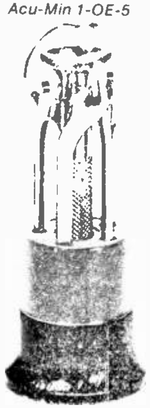
Drills
Bits; 0207, 1501, 1502, 1602, 2308
Power drills; 1601, 3201, 3601, 3704, 3103
Taps & Dies; 0208, 1306, 1503, 1703, 2207
Chassis punches; 2101, 2403
Pin chucks & pin vises; 0203, 1703, 3302

Vises & PCB holders *1603, 2207, 2901, 2403*

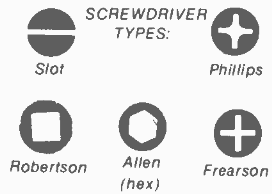
Miscellaneous
Files; 1703, 1906, 2206, 2701
Saws; 1701, 2309, 3201
Tool boxes; 0901, 1306, 2701, 2403
Complete kits; 2308, 3815, 2403
Alignment tools; 2001, 2002, 3103

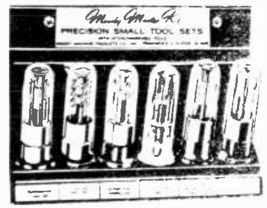


AP IC Clip

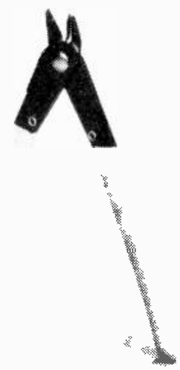


Acu-Min 1-OE-5

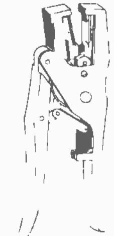




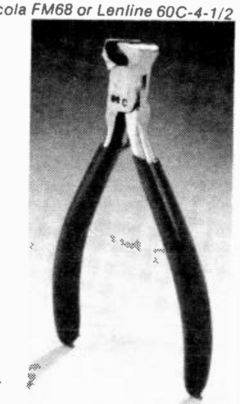
Acu-Min TRK-6



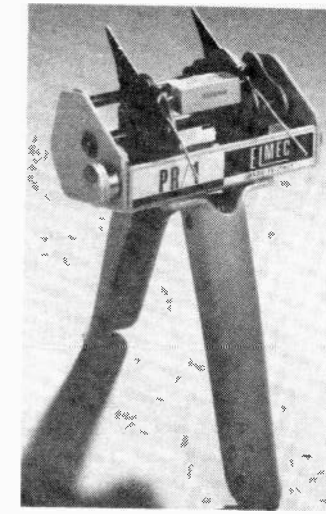
Adcola FM47 & FM48. Also in Lenline



Adcola FM27 or Lenline 70-157



Adcola FM68 or Lenline 60C-4-1/2



Adcola FM26. Also in Lenline

01 AP

Available from Saynor

0101 IC TEST CLIPS

This product is not only a tool for inserting and removing DIPs, it also provides an electrical connection to the IC for testing. Available for all sizes from 8 pin to 40-pin

02 ACU-MIN

Manufactured by Moody Tools Inc. distributed in Canada by Len Finkler

0201 SINGLE-END MINIATURE TOOL SETS

These tools have plated steel handles with turning tops (except for the wrench set)

1-SD-S Set of six screwdrivers
1-CH-S Set of two Phillips drivers and three Allen wrenches
1-HX-S Set of Allen wrenches
1-SW-S Set of five nut drivers
1-OE-S Set of eight offset open wrenches

0202 DOUBLE END MINIATURE TOOL SETS

2-SD-S Set of three double-ended screwdrivers
2-HX-S Set of three double-ended Allen wrenches
2-CH-S Set of four Phillips and Allen wrenches
2-SW-S Set of three double-ended nut drivers
2-OE-S Set of four double-ended wrenches

0203 PIN VISES

With light weight aluminium handles and steel chuck

PV1 Pin Vise, capacity to 0 31
PV2 Pin Vise capacity 0 032 to 0 0365

0204 TECHNICIAN'S REPAIR KIT

TRK-6 Packs six popular tool sets in one case

0205 MINIATURE SCREWDRIVER SETS

JS-6 Set of six mini screwdrivers, with removeable blades
PO-12 As above, with extra set of nickel-plated blades
52 Similar to JS-6 but one handle and six blades

0206 REVERSIBLE TIP SCREWDRIVER

51 Reverse tip for 1/6 or 5/64

0207 TAPS & DRILLS

TS-5 Five taps and one chuck-type handle
70 Five drill bits and a pin-vise handle

0208 DIES

71 Fine hex dies for use with 5/8" wrench

03 ADCOLA

These British-made products are distributed in Canada by GE Irving Industries, Ltd

0301 THERMOSTATICALLY CONTROLLED SOLDERING STATION

101 Variable controlled temperatures between 120°C and 420°C Price **$119.30** (PST extra)

0302 "INVADER" SOLDERING IRONS

20W, 25W, or 30W, at 410°C, or 17W, 23W, 27W at 360°C Available for 12, 24, 110, 220, or 240V use 23W, 3/16" bit model costs **$13.50** (120V) or **$15.75** (12V) (PST extra)

0303 "A" SERIES SOLDERING IRONS

Similar to the Invader series but with bulbous handle and 5/16" bits **Price $14.50.**

0304 "R" SERIES SOLDERING IRONS

Heavy-duty instruments available up to 60W in either hand held or bench-mounted models Prices from $10 40 to $35 30

0305 COMPONENT BENDING TOOL

FM26 Bends component leads to exact size required for PCB mounting Bends with minimal strain on point where leads join body of component. **$42.90.**

0306 WIRE CUTTING TOOLS

FM16 Scissors for wire cutting or intricate snipping **$19.80**
FM17 Scissors to replace side-cutters **$19.80**
FM18 Scissors for cutting leads on PCBs **$25.75**

0307 WIRE STRIPPERS

R310 Bench-mounted thermal stripper **$29.70**
FM29 Adjustable wire stripper
FM47 Shears rather than bites, double coil return spring **$9.90**
FM48 This safety clip for the FM47 holds the severed wire preventing the danger of damage to the eyes or to the circuit **$3.30**
FM27 Self-adjusting wire strippers even works on several wires of different diameters **$39.60**
FM28 Light weight version of FM27 with additional wire cutter **$39.60**

0308 SOLDERING AIDS

FM49 Three tools giving fork, brush, hook, spike knife and scraper ends **$8.25**

0309 DESOLDERING TOOLS

R500 25W tool with hand-operated bulb **$44.55**
FM37 Remov-IC desoldering and extraction tool **$478.50**
FM41 IC puller for desoldering **$18.15**
B66/B67 Desoldering bit for ICs **$28.05**
FM22 Desoldering Gun, plunger type **$16.50**

0310 DIAGONAL CUTTERS

FM58-FM64 110mm to 160mm (cutting edges 11mm to 22mm) with box joints and laminated springs No external bevel for flush cutting

0311 HEAD CUTTING NIPPERS

FM65-FM68 For flush cutting

0312 PLIERS

FM69-FM73 Snipe-nosed pliers
FM74/FM75 Flat-nosed pliers
FM76 Round-nosed pliers
FM77 Kelly pliers, grips object leaving hands free

04 ALPHA

Available from Cesco and Electo Sonic

0401 STRIPPER

STRP-25 Plastic Blade stripper **$47.94**

05 AMERICAN BEAUTY

Distributed by Len Finkler, Saynor, Electro Sonic Also handle a range of heavy-duty soldering equipment

0501 SOLDERING IRONS

3108 20W, 1/8" bit, modular construction
3110 25W, 3/16" bit, modular construction
3112 40W 1/4" bit, modular construction
T12/T30 17W/30W, 1/16" bit, isolated from line irons (protects delicate components from line-volts leakage)

0502 STANDS & CLEANERS

480 Four sponges to clean all sides of bit
476 Stand with guard, keeps iron at preset temperature
475 Automatic-operation guard
476 Stand with guard holds tip in molten solder
481 Low profile cleaner for miniature irons
483 Safety stand with tip cleaner for pencil-type irons

0503 SOLDERING STATIONS

V3600 Varies voltage to iron, 0-100% of line voltage Use with irons up to 60W
T7 A 12W soldering station with tip temperatures variable from 175° to 910°F (79° to 487°C)

06 ARMACO

These tools can be found in the Electro Sonic catalogue

0601 PLIERS

X412/X413 Slip-joint pliers, 5"/6 long **$1.09**

0602 DRIVERS

TFJS Set of six jewellers screwdrivers **$.71**
E404 Set of five nut drivers, jeweller-type **$3.70**
E401 Set of 3 screwdrivers (one Phillips) and 1 awl, 1 auger **$1.32**
E403 Set of 3 screwdrivers (one Phillips) and 1 awl, 1 auger **$1.32**
E414 Automatic nut driver — fits five sizes **$3.75**
E406 Two Phillips drivers, three box keys, plus handle **$3.70**
E451 One screwdriver, one Phillips driver eight nut drivers **$1.89**
E419 Six double-ended nylon alignment tools **$.94**
E450 Eight-size hex socket wrench set **$2.08**
E453 Three Phillips, three regular, one awl, one screw-starter **$1.04**
E456 Screwdriver with four blades (inc awl & screw) **$.56**
E428 Seven Allen Keys **$1.23**

0603 WRENCHES

E454 Eight wrenches, 13/16 to 3/8 **$.81**
E405 Five wrenches, 1/8" to 5/16 **$3.70**
E459 Adjustable spanner 100mm long **$.56**

0604 KITS

E452 Nine tools **$1.89**
E457/458 Five miniature tools **$.81**
E455 8 wrenches (double ended) Phillips and regular drivers, and screw starter and power handle **$1.04**

0605 MISCELLANEOUS

TFAZ 5 tweezers **$.94**
E415 3 heatsink clip **$.56**

07 AUGAT

Available from Saynor

0701 IC INSERTION TOOL

T8136-7/T8136-8 IC insertion tool (14 and 16 pin)/(24 pin) **$15.16/$23.13**

08 BAHCO

Distributed by G E Irving

0801 DIAGONAL CUTTING NIPPERS

2111-4 Cuts wire up to 1 5mm dia, bevel on outer edge **$25.60**
2112-4 Cuts wire up to 1 5mm dia, no bevel **$25.60**
2113-4 Cuts wire up to 1 00mm dia, no bevel **$31.75**
2118-6 Cuts wire up to 1 5mm dia, no bevel **$32.20**

0802 NEEDLE NOSE PLIERS

2411-4 35mm jaws, plain gripping surface **$19.10**
2412-4 36mm jaws, tips set at 60° **$25.60**
2413-4 35mm jaws, extremely thin **$27.30**
2418-4 23mm jaws **$23.95**

0803 END CUTTING NIPPERS

2211-4 Jaws set at 70° with 14mm cutting edge **$29.70**
2212-4 Sharply angled 15mm blades with level **$29.70**
2213-4 Angled 5mm blades for flush cutting **$35.15**
2215-4 27mm jaws with 2 5mm cutting ends **$23.60**
2218-6 Jaws at 30°, 3mm cutting edge **$30.20**

0804 PLIERS

2511-4 With 21mm round section jaws **$20.80**
2515-4 With 35mm rectangular section jaws **$19.95**
2516-4 With 35mm extremely slender rectangular jaws **$19.50**

09 BEACH

Available from ElectroSonic Many more models than these

0901 TOOL BOXES

5 14" x 6" x 6 5 box with tray and draw-pull catch **$6.15**
B418 18" x 10" x 13 Four cantilever trays with divider **$24.98**
B27 18" x 27" x 34" high cabinet on 4 wheels Three 16 5 x 24 x 4 draws plus 12 deep space behind lockable door **$95.55**

10 BELDEN

Available from ElectroSonic

1001 STRIPPER

8196 Wire and cable stripper

11 BEAU TECH

Available from ElectroSonic

1101 SOLDERING AIDS

SH20/SH40 8 tool double ended with reamer, fork, brush, scraper, slot **$1.95 ea.**
SH20-SE/SH40-SE/SH60-SE 6 5 singel-ended tools **$1.85 ea.**
SH20,C,D,E,G,Gf 5 5 double-ended tools **$1.63 ea.**

1102 SOLDERING AID KITS

SH120 Six tools in case **$11.44**
SH121 Four tools in case **$7.22**
SH122 Four dearer tools in case **$8.13**

1103 LEAD CLEANER

SH66 Cleans off oxides to NASA spec **$2.73**

12 CAMBION

Available from Cesco

1201 WIRE WRAP TOOL

593-3467/3471 Line battery wire wrap tool **$154.90/$129.10**

13 CLUTHE

These tools are available from ElectroSonic

1301 SLOT SCREWDRIVERS

3042C 4 25" pocket clip type **$0.47**
A4225C 2 25 blade 1/8" tip **$0.17**
3044C 4 5 blade 1/8" tip **$0.74**
30425 2 5 blade 1/8 tip **$0.67**
30445 4 5 blade 1/8" tip **$0.80**
3046 6 blade 1/8 tip **$0.87**
3048 8" blade 1/8 tip **$1.01**
3064 4" blade, 3/16 tip **$0.94**
3066 6" blade, 3/16" tip **$1.17**
30610 10 blade, 3/16 tip **$1.34**
3081 1 25 blade, 1/4" tip stubby **$1.11**
30845 4 5 blade, 1/4 tip **$1.27**
3086 6 blade, 1/4 tip **$1.37**
3088 8" blade, 1/4 tip **$1.61**
30106 6" blade, 5/16" tip **$1.64**
30108 8 blade, 5/16 tip **$1.78**
301012 12" blade, 5/16" tip **$2.18**

1302 PHILLIPS SCREWDRIVERS

21430 3 blade, 1/8 tip **$0.90**
21631 blade 3/16" tip **$1.04**
21842 4 blade, 1/4" tip **$1.21**
211063 6 blade 5/16" tip **$1.57**
211284 8 blade 3/8" tip **$2.28**
21611 1 blade 3/16" tip **$1.01**
218152 1 5" blade 1/4 tip **$1.04**

1303 ROBERTSON SCREWDRIVERS

2264/2284/2294 4 blades five sizes from **$0.80 to $0.97**
22815 Stubby types with 1½" blades (sizes 1,2 or 3) **$0.90**

1304 CLUTCH OFFSET SCREWDRIVERS

151845 4 slot type double ended **$1.57**
15384 4 Phillips type double ended **$1.24**
15284 1 Robertson type, double ended **$2.41**

1305 UNI-DRIVER PARTS

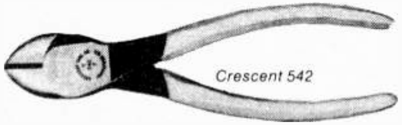
1965 Handle only, will store 9 bits **$1.54**
1975 Large handle, stores 13 bits **$1.81**
U615/U815 Slot driver bits **$0.47**
RU01/2/3 Phillips driver bits **$0.47**
CU Clutch-type bits **$0.84**
SHU615/815 Screw-holding slot bits **$0.67**
NU Nut driver bits **$0.67**
TU84 Tack-puller bit **$0.67**
U291 Stubby handle **$0.57**

1306 MISCELLANEOUS

1935 7 awl with 3 5 blade **$2.41**
1603 Three-sizes-in-one tap **$3.52**
600 Polypropylene tool caddie **$2.75**

ETI Tools Catalogue


Crescent 888-6C


Crescent 542

14 CRESCENT

Available from ElectroSonic. Catalogue numbers give PP-LL-SCEP. PP: product number, LL: overall length, S: coil spring opening, C: cushion grip handle, E: full flush cutting edge, P: plain jaw (no serration).

1401 DIAGONAL CUTTERS

200-4SCEB Stainless **$12.87**
943-5SC Slim nose **$6.79**
946-4.5SCE Full flush **$7.74**
951-4SCE Regular **$8.16**
542-7C/8C Heavy duty **$5.75/$6.44**
941-45C Midget **$6.86**
9424SC/6SC Semi flush, six types **$5.42/$6.47**
9406C/6SC Short nose for leverage **$5.20/$6.47**

1402 SIDE CUTTING PLIERS

50-6C/7C/8C Regular **$5.95/$6.34/$7.38**
1950-6C/-7C/-8C Linemen's **$6.60/$6.86/$8.07**
654-5.5SC/-7SC Five types, long nosed, from **$5.85** to **$7.06**
622-5C/SC Short chain-nosed **$5.75/$6.01**

1403 TIP CUTTING PLIERS

775-4.5CS/5SC For delicate work **$7.13/$7.38**
27-4.5SC 30° angle tip cutter **$8.92**
776-6SC For cutting and looping **$7.22**
72-6C/-7C/-8C End-cutting nippers **$5.95/$6.53/$7.38**

1404 PLIERS WITHOUT CUTTERS

888-6C Long angle-bent nose **$6.50**
2S4.5SC Midget chain-nose type **$5.49**
22-4SC/55C Short chain-nose **$5.17/$5.07**
20-4SCP Plain jaw flat nose **$5.22**
21-4.5SC/6C Round nose **$5.22/$5.85**
1033-5.5SC/7C Four types, long chain nose from **$4.73** to **$5.32**
777-6SC/7SC Needle nose **$5.85/$6.20**
666-4.5SCP/6SC Extra thin needle nose **$6.79/$6.37**
665-5.5SC Very fine needle nose **$6.01**

1405 HEAVY DUTY PLIERS & WRENCHES

L26 Slip-joint pliers with cutter **$2.68**
2050-9C High leverage with cutter **$8.16**
R27-7C Straight jaws, multiple slip joint **$4.05**
R210-10C Straight jaws, multiple slip joint **$5.17**
R212-12C Straight jaws, multiple slip joint **$5.16**
R410-10C Curved jaws, multiple slip joint **$5.16**
AC1-4/6/8/10/12 Adjustable wrenches from **$4.44** to **$9.41**

15 DORMER

Available from ElectroSonic

1501 HIGH SPEED DRILLS

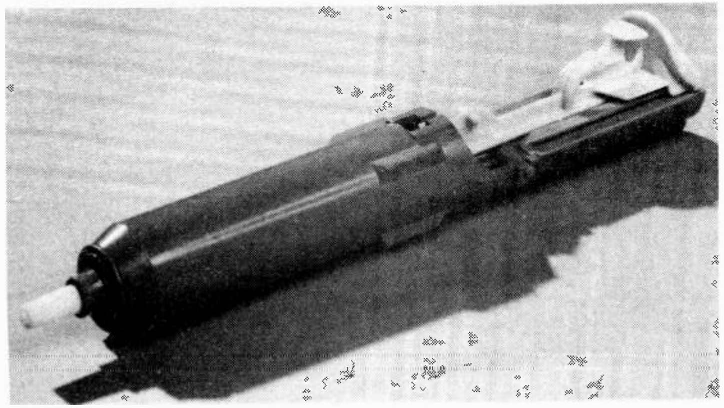
Fractional sizes (32) from 1/64" to 1/2", $0.71 to $5.15
Number sizes (80) from No 1 to No 50 to No. 80, $1.15 to $0.40 to $0.71 to $0.40 to $5.15.

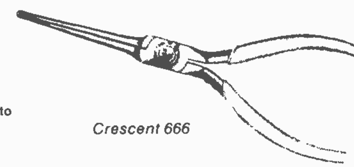
1502 DRILL KITS

Six fractional kits For example, eleven drills from 1/16" to 3/8" in retractable steel case for $16.80 (Catalogue number 4K).
Four metric kits. For example, seven drills 1mm to 7mm for $5.60, in retractable steel case. Or fifty-one drills from 1 to 6mm by 0.1mm steps for $39.90, in the steel case.
Dormer Drill Kits **42 MK** covers 1mm to 13mm in 39 sizes for $64.30.

1503 TAPS

Fractional taps from 4-32 ($4.25) to 1/4-20 ($1.85) in eight sizes.
5029 5 hex keys **$1.48**
5026 9 metric hex keys **$2.62**


Edsyn VS140 Universal Soldapullt


Crescent 666

16 DREMEL

Available from Efstonline

1601 DRILLS

G6540 Variable speed "Moto Tool 5000 thur 25000 rpm, 1/8 collet **$69.50**
G6545 "Moto Tool", over 30 accessories **$84.95**
G6525 Compact "Moto Tool", 30,000 rpm pencil grip **$55.95**
G6530 Kit of 34 accessories with G6525 **$69.95**
S7212 Stand for Moto-Tool, adjustable angle **$19 95**
P6206 12 drill-press stand with 4 x 4 table for G6525 **$29.50**
R6960 Router base for Moto Tool **$16.75**
H4995 Holder for mounting Moto-Tool in vise **$10.40**

1602 BITS

S1502 12 grinding point bits **$16.95**
S1501 12 abrasive (emery wheel) bits **$16.95**
S1252 6 high-speed router bits **$30.95**

1603 VISE

V2845 Adjustable-angle vise, opens to 2½ **$38.50**

17 ECLIPSE

Available from ElectroSonic

1701 SAWS

20T Hacksaw for 10 or 12 blades **$6.75**
55S Sheet saw for standard 12 hacksaw blade **$6.70**
675 Junior hacksaw, for 6 blades **$3.95**
12PH Pad handle for new or broken hacksaw blades **$2.70**

1702 PUNCHES & SCRIBERS

E171 Automatic, adjustable centre punch **$6.40**
81D 4" centre punch **$1.15**
E220 Pocket-clip scriber **$2.50**
E222 Hook scriber-double ended **$1.60**
E227 Machinist Scriber (single ended) **$0.95**

1703 MISCELLANEOUS

E141/142 Chuck-type tap wrench (sizes 4&6)/(4,6,8 & 10) **$3.00/$3.60**
301628 Flat smooth cut (for line finish on hard metals) 6 file **$1.79**
306212 Round smooth-cut 6 file **$1.46**
302326 Half-round smooth-cut 6" file **$2.30**
160 Pin chuck for 0 01" to 0 1" with three interchangeable collets Allows fine bits to be used in standard drills **$5.95**

18 EDSYN

1801 SOLDAPULLT DESOLDERING TOOLS

DS117 Power head & holder, automatic desoldering tool for production work
DS017 Deluxe Soldapullt Heavy-duty plunger type
PT109 Soldapullt III, slimline model
US140 Universal Soldapullt, compact model, with shielded recoil action
SS011 Standard Soldapullt
MMS15 Micro-tipped Soldapullt
LTS13 Long-tipped Soldapullt
AS196 Siverstat Soldapullt, low static discharge because tool is grounded via operator

1802 SOLDAVAC DESOLDERING TOOLS

DS101 Deluxe Soldavac, clear barrel
SV026 Standard Soldavac
SV073 Micro-tipped Soldavac

1803 OTHER DESOLDERING TOOLS

SN104 'Snort' simple two-piece desoldering pump
MV124 'Snort Ini' desoldering pump for miniature components

1804 SOLDERING EQUIPMENT

950A "Loner" Soldering iron, clear barrel temperature controlled and variable 9W to 50W, 590° to 750°F

19 EREM

Available from Len Finkler, and Saynor

1901 DIAGONAL CUTTERS

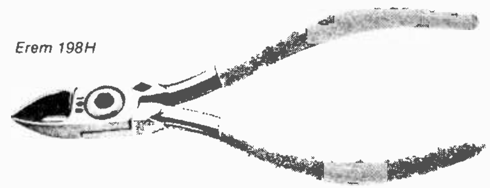
96H 4 5/5/6" round tip semi-flush general purpose
97EH 4" round tip semi-flush type for fine wire
99EH 4" round flush cut for very fine wire
84EH 4¾" relieved head, flush cut
86EH 4¾" tapered jaw, full flush
76EH 4" relieved head, full flush
92EH 4" relieved head, full flush
95EH 4" small tapered jaws, full flush
77EH 4" small tapered jaws, full flush
194H 4" miniature head, flush cut "shimless joint"

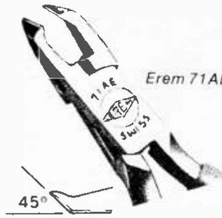
1902 NIPPERS & TIP CUTTERS

66H 4 5" nipper oblique blades, flush cut, curved handles
94LH 4 5 nipper angled blades, flush cut, for fine wire
67H 4¾" nipper, perpendicular flush cut, straight handles
71AEH 4 5", 45° flush cut tip, relieved jaw, alignment pin
90EH 4¾" 40° flush cut tip
57EH 4" 33° flush cut tip, alignment pin
59EH 5" 40° flush cut tip, alignment pin
115H 4.5" relieved head tip cutters, flush cut

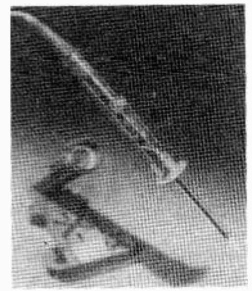
1903 PLIERS

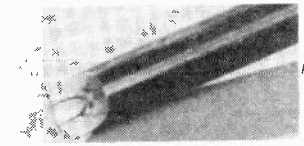
Catalogue Number
14H 4.5"/6" with 5/8" 12-3/16" smooth jaws, needle nose
47H 4.5" with 7/8' smooth jaws, box joint, needle nose
5H 5 5" with 1-7/8" jaws and ¾" serrated tips, needle nose
11H 4¾" with 1-1/8" smooth jaws, chain nose
11DH 4¾" with 1-1/8" serrated jaws, chain nose
44AH 4 5" with 7/8" smooth jaws, chain nose, narrow head, box joint.
19H 4¾" with 1¼" smooth jaw, long round nose.
43H 4.5" with ¾" smooth jaws, round nose, narrow head, box joint.
11DH 4¾" with 1-1/8" jaws and ¾" serrated tips

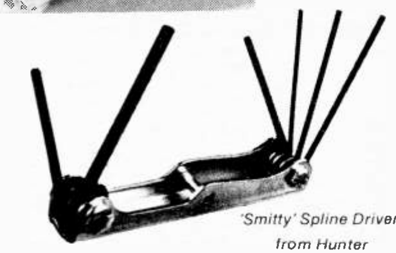

Erem 198H



Erem 71AEH


Edsyn 'Loner'
Closed Loop Soldering Iron


Hunter
Magic Tip


'Smitty' Spline Drivers
from Hunter

1904 TWEEZERS

Many styles of 4 5" tweezer - stainless - acid resistant (hydrofloric and nitric) - angled tips - non-magnetic - blunt end - fine point - cutting tweezer (no **11ANO**), oblique cutting tweezer (no **15AGW**) Also larger sizes Special (**No. 85ASA**) tweezer for handling dice and wafers up to 2" diameter, thicknesses from 0 010". Also **90SA/91SA** for wafers up to 3"

1905 FORCEPS

35PH 5" straight forceps
37PH 6" straight forceps

1906 MISCELLANEOUS

228 Set of 12 needle files
204 Set of 6 miniature screwdrivers
210 Set of 6 double ended deburring and countersink tools

20 G C ELECTRONICS

Available from ElectroSonic

2001 INDIVIDUAL ALIGNMENT TOOLS

Thirty-one types of alignment tool mainly priced between $1.00 and $2 00

2002 ALIGNMENT TOOL KITS

5040 12 tools for TV alignment **$14.46**
8283 25 tool deluxe kit **$19.15**
8280 16 tool TV kit **$11.94**
8455 9 tool TV kit **$11.44**
8454 5 tool kit (eight hex ends) **$4.11**
18-530 9 tools for CB servicing **$5.94**

2003 SPLINE KEY WRENCHES

5070 Set of 6 **$1.47**
5028 12 hex & spline keys **$2.62**
D 303-6 1/16" diameter points, 6-5/8" model **$5.14**
D 302-6 6¼" model with 70° bend in nose **$6.32**
203 5-9/16" to 7-1/8" with side cutters at hinge **$5.63/$6.18**
D 314-8 8" model with 1-15/16' jaws **$5.90**

2004 STRIPPERS

760 8 stop adjustable **$2.75**
733 Standard "speedex" stripper **$10.85**
744/766/802 Automatic/heavy duty/"speed strip" **$13.22**
766-K Speedex stripper kit (with blades & box) **$27.60**

2005 GRIPPING WRENCHES

9358 "Knurl-tite" wrench with collet type jaws tightens or loosens nuts then releases with a reverse quarter turn, for ½" nuts **$11.67**
9359 As above, but for 5/8" nuts **$10.55**

21 GREENLEE

Available from Saynor and ElectroSonic

2101 CHASSIS PUNCHES

Round punches, 26 sizes from ½" dia to 3". From **$6.66** to **$67.64**
Meter hole punch 2-25/32" dia **$35.13**
Square punches, five sizes from ½ to 1 from **$17.70** to **$23.22**
Also "Key" and "D" punches
Chassis Punch set, seven sizes from ½ to 1¼ **$51.77**
Bigger range in ElectroSonic catalogue also includes metric size round punches, relay socket punches, etc

22 HUNTER

Available from Len Finkler, Saynor and Efstonline Catalogue available

2201 SCREWDRIVERS

30195 Not for screwdriving — for holding, starting and retrieving
30220/25/30 Double-ended blade, reversible in handle Three types mixing slot & Phillips tips
30115-30155 Magic Tip Screwdrivers (illustrated) 1/8" / 3/16" / ¼" tip

2202 SCREWDRIVER KITS

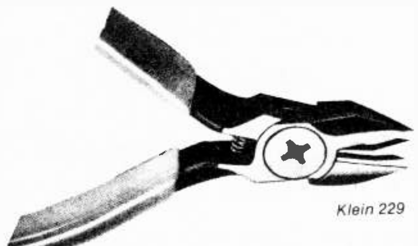
32362 Seven screwdrivers & big handle-pocket size
561841 Five blades & one handle, miniature sizes
30705 Five blades (3 Phillips, 2 slot) and swivel handle (for regular or T-bar use)
56182 Four slot blades, one handle, miniature sizes
56185 Six jewellers screwdrivers

2203 NUT DRIVERS

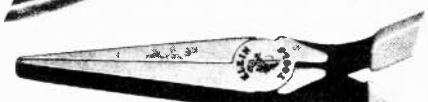
56035 Five miniature nut drivers (available individually) in one kit.
56054 Five nut driver shafts and one handle in one kit
330001 to 33055 Nut drivers in eleven sizes from 5/32" to 9/16"
32202/4/6 6 5" long shaft nut drivers, ¼"/5/16"/3/8"
33050 Stubby ¼" nut driver
32086 Seven nut drivers from 3/16" to 3/8" in a kit
32202-32316 Pocket nut drivers from 1/8" to 3/8"
32366 8 nut driver shafts and one handle in a kit.
32102-32120 A range of ten metric nut drivers, 4mm to 11mm
56020-56028 Five miniature nut drivers from 5/64" to 5/32"
32087 Seven metric nut drivers (5mm to 10mm) in a kit.

ETI Tools Catalogue

Klein D366-6C



Klein 229



Klein D304-6

2204 COMBINATION KITS

39992 Four screwdriver blades, seven nut drivers shafts, handle and big handle, in roll-up kit
39991 As above in plastic pocket kit
39993 Similar to above, plus 6" adjustable wrench, long chain-nosed plier, and heavy diagonal cutter in roll-up kit
56080 Miniature roll-up kit. 2 handles, 4 slotted blades 2 Phillips blades, 5 nut driver shafts, 5 hex shafts, 5 spline shafts, 5 end-wrench bits and 1 awl
32364 Handle plus 2 slot blades, 2 Phillips blades, and 3 nut drivers in plastic pocket kit

2205 HEX AND SPLINE DRIVERS

56050 5 hex shafts plus handle
56044 5 spline bits plus handle
1018/16/61/06/91/81 & 14005 Pocket hex and spline kits with pen knife-type construction
12005-12290 Hexdrivers, screwdriver-style, including metric plus range of T-wrenches and L-keys

2206 FILES

58310 Twelve 6½" needle files in kit.
58315 Twelve 5¾" needle files in wooden stand
58305 Six needle files in kit

2207 MISCELLANEOUS

70102/04/06 Chucks for fine drills
85020 Six piece tap kit
85008 Three taps on one blade
25002/04/10 Snap ring pliers
50120/30/60/70 Collet-type knives, inc pocket and industrial models.
50182/83 2 handle 10 blade, and 3 handle 10 blade knife sets
65002 DIP inserter
66066/72 PCB holder.
20230/32/34 5"/6"/8" slip-joint pliers
20252/54/56 6 5"/10"/12" multi-groove pliers.

2208 STRIPPERS & CUTTERS

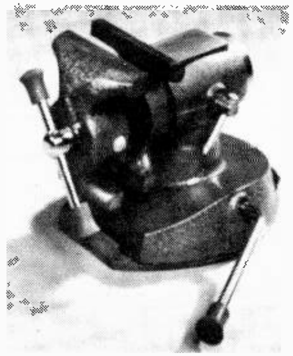
50199 "Kwik-Rip" cable cutting blade
25506/08 Stripper, optional return spring, with shear-action cutter
25502 "4 in 1, the Plike", serrated plier, crimper, six stripping holes and shear cutter
25504 "5 in 1" Plier, six stripping holes, crimper, shear cutter and six screw-cutting holes

2209 SOLDERING AIDS

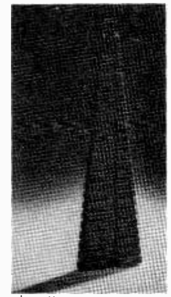
63502/04/06 Large, medium and small heatsink clips
6202/04/06/08/18/22/24 Fork, hook, brush, knife, reamer, soldering aids
62130 Kit of soldering probes

2210 TWEEZERS & FORCEPS

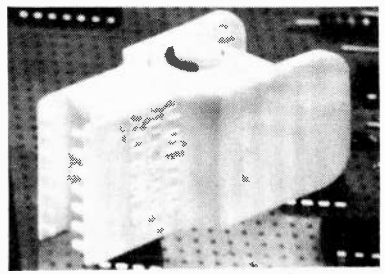
54035/37 5"/6" straight-nosed forcep clamp
54036/38 5"/6" curved-nosed forcep clamp
55008/14 4.5" / 6¼" general purpose tweezers
55010/12 4.5"/6" reverse tension tweezers
55002/04/06/16/18 4¼" precision tweezers, various styles



Lenline 61



Lenline PD801



Lenline 565

23 KLEIN

Available from Saynor

2301 SIDE CUTTING PLIERS

201NE Streamline 6¼"/7-5/8"/8½"/9¼" types **$6.62/$6.76/$8.18/$8.48**
12098 Universal model, with wire-cutter **$8.11**
213-9 Original 9¼" high-leverage model **$9.27**
213-NE 8½"/9¼" Streamlined high leverage model **$8.48/$8.97**
D213-9NE-CR As above (9¼") but with crimping die **$12.30**
201 Original general purpose square nose type 6¼"/7-5/16"/8½"/9¼" **$6.62/$7.02/$8.30/$9.09**

2302 STANDARD DIAGONAL CUTTERS

202 5½" / 6-1/16" optional coil spring **$5.88/$6.05**
210 5½" / 6-1/16" semi flush cut, coil spring **$6.20/$6.28**
245 5" optional coil spring **$5.58/$5.84**
D245-5W As above, with "W" stripping notches **$5.81**
240 5½"/6-1/16" model with 0.052" skinning hole **$6.25/$6.35**

2303 ELECTRONIC DIAGONAL PLIERS

257 4-3/16" semi-flush, spring optional **$5.02/$5.28**
209 4-3/16"/5" semi-flush, coil spring, sharp nose **$5.42/$6.18**
219 4-3/16"/5" semi-flush, coil spring sharp relieved head **$5.72/$6.32**
229 5" like model 209, with springs to hold clipped ends **$8.69**
259 4-3/16" full flush, coil spring **$6.63**
244 5" full-flush, coil spring **$10.27**
052 5-1/8" cuts and crimps wires on pcbs **$8.14**
295 4-3/16" Full-flush midget-jaw **$6.63**
230 4-3/16" high hardness for nickel ribbon cutting **$6.84**
263 4" semi-flush, high hardness, matrix cutter **$8.25**
275 5" lightweight flush-cut model **$3.51**

2304 END CUTTERS

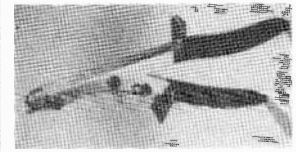
224 4-5/8" semi-flush, coil spring **$7.13**
232 7-23/32" high leverage model **$7.70**

2305 STANDARD LONG-NOSED PLIERS

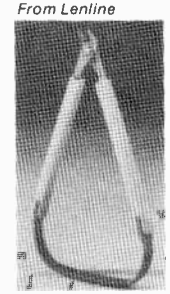
301 base model 5-9/16"/6-5/8"/7-1/8", optional coil spring **$4.88 - $5.48** (301 has 3/32" points)

2306 DUCK-BILL PLIERS

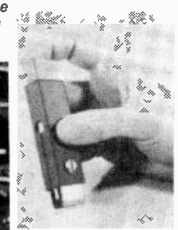
D 232-4½ 4¾" smooth-jaw, optional spring **$5.24/$5.60**
D 305-6 6½" knurled-jaw model **$5.86**
D306-5½C 5-19/32" smooth concave jaws, coil spring **$5.88**
D304-6 6½" smooth-jaw type **$5.69**



Lenline Nibbler K88



Stirex Cutters From Lenline



Lenline IC Inserter

2307 ELECTRONIC LONG-NOSED PLIERS

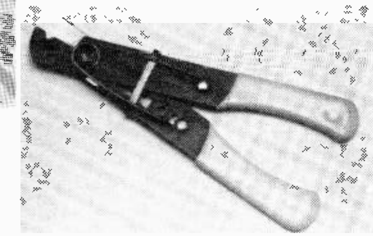
D 321-4½ Slim knurled-jaw pliers, optional spring **$4.83/$5.09**
D322-4½C As above but smooth jaws, coil spring **$5.60**
D 327-5½C Smooth jaw 5-9/16" slim long-nosed spring pliers **$6.44**
D 307-5½ 5-9/16" knurled jaws, optional spring **$4.83/$5.09**
D 309-6C Knurled jaws, coil spring, 5-15/16" with 1/32 tip **$5.19**
D 310-6C 6-5/8" knurled jaws, coil spring, tapered long-nose **$5.19**
D 301/203 6-5/8" needle-nose, knurled, spring, optional cutters **$6.49/$7.35**
D 335-5½C Slim needle-nose, knurled, spring, 5½ **$7.25**
D 317-5C Chain-nose 5¼" model, coil spring **$5.27**
D221/222 5-9/16"/5-15/16" knurled, spring, with side-cutters **$5.97**
D 318-5½ 5-13/32" long needle-nose, knurled, optional spring **$6.14/$6.41**
D 366-6C 7½" ergonomic-design needle-nose pliers **$10.93**
D 338-5½C 5½" smooth-jaw, sprung, needle-nose with 60° bend **$7.07**
D320-4½C 4-5/8" smooth-jaw, sprung, chain-nose with 60° bend **$9.39**
D 328-5½C Long needle-nosed, smooth jaw, sprung **$6.90**
D 317-6PC 6" sprung narrow-tip, with cutting blade & knurled tips **$6.58**
D 208-6C 6-5/8" long-nosed plier with replaceable blade **$7.55**

2308 MISCELLANEOUS

511/413/502 Slip joint and pump pliers **$2.60 to $9.49**
1003/04 Wire strippers, optional spring **$1.68 to $1.91**
1305-33A Tool kit with side cutting pliers, long nosed pliers, diagonal cutters, knife, file, screwdriver & tweezers **$34.71**
1000 7½" "6-in-1" tool, cuts wire & bolts, crimps, strips and gauges **$8.25**
1002 "All purpose" tool, similar to above, 8½" **$9.39**
500 Adjustable wrenches eight sizes from 4" to 24" long, ½" to 2-7/16" capacities, optional plastic-dipped handle from **$5.12 to $50.89**
68100-68107 Open-end wrenches; double-ended, from 1¼" and 5/16" to 1¼" and 1-5/16" in eight sizes from **$1.72 to $13.43**
68102/122 Five or seven open-ended wrenches in set **$21.46/$30.99**
64002 Spring action push-drill with eight bits in handle from 1/16" to 11/64" **$14.01**
1558 Slitting tool for control cable **$5.12**

2309 SAWS

701-10/-12 For 10" to 12" hacksaw blades, in die-cast zinc **$7.30 to $7.38**
700-12 For 12" hacksaw blades, in die-cast aluminium **$4.60**
713 Handle for broken or regular blades **$2.32** (with 10" blade)
Klein also have a range of belts, punches, and harnesses for linemen and climbers



Miller 101

24 LENLINE

The Lenline catalogue includes tools listed elsewhere in this article under the manufacturer's name (American beauty, Edsyn, Erem, Hunter, Miller, Moody, OK, Panavise, and Wahl) Here are some of the items from the remaining range of products; more are featured in our advertising brochure on the back of this magazine
Available from Len Finkler

2401 CUTTERS & STRIPPERS

70156/70158/STR23/1235 Automatic wire strippers — some can even strip three wires of different thicknesses in one action
UT5800 to UT8000 Precision coaxial cable stripper
KM1976M Multi-bladed electrician's knife

2402 DRIVERS & WRENCHES

D8-141A Self-adjusting nut driver. Automatically selects ¼", 5/16", 3/8", 7/16"
3055-1 to 3057-1 Slot & Phillips type screwdrivers with screw holding sleeve.
2000/3005 3 piece/5 piece kit of tools for holding screws, nuts, components, etc.
4800 Universal wrench: fits nuts from 3/8" to 1-3/16", 9mm to 22mm.
26AB-8/-10/-12 Adjustable box wrench for ¼" to 1"/3/8" to 1-1/8" / 7/16" to 1-7/16 nuts
70-165 Locknut wrench (for ½" locknuts & ½" hex chase nipples)

2403 MISCELLANEOUS

70-126 to 70-154 Sheet metal punchers 7/16" to 2" round, plus 11/16" and 1" square. Driven by the hex key.
K88/03 Standard/heavy duty nibbler, cuts up to 0.8mm/2mm sheet steel.
TRS Tool kit: 2 screwdrivers, 1 stripper, needlenose pliers, side cutter
TR11 Tool kit, 2 slot screwdrivers, 1 stripper, electricians pliers, needlenosed pliers, side cutters, Phillip screwdriver, electricians (2-bladed) knife, self-adjusting nut driver, adjustable wrench, 110V neon tester.
TR21 Tool kit: pocket screwdriver, cutter, needle nosed pliers, chain nosed pliers, side cutters, 3 slot-type screwdrivers, 3 Robertson screwdrivers, 2 Phillips screwdrivers, electricians knife, self-adjusting nut driver, adjustable wrench, 110V neon tester, and combination crimper, cutter, stripper wrapping pliers.
B526 Electricians tool box, 14" x 6" x 6¼" with removable tray
MVV Mini Vacu Vise — 2-5/8" x 2¾" x 3½"
PB414/13T Heavy-duty plastic (unbreakable) tool boxes
61 Two headed vise with vacume base. "Stirex" Cutters and pliers.
565 Plastic IC clip.
PD801 Plastic wire bending jig
600T/605T/610T Platt tool cases 18½" x 13", 6" / 4½"/5¼" deep Lightweight ABS plastic, aluminium rim, with pallets 5 year guarantee.

25 MILLER

From Len Finkler, Saynor.

2501 CUTTERS & STRIPPERS

100/101 5" adjustable stop stripper, optional spring **$1.95/$2.59**
103 5-5/16" adjustable strippers **$3.49**
105 Similar to 100 but with cable stripper attached. **$4.90**
106/107 Dial-adjusted stripper, 5-5/16" replaceable blade.
95 Cable nipper with replaceable blade **$1.98**
3088 Stripper with plier nose **$10.95**
200PH Coaxial cable stripper, adjustable for dielectric, braid, and jacket. **$31.91**

2502 MISCELLANEOUS

85 5¾" lightweight long-nosed pliers **$2.26**

National Camera D-5110

National Camera W6690

National Camera W6610 Adjustable Wrench

26 MOODY

2601 MINIATURE DRIVERS, WRENCHES, ETC.

J56-6A Set of six chuck-type jewellers screwdrivers **$10.15**
52 One handle & six blades, mini screwdriver set **$5.69**
PD-12 Six handles & twelve blades, "type II", mini screwdriver set **$13.30**
SC-5 One handle, 4 screwdriver blades and 1 awl. **$3.62**
PA-5 Two Phillips and 3 Allen blades, 1 handle **$4.94**
SW-5 Five socket wrench blades and 1 handle **$6.25**
OE-5 Five offset, open-ended wrenches, 1 handle **$4.31**
TS-5 Five taps and 1 handle (with rorque hole) **$19.04**
70 Five drills (companion to TS-5) and handle **$7.61**
MMK-6 Six sets (SC5, PA5, SW5, OE5, TS5, & 70) in case **$46.95**
MMK-4 Four sets (SC5, PA5, OE5, & SW5) in case

2602 SCRIBERS

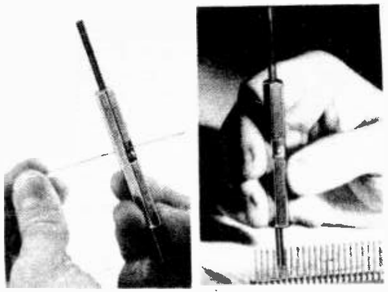
M52/MT52/MRS/MH5/MP5 Scribers with hooks and straight point/same but with threaded handle/pocket, straight, reversable model/hook and straight scriber, with adjustable sleeve handle/hook and straight scriber From **$1.65 to $2.40**

27 NATIONAL CAMERA

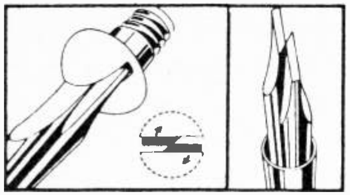
These products are available from Efstonline The catalogue is 80 pages full of tools for the electronics and photographics workshop, and sells for $1 00. Many of the products are look-alikes of other products in this article (Ungar, Edsyn, Hunter, etc.) and several are listed under the manufacturer's name (Dremel, Moody, Quick Wedge, Starrett), and listed as such in this article We only have space here to mention a few of the remaining tools

2701 MISCELLANEOUS

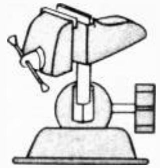
W6690 Adjustable ratchet wrench (3/8" to 7/8") **$19.25**
T-8580 Vacuum tweezers **$71.95**
P3900 to P3903 Flexible files **$7.25**
S1830-S7535 Sharpener for jewelers screwdrivers **$7.95 to $25.95**
D5110 Tiny hand drill (archemedian drive) 4" long **$5.75**
I-5190 Oryx 15W miniature soldering iron **$20.95**
S5500 Eleven inches of AC outlet with 4ft cord **$3.75**
K3661 Kit of 5 drivers, screwholding type **$18.25**
S1304 50 drills from 1 00mm to 5.0mm in 0.1mm steps **$112.25**
H4820 Holds your copy of ETI, or other book, at 45°. **$2.29**
C4625 File cleaning brush **$3.15**
K3432 "Disposible" scissors, pliers (forceps) and tweezers. All three. **$6.25**
C0100 Portable tool caddy with two revolving trays 11½" diameter. **$7.39**
W6740 3/8" to 1-1/8" adjustable socket for nut driving **$45.50**



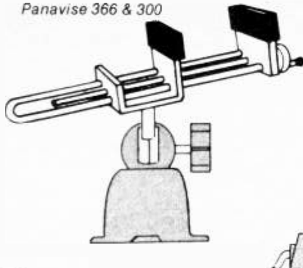
OK WSU-30



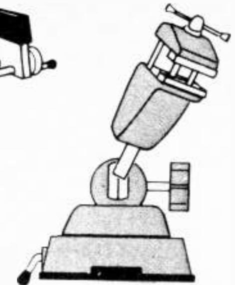
'Quick Wedge' Tip



Panavise 303 & 305

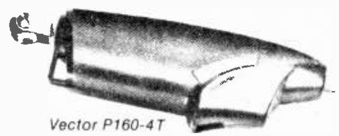


Panavise 366 & 300

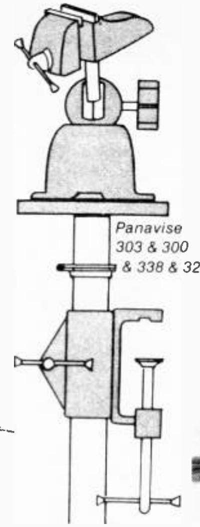


Panavise 304 & 380

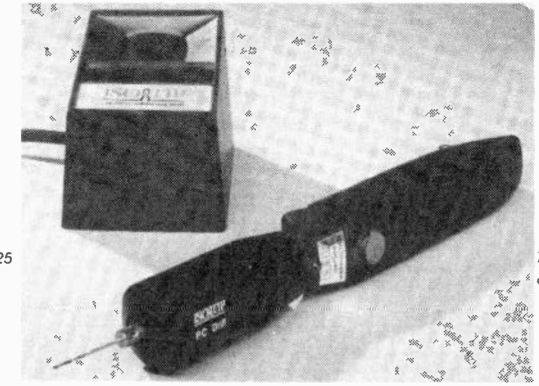
OK BW630



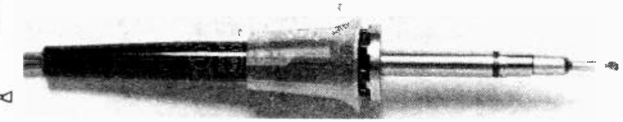
Vector P160-4T

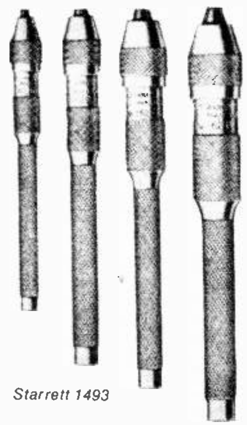


Panavise 303 & 300 & 338 & 325

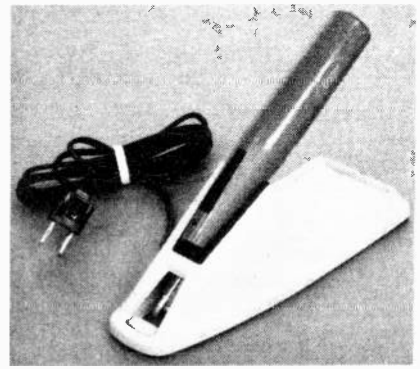


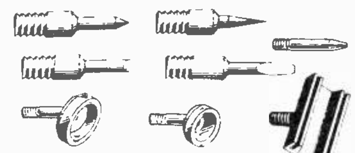
Wahl 7500 & 6500





Starrett 1493





Above: Ungar 3-Wire Iron & Tips
Left: Ungar 225.

28 OK TOOLS

Available from Len Finkler, Electro Sonic

2801 WIRE WRAP TOOLS

G100/G200 Aluminium/Lexan manual wire-wrap tools **$73.14/$51.54**
G100-R3278/G200-R3278 As above, but with chuck to take bits and sleeves made for power tools
EW7D Power wrapper or unwrapper with optional "back force" **$154.38/$168.54**
BW515 Rechargeable power tool, optional "back force" **$213.90/$228.41**
HW22/24/30 Hand wrapping tool **$26.76 to $36.42**
HW-UW-224/30 Hand wrap-unwrap tool **$45.96/$55.14**
UW-1/UW120/UWD93 Hand unwrap tools **$9.00/$13.38**
BW630 Hobby unwrap tool (battery powered) **$48.57**
WSU-30 Habby hand wrap-strip-unwrap tool **$8.47**

29 PANAVISE

Fron Len Finkler, Saynor, ElectroSonic, Heathkit (some items)

2901 VICES

301 One lock-knot permits any angle, vise **$26.56**
305 Low profile base (only) **$15.18**
380 Vacuum base **$21.52**
303 Vise head with 2½" nylon jaws **$12.08**
304 Vise head with horizontal jaws (vertical opening) **$12.08**
366 Vise head, 1¾" jaws opening to 6½" **$12.59**
311 Bench clamp adapter for vise bases **$12.50**
315 PCB-holder head, 6" arms open up to 8" wide **$21.52**
Plus many other accessories

30 QUICK WEDGE

From Saynor, Efstonline

3001 SCREW-HOLDING SCREWDRIVERS

1253 to 23514 Sixteen screwdrivers from 1/8" to ¼", blades from 2" to 14", prices **$2.18 to $4.16**

31 RADIO SHACK

The 1978 catalogue has about 4 pages of tools sold under the Archer name. Many of these tools look identical to others in this article (the Ungar cordless soldering iron and a few of their other irons, Miller strippers, Edsyn desoldering tool, possibly a GC stripper, etc.) Other items include:

3101 PLIERS & CUTTERS

64-1844 6½" needle-nose pliers **$3.69**
64-1845 6" diagonal pliers **$3.69**
64-1847 6" pliers with stripper, cutter, crimper, wrench **$3.95**
64-1840 9" end-cutting nippers **$3.69**
64-1841 4½" diagonal cutters **$3.69**
64-1843 5" long nosed pliers **$3.69**

3102 SCREW & NUT DRIVERS

64-1948 Six screwdrivers, 0.8mm to 3.8mm **$3.99**
64-1957 Five nutdrivers in kit **$3.99**
64-1958 Two Phillips drivers, three hex keys **$3.99**
64-1850 21-piece socket set **$16.95**
64-1849 18-piece hex key set **$2.39**
64-1839 Folding hex key tool - six sizes **$1.49**
64-1835 Eight screwdrivers (3 Phillips, 3 slot, awl, gimlet) **$3.29**
64-1823 Seven screwdrivers (2 Phillips, 5 slot) **$5.95**

3103 MISCELLANEOUS

64-2223 2 piece alignment tool kit **$1.69**
64-2222 3 piece alignment tool kit **$2.39**
64-2220 5 piece alignment tool kit **$3.98**
64-227 3 soldering tools & heatsink **$3.69**
64-2178 Rechargeable drill set **$19.95**

32 SKIL

Available from Electro Sonic

3201 POWER TOOLS

599 Adjustable drilling 0 to 850 rpm and 33,750 blows per minute hammering, 1/3HP motor **$50.82**
917 Adjustable drilling 0 to 750 rpm, ¼HP motor, 3/8" chuck **$43.09**
918 Presettable drilling 0 to 500 rpm, ¼HP motor, ½ chuck **$47.91**
2002 Adjustable drilling, 3/8" chuck, rechargeable cordless model **$40.46 including charger**
497C Adjustable jigsaw, 0 to 3500 shakes per minute, 1/3HP motor cuts ¼" aluminum or 1/8" mild steel **$45.16**

33 STARRETT

Available from Efstonline

3301 MINIATURE SCREWDRIVERS

1601-1606 Jeweller's screwdrivers from .025" to 0.100" in six sizes **$4.35 each**
1607 Jeweller's Phillips No 0 screwdriver **$4.85**
1608 Seven screwdrivers (as above) in case **$21.75**
1058 Screwdriver with two blades (each 0.100") and screw holder **$7.25**

3302 PIN VISES

1493 Set of four pin vises covering 0 to 0.187" **$14.50**

34 UNGAR

Made by Eldon. Available from Saynor, Electrosonic, Dominion, Heathkit

3401 SOLDERING IRONS: "CRAFTLINE"

225 Cordless with charger **$29.98**
7217 Handle, 27W heat unit, 6 interchangeable tips **$10.98**
7364 27W one-piece soldering iron **$5.38**
7365 27W iron with thread-in fine tip **$5.99**
7454 27W iron with four "hobby" tips **$7.58**

3402 SOLDERING IRONS "3 WIRE LINE"

145 45W, 950°F, iron **$14.30 (tip extra)**
135 35W, 800°F, iron **$14.30 (tip extra)**
127 27W, 700°F, iron **$14.30 (tip extra)**
145K 45W iron with tip **$16.98**

3403 SOLDERING IRONS: STANDARD 2 WIRE LINE

7776 Cork-grip L handle & cord **$5.30**
7777 "Clean-room" handle & cord **$5.60**
1237 to 7539 42W/50W/27W/ heat units, integral tip optional, **$7.00/$9.40/$5.70**
Wide range of threaded tips for 1/8", 3/16", 1/4" fittings on heat units
7791 Technicians kit: 42W iron with chisel tip **$10.98**

3404 SOLDERING IRONS: IMPERIAL LINE

6110 Handle **$4.60**
6113-3 3 wire cord NEMA plug **$6.50**
6200/01/02/03 45W/35W/25W/55W heat cartridge **$13.00/$14.50**
6304-6526 Tips from **$1.80 to $4.10**

3405 SOLDERING IRONS: PRINCESS LINE

6903 3-wire handle **$12.90**
6910/15/18 10W/15W/18W heat capsule **$11.30**
Nibs from $1.00 to $3.10
6976 10W, 3 wire, iron, 3 nibs **$29.00**
6990 Holder with sponge **$9.60**
6939-6948 Desolder tips **$4.80 to $6.70**

3406 TEMPERATURE CONTROLLED IRONS

50T6 600°F soldering station with power supply, 24V iron, and holder **$69.95**
50T7 700°F soldering station **$69.95**
50T8 800°F soldering station **$69.95**
The 24V irons, the thread-in heaters, and a dozen tips ($2.60 each) are available separately

3407 ACCESSORIES & MISCELLANEOUS

6982 Spring-loaded DIL extractor **$4.80**
6983 Spring-loaded T05 extractor **$5.70**
6939 18W "Princess iron" with 3 desolder tips for T05 and DIL WORK) **$36.70**
7805 Desoldering bulb with TFE tip **$3.50**
7600 Iron holder for 7776 & 7777 handles
6800 Iron holder for Imperial & 3-wire irons

35 VECTOR

Available from Electro Sonic

3501 POWER WIRE-WRAP TOOLS

P160-4R Rechargeable wrapping tool with charger **$61.67**
P160-4L As above, but unwrapping action **$74.25**
P180 Wiring tool (fits to P160-4R with $1.69 adapter) with spool and slitter (exposes bare wire at corners of the post) Doesn't cut wire in going from post to post
P160-4T1 110V wrapping tool with P180 slitter **$109.00**

3502 HAND WRAPPING TOOLS

P160-9 Wrap and unwrap tool (26 to 30 gauge wire) **$24.84**
P160-7 Unwrap tool (26 gauge wire) **$12.83**
P160-6 Wrap tool (26 gauge wire) **$20.59**
P160-6-1 Wrap and strap tool with spool (22 to 26 gauge) **$26.93**
P160-2A-1 Wrap and strap tool with spool (22 to 26 gauge) **$16.81**
P160-1A Unwrap tool for 0.025 posts **$12.83**

3503 MISCELLANEOUS

P181 Clipper for small wires **$7.43**
P173 Wiring pencil, with 250 ft of 36 gauge wire automatically strips insulation and solders when heated **$12.83**

36 WAHL

Available from Len Finkler, Electro Sonic

3601 "ISO TIP" CORDLESS SOLDERING IRON

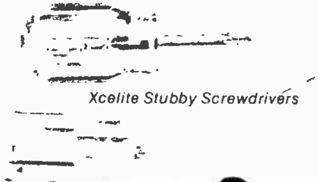
7500 Cordless iron with tip and 120V charger **$27.20**
7585 12V automobile charger **$9.35**
7531-7596 Eleven tip styles, $3.50 to $5.95 (tuner extension tip) **$3.50**
6500 PCB drill attachment **$18.75**

ETI Tools Catalogue

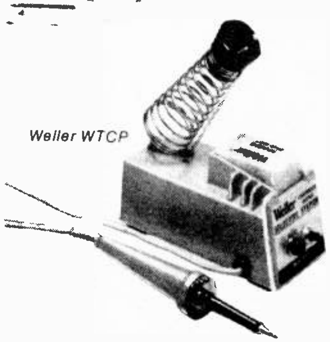
Weller 8200

Weller D550

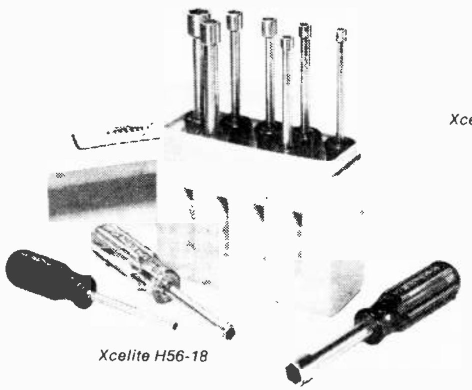
Weller GT7A



Xcelite Stubby Screwdrivers

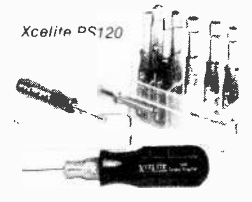


Weller WTCP

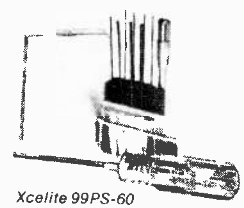


Xcelite H56-18

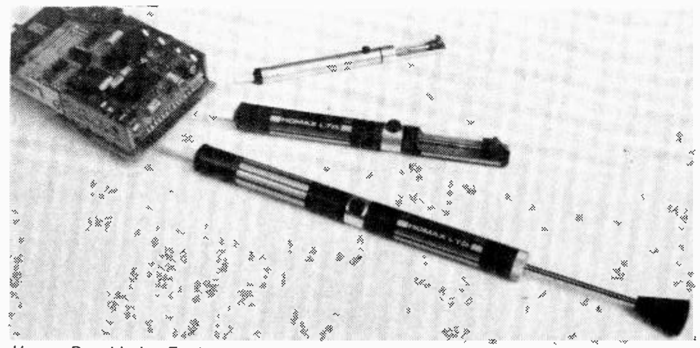
Xcelite PS88



Xcelite PS120



Xcelite 99PS-60



Homax Desoldering Tools

37 WELLER

Available from Saynor, Electro Sonic

3701 SOLDERING GUNS

8200 Dual-heat (100W/140W) gun **$12.72**
8200-3 8200 with 3 wire cord **$13.74**
8200-PK 8200 and 3 tips in case **$14.70**
8200-PK-3 8200, 3 wire cord, 3 tips in case **$16.16**
D550 Dual-heat (240W/325W) gun **$17.39**
D550-3 as above, plus 3-wire cord **$18.77**
D550-PK 3 tips, gun and case **$20.60**
D550-PK-3 3 wire version **$21.83**
GT7A-3 Temperature controlled (700°F) gun **$20.76**

3702 SOLDERING IRONS

SP23 25W, 750°F, removeable tip iron **$4.92**
SP23-3 Three wire version **$6.42**
SP23K 3 tip kit with SP23 iron **$7.34**
SP40 40W iron, ¼" tip **$6.38 ($7.86, 3 wire)**
SP80 80W 3/8" tip, pencil type iron **$8.25 ($9.66 3 wire)**
SP120 120W ½ tip **$11.90 ($13.40 3 wire)**
SP175 175W 5/8" diameter tip **$14.40 ($15.80 3 wire)**
230K Hobby kit based on SP23 iron, in case **$10.68**
W60-3 60W ¼" tip 700°F controlled output **$18.10**
W100-3 100W 3/8" tip 700°F controlled output **$22.83**
W200-3 200W, ½" tip 700°F controlled output **$35.54**
WP25 "Professional" 25W 1/16" tip iron **$10.05 (3 wire $11.88)**
WP40 "Professional" 40W, 1/8" tip, iron **$12.83 (3 wire $14.67)**
WC100 Rechargeable cordless iron, 6 second heat-up with charger **$19.76**
WC100K WC100 in 3-tip kit **$26.76**

3703 SOLDERING STATIONS

MP156 Power unit and 650°F iron (micro point tip) **$48.00**
MP157 Power unit and 750°F iron (micro point tip) **$48.00**
WTCP-N 700 F low voltage iron and power unit **$41.25**
DS100 Vacuum soldering/desoldering station **$375.00**

3704 MISCELLANEOUS

SFA1/SFA60 side rail stand for iron **$2.21**
PH60/PH100 Stand with base and sponge **$6.59/$7.71**
DS40 40W desoldering tool **$20.07 (3 wire $21.90)**
AC303P Desoldering bulb **$2.69**
PUL-DIL IC extraction tool **$24.22**
601K "Mini Shop" kit grinding, cleaning, drilling, etc, bits and discs, plus 110V power unit and case **$45.71**

38 XCELITE

Available from Cesco, Saynor, Electro Sonic

3801 SCREWDRIVERS — SLOTTED, SQUARE BLADE

Reference numbers are based on tip size and blade length
S3163/141/5161 3/16" / ¼" / 5/16" stubby screwdrivers **$1.16/$1.28**
S3163-3168 3/16" screwdrivers with 3"/4"/6"/8" blades **$1.47 to $2.08**
S144-148 ¼" screwdrivers with 4"/6 /8" blades **$1.97 to $2.37**
S5164-S51610 5/16" screwdrivers with 4"/6"/8"/10 blades **$2.19 to $3.23**
S388/53812 3/8" screwdrivers with 8"/12" blades **$3.91 to $5.32**
S71612/71618 7/16" screwdrivers with 12"/18" blades **$5.62 to $6.43**

3802 SCREWDRIVERS — SLOTTED, ROUND BLADE

R332/3/4 3/32" pocket clip style 2"/3"/4" blades **$.74 to $.85**
R181/3 1/8" pocket style 2"/3" blades **$.74/$.81**
R182-1810 1/8" screwdrivers with 2"/4"/6"/8"/10" blades **$.85 to $1.41**
R5323-R5328 5/32" screwdrivers with 3"/4"/5"/8" blades **$1.05 to $1.41**
R3163-R31610 3/16" screwdrivers with 3"/4"/6"/8"/10 blades **$1.38 to $2.21**
R144-R1410 ¼" screwdrivers with 4"/6"/8"/10" blades **$1.94 to $2.37**
R5164-R5168 5/16" screwdrivers with 4"/6"/8" blades **$2.21 to $7.52**
R388 3/8" screwdrivers with 8" blade **$3.44**

3803 SCREWDRIVERS — PHILLIPS

Phillips Sizes, point sizes & blade diameter 0-1/8", 1-3/16", 2-¼", 3-5/16", 4-3/8"
P125 Size 0, Pocket-clip style 2" blade **$0.95**
SX101/102 Size 1/2, stubby style, 2-15/16" / 3-5/16 overall **$1.47/$1.63**
X100 to X1020 Sizes 0 to 4, blades 2" to 10" **$1.04 to $3.53**
P0/P1/P2 3½" overall size, sizes 0,1,2 **$.92/$1.24/$1.38**
2 $.92/$1.24/$1.38
XST100 to 1020 0,1,2 sizes; blades 2" to 10" black oxide tips **$1.32 to $3.08**

3804 SCREWDRIVERS — ALLEN HEX

LN20 to LN28 to LN964 0.05" to ¼" by 1/64"; blades 4"/6" **$1.52 to $1.83**
LN20BP to LN28BP same sizes as above, 4" blades with "ball point" ends **$2.35 to $2.59**

3805 SCREWDRIVERS — ROBERTSON

Robertson sizes: Tip size 0,1, 2,3. Screw size 3 & 4, 5,6, & 7, 8,9, & 10, 12 & 14
SL0 to SL3 "Scrulox" screwdrivers **$1.80**

3806 SCREWDRIVERS — REED & PRINCE (FREARSON)

RP101/102 3/16" / ¼" blade **$1.69/$2.16**

3807 NUT DRIVERS

P3-P12 3/32" to 3/8" by 1/32" steps, pocket clip style **$1.05**
6-12 Regular sized (3" shaft) nut drivers (sizes as above) **$1.74**
14/16 7/16" / ½" nut drivers **$2.21**
HS6-HS12 Hollow shaft types (when protruding bolts are a problem) 3/16" to 3/8" **$1.97**
H514/16/18 7/16" / ½" / 9/16" hollow shaft **$2.32**
A6 to A12 Extra long hollow shaft nut drivers (6¾" hole) **$2.41**
4MM to 11MM Metric nut drivers **$2.08 to $2.55**
12MM/13MM Hollow-shaft nut drivers, 12mm/13mm **$2.79**

3808 HANDLES & BLADES — INTERCHANGEABLE

99-1 Regular handle **$1.44**
99-1R Regular handle with ratchet **$9.82**
99-3 Stubby handle **$1.36**
99-4 T-shaped handle **$1.88**
99-4R T-shaped handle with ratchet **$9.86**
99-6 to 99-16 Nut drivers (incl stubby types) 3/16" to ½" **$1.04 to $1.61**
99-20 to 99-26 Allen hex shafts 0.05" to 3/16" **$1.24**
99-SC0/1/2/3 Scrulox (Robertson) blades **$1.31**
99-820/1/2 Phillips blades **$1.36**
99-61 to 99-69 4-flute & 6-flute Bristol multiple spline drivers **$1.24**
99-811 to 99-125 tapered-tip slotted drivers 3/16" to 1/8" **$1.36**
99-38 1/8" to 3/8" reamer **$3.48**
99X5/X10 4"/7" extension blades **$1.88/$2.03**
99-4MM to 99-11MM Metric nut driver shafts **$1.72 to $2.15**
99-71MM to 99-77MM Metric size Allen shafts **$1.56**
99-8-M/99-10-M Magnetic nut drivers **$1.72/$2.14**

3809 HANDLE & BLADE KITS

99-PS-51MM ten metric nut driver and handle **$16.78**
00PS-41MM Seven metric Allen drivers and handle **$13.05**
99-PS-41MM BP As above, but "ball point" ends **$17.23**
99-PS-40 BP Nine "ball point" Allen drivers, handle & 4" extension **$19.72**
99PS40 Nine Allen drivers, handle & extension **$14.63**
99PS50 Seven nut drivers, two slotted and two Phillips drivers handle, and 4" extension **$17.90**
99PS60 Nine Bristol fluted blades, extension and handle **$14.63**
99PR Nine nut drivers, four screwdrivers and handle in roll-up case **$18.31**
99MP Regular and T-shape handles, 10 nut drivers, 9 Allen drivers, 9 Bristol drivers, 5 screwdrivers, 2 reamers, 1 awl, 1 extension. Folding case **$54.33**
99SL Four Scrulox blades, one slot blade, and handle **$7.17**

3810 ONE-PIECE DRIVER KITS — POCKET SIZE

PS7 3½" overall drivers, 2 nut drivers, 2 slot tip, 2 Phillips drivers, plus "piggyback" handle **$8.28**
PS44 3½" "scrulox" drivers — five sizes and "piggyback" handle **$8.63**
PS88 3½" screwdrivers - 5 slot and 3 Phillips types plus "piggyback" handle **$8.63**
PS89 3½" nut drivers, ten sizes plus "piggyback" handle **$11.96**
PS130 3½" screwdriver & nut driver set: 5 of each plus "piggyback" handle **$11.42**
M60 Eight Allen type drivers and "piggyback" handle **$4.16**

3811 ONE-PIECE DRIVER SETS FULL SIZE

LN11 Roll-up case with eleven Allen drivers 0.05" to ¼" **$18.59**
HS6-18 Ten hollow shaft nut drivers in case **$22.76**
127TB Seven solid-shaft nut drivers (3/16" to 3/8") in trays **$13.20**
147TB Seven hollow-shaft nut drivers (¼" to ½") in tray **$16.58**
4-13MM Ten nut drivers 4mm turn 8mm, 10mm, 11mm, 13mm in cardboard box **$20.04**

3812 MISCELLANEOUS DRIVERS

25 Handle with 7/16" socket **$1.38**
RB1/2/3 6¼" blades: slot one end, Phillips at other **$1.88**
CK3 Handle and 3 reversible blades in pocket roll **$7.43**
XL70 Offset ratchet screwdriver set (12 Allen bits, 2 slotted bits, 2 Phillips bits, reversible offset ratchet handle, 6" extension case) **$21.26**
XL75 Ratchet and four screwdriver bits (¼" hex shank) **$6.70**

3813 CUTTERS

86CG 6½" coil-sprung shear type electronic snips **$7.52**
54CG/55CG/64CG/66CG/67CG Diagonal cutters 4"/5"/4"/6"/7" **$7.34/$7.79; $9.78/$8.32; $8.17**
96CG 5" flush-cut electronic shears **$4.55**
97CG As above, but with retaining clip for off-cuts **$6.37**
74CG 4" spring opening diagonal cutters **$10.14**
84CG 4" full-flush diagonal cutter, spring opening **$10.56**
95CG 5" full-flush diagonal cutter, spring opening **$11.37**
62CG 6" end cutter, flush cut **$10.49**

3814 PLIERS (SOME WITH CUTTERS)

41CG 4" long nosed, serrated jaws **$6.96**
52CG 6½" long nosed pliers **$6.71**
51CG As 52CG but with side cutters **$8.32**
56CG 6" needle nosed pliers, serrated jaws **$8.34**
57CG 5½" needle nosed, spring opening, serrated jaws **$8.55**
58CG 6" plier with 5/16" cutter 3/16" back from tip **$9.91**
59CG 8" high leverage chain nosed plier **$9.53**
60CG 6" side cutting pliers, serrated jaws **$8.46**
68CG 8" side cutting pliers serrated jaws **$10.51**
70CG 5" "flat nose" pliers **$7.83**
71CG 4½" round nose pliers **$8.08**
72CG 5" chaine nose pliers **$8.17**
69CG 5" pliers with 5/16" cutter 1/8" back from tip **$10.93**
73CG 4½" needle nose pliers with 45 cutter at tip **$12.60**
79CG 5" needle nose, serrated jaws with 60 bend **$11.19**
50CG/53CG/63CG 5"/7"/10" multiple-position joint pliers **$4.99/$5.75/$7.34**
75C/76C/78C 5"/6"/8" slip joint pliers **$3.42/$3.54/$4.28**
44CG/46CG/48CG 4"/6"/8" adjustable wrench (1/2" /3/4"/15/16" maximum opening **$6.70/$6.79/$7.25**

3815 TOOL KITS

99SM Roll-up kit with 6" long-nose plier, 5" diagonal cutter, 6" adjustable wrench, regular and stubby driver handles, 9 regular and 3 stubby nut driver blades, 3 screwdriver blades, 2 reamer blades and a 7" extension. **$52.60**
TC200/ST Ten individual tools and 28 "series 99" interchangeable blades and handles, in attache case **$54.58**
TC100/ST 41 individual tools, 16 "series 99" interchangeable blades and handles, and 5 specialized screwdriver/nut driver kits in attache case **$311.57**

39 MINOR ITEMS

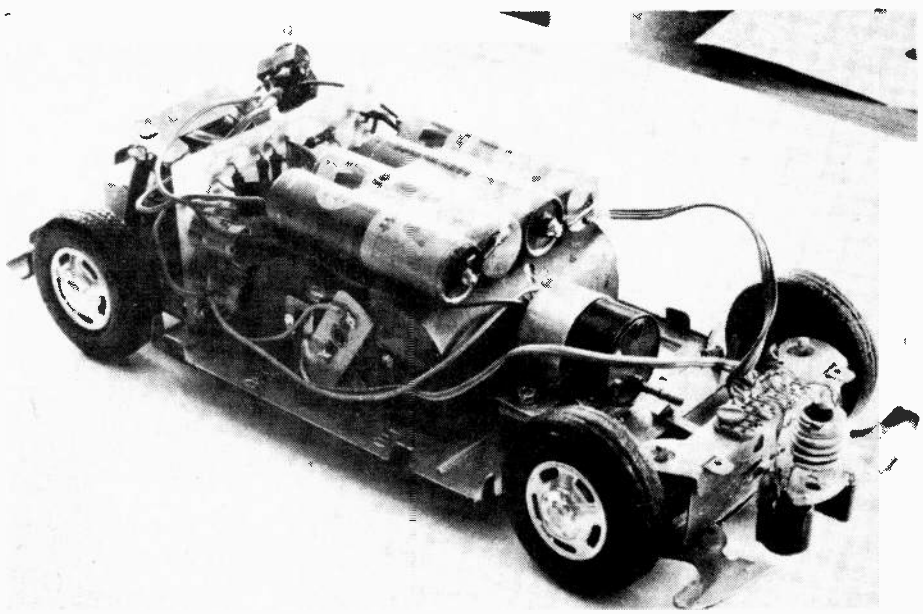
Here's a couple of items too small to warrant listing in the main section:

2901 MISCELLANEOUS

72000 Homax desoldering tool **$18.29**, from EMX Ltd, 11 Glen Cameron Rd, Unit 2, Thornhill, Ont. L3T 4N3. (Also sell Homax IC desoldering tool for **$15.75**)
IN00450 to IN9300 Alignment tools, slot and hex, from Injectorall. Prices **$0.85 to $1.25.** Also kit of four tools **($2.55)** or six tools **($4.75).** From Omnitronix Ltd, 2056 South Service Road, Trans Canada Highway, Dorval, Quebec, H9P 2N4.
44 Printed circuit solder from Kester in 28g box.

White Line Follower

This toy car will follow a track around — but there's always the danger of spinning off!



THE IDEA OF A SLOT CAR that doesn't need a slot is not new — in fact, sophisticated systems based on inductive loops have been used in large factories for some years. This project is at the other end of the complexity scale, and uses a simple light/photocell combination to follow a white line. The electronics involved make up a simple feedback control system — as soon as one photocell sees more light than the other, the differential amplifier applies a correcting voltage to the steering servomotor and so the model steers itself back on to the line.

We are not sure whether to class this project as a toy or as a serious experimental project. Certainly, the basic project makes a great toy, but there is tremendous scope for experimenting and 'tuning' the control circuitry. Like all control systems, this one displays a characteristic called 'damping' — if the system is overdamped, the car will steer sluggishly and will have difficulty following anything except the smoothest curves. If the control circuitry is underdamped, the car will oscillate from side to side on curves — this may also be set off by small deviations on the straights.

The ideal situation is to have a 'critically damped' system, which has just the right combination of characteristics to respond quickly on curves without oversteering. This can be achieved by theoretical analysis, using techniques like Nyquist's Criterion, but it's more fun to tune by trial and error. The damping is a factor of the photocell spacing, the amplifier gain and the servomotor characteristics.

You can have a lot of fun racing these cars, especially since there is quite a bit of scope for tinkering and tuning them. The layout of your race track should include both smooth and tight curves — you may have problems with figure-8 s that cross at anything but right angles.

CONSTRUCTION

Construction of the mechanical side we must leave to the individual reader. The car we used was purchased from Woolworth's and already had steerable front wheels, which saved a lot of work in designing and building, although for the enthusiast a plastic kit would be a good start.

The motor for the steering should operate on 1.5 V reliably and has to be geared down. The motor we used had an internal 15:1 gearbox and the steering

arms were driven by a piece of fishing line wrapped around the shaft (see photo). This is only one possible method — we leave the final choice to you.

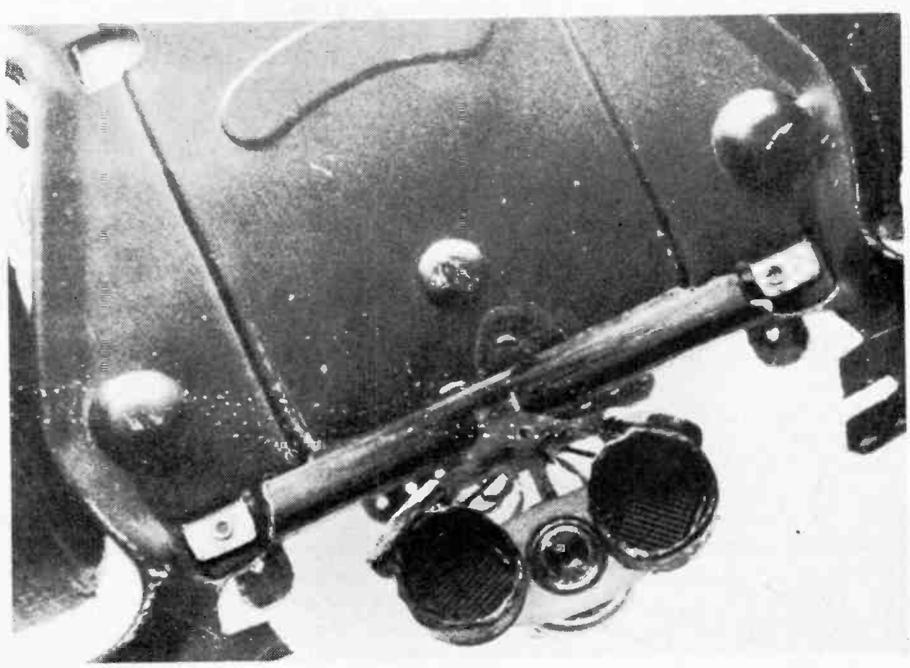
The sensors should be mounted in front of the wheels and should move with them so that when the wheels turn to the right, the sensor also moves to the right and vice versa.

The LDRs were housed in short lengths (about 10 mm) of cardboard tube to act as a shield and were spaced about 15 mm apart (we used a 12 mm wide line) with the bulb mounted between them.

Electrically the components can be built onto the PC board described which can be mounted somewhere in the car. We used separate batteries for the electronics and ran the bulb off the main batteries, to keep the electronics supply more constant.

EXPERIMENTING

Using different motors/gear ratios some changes to the electronics will probably be found necessary. These would mainly involve C1, R1 and R10. Increasing R10 or reducing R1 increases the DC gain, while increasing C1 increases the dynamic damping to reduce overshoot. Track width may also be experimented with as well as LDR spacing.



Underneath view of the photo resistors and the light bulb.

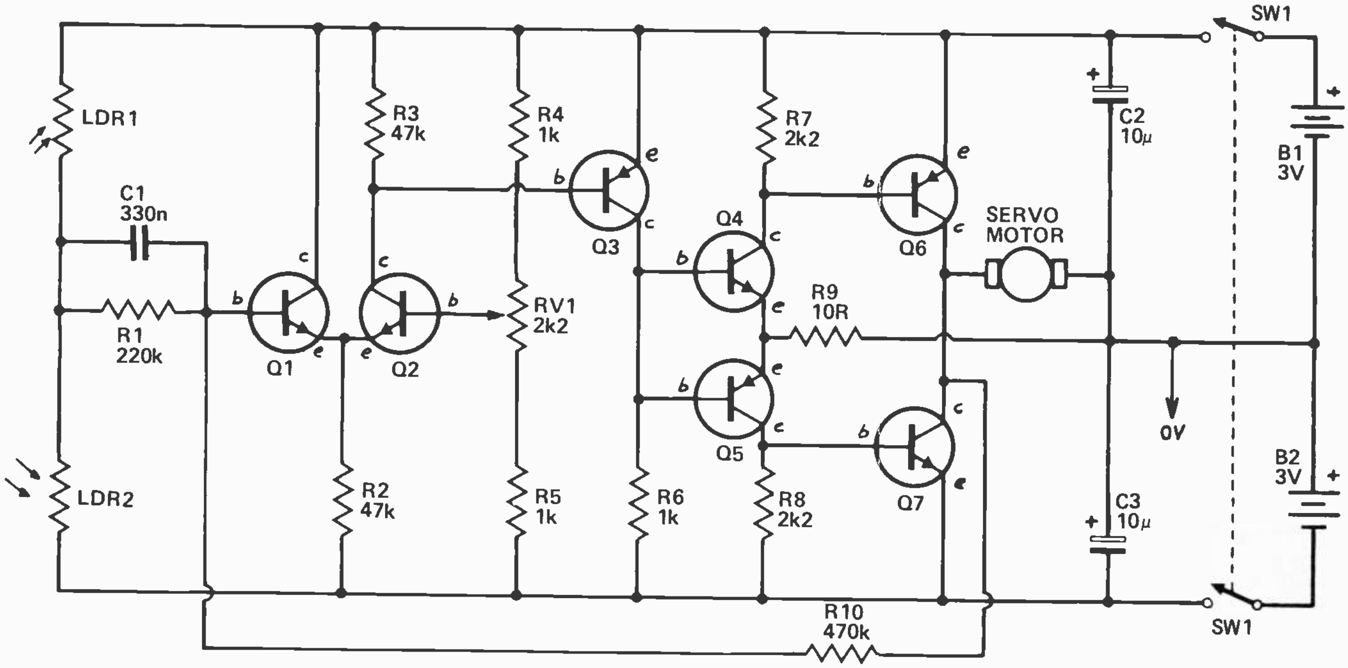
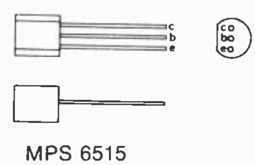
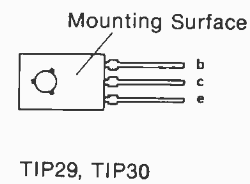


Fig. 1. The circuit diagram of the electronics.





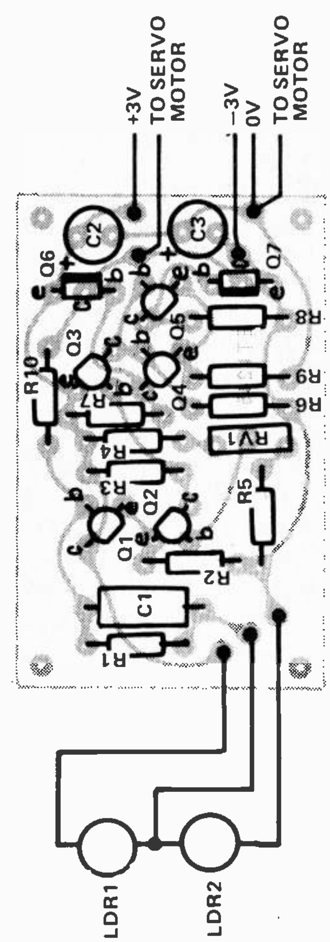


Fig. 2. Component overlay.

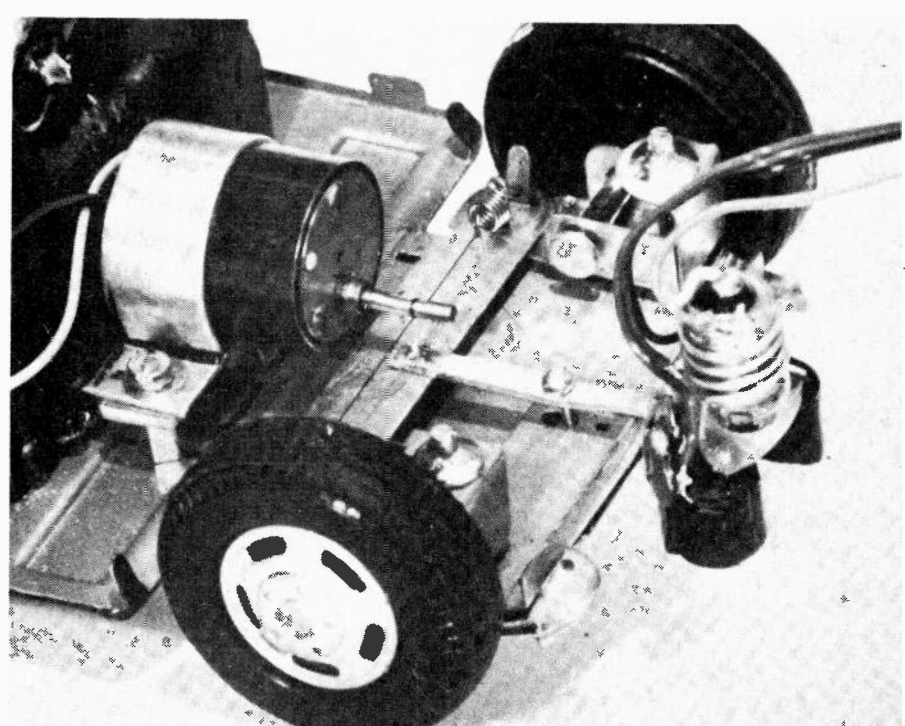
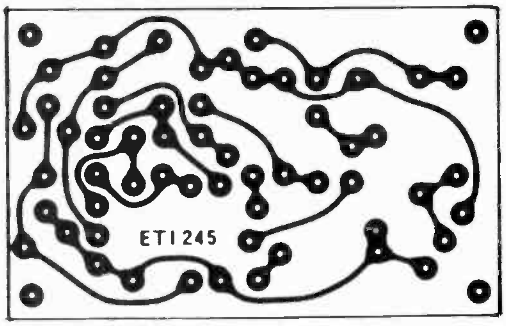


Photo showing the mechanical side of the project.



PARTS LIST

RESISTORS all ½W, 5%
- R1 . . . . . 220k
- R2,3 . . . . 47k
- R4—R6. . . 1k
- R7,8 . . . . 2k2
- R9 . . . . . 10R
- R10. . . . . 470k

LIGHT DEPENDENT RESISTORS
- LDR1,2 . . Philips 8-731-03 or similar

POTENTIOMETERS
- RV1 . . . . 2k2 Trim

CAPACITORS
- *C1. . . . . . 330n polyester
- C2,3 . . . . 10µ 10V electrolytic

SEMICONDUCTORS
- Q1,2 . . . . MPS6515
- Q3 . . . . . 2N3905
- Q4 . . . . . MPS6515
- Q5 . . . . . 2N3905
- Q6 . . . . . TIP30C
- Q7 . . . . . TIP29C

MISCELLANEOUS
- PC Board ETI 245
- 3V bulb
- *servo motor and gears
- toy car
- 2 pole toggle switch

*see text

HOW IT WORKS

The sensor used to look for the white line is a pair of light dependent resistors (LDRs) which are aimed at either side of the line so that each sees half white half dark. The line is illuminated by a bulb to ensure that the LDRs have a relatively low resistance. If the car is moved off the centre line one LDR will see more 'white' and its resistance will fall. The two LDRs are connected in series across the supply voltage and so the voltage at the junction will vary as the car moves in relation to the line.

This voltage is compared with that set on RV1 by Q1 and Q2, the error signal driving the servo motor in the correct direction to try to eliminate the error. Negative feedback is provided by R10 to reduce the 'open loop gain', and dynamic feedback is provided by C1 which is used to reduce overshoot.

When designing the mechanical side of the car's steering mechanism, provision should be made to somehow move the sensors with the front wheels to provide additional negative feedback.

The motor used in the prototype was an expensive one (about $40) with an internal 15:1 gearbox. While a motor of this quality is probably not justified a reasonably good motor and reduction gear is necessary, as the cheap (50c) motor we tried didn't seem to like starting on 1.5 V.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Add-On FM Tuner

This 'add-on' FM tuner may be incorporated into an existing AM radio or hi-fi system. The case and power supply are left to the individual constructor.

THIS TUNER has a minimum of initial adjustments and few operating controls, it can draw its power from any widely varying available dc voltage source (for example, a power amplifier supply rail). Thus it is not intended primarily to compete with the 'free standing' designs, but it is nevertheless capable of equally excellent performance. Distortion of 0.1% and signal to noise of 70dB (unweighted mono) was exhibited by the prototype using an HP spectrum analyzer.

Many options are available, — in one extreme case the tuning could be preset by a trimpot, with no meters or switches at all: the board being built into an existing amplifier as an extra program source using no additional panel space. In another extreme case a line operated power supply could be provided, a 10 turn helipot used as a tuning control, tuning, carrier strength and frequency meters provided, AFC, mute defeat and mono/stereo switches provided, with the whole unit built into a wooden box whose front panel could be graced by the above controls plus a stereo indicator LED.

PRACTICAL CONSIDERATIONS

The tuner is constructed on a small, single sided printed circuit board, the pattern for which is shown in Fig. 4. The components layout is shown in Fig. 2.

Filter frequency determining capacitors should be mica, polystyrene or polyester for the larger values surrounding IC3. The external components shown in Fig. 2 are all optional except the tuning potentiometer RV6. No special constructional difficulties should be encountered.

ADJUSTMENTS

Connect an antenna as shown in Fig. 2. Tune into the local stereo station by monitoring the stereo outputs with headphones or amplifier, ensuring that the mute defeat switch is on (closed) and that the AFC switch is off (connected to R36). Adjust RV4 until the oscillator signal at the test point (TP) reads 19.00 kHz or set RV4 halfway between the points at which the stereo LED comes on (anticlockwise and clockwise). Adjust RV5 until pins 6 of IC4,5 read about 6 V as read by a multimeter.

Observe pin 1 of IC2 with a high frequency oscilloscope and tune across the station, observing the rise and fall of the 10.7 MHz IF signal. Set the tuning so that this signal is maximized, thus ensuring that we are sitting centrally in the ceramic filter bandpass range. (If an oscilloscope is not available M2 may be used as an indicator of IF signal strength). Leave the tuning set and remove the secondary slug from L1. Adjust the primary slug so that the tuning meter is centred. Insert the secondary slug and adjust until maximum swing away from centre is observed on M3. Readjust the primary slug so that M3 is centred again. L1 is now adjusted.

Now detune the station slightly and turn the AFC on via SW3. Note that M3 swings towards centre from either side, confirming that tuning errors and thus distortion are decreased due to the action of the AFC.

Tune off the station, open SW1, and adjust the mute level control RV3, for reasonably quiet interstation noise. Verify that the station output is not muted on this setting.

The following section applies only if the frequency readout capability is required. Connect the output of a VHF signal generator into the antenna terminals and set to 98 MHz (assumed accurate). Adjust RV1 until M1 is centred. Set the generator to 88 MHz and adjust RV2 to give maximum negative deflection on M1. Set the generator to 108 MHz and verify maximum positive deflection on M1. (Some interaction occurs here and successive adjustments are necessary).The exact frequency scale can now be calibrated on to the meter. If no instruments are available the following may be used as a rough guide:

Frequency (MHz)	Tuning Voltage
88	2
98	6
108	18

The tuner is now fully adjusted and operation of all the controls may be rechecked.

FM stations of known frequency may of course be used to provide calibration points.

Add-On FM Tuner

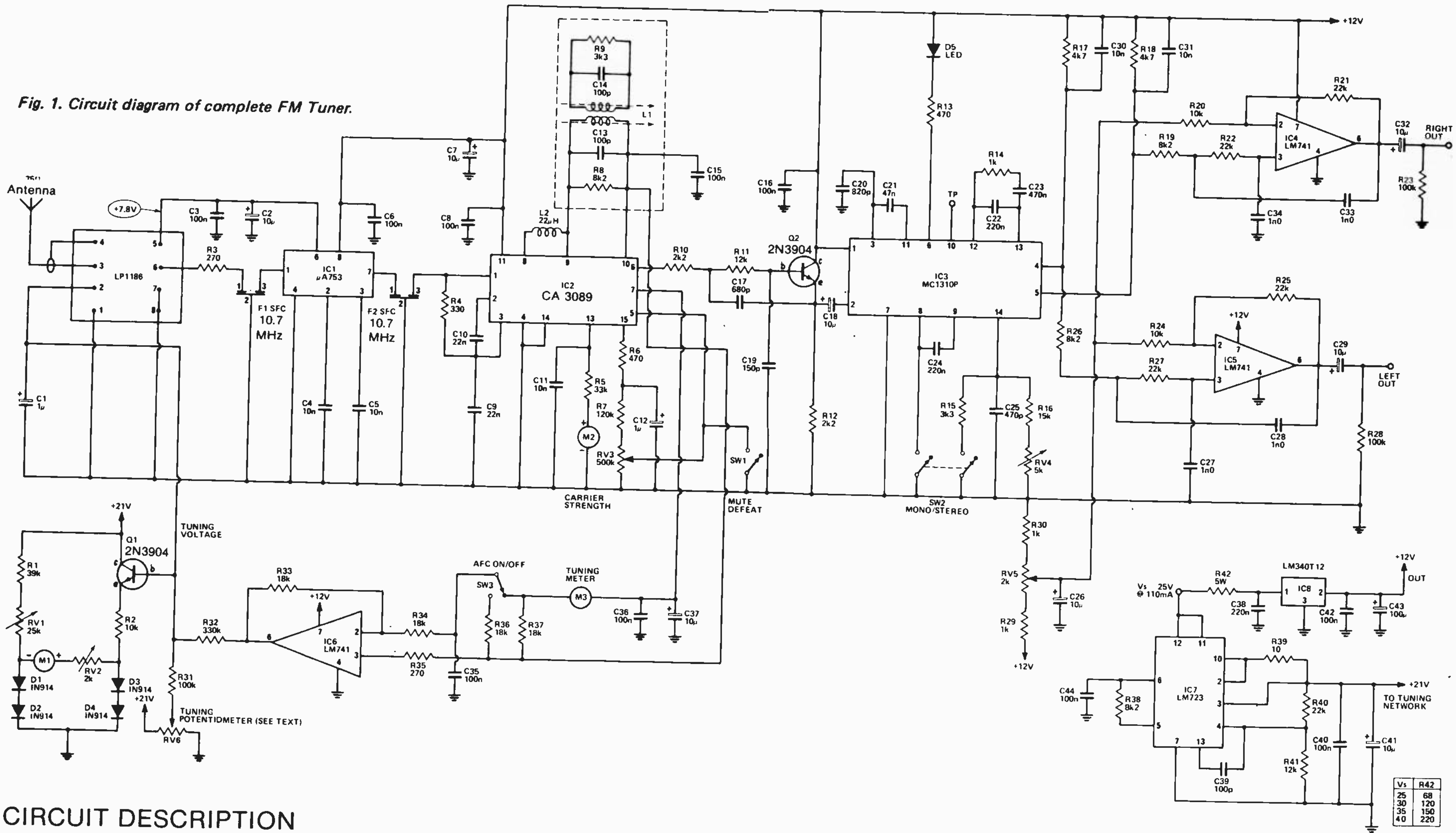


Fig. 1. Circuit diagram of complete FM Tuner.

CIRCUIT DESCRIPTION

The full circuit for the tuner is shown in Fig. 1. The front end consists of the well known Philips LP 1186 varicap tuned FM tuner module. At the time of writing this is readily available. This module requires an 8V, 6 mA power supply (pin 5) and covers the frequency range 87.4 – 108 MHz with a diode tuning voltage range of 2-17V. Antenna (pins 3,4) and output (pin 6) impedances are 75Ω unbalanced and meter M1 is nearly linearly related to the tuned frequency.

The IF signal from the LP1186 passes through the Murata ceramic resonator F1 to the IF amplifier IC1, R3 providing the correct input impedance match to F1. The output impedance of F1 and the input impedance of F2 are correctly matched by IC1 which has two separate outputs providing two choices of gain. In this is inverted by IC6 and added via R32 to the voltage provided by the tuning potentiometer in such a proportion and phase as to hold the captured station over a reasonable range of tuning voltage. In the future, when closely adjacent stations may exist, less holding power will be desirable and R32 should be increased, or indeed the holding range limited to a maximum of less than the interstation spacing by

TABLE 1

Preferred design values for VCVS filters formed by IC4, IC5.

GAIN	R21,25	R19,26	R22,27
2.0	10k	12k	12k
3.2	22k	8k2	22k
4.3	33k	6k8	27k
5.7	47k	5k6	33k
6.6	56k	4k7	39k

the IF output centre frequency is 10.70± .05 MHz. Provision is made for an AFC input voltage, but in this circuit it was found more convenient to supply AFC as an additive correction on the tuning voltage (pin 2). The module has three stages, a tuned antenna and RF stage, giving good image and IF rejection, a separate oscillator stage for good signal handling, and a mixer stage with a double-tuned IF output circuit. Note that none of the adjustments on the LP 1186 should be tampered with.

TUNING

The tuning voltage is derived from the rough supply voltage (V_S) via IC7, an LM 723 precision regulator connected to provide an output voltage of 20-21V at pin 3, current limited by R39. This voltage is filtered and applied across the tuning potentiometer (RV6) whose wiper provides the tuning voltage for the LP 1186 via R31. For general purpose use it is recommended that RV6 be a 10-100 k, 10 turn helipot since extremely fine control is needed over the tuning voltage for minimum distortion of the received program. If it is not desired to have the AFC facility, the extreme stability requirement on the varicap voltage is satisfied by the choice of a precision regulator and a high quality helipot, but the inclusion of AFC is a strong recommendation. Other tuning potentiometer systems could of course be used. For example, a push-button tuning control using a set of voltage dividers and narrow range trimpots is quite feasible.

READOUT

Since the dependence of tuned frequency on the varicap supply voltage follows a pseudo-logarithmic law, some form of compensation is required to produce a linearly scaled frequency readout. Q1 and associated components form a crude logarithmic converter, and it happens that the out of balance current passing through the centre zero circuit the lower gain is used (output pin 7), sufficient for city use, but if a higher sensitivity is desired it is quite easy to take the higher gain output (pin 5) instead. IC1 also includes a regulated power supply of 7.8V (pin 6) which is very convenient for powering the LP1186 module.

FILTERING

The amplified output from IC1 passes through the passband matched (same colour code as F1) filter F2, correctly loaded by R4, to the detector chip IC2, an RCA CA 3089 which performs the functions of FM amplification and detection, interchannel controlled muting, AFC output and carrier strength output.

MUTE OPTION

The carrier strength output (pin 13) may be used, if desired, to drive meter M2 via R5. The mute input (pin 5) takes the form of a dc volume control, and in this circuit, rather than the normal mute output (pin 12), the AGC output (pin 15) was used to control muting as a more sensible characteristic was observed. The mute level control RV3 can easily be set to receive a desired station strongly while largely eliminating interstation noise. The mute defeat switch SW1 is self explanatory.

DETECTOR

The external components involved with the quadrature detection of the FM signal are the RFC L2 and the double tuned 10.7 MHz tank L1. Constructional details for L1 are given in Fig. 3 and adjustment procedures follow later. Note that the can of L1 forms an integral part of the circuit continuity if the author's printed circuit board layout is adopted, and that the circuit will not work without it.

AFC

The AFC output (pin 7) of IC2, relative to the reference bias (pin 10) back to back diodes across R33 or some such technique. At present the holding range is largely a matter of personal taste and it is fascinating to lower the value of R32 and watch the tuning control have virtually no effect as it is rotated through one turn or so.

The AFC output current is measured by the centre-zero meter M3 which acts as a tuning meter. The AFC may be switched out by SW3 without affecting the basic tuning voltage or the tuning meter action. Note that R35 is not strictly necessary but is used instead of a jumper for aesthetic reasons.

The detected output appears at pin 6 of IC2 and passes through the two pole VCVS active filter formed by the network around Q2. This network has a response which is optimally flat to about 100 kHz and then rolls off sharply at 12 dB/octave above this, eliminating the undesirable effects of wideband noise. Since the wanted components of the stereo signal extend only up to 53 kHz, these are unaffected by the filter.

DEMUX

The multiplex signal now passes to the input of IC3, an MC1310P FM stereo demodulator connected in a standard circuit as recommended by the manufacturers. No inductors are required for this phase locked loop chip which provides an output (pin 6) to directly drive the stereo indicator LED (D5) when a 19 kHz pilot tone of greater than 20 mV RMS is received at pin 2. Full details of the operation of IC3 may be obtained from the manufacturer.

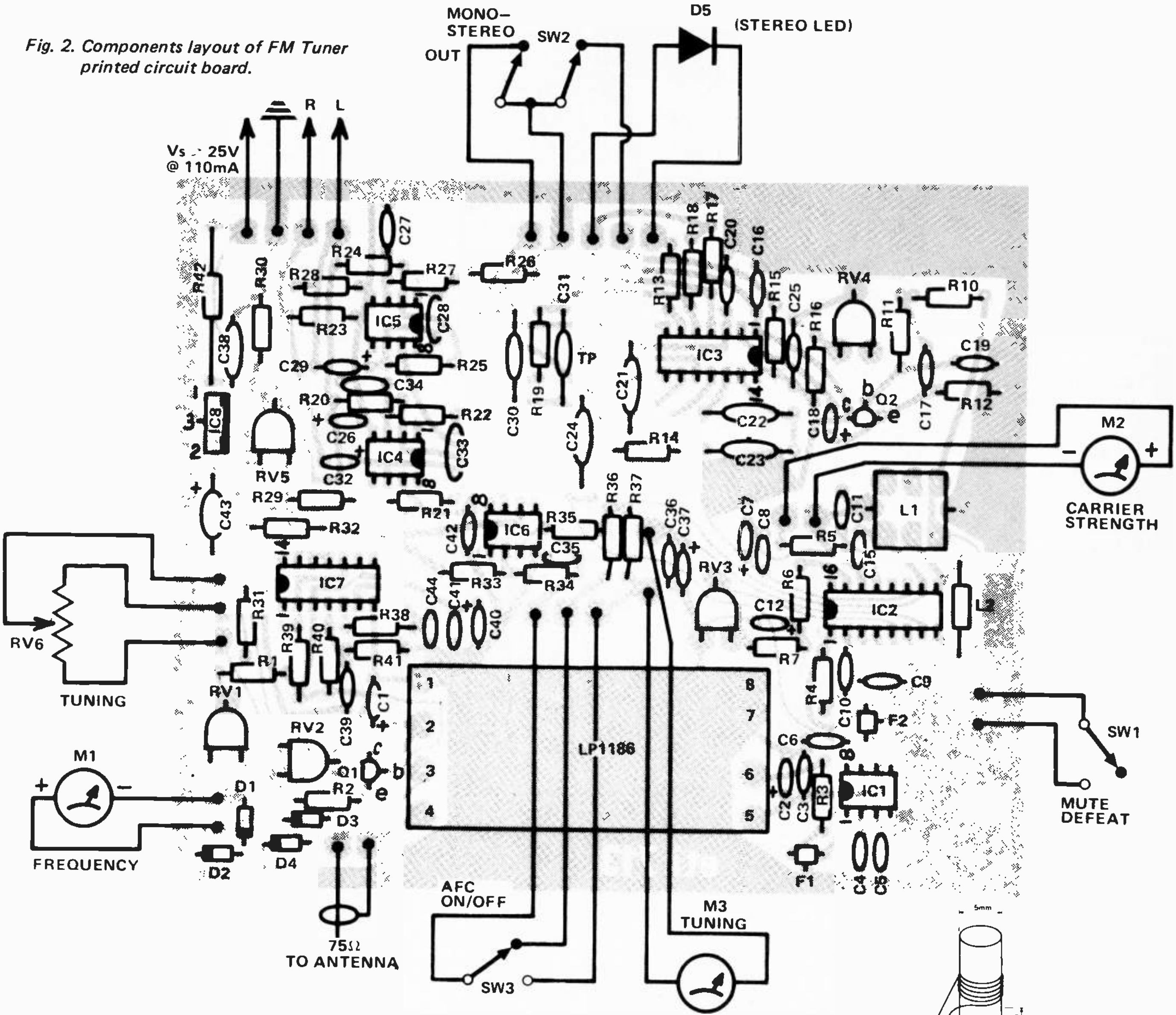
The 19 kHz output of the internal divided down oscillator is brought out from pin 10 to a test point to allow ready frequency adjustment. The frequency is determined by the external network C25, R16, RV4, and these components should be selected high stability, tight tolerance types. (C25 mica or polystyrene, R16 metal film). Mono operation of the circuit is accomplished by closing SW2 which disables the oscillator to prevent interference, and disables the stereo switch to prevent false lamp triggering.

MORE FILTERS

The demodulated left and right channel outputs appear at pins 4 and 5 respectively, and pass to identical VCVS two pole active filters centred around IC4,5. These provide a basic gain of 3.2 and have a response which is optimally flat to 12 kHz and rolls off at 12dB/octave thereafter. This adds to the internal rejection of the MC1310P of 19 kHz and 38 kHz switching frequencies. All frequency determining components surrounding IC4,5 should once again be of accurate values and high stability. It should be noted that the gain of these output filter/amplifiers can of course be changed to suit individual purposes by changing R21,25 but this changes the shape of the frequency response (for example increasing R21, 25 will produce a large peak at the cut-off frequency). Thus if it is desired to change R21,25, then R19, 22 and R26,27 will have to be changed as well according to the values given in Table 1. With the circuit values shown outputs of about 3 V peak to peak are obtained on the maximum excursions of typical program material. RV5 sets the dc operating conditions of IC4, 5 to ensure that their outputs (pins 6) sit at half supply voltage.

Most of the tuner runs from a 12 V supply obtained from the raw supply (Vs) via a standard three terminal regulator IC8. The circuit draws about 110 mA and excess power due to having an input voltage substantially greater than 12 V is largely dissipated in R42, a 5 W wire wound resistor chosen according to the table on Fig. 1. IC8 does not require a heatsink.

Fig. 2. Components layout of FM Tuner printed circuit board.



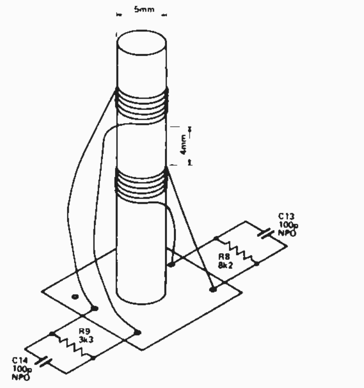


Fig. 3. Constructional details for quadrature coil L1. Mount R8, 9 and C13, 14 inside metal can.

PERFORMANCE

The antenna sensitivity of the tuner has not been extensively studied, but is quite adequate for the normal metropolitan situation. IC1 has a choice of two gain options and wideband preamplification could be provided before the front end if fringe area reception were desired.

An HP spectrum analyzer was used to measure noise and distortion. Ultimate unweighted mono signal to noise ratio was found to be 70 dB while a distortion figure of 0.1% at 3V peak to peak output (mainly second harmonic) was obtainable if L1 was finely adjusted while observing the spectrum analyzer. For adjustment of L1 using the technique described earlier distortions of 0.2–0.3% (second and third harmonic) were obtained. These figures of course assume accurate tuning. Typical maximum output voltage was about 3 V peak to peak as stated earlier.

Specifications relating to RF performance are obtainable from the LP1186 data sheet.

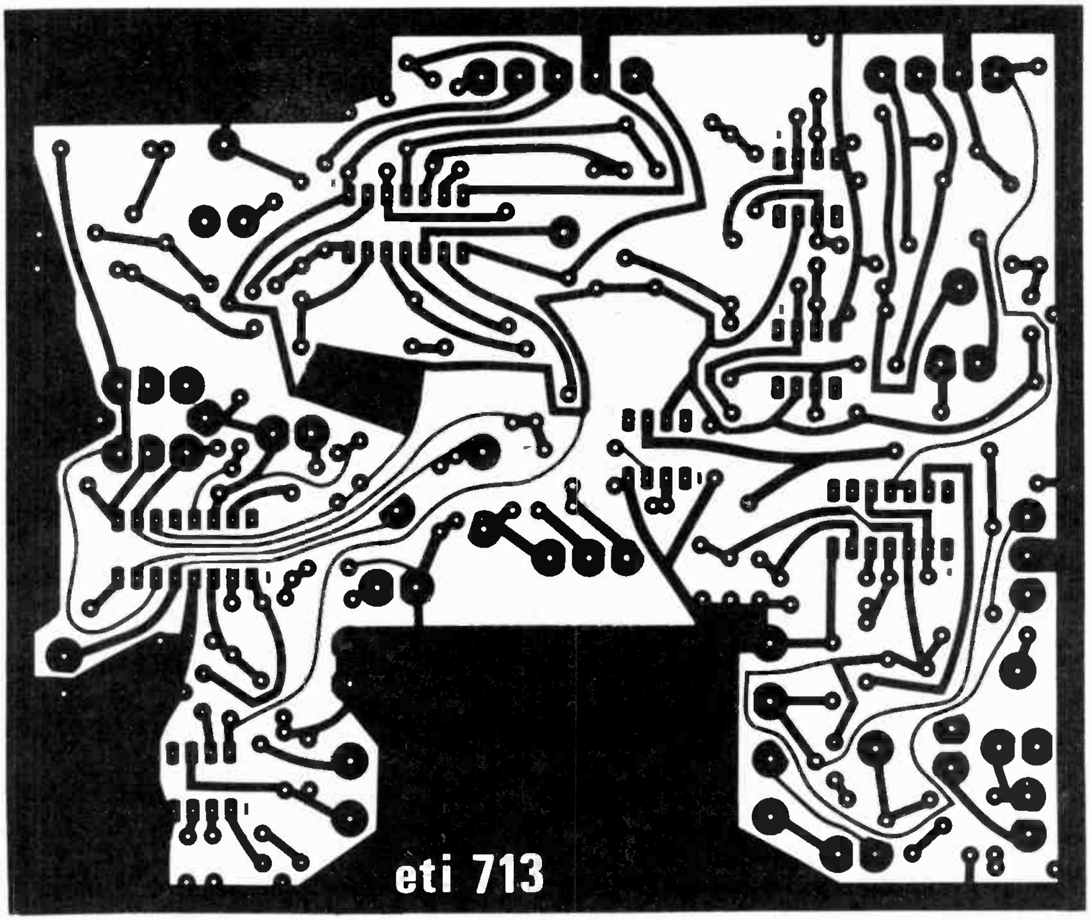
REFERENCES

1. "Novel Stereo F.M. Tuner" (part 2) J.A. Skingley and N.C. Thompson, Wireless World, p. 124, May 1974.
2. "Operational Amplifiers — Design and Applications" J. Graeme, G. Tobey, L. Huelsman McGraw-Hill p. 297, 1971. (The well known Burr-Brown handbook)
3. Motorola Semiconductor Data Library. Vol 6, Series A "Linear Integrated Circuits" p. 8-19, 1975.

PRIMARY AND SECONDARY

22 turns 34gauge close wound on Neosid long 5 mm former and separated by 4 mm.
2 Neosid F16 slugs.
R8,R9; C13,C14 are all connected to pins as shown and contained inside can.

Fig. 4. Printed circuit pattern for FM Tuner. Full size 142 x 118 mm.



Kits and parts available from Livingston Electronics. Some parts from Northern Bear Electronics. See their ads in this issue.

PARTS LIST

RESISTORS	¼W 5% unless stated otherwise
R1	39k
R2	10k
R3	270
R4	330
R5	33k
R6	470
R7	120k
R8	8k2 ⅛w
R9	3k3 ⅛w
R10	2k2
R11	12k
R12	2k2
R13	470
R14	1k
R15	3k3
R16	15k
R17,18	4k7
R19	8k2
R20	10k
R21,22	22k
R23	100k
R24	10k
R25	22k
R26	8k2
R27	22k
R28	100k
R29,30	1k
R31	100k
R32	330k
R33	18k
R34	18k
R35	270
R36,37	18k
R38	8k2
R39	10
R40	22k
R41	12k
R42	see text

POTENTIOMETERS	
RV1	25k trim
RV2	2k "
RV3	500k "
RV4	5k "
RV5	2k "
RV6	10k–100k 10 turn rotary

CAPACITORS	
C1	1μ0 25V tantalum
C2	10μ 16V "
C3	100n disc ceramic
C4,5	10n polyester
C6	100n disc ceramic
C7	10μ 16V tantalum
C8	100n disc ceramic
C9,10	22n polyester
C11	10n "
C12	1μ0 25V tantalum
C13,14	100p ceramic mini
C15,16	100n disc ceramic
C17	680p *
C18	10μ 16V tantalum
C19	150p *
C20	820p ceramic
C21	47n polyester
C22	220n "
C23	470n "
C24	220n "
C25	470p ceramic
C26	10μ 16V tantalum
C27,28	1n0 *
C29	10μ 16V tantalum
C30,31	10n polyester
C32	10μ 16V tantalum
C33,34	1n0 *
C35,36	100n disc ceramic
C37	10μ 16V tantalum
C38	220n polyester
C39	100p ceramic
C40	100n disc ceramic
C41	10μ 16V tantalum
C42	100n disc ceramic
C43	100μ 16V electro
C44	100n disc ceramic

***low tolerance mica or polystyrene**

INDUCTORS	
L1	see text
L2	22μ H RFC

SEMICONDUCTORS	
IC1	μA 753
IC2	CA 3089
IC3	MC 1310P
IC4–IC6	LM741
IC7	LM723
IC8	LM340T12
Q1	2N3904
Q2	2N3904
D1–D4	1N914
D5	LED

MISCELLANEOUS	
PC board ETI 713	
SW1	SPDT toggle
SW2	DPDT toggle
SW3	SPDT toggle
M1	±100μ A centre zero
M2	200μ A
M3	±100μ A centre zero
F1,2	10.7 MHz filter SFC10.7MA
Tuner module LP1186	

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FEEDBACK

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Please continue to print these negs since I sunk some 20 odd dollars into a photo method PCB making kit. If you cannot afford to print these neg's (since it uses glossy paper) consider printing just the top projects every 3 to 5 months.

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SGM, Hamilton, Ontario

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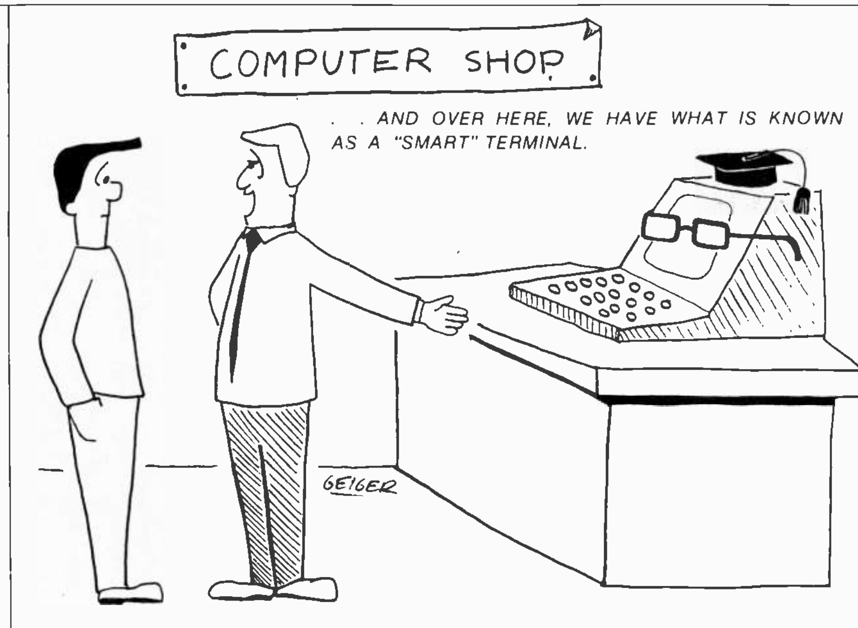

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Equivalent Noise Level:	Less than dB SPL
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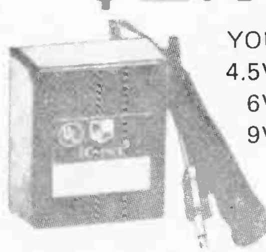

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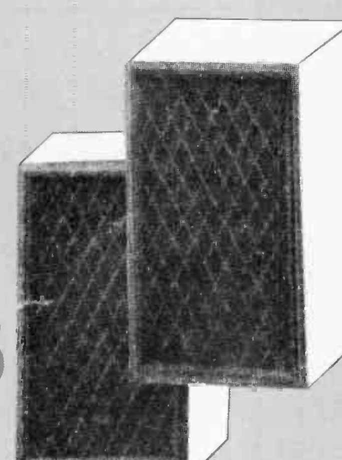

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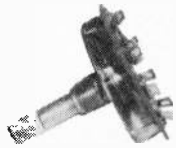

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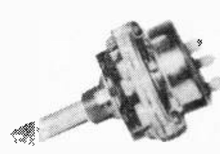

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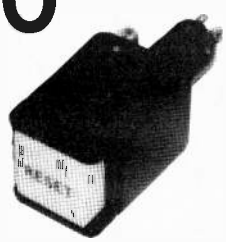

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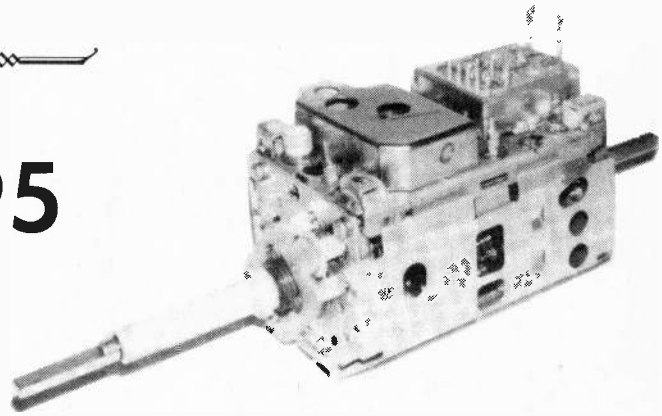

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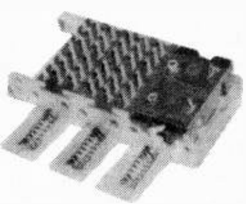

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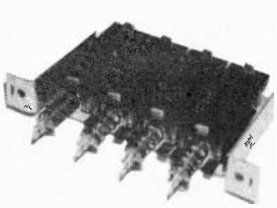
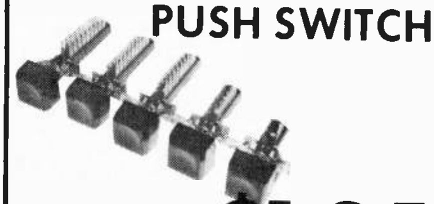
4 SECTION
PUSH SWITCH



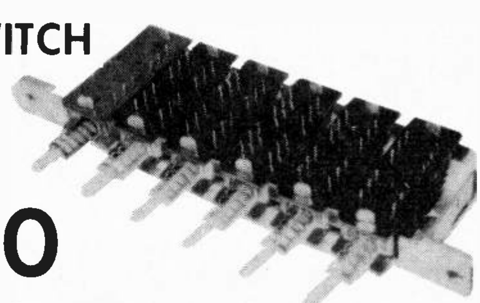
95¢

5 SECTION
PUSH SWITCH



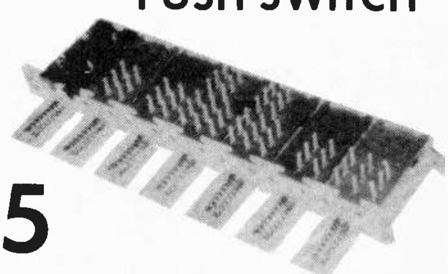
WITH KNOBS **$1.95**

6 SECTION
PUSH SWITCH



$1.50

7 SECTION
PUSH SWITCH



$1.75

DOMINION RADIO & ELECTRONICS COMPANY

THE HOME OF RADIO & ELECTRONIC SUPPLIES

Prices Subject To Prior Sale

THUMBWHEEL SWITCH

$1.95 ea.

10 POSITION

RIBBON WIRE

10 COND.	.20/ft
20 COND.	.40/ft
30 COND.	.60/ft
40 COND.	.80/ft
50 COND.	1.00/ft
60 COND.	1.20/ft

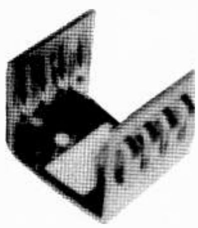
COLOR CODED

4 SECTION CONTROLS

Your Choice
20 Mπ
25 kπ
100 Kπ

$1.39 ea.

DIP HEAT IC SINK



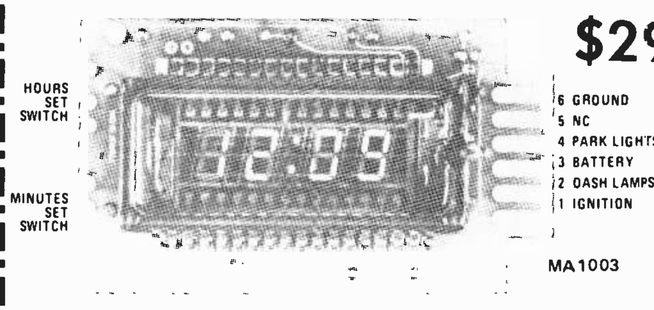
.25¢ ea.

AUTOMOTIVE CLOCK MODULE

FEATURES

- Ideal for automotive applications
- Operates from 12 VDC supply
- Internal crystal timebase
- ± 0.5 second/day accuracy
- Complete—just add switches
- Low standby power consumption

$29.95



CRYSTAL CONTROLLED

SOLDERLESS QUICK CLIP BANANA PLUG

.49¢ pr.

1 red - 1 black

TOS XISTOR HEAT SINK

.10¢ ea.

TOUCH TONE PAD

$5.95 ea.

SURPLUS DEAL

LIMITED SUPPLY

EXTRA LARGE BANANA PLUG

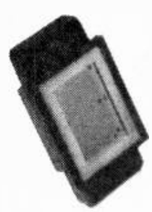
.25¢ ea.

Black only

DIGITAL READOUT

7 SEGMENT

$2.50 ea.



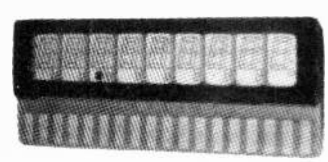
13 SEGMENT

$3.50 ea.

9 volts

9 DIGIT READOUT

$2.95 ea.

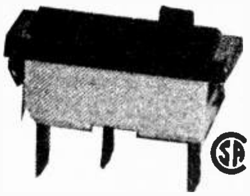


5 volt.

Prices Subject To Prior Sale

PARTS BARGAINS

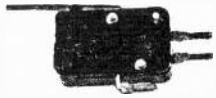
ILLUMINATED LIGHT SWITCH

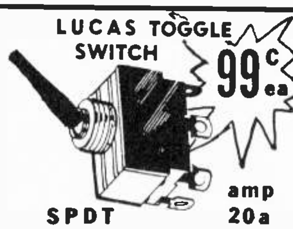


$1.79

SPDT LEVER SWITCH

.99





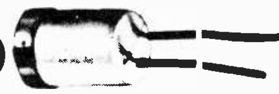
PUSH SWITCH

LOW AS 1.29 ea.

S. P. S. T. $1.29
S. P. D. T. $1.49
D. P. D. T. $1.69

2 AMP CADMIUM SULPHIDE PHOTOCELL

$2.50



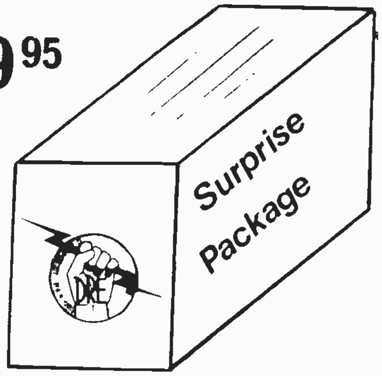
SURPRISE PACKAGE

OVER $30 VALUE

$9.95

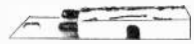
RESISTORS
CAPACITORS
TRANSISTORS
CIRCUIT BOARDS
HARDWARE
COILS
IC'S ETC.

GUARANTEED DRE VALUE



145° THERMAL SWITCH

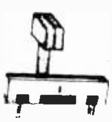
.99



4 AMP AC FILTER (LC)

.99

slide CONTROLS



$1.29

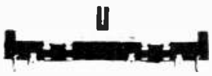
MODEL		TRAVEL
JJ-10006	10K	30mm
JJ-10006B	100K	30mm
JJ-10006C	500K	30mm
JJ-10006D	1 MEG	30mm

$1.59

MODEL		TRAVEL
JJ-10007	10K	45mm
JJ-10007A	50K	45mm
JJ-10007B	100K	45mm
JJ-10007C	500K	45mm
JJ-10007D	1 MEG	45mm

Available in log taper only
Knob included

PIHER SLIDER CONTROLS

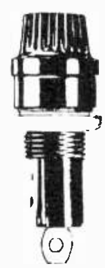


60mm Travel

Available in
10 K ohms
50 K ohms
100 K ohms
log or linear taper

$2.49

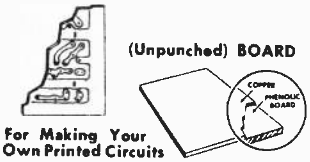
Matching Knob 49¢



79¢ ea

Panel Mount Fuse Holder
Bayonet type Knob ½" (12.7 mm) panel hole. Accommodates all ¼" (6.3 mm) x 1¼" (31.7 mm) Fuses.

Copper-Clad Solid Board



(Unpunched) BOARD

For Making Your Own Printed Circuits

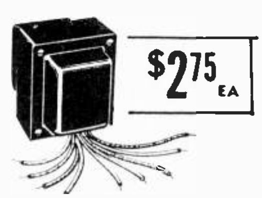
$1.99 lb

- *Expressly for Making Your Own Printed Circuits!*
- *Quality-Manufactured Boards Bonded with Copper!*

1 lb. Assortment of various sizes of fiber and epoxy - copper clad board.

POWER TRANSFORMER

PRI: 110V
SEC: 125 V 3A



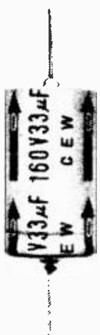
$2.75 EA

Prices Subject To Prior Sale

ELNA

ELECTROLYTIC AND TANTALUM CAPACITORS

AXIAL LEAD



uf C \ wv (sv)	16 (20)	25 /32)	50 (63)	80 (100)
1			.20	
2.2			.20	
3.3			.20	
4.7			.20	
10	.20	.20	.25	.30
22	.25	.25	.30	.35
33	.25	.30	.30	.35
47	.30	.30	.30	.35
100	.30	.35	.45	.50
220	.30	.35	.50	.60
330	.35	.45	.60	
470	.40	.50	.70	.90
1000	.50	.60	.90	1.10
2200	.65	.90		
3300	.90	1.20		
4700	1.40	1.60		

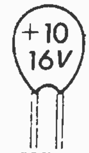
RADIAL LEAD

uf C \ wv (sv)	16 (20)	25 (32)	50 (63)	80 (100)
1			.20	
2.2			.20	
3.3			.20	
4.7		.20	.20	
10	.20	.20	.20	.25
22	.20	.20	.20	.25
33	.20	.20	.25	.30
47	.20	.25	.30	.35
100	.25	.25	.30	.35
220	.25	.30	.40	.50
330	.30	.35	.50	
470	.35	.45	.75	
1000	.50	.65		
2200	.80			

POWER SUPPLY TYPE

uf C \ wv (sv)	16 (20)	25 (32)	50 (63)	100 (125)
2200		2.10	2.80	4.90
3300	2.10	2.70	3.50	6.50
4700	2.30	2.90	4.10	8.00
6800	2.90	3.50	5.20	12.00
10000	3.70	4.00	7.50	
15000	4.20	5.50	12.00	
22000	5.10	7.50		
33000	7.50			
47000	8.50			

PRICE INCLUDES MOUNTING CLAMPS



DIPPED SOLID TANTALUM

Capacitance Tolerance −20 +20%

DC Leakage Current(uA) 0.02 or 1.0

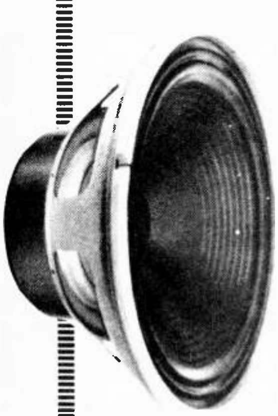
uf C \ wv (sv)	16 (20)	25 (32)	35 (46)
0.22			.30
0.33			.30
0.47			.30
0.68			.30
1.0			.30
1.5			.30
2.2			.30
3.3			.30
4.7	.30		.35
6.8	.30		.35
10	.40	.45	.50
15	.45	.50	.80
22	.50	.60	1.30
33	.60	1.00	2.00
47	1.30	2.00	
68	2.00		
100	2.50		

POLYESTER FILM CAPACITORS

Characteristics	
Operating temperature range	−40° ∼ +85°C
Rated voltage	100V.DC
Standard capacitance value	0.001 μF ∼ .22 μF

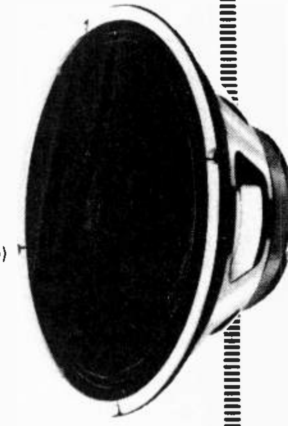
CAP uf	PRICE EA.	CAP uf	PRICE EA.	CAP uf	PRICE EA.
.0010	$ .15	.0068	$ .15	.047	$ .25
.0012	.15	.0082	.15	.056	.25
.0015	.15	.010	.15	.068	.25
.0018	.15	.012	.15	.082	.25
.0022	.15	.015	.15	.10	.25
.0027	.15	.018	.20	.12	.30
.0033	.15	.022	.20	.15	.35
.0039	.15	.027	.20	.18	.40
.0047	.15	.033	.20	.22	.45
.0056	.15	.039	.20		

Goodmans POWER RANGE LOUDSPEAKERS



Nominal impedance:	8 or 15 Ohms
Nominal power handling:	50 Watts
Fundamental resonance:	85 Herz
Sensitivity (96dB at 1m):	1.6 Watts
Recommended enclosure volume for single unit:	50 Litres
Depth, overall:	152 mm
Diameter, overall:	311 mm
Baffle hole diameter:	278 mm
Fixing hole diameter:	4 off 8 mm
Fixing nole centres:	298 mm (PCD)

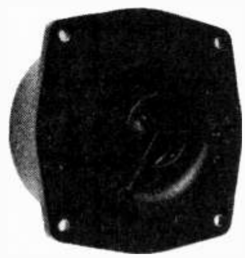
Audiom 12P
12" WOOFER
$59.^.95^



Nominal impedance:	8 or 15 Ohms
Nominal Power handling:	60 Watts
Fundamental resonance:	55 Herz
Sensitivity (96dB at 1m):	0.6 Watts
Recommended enclosure volume for single unit:	40 Litres
Depth, overall:	142 mm
Diameter, overall:	311 mm
Baffle hole diameter:	278 mm
Fixing hole diameter:	4 off 8 mm
Fixing hole centres:	298 mm (PCD)

Audiom 12P-D
12" WOOFER
$69.^.95^

DOME TWEETER $29.95



Axent 100

Frequency range:	typically 2,000–22,000 Hz ±2dB
Maximum RMS input:	3 Watts
Recommended amplifier music power:	for use in systems rated not more than 40 Watts
Impedance:	8 ohms
Maximum dimensions across corners:	112mm
Baffle hole diameter:	70mm rear mounted

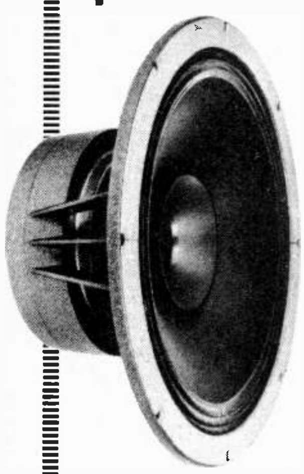
FOR COMPLETE CATALOGUE AND PRICE SHEET
ON THE FULL RANGE OF GOODMANS SPEAKERS
PLEASE MAKE NOTE ON THE ORDER FORM

HORN MID RANGE $79.95

Impedance:	For use with systems rated at 8 or 15 Ohms
Nominal power handling:	systems rated at 50 Watts
Sensitivity:	(96 dB at 1m) 0.11 Watts
Depth Dverall:	250mm
Baffle hole:	163 x 81mm
Fixing hole diam:	6 off 5mm

Hifax 50HX

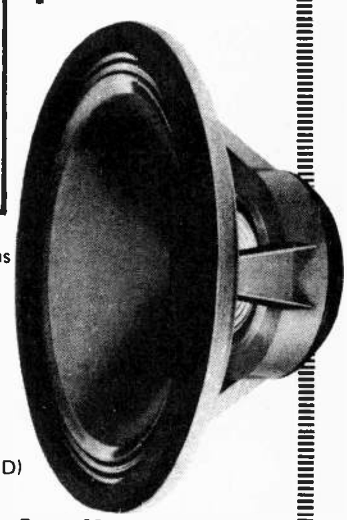
15" WOOFER
$89.^.95^



Nominal impedance:	8 or 15 Ohms
Nominal power handling:	50 Watts
Fundamental resonance:	56 Herz
Sensitivity (96dB at 1m):	0.9 Watts
Recommended enclosure volume for single unit:	80 Litres
Depth, overall:	163mm
Diameter, overall:	383mm
Baffle hole diameter:	330mm
Fixing hole diameter:	8 off 7mm
Fixing hole centres:	370mm (PCD)

Audiom 15P

18" WOOFER
$149.^.95^

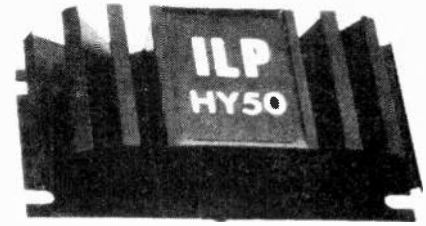


Nominal impedance:	8 or 15 Ohms
Nominal power handling:	100 Watts
Fundamental resonance:	45 Herz
Sensitivity (96dB at 1m):	0.6 Watts
Recommended enclosure volume for single unit:	120 Litres
Depth, overall:	222 mm
Diameter, overall:	459 mm
Baffle hole diameter:	413 mm
Fixing hole diameter:	8 off 8 mm
Fixing hole centres:	438 mm (PCD)

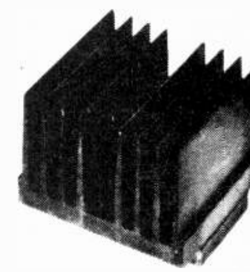
Audiom 18P

Prices Subject To Prior Sale

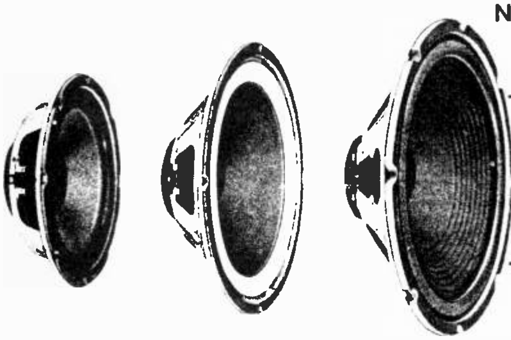
ILP ELECTRONICS LTD.



HY 5	Preamplifier Mono	21.99
HY 30	Power Amplifier	21.99
HY 50	Power Amplifier	28.57
HY 120	Power Amplifier	61.95
HY 200	Power Amplifier	89.67
HY 400	Power Amplifier	122.94
C15/15	Stereo Amplifier 12VDC	75.78

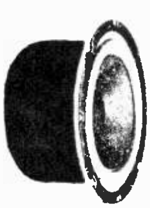


LOUDSPEAKERS



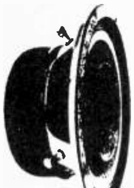
NUMBER	TYPE	SIZE	RMS POWER	PRICE
80W8	WOOFER	8″	10W	$11.95
100W8	WOOFER	10″	10W	$13.95
120W8	WOOFER	12″	10W	$15.95

MID RANGE 5″



400 - 7000 Hz
40 Watts

$11.95

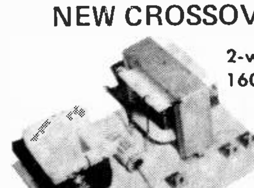


8″
$16.95

20 WATTS RMS

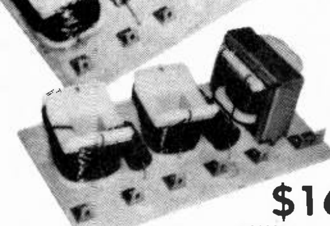
DRE DC8

NEW CROSSOVERS



2-way 50W
1600 HZ 6db $11.95

$11.95



$16.95

3-way 50W
500 4.5KHz 6db

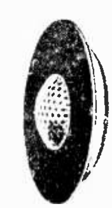
3-way 100W
700 4KHz 12db

24.95

TWEETER

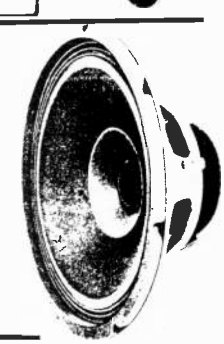
3000 - 20000 Hz
40 Watts

$9.95



8 OHM

12″
$26.95



DRE DC12

Prices Subject To Prior Sale

AUTOMOTIVE SOUND

FEATURING RELIABLE 100% SOLID STATE

VERSATILE SHORT DEPTH CHASSIS

Front panel plate kit included with all models

$39.95

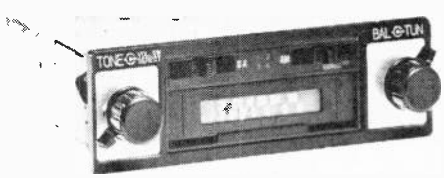
MK4 JIL AM PUSHBUTTON CAR RADIO
Universal In-dash or Under-dash mounting.
12V DC Negative ground 4.5W Output.
5 Station Pre-set pushbuttons.
On/Off Volume, Widerange Tone & Manual Tuning Controls.

Speakers Extra

$55.95

MK55 JIL CAR STEREO 8-TRACK PLAYER WITH AM RADIO
In-dash mounting. 12V DC Negative ground.
4W + 4W Output.
Right Volume, On/Off-Left Volume, Tone, Tuning & Program Select controls.

Speakers Extra

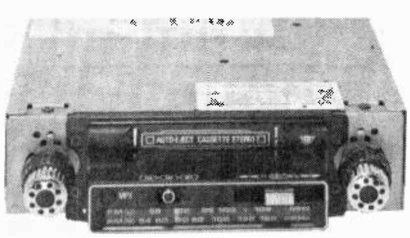


$89.95

MK95 JIL CAR STEREO 8-TRACK PLAYER WITH AM/FM-MPX RADIO

Speakers Extra

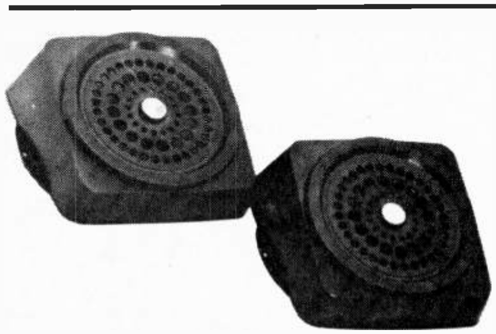
In-dash mounting with 5 position adjustable shaft.
12V DC Negative ground.
4.5 + 4.5W Output.
Controls: On/Off-Volume-Channel Select, Widerange Tone, Local-Distant switch, AM-FM select switch, Tuning, Balance.
FM Stereo light, Program indicator lights.



$99.95

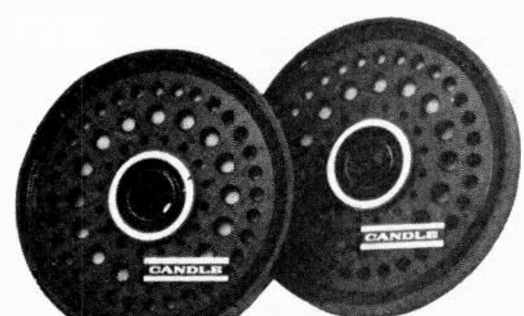
MK63 JIL CAR STEREO CASSETTE PLAYER WITH AM/FM-MPX RADIO
In-dash mounting with 6 position adjustable shaft.
12V DC Negative ground.
5W + 5W Output.
Widerange Tone & Volume controls. Tuning & Balance
FF/Eject/Rew Button

Speakers Extra



$8.95 PR.

CRV3 – Deck Mount. 5W.5". 2 oz. magnet. 4-8 ohms.



$19.95 PR.

CR737 – Flush Mount. 5¼". 8 oz. magnet. 10 Watts. 4-8 ohms.

Prices Subject To Prior Sale

Club Call

Houston Secondary School Computer Club

PO Box 760, Houston, BC, V0J 1Z0.

OK so now we have a computer club! One of the guys has an "ELF" 1802 that he built from components and a PC board. He is adding a hex keyboard and a TV inteface. A few kids in our school and a couple of staff members are interested and would like to be more involved in all this.

As club sponsor, I need some ideas — things that we could do together as a club. Programs for games, instructions for writing our own programs. Flow charts to convert into programs, etc. Anything that we can do involving "our" one computer that is not too expensive or difficult, but still difficult enough to be interesting to the group would be appreciated.

Sure hope you can help us!

Richard L. Rose

If anyone has any suggestions please write to Club Call. We'd be interested in seeing any short machine-code programs for software games or small-scale microprocessor-based systems.

West Island Amateur Radio Club

Box 2188, Dorval, Quebec.

We received a newsletter from this club detailing activities in March & April. It looks like they meet on the second Tuesday of the month at 7.45 pm at Stewart Hall, Pointe Claire, Quebec. But check first. The newsletter was issued by VE2GA

The Ontario Short Wave Correspondence Club

P.O. Box 524, Prescott, Ont. K0E 1T0.

Two of my friends, and I have a short wave club, and we would appreciate your help. The club has not really started yet so your help advertising the club would be great. We are going to publish a 5 page newsletter, containing short-wave DX tips for members, and interesting articles. Our name is The Ontario Short Wave Correspondence Club, and we are operational to all people, but prefer those who livea long the St. Lawrence Valley. All inquiries can be sent to the address above. Meetings will be held every month at a supervisor's house. A newsletter of 1 page will be printed shortly, containing all details.

Martin Bordt

Previously Listed Clubs

TRACE: Computer Club, Toronto. See p7 Jan 78 ETI.

CSWLI: SWL Club, Thunder Bay. See p7 Mar 78 ETI.

TRAC: Amateur Radio Club, Thornhill. See p7 Mar 78 ETI.

ODXA: SWL Club, Don Mills. See p61 Apr 78 ETI.

CCCC: Computer Club, Montreal. See p61 Apr 78 ETI.

ECEC: Electronics Club, Elphinsone. See p61 Apr 78 ETI.

Club Call

Send information about any clubs not mentioned on this page to ETI Club Call, ETI Magazine, Unit 6, 25 Overlea Blvd., Toronto, Ontario, M4H 1B1.

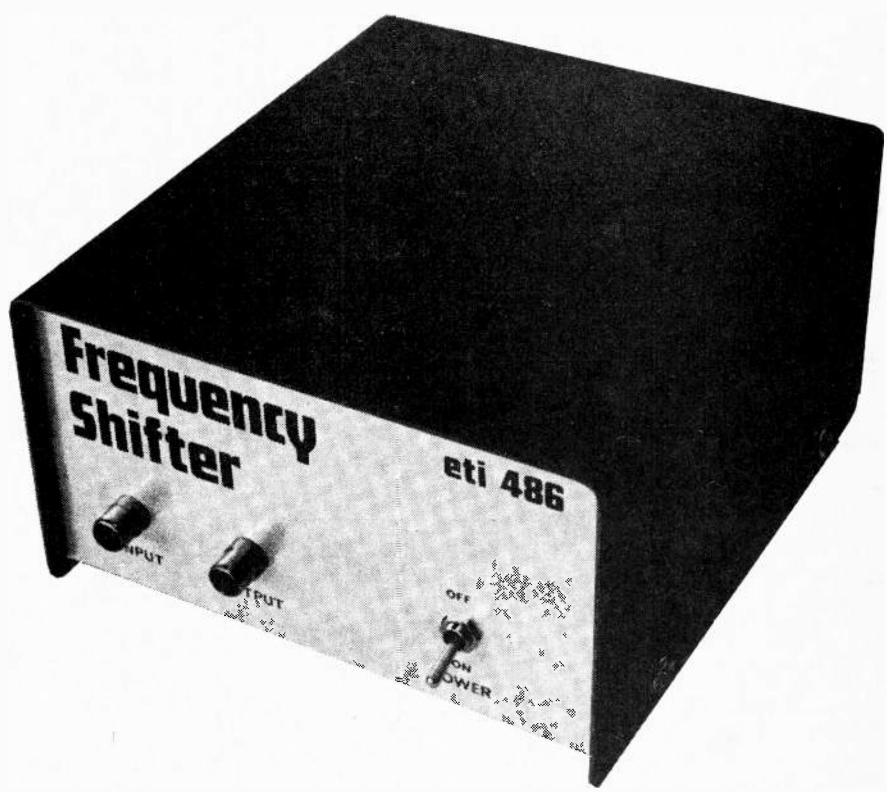
Audio Feedback Eliminator

Feedback problem in halls can be corrected by the use of this clever gadget.

ANYONE WHO HAS USED a microphone in public address work has come across problems with feedback. These are caused by the level of sound reaching the microphone from the speaker approaching or exceeding that from the person originating the sound. As the reflected sound approaches the level of the original signal, the sound becomes distorted or 'coloured', then audible ringing occurs and finally complete oscillation or howl-round occurs as the reflected sound exceeds the level of the original signal.

The most effective method of eliminating this problem in many cases is to use the correct location for the speakers and the correct choice of microphone. Also the use of the microphone is important so if you are in charge of a sound system don't be afraid to tell the singer or speaker how to use the microphone as a good performer will take advice.

However in certain environments the most effective use and selection of microphone/speakers does not help the problem of feedback. These are the halls and rooms which have little sound-absorbing material on the walls and are very 'live'. If a frequency response curve is drawn for such a room it will be found that there are many peaks and troughs, normally only 4 or 5 Hz apart, along with perhaps major resonances.



SOLUTIONS

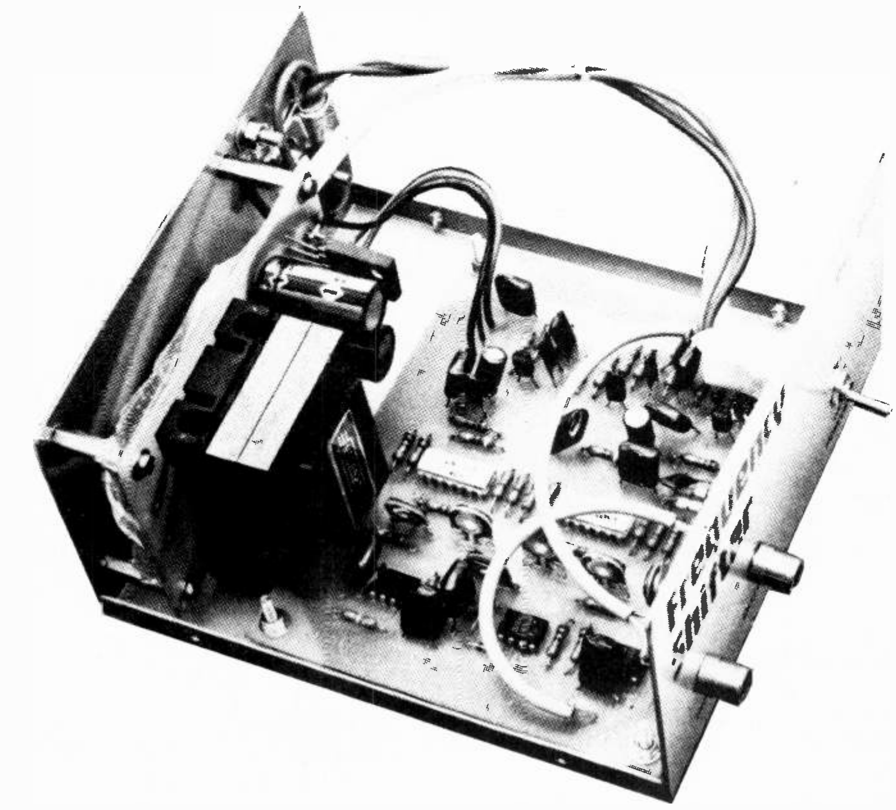
There are various electronic devices which have been developed to deal with this problem, the main ones being the graphic equalizer, the variable notch filter and the frequency shifter. The first two (especially the notch filter) are ideal for eliminating major resonances. These however also alter the frequency response of the original sound. They can also help if the offending 'echo' is actually a direct path and not dependent on the room (i.e. if the speakers are behind the microphone). The other method, frequency shifting, is described here.

As its name implies, the frequency shifter takes an input signal, such as that from a microphone, and shifts the entire audio spectrum up or down by a small amount. Thus, the signals coming from the speakers are, for example, very slightly (but to most people undetectably) raised in pitch. The shift is great enough to prevent the sound from the speakers reinforcing itself at the microphone to nearly such a great extent. With a frequency shifter the echo signal is of slightly different frequency on each path round the loop and cannot directly reinforce itself so that while on the first echo it may strike a room resonance the second time it will probably be in a null. This tends to even out the frequency response of the room and allows 5 to 8 dB higher levels to be used in the average room. Also the onset of oscillation is not as dramatic as with the conventional system and the distortion which normally occurs below the feedback level is not as noticeable. The system does not however do a great deal for oscillations not associated with room resonances.

Only a small shift is normally required and it does not matter if it is an increase or a decrease. We chose to increase the frequency by about 5 Hz as it is more noticeable if a vocalist is flat rather than sharp. As the frequency response of the unit is good it is suitable for vocal work as well as general public address use. The frequency shift and the slight amplitude modulation cannot be detected by most people.

SPECIFICATIONS

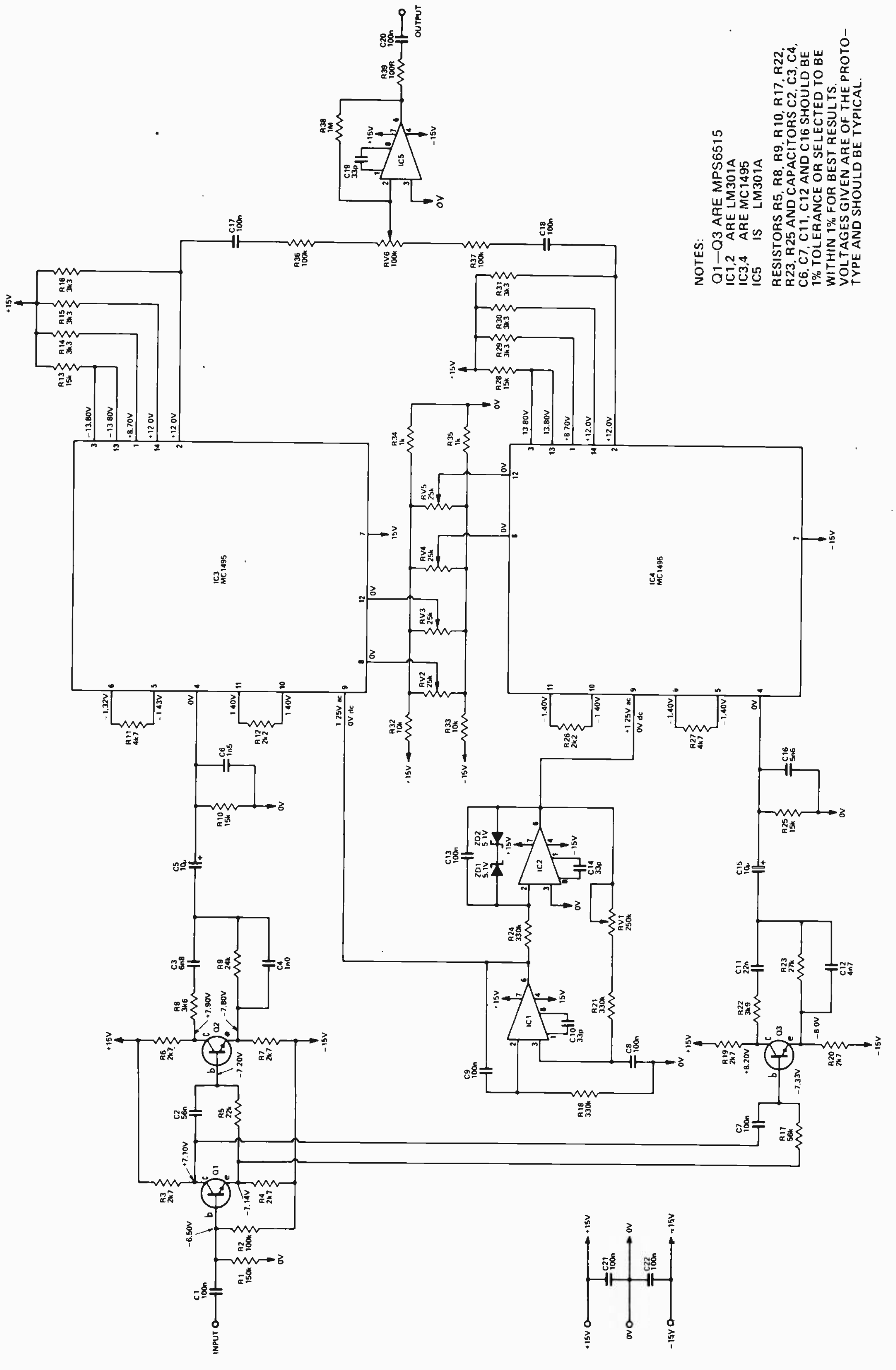
Frequency shift	5 Hz upwards
Maximum input voltage	3V
Frequency response +½ dB, −3dB	30Hz – 20kHz
Signal to noise ration re 3V output	70 dB
Distortion @ 1kHz, 2V out	0.25%
Amplitude modulation	100Hz – 10kHz < 1dB
Phase shift network 50Hz – 20kHz	$90^{\circ} \pm 5^{\circ}$



ALIGNMENT

Equipment needed – a sensitive AC voltmeter (100 mV or less) or preferably an oscilloscope and an audio oscillator.

1. Check the output of the 5 Hz oscillator and adjust RV1 until it stops. If it cannot be completely stopped, try a link across C9.
2. Apply a signal of about 1 – 2 V amplitude at about 1 kHz to the input and measure the output of IC3 at pin 2. (If your meter does not reject DC, measure at the junction of C17 and R36). Adjust RV3 to give the minimum output.
3. Measure the output of IC4, pin 2 (or the junction of C18 and R37) and adjust RV5 for minimum output.
4. Measure the output of the 5 Hz oscillator on pin 6 of IC1 and adjust RV1 until it starts, then adjust to give about 1.25 V RMS.
5. With no input signal, measure the output of IC3 (or the junction...) and adjust RV2 for minimum output.
6. Measure the output of IC4 (or...) and adjust RV4 for minimum output.
7. If an oscilloscope is available, monitor the output with a 1 – 2 V input signal and adjust RV6 to give the minimum amplitude modulation. Alternatively, by using an amplifier and speaker, RV5 can be adjusted by ear. The unit is now set up.



NOTES:
Q1—Q3 ARE MPS6515
IC1,2 ARE LM301A
IC3,4 ARE MC1495
IC5 IS LM301A

RESISTORS R5, R8, R9, R10, R17, R22, R23, R25 AND CAPACITORS C2, C3, C4, C6, C7, C11, C12 AND C16 SHOULD BE 1% TOLERANCE OR SELECTED TO BE WITHIN 1% FOR BEST RESULTS.
VOLTAGES GIVEN ARE OF THE PROTOTYPE AND SHOULD BE TYPICAL.

Fig. 1. Circuit diagram of the frequency shifter.

HOW IT WORKS

There are numerous methods of generating a frequency shift in an audio signal. Most however require coils and precise tuning which rules them out for a project. With this method only resistors and capacitors have to be accurate, yet it gives a result adequate for the purpose.

The audio input is split into two circuits which provide a frequency-related phase shift as shown in Fig. 4. The amplitude however remains constant. Due to the different component values in the two networks the phase shifts are not the same but differ by 90° at all frequencies (50 Hz — 20 kHz ± 5°

IC1 and IC2 form a quadrature sine wave oscillator with the frequency set by R18, R21, R24, C8, C9 and C13. Amplitude stability is provided by ZD1 and ZD2 along with RV1 (see adjustment section). The outputs from these two op amps are the same amplitude but 90° phase shifted.

We now multiply (the MC1495 is a four-quadrant multiplier) one of the audio signals by one of the 5 Hz outputs and the second audio input by the second 5 Hz signal. When we multiply two waveforms together the output consists of the sum of the two frequencies and their difference. This means that if the audio signal is 100 Hz the output will contain a 95 Hz signal and a 105 Hz signal. These will beat with each other to produce a 10 Hz beat note as shown in Fig. 2. Due to the phase shift between the inputs of the multipliers the 105 Hz components of the outputs are in phase, while the 95 Hz components are 180° out of phase. Therefore by adding the outputs of the two multipliers in IC5 the 95 Hz components cancel out, leaving only the 105 Hz signal. Provided the multiplier inputs have the 90° phase relationship there will always be a 5 Hz shift, independent of frequency.

Due to the inability to maintain exactly the 90° phase relationship, the 95 Hz, or lower sideband, will not completely cancel and the result is a slight beat giving rise to an amplitude modulation effect (we had about 1 dB). This is not normally noticeable on speech or music.

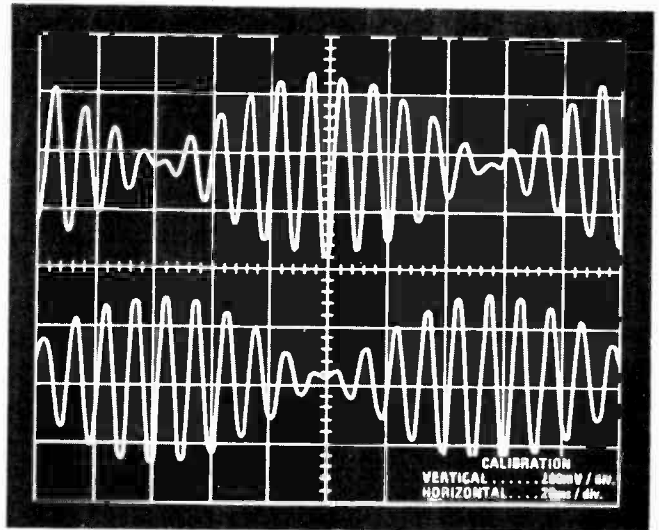


Fig. 2. The output of IC3 (top) and IC4 (lower) with a 100 Hz input signal. Note the phase difference.

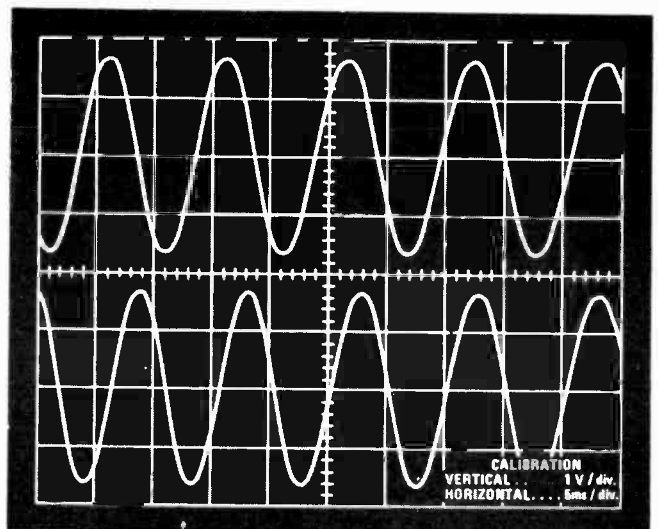


Fig. 3. The input signal (top) and the output (lower). Note the difference in frequency.

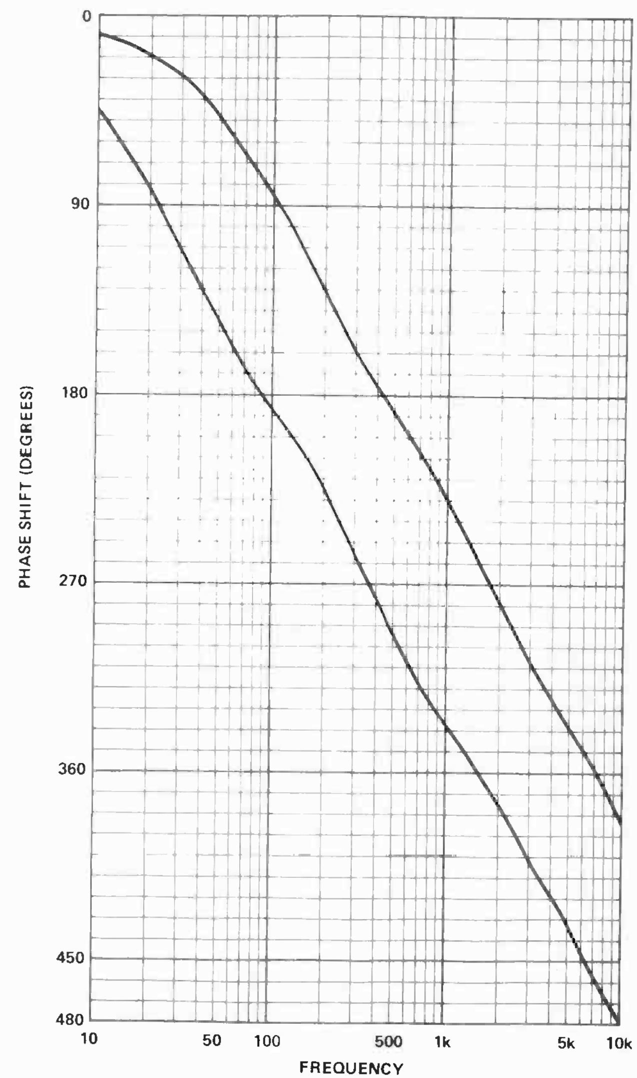


Fig. 4. The phase response of the two filters.

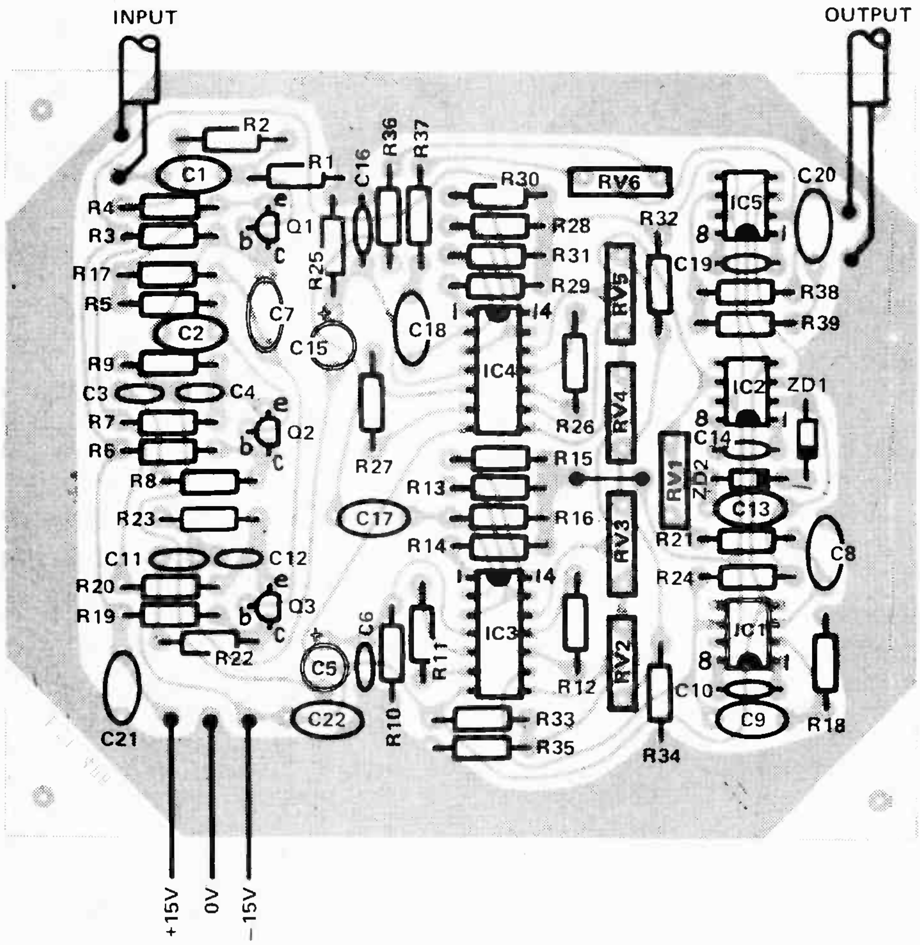


Fig. 5. The component overlay.

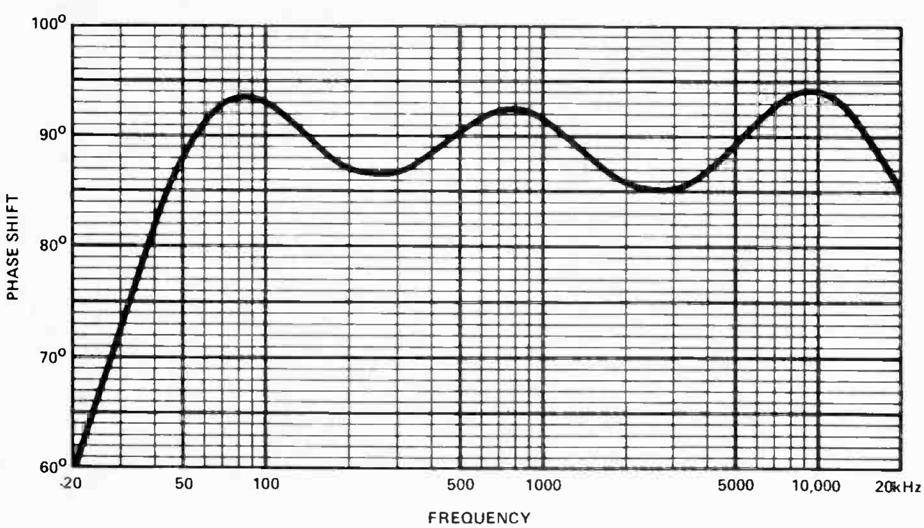


Fig. 6. The phase difference between the two filter networks.

PARTS LIST

RESISTORS all ½ W 5%

R1	150k
R2	100k
R3,4	2k7
* R5	22k
R6,7	2k7
* R8	3k6
* R9	24k
* R10	15k
R11	4k7
R12	2k2
R13	15k
R14–R16	3k3
* R17	56k
R18	330k
R19,20	2k7
R21	330k
* R22	3k9
* R23	27k
R24	330k
* R25	15k
R26	2k2
R27	4k7
R28	15k
R29–R31	3k3
R32,33	10k
R34,35	1k
R36,37	100k
R38	1M
R39	100R

POTENTIOMETERS

RV1	250k trim
RV2–RV5	25k trim
RV6	100k trim

CAPACITORS

C1	100n polyester
* C2	56n polyester
* C3	6n8 polyester
* C4	1n0 polyester
C5	10µ 25V electro
* C6	1n5 polyester
* C7	100n polyester
C8,9	100n polyester
C10	33p ceramic
* C11	22n polyester
* C12	4n7 polyester
C13	100n polyester
C14	33p ceramic
C15	10µ 25V electro
* C16	5n6 polyester
C17,18	100n polyester
C19	33p ceramic
C20–C22	100n polyester

SEMICONDUCTORS

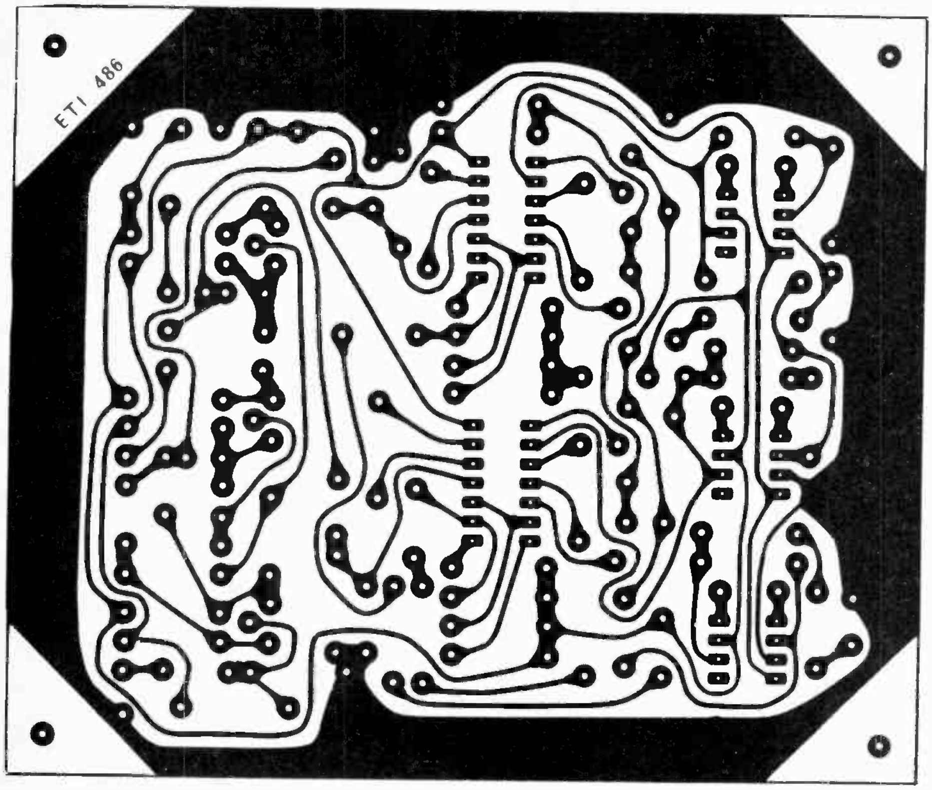
IC1,2	LM301A
IC3,4	MC1495
IC5	LM301A
Q1–Q3	MPS6515
ZD1,2	5.1V 300mW

MISCELLANEOUS

PC board
Power supply ± 15V 40mA

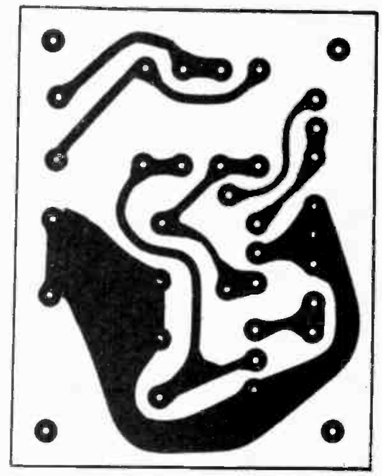
* For best results the components should be as accurate as possible, preferably 1% tolerance or selected to be within 1%.

Parts and kits for these projects are available from Dominion Radio and Livingstone electronics. See their advertisements in this issue.

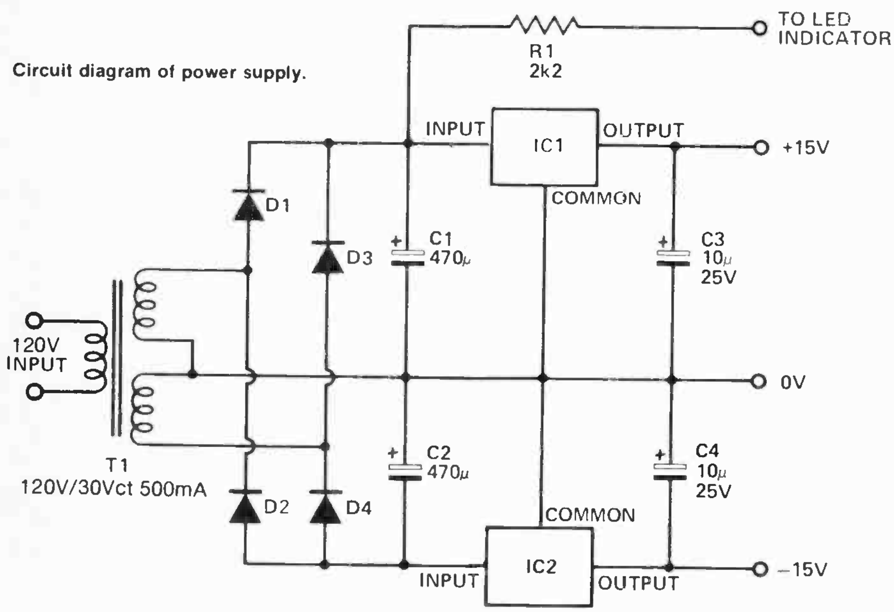


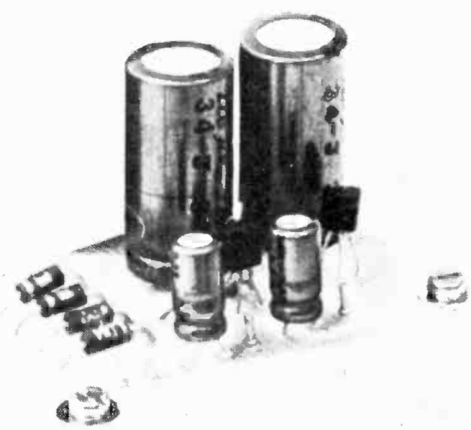
Printed circuit board foil pattern for main board.

PCB foil pattern for power supply board.



Circuit diagram of power supply.

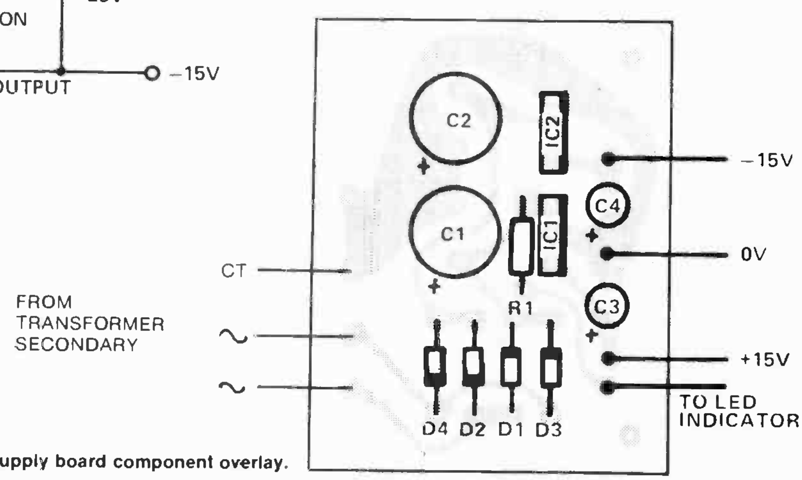




PARTS LIST

Power supply.

R1	Resistor	2k2 ½W 5%
C1,2	Capacitor	470u 35V
C3,4	"	10u 25 V
D1–D4	Diodes	1N4001
LED1	Indicator	
IC1	Regulator	7815
IC2	"	7915
T1		120V/30Vct 500mA



Power supply board component overlay.

Memory Data Special

The information you need to know about the most popular memory chips, and the principles involved.

2107 Dynamic RAM

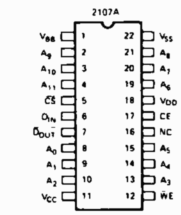
WHEREAS STATIC RAMS basically consist of flip-flops and will retain data for as long as power is applied, with dynamic RAMs, life wasn't meant to be easy. The basic storage element in a dynamic RAM is a capacitor which is subject to leakage and requires data to be read from a cell, amplified and written back again in order to avoid total decay of the data.

Because the memory cell in a dynamic RAM is one transistor and a capacitor as against the six transistors of the static type, the density of dynamic RAMs is around four times higher. Thus, we now have 16K dynamics, and 64K types are rumoured to exist in research labs around the world! Anyway, enough of this contemplation of the wonders of LSI, let's get down to brass tacks.

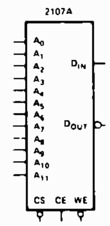
The innards of dynamic RAMs, like statics, are organised into rows and columns, 64 rows x 64 columns for a 4 K RAM, to be precise. All the cells in a single row are refreshed at the same time, and so to fully refresh a 4 K RAM, one need only cycle through all combinations of the low-order six address bits within 2 ms.

The discussion here will be limited to 4 K dynamic RAMs. Although 16 K types are available, they are still fairly expensive and 4 K types are a much more viable proposition for the amateur user. In particular, we shall address our remarks to the 2107B type of RAM, as its cousin the 2104A is slightly more awkward to use. The 2104 is a 16 pin (!) 4 K RAM, and to get all the address lines into the package, the 12 bits are split into two groups of six and then mutiplexed over six pins using the

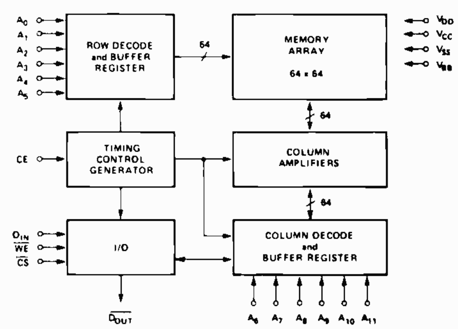
PIN CONFIGURATION



LOGIC SYMBOL



BLOCK DIAGRAM



PIN NAMES

D_{IN}	DATA INPUT	CE	CHIP ENABLE
A_0-A_{11}	ADDRESS INPUTS*	$\overline{D_{OUT}}$	DATA OUTPUT
$\overline{WE}$	WRITE ENABLE	V_{CC}	POWER (+5V)
$\overline{CS}$	CHIP SELECT	NC	NOT CONNECTED

*Refresh Addresses A_0-A_5.

A.C. Characteristics $T_A = 0°C$ to $70°C$, V_{DD} = 12V ± 5%, V_{CC} = 5V ± 10%, V_{BB} = -5V ± 5%,

READ, WRITE, AND READ MODIFY/WRITE CYCLE V_{SS} = 0V, unless otherwise noted.

Symbol	Parameter	2107B		2107B-4		2107B-5		Units
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{REF}	Time Between Refresh		2		2		1	ms
t_{AC}	Address to CE Set Up Time	0		0		10		ns
t_{AH}	Address Hold Time	100		100		100		ns
t_{CC}	CE Off Time	130		130		200		ns

READ CYCLE

Symbol	Parameter	2107B		2107B-4		2107B-5		Units
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{CY}	Cycle Time	400		470		590		ns
t_{CE}	CE On Time	230	4000	300	4000	350	3000	ns
t_{CO}	CE Output Delay		180		250		280	ns
t_{ACC}	Address to Output Access		200		270		300	ns

WRITE CYCLE

Symbol	Parameter	2107B		2107B-4		2107B-5		Units
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{CY}	Cycle Time	400		470		590		ns
t_{CE}	CE On Time	230	4000	300	4000	350	3000	ns
t_{WP}	$\overline{WE}$ Pulse Width	50		50		75		ns
t_{WW}	$\overline{WE}$ Delay	75		75		75		ns

RAS (Row Address Strobe) and CAS (Column Address Strobe) pins to tell the chip whats coming in. This makes fairly critical demands on timing, and so poses a few problems for the hobbyist. Whilst single chip refresh controllers are available, which take on the job of multiplexing the address bits, and also include an on-chip refresh counter which cycles through the addresses to be refreshed, these still do not do all the work. There are some tricky design problems associated with using dynamic RAMs, and if you're doing it as a hobby there's no need to make your life difficult.

For these reasons, most hobbyists (and not a few professional designers) will concentrate on the 2107B. This chip is in a 22 pin package, so you can't get so many of them into the same space compared with the 2104A, but because it uses less interface and control circuitry, the real estate difference is not that great, and the timing problems aren't so critical.

The first problem with these chips is that they are not fully TTL-compatible as is the 2102, for example. The chip enable input of the 2107B requires a high-level signal of at least 11 V to operate, but this can easily be got from a special driver chip, the Intel 3245, which also provides some selection logic.

Given a 3245 and a handful of external logic, it looks as though the 2107B would be a good choice for hobbyists using the Z-80. The 2107 does not require address strobing, and consequently could run directly off the data bus, with the Z-80 supplying the refresh logic (the Z-80 has an internal refresh counter which is output while the processor decodes instructions).

If you are designing your own memory system, and your processor is not a Z-80, you will have to decide on one of three refresh schemes: Asynchronous, which insists on refresh occurring, even if this interrupts the processor; Synchronous, which runs 'in phase' with the processor, supplying refresh at times when the processor is not accessing memory; and Semi-synchronous, which is a combination of these schemes. Your decision will be dependent upon the circuit complexity, processor speed and overhead, and a number of other considerations.

The second problem you will face in using dynamic RAMs is getting your memory system to work. It is a good idea to have some static RAM in the system so that the processor can be checked out without having to worry too much about the memory. Once this is done, attention can be turned to the dynamic memories. In general, dynamic memory is a good choice for expanding your memory size, but not for starting a system.

There is obviously much more we could say about dynamic RAMs that we just haven't got the space to cover here. If you are in the market for large amounts of memory, then check out some of the manufacturers' data books for further information.

D.C. and Operating Characteristics

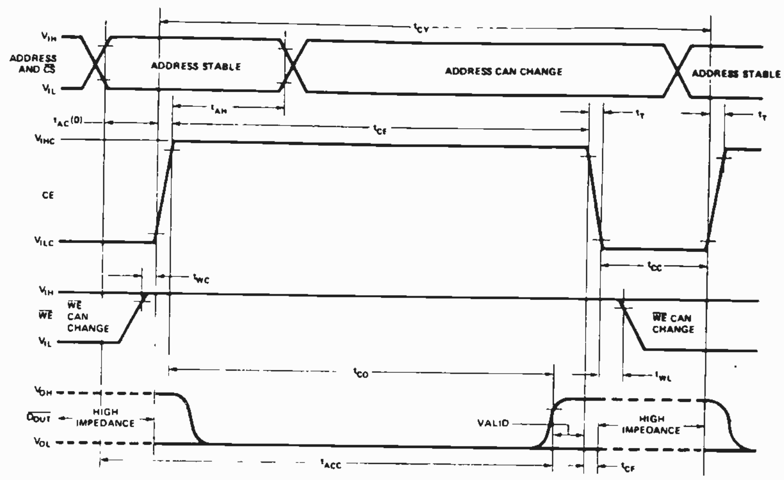
T_A = 0°C to 70°C, V_{DD} = +12V ±5%, V_{CC} = +5V ±10%, V_{BB} [1] = −5V ±5%, V_{SS} = 0V, unless otherwise noted.

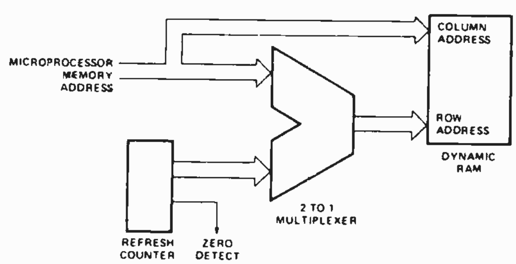
Symbol	Parameter	Limits Min.	Typ.[2]	Max.	Unit	Conditions
V_{IL}	Input Low Voltage	-1.0		0.6	V	t_T = 20ns, V_{ILC} = +1.0V
V_{IH}	Input High Voltage	2.4		V_{CC}+1	V	t_T = 20ns
V_{ILC}	CE Input Low Voltage	-1.0		+1.0	V	
V_{IHC}	CE Input High Voltage	V_{DD}-1		V_{DD}+1	V	
V_{OL}	Output Low Voltage	0.0		0.45	V	I_{OL} = 2.0mA
V_{OH}	Output High Voltage	2.4		V_{CC}	V	I_{OH} = -2.0mA

Absolute Maximum Ratings*

Temperature Under Bias .... 0°C to 70°C
Storage Temperature .... −65°C to +150°C
All Input or Output Voltages with Respect to the most Negative Supply Voltage, V_{BB} .... +25V to −0.3V
Supply Voltages V_{DD}, V_{CC}, and V_{SS} with Respect to V_{BB} .... +20V to −0.3V
Power Dissipation 1.25W

Read and Refresh Cycle [1]



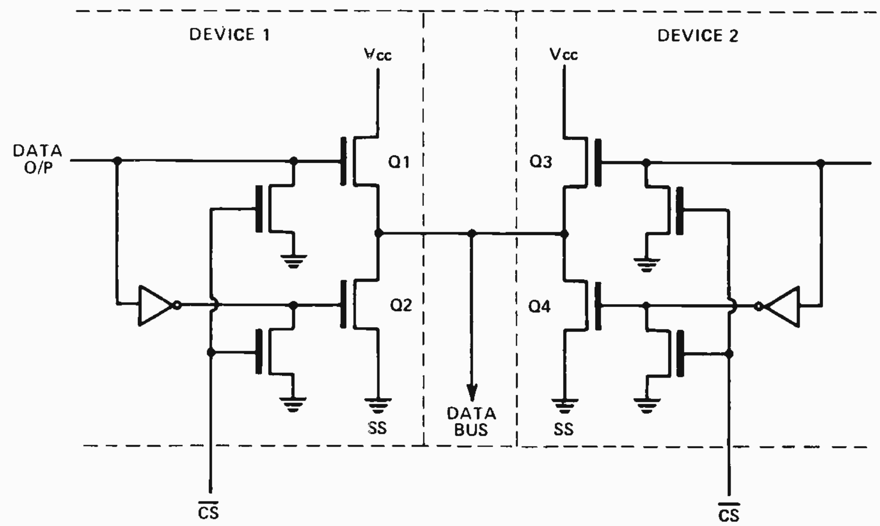


Bit Storage

NORMALLY, LOGIC GATE outputs have two states, 1 and 0, (in TTL, +5 V and 0 V). Three-state logic devices, such as some memories and buffers, have an input which can be used to force the output to a high impedance condition, effectively disconnecting the device so that it does not interfere with the operation of other devices connected to that point.

The idea of three-state control (TSC) is central to systems which use a single data bus to connect the processor to several memory chips. When the processor reads from a memory location, only the memory concerned is enabled and outputs data onto the bus; all other memories and devices on the bus should be in the high-impedance state.

Care should be taken to avoid situations where two or more chip outputs are enabled at the same time; this could happen in worst-case system timing errors or just plain wrongly-designed logic. The output buffers of a typical MOS memory chip are shown in Fig. 1. Should device 1 and device 2 both be enabled at the same time and be outputting different data (e.g. Q1 and Q4 both on) it can be seen that this virtually puts a short across the supply. At best this is likely to cause an incorrect read, and may possibly destroy one or both devices.



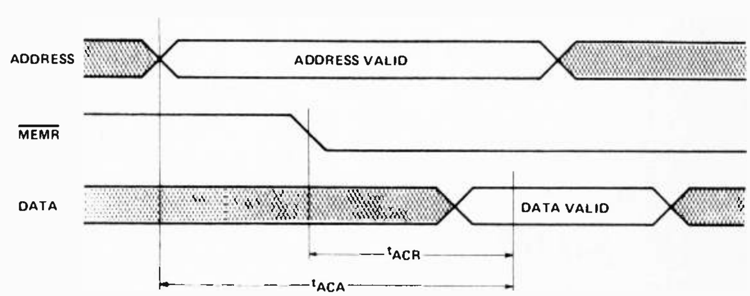
Speed

OFTEN IN ADVERTISEMENTS, memories are described as 'prime, high speed, low power'. The advantages of low power consumption are obvious — less expensive and bulky power supplies, cooler on-card regulators, etc. But the advantages of using high speed memories are not quite so evident — bear in mind that most hobby computers operate at speeds far in excess of human reaction times, making increases in speed of only marginal, indeed dubious, value.

Let's look at what happens when an 8080-type microprocessor reads a memory location. First, the processor issues the memory address on the address bus. This settles down, and around 100 ns later the memory read strobe (MEMR) goes active, requesting the selected memory location to place its contents on the data bus. Roughly 350 ns after that, the processor accepts the data that is on the bus.

If the memory cannot respond in that time, the processor can be forced to enter a WAIT state by pulling its READY input. As long as READY is false, the processor will wait.

It can be seen that the time between the address lines stabilizing and the processor accepting data is the maximum time the memory system (including external decoding and buffering) has to respond. The important parameter of a memory from this point of view is the access time, t_A, which is the time between a stable address being presented to the memory and data being available at the output. This time, plus any delays due to decoding/buffering, should be less than the processor required read access time t_{ACA}.



2102 1K Static RAM

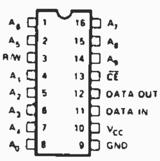
P/N	Standby Pwr. (mW)	Operating Pwr. (mW)	Access (ns)
2102AL-4	35	174	450
2102AL	35	174	350
2102AL-2	42	342	250
2102A-2	——	342	250
2102A	——	289	350
2102A-4	——	289	450
2102A-6	——	289	650

THE ELECTRONICS PRESS is full of articles high-lighting the latest advances in memory technology, and we must plead guilty to this ourselves; it's quite fascinating. But we discovered that a lot of hobbyists who are using memories don't have access to good information on the devices available, and are consequently running into problems while trying to get their systems up and running.

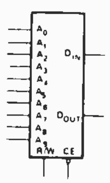
Here we attempt to give some real nitty-gritty down-to-earth useful information on memories. The data sheets are not complete by any means, but we hope they contain the most important information. If you require more specs, then check with a distributor. Bear in mind that distributors deal (in the main) with commercial organisations, and cannot possibly afford to supply hobbyists with heaps of expensive books, brochures and data sheets. If you request information from a manufacturer or distributor, please make life easy for them by enclosing a payment, if any is required.

The 2102 is, without doubt, the commonest RAM in use today. It is a static 1024-bit (1K x 1) memory and is exceptionally easy to use, as many hobbyists will testify.

PIN CONFIGURATION



LOGIC SYMBOL



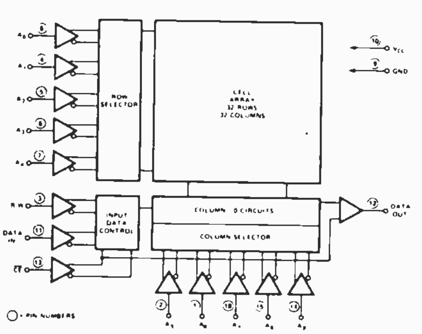
PIN NAMES

D_{IN}	DATA INPUT
A_0-A_9	ADDRESS INPUTS
R/W	READ/WRITE INPUT
$\overline{CE}$	CHIP ENABLE
D_{OUT}	DATA OUTPUT
V_{CC}	POWER (+5V)

TRUTH TABLE

$\overline{CE}$	R/W	D_{IN}	D_{OUT}	MODE
H	X	X	HIGH Z	NOT SELECTED
L	L	L	L	WRITE 0
L	L	H	H	WRITE 1
L	H	X	D_{OUT}	READ

BLOCK DIAGRAM



D. C. and Operating Characteristics

T_A = 0°C to 70°C, V_{CC} = 5V ±5% unless otherwise specified.

Symbol	Parameter	2102A, 2102A-4 2102AL, 2102AL-4 Limits Min.	Typ.[1]	Max.	2102A-2, 2102AL-2 Limits Min.	Typ.[1]	Max.	2102A-6 Limits Min.	Typ.[1]	Max.	Unit	Test Conditions
I_{LI}	Input Load Current		1	10		1	10		1	10	μA	V_{IN} = 0 to 5.25V
I_{LOH}	Output Leakage Current		1	5		1	5		1	5	μA	$\overline{CE}$ = 2.0V, V_{OUT} = V_{OH}
I_{LOL}	Output Leakage Current		-1	-10		-1	-10		-1	-10	μA	$\overline{CE}$ = 2.0V, V_{OUT} = 0.4V
I_{CC}	Power Supply Current		33	Note 2		45	65		33	55	mA	All Inputs = 5.25V, Data Out Open, T_A = 0°C
V_{IL}	Input Low Voltage	-0.5		0.8	-0.5		0.8	-0.5		0.65	V	
V_{IH}	Input High Voltage	2.0		V_{CC}	2.0		V_{CC}	2.2		V_{CC}	V	
V_{OL}	Output Low Voltage			0.4			0.4			0.45	V	I_{OL} = 2.1mA
V_{OH}	Output High Voltage	2.4			2.4			2.2			V	I_{OH} = -100μA

Notes: 1. Typical values are for T_A = 25°C and nominal supply voltage.
2. The maximum I_{CC} value is 55mA for the 2102A and 2102A-4, and 33mA for the 2102AL and 2102AL-4.

A. C. Characteristics

T_A = 0°C to 70°C, V_{CC} = 5V ±5% unless otherwise specified

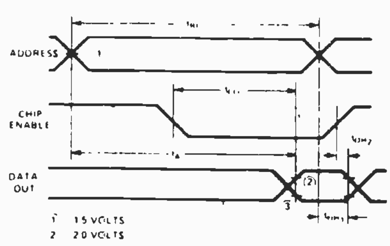
READ CYCLE

Symbol	Parameter	2102A-2, 2102AL-2 Limits (ns) Min.	Max.	2102A, 2102AL Limits (ns) Min.	Max.	2102A-4, 2102AL-4 Limits (ns) Min.	Max.	2102A-6 Limits (ns) Min.	Max.
t_{RC}	Reac Cycle	250		350		450		650	
t_A	Access Time		250		350		450		650
t_{CO}	Chip Enable to Output Time		130		180		230		400
t_{OH1}	Previous Read Data Valid with Respect to Address	40		40		40		50	
t_{OH2}	Previous Read Data Valid with Respect to Chip Enable	0		0		0		0	

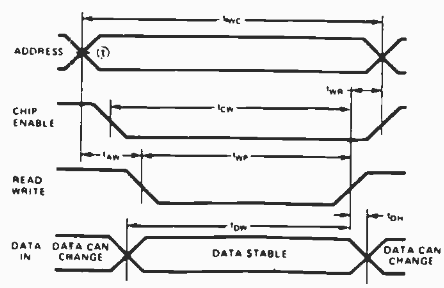
WRITE CYCLE

Symbol	Parameter	2102A-2, 2102AL-2 Min.	Max.	2102A, 2102AL Min.	Max.	2102A-4, 2102AL-4 Min.	Max.	2102A-6 Min.	Max.
t_{WC}	Write Cycle	250		350		450		650	
t_{AW}	Address to Write Setup Time	20		20		20		200	
t_{WP}	Write Pulse Width	180		250		300		400	
t_{WR}	Write Recovery Time	0		0		0		50	
t_{DW}	Data Setup Time	180		250		300		450	
t_{DH}	Data Hold Time	0		0		0		20	
t_{CW}	Chip Enable to Write Setup Time	180		250		300		550	

READ CYCLE



WRITE CYCLE



NOTES. 1. Typical values are for T_A = 25°C and nominal supply voltage.
2. This parameter is periodically sampled and is not 100% tested.

2708 EPROM

The 2708 is a static 1K x 8 EPROM (Erasable Programmable Read Only Memory), which has a quartz window on top to allow erasure under ultra-violet light. The 2708 requires three supplies, +5 V, −5 V and +12 V in normal operation, and a 26 V pulse on the Program pin is required during programming.

The Data I/O pins (O1 − O8) are three-state; when pin 20, the CS/WE pin is at V_{IL} (0 V), the chip is selected for normal read operation but when pin 20 is at V_{IH} (3 V min) the data outputs are in the high impedance state. The CS/WE pin has a third function – when it is at V_{IHW} the device is Write Enabled and ready for programming.

As this is a 1 Kbyte device it has 10 address pins (A0 – A9). For full address decoding, this leaves six bits to be utilised for the CS input, a requirement that is easily met by the use of (say) a 74LS154.

Programming the 2708 is straightforward, but not easy. Commercial users get round this by buying a sophisticated PROM programmer (such as those made by Data I/O) or by having their distributor supply the EPROMs pre-programmed – many distributors now offer this service. This doesn't help most hobbyists, who are unable to supply paper tape in the correct format to enable an EPROM to be blown.

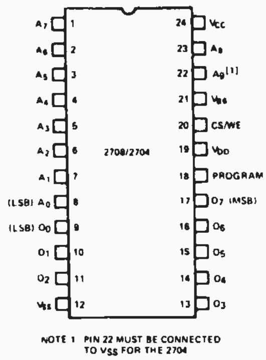
To program a 2708, a circuit is required to do the following: put +12 V on CS/WE (pin 20), apply data and address to the 2708 and then, once the address and data lines have stabilized, pulse the PROGRAM pin to 26 V for between 0.1 ms and 1.0 ms. The address input can then be incremented, the data associated with that location presented and the PROGRAM pin pulsed. The sequence is repeated for all 1024 addresses; this is defined as one program loop.

This entire sequence is then repeated at least one hundred times. The number of program loops, N, is a function of the program pulse width T_{PW}, such that:

$$N \times T_{PW} \geq 100\,\text{ms}$$

It is not permitted to apply N program pulses to an address and then change to the next address and apply N program pulses. There must be N successive loops through all 1024 addresses.

Fig. 3 illustrates a circuit recommended by Intel for a typical program



PIN NAMES

A_0–A_9	ADDRESS INPUTS
O_1–O_8	DATA OUTPUTS/INPUTS
$\overline{CS}$/WE	CHIP SELECT/WRITE ENABLE INPUT

Fig. 1. Pinouts for 2708/2704.

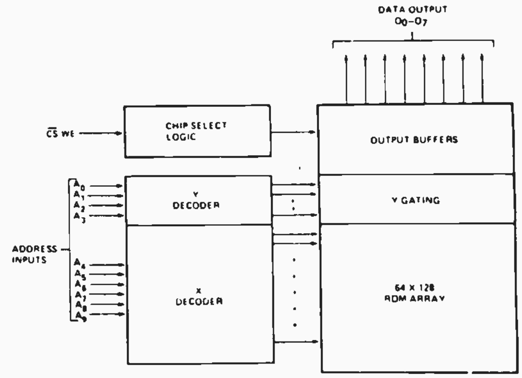


Fig. 2. Internal organization of 2708/2704.

PIN CONNECTION DURING READ OR PROGRAM

MODE	DATA I/O 9-11, 13-17	ADDRESS INPUTS 1-8, 22, 23	V_{SS} 12	PROGRAM 18	V_{DD} 19	$\overline{CS}$/WE 20	V_{BB} 21	V_{CC} 24
READ	D_{OUT}	A_{IN}	GND	GND	+12	V_{IL}	-5	+5
DESELECT	HIGH IMPEDANCE	DON'T CARE	GND	GND	+12	V_{IH}	-5	+5
PROGRAM	D_{IN}	A_{IN}	GND	PULSED 26V	+12	V_{IHW}	-5	+5

Absolute Maximum Ratings

Temperature Under Bias . . . . −25°C to +85°C
Storage Temperature . . . . −65°C to +125°C
V_{DD} With Respect to V_{BB} . . . . +20V to −0.3V
V_{CC} and V_{SS} With Respect to V_{BB} . . . . +15V to −0.3V
All Input or Output Voltages With Respect
to V_{BB} During Read . . . . +15V to −0.3V
$\overline{CS}$/WE Input With Respect to V_{BB}
During Programming . . . . +20V to −0.3V
Program Input With Respect to V_{BB} . . . . +35V to −0.3V
Power Dissipation 1.5W

READ OPERATION

D.C. and Operating Characteristics

T_A = 0°C to 70°C, V_{CC} = +5V ±5%, V_{DD} = +12V ±5%, V_{BB}[1] = −5V ±5%, V_{SS} = 0V, unless otherwise noted.

Symbol	Parameter	Min.	Typ.[2]	Max.	Unit	Conditions
I_{LI}	Address and Chip Select Input Sink Current		1	10	μA	V_{IN} = 5.25V or V_{IN} = V_{IL}
I_{LO}	Output Leakage Current		1	10	μA	V_{OUT} = 5.5V, $\overline{CS}$/WE = 5V
I_{DD}[3]	V_{DD} Supply Current		50	65	mA	Worst Case Supply Currents:
I_{CC}[3]	V_{CC} Supply Current		6	10	mA	All Inputs High
I_{BB}[3]	V_{BB} Supply Current		30	45	mA	$\overline{CS}$/WE = 5V; T_A = 0°C
V_{IL}	Input Low Voltage	V_{SS}		0.65	V	
V_{IH}	Input High Voltage	3.0		V_{CC}+1	V	
V_{OL}	Output Low Voltage			0.45	V	I_{OL} = 1.6mA
V_{OH1}	Output High Voltage	3.7			V	I_{OH} = −100μA
V_{OH2}	Output High Voltage	2.4			V	I_{OH} = −1mA
P_D	Power Dissipation			800	mW	T_A = 70°C

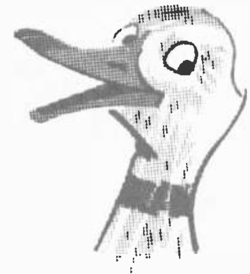
NOTES: 1. V_{BB} must be applied prior to V_{CC} and V_{DD}. V_{BB} must also be the last power supply switched off.

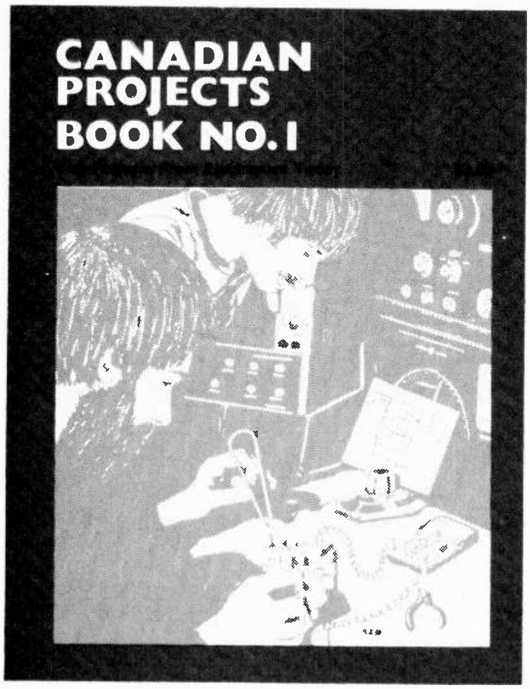
A. C. Characteristics

T_A = 0°C to 70°C, V_{CC} = +5V ±5%, V_{DD} = +12V ±5%, V_{BB} = −5V ±5%, V_{SS} = 0V, unless otherwise noted.

Symbol	Parameter	2708-1 Limits Min.	2708-1 Limits Typ.	2708-1 Limits Max.	2708 Limits Min.	2708 Limits Typ.	2708 Limits Max.	Units
t_{ACC}	Address to Output Delay		280	350		280	450	ns
t_{CO}	Chip Select to Output Delay		60	120		60	120	ns
t_{DF}	Chip Deselect to Output Float	0		120	0		120	ns
t_{OH}	Address to Output Hold	0			0			ns

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.

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☐ Bill Mastercharge. ☐ Bill Chargex. Expiry Date ____________ pulse driver. Beware! A single transistor from the +26 V line with an emitter pull-down resistor will not work, as it cannot get the output down to within 1 V of V_{SS}.

To erase the 2708, it should be exposed to ultra-violet light of a wave-length shorter than approximately 4000 Angstroms. Warning: sunlight and certain types of fluorescent lighting have wave-lengths in the range 3000 – 4000 Angstroms. Intel's data shows that continuous exposure to room level fluorescent lighting could erase a typical 2708 in approximately 3 years, while direct sunlight will take approximately 1 week to do the job. While this may be one way of erasing your 2708s, you generally don't want it to happen, and so an opaque label should be stuck over the quartz window.

The best, and recommended, way of erasing a 2708 is to expose it to short-wave ultra-violet light which has a wave-length of 2537 Angstroms. The integrated dose (i.e. UV intensity x exposure time) for erasure should be a minimum of 15 W-sec/cm². The erasure time with this dosage is approximately 15 to 20 minutes using an ultra-violet lamp with a 12000 µW/cm² power rating. The 2708 should be placed within 1 inch of the lamp during erasure.

CAPACITANCE[1] $T_A = 25°C$, f = 1 MHz

Symbol	Parameter	Typ.	Max.	Unit.	Conditions
C_{IN}	Input Capacitance	4	6	pF	V_{IN} = 0V
C_{OUT}	Output Capacitance	8	12	pF	V_{OUT} = 0V

Note: 1. This parameter is periodically sampled and is not 100% tested.

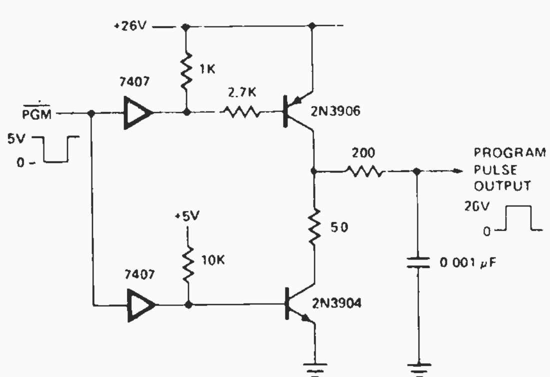
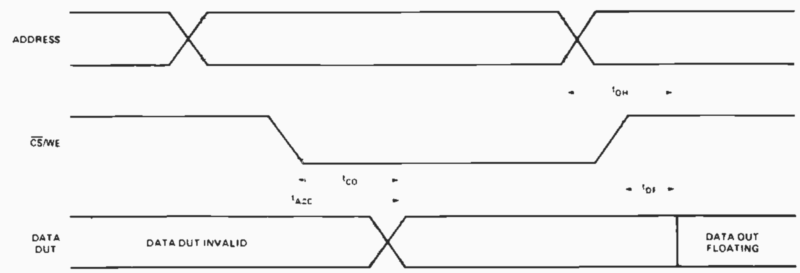


Fig. 3. PROM blowing circuit.

Waveforms



PROGRAM CHARACTERISTICS

T_A = 25°C, V_{CC} = 5V ±5%, V_{DD} = +12V ±5%, V_{BB} = -5V ±5%, V_{SS} = 0V, Unless Otherwise Noted.

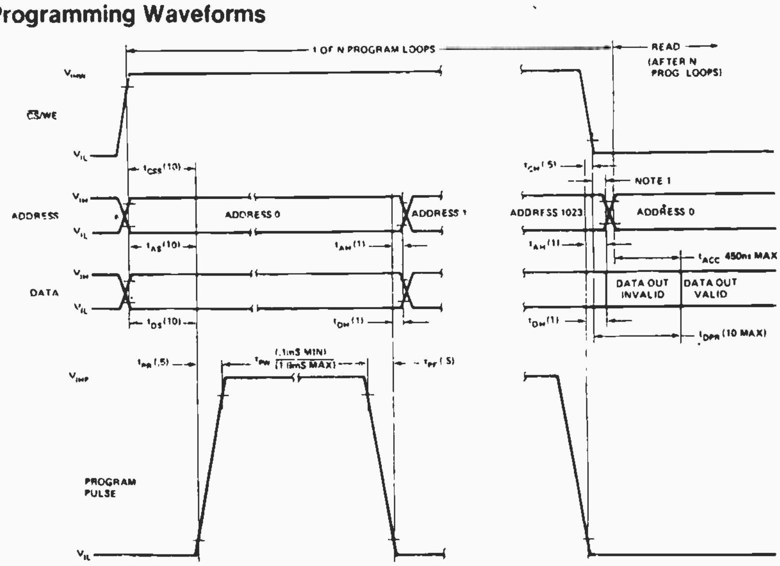
D.C. Programming Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I_{LI}	Address and CS/WE Input Sink Current			10	µA	V_{IN} = 5.25V
I_{IPL}	Program Pulse Source Current			3	mA	
I_{IPH}	Program Pulse Sink Current			20	mA	
I_{DD}	V_{DD} Supply Current		50	65	mA	Worst Case Supply Currents:
I_{CC}	V_{CC} Supply Current		6	10	mA	All Inputs High
I_{BB}	V_{BB} Supply Current		30	45	mA	CS/WE = 5V; T_A = 0°C
V_{IL}	Input Low Level (except Program)	V_{SS}		0.65	V	
V_{IH}	Input High Level for all Addresses and Data	3.0		V_{CC}+1	V	
V_{IHW}	CS/WE Input High Level	11.4		12.6	V	Referenced to V_{SS}
V_{IHP}	Program Pulse High Level	25		27	V	Referenced to V_{SS}
V_{ILP}	Program Pulse Low Level	V_{SS}		1	V	$V_{IHP} - V_{ILP}$ = 25V min.

A.C. Programming Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units
t_{AS}	Address Setup Time	10			µs
t_{CSS}	CS/WE Setup Time	10			µs
t_{DS}	Data Setup Time	10			µs
t_{AH}	Address Hold Time	1			µs
t_{CH}	CS/WE Hold Time	.5			µs
t_{DH}	Data Hold Time	1			µs

Programming Waveforms



NOTE 1. THE CS/WE TRANSITION MUST OCCUR AFTER THE PROGRAM PULSE TRANSITION AND BEFORE THE ADDRESS TRANSITION
NOTE 2. NUMBERS IN ( ) INDICATE MINIMUM TIMING IN µS UNLESS OTHERWISE SPECIFIED

Decoding

PROBABLY THE COMMONEST size of memory chip in use today is 1 K x 1, or in ROM, 1 K x 8. The 2102, for example, is exceptionally easy to use from the point of view of address decoding. Ten bits of the address bus are decoded by the chip itself, leaving only six bits from which to derive the CE signal.

If full address decoding is not required, for example, in small dedicated systems, then it is possible to invert the individual high order bits of the address bus and use them directly as chip selects. This will allow the use of up to 6 K of 2102s or a combination of RAM/ROM (less if you use memory-mapped I/O).

Beware! This method can lead to bus contentions. For example, when a 6800 restarts, it looks for its restart vector in locations FFFE and FFFF, thus setting all those high-order address bits high simultaneously. This will enable all of your RAM simultaneously, leading to all kinds of nasties; see the section on three-state control.

From the hobbyist's point of view, and in any general-purpose or large system, it is better to fully decode the address bus. As we have said, the 2102 and the 2708 decode 10 bits, leaving six to be decoded by external circuitry. The most common, and probably the easiest way of doing this is to use the 74154 (or 74LS154) 4-line-to-16-line decoder

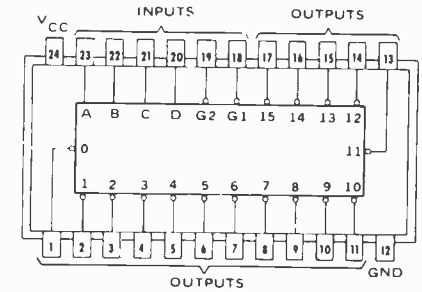


Fig. 1. The 74(LS)154 pinout.

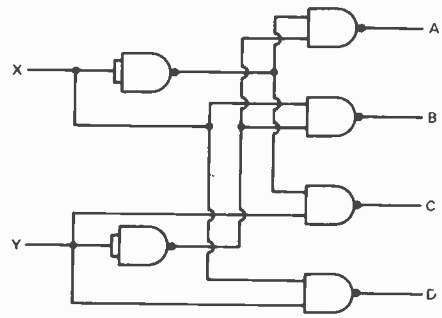


Fig. 3. This circuit can be used to decode two bits to one of four.

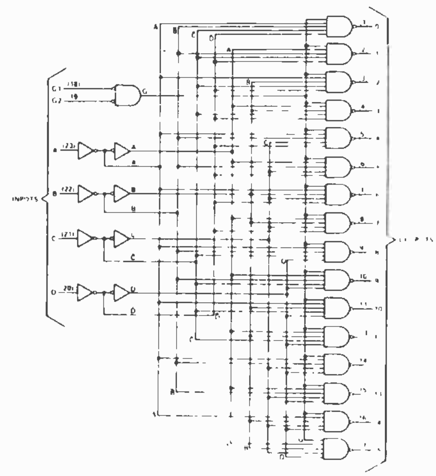


Fig. 2. The internal circuit of the '154.

The 74154 will decode a 4-bit input to one of 16 *mutually exclusive* outputs. The outputs are normally high and go low when selected, thus matching the CE and CS inputs of most memories. For example, if the input code is 1010, output 10 will go low.

We have said that the '154 decodes 4 bits; how do you cope with the remaining two? Well, the '154 has two enable inputs, G1 and G2, which can be used, in conjunction with a couple of NAND gates, to decode A14 and A15. By slightly increasing the complexity of this bit of circuitry, it is possible to decode the read and write strobe signals of your computer to ensure correct timing in operation.

microbiography

MPU — spotter's guide to what was, is and will be.

SINCE LAST OCTOBER Microbiography has been looking at some of the more popular processors individually. This month we are deviating from that theme a bit (?) to make a quick survey of the overall micro scene.

PAST TRENDS

Early microprocessors were rather tricky to deal with in that they needed a lot of hardware support. That is to say you had to provide typically three supply voltages, a complicated clock driver circuit (probably two phase) and heaps of TTL to perform various functions for the main chip. Since then the typical mpu has become much "cleaner" and nicer to work with, one power supply voltage, on chip clock, and many other work saving features.

Of course at the same time the trend has been to faster and lower power ICs, while increasing the computation power of the mpu and the intelligence of peripheral chips, I/O ports and so on, to allow the mpu to concentrate on its own job.

THE FUTURE

Developments have been and will continue to occur in two distinct areas, namely at the top and bottom of the market. At the top we'll be getting more computational power, more speed, and probably more intelligent peripheral chips. This will tie in to the increasing trend toward 16 bit machines, and the addition of features such as hardware multiply and divide. In fact today's minicomputers are already receiving competition from microprocessor systems.

At the other end of the scale there is a huge market for better "controller" oriented systems. Here we are talking about controllers for household appliances, elevators, and a wide assortment of other machines. (Our own review of the microprocessor controlled Heathkit-Bally pinball machine will appear next month). After the manufacturer of such a system has initially debugged the program he will typically require one or two kilobytes of ROM to store it in, and only a small amount of RAM to operate with. thus "one chip" systems are becoming popular, where the mpu chip itself includes the ROM and RAM, and possibly even a few I/O lines to boot. This results in an extremely compact system.

These "one chippers" are probably of less direct interest to the microcomputer hobbyist who is generally looking at a larger system, and probably needs the flexibility of being able to switch ROMs occasionally. However at least one hobbyist system has appeared recently using an 8048, Intel's one chip unit which can be expanded to the size of any typical system.

GENERAL INSTRUMENTS

1600: General Instruments' 16 bit processor which features eight general purpose registers and a 64K word address space. Four addressing modes are provided. Some interesting peripheral chips are available including a dual 10 bit digital to analog convertor.

RCA

1802: RCA again show off their expertise in the CMOS field with this CMOS processor, the heart of the COSMAC family. This mpu provides the convenience of loose voltage requirements and low power, but achieves instruction times as low as 2.5us with a 6.4MHz crystal attached to its on chip-clock generator. The somewhat novel internal architecture of the 1802 is designed around a 16 by 16 bit register array, with three other registers to keep track of which registers are being used as the program counter, data pointer, and other functions such as "accumulator". The instruction set reflects this with an emphasis on the heavy use of these internal registers as the source of addresses for operands, and auto-increment type instructions for convenient use of tables. The use of a stack in main memory is quite familiar, as is the interrupt scheme with limited priority which causes a call to a predetermined lcoation. Direct memory access is built right into the 1802 for data transfers up to 80K bytes per second. In addition this DMA capability can be used in "load" mode to load in a program upon power-up.

The popularity of CMOS in low power battery applications is widely shared and is no doubt carrying over to this product. We have seen several battery operated development and training kits based on the 1802, but no large systems as yet. ROM, RAM, serial and parallel I/O units are available, and of course the extensive selection of readily available CMOS parts make good companions for the 1802. See ETI-Canada January 78.

SIGNETICS

2650: Philips' entry into the microprocessor market is through their Signetics wing. The 2650 is strong in the area of interfacing, and in fact was originally introduced by itself for use with standard components. Since then however several support chips have been brought out and now the 2650 along with the 2656 memory interface is considered to be a two-chip set.

Only 32K of address space is provided on this 8 bit machine, but that will rarely limit the user. The architecture is unusual with no specific accumulator, but 7 general purpose registers configured in a clever manner. the stack is on chip and provides for 15 levels of return addresses. The I/O possibilities are quite varied, with four levels of sophistication to match the need, the simplest being to use the serial I/O lines provided on the 2650 itself.

The instruction set, which is fairly standard for an mpu, is made especially powerful by the inclusion of indirect and indexed modes along with auto-increment features.

As yet not too much has been seen of this processor in the hobbyist field, its uses having been mostly confined to the industrial controller market. See ETI-Canada March 78.

FAIRCHILD

3850, 3859, 3870: See F8 family.

DATA GENERAL

mN601: This 16 bit microprocessor comes from Data General Corporation and forms the heart of their MICRO-NOVA system.

INTERSIL

6100: A 12 bit machine from Intersil (and second source Harris) which emulates the popular DEC PDP-8 minicomputer. Its other big plus is the fact that it uses lower power CMOS technology, and several CMOS support chips are available.

MOS TECHNOLOGY

6502: Although this mpu from MOS Technology has been around for some time, it is only recently that it has started to catch on. The 6502 is actually the biggest and best of the 6500 series, which included the 6501, a version hardware compatible with the 6800 but with 6500 instruction set, and a number of versions identical to the 6502 except for smaller package size (28 pins) necessitating the elimination of some lines such as address, and different clock configurations. A 6502 system can use many of the peripheral interface chips of the 6800 family and vice versa.

The 6502 has several advantages over the 6800. One of the most useful for hobbyists is the fact that it uses only static logic and thus may be stopped in any state, allowing the direct observation of address and data lines. It also has an on board clock generator. MOS Technology amply demonstrated the advantages of these features in their very popular KIM demonstrator kits. The 6502 also has surprising power in the software department with the inclusion of indirect indexed and indexed indirect addressing modes. These software advantages are probably in no small measure responsible for the fast verions of BASIC available on the Commodore PET, Ohio Scientific Challenger, and Apple 2, all 6502 based home systems.

With Commodore now backing MOS Technology, the 6502 also available from Rockwell, and versions up to 4MHz, we expect to hear more about this chip. See ETI-Canada December 77.

MOTOROLA

6800: Motorola's mpu (also supplied by Fairchild and American Microsystems) is probably the closest thing to big competition to the 8080. It requires only a single 5V supply, but does need a special clock driver. The address bus is 16 bits wide, and the data bus is 8, with a simple control bus. Two accumulators are provided along with the program counter, index and stack registers. The software includes implied, immediate, absolute (and zero page), relative and indexed addressing modes, which in some situations can lead to programming advantages over the 8080, and even the Z80. Interrupts are generally handled by polling.

The 6800 is available in options upto 4MHz, and its fairly wide acceptance has brought a variety of peripheral chips onto the market. See ETI-Canada December 77.

MOTOROLA

6801, 6802/6846: These are the one and two chip versions of the 6800 from Motorola. Starting with the two chip version, the 6802 contains the processing power of the 6800, clock generator, and 128 byte RAM, of which 32 bytes can be backed up by battery power in case of power failure, or simply for the saving of needed system variables between uses of the machine. The 6846 contains 2K ROM, 10 I/O lines and a timer.

The 6801 might better be described as a "one-chip 6804½" since it shares with the 6809 such features as a number of 16 bit operations and the eight bit unsigned multiply, which incidentally takes only 10us to reach the 16 bit result. 128 bytes of RAM, 2K ROM, a timer, two serial and 31 parallel I/O lines are included.

MOTOROLA

6809: Motorola views this processor as an easy way to get into the 16 bit field by making this mpu very similar to the 6800. It almost functions as a dual 8 bit processor, or as a full 16 bit machine. In addition to more instructions and registers than the 6800 it has such sophisticated features as auto increment and decrement addressing modes, relative branches over the entire address space, and hardware multiply.

Delivery of the 6809 is not expected until around September.

Looking into the future, Motorola is working on a more powerful processor family they call MACS, designed around a 16 bit data bus and 24 bit (16 Megabyte) address space.

INTEL

8008: This is the chip that started it all. Now obsolete and very little used, the 8008 required many TTL chips for support, a separate clock driver, and two supply voltages. By today's standards very slow (12.5us per instruction cycle, with 1 to 3 cycles per instruction) and difficult to use. Intel must have learned a lot from this mpu, their second attempt has proved quite an improvement . . . the 8080.

The 8008 uses 8 bit data bytes, and 14 bit addresses, these being multiplexed onto an 8 bit bus. Forty-eight instructions are provided, and in addition to the accumulator and program counter there are 6 general purpose registers, and a 7 level stack. Vector interrupts may be used. See ETI-Canada October 77.

INTEL

8048: A one chip mpu from Intel which includes 1K ROM, 64 bytes of RAM, 27 I/O lines, a timer/event counter and one level of interrupt. It uses 90 instructions, most of which are single byte, and is expandable with 8000 family ROM and RAM components and peripheral devices. There is also an 8748 with EPROM instead of ROM, and an 8035 with no ROM. Coming up are an 8049 with 2K ROM, and a "half-chip" design, the 8021 with a minimum of memory and I/O capability running a subset of the 8048 instruction set.

INTEL

8080: This processor is considered to be the closest thing that the industry has to a standard. Intel was the originator, and it is now also supplied by Advanced Micro Devices, National

Semiconductor, NEC Microcomputer and Texas Instruments.

The 8080 has been improved and enhanced many times over, and what was originally a 1MHz device is now available in 3 or 4 MHz versions. It has a 16 bit address bus, 8 bit data bus and the typical system will include an 8224 clock driver and 8228 system controller. With these the user can employ standard memory chips and because of the wide acceptance of the 8080 has available a wide choice of peripheral ICs from a variety of sources. Three supply voltages are needed, +12, +5, and -5V.

Seventy-eight instructions are available, with immediate, direct (absolute), register (implied) and indirect addressing modes available. Registers include program counter, accumulator, three pairs of general purpose registers and a stack pointer (the stack located in main memory keeps track of subroutine calls and interrupts). Vector interrupts are used. See ETI-Canada October 77.

INTEL

8085: A descendant of the 8080 this mpu features only one supply voltage (+5V), on board clock, multi level interrupts and serial I/O on the chip. To achieve this some of the address and data lines had to be multiplexed together to save pins. Thus one must use MCS-85 system components (memory, peripheral controllers) which unmultiplex internally, or use some external ICs to do the demultiplexing. Versions of this mpu are available for upto 5MHz, and it is interesting to note that for an 8080 and an 8085 running at the same speed the actual access time specs required of the memory chips can be 50% slower in the 8085 system.

The 8085 software is identical to that for the 8080, except for two added instructions used for serial I/O. Because of the built in serial I/O feature and small number of "extra" chips required in an 8085 system, it lends itself readily to controller applications, communication with a teletype etc., but retains compatibility with the 8080 and may be expanded to the same size as an 8080 system.

The 8085 is available from Intel. See ETI-Canada November 77.

INTEL

8086: This is the 8080 grown into a 16 bit machine. 20 bit address provides 1 megabyte memory space. Additions to the 8080's powers are block move and searhc capabilities, and hardware multiply and divide. The initially available part will be a 5MHz version (June 78) with 8MHz unit to follow.

FAIRCHILD

9440: Fairchild's one chip 16 bit mpu is part of their new "Microflame" family.

9900: A very powerful 16 bit mpu, this chip from Texas Instruments is capable of minicomputer tasks. Among its outstanding features are memory-to-memory architecture, and hardware multiply and divide. At 3MHz speed these operations are possible in approximately 20 and 40 usec each! Many interesting hardware features, and a full complement of addressing modes including indirect, indexed and auto-increment.

There is also a one chip version of the 9900, the 9940 which contains 2K ROM and 128 bytes of RAM (8 bit bytes) and 32 I/O lines. On top of this an IIL technology version of the 9900 is expected.

NATIONAL

COPS: This family of Calculator Oriented Processor Systems is really a set of special purpose microprocessors, including typically some ROM, RAM and direct interfaces for keyboard and seven segment numeric displays. The Sinclair Cambridge Programmable calculator employs one of these chips.

FAIRCHILD

F8 Family: When the F8 system was originally introduced by Fairchild it was envisioned as having a two chip heart sharing the processing functions. The 3850 mpu contains clock and interrupt logic, accumulator and arithmetic logic, 64 bytes RAM and two bit I/O ports. The system bus uses only 5 lines for all data, address, and control information. This requires that each device hanging onto the bus must contain a register for the program counter, stack register, and possibly a data counter. The 3851 "Program Storage Unit" in particular, the usual sister chip to the 3850, contains all these registers and 1K ROM plus two 8 bit I/O ports and additional interrupt logic. The family includes a chip which interfaces between this strange bus and standard dynamic memories, including refreshing them. Another IC interfaces to standard RAMs and has a timer in addition. Considering most microprocessor systems use buffers between the mpu and memory, the F8 configuration looks no less efficient. In fact, it appears to be quite effective in small to medium size applications, and the software also can be quite effective with use of the internal sratchpad RAM.

The 3850+3851 functions have been embodied in one chip models, the 3859 1K ROM and 32 I/O lines, and the 3870 with 2K ROM and 32 I/O lines.

Not many hobbyist systems have appeared using this family, although recently the "Video Brain" was introduced by Umtech Inc. which, designed by the ex-director of Fairchild's F8 group naturally uses an F8 system. Mostek are also in the F8 business.

NATIONAL

PACE: National's 16 bit microprocessor family has been around for quite a while and uses a fairly standard architecture. Four general purpose accumulators have been included and the software addressing modes include base page, absolute, program relative, indexed and indirect modes.

A new version of the PACE has been introduced, known as the 8900, and it purportedly has numerous improvements.

An interesting feature of National's development systems for PACE, 8080, 8900, and SC/MP is their MOCROBUS which allows the interfacing of components of each system with the others.

NATIONAL

SC/MP: Standing for Simple Cost-effective MicroProcessor, the SC/MP is National's low end control system. The ISP-8A/600 is the SC/MP-II version and includes single supply requirement, on-chip clock, fairly standard architecture, serial I/O lines and fairly simple bus arrangement.

Addressing modes include relative, indexed and auto-increment. Main popularity of the SC/MP system has been in the basic controller-evaluation kit area.

ZILOG

Z8: Here's a one chip unit from Zilog expected this year. Said to be on this chip are 2K ROM, 128 bytes of RAM, four 8 bit parallel I/O ports, serial I/O lines, seven level interrupt scheme, and two timers! It is to run a subset of the Z80 instruction set, will be quite fast, and expandable upto 64K of external RAM or ROM.

ZILOG

Z80: This mpu from Zilog appears to be the one which has caused the most excitement recently, probably because it has a snappy sounding name. It too evolved from the 8080, but is a tremendous improvement, able to win over supporters of both 8080 and 6800. Starting with the hardware, the Z80 features single supply voltage, simple single phase clock, (4MHz standard), automatic dynamic memory refresh transparent to the programmer, and about twice as many registers inside.

On the software side the Z80 incorporates a large number of additional instructions, with increased versatility coming from the extra registers, and the ability to handle data in one, 4, 8, and 16 bit units. The addressing modes added in the Z80 are: relative, and bit. The very useful abilities to do block moves, searches, and I/O are also included, along with three different kinds of interrupt.

All 8080 software will run on a Z80 system, although the instruction mnemonics are different for op-codes which do the same thing.

Mostek is the second source for the Z80. See ETI-Canada November 77.

ZILOG

Z8000: We expect this one to be the chip of the year award winner, it's really exciting! Zilog claims that it is comparable to the DEC PDP11-45 in architecture, and computational power and speed. The 23 bit address bus handles 8 Megabytes of memory directly. The Z8000 includes all the software features of the Z80, in a total of 418 instructions. The internal 16 by 16 bit register array also allows some 32 bit manipulations, and some interesting string manipulation functions are reportedly included.

First available samples of this chip are expected in July with production quantities in September.

Oh yes, it also has hardware multiply and divide.

As you can see from this listing, some amazing things are happening in the fast moving microprocessor industry. What is even more amazing is the vast number of applications that are going to use mpus, and the increase in the intelligence possible in so many of the machines that are a part of our everyday lives. We sure hope this will be an improvement.

Tic-Tac-Toe

This sophisticated program for the HP67 calculator was written by François Roy of Hull, P.Q.

THIS PROGRAM designed to operate on an HP-67, plays TIC-TAC-TOE against the user. Unlike similar programs which have appeared before, including one in HP's "Game Pac", **no** restrictions are placed upon the user: he may start the game in **any** one of the nine squares, or he may let the Calculator play first.

The program is even more enjoyable due to the fact that it CAN be beaten, although it plays a very good game. The only "catch" is that the Calculator "thinks" for about 35 seconds before replying to a move (except the first move).

EXECUTION

Operation of the program is also very simple (it is recommended that the game be played with pencil and paper): you simply press the key that corresponds to the position of your move on the HP-67 keyboard (or enter a zero to have Calculator start) and you press "A". The reply is in the form: n.r where n indicates whether this is the first, second, etc. move and r is the reply itself (integer showing position of move on HP's keyboard). If the display switches to format: n.r00000000, you just LOST a game. A flashing decimal indicates a tie game. To reset (start a new game) depress "B" and then proceed as above.

Theory of operation: First, the three rows, the three columns and the two diagonals are examined for "two of a kind" with 3rd square free. If two of "Machine's" kind are found, coordinate of empty square is stored in R11 (Secondary register 1). Same goes for two of "Player's" kind and R10. Then if R11 is nonzero, the indicated square is played and flag 1 is set (machine wins). Else, if R10 is nonzero, the square it contains is played (to BLOCK Player's win). If both R10 and R11 are zero, Calculator will briefly "examine" the board to see if you have any "sneaky" plans in mind, and will play a "semi-random" move based on this "study". Play continues until 8 (9 if Calculator starts) moves have been played or until Machine wins (it won't admit a loss!).

The board's status may be examined at any time by recalling register 1 thru 9. The 4's represent the Machine's moves; the 1's denote the Player's moves and zeros denote empty squares. The board is "mapped" onto the Calculator's keyboard such that keys 1 to 9 represent the 9 squares of the tic-tac-toe grid.

If an attempt is made to play a nonempty square, the program will halt shortly after you have pressed "A" in which case you should reenter a correct move and press "A" again. The user is expected to be "fair" enough to avoid cheating by manually storing moves in the Calculator's registers. The program **can** be beaten without cheating.

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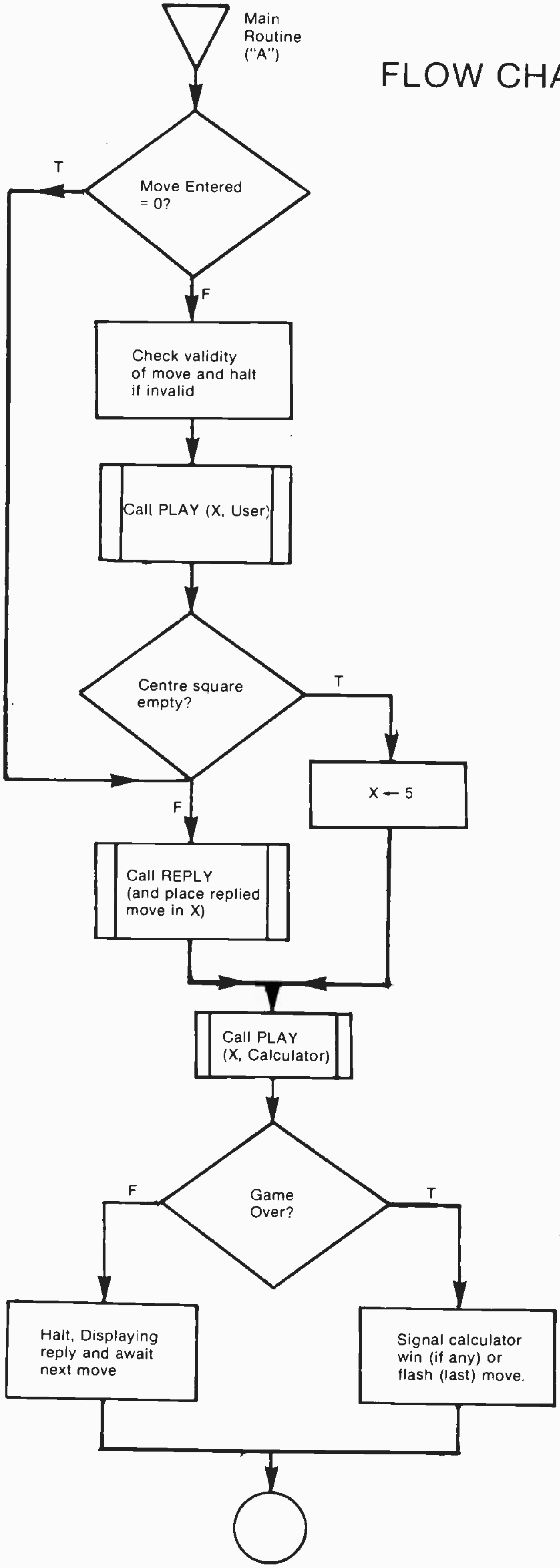
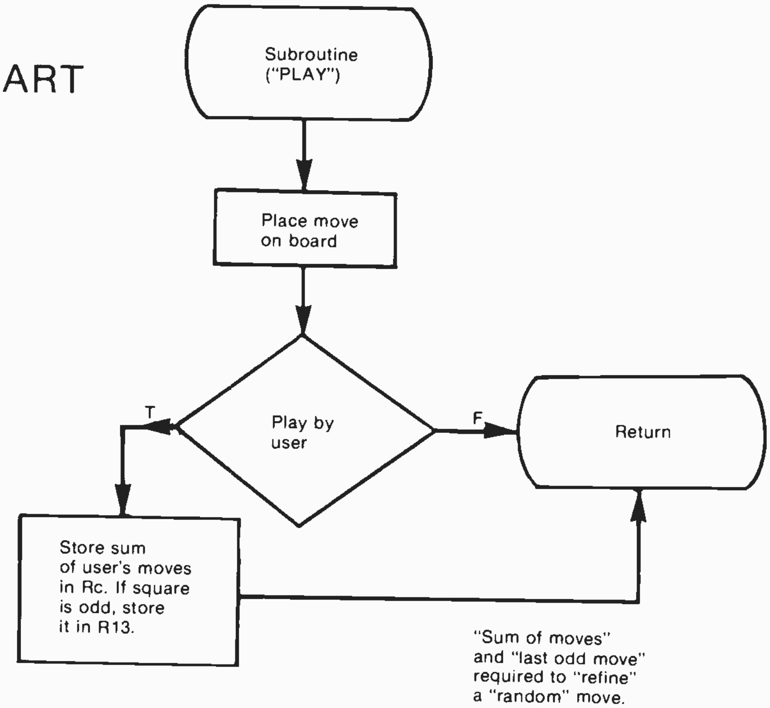
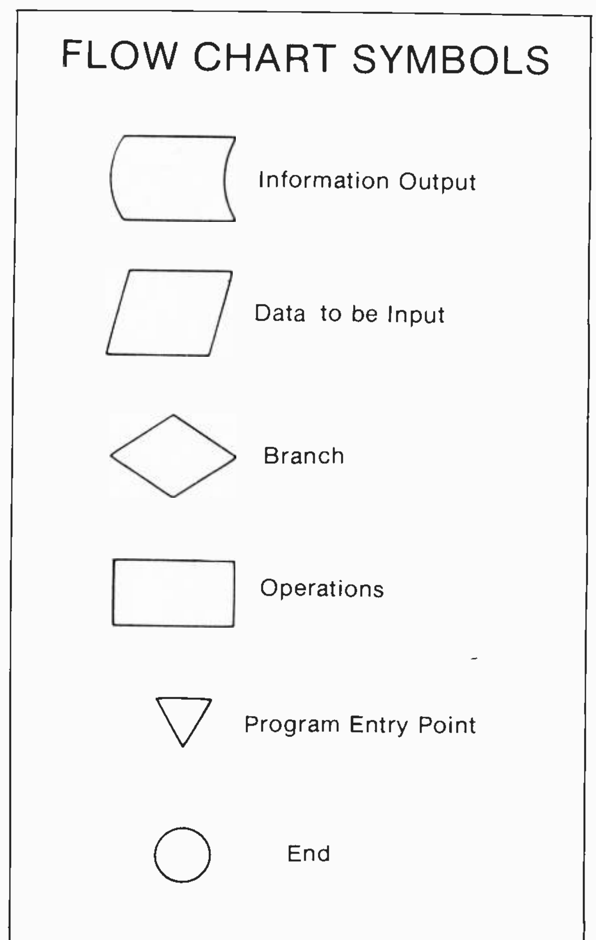
FLOW CHART


Main
Routine
("A")
Move Entered
= 0?
T
F
Check validity
of move and halt
if invalid
Call PLAY (X, User)
Centre square
empty?
T
F
X ← 5
Call REPLY
(and place replied
move in X)
Call PLAY
(X, Calculator)
Game
Over?
F
T
Halt, Displaying
reply and await
next move
Signal calculator
win (if any) or
flash (last) move.


Subroutine
("PLAY")
Place move
on board
Play by
user
T
F
Return
Store sum
of user's moves
in Rc. If square
is odd, store
it in R13.
"Sum of moves"
and "last odd move"
required to "refine"
a "random" move.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Information Output
Data to be Input
Branch
Operations
Program Entry Point
End

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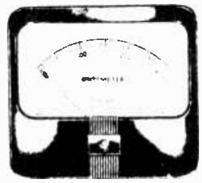

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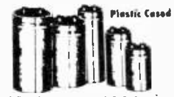

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500	200 v.
1,500	100 v.
1,500	150 v.
2,000	50 v.
2,000	100 v.
3,500	75 v.
3,750	75 v.
5,000	55 v.
11,000 mfd	19 v.
14,000	13 v.
15,000	10 v.
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6BH6	12BE6	6AU6	12BY7	5AT8	6JU8	6HJ7	17BF11
6BZ6	12AD6	6GK6	12BR7	6CL8	10JA8	6JT8	17KW6
6CB6	12AL5	6J6	12DB5	6EM5	10JY8	9ED4	27GB5
6J4	12SN7	6SQ7	19EA8	6GH8	12FX5	9V9	40KG6
6W4	12X4	8CG7	25AX4	6HB7	14GW8	10GN8	42EC4

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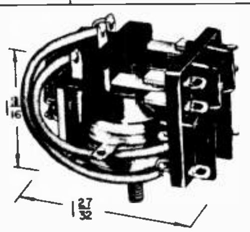

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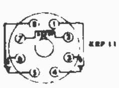

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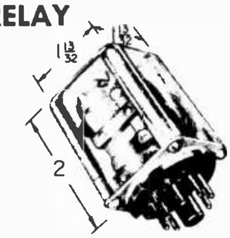

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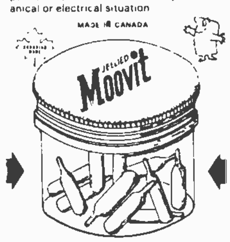

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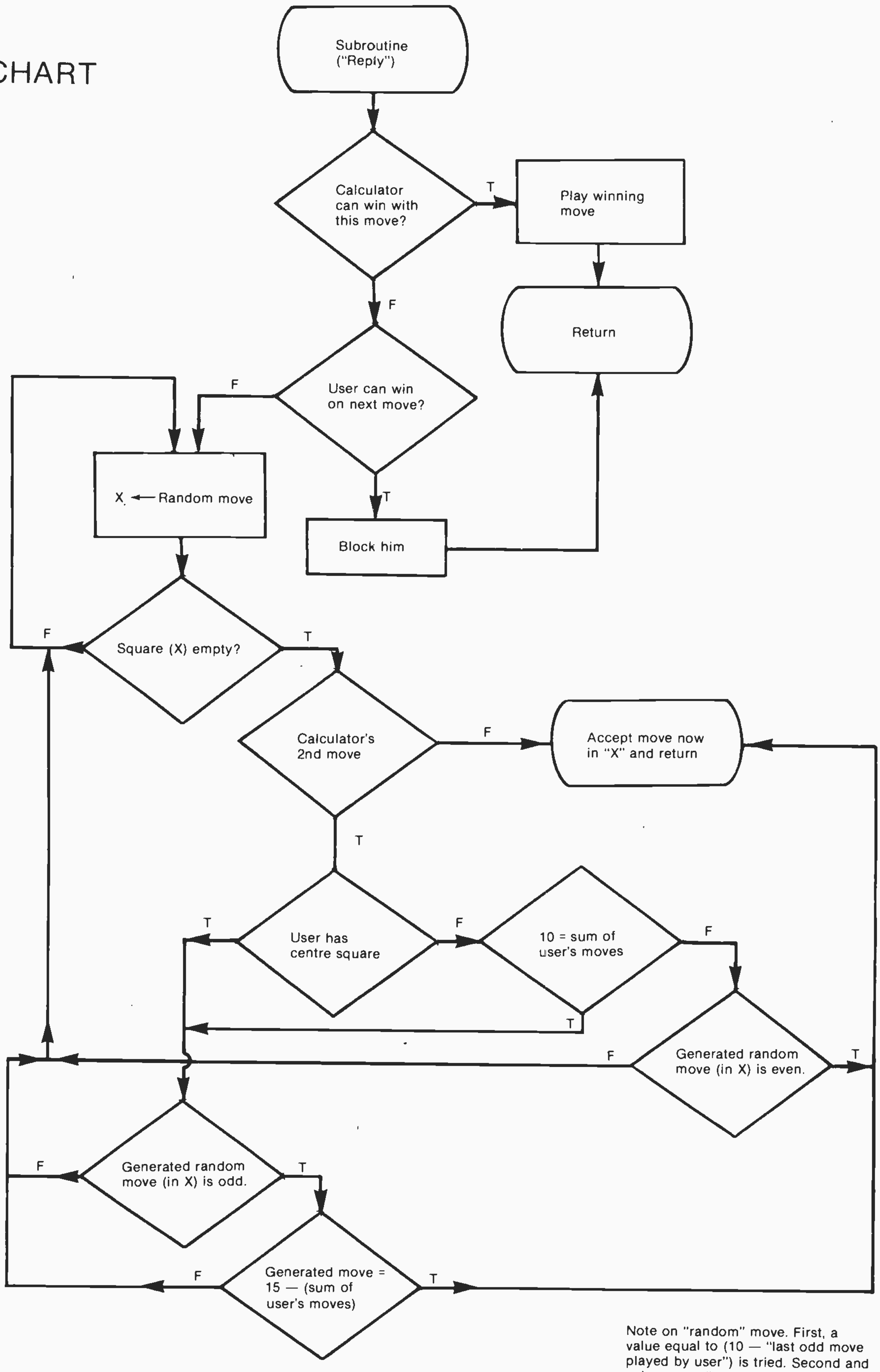

Note on "random" move. First, a value equal to (10 — "last odd move played by user") is tried. Second and subsequent "random moves" are truly random.

PROGRAM

g LBLf a	32 25 11	Subroutine to
h STI	35 33	examine a square
h R↓	35 53	
STO A	33 11	
0	00	
STO 0	33 00	
STO B	33 12	
f b	32 22 12	
f b	32 22 12	
f b	32 22 12	
RCL B	34 12	
f x=0	31 51	
h RTN	35 22	
0	00	
h STI	35 33	
RCL 0	34 00	
4	04	
÷	81	
f INT	31 83	
h LST x	35 82	
g FRAC	32 83	
4	04	
×	71	
f P⇄S	31 42	
2	02	
g x=y	32 51	
GTO 9	22 09	
f ISZ	31 34	
h x⇄y	35 52	
h R↓	35 53	
g x≠y	32 61	
f ISZ	31 34	
f LBL 9	31 25 09	
RCL B	34 12	
STO (I)	33 24	
f P⇄S	31 42	
h RTN	35 22	
g LBLf b	32 25 12	Subroutine to
RCL (I)	34 24	check a square
STO + 0	33 61 00	
f x≠0	31 61	
GTO fb	22 31 12	
h RCI	35 34	
STO B	33 12	
g LBLf b	32 25 12	
h RCI	35 34	
RCL A	34 11	
+	61	
h STI	35 33	
h RTN	35 22	
g LBLf c	32 25 13	Subroutine to
1	01	generate reply
ENTER↑	41	
f a	32 22 11	1st row
1	01	
ENTER↑	41	
4	04	
f a	32 22 11	2nd row
1	01	
ENTER↑	41	
7	07	
f a	32 22 11	3rd row
3	03	
ENTER↑	41	
1	01	
f a	32 22 11	1st column
3	03	
ENTER↑	41	
2	02	
f a	32 22 11	2nd column
3	03	
ENTER	41	
f a	32 22 11	3rd column
4	04	

ENTER	41	
1	01	
f a	32 22 11	1st diagonal
2	02	
ENTER	41	
3	03	
f a	32 22 11	2nd diagonal
f P⇄S	31 42	
RCL 1	34 01	
f x≠0	31 61	
h SF 1	35 51 01	Machine wins
f x≠0	31 61	
GTO 8	22 08	
RCL 0	34 00	
f x≠0	31 61	Machine blocks
GTO 8	22 08	
9	09	
RCL 3	34 03	
f P⇄S	31 42	
f x=0	31 51	
GTO 0	22 00	
-	51	
f LBL 6	31 25 06	
h ST I	35 33	
f ISZ	31 34	Check square to
(I)	34 24	see if empty.
f x=0	31 51	
GTO 9	22 09	
f LBL 0	31 25 00	Examine board
RCL E	34 15	and generate
hπ	35 73	semi-random
+	61	move
g FRAC	32 83	
STO E	33 15	
9	09	
×	71	
f INT	31 83	
GTO 6	22 06	
f LBL 9	31 25 09	
RCL D	34 14	
2	02	"Random" move
g x≠y	32 61	refined
GTO 7	22 07	
RCL 5	34 05	
1	01	
g x=y	32 51	
GTO 9	22 09	
RCL C	34 13	
1	01	
0	00	
g x≠y	32 61	
GTO 9	22 09	
f e	32 22 15	
f x≠0	31 61	
GTO 6	22 06	
GTO 7	22 07	
f LBL 9	31 25 09	
f e	32 22 15	
f x=0	31 51	
GTO 6	22 06	
h RCI	35 34	
1	01	
5	05	
RCL C	34 13	
-	51	
g x=y	32 51	
GTO 6	22 06	
f LBL 7	31 25 07	
f P⇄S	31 42	
h RCI	35 34	
f LBL 8	31 25 08	Now x register
0	00	contains
STO 0	33 00	machine's reply
STO 1	33 01	
h R↓	35 53	START POINT

f P⇄S	31 42	
h RTN	35 22	
g LBLf d	32 25 14	Subroutine to
h STI	35 33	play a move on
1	01	the board
STO (I)	33 24	
3	03	
h F? 0	35 71 00	
STO + (I)	33 61 24	
h F? 0	35 71 00	
h RTN	35 22	
RCL C	34 13	Some things
h RCI	35 34	must be stored
+	61	for randomness
STO C	33 13	refinement.
f e	32 22 15	
fx = 0	31 51	
h RTN	35 22	
h RCI	35 34	
f P⇄S	31 42	
STO 3	33 03	
f P⇄S	31 42	
h RTN	35 22	
f LBL A	31 25 11	Entry to PLAY
f x=0	31 51	routine.
GTO 9	22 09	
h STI	35 33	
RCL D	34 14	
1	01	
+	61	
STO D	33 14	
RCL (I)	34 24	Check if square
f x≠0	31 61	is empty. If not,
R/S	84	halt.
h RC I	35 34	
hCF 0	35 61 00	
f d	32 22 14	Play user's move
RCL 5	34 05	
f x≠0	31 61	
GTO 9	22 09	
5	05	
GTO 5	22 05	
f LBL 9	31 25 09	
f c	32 22 13	
f LBL 5	31 25 05	
h SF 0	35 51 00	
f d	32 22 14	Play machine's
h F? 1	35 71 01	move
DSP 9	23 09	
4	04	Machine wins?
RCL D	34 14	
h RCI	35 34	
1	01	
0	00	
÷	81	
+	61	
g x≤y	32 71	Game a tie?
h RTN	35 22	
f-x-	31 84	
B	31 22 12	
h RTN	35 22	
f LBL B	31 25 12	Entry to "RESET"
hπ	35 73	
f CL REG	31 43	
STO E	33 15	
h CF 1	35 61 01	
DSP 1	23 01	
h RTN	35 22	
g LBLf e	32 25 15	
h RCI	35 34	
2	02	
÷	81	
g FRAC	32 83	
h RTN	35 22	

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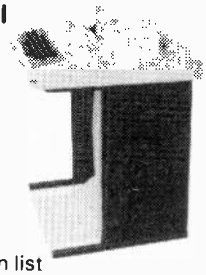

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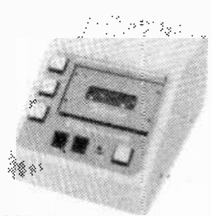

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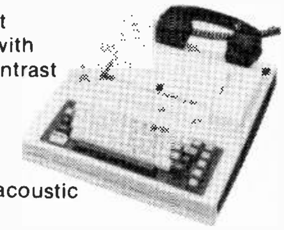

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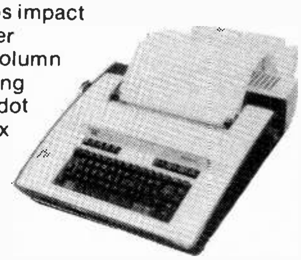

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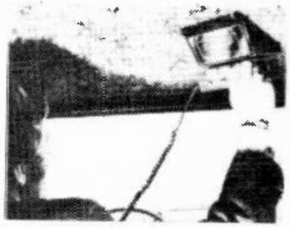

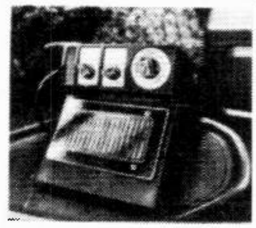

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± 15V, 100mA kit, ideal for op amps & ETI's Audio Feedback Elim. **19.95**
Kits are less cabinets. Add $1.00 post./hand.; Sask. orders add 5% tax.
Money Order or Certified Cheque ensures faster service. Thank you!

MA 1003 12VDC Crystal Controlled Car Clock, with 3 Switches.......... $24.95
Extruded Aluminum Case........... 4.95
MA 1002 AC Clock Module Kit with Transformer and Switches.. 19.95
Keyboard Kit, 88 Key, ASCI, PROM on Board, all New Parts................ 59.95

IC SOCKETS

8 Pin LP	.25	14 Pin LP	.25
16 Pin LP	.30	24 Pin	.25

VISA, MASTERCHARGE, COD, PMO All OK, $5.00 Min, Postage Extra

Send for our FREE 1978 Catalogue
ARKON ELECTRONICS LTD.
91 QUEEN ST. E. TORONTO, ONT
M5C 1S1

ETI Project File

Updates, news, information, ETI gives you project support

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.

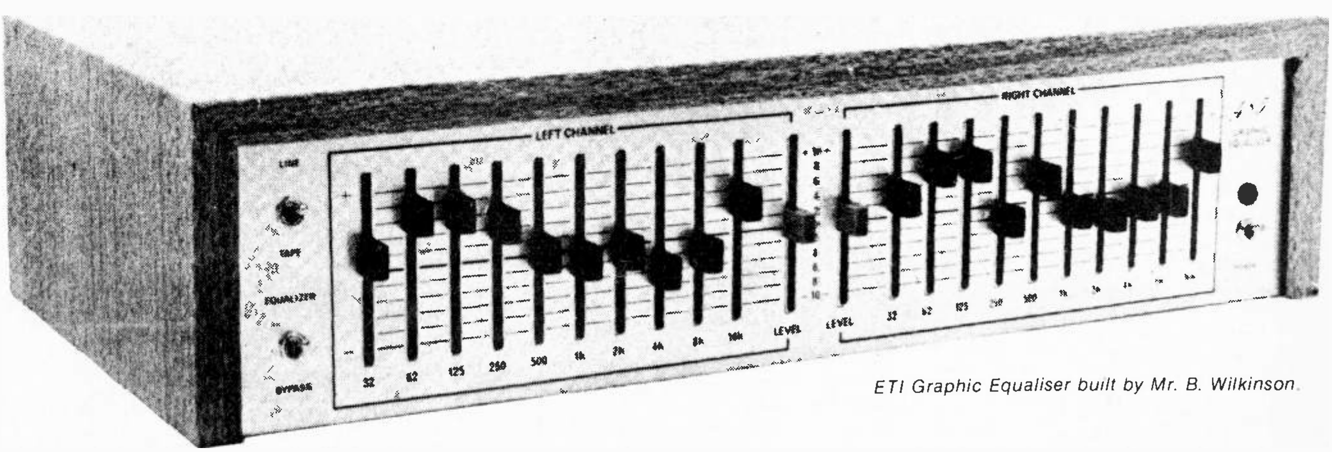
We obviously cannot troubleshoot the individual reader's projects, by letter or in person, so if you have a query we can only answer it to the extent of clearing up ambiguities, and providing Project Notes where appropriate. If you desire a reply to your letter it must be accompanied by a self addressed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



ETI Graphic Equaliser built by Mr. B. Wilkinson.

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.

Reader's Project

Mr. B. Wilkinson of Sydney sent us extensive details of the ETI Graphic Equaliser he built. He says that it works very well, and points out some "better ideas" he incorporated. These include putting the signal switches at the opposite end of the front panel from the power switch to reduce hum, and putting the two level controls in the middle so they may be operated together. He has enclosed a photo of his model — nice lettering job and cabinet, eh?

Project Notes

LED PENDANT
Jan. 78

The circuit diagram is correct but there are a few discrepancies between the schematic and component layout. The only important change required is that in the component layout C2 (+) should be shown connected to IC pin 5 rather than to pin 6.

CB PSU
Feb. 78

Q2 is the transistor which needs heatsinking, which should be obvious from the component layout. In addition Q2 and Q3 are interchanged in the How It Works description. Q3 is specified as a 2N3905, but in some situations, especially with a low-beta Q2, may not be heavy-duty enough, a TIP 30A would be better and should be used instead.

ETI Project Chart May 77 to May 78

ISSUE DATE	ARTICLE
May 77	Burglar Alarm
May 77	Ceramic Cartridge Preamp
May 77	Ni Cd Battery Charger
May 77	Bench Power Supply
May 77	Fuzz Box
May 77	Stereo Rumble Filter
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

ISSUE DATE	ARTICLE
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
Mar 78	True RMS Meter
Apr 78	Neg
Mar 78	Home Burglar Alarm

ISSUE DATE	ARTICLE
Apr 78	Neg
Apr 78	Computer PSU & Neg.
Apr 78	Audio Delay Line & Neg
Apr 78	Gas Alarm & Neg.
May 78	White Line Follower
May 78	Add-on FM Tuner
May 78	Acoustic Feedback Eliminator

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.

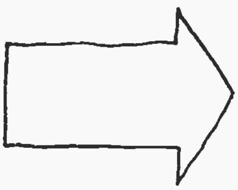
1977	1978
February	January
[redacted]	February
[redacted]	March
May	April
June	May
July	
[redacted]	
September	
October	
November	
December	

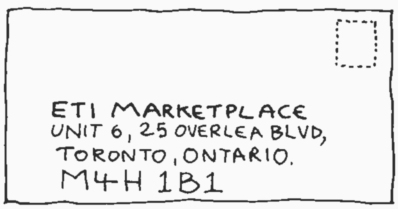
We can supply photocopies of any article published in ETI-Canada, for which the charge is $1.00 per article, regardless of length. Please specify issue and article. (A special consideration applies to errata for projects, see Project File.)

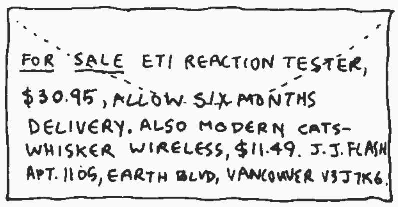
LIABILITY: Whilst every effort has been made to ensure that all constructional projects referred to in this edition will operate as indicated efficiently and properly and that all necessary components to manufacture the same will be available, no responsibility whatsoever is accepted in respect of the failure for any reason at all of the project to operate effectively or at all whether due to any fault in design or otherwise and no responsibility is accepted for the failure to obtain any component parts in respect of any such project. Further no responsibility is accepted in respect of any injury or damage caused by any fault in the design of any such project as aforesaid.

ETI MARKET PLACE

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.







WANTED BARLOW-WADLEY OR SIMILAR PORTABLE SHORT WAVE RECEIVER. STATION V01HH, BOX 500, CARBONEAR, NFLD. A0A 1T0.

FOR SALE OR TRADE TEST EQUIPMENT & NEW TUBES. WANTED G.R. 1606 R.F. BRIDGE OR EQUIVALENT. M. POWELL, JR., BOX 500, CARBONEAR, NFLD. A0A 1T0.

FOR SALE: TRANSISTORISED MULTI-METER WITH 5 POPULAR SCALES. ALSO, 5" **OSCILLOSCOPE** — NEVER BEEN USED. DETAILS — OFFERS, OTTO A. WEINKAUF, BOX 400, MACKLIN, SASK. S0L 2C0.

FOR SALE: REALISTIC SCT-11C CASSETTE DECK (STEREO). LIKE NEW. ORIGINAL PRICE — $280.00; SELLING PRICE — $225.00. OTTO A. WEINKAUF, BOX 400, MACKLIN, SASK. S0L 2C0.

DESPERATELY SEEKING A **QUAD TUBE TYPE F.M. TUNER** IN GOOD ORDER OR REPAIRABLE. PIERRE OLIVIER. 790 DE ROUSSILLON #2, LONGUEUIL, QUEBEC. J4H 3R7

FOR SALE: BEERCAT 210 RADIO SCANNER. NO EXPENSIVE CRYSTALS, SCANS 36,000 FREQUENCIES 32-50, 146-174 & 416-512 MHZ. BRAND NEW. PHONE OR WRITE. M P. YADAV, 1221, ALGONQUIN AVE., NORTH BAY. ONT. P2B 4Y3. PRICE $325 00

FOR SALE: HEWLETT PACKARD VOLTMETER MODEL 427A, BATTERY OPERATED, C/W CASE $350.00. BRUCE WINTER, 6528 BUTLER ST., VANCOUVER, V5S 3K9 (604) 435-6215.

FOR SALE: HAMMARLUND MODEL SP-600 RECEIVER, 0.54 MHZ TO 54MHZ, 6-BANDS, RECONDITIONED, $250.00. WRITE: K. PAON, BOX 139, CHARLO, N.B. E0B 1M0.

WANTED: TRIGGERED SCOPE DC TO 5MHZ+. USED, CHEAP. NON-WORKING OK IF SCHEMATICS AVAILABLE. M. PUPEZA (416) 599-6089 OR (416) 535-4127 HOME. (TORONTO)

WANTED DUAL TRACE SCOPE PLUS OTHER USED TEST GEAR. SEND DETAILS/ PRICE. RAY ALEXANDER, FREDERICTON JUNCTION, N.B. E0G 1T0.

WANTED: POWER TRANSFORMER FOR **EICO MODEL 460 OSCILLOSCOPE** (USED OR NEW). ALSO WANTED: MANUAL (OR COPY OF SAME) FOR **EICO MODEL 666 TUBE/TRANSISTOR TESTER.** RON AITKEN, 10840 AINTREE CRES., RICHMOND, B.C. V7A 3V1.

INFORMATION EXCHANGE: WILLING TO TRADE DIAGRAMS AND/OR IDEAS IN **AUDIO SYNTHESIS.** KEITH DANIEL, 6230 BANNANTYNE, VERDUN QUE. **H4H** 1J3.

LENLINE

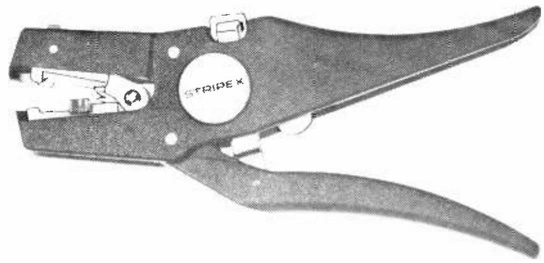
LENLINE

TOOLS FOR ELECTRONICS

STRIPPERS & CUTTERS

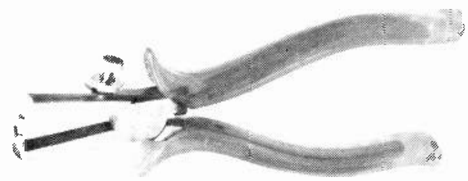
TC-112
STUDENTS TOOL KIT

Student technicians kit includes 12 of the most needed basic tools for electronic work. 30 watt Soldering Iron (CSA), Soldering Aid, Chain Nose Pliers, Side Cutters, Wire Stripper, Adjustable Wrench, 3 Nut Drivers, 3 Screwdrivers and a Jeflin Moulded Plastic Tool Box with Lift-Out Tray



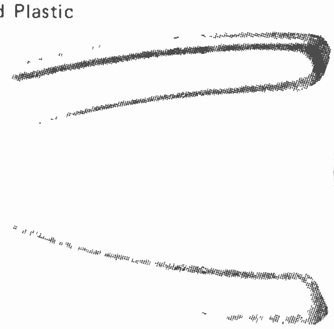
70-156
SELF-ADJUSTING
WIRE STRIPPER

A precision stripper and cutter. Strip 1 to 8 cables at one time. Strips most types of PVC wire and cable from 10 to 38 AWG solid or stranded. Strips insulation in 1 operation. Excellent for multi conductor cables. Durable but lightweight, made of nylon reinforced with fiberglass.



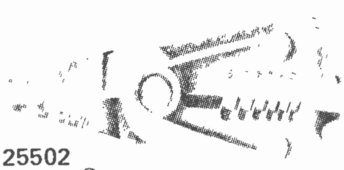
8802
WIRE STRIPPER

An end action stripper with a sensitive screw adjustment for setting the right cut to take only the insulation without nicking the conductor. Handles are insulated with vinyl cushion grips.



25502
PLIKE ® 4 IN 1
WIRE STRIPPER

The original 4 in 1 tool by Hunter. Combines Plier, Diagonal Cutter, Crimper and Stripper.



MILLER STRIPPERS

101-S

An excellent stripper and cutter for all commonly used stranded and solid wire. Features adjustable stop on handles for various wire sizes, and self opening spring.

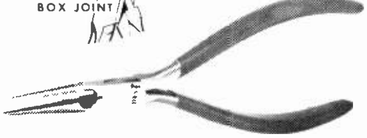
105

Similar to 101-S but with cable slitter for heavy duty loomex. Sharp adjustable blade mounted in a channel for drawing the wire through.

PRECISION PLIERS & CUTTERS

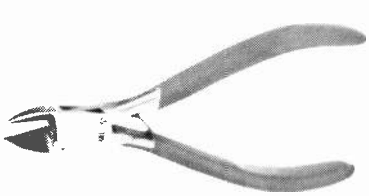
Box Joint Type

Made from German Tool Steel, wobble free box joints for positive jaw alignment with leaf springs for self opening operation.



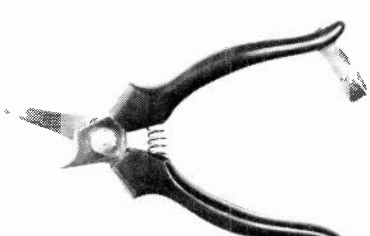
27B-5-1/2

5-1/2" long-nose plier with side cutter. Box joint, no spring. Blue cushion handles.



48C-5

5" flush cutter for soft wire. Box joint, leaf spring. General purpose. Blue cushion handles.

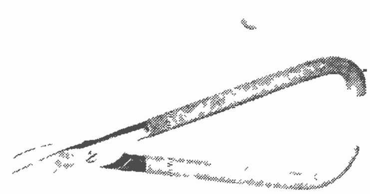


47
COMBI CUTTER

A universal cutter for cardboard, textiles, sheet metal, plastic, etc. Extra sharp teeth of stainless, refined steel with strong spring opening handles made of impact resisting plastic.

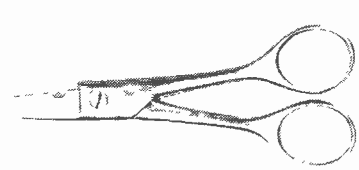
270-F
THIN PROFILE SAFETY
WIRE CUTTER

5" angled flush cutters with patented shearing action for soft wire to 20 gauge. Built-in lead catcher retains cut off wire. High carbon steel fabrication, double-coil spring return and unique vinyl foam non-slip handles for lower stress and operator fatigue.



70 PVC
JEWELLERS SNIPS

For cutting light metal, wires, insulation. Made of good cutlery steel with PVC enamelled handles. 7" overall length.

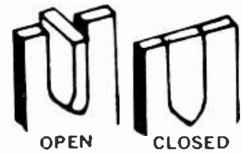


56A
WIRE SHEARS

Snub nosed, nickel plated cutting shears with a smooth edge. Tips are rounded. Has many uses where splicing, wiring, etc. is done.

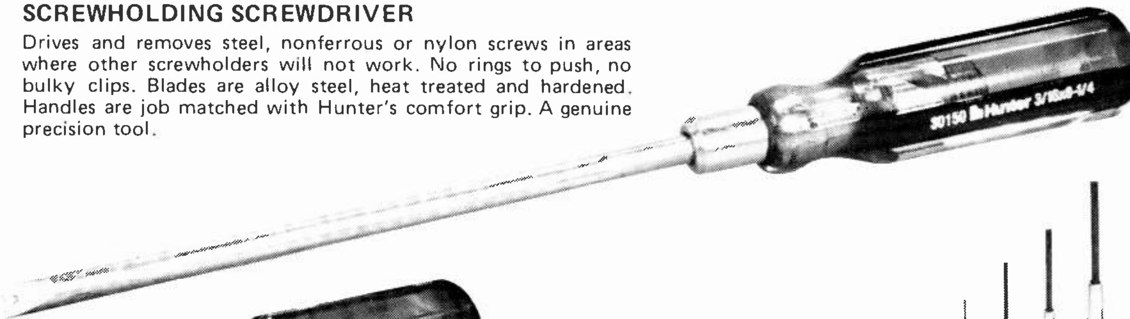
SCREWDRIVERS

LENLINE



HUNTER "MAGIC TIP" SCREWHOLDING SCREWDRIVER

Drives and removes steel, nonferrous or nylon screws in areas where other screwholders will not work. No rings to push, no bulky clips. Blades are alloy steel, heat treated and hardened. Handles are job matched with Hunter's comfort grip. A genuine precision tool.

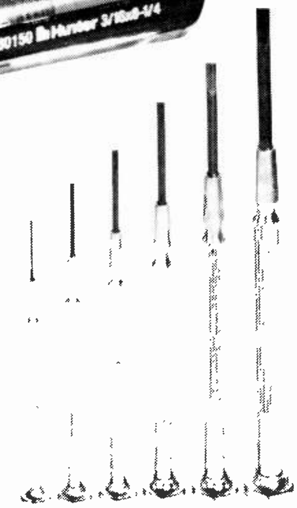


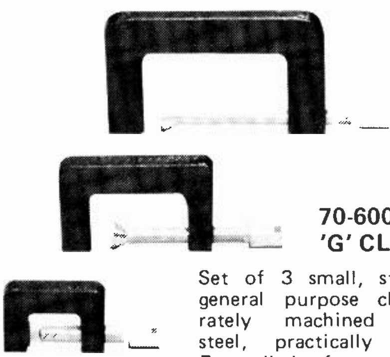
HUNTER NUT DRIVER

The most popular series of nut drivers. Precision sized socket with solid shaft for strength and durability with colour coded job matched comfort grip handles to take the fatigue out of the job.

CDVSP JEWELLERS SCREWDRIVER SET

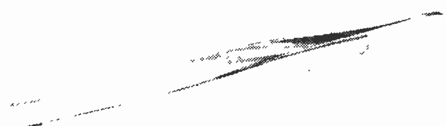
Screwdriver sizes 1 to 6 for work on watches, clocks, instruments, optical products, etc. Handles and swivel heads solid, non-rusting brass, nickel plated. Tempered tool steel blades. Straight nurled for good grip. Packed in attractive plastic box.





70-600 'G' CLAMPS

Set of 3 small, strongly made general purpose clamps. Accurately machined of carbon steel, practically unbreakable. Enamelled frame and plated clamp screw.



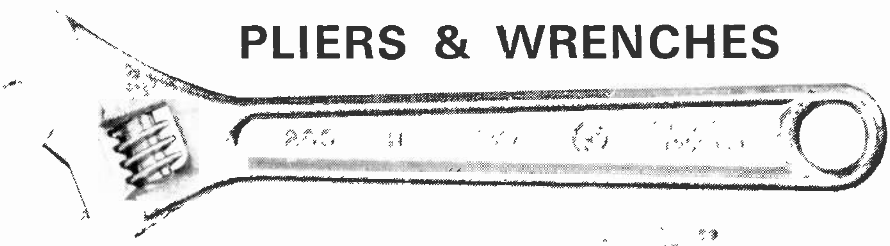
1512 TWEEZERS

These are extra long 8" tweezers, bright nickel plated. The tips are serrated. Available with straight or curved tips. For electronic assembly or repair.

5410 EYE MAGNIFIERS

Jewellers and tool makers series of magnifiers. Loupes for close up examination of all sorts of P.C.B. assemblies, components, machine work, etc.

PLIERS & WRENCHES

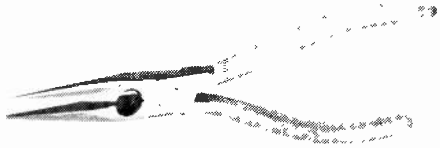


70-162 ADJUSTABLE WRENCHES

One of a series of convenient and useful wrenches, especially for the tool case or box. Made of molybdenum steel, fully drop forged and polished chrome finish on the head and dull finished handles.

70-107 NEEDLENOSE PLIERS & CUTTERS

German made 8" tool with polished head and red PVC covered handles (5000v insulation).

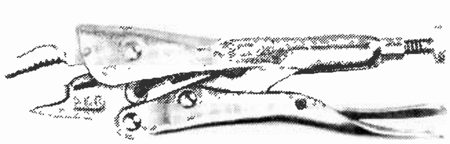


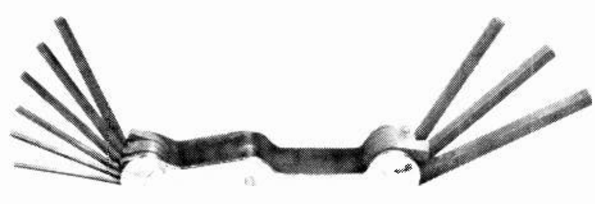
70-166 SLIP JOINT PLIERS

6 inch adjustable pliers, cadmium plated.

5WR 5" VISE-GRIP

U.S. made, rugged, curved jaw Vise-Grip locking pliers combine clamp, super pliers, locking wrench, hand vise and wire cutters . . . . all in one tool.



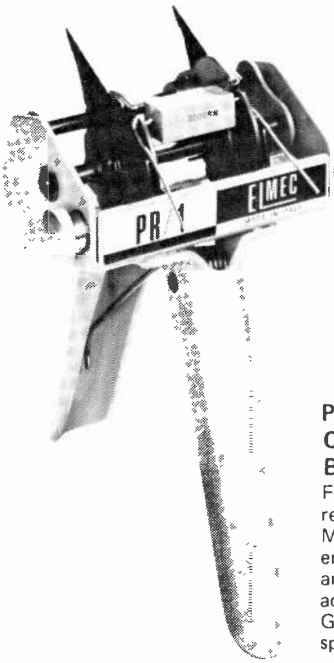


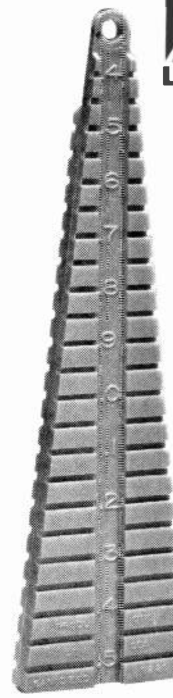
"SMITTY" HEX WRENCHES

The original and most popular folding Hex Key set from Hunter. Blades of cold alloy steel heat treated and hardened with special attention to the tips. Cases are deburred and heavily nickel plated for comfort and durability.

THESE PRODUCTS ARE AVAILABLE FROM YOUR FAVOURITE ELECTRONIC PARTS DISTRIBUTOR. IF YOU CANNOT LOCATE A LOCAL OUTLET PLEASE WRITE US FOR THE NEAREST DISTRIBUTOR IN YOUR AREA.

LEAD CUTTING & BENDING TOOLS





TP/2A
CUTTING & BENDING TOOL

Rugged but light tool evenly cuts and bends, at the same time, the leads on various components to be inserted into the P.C.B. Does leads from .3 to 1.5mm with no adjustment. Made of blue poliamide and glass fibre.

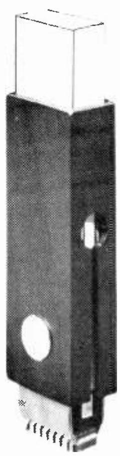
PR/1
COMPONENTS LEAD BENDING TOOL

For bending the legs or leads of resistors, capacitors, transistors, etc. Made of pressed iron with baked enamel finish. The bending clamps are of tempered steel. Bend distance adjustable from 12mm to 50mm. Guides on tool can be set to precise spacing required.

PD801
SPEEDY BEND

This affordable tool bends 1 component or 100 in less time than it takes to set up and run any automatic bender. 1 tool forms jumper, 1/4 and 1/2 watt resistor, and diode leads. Made of high impact cycolac plastic.

'IC' INSERTERS & EXTRACTORS

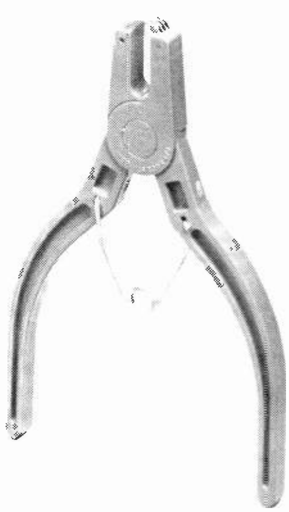


4990 SERIES
DIP INSERTER

Fastest manual inserter available. Compensating screw allows you to adjust for package tolerances and make corrections for lead spacing. Inserts with no stress on package body and is safe for M.O.S. and CMOS devices. Anodized aluminum and stainless steel construction.

565
IC EXTRACTOR

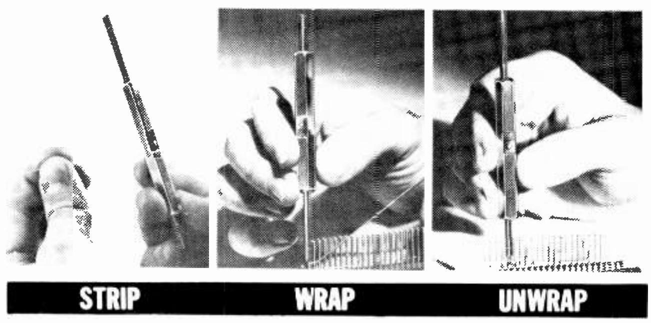
For use on up to 16 way D.I.L. integrated circuits. Made of plastic, small clip type opens over IC. Jaws grip IC under leads.

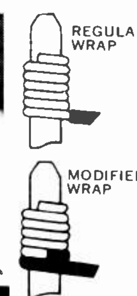


4916
IC EXTRACTOR

Unique plier type construction. Withdraws IC straight up out of the board without bending leads of the IC. Removes all 14-16-24 lead dual inline packages. Insulated, made of A.B.S. plastic.

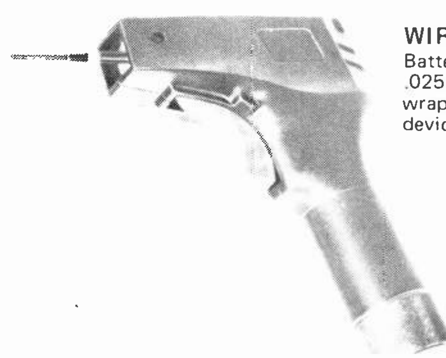
WIRE WRAPPING TOOLS





HOBBY WRAP TOOL

Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0,63mm) Square Post.

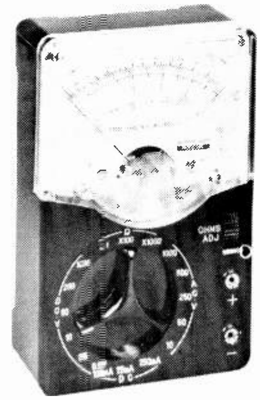


WIRE-WRAPPING TOOL

Battery operated wire-wrapping tool. For .025" (0,63mm) square post "MODIFIED" wrap, positive indexing, anti-overwrapping device.

SK-33
MULTIMETER

10,000 ohms per volt DC, 4,000 ohms per volt AC. Unit has unbreakable plastic meter front and single selector range switch. Size 3-3/8" wide x 5-1/8" long x 1-3/8" deep.



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LENLINE

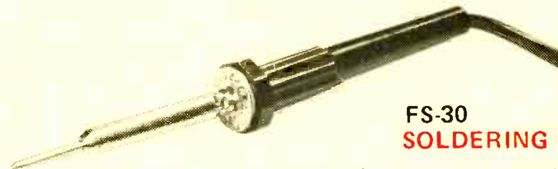
NIBBLER

03
HEAVY DUTY HAND NIBBLER
Cuts sheet metal up to 18 gauge, or plastic material up to 14 gauge quickly and cleanly without bending or distortion. Nickel plated, PVC coated handles and self or spring opening.

SOLDERING IRONS

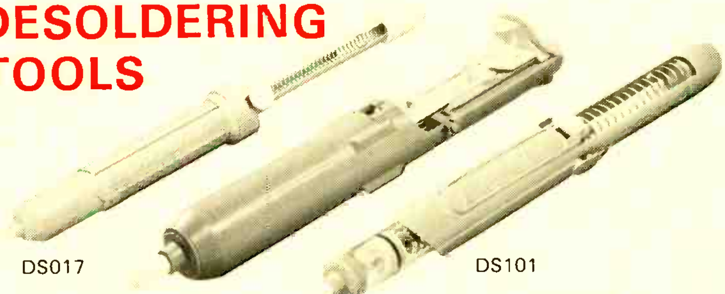
7700
QUICK CHARGE "ISO-TIP" CORDLESS SOLDERING IRON
Solder anywhere, anytime, indoors or outdoors. Kit consists of cordless soldering iron, recharging stand, one fine tip and one heavy duty tip. Premium long-life nickel cadmium batteries.

6500
"ISO-TIP" PC DRILL ATTACHMENT
This high speed drill attachment fits over the "ISO-TIP" Iron after tip has been removed. Ideal for drilling PC boards and removing components.



FS-30
SOLDERING IRON
30 watts, 110 volts AC. Comes complete with 4-1/2 foot 3 wire cord, tip and stand. Built-in light shield. Lightweight, comfortable to hold and use.

DESOLDERING TOOLS



DS017 US140 DS101

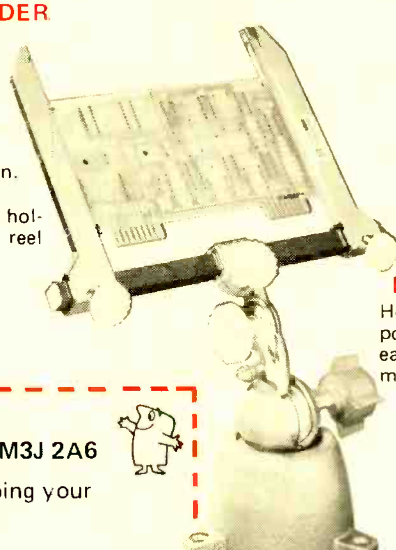
DS017 DELUXE "SOLDAPULLT" DESOLDERING TOOL. Extremely rugged for volume desoldering.

US140 UNIVERSAL "SOLDAPULLT" DESOLDERING TOOL. Compact tool for convenient tool box storage.

DS101 DELUXE "SOLDAVAC" DESOLDERING TOOL. Features an enclosed loading shaft with storage locks and clear barrel for easy cleaning.

CIRCUIT BOARD HOLDERS AND VISES

ST-10
CIRCUIT BOARD HOLDER
Freely rotatable with printed circuits clamped on it. Heavy base, clamp tilts for preferred working position. Useable as a soldering iron holder and solder reel keeper.



PANAVISE® CIRCUIT BOARD HOLDER
Holds boards of any shape, up to 8" wide, in any position . . . flat, vertically, at any angle. It is easily rotated, tipped, tilted, elevated, lowered, moved left or right, or turned over.

61
2 HEADED VISE C/W VACUUM BASE
Grips on any smooth surface. 1 large and 1 small jaw. Heads rotate in horizontal as well as vertical direction.

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