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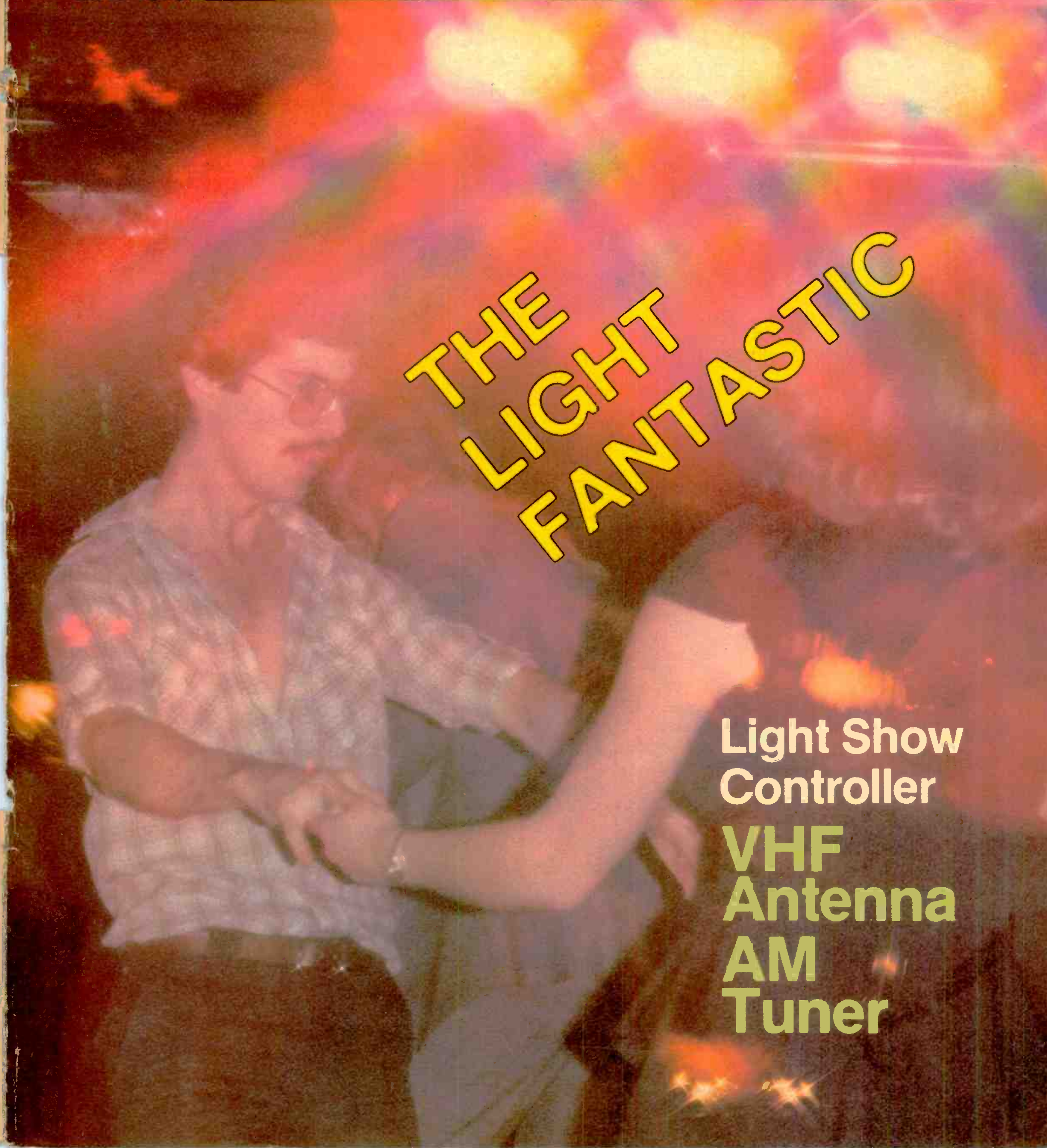
MAY 1979



THE LIGHT FANTASTIC

Light Show Controller

VHF Antenna

AM Tuner

Vol. 3. No. 5
MAY 1979

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INCORPORATING **ELECTRONIC WORKSHOP**

PROJECTS

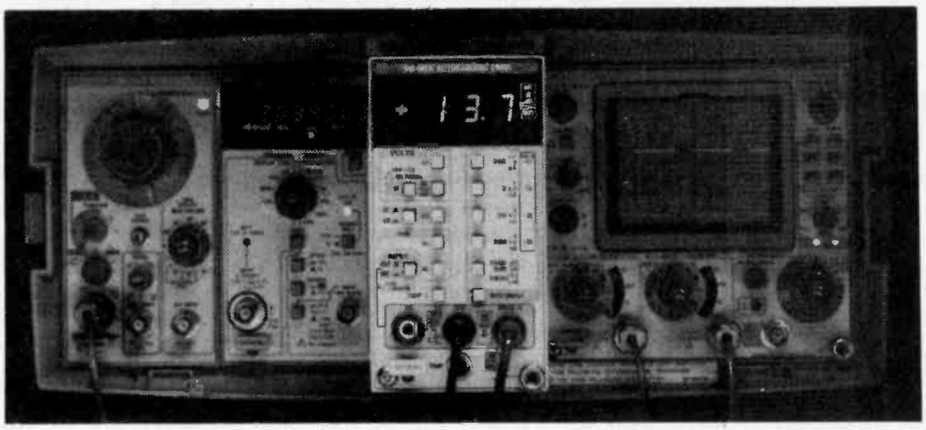
FEATURES

NEWS & COLUMNS

INFO & MISCELLANEOUS

Freak Out! With your own light show, see page 21. If you want the real thing, boogie down to Misty's disco at Toronto Airport Hilton — where we took this month's cover picture. Our thanks to the Hilton management who allowed John & Sue to shake their boodies.

NEWS DIGEST



Plug-In DMM

The latest entries in the Textronix DM 500 line of modular instruments are the DM 502A and DM505 digital multimeters. Seven functions make the DM 502A the most complete 3½ digit DMM availale. The DM 505 provides a five-function DMM (dc and ac volts, dc and ac current, and high/low resistance). The extra functions are the DM 502A are dBV and dBm measurements, temperature measurement, true rms readings, and autoranging for volts, and dB measurements.

With the high/low resistance feature, the low setting is used for in-circuit measurements where it is important not to forward bias diode junctions (maximum imposed voltage is 0.2V). The high setting (maximum imposed voltage 2.0V) is used where measurements on diode junctions are desired.

For further information, please contact: Tektronix Canada Ltd, P.O. Box 6500, Barrie, Ontario, L4M 4V3. Phone 705-737-2700.

Dialog

Lockheed Missiles & Space Company have arranged for Micromedia Limited of Toronto to represent their Dialog computerized information retrieval service in Canada. Micromedia will initiate a program of Dialog training sessions, demonstrations and exhibits.

Battery RF Generator

Clemens Manufacturing Co of St Louis has announced a new RF signal generator, their model SG-83C. It covers 50 kHz to 54 MHz in six bands and includes a 1 MHz crystal oscillator with usable harmonics to 30 MHz.

Amplitude modulation is included, is variable from 0 to 50%, and is indicated on a front panel meter. Power is 115VAC or from an internal 9 volt transistor battery.

The price of the SG-83C is $744, duty and FST exempt, FOB North Vancouver. For further information, contact National Electrolab Ltd, 1536 Columbia Street, North Vancouver BC, V7J 1A4. Phone 604-985-0511.

Science Den

A bookstore devoted to books on general science (no textbooks) has now opened in Toronto. 'Science Den' carries a wide assortment of personally-selected books, on all topics, and for all ages. Many of these books are not carried by ordinary bookstores. There is also an assortment of scientific games. More details from Science Den, 3701 Chesswood Drive, #208, Downsview Ont. M3J 2P6. Phone 416-638-5629.

Canadian Projection TV

The Vistavideon system is a self-contained unit with a 31x41 inch screen. In other words it is a TV set with a 52 inch (diagonal) screen. It is marketed by Advicon of 2616 Woodchester Drive, Unit A114, Mississauga, Ontario, L5K 3Z7. For more information you can call 204-233-3348.

The Beauty Of The Metric System

The latest addition to the metric system is said to be the millihelen. Apparently unconnected with the millihenry, the millihelen is the unit quantity of beauty sufficient to launch one ship.

VISC

Matsushita Electric has unveiled the development of "VISC", a home video disc player system capable of one-hour or two-hour playback in color with stereo sound.

The Matsushita system uses a 300 mm (12") diameter disc. The one-hour system called "VISC I" plays 30 minutes on each side and is suitable for musical or educational programme playback. The two-hour system, "VISC II", plays 60 minutes on each side and is suited for long program playback such as feature movies or sports events.

In order to record the 10 MHz signal conventional mechanical master disc cutting would take many times longer than the real disc playing time. But the newly-developed Matsushita direct cutting method makes it possible to record the signal in real playing time (by using the specially-developed "ultra precision micro-cutting stylus" which is driven by a peizo ceramic material device).

New developments of VISC are a 7-inch disc (7 minutes per side) and digital stereo adapter.

Gladstone's 1979 Catalogue

Gladstone Electronics' 1979 catalogue is now available free on request. Featured in the 48 pages are a wide variety of electronic products including stereo equipment, speaker kits, electronic test equipment, hobbyist kits, and electronic specialty items.

Unique product lines included are ILP Audio power amplifier modules, Sinclair digital multimeters, PAIA electronic music synthesizers kits, and speaker components by a wide variety of manufactures including Philips DeForest, KEF, Peerless and Decca.

From Gladstone Electronic Supply Co. Ltd., 1736 Avenue Road, Toronto, Ont. M5M 3Y7. Phone 416-787-1448.

Data 79

The Data 79 conference and exhibition takes place May 1 to 3, 1979, in Toronto, at the Queen Elizabeth Building Exhibition Place. Executive luncheons will be held each day at the Harbour Castle Convention Centre, with free transportation provided between the two locations. The luncheon speakers will be Gene Amdahl, Alvin Toffler and Gordon Thompson.

More i..fo from Data 79, Suite 2504, 2 Bloor St. West, Toronto, Ontario, M4W 3E2. Phone 416-967-6200.

Intelec 79

The first International Telecommunications Energy Conference was held last October, the next will be from November 26 to 29 this year. The event is sponsored by the IEEE Communications Society and will be held in the Sheraton Park Hotel in Washington, DC.

The Call For Papers has been issued with deadlines of June 15 for abstracts and September 15 for manuscripts. Enquiries about papers should go to M E Jacobs, Bell Labs, Whippany Rd, Whippany, NJ 07981. Enquiries about exhibiting power equipment should go to Jim Miller, Inc, E 8th Ave, Hialeah, Florida 33013 (phone 305-866-5154).

The Canadian Liason is being handled by J S Jezioranski, Bell Northern Research, PO Box 3511, Station C, Ottawa, K1Y4H7.

Telequipment Scopes

A new range of 10 and 15 MHz oscilloscopes, the Telequipment 1000 Series, comprises four models, each with dual-trace, single time base, a 10 x 8 cm display and 5% time and voltage accuracy.

For both bandwidths, 10MHz or 15MHz, models are available with 5m V, sensitivity or with 1mV sensitivity at 4MHz. The high-sensitivity models also offer a choice of modes: algebraic add, true X/Y, X5 vertical gain switching, and variable sweep speed.

A full range of triggering facilities is incorporated. The series has been specifically designed for reliability and ease of maintenance. For further information, please contact: Tektronix Canada Ltd, Marketing Communications Dept, PO Box 6500, Barrie, Ontario L4M 4V3. Phone 705-737-2700.

Zentronics Move

Zentronics of 99 Norfinch Dr, Downsview, Ontario, are moving to 1355 Meyerside Dr, Mississauga, Ontario, L5T 1C9. The new phone number will be 676 90XX; they wouldn't tell us the last two digits because they are offering a prize to anyone who can guess them.

Salon de l'Electronique

The Electronics Technicians' Association of Quebec announce the 3rd Salon de l'Electronique, at the Chateau Champlain, Montreal, May 24 — 27. All electronics technicians are invited free of charge, provided they show their business cards at the reception. Fifteen famous television and stereo manufacturers will present their latest products, including Sony's new projection TV, Magnavox's new video-disc, and Sony's new mini-stereo. Toshiba, Hitachi, Zenith, and RCA, will attend.

Seminars will be held on May 24th. Zenith will talk about their new System III, Magnavox about their computer 330 (TV set), Sony will hold two seminars on the Betamax II video-recorder. Toshiba will sponsor a lecture on micro-wave oven repairs, Sencore on test instruments and RCA on their SK semiconductor line. The Salon will open Thursday at 3.00 pm and will close at 10 pm. On Friday, Saturday the hours will be 10 am to 9 pm. On Sunday 10 am to 6 pm.

Digital+Analogue Watches

Get the best of both types of presentation with a watch from the new Heuer line. Five basic styles in the 1979 collection feature both types of display on the same watch face. The Senator, and the Manhattan use analogue dials with sweep-second hands, and have an LCD display set above the 12 on the dial. The Memphis Twin, the Verona Twin and the Carrera do not have the sweep-second hand but have the LCD set into the face of the watch (between the 4 and the 8 on the dial). The LCD section can be used as a stopwatch, can be used in sync with the analogue display, or can be used to show time in another time-zone (eg, GMT).

For more information contact the Chronometric Company, 17 Queen St E, Toronto, M5C1P9. Phone 416-366-5554.

AVO DMM

AVO's new DA-116 is a 3½ digit LCD DMM with ½ inch high characters. Standard features include overange indication, low battery indication, auto polarity, and the ability to withstand overload inputs of up to 1500 volts on the AC and DC voltage ranges.

For more information contact Metermaster, 214 Dolomite Drive, Downsview, Ontario, M3J 2P8.

ACA News: Marketing Mgr. 15MHz Scope, Xtal Oscillator, & RPM Convertor

David Green has been promoted to the position of Marketing Manager of Allan Crawford Associates Ltd.

In this new position he will be responsible for the planning and implementation of marketing programs covering all Allan Crawford product lines and divisions. Previously he held the position of Manager, Distributor Products, and was responsible for implementation and operation of the nationwide ACA Electronic Centres.

The new Gould Advance OS255 oscilloscope, available in Canada exclusively from Allan Crawford Associates, is a dual channel 15MHz instrument.

Another new product from ACA is the Wavetek model 2102 a precision 5 MHz crystal oscillator. The 2102 has an accuracy of 0.05ppm after one hour warm-up. Each of its two RF outputs will drive one 50 ohm load or up to five TTL devices.

Finally, ACA have a new RPM converter which measures rotary speed directly. Designed especially for tachometry applications in the automotive industry, the RPM coverter accepts inputs from ignition coil primaries, magnetic proximity pickups, and optical pickups. The unit operates as a frequency-to-voltage converter calibrated to read out directly in revolutions per minute. It is plug-in compatible with Gould 2000 series recorders or may be operated independently.

For more information on any of the above items, contact Mr. David Green, Allan Crawford Associates Ltd, 6503 Northam Drive, Mississauga, Ontario, L4V 1J2. Phone 416-678-1500.

NEWS DIGEST

Pulse Function Generator

A new 30 MHz pulse/function generator, the Exact model 734, is now available in Canada from Webster Instruments Ltd.

As a pulse generator, the 734 produces pulses 10 ns to 10 ms wide with periods from 34ns to 10,000s in 12 overlapping ranges. These pulses can be single, double or delayed. Dedicated outputs include ECL, $\overline{\mathrm{ECL}}$, TTL, and $\overline{\mathrm{TTL}}$.

As a function generator, the 734 produces sine, triangle, square, and pulse waveforms at 30 V P-P open circuit. (15 V P-P into 50 ohms) over a frequency range of 0.0001 Hz to 30 MHz, allowing millivolt signals to be offset by as much as + 7.5 V for noise immunity tests.

Tools and Meters

Seven new products this month from Len Finkler.

First product is a range of terminal strips that are end-stackable via interlocking dovetails (to create strips of any desired length). The terminals feature vibration-proof screws for secure clamping of solid or stranded wires (16-26 AWG). Bodies are molded of high dielectric nylon. Electrical rating is 5 amps at a nominal 50 VDC. Pins facilitate soldering to PC boards.

Xuron model 270F is a 5", thin-profile, safety-angled, flushcutter with patented shearing action for soft wire to 20 gauge. A lead-catcher is built-in.

Xuron model 280 thin profile wire cutter has low-mass, right-angle blades providing maximum visibility and control for flush-cutting.

The first of four meters from Hansen is model AT10, a 10,000 ohms-per-volt (on DC ranges) multimeter. Features include overload protection, battery test, and dB scale. An "L1" scale facilitates semiconductor testing.

Hansen model At105 is a 5,000 ohms-per-volt (on AC ranges) multimeter. Features are basically the same as the two meters mentioned above.

Hansen model AT20 features 100-degree meter, overload protection, dB scale, and the "L1" scale. Sensitivity is 20k/8k ohms-per-volt (DC/AC).

The Hansen model AT205 multimeter features 50k ohms-per-volt (10k on AC ranges). The 100-degree meter has the same protection and scales mentioned above. For further information contact: Len Finkler Limited, 25 Toro Road, Downsview, Ontario, M3J 2A6. Phone: 416-630-9103.

Club Call: SHARC

The South Huron Amateur Radio Club was formed in January and has about 25 members. The club operates the VE3OBC 2m repeater (146.31 in, 146.91 out). Another project is assisting prospective hams. Further info is available from Clark Forrest, VE3BOF, Box 255, Hensall, Ontario, N0M 1X0.

Voltage Standard

The Data Precision 8100 is a line-powered, dual output (111 mV and 11 V DC), EMF reference source introduced by Webster Instruments Ltd.

For more information contact: Mr. Roger Webster, Webster Instruments Ltd. P.O. Box 427, Port Credit PS, Mississauga, Ontario, L5G 4M1. Phone 416-275-2270.

Atlas News

Five items this month from Atlas Electronics, 50 Wingold Ave. Toronto, Ontario, M6B 1P7. New Phone: 416-789-7761.

On February 23rd after many years on Cavendish Boulevard, Atlas Electronics Limited, and Noresco Canada Incoporated, the recently acquired consumer electronics division of the Atlas group of companies, moved into new Montreal offices at 970 Montee de Liesse in St. Laurent. Telephones: Atlas: 514-337-5260; and Noresco: 514-337-5503.

Available from Atlas is the EP series of Corcom RFI power line filters which was developed to provide noise suppression in switching power supplies. One of the features is that these filters bring switching-type power supplies into compliance with German and the proposed North American specifications.

Atlas can now supply the 1979 RFI Power Line catalogue from Corcom. This new catalogue features technical data on the design and application of RFI Filters.

Also available in this area is a 12 page application brochure is available on the use of RFI & EMI line filters.

The final item available from Atlas is a new mini catalogue on tools & terminals from Vaco. The catalogue describes the complete line of screwdrivers, pliers, speciality tools and solderless terminals.

DP935 DMM

Last month we mentioned the Data Precision 935 LCD DMM available in Canada from Webster Instruments Ltd. Two corrections are needed: the number of ranges is 29 (not 20) and the $198 price includes duty but not taxes. More details from Webster Instruments Ltd, PO Box 427, Port Credit PS, Mississauga, Ontario, L5G4M1.

microfile

Pet Software

The following PET programs are now released with complete documentation:

1. ENTRY, list price $24.95. Used as a general-purpose data entry program for business applications with user definable entry format. The program may be used for a mail list, daily journal, general ledger, record keeping etc. It works with cassette printer and other IEEE devices.
2. PROCESS, list price $24.95. General purpose data process program designed for limited data processing power on the PET. Basic operation includes SORT, EDIT, DELETE, INSERT, and MACRO. The program is particularly useful for merging large amounts of data from different input sources.
3. DCE TEXT EDITOR and FORMATOR, list price $24.95. This word processor package makes full use of the screen editor and includes all cursor movements with repeatable cursor. Data is exactly what you see on the screen, pages may be scrolled up and down. Output margins and justification are user definable. Programs are written in machine language, 4K bytes are left free for user text data.
4. INVENTORY, list price $24.95. Inventory control program on the PET. Data includes item #, description, quantity on hand, reorder limit and prices. It generates an inventory report and a low inventory report. It can handle up to 60 items on the 8K PET. Data may be instantly inserted, deleted, or changed in the memory.

For more information contact the Home Computer Centre, 6101 Yonge Street, Willowdale, Ontario M2M 3W2. Phone 416-222-1165.

NEWS DIGEST

OSI for Business

Ohio Scientific has a new disk-based small business accounting system, OS-AMCAP, which is furnished on three 8" floppy disks, and may be used on any Ohio Scientific 6502-based system with 48K of RAM and at least a dual-floppy capability.

American Microprocessor Equipment and Supply, developer of OS-AMCAP, offers problem solving by phone every day and every evening except Sunday evening. Training is offered by Ohio Scientific dealers. Suggested US retail price of OS-AMCAP is $975. For further information, contact Nancy M. Valent at 216-464-3636.

Intelligent Terminal

The CT-82 intelligent terminal features 128 software based control functions, graphic capability, upper and lower case 7 x 12 dot matrix characters (82 characters per line), editing capabilities, rolls, scrolls, slides and other similiar functions. It can block transmit data to the computer or output material to a remote printer. Protected fields, shift inversion, and dual intensity are provided. The keyboard has fifty-six alphanumeric keys plus a 12 key cursor pad (or optional numeric pad). The terminal will work with almost any computer system or modem interfaced RS 232 serially from 50 to 38,400 baud. The terminal is intended for business, industrial, educational or personal use.

The CT-82 is made by Southwest Technical Products and is available from SDS Technical Devices Ltd, Box 1998, Winnipeg, Manitoba, R3C 3R3. Phone 204-944-1448.

Shamrock Canadian Computer

Mr R Hugh Patrick, President of Patrick Computer Systems, Inc, has announced the introduction of Canada's first S-100 based computer system. Called the "Shamrock" the Z-80 micro-computer features two Shugart SA-400 disk drives, 32K RAM (expandable to 64K by plugging in ICs), both for a serial and a parallel port, CP/M DOS, E-Basic and a software driver for Centronics printers.

The "Shamrock" is shipped complete with 10 blank diskettes, full documentation, and to allow expansion, both power and installed connectors for 5 more S-100 circuit boards. An interface board from the S-100 and the IEEE-488 Instrumentation Standard is just one of the optional interfaces available either as part of the "Shamrock" or available separately.

The price is $4000, shipped prepaid anywhere in Canada. Delivery is stock to three weeks.

For further information contact Mr R Hugh Patrick, Patrick Computer Systems Inc, 499B-491 Portage Avenue, Winnipeg, Manitoba. Phone 204-775-5741.

Micro Analyser Module

A general-purpose module from Motorola can be used to monitor activity on virtually any microprocessor. Model 10264A connects Hewlett-Packard's Model 1611A Logic State Analyzer to a microprocessor, allowing the user to see, in real time, the system's operation. More details from the Inquiries Manager, Hewlett-Packard (Canada) Limited, 6877 Goreway Drive, Mississauga, Ontario, L4V 1M8.

Intertube Terminal

The Intertube uses a Z-80A to control all internal functions, unlike older design terminals that use TTL logic chips. The end result is that the Intertube does not require a cooling fan, and therefore is silent in use. The selling price for the terminal is $1425, FST incl. Educational and quantity discounts are available. For more details call 613-725-3192, or write Compumart, PO Box 6132, Station J, Ottawa, K2A 1T2.

Graphic Digitizer

The Ladd Graphic Digitizer Model 241 has movable coordinate zero and adjustable scale readouts for X and Y. It uses ordinary ball-point pen or similiar stylus as the input device. Unlike capacitive or magnetic sensing tablets, there is no effect on accuracy by conductive, ferromagnetic, or variable dielectric constant media (eg, metal sheets, paper with graphite pencil markings, etc). Resolution is 0.1 mm and reproductibility is plus or minus ½ least significant digit (4000 counts). Working area is 11" x 15" (28cm x 38cm), and interfaces are available to connect to any calculator, printer, or computer. Output codes can be binary, BCD, EBCDIC, or ASCII, per customer option.

For more details write Commetrics Ltd, PO Box 278, St. Lambert, Quebec J4P 3N8. Or phone 514-672-4534.

8088

Intel Corporation plans to announce the 8088, claimed to be the world's highest performance 8-bit microprocessor. It contains the 16-bit internal architecture of the 8086 combined with the 8-bit bus interface of the 8085A. The 16-bit internal structure provides the superior 8-bit performance.

The 8088 is 100 percent software compatible with the 8086. It features advanced arithmetic and alphanumeric (ASCII) data capabilities so that programs require fewer instructions and run faster than with other 8-bit machines.

The internal architecture of the 8088 is essentially the same as the 8086. The 8088 features 20-bit addressing which means it can directly address up to a megabyte of memory. The memory space is addressed in segments of 64K bytes with a very flexible address development structure. The device has 24 addressing modes including those with three levels of indexing (base register value, index register value, and displacement) summed then added to the appropriate segment register to create the addresses. These modes make it easy to perform string, table and metric operations within the basic instruction set. Segmentation allows program code and data to be dynamically relocated by moving the code or data and changing the value of the segment register.

The 8088 contains its own hardware 8-bit and 16-bit signed and unsigned multiply and divide instructions. Arithmetic operations can be used with binary, ASCII or packed decimal (2-digits per byte) numbers. In addition to its number crunching capabilities, the 8088 includes many string operations specifically intended for handling alphanumeric data.

Inside, the 8088 is divided into two processors — a bus interface unit (BIU) and an execution unit (EU). The bus interface unit handles input/output data transfers and interfaces with memory. It continually fetches instructions and stores them in a four byte queue. The execution unit, which includes the ALU (Arithmetic/Logic Unit) executes the instruction stream from the queue and manipulates the internal registers.

The 8088 is being sampled now and will soon be shipped for distributor stocking. Pricing will be available shortly.

Audio Today

Developments in audio reviewed by Wally Parsons

THOSE OF YOU who were here last month will recall that we discussed some of the potentialities inherent in matrixing the two stereo channels into different combination forms.

For those who were out changing the snow tires while all this was going down, a brief summary:

Most of the information needed to reproduce an audio signal in stereo is transmitted identically along two channels. That is to say, the signal in each channel is identical to the other in all respects except for those signal components which convey spacial and directional information. This can be verified empirically by listening alternately to only one channel of a stereo programme at a time. Generally, you won't miss very much of the music itself; even instruments which ordinarily should come from one side or the other will still be present in each channel, albeit with some differences in level . . . sometimes.

It follows, then, that the two channels can be combined into one by simple mixing and all the *essential* information will be there. Of course, there will be no directionality or spacial perception. For this we require additional information which is transmitted as the *difference* between the two channels. This is not *essential* information in the sense used here, a fact which can be demonstrated by extracting the difference signal and listening to it by itself. This can be accomplished by combining the two channels out of phase with each other; signal components which are equal to each other in phase and amplitude in each channel will cancel out, leaving only signals in which there is a *difference* of either phase or amplitude, or both. Listen to the centre stage disappear, even though reverberation of it may be audible. Especially try this with a live FM broadcast of a concert or other show such as Belafonte at Carnegie Hall, (any version) or perhaps Nana Mouskoura. Or listen to the opera and marvel as a singer moves across the stage while singing, starts off at one side, disappears as the centre is approached and gradually re-appears on the other side. This is why it is not really *essential* information; by itself it is not useable, while an in-phase sum is.

When the two channels are combined in-phase, any out-of-phase components in the two channels will tend to cancel out, and if their amplitudes are equal, cancellation will be complete. The result is mono sound, with no sense of directionality or of spacial quality. SO WHAT!

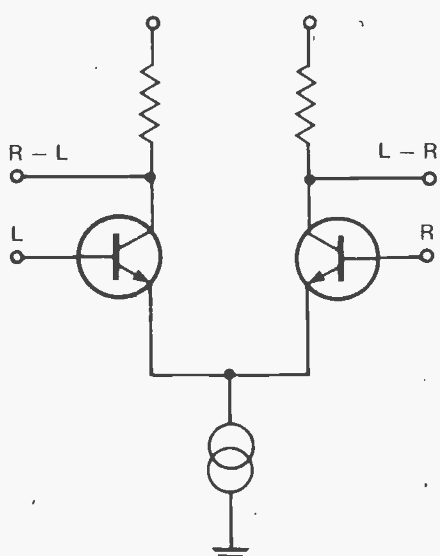


Fig. 1. R–L and L–R from L and R.

Figure 1 shows a practical way of obtaining both a L-R and a R-L difference signal. By applying each channel signal to a different input of a differential amplifier, the input at each base appears at both collectors, but opposite in phase. This is true if each input is a different signal or if they are the same, but of opposite phase. However, since the sum of the currents in each transistor must always equal the current through the constant current source, which by definition is constant, then if identical signals appear at each base, there can be no change in current, therefore no gain. Since anything times zero equals zero, there is no output from such an input.

The first obvious use for such a circuit is in providing for rear channel ambience enhancement. Since a great deal of the difference signal is, in fact, hall ambience, and is of a random nature, by feeding such signals to separate amplifiers and rear speakers much of the spaciousness normally associated with quadraphonic sound is introduced into the reproduction. By adding a suitable time delay system, phase shift networks, and/or tailoring the frequency response of the rear channels a wide range of sonic ambience can be simulated. Figure 2 shows in block form how this may be accomplished.

Figure 3 shows a simple two input mixing circuit, suitable for providing a L+R signal. Suppose we wish to install a fairly elaborate music system, in which all rooms in a home are provided with music from the main system. Or perhaps it's a commercial installation or even a studio in which some large areas are to be provided with stereo sound, perhaps from a music system, or an on-stage performance, or possibly on-air programme. Ordinarily we might install two lines one for each channel, but suppose some areas are to be covered by mono only, say the bathroom, kitchen, laundry room, work-shop, or possibly hallways, and so forth, while others require stereo. If we are using separate amplifiers at each monitor location, a highly desireable practice, even if not the cheapest, the two difference signals can be sent along a twin pair, one signal on each side, while the sum signal is sent along another pair as a balanced line. A mono station can take a feed only from the sum line, possibly requiring only one line to be routed into a given area. If stereo is required at another station both lines can be fed in and the original channel arrangement recovered by adding, or mixing, the sum signal with each of the difference signals. Here's how it works. Suppose we wish to recover a Left channel. If we mix the L+R sum signal with the L-R difference signal, the L components being in phase will add up to 2L, while the R components being out of phase, will cancel, giving zero R. Similarily if we combine L+R with R-L we get 2R and zero L. Figure 4 shows one way of combining the signals. Figure 5 is a more elaborate system, similar to one used in many FM multiplex decoders.

Needless to say, we still have the option of quadraphonic simulation as before.

If you've been paying attention, another option becomes apparent, we don't need the two difference signals. Since they are inverse expressions of each other, we only need one signal, which we can invert as needed to produce the other. And if we wish to preserve balance, another differential

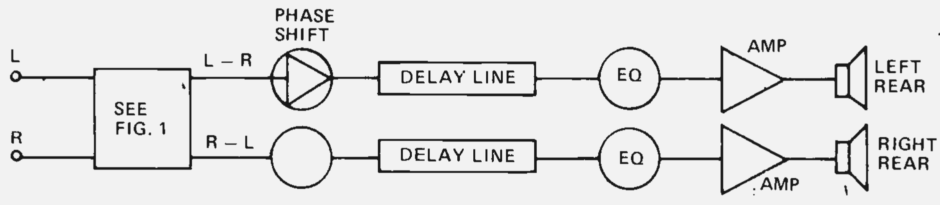


Fig. 2. Rear channel simulates sonic ambience.

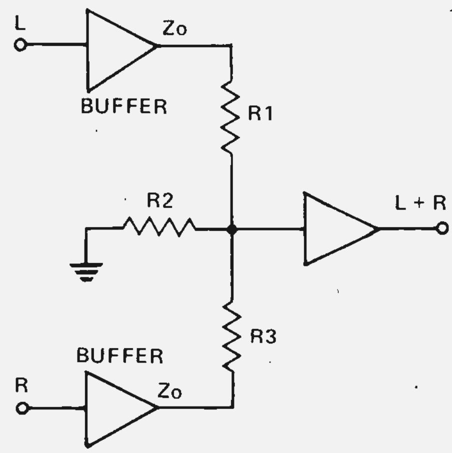


Fig. 3. Summing L and R together.

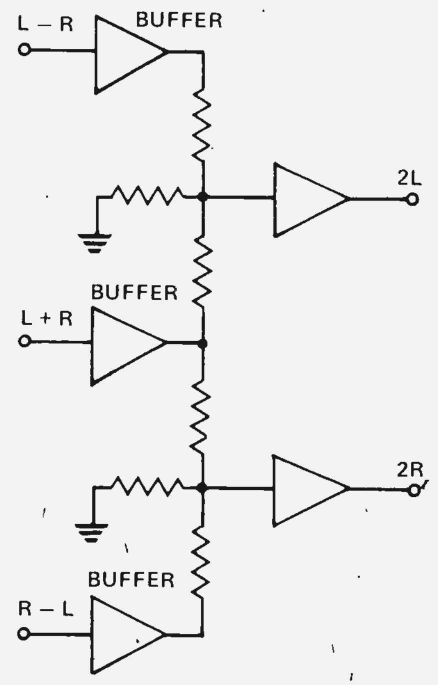


Fig. 4. How sum and difference are used to get L and R.

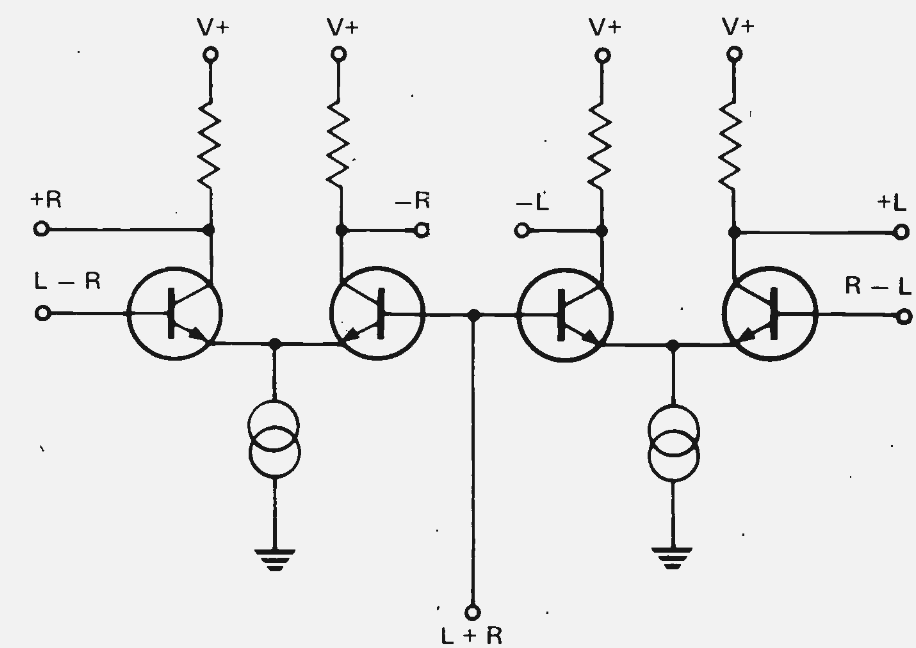


Fig. 5. A transistorized Fig. 4.

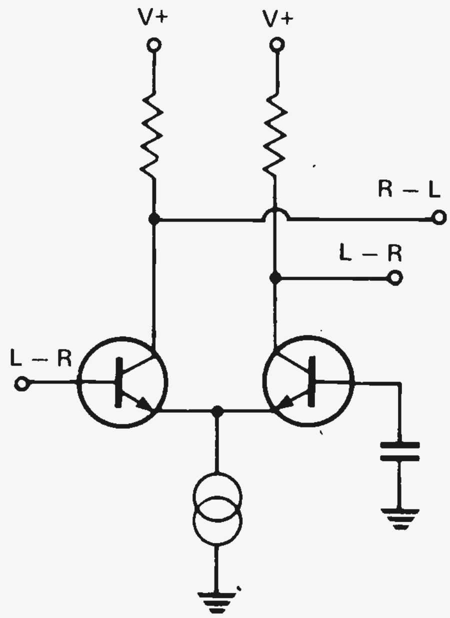


Fig. 6. Inverter and buffer scheme.

amplifier will do it as in Figure 6. Turning back to our elaborate installation again, if we are prepared to provide the inverting circuitry at each station, then we can send both signals over a shielded pair.

SEPARATION

This last facility might seem like no big deal, because we can do the same with two discrete stereo channels, can't we? Yes, but not so well. There's always the problem of cross-talk with two lines running in proximity. Since the original channels are re-created by combining sum and difference signals, it is possible to control the channel separation by varying the ratios in which the two signals are combined. With discrete channels we can only reduce separation, that is blend channels, to some value below that received, whereas, by increasing the magnitude of the difference signal in the final mix, it is possible to *increase* separation, thus compensating for unwanted blending.

This is easily demonstrated with an FM Stereo tuner. Insert an equalizer between the detector and the decoder which will provide a boost above 20 kHz. This will boost the level of the difference signal transmitted, and it's even possible to turn even a wall-to-wall muzak signal into ping-pong stereo. This is *not* recommended, by the way, as a method of increasing separation of such a tuner. Unless the filter response is precisely shaped you'll likely boost the upper side-bands more than the lower, with resulting distortion.

A PRACTICAL PRE-AMP

One major difference between a very good pre-amp selling at a high price and an apparently similar one selling at a much lower price, and with audibly inferior performance lies in the area of imaging quality. Although the whole subject of phase response and its importance in sound reproduction is rather controversial, attention to this aspect seems to characterize many of the best components. Much experimentation has shown that the preservation of phase relationships between channels is of significance in such image parameters as front-to-back depth, elevation and overall ambience. The ability of the ear to ignore very large amounts of phase shift on single tones, and even complex tones in a single channel programme has been observed by many researchers, yet we seem very sensitive to the effects of even a few degrees shift between two channels whose combined output is intended to reproduce a three-dimensional sound field. This seems quite reasonable when we consider that only left and right images alone are *real* images, and all others are virtual, and that phase relationships form part of that illusion, and, indeed, are part of our directional senses.

The implications are clear for any frequency selective circuit, such as equalizers and tone controls, and even volume controls. In order that accurate channel balance be maintained, volume controls must track very closely, something which costs money. The same holds true for tone controls, filters, and variable equalizers, with the additional problem of varying phase shift due to changing time constants. On top of that, even fixed equalizers will show significant phase differences as a result of capacitor tolerances.

On the other hand, small changes in the ratio of sum and difference signals, when combined, will only produce a slight change in the *amount* of channel separation. Phase differences similarily will alter somewhat the amount of separation, but in neither case are the effects as serious. Thus, with a sum and difference system we don't have to spend a king's ransom in order to maintain close channel matching.

Earlier we made reference to the ability to vary channel separation. This can also be frequency selective. By applying boost to a frequency band in the difference channel, it is possible to increase separation in that range, or conversely, a roll-off will reduce separation. Why would we want to do this? Separation increase can be useful in compensating for deficiencies in other components such as pick-ups. Even more useful, however, is the ability to reduce noise without loss of high frequency response. Because noise is random in nature, many of the components will be common to both channels much of the time. Therefore, in the sum channel they will cancel out. By not applying the noise components from the difference channel, it remains cancelled. The ear is more tolerant of less separation than of less response. Obviously, this not a cure for serious noise problems, but is useful for moderate cases.

At the bottom end, one should remember that the difference signal appears on discs as vertical modulation. By removing the difference signal at low frequencies, we also reduce or eliminate infra-sonic signals due to record warp, without reducing low frequency response.

Figure 7 shows, in block diagram form, a pre-amp system which incorporates many of these features.

So far, all we've discussed have been active circuits. Some of these techniques can also be applied passively in loudspeaker circuits. Next month we'll see how. Including a stereo speaker in a single box.

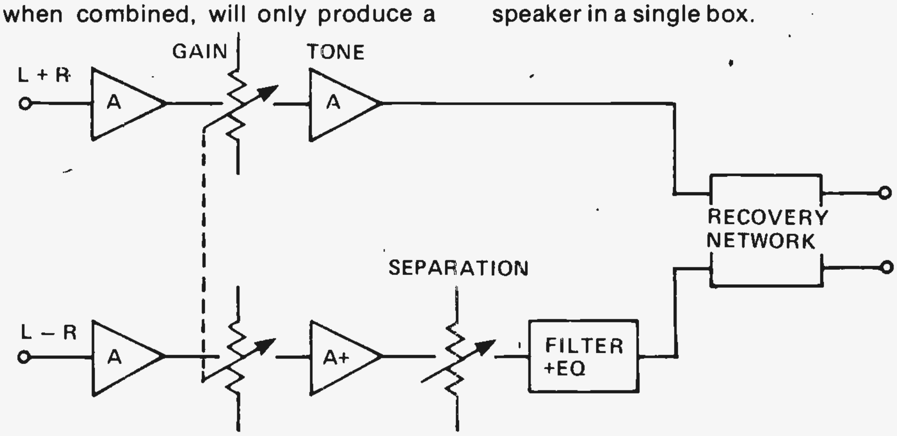


Fig. 7. Messing around with the sum and difference for effect.

Audio Today Letters

Want to express your views or report on news? Write to Audio Today, ETI Magazine, Unit Six, 25 Overlea Blvd., Toronto, Ont. M4H 1B1.

PHILIPS SPEAKERS

Going back to the July '78 issue of ETI, you mention modifying the Philips dome midrange, AD 0211. I am at present using its predecessor, the AD0210 in a homebuilt system, along with the AD0162 Philips tweeter and the Quam 10C20 woofer, and I have also noticed the ringing in the midrange. Could you please tell me how to remedy this situation?

P.S. Keep up the good work — both you and ETI — one of the few magazines worth its money nowadays. Many thanks. How about a loudspeaker construction article?

E.H. Vancouver B.C.

If any of you sceptics think I make up these complimentary letters, you're welcome to look at the originals.

Anyway, by now you will have received the speaker modification sheet. However, I doubt very much that it will eliminate the ringing you complain of. The modification is not intended to make a good speaker out of a poor one, but rather is an improvement on what is already an excellent unit. True ringing is more likely to be due to improper cross-over design. You might find, though, that the AD1600 tweeter is a better match to your midrange.

Keep on asking for those loudspeaker articles. Enough requests, and it will be forthcoming.

I have just read the February issue of ETI magazine. The only reason I buy your magazine, is for your column. You can expand it anytime.

Can you please send me information regarding the speaker system you are currently building, especially the surgery on the AD0211. Unfortunately I have not read your July column, and would appreciate more information.

I feel today, that building a speaker system is about the only side of audio that the home constructor can truly get involved in. A column dealing in some depth with this topic would be a first in any North American Magazine (Note from W.P.: Pay attention Steve). I like the idea of using speakers readily available, such as the Philips line.

Elsewhere in your magazine comments are made regarding sources of electronics parts. I think this could be very useful. I spent many months, eventually unsuccessful, trying to find non-polarized tantalum capacitors, 2% silver micas, and precision resistors. At the time I was trying to update a Dyna PAT-5.

Hoping you can send along details regarding your speaker design.

J.D.J., Belleville, Ont.

What would you do with non-polarized tantalums in a PAT-5? Anyway, you're not likely to get any, so you might as well roll your own. Connect two units back to back as in fig. 1. Each one should be equal to the desired final value. If only a few milliamps of current are required, you can use hot-carrier (Schottky) diodes. Otherwise use signal diodes, and by pass the whole network with a mylar unit of about 10% of the total value.

Contrary to what you might have read (maybe in all those magazines which ETI readers say they don't really read anymore) electrolytics should not be simply connected back to back.

As for the rest of your parts, I can only suggest Electro Sonic in Toronto. Call the order desk at (416) 494-1555 and order a catalogue. It's worth the ten bucks. Other suppliers, pay attention. This is a free plug for a company which doesn't need one. How about dropping a line to ETI and get a mention. It's free, except for the postage. While you're at it, ask about our attractive advertising rates, and all those readers who are begging to know about you and your products.

If you've read this month's column you'll know that I don't agree that the speaker is the only thing left for the audiophile to get involved with. That's just Japanese brain-washing. It's really one of the toughest, because any fool can build a speaker that works. The trick is to make a **good** *one.*

Anyway, for full details on the Parsons designed transmission line, come to the Audio Trade Show in Toronto this summer. We're presently working on a production version, and although somewhere along the way I intend to publish design data, in all fairness to my associates, this will have to wait until after commercial production is launched.

My reply to your last letter prompted a rash of applications for membership in the Audio Engineering Society. Hope you were one of them. If you can make it to a Toronto meeting some time, look me up.

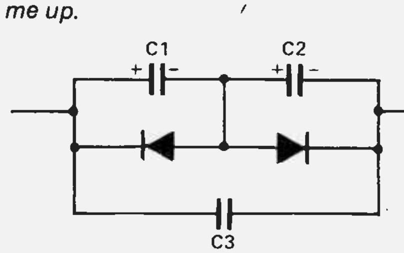


Fig. 1. (letters) Non-polarized capacitor in disguise.

Audio Today Products

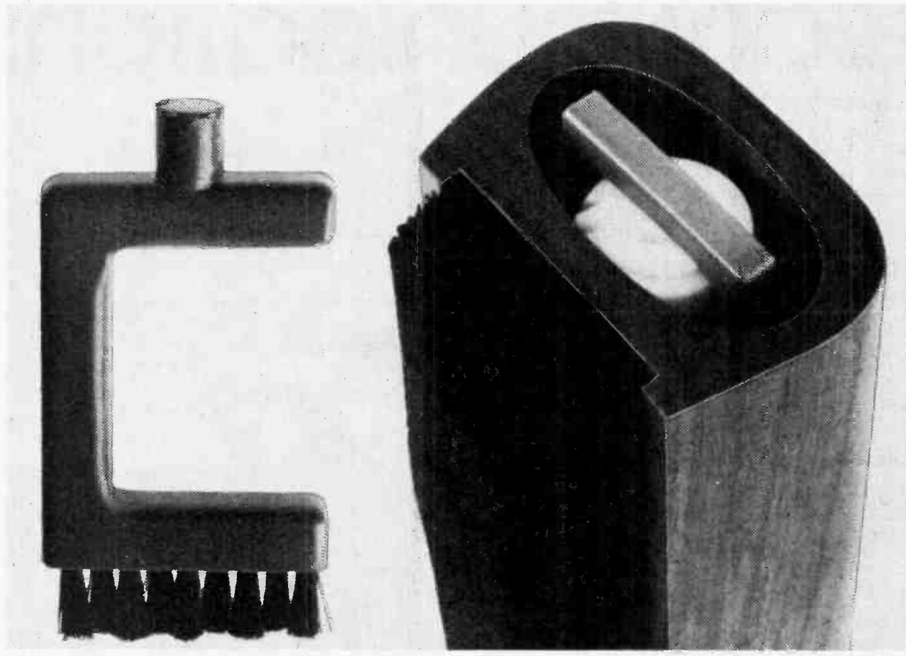
Audio developments reviewed by ETI's Contributing Audio Editor Wally Parsons.

From the people who brought you the DISCWASHER and DISCTRAKER comes the DISCKEEPER, a precision record rack (for precision records, natch). It features a calculated compression bar to hold records flat and upright, but which pulls forward to allow browsing.

Made of solid walnut and custom-formed anodized aluminum, in dark shades of natural wood and matte black, it comes with wall mounting hardware. May also be installed in multiples, on racks, etc. Price $119.00.

H. ROY GRAY LTD, 14 LAIDLAW BLVD, MARKHAM ONT L3P 1W7 Phone (416) 294-4833.

Ever felt bemused over the problem of cleaning a record cleaner? After all, a plush pad may take the guck off the record, but what takes the guck off the pad? No more need you wipe it on the cat, because the DISCWASHER people (same guys) now market a brush for that purpose, the model DC-1. Actually it's intended specifically for use with the DISCWASHER pad, and fits into the bottle hole along with the D3 fluid in the DISCWASHER system. No doubt it will work with other pads more or less effectively. And no fair wiping the *brush* on the cat.



Space Shuttle Communications

The successful operation of the Space Shuttle is dependent on a complex communications and navigation system. By Brian Dance.

THE SPACE SHUTTLE has been designed to carry out a very wide variety of missions, including the launching of international communications satellites, of space laboratories, etc. The Orbiter vehicle employed for the Shuttle contains complex communications systems; these systems have been carefully designed to provide all facilities required for the various missions with very little modification of the communications equipment for any particular mission.

The Orbiter vehicle carries up to 23 antennae for communications with ground stations, with detached payloads launched by the Orbiter, and with the Orbiter vehicle crew when they are carring out extra-vehicular activities. Information can be transmitted as voice or data signals using these antennae over a wide range of radio frequencies in the S-, Ku-, L-, C- and P-bands. The frequencies used for various purposes are listed on Table 1.

GROUND LINKS

The S-band equipment in the Orbiter vehicle can communicate directly with the US ground station at White Sands, New Mexico or with other stations of the US Space Tracking and Data Network (STDN), the frequencies being somewhat over 2000 MHz. Two digitised phase-modulated links are available for this purpose, the four frequencies being shown in Table 1.

In addition, frequency modulated signals are transmitted from the Orbiter to the ground on an S-band carrier together with the frequency modulated data from the "Development Flight Instrumentation" (DFI) equipment

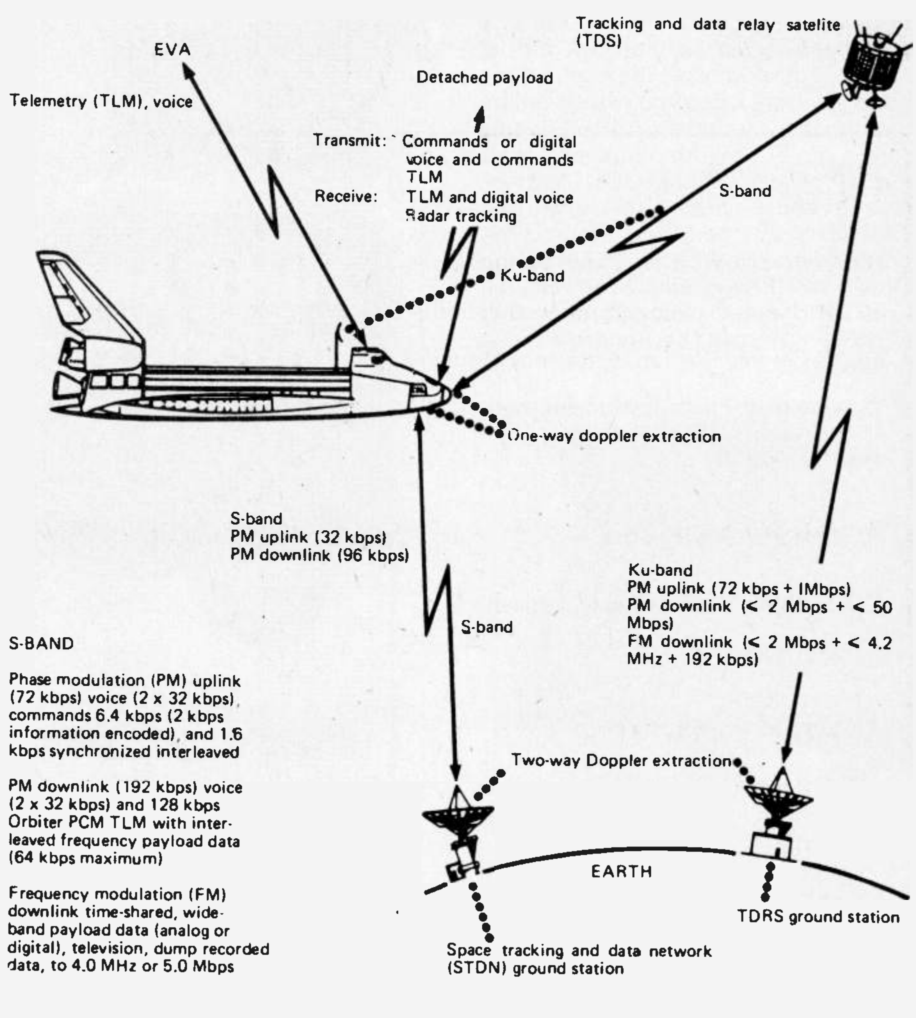
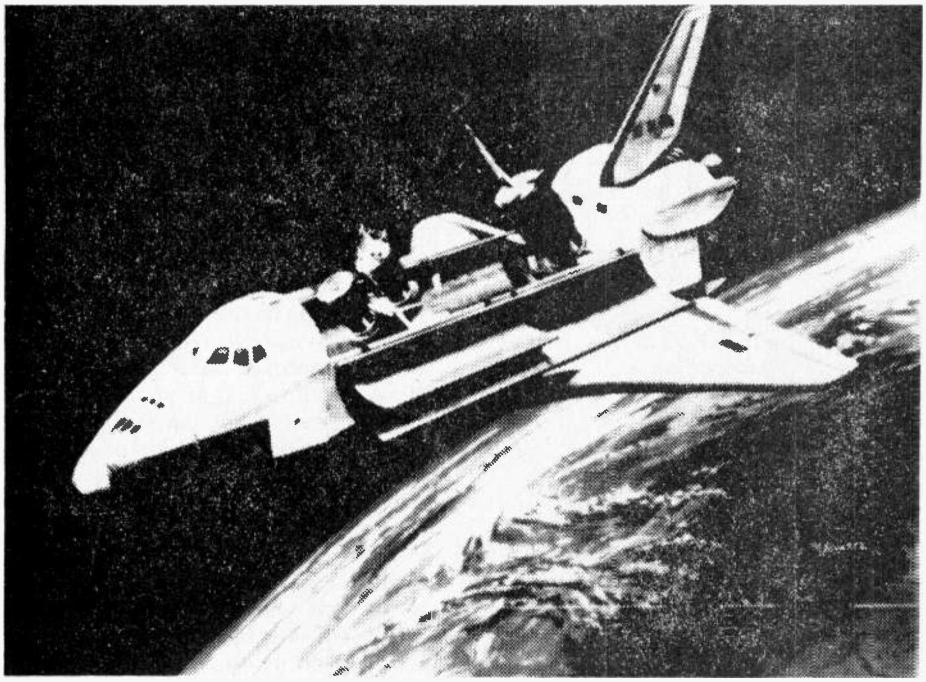


Figure 1. Overview of Space Shuttle communications.



use of Tracking and Data Relay Satellites which will be placed in geosynchronous orbits 35800 km above the equator over the Atlantic and Pacific oceans. The Shuttle can employ S-band frequencies for communication with one of these satellites, but Ku-band frequencies can also be employed for wide bandwidth links capable of high data rate operation (Fig. 1).

The satellites can relay signals to and from the earth using Ku-band frequencies at data rates of up to about 2 megabits/second. The advantage of using relay satellites is that one or both of the satellites will be able to "see" both the orbiting Shuttle vehicle and also a particular ground station at least 95% of the time the Shuttle is in orbit. The satellite link carries the same kind of information as the direct S-band link, but much higher data rates are possible. The information carried will include scientific and engineering data, command signals, digital voice transmissions, video signals and performance monitoring information.

Multichannel two-way communication between the Orbiter vehicle and either attached or detached payloads is also available using S-band frequencies. However, the Orbiter rendezvous radar and the microwave scan beam landing system operate in the Ku-band.

Table 1. Channels and uses.

FUNCTION OR SYSTEM	ORBITER TRANSMIT	ORBITER RECEIVE
STDN Communication, Phase Modulation – 1	2287.5 MHz	2106.4 MHz
STDN Communication, Phase Modulation – 2	2217.5 MHz	2041.9 MHz
STDN Communication, Frequency Modulation	2250.0 MHz	None
Development Flight Instrumentation	2205.0 MHz	None
NASA Payloads	2025.0 to 2120.0 MHz	2202.5 to 2297.7 MHz
Separated payloads	1760.0 to 1843.0 MHz	2202.5 to 2297.7 MHz
Extra-vehicular activity communications	296.8 MHz	259.7 MHz
Rendezvous radar	13.679 to 13.887 GHz	13.679 to 13.887 GHz
Ku-band communications	15.0034 GHz	13.775 GHz
TACAN	1025 to 1150 MHz	962 to 1213 MHz
Air traffic control, voice	296.8 MHz	259.7 MHz
Microwave scan beam landing system	Ku-band	Ku-band

carried aboard the Shuttle during its test flights.

During the Orbiter approach and landing phases of any mission, standard L-band TACAN units will be employed, as well as C-band radar altimeters and P-band analogue voice links for air traffic control. Voice communications for extra-vehicular activities will also use the P-band.

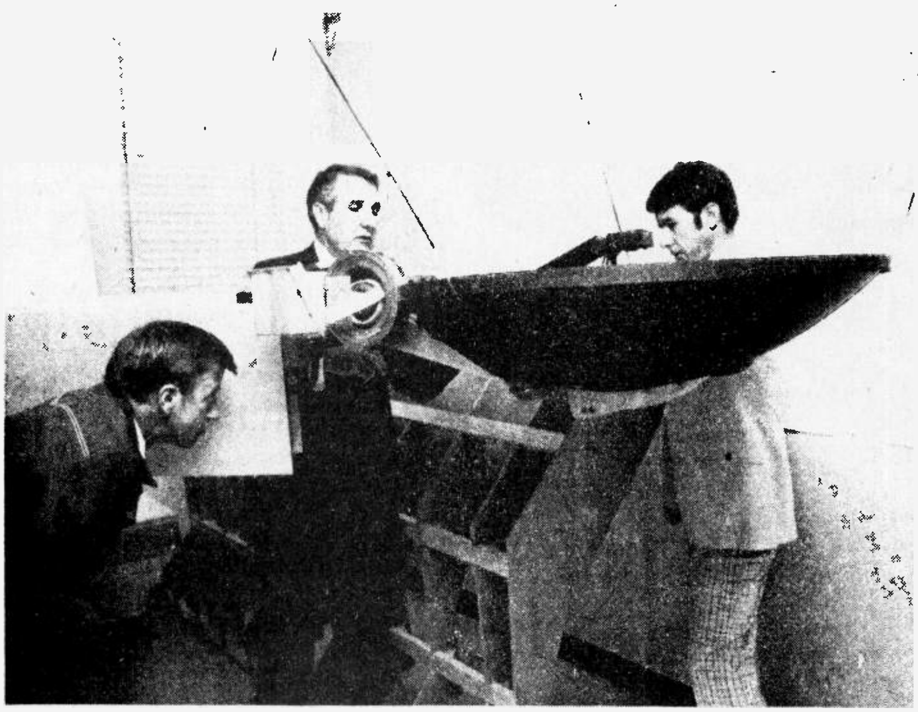
Communications with the earth networks will also be available through the

S-BAND SYSTEMS

A variety of voice, command signals and telemetered data can be sent to or from the Orbiter vehicle using S-band links. Phase modulated signals beamed directly at the Orbiter vehicle from the Space Tracking and Data Network stations or relayed by means of a satellite can be transmitted at two different data rates. In the high bit rate mode, two digital voice channels at 32 kilobits per second per channel and 8 kilobits per second of command data are inter-leaved into a 72 kilobits per second digital data stream.

The low bit rate consists of a single 24 kilobits per second digital voice channel together with 8 kilobits per second of command data. Transmissions via the relay satellite are convolutionally encoded.

Two bit rate modes are available for transmissions from the Orbiter directly to a ground station or via a satellite using phase modulation. The high bit rate mode accepts two digital voice channels at 32 kilobits per second per channel inter-leaved with 128 kilobits of telemetered information to form a 192 kilobits per second stream of digital



Orbiter Astronauts Paul Weitz (left) and Bill Lenoir (right) examine antenna and microwave portions of full scale mock-up of the Shuttle Ku-band Integrated Radar and Communications Subsystem set up at the Hughes Aircraft Company with program manager Lowell Parode.

information. Data from a payload can occupy up to 64 kilobits per second. When the low bit rate mode is being used, one channel of a digitised voice signal plus 64 kilobits per second of a telemetry signal can be inter-leaved for transmission.

The S-band frequency modulated signals from the Orbiter sent directly to ground can carry signals from the payload and Orbiter with a 4.5 MHz maximum bandwidth. The signals can include recorded voice, real time closed circuit television, main engine data, etc.

The Orbiter can transmit or relay a 2 kilobits per second command signal to attached or detached NASA payloads. Commands to free-flying payloads are sent at a one or two kilobaud rate by using a ternary frequency shift keyed (FSK) amplitude modulated signal. A 500 or 1000 Hz synchronisation signal is provided as the amplitude modulated signal.

KU-BAND SYSTEM

The Space Shuttle Orbiter vehicle will employ an integrated radar and communications Ku-band subsystem packaged in two sets of assemblies. One of these, Radar/Communications A, is carried aboard the Orbiter as standard equipment. It employs an antenna mounted on the starboard payload bay door and an electronics assembly. During the ascent of the Orbiter, the antenna is stowed in the space between the payload bay door panels and the clear volume of the payload bay.

Before the Shuttle can use the tracking and data relay satellites for communications work, it must first locate the satellites in space. When the vehicle first arrives in its orbit, the cargo bay doors are opened by the crew using a remote control system. The parabolic antenna moves into its operating position. The general location of the satellite is obtained from the Shuttle's computer and fed to the communications and radar subsystem. The antenna then makes a spiral scan of the area until it finds the target satellite.

In communications acquisition, the search is first performed over an 8° spiral conical scan, but if the satellite is not found, the search is automatically expanded to a 20° scan. Scanning ceases when the increase in the received signal indicates a successful acquisition of the satellite, a complete 20° search for a satellite about its expected position taking some two minutes.

RADAR SEARCH

Radar search for objects near to the Shuttle vehicle can be carried out using a somewhat wider scan of 30°. The Ku-band radar and communictions subsystem can detect, acquire and automatically track a passive target at a range of 19 km if it has an equivalent radar cross section of one square meter. In this passive mode only the reflected radar beam is detected, but the maximum tracking range is increased to 560 km when the target is fitted with a transponder beacon which is triggered by the radar beam (active mode). The radar system can acquire a target in no more than 60 seconds after being directed along the expected target vector and can provide line-of-sight range of the target, angles relative to the Orbiter rendezvous axis, rates of change of range and of angles at any distance from the maximum down to 30 m.

The Shuttle's radar and tracking facility enables the Orbiter vehicle to locate and rendezvous with objects in low earth orbits, such as satellites or space experiment packages, without any assistance whatsoever from the ground. For example, a satellite which was not working correctly could be located and the Shuttle could be brought to rendezvous with it so that the Shuttle crew could try to repair the satellite in space. Alternatively, the Shuttle crew could load some types of satellite into their cargo bay so that the satellite could be returned to earth for maintenance. This facility adds greatly to the cost-effectiveness of the Shuttle.

During rendezvous operations the ground station communications system is not normally required to operate over its high data rate link. Thus the Ku-band system can be used entirely for radar purposes, other communications systems on board the Shuttle being available for voice communications with the ground during rendezvous operations.

The Ku-band communications system can operate in two modes when sending data to the earth via the tracking and data relay satellites. In mode 1 rates of up to 50 megabits per second of wide-band data from an attached payload, plus up to five megabits per second of operational, stored or experimental data and 192 kilobits per second of operational data can be transmitted. The mode 2 transmissions consist of 4.5 megabits per second of television analogue data from either the Orbiter vehicle or an attached payload or four megabits per second of payload data, plus up to five megabits per second of stored or experimental data and 192 kilobits per second of real-time operational data from the Orbiter.

Table 2.

GENERAL CHARACTERISTICS:			
Radar and communications transmitted EIRP			52.8 dBW
Maximum data rate			50 Mbps
Radar detection range:	passive		22.2 km
	active		556.6 Km
Weight:	Set A		117.3 kg
	Set B		83.9 kg
Power consumption:	Radar		422 W
	Communications:	Set A	464 W
		Set B	434 W
RADAR CAPABILITIES WITH PASSIVE TARGET:			
Search and acquisition volume			±30°, 30.5 m to 22.2 km
Range accuracy (to 3 times standard deviation)			24.4 m or 1%
Velocity accuracy (to 3 times standard deviation)			0.3 m/s
Angle accuracy (to 3 times standard deviation)			8 mr
Angle rate measurement accuracy (to 3 times standard deviation)			0.14 mr/sec
COMMUNICATIONS CAPABILITIES:			
Search and acquisition volume			±10° about designated point
Forward link:	data rate		216 kbps
	spread spectrum code rate		3.0 megachips/s
	Signal power density from satellite:		
		acquisition	2×10^{-13} Wm^{-2}
		track	0.8×10^{-13} Wm^{-2}
Gain/Noise temperature			6.0 dB/°K
Return Link:	data rate		50 Mbps
	Signal power at satellite		3.0×10^{-12} Wm^{-2}
NARROW-BEAM ANTENNA PERFORMANCE			
Antenna type			Parabola — focal point feed
Diameter			0.914 m max.
Overall depth			31.8 cm max.
Weight			1.8 kg max.

If a continuous Ku-band transmission of data is required over more than 40% of an Orbiter's orbit, then a second set of Ku-band equipment is required. This extra equipment, Communications B, is for communication only and not for radar use. It permits the Orbiter to communicate with both of the tracking and data relay satellites, sequentially, without disrupting the flow of data during the satellite handover sequence from one satellite to the other. However, the weight of the additional equipment must be deducted from the maximum weight of the payload which can be carried.

Further details of the Integrated Radar and Communications Subsystem is given in Table 2. This Ku-band system is being manufactured by Hughes Aircraft Company for the main Shuttle contractor, Rockwell International, for delivery in 1979.

FIBRE OPTICS

At the present time fibre optics links are receiving great attention for ground based communications applications systems and have been included as part of experimental telephone systems. However, they have also a great potential as a signal carrying system aboard satellites and other space craft. It is therefore expected that at least one fibre optics experiment will be included as part of the payload of the first operational flight of the Space Shuttle.

NASA has chosen a number of experiments to measure how well fibre optics will be able to withstand the unusual conditions of a space environment; the length of the original experiments may be of the order of six months at radiation dose rates of about 1000 to 10 000 rad/year. In addition to monitoring the performance of different types of fibre optic line, the project will test designs for mounting techniques, terminal coupling and sheathing.

Light emitting diodes will be used for providing the light pulses in microprocessor controlled experiments using digital signals at a 10 MHz rate. The microprocessor will programme the test signals through each fibre line in turn on a pseudo-random code with a detector set to measure the threshold error level for each line. The equipment designed by the Jet Propulsion Laboratory is expected to be able to detect changes in the losses in a line of 0.01 dB.

GLOSSARY OF TERMS

ATC	Air traffic control
C and T	Communications and tracking
DFI	Development flight instrumentation
Downlink	The link from an Orbiter or satellite down to earth
EVA	Extra vehicular activity
FSK	Frequency shift keying
G, N and C	Guidance, Navigation and Control
IRCS	Integrated radar and communications subsystem
kbps	kilobits per second
KSC	John F. Kennedy Space Centre (launching centre)
LOS	Line of sight
Mbps	Megabits per second
MSBLS	Microwave scan beam landing system
MSFC	George C. Marshall Space Flight Centre, Alabama
NASA	National Aeronautics and Space Administration
PCM	Pulse code modulation
PM	Phase modulation
OMS	Orbital manoevering subsystem
OPF	Orbiter processing facility
RCS	Reaction control subsystem
SGLS	Space-ground link subsystem
STDN	Space tracking and data network
TDRS	Tracking and data relay satellite
TDRSS	Tracking and data relay satellite system
TLM	Telemetry ●
Uplink	The communications link up from the earth to the Orbiter or to a satellite
VAFB	Vandenberg Air Force Base, California

ASCII Keyboard Kit

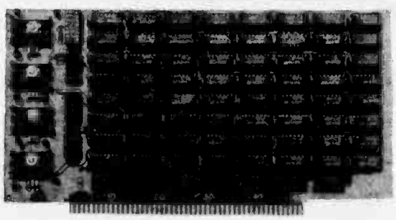
The ARKON KB-1 keyboard has been developed for use with many popular microcomputers using standard ASCII. Uses the popular KR2376 ROM IC.

- TTL/DTL/MOS Compatible
- Odd/Even Parity
- 2 Key Rollover
- N Key Lockout
- Debounced
- Plus/Minus Logic

The kit is easy to build, uses tested prime parts and fits into a standard Hammond box. Uses +5v -20ma, -12v-5ma.

Complete kit of parts with instructions	$69.95
Optional power supply PS-1	$14.95

8K Lowpower RAM Kit



Fully socketed, fully buffered, Phantom jumper selectable to pin 67, 47805 regulators, S100 (Imsai/Altair) compatible, uses 21L02 static RAM's.

450 NS	$160.00
350 NS	$175.00
300 NS	$185.00
250 NS	$195.00

ARKON

RE6416 Terminal Kit

SPECIFICATIONS

DISPLAY: 64 char per line x 16 lines per frame of 5 x 7 dot matrix, 64 ASCII char

VERT SYNC: 60 Hz XTAL controlled

HOR SYNC: 15.840 KHz XTAL controlled

VIDEO O/P: IV P-P composite video

I/O: Parallel port to ASCII keyboard +20ma current loop +RS232 IO

BAUD RATE: 110 to 9600 Baud remote select

MISC: Full/half duplex, break, display all (transparency) mode

POWER: 5v 1A DC + $\pm$12 VDC for RS232 (power supply option does not supply $\pm$12)

RE6416 ...$159.95

LOWER CASE OPTION . . . . . . **$12** POWER SUPPLY OPTION **$12**

WIRED and TESTED **$239.00**

NOTE: The manual, parts list and schematic of the RE6416 are available for $5.00 which is refundable upon purchase of an RE6416. Dealer inquiries invited.

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NEW from ARKON Waveform Generator Kit

Free... SPEC SHEET. ASK

Single board design with sine, square, and triangles waveform generation in 4 overlapping bands from 1Hz to 100 KHz. Typical specs: THD .3%, 20 RPM frequency stability. .01% per volt supply without deviation. Runs on +, - 6 to 12 volts. Output variable from 0 to 6 volts at 600 OHMS o/p impedance, may be AM or FM modulated. This kit has many uses such as testing audio AMPS with sine or square wave input, testing logic

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WG 1...$24.95

PCB Material, Etchant Etc

PC board...$1.00/LB. Ferric chloride...$2.50/LB. Arkon dry transfer-to-board-and-etch material, $2.95 for a large sheet with all patterns on it (don't go broke buying sheets you won't ever use).

ARKON LIGHT ORGAN KIT

A super kit, 3 channels low, mid range and high each with its own control. Each channel good for 200 Watts of incandescent light. Easy to build with our step-by-step instructions.

LO-1 . . . . $12.95

ARKON STROBE LIGHT

The Arkon strobe light kit is designed to emit a brilliant flash of light at a variable repetition rate from a xenon flash tube. It's a lot of fun at parties or as a visual burglar alarm.

SL-1 Kit of all parts $12.95

MAGNETIC PREAMP KIT

The Arkon magnetic preamp kit is a small low-noise stereo preamp designed to take the low level signal from a magnetic cartridge and boost it up to the level needed for most amps. The preamp uses 12 to 24 vdc from the main amp.

MP-1 WIRED AND TESTED	$8.95
MP-1 KIT OF ALL PARTS	$6.95

POWER SUPPLY KIT

Arkon has done it again, an ideal power supply for audio, logic, small projects, bench testing etc. The PS-1 produces 5VDC regulated (IC) at 1 AMP plus a variable regulated supply of 3 to 25VDC at ½ AMP. (This also uses an IC regulator) Both supplies are fully floating and current limited.

PS 1...$14.95

FREQUENCY COUNTER

KIT $129

CT-50

SPECIFICATIONS:

Frequency range: 5 Hz to 65 mHz
Resolution, 1 Hz @ 1 sec gate
Readout 8 digit, 0.4" high LED.
Accuracy, adjustable to 0.5 ppm
Stability: 2.0 ppm over 10° to 40° C.
Input: BNC, 1 megohm / 20 pf direct.
Overload 50VAC maximum, all modes
Sensitivity less than 25 mv to 65 mHz
Power 110 VAC 5 Watts or 12 VDC @ 400 ma
Size, 6" x 4" x2", high quality aluminum case

Light Show Controller

Do fancy things with lighting, using this voltage controlled dimmer unit.

THIS PROJECT allows the control of lights, or other loads, by a voltage signal. It can thus form the power control section of a variety of lighting units.

As the dimmers are voltage controlled they are useful not only as 'stage' type dimmers but also as the basis of colour organs, colour sequencers and chasers etc. It is partially for this reason that we have built three dimmers on one PC board.

DESIGN FEATURES

For safety reasons, the control circuitry is fully isolated from the AC line, which also provides flexibility of control.

In this particular unit we have three channels, however the constructor might wish to incorporate more or less, all sharing the same power supply and oscillator circuitry.

SPECIFICATIONS

Number of channels	3
Maximum load per channel	500 Watt, as built
Control method	phase control
Rise time	10μs
Control voltage	0 to 10V*
Input impedance (control)	> 470k ohm
Protection	5 Amp fuses
Dimensions	310 x 270 x 80mm

*The control voltage range can easily be modified if required.

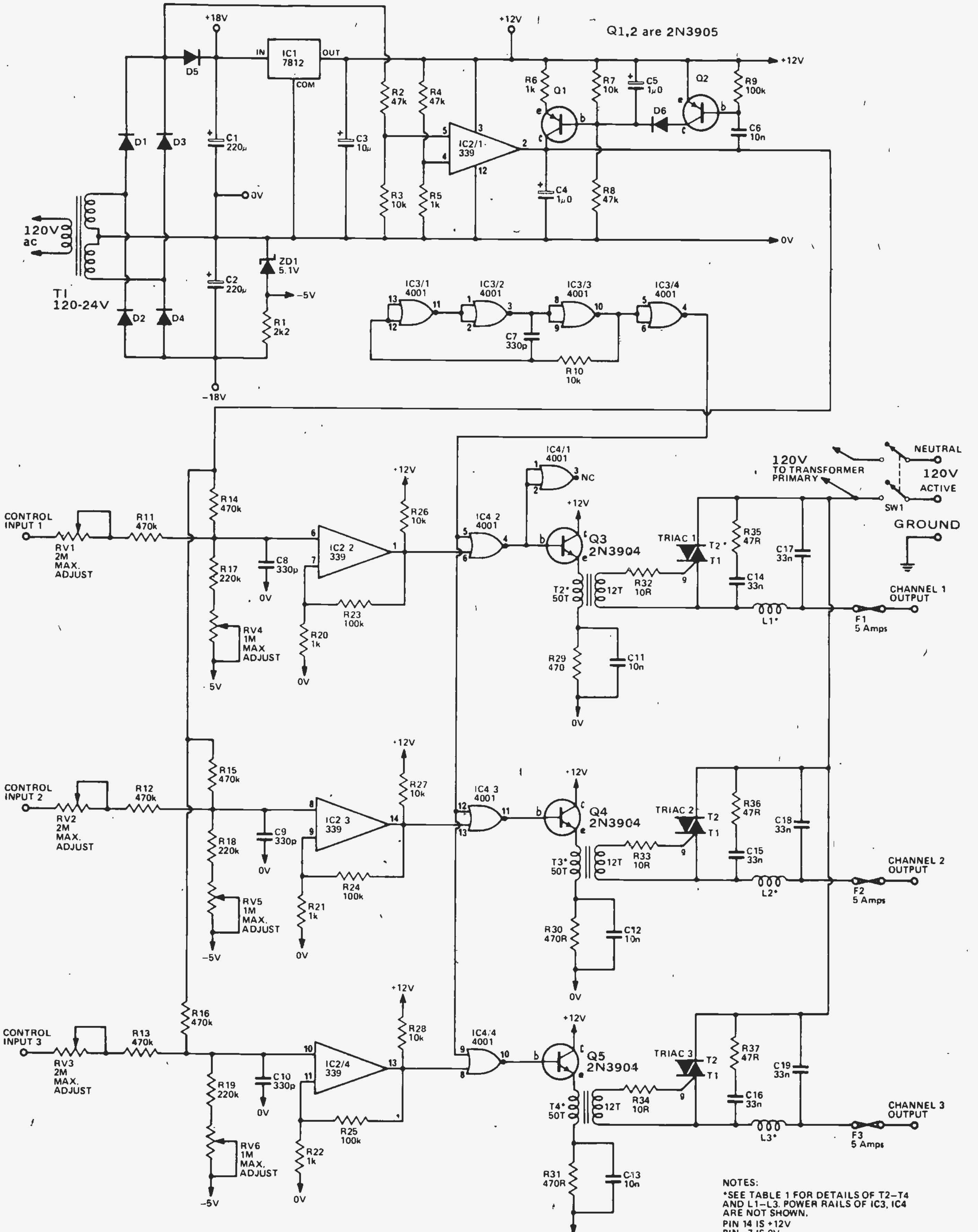


Fig. 1. The circuit diagram of all three channels.

HOW IT WORKS

The output of the transformer is full wave rectified to provide ∓18Vdc on C1 and C2. An isolating diode D5 is used in the positive supply line and a full wave rectified (but not smoothed) voltage is available at the junction of D1, D3 and D5. The positive supply is regulated to +12 V by IC1, while the negative supply is regulated to −5 V by ZD1. We have provided ∓18V outputs to allow for any additional circuitry which may be attached.

The first section of IC2 compares the voltage on pin 4 (about +250 mV) with that on pin 5 which is the full wave rectified signal. When this signal drops below that on pin 4 (which occurs only for about 100 μs at the zero crossing of the sine wave), the output of IC2/1 goes low discharging C4. The output stage of this IC is an open collector NPN transistor which can only sink current and not source any. The capacitor C4 is charged by the constant current source Q1, and discharged every 10 ms, forming a sawtooth waveform. On the discharge of C4, capacitor C6 turns on Q2 which discharges C5 to about 700 mV. This reduces the current supplied by Q1, with it slowly building up again over about 3 – 4 ms. Thus the charge waveform of C4 is modified from what would normally be a straight line. This waveform is used as the synchronising cum timing waveform, and is common to all three dimmers.

Also common to all the dimmers is a high frequency oscillator formed by IC3. This runs at about 150 kHz.

The synchronising waveform is added with the control input voltage and an offset current from the −5 V supply; when the sum is zero the comparator IC2/2 detects this and its output will go low, allowing the high frequency from the oscillator to be gated through IC4/2. The transistor Q3 is used to buffer this output and drives the pulse transformer. The output of the pulse transformer drives the triac gate, turning it on.

By adjusting the voltage on the input the time at which the voltage on pin 6 crosses zero can be varied, thus adjusting the output light level. The capacitor C8 is needed to stop the high frequency signal from IC3 being picked up in the high impedance circuitry at this point.

All three dimmer sections are identical except for component numbering.

RF suppression is provided by L1/C17 which gives about 10 μs rise time. If a fluorescent load is to be used, R35/C14 are needed to ensure the triac does not turn off between pulses from the pulse. No resistive load is needed for a fluorescent load although a special ballast (or an additional filament transformer) is needed in the fitting.

We decided to economize on heat sinking in this unit, if greater power drive capability is required, use bigger heatsinks, the SC151 is good for 15A at 80 degrees C. To work out heatsink required: heat dissipated by triac is about 2 x I = P(watts). (The voltage drop across an "on" triac is about 2V). Then get a heatsink that will keep the triac below 80 degrees. Heatsinks are rated by degrees C/watt, that is to say temperature rise above ambient per watt dissipated by the device (not the load). For example, for 1000W load, I = 10A, thus P = 20W. A Delta 641 heatsink rated at about 3 degrees/watt will do the trick. Be sure to use insulators and silicone heatsink compound on the triacs!

Bigger triacs may be used.

CONSTRUCTION

All the electronic components are mounted on the pc board and this can be assembled with the aid of the overlay in Fig. 3. The chokes and pulse transformers can be wound as per the winding details in Table 1. The main point to watch is the insulation of the triacs from the heatsink. The correct mica insulators should be used with great care to remove any burrs, etc., and possibly double insulators to be sure. The heatsink should be earthed if it is in a position where it can be touched. In the box we used we screwed the heatsink onto the lid of the box to help get the heat out and a ground is essential! For 500 watts per channel about 15,000 sq mm of heatsink is needed to keep the temperature rise of the triacs around 50 degrees C.

When wiring the unit use wire of adequate size as the input current will be 12A at full load. We have given a wiring diagram in Fig.4 showing how we fitted it in to the box. The ground wire should be continuous all the way and not just links. This is to ensure that if one connection comes loose the ground is not lost to any other part of the circuit.

ADJUSTMENT

The only adjustment is the setting of maximum and minimum light levels. With lights plugged in and everything switched on, rotate the level controls to the minimum or reduce the control voltage to 0V and by using RV4-RV6 adjust the lights to the desired minimum level. Now rotate all the level controls to maximum or raise the control voltage to its maximum, then adjust RV1-RV3 to give the desired maximum level. If all the presets are wound up to maximum level the triacs will be on continuously and there will be no (or little) noise from the chokes. Now by reducing the level using the maximum presets until the chokes start to make a noise the maximum control range will be achieved.

TABLE 1

CHOKE WINDING DETAILS L1–L3

Core	65mm long 10mm dia. ferrite rod
Winding	55 turns close wound, 1mm dia. enamelled wire

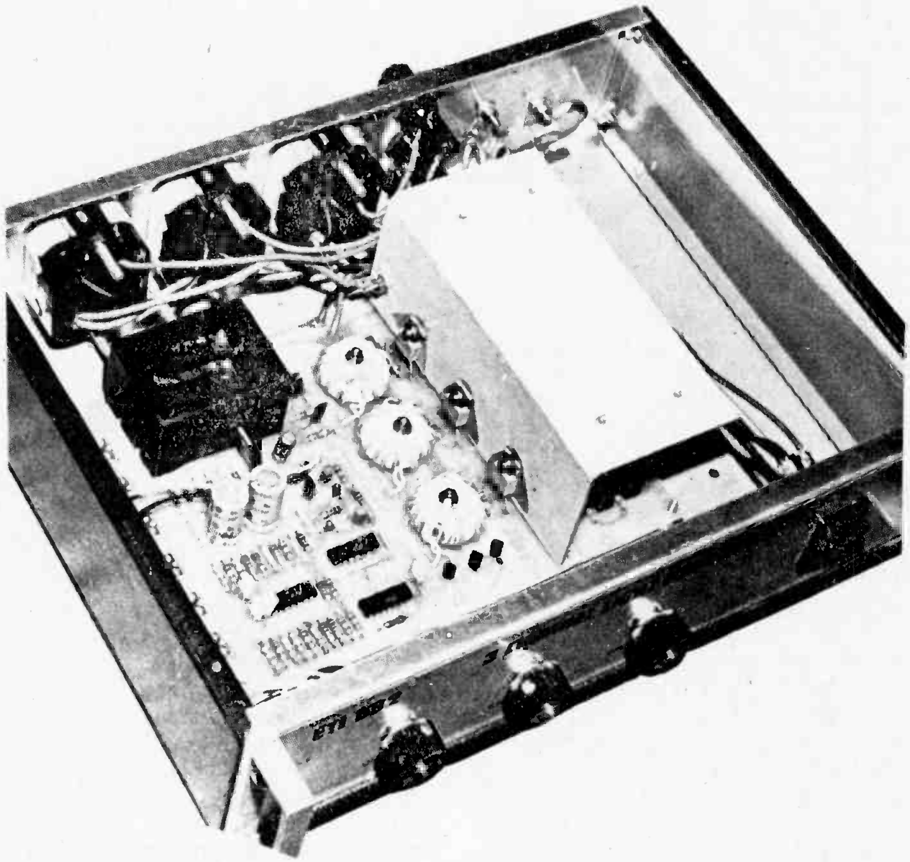
Tape ends of coil to prevent it unwinding and when fitting it to the board space it about 1mm above the board. Pour some epoxy cement over the coils to help prevent noise.

TABLE 2

PULSE TRANSFORMER WINDING DETAILS T2–T4

Core	Philips 23CT 7/3H1
Winding	
Primary	50 turns, 24AWG stranded pvc insulated (about 1.5 meters)
Secondary	12 turns, 20AWG stranded pvc insulated (about 300mm)

These pulse transformers are wound on a toroidal core and with the primary it is easier to start the winding by feeding the wire through the centre about half way and winding one end first, coming back to the other end when down to about 30mm of wire. There is about 30 turns on the first layer using stranded 24AWG wire.



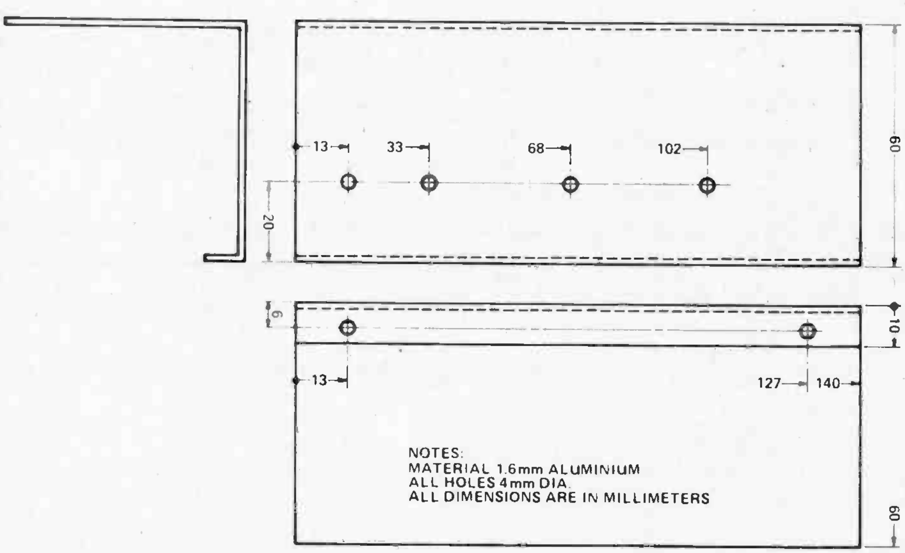


Fig. 2. The heatsink used on the prototype.

PARTS LIST

RESISTORS all ½W, 5%
R1 . . . . . . 2k2
R2 . . . . . . 47k
R3 . . . . . . 10k
R4 . . . . . . 47k
R5, 6 . . . . . 1k
R7 . . . . . . 10k
R8 . . . . . . 47k
R9 . . . . . . 100k
R10. . . . . . 10k
R11–R16 . . 470k
R17–R19 . . 220k
R20–R22 . . 1k
R23–R25 . . 100k
R26–R28 . . 10k
R29–R31 . . 470R
R32–R34 . . 10R
R35–R37 . . 47R

POTENTIOMETERS
RV1–RV3. . 2M trim
RV4–RV6. . 1M trim
RV7–RV9. . 47k lin*

CAPACITORS
C1, 2 . . . . . 220µ 35V electro
C3. . . . . . . 10µ 35V electro
C4, 5 . . . . . 1µ0 tantalum
C6. . . . . . . 10n polyester
C7–C10 . . . 330p ceramic
C11–C13 . . 10n polyester
C14–C19 . . 33n 250 Vac

SEMICONDUCTORS
IC1 . . . . . . 7812 regulator
IC2 . . . . . . LM339 quad comparitor
IC3, 4. . . . . 4001 quad NOR gate

Q1, 2 . . . . . 2N3905
Q3–Q5. . . . 2N3904

Triac 1–3 . . SC151 (with insulation kit)

D1–D5. . . . 1N4004
D6 . . . . . . 1N914
ZD1. . . . . . 5.1 volt 400mW

MISCELLANEOUS
PC board ETI 592
L1–L3 chokes (see text)
T1 transformer 120V-24V ¼A
T2–T4 pulse transformer (see text)
Case to suit
3 wire lead and plug (15A)
Heatsink (see Fig. 5)
3 Fuse holders
Three 5 Amp 3AB Fuses

*These are the main faders and may be slide or rotary and the value may be from 10k to 100k.

PCB for this project from Spectrum Electronics, 38 Audubon St. S., Hamilton, Ont. L8J 1J7.

For the toroid cores: Philips suggest LA Varah Ltd., 505 Kenora Ave., Hamilton, Ont.

WARNING

While the control circuitry of these dimmers is isolated from the mains, there is 120V on the PC board and care should be taken to prevent accidental contact with this area. Also take care to segregate the low voltage wiring and ensure that if a wire does come adrift that it cannot touch the 120V side (or vice versa).

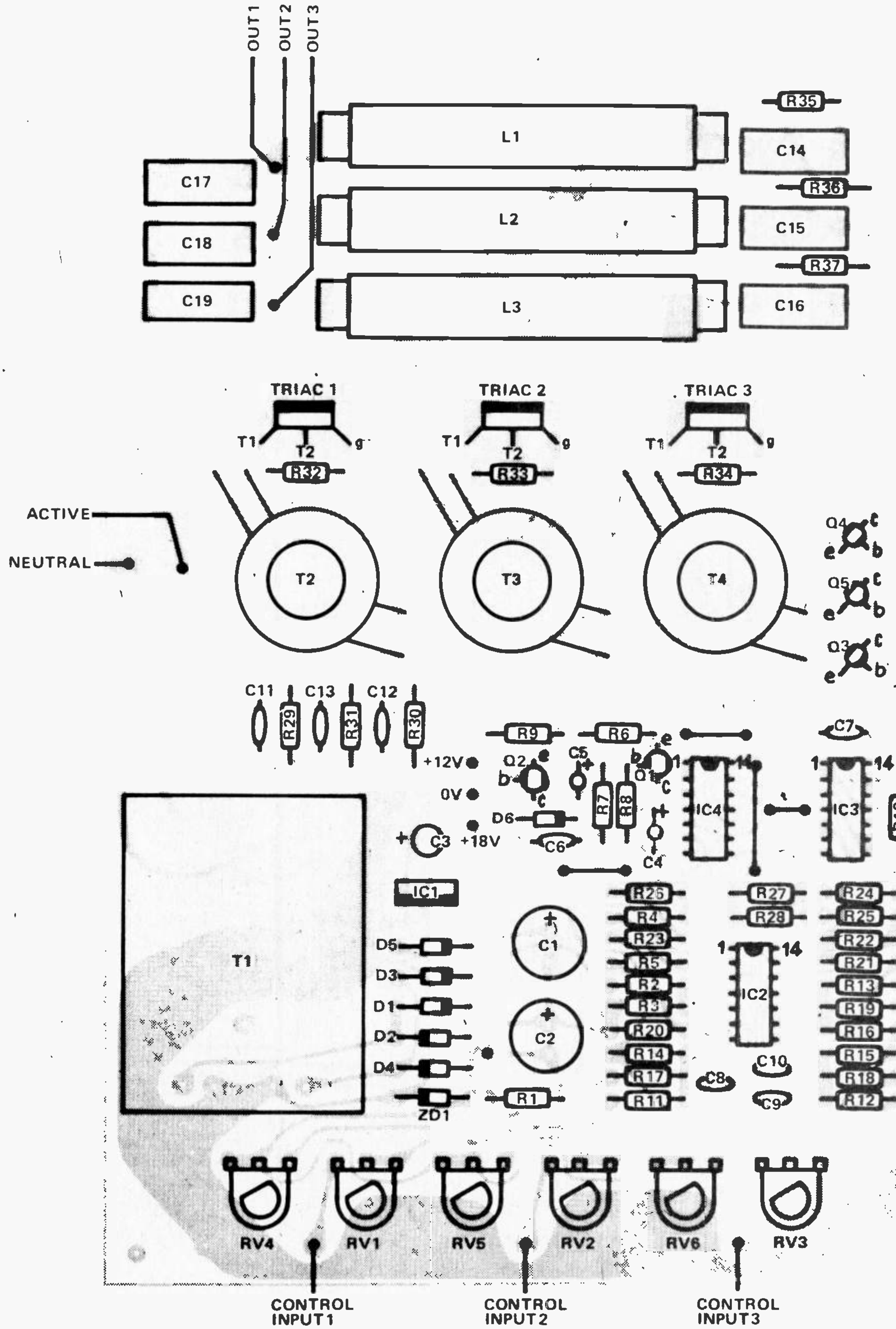


Fig. 3. The component overlay of the board with the heatsink removed.

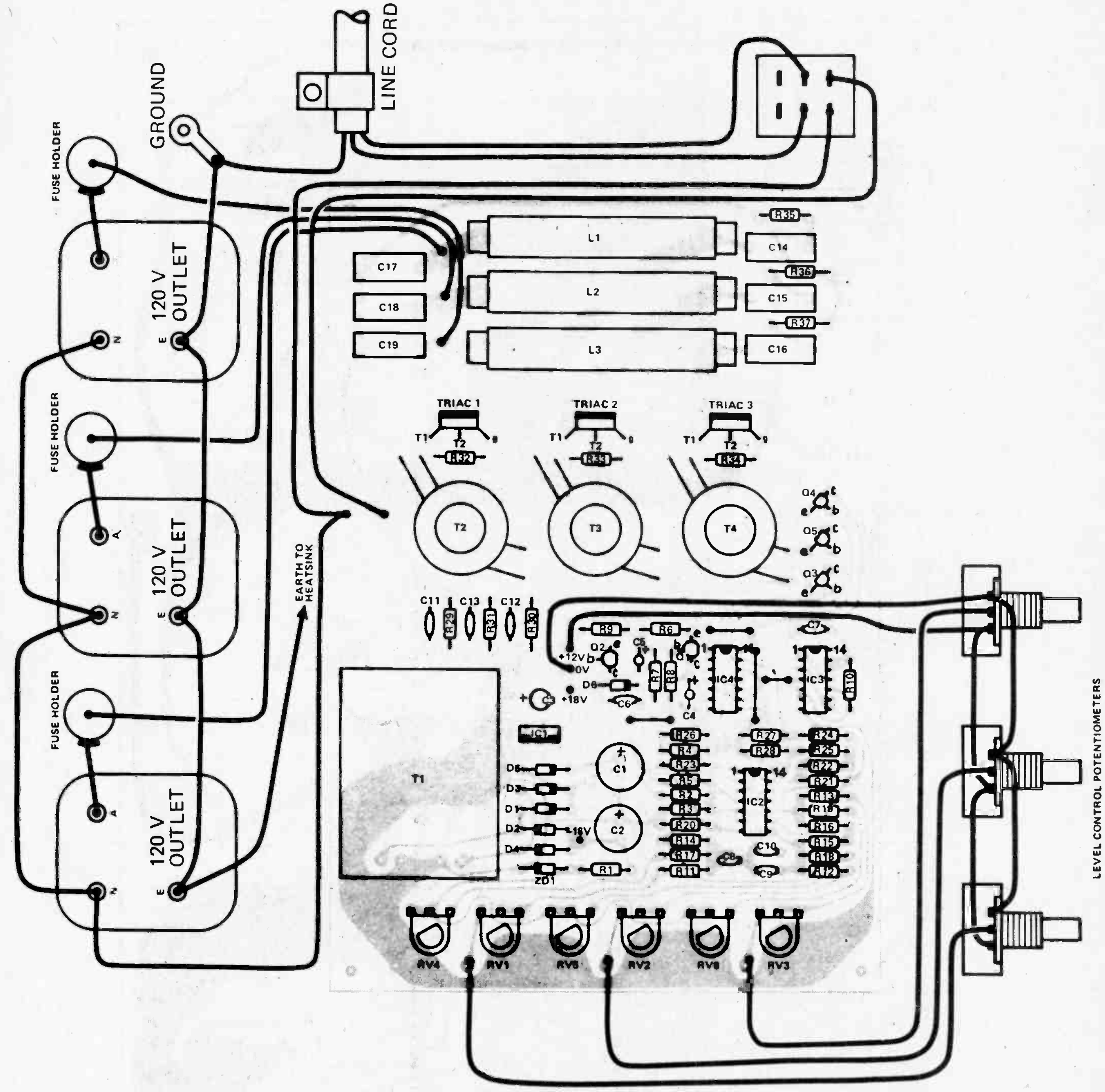
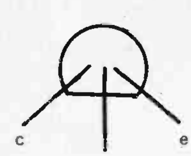
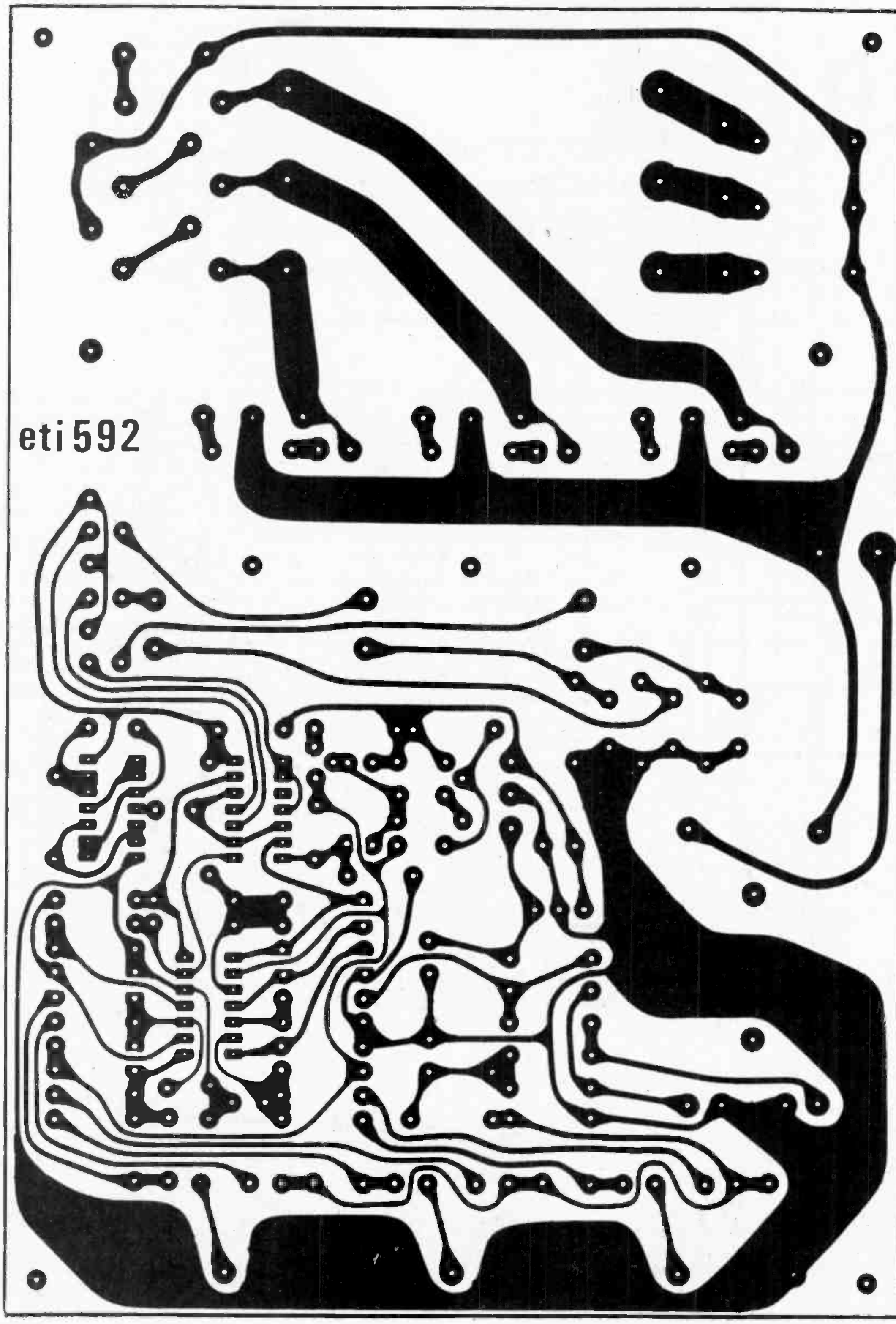


Fig.4. Point-to-point wiring diagram. The earth wire should be continuous so that if it comes adrift at any point, connections further down the wire will not be left floating. Note also that on the prototype the heatsink is earthed.



2N3904/5
BOTTOM VIEW

NOTE: ORIENTATION SHOWN FOR Q1-5 APPLIES ONLY TO A FEW GENERAL PURPOSE PNP AND NPN TYPES. FOR TYPES LISTED ROTATE 180 DEGREES.


eti592

PCB Drill

Drilling holes in a printed circuit board is not the easiest job. This project describes a simple hand drill press made of cheap available materials. By A.J. Lowe.

THIS PROJECT IS for the real do-it-yourself enthusiast — the one who makes his own printed circuit boards and is faced with the tedium of drilling them accurately.

There is a home-made drilling machine which, though not as fast as an electric drill press, certainly costs a great deal less, and takes a lot of the 'ill' out of drilling. This article can indicate only the general idea as final details must be settled to suit the material finally used.

As can be seen in the assembly photograph the machine is simply a support made from the base of a food mixer, with an ordinary hand drill attached. The drill does not move up and down, as in a proper drill press, but the drill table does. The table is forced upward against the drill by a spring below it. A hole in the centre of the table receives the drill bit once it has penetrated the printed circuit board.

So, to operate — you simply press down the table against the spring, slide the work into position below the drill and let the work rise by releasing pressure on the table. When the drill centres on the centre mark you start turning the crank of the hand drill. The upward thrust provided by the spring is enough to ensure good drilling without drill breakage. A couple of fingers remain on the work to stop it turning and ready to press down and reposition for the next hole.

CONSTRUCTION

The frame of the prototype is, as stated, the base of a food mixer. All you need is something with a horizontal table and a rigid upright.

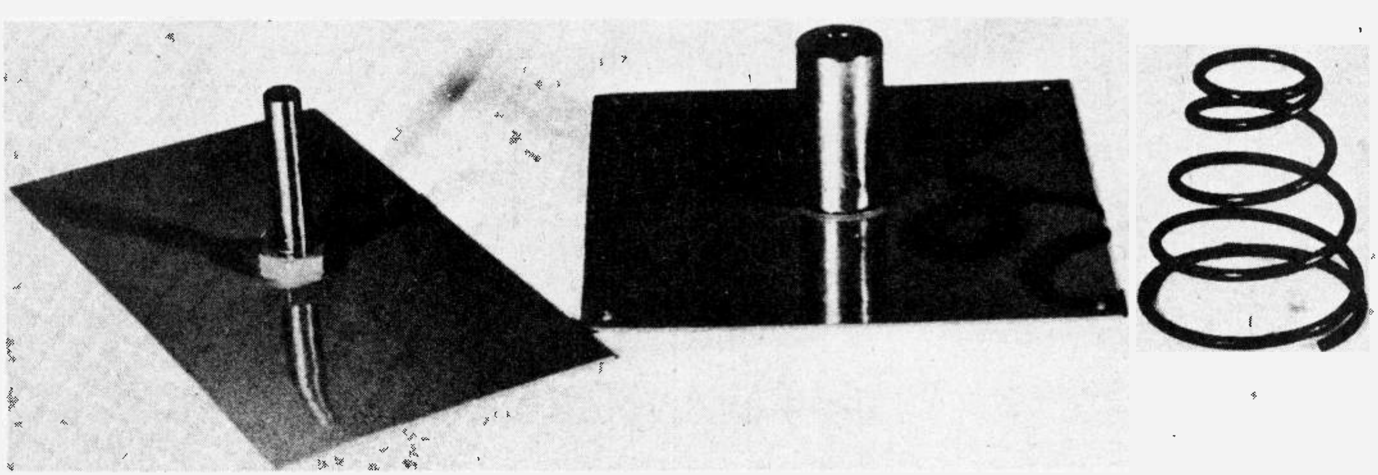
It's best to start construction with the table — because the height of it determines the necessary height of the drill and the angle of the outrigger arm attached to the base.

The table comprises three parts — shown in the detail photograph: the top table — on the left; the base plate and guide; and the spring.

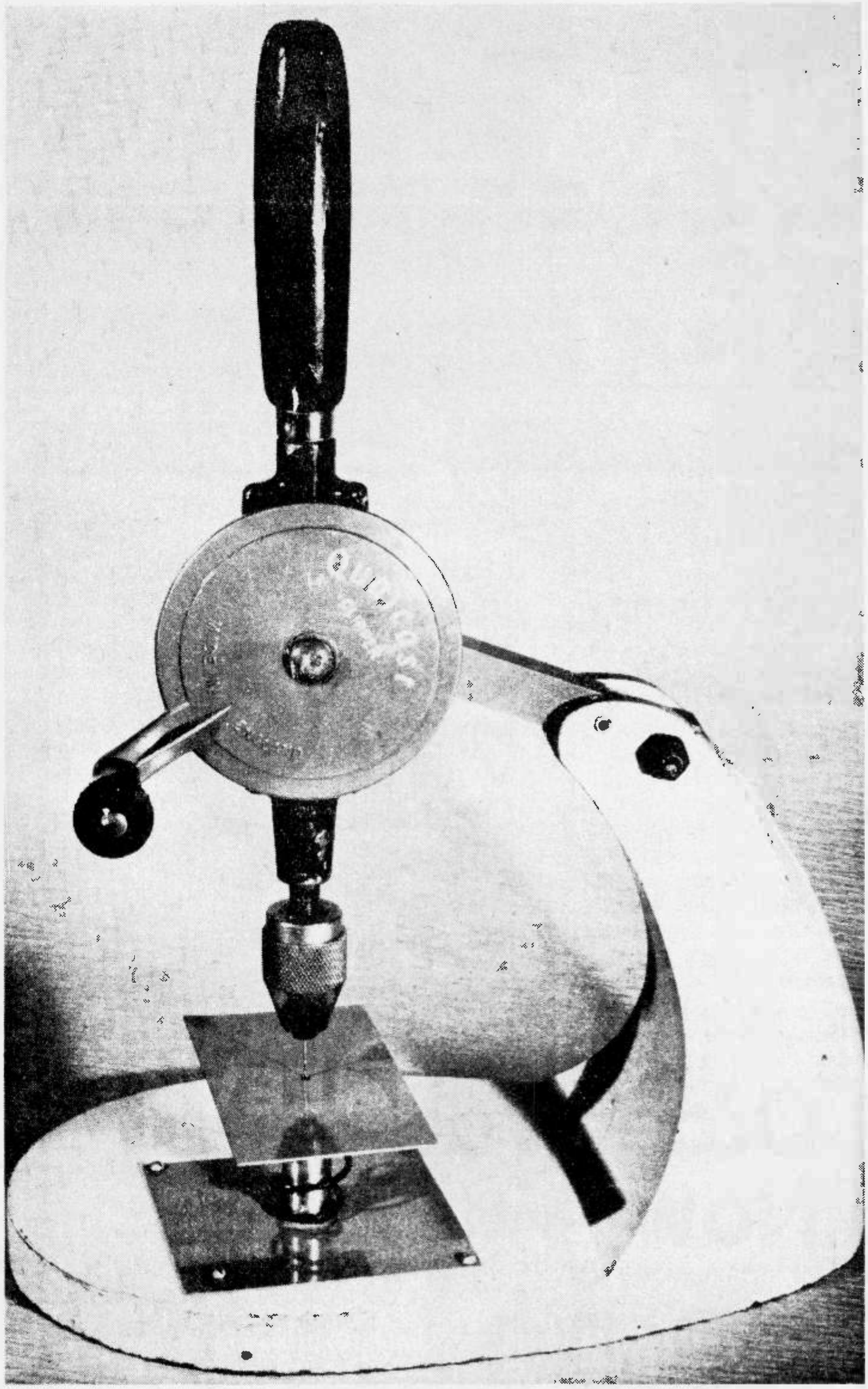
The spring should be about 45 mm long — uncompressed. It need not be conical — the spring selected for the prototype just happened to be so. The spring should be reasonably stiff so that when it is compressed about 7 mm there's enough push in it to cause a drill to drill holes. That's a bit vague but a little bit of squeezing a few springs will give the idea. Start at the garage or auto electrician and ask for any old springs about this by this and you'll get a range of springs — free most likely. Valve springs are too stiff. The spring used in the prototype came from a car door — fitted behind the window winder handle. It's just right.

Having got your spring you need to make the top table — from sheet steel, about 1 mm x 110 x 60 mm or any size to suit, and drill a central hole in it about 3 mm diameter.

You now need a ¼" bolt with about 28 mm of unthreaded portion on it. A good quality bolt with a machined finish is desirable. The head of the bolt should be flattened, preferably in a lathe (but a file will do) and then drilled, on axis, to a depth of 8 mm or so and 3 mm diameter to receive the



The three main elements of the table of the drill are the top table, the base-plate and guide, and the spring.



drill bit. This bolt is soldered square on to the top table and directly over the hole.

The guide for the bolt is a piece of brass or steel round bar with a suitable outside diameter for the spring chosen (the prototype is 15 mm O.D.). A hole to receive the bolt on the top table is bored right through the guide. This should be done on a lathe or a drill press. Alternatively, an appropriate piece of pipe may be used.

The two parts should fit together freely but not loosely. The length of the guide should be selected so that it provides adequate guidance for the top table and yet allows enough movement of the top table to get suitable spring compression. The prototype is 30 mm long. As the sliding bolt acts like a piston in the guide a small vent hole should be drilled radially through one side of the guide close to the bottom.

The ends of the guide should be filed or turned square to its axis so that it stands upright.

The guide is then fixed by soldering or using an epoxy resin to the centre of a steel base plate. The plate in the prototype measures 1 mm x 90 mm square.

Now put the table together and see that it operates satisfactorily.

It should be stood on the base of the mixer and then the hand drill, loaded with a fine bit, held over it so that the bit enters the hole of the table when the spring is not compressed. The position of the hand drill — as far as height is concerned, should be measured carefully as it must be fixed at this height.

Having settled the height of the hand drill then the outrigger arm may be fixed to the base at such an angle that it can carry the drill at the right height.

The outrigger arm in the prototype is a 150 mm length of 16 mm square steel bar which fitted neatly into the top recess in the upright. This outrigger arm is bolted, using the original holes in the upright, and also fixed by means of a smaller bolt or spring pin so that it cannot move. Rigidity is essential.

The hand drill is then attached, at the height already determined, to the outrigger arm by means of a bolt passing through the arm and into the drill in place of the usual side handle. In some inexpensive drills the side handle is merely pressed on to a fixed steel rod. In this case the steel rod should be threaded and fixed to the outrigger arm with a nut.

Having mounted the drill adjust it until it is truly vertical and then tighten up the fixing bolt or nut.

Next place the table directly below the drill so that a drill bit centres in the hole in the top table. The position of the base plate is then carefully marked. Next, by means of four small bolts the base plate is fixed to the base of the mixer in the marked position. A coat of paint is the finishing touch.

ADJUSTMENT

A certain amount of adjustment is possible in this simple machine. The height of the bit in the drill chuck can be varied and the uncompressed height of the table can be increased by means of packing washers below or above the spring. By the way — if small drill bits are hard to get — try a local Model Shop.

AM Tuner

One of the most exciting projects for the beginner to build is a broadcast-band receiver. This one is simple to build, but gives very satisfactory results.

UNLIKE MOST simple radios, this unit has its own inbuilt antenna. This consists of a ferrite rod approx 6 mm in diameter and between 100 mm and 200 mm in length.

To make the antenna simply wind about 75 turns of 26 SWG insulated wire neatly around one end of the rod. Secure the ends of the winding with sticky tape.

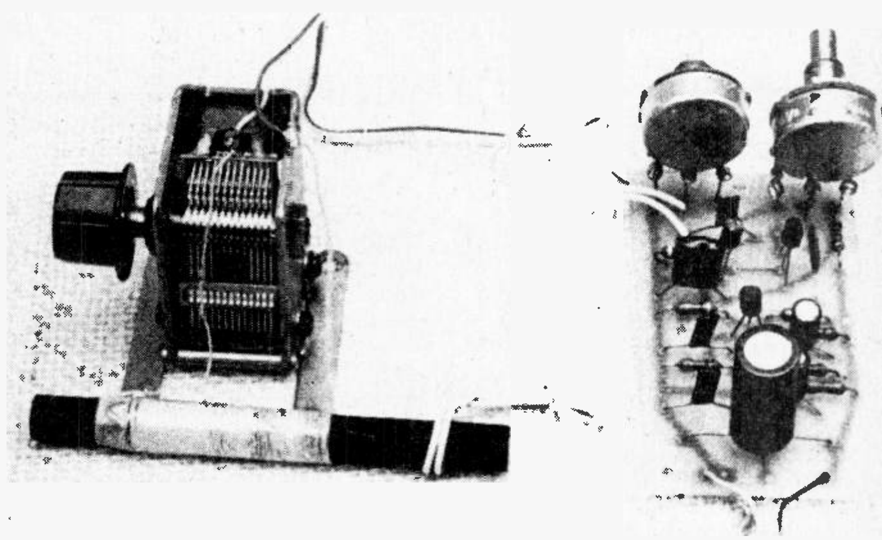
The tuning range covered depends on the value of the tuning capacitor and the number of turns wound around the ferrite rod. Most tuning capacitors adjust from 0 - 415 pF and our coil was wound to suit one of these. Tuning capacitors adjustable from 0—180 pF are also in common use and if you use one of these simply wind on about 30% more turns.

To raise the highest tuneable frequency simply remove turns. As an interesting experiment why not wind on more turns than you know you need (start with 100 or so) and then remove five turns at a time to see what happens.

We have added an optional feedback circuit to this radio. This circuit increases the radio's ability to separate stations that are close together in frequency. It also increases the amplification of the circuit.

In many areas this part of the circuit will not really be required — it can be omitted at first and then added if the radio will not adequately separate stations.

The components concerned are:—
Resistor R1
Potentiometer RV2
Capacitor C3



T2 — two turn coil on ferrite rod.

If the feedback circuit is not used simply omit the above components. If it is used T2 should be made by twisting a couple of turns of wire around the ferrite antenna rod at the opposite end from the main coil.

General construction is straightforward as long as the layouts shown here are used. The unit should be assembled on Veroboard or pc boards — it is not advisable to try to build it using tag strips or other methods.

When housing the finished project do remember that radio waves won't readily pass through metal — so make the enclosure out of wood — or use a suitable plastic case.

Potentiometer RV1 is an 'RF gain' control. Both this and the feedback control potentiometer (RV2) should be turned up until slight distortion is heard — and then backed off a little bit. In practice it will usually be found that RV2 will not need resetting once the initial optimum point has been found.

The output from the receiver appears across the point marked 'audio output' and the 0 V line. A screened lead and suitable jack plug should be connected to these points so that the radio signals may be fed into an amplifier — or your home hi-fi system.

A volume control may be added by connecting the output of the radio to the amplifier via a potentiometer

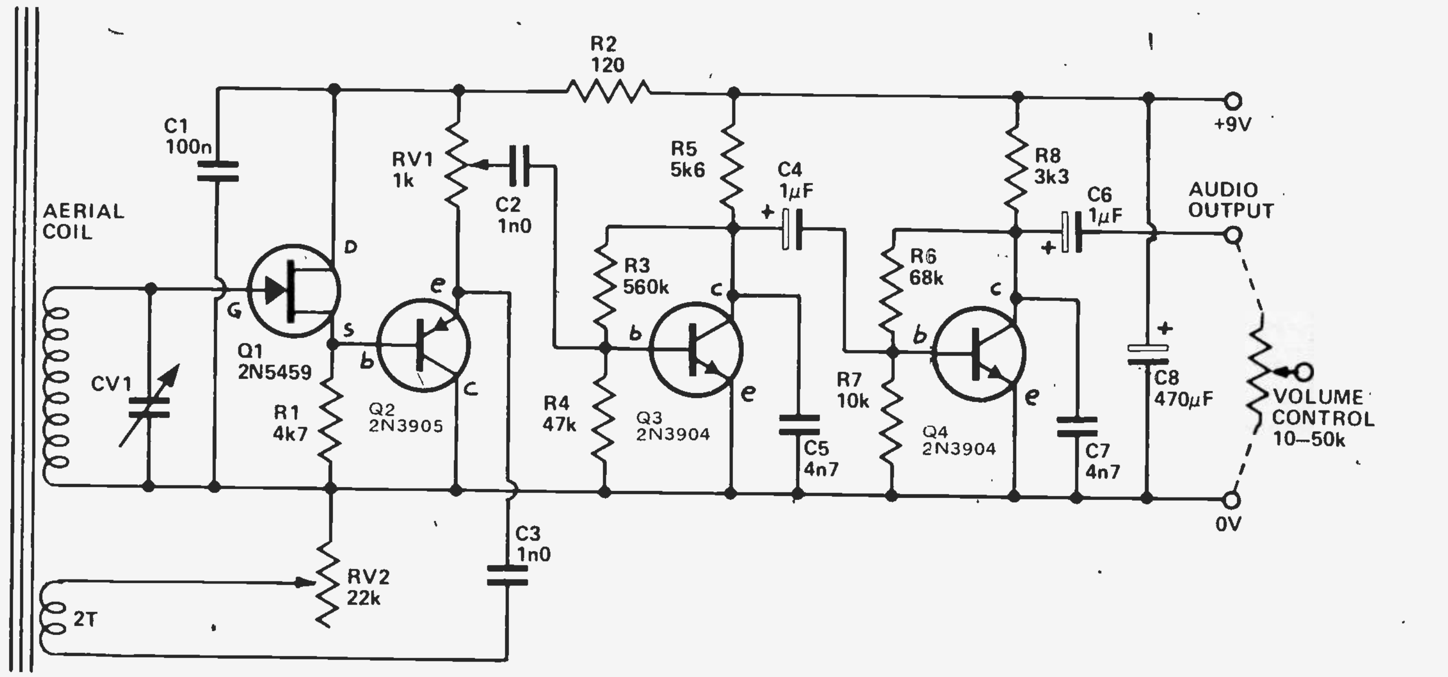


Fig 1. Circuit diagram of the tuner.

HOW IT WORKS

The antenna coil and the tuning capacitor form a resonant circuit which has a low impedance all frequencies except that of the station that is to be received, thus the antenna picks up all signals but only the particular signal required will appear at the gate of Q1.

Transistor Q1 is a 'field effect transistor'. Field effect transistors (often abbreviated to FETs) have a very high input impedance. The one used here is connected as a 'source follower' the voltage at the source follows the voltage at the gate except that the source voltage is about two volts dc higher. The purpose of this FET is to act as a buffer between the antenna coil and the rest of the circuit.

Transistor Q2 is used simply to remove any load from Q1 — necessary to prevent Q1 oscillating. The voltage gain of the circuit is unity up to the emitter of Q2.

Transistor Q3 amplifies the signal from Q2 and, due to the bias point chosen plus the action of capacitor C5, acts as a detector (it rectifies the signal). This has the effect of blocking the radio-frequency signal — the signal passed on to the next stage is an audio waveform which corresponds to the audio signal fed in to the transmitter at the radio station.

The signal at this point is still quite small so transistor Q4 provides additional amplification.

To avoid the cost and complexity of automatic gain control we have instead included a manual RF gain control, RV1.

A small portion of the signal from Q2 is fed back to the antenna via C1 and the two turn coil. This increases receiver sensitivity. The radio will oscillate if RV2 is turned up too high — maximum sensitivity occurs just before oscillation.

PARTS LIST

R1	Resistor	4k7	½ W 5%
R2	"	120 ohms	" "
R3	"	560 k	" "
R4	"	47 k	" "
R5	"	5k6	" "
R6	"	68 k	" "
R7	"	10 k	" "
R8	"	3k3	" "
RV1	Potentiometer	1 k	lin rotary
RV2	"	22 k	lin rotary

(Above pots should preferably, but not essentially have plastic shafts, non-metallic knobs must be used)

C1	Capacitor	100 n	disc ceramic
C2,3	"	1n0	ceramic
C4	"	1 µ	16 V electro
C5	"	4n7	polyester
C6	"	1 µ	16 V electro
C7	"	4n7	polyester
C8	"	470 µ	16 V electro
Q1	Transistor	2N5459	
Q2	"	2N3905	
Q3,4	"	2N3904	
CV1	Variable capacitor 0-180 or 0-415 p		

Aerial rod
PC board ETI 062

(anything between 10 k and 50 k will do).

Battery voltage is not critical — the radio will work well from any voltage from about 9 V to about 15 V.

This is an essentially simple circuit and if built as shown should work first time. If the unit does not work check all connections, particularly transistor connections, check that the tuning capacitor's moving vanes are not shorting to the fixed vanes. If the feedback circuit does not seem to work — reverse the two-turn coil on the ferrite rod.

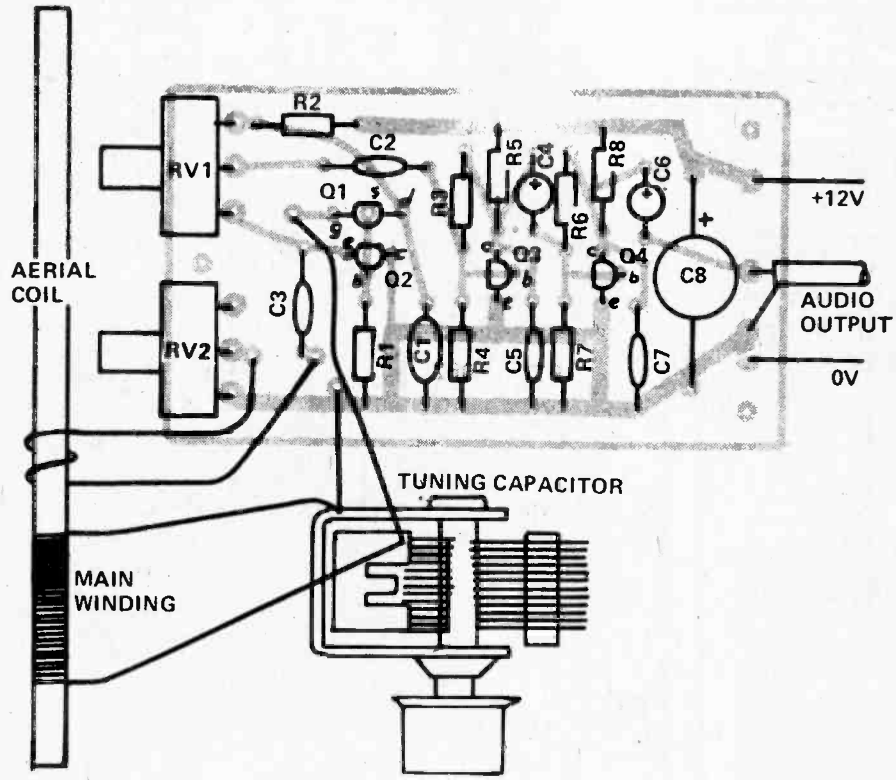


Fig 2. Component overlay using the PCB.

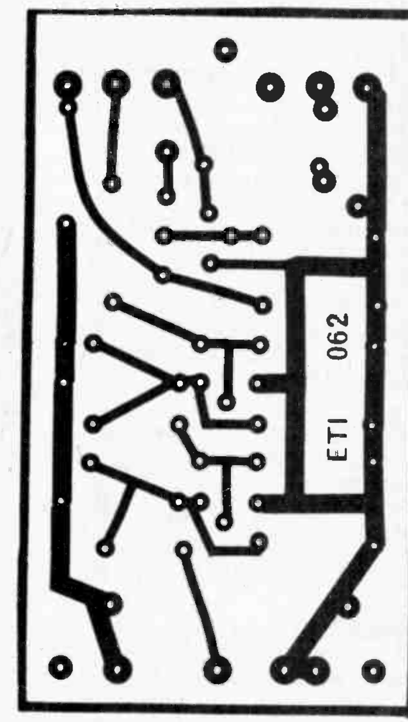


Fig 3. Printed circuit board layout for the tuner. Full size 90mm x 50mm.

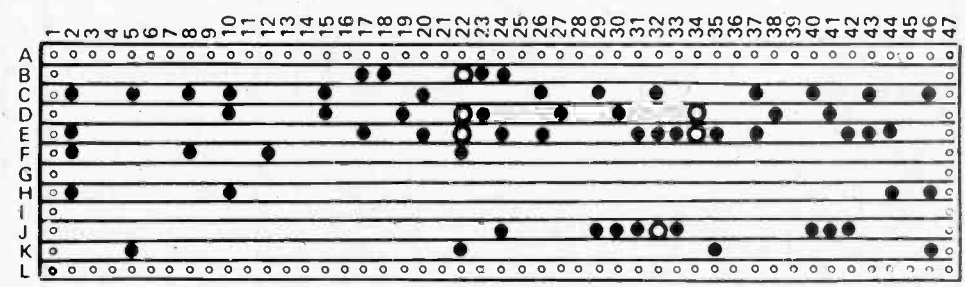


Fig 5. The underside of the Veroboard showing the breaks in the tracks (circles) and the solder joints (dots).

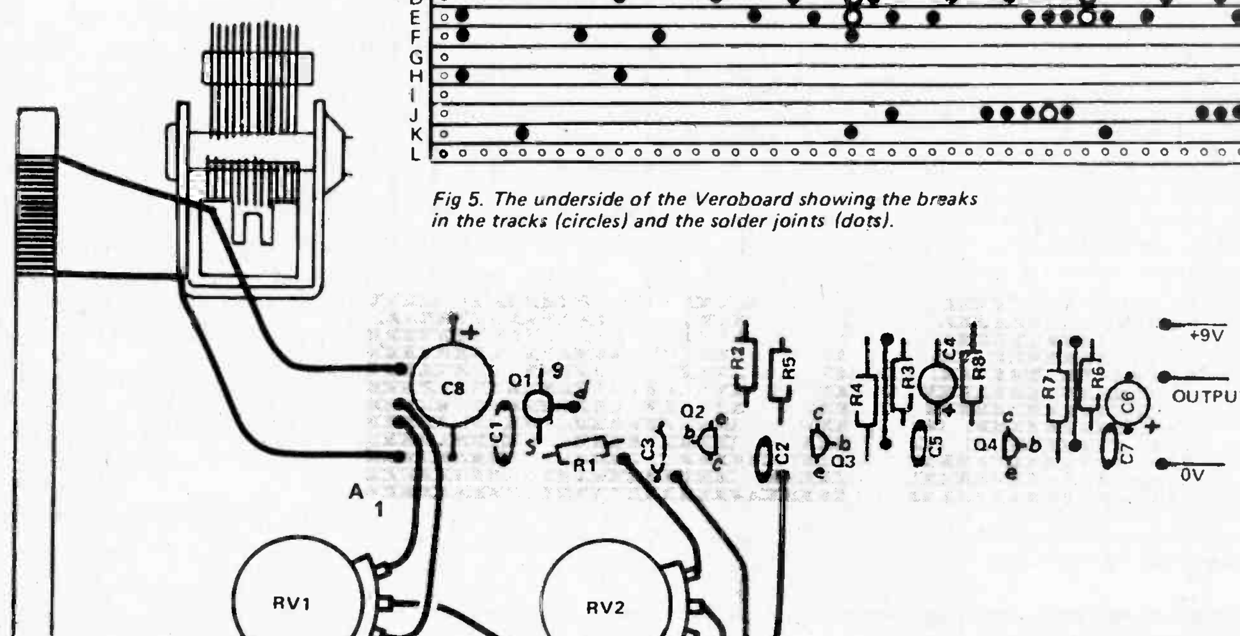


Fig 4. Component overlay for the Veroboard version. Note the two links required.

Printed circuit for this project from Spectrum Electronics, 38 Audubon St. S., Hamilton, Ont. L8J 1J7.

Veroboard is available from: Saynor Electronics, 99 Scarsdale Rd., Don Mills, Ontario M3B 2R4.

TV/FM/VHF Log Periodic Antenna Pt I

by Roger Harrison, who swears the prototype is still in use!

WITH THE AVAILABILITY of many imported transistor receivers that cover a variety of VHF bands, many people have discovered the delights of 'VHF Listening'. There are many interesting communications services using channels in the VHF region including taxis, aircraft, courier services — even weather satellites can be heard! From the small transistor 'portable' with auxiliary VHF coverage, many enthusiasts graduate to a more expensive 'general coverage' VHF receiver like the Eddystone 990R for example.

To receive the various transmissions that are spread over a wide range of frequencies, in various bands between 60 and 250 MHz, a wideband antenna is necessary. Most enthusiasts put up a simple dipole or perhaps several. Some make do with a TV antenna. Either system is a compromise. A 'discone' antenna is installed by some enthusiasts and while it is wideband with omnidirectional coverage, it has no gain.

Apart from the general VHF listening aspects, there are many 'TV DX' enthusiasts who seek out long distance reception of TV stations. During the summer months sporadic-E propagation via the ionosphere 'skips' distant TV transmissions many thousands of kilometres. Certain favourable weather conditions produce atmosphere 'ducts' which propagate VHF signals long distances. Radio amateurs often use TV DX as an indicator to amateur band DX 'openings'. A wideband antenna is worth its weight in QSL cards in these circumstances!

There are also many Hi-Fi enthusiasts using their TV antenna installation in a dual role: adding a splitter and connecting the TV and FM tuner. This situation is also very often a compromise. Many TV antennas, while having reasonable, if not adequate, response on most TV channels, do not have the required sensitivity or directivity over the 88 to 108 MHz FM broadcast band. They have demonstrably poor performance on stereo FM transmissions in many cases, particularly if one lives a fair distance from the transmitters, but not necessarily in a fringe area.

The difficulty in using a readily available TV antenna arises in the fact that it is generally a compromise. Those marketed for use in metropolitan areas are a compromise in several parameters. Response from channel 2 to channel 13, is required in major cities — a frequency range spanning 54 to 216 MHz.

A number of antennas are manufactured to respond to channels 2 to 6 (to cover the low frequency channels 7 to 13 in the upper range. That leaves a big hole in the middle.

The bandwidth response of these antennas on the lower frequency TV channels is often poor, although the effect may go largely unnoticed. When colour TV is installed and perhaps a splitter is added to allow connection of an FM tuner, the existing limitations of the installation become embarrassingly apparent.

Well, here's an antenna to solve all the multifareous problems for the various enthusiasts outlined above.

LOG-PERIODIC ANTENNA

The antenna described is of the log-periodic type, so called for its physical design and wide frequency response. It has virtually constant gain and directivity pattern across the design frequency range. It uses a number of elements, arranged in this design as a series of dipoles. Only a small group (generally three or four) of these are 'working' on the chosen frequency or across a relatively narrow band within the design frequency range when the antenna is in use. A reflector element has been added to improve the front-to-back ratio, particularly on the lower frequencies.

Construction, although it appears complicated, is quite easy and inexpensive to boot! Most, if not all, the components can be purchased from hardware stores.

There are basically two models: one covering 60 to 250 MHz and the other covering 40 to 250 MHz.

The overall construction of the 60 to 250 MHz model is illustrated in Figure 1. The 40 to 250 MHz model requires an additional three-elements of a larger size to accommodate the lower frequency range from 40 to 60 MHz. Construction of the additional elements is illustrated in Figure 6.

The model in Fig. 1 consists of ten dipole elements plus a parasitic reflector. A balun transformer with a 1:1 impedance ratio converts the approximately 70 to 80 ohms antenna feedpoint impedance from a balanced configuration to unbalanced, to suit a 75 ohm coaxial cable feedline.

CONSTRUCTION

Each of the dipole halves must be insulated so an insulated boom is required, along with some convenient method of mounting the dipole elements on it. There are two basic ways of achieving this — using a wooden boom and wooden element support brackets; or using a boom of ABS or PVC water pipe of a suitable diameter and conventional element to boom brackets.

TABLE

ELEMENTS	DIMENSION A
LOW REFLECTOR LOW DIPOLES 1, 2 & 3	400 mm
REFLECTOR (2600 mm) DIPOLES 1 & 2	250 mm
DIPOLES 3, 4, 5 & 6	200 mm
DIPOLES 7, 8, 9 & 10	140 mm

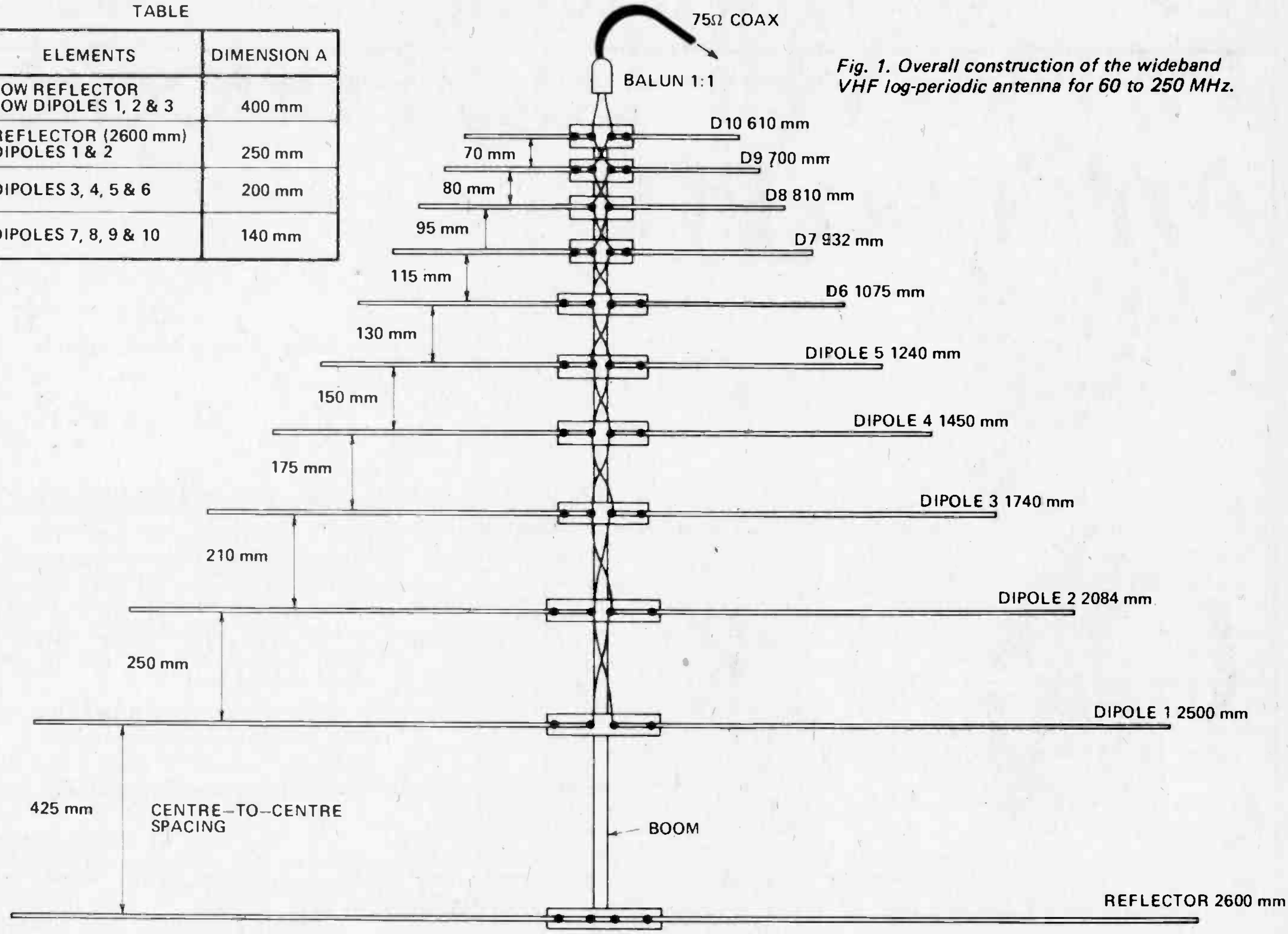


Fig. 1. Overall construction of the wideband VHF log-periodic antenna for 60 to 250 MHz.

WOODEN CONSTRUCTION

The boom chosen for the model in Fig. 1 was ordinary rectangular-section 1 by 2 dressed timber. Pine is cheapest, but it is subject to warp. Western red cedar, or any close-grained, well-seasoned hardwood, free of warps and knots, would be a better choice. A length a little over 1.7 metres is necessary for the boom alone. A further 1.9 m length will be necessary to make the element to boom brackets.

The elements on the prototype were cut from nine, 1.83 m long (six foot) lengths of 10 mm (3/8") diameter aluminium tubing. This can be bought in many hardware stores, or from specialist aluminum suppliers for a modest price. Alternatively, the tubing can be bought in any of the standard length sizes, sufficient to make the required number of elements. The total length required is about 15.75 m, although around 700 to 800 mm must be added to this figure to account for wastage in offcuts. Thus, about 16.5 m will be needed altogether.

Each of the dipole halves is cut 5 mm shorter than required. The element lengths indicated on Fig. 1 are tip-to-tip measurements, and a 10 mm gap is allowed in the centre of inter-element feedline connection on each dipole. This is illustrated in Fig. 2.

If you are purchasing the aluminium tubing in 1.83 m lengths, they should be cut in the following way:—

Firstly, the reflector will have to be made from two halves, necessitating a joint at the centre during final construction. All the elements should be cut and then stacked according to size before going on with the next stage of construction.

(a) From one length, cut exactly half the reflector, and half of dipole 7 (5 mm less than 466 mm, or 461 mm as explained). Repeat this with another length. You should end up with two pieces 1.30 m long, and two pieces 461 mm long. You then have the reflector and dipole 7 (or D7).

(b) From one length cut half D1 and half D6. Repeat this with another length.

(c) From one length cut half D2 and half D4. Repeat this with another length.

(d) Cut both halves of D3 from one length of tubing.

(e) Cut both halves of D5 and one half of D8 from one length.

(f) Last of all cut one half of D8 plus both halves of D9 and D10 from one length of tubing.

The wooden element to boom brackets should be cut next. Dimensions are given in the table in Figure 2. Three, 250 mm lengths will be needed for the reflector and dipoles, 1 and 2. Four each of 200 mm and 140 mm lengths will be needed for the other elements. The first line in the table in Fig. 2 refers to the low frequency portion, described later.

Once these are cut and drilled, the element halves should be individually drilled according to Fig. 2, and then screwed to the brackets using 20 or 25 mm screws as in Fig. 3. Solder lugs are placed under the screws holding the

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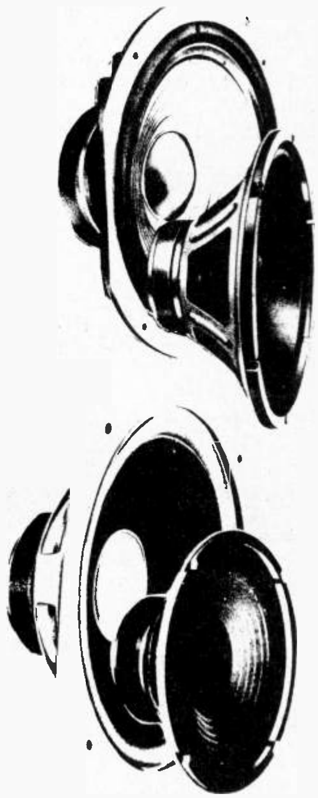

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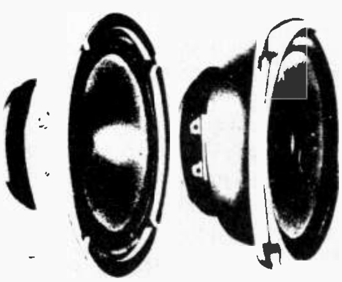

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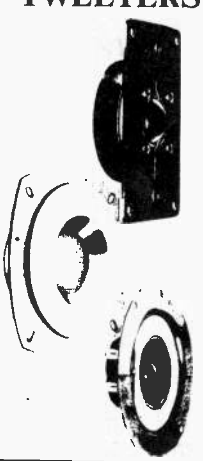

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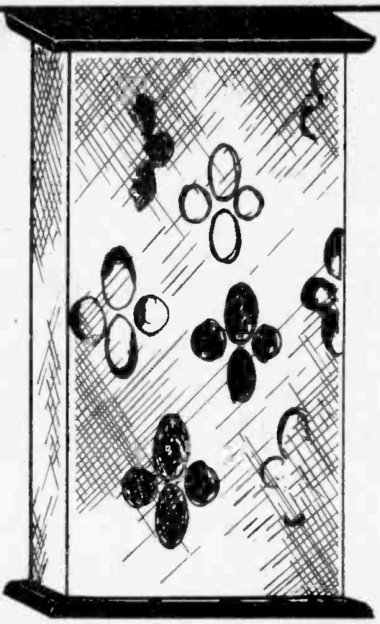

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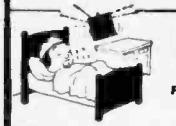

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MP-7 Cat. No 92CU1909

$7.50

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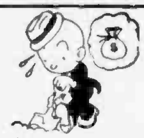

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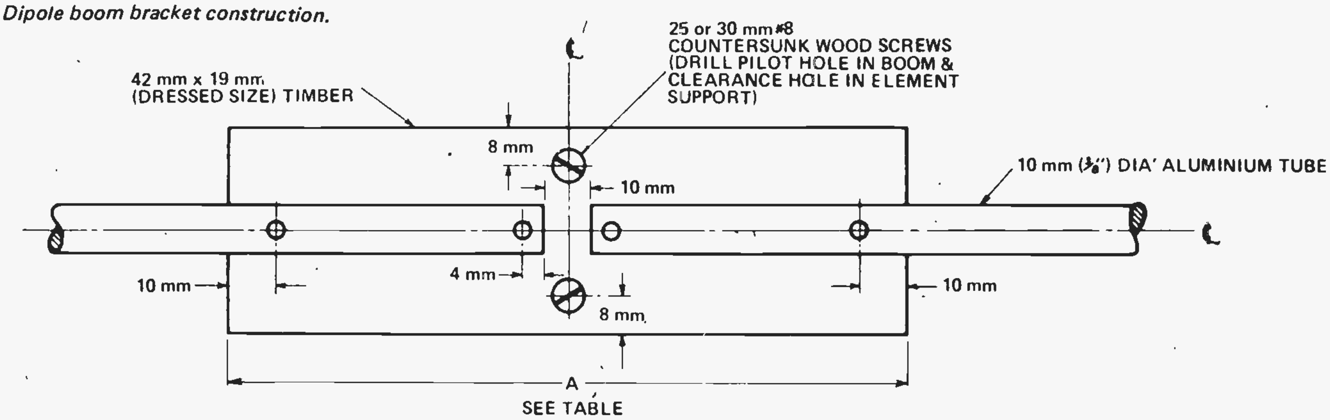
Fig. 2. Dipole boom bracket construction.



centre ends of the dipole halves, as illustrated in the diagram. These provide for the feedline connections.

When the elements and brackets are all assembled, they can be mounted on the boom. Commencing with either dipole 10 or the reflector, mark the position of each bracket on the narrow side of the boom, one by one, and mount them.

Align each bracket and element at right angles to the boom. A pilot hole should be drilled in the boom, to suit the 35 or 40 mm long screws, to avoid splitting the timber.

The spacings between each dipole, given in Figure 1, are centre-to-centre spacings of the elements.

'PLUMBER'S DELIGHT'

This style of construction, while more expensive than the wooden construction, is likely to last longer and will certainly give a more professional appearance if done carefully

The technique is illustrated in Fig. 4.

Standard element to boom brackets are used. These consist of a cad-plated

Fig. 3. Element mounting using wood construction.

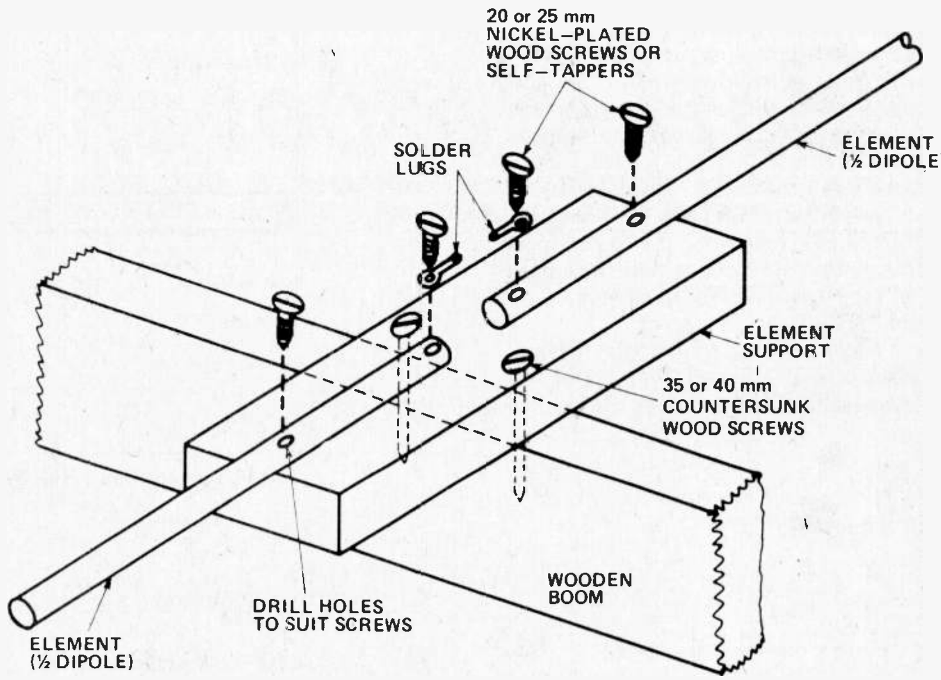
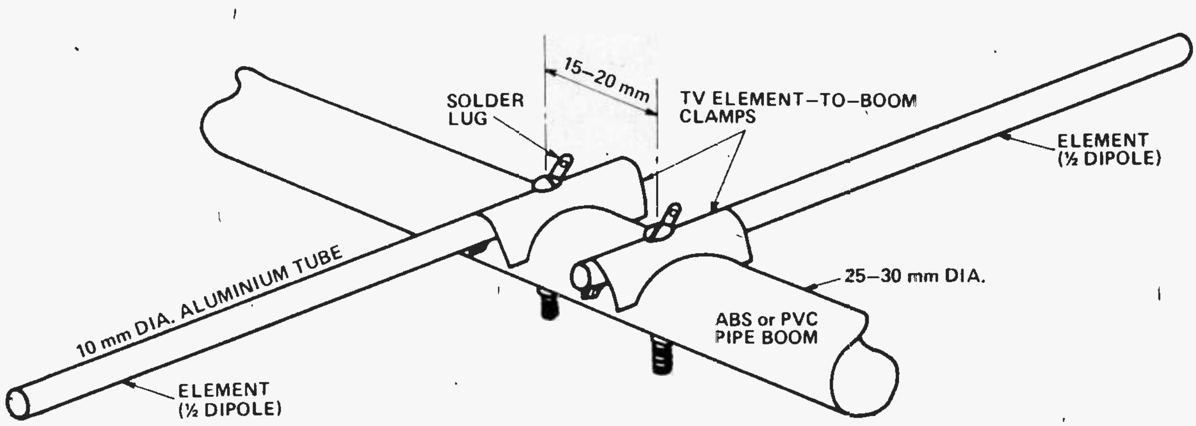


Fig. 4. Element mounting for the 'plumber's delight' version.



piece of steel punched and bent to the required shape, and drilled through the 'top' centre to take the securing bolt. They are made to accept 10 mm diameter elements and fit 25 to 30 mm diameter booms. Each half of the elements is attached to an insulated boom consisting of a 1.7 m (approximately) length of ABS or PVC plastic pipe, often used these days for domestic plumbing. An offset between the dipole halves of about 15 or 20 mm is used.

The reflector may be in a single length if possible (not if 1.83 m lengths of tubing are purchased). Otherwise, two halves may be placed as close as the element to boom brackets will permit and a solid electrical joint made between the two securing bolts.

The position of each dipole half should be carefully measured and marked before drilling the boom to take the element securing bolts. Make the holes a little oversize so that the elements can be rotated a little to line them up for the sake of appearance.

Cut all the elements to size, more or less in the order given previously. However, with this form of construction, each dipole half will need to be longer by an amount equal to half the length of the element to boom clamps -- about 25 mm.

Next drill all the dipole halves according to the requirements of the element to boom brackets, and assemble

Fig. 5. Feedline connections between the elements.

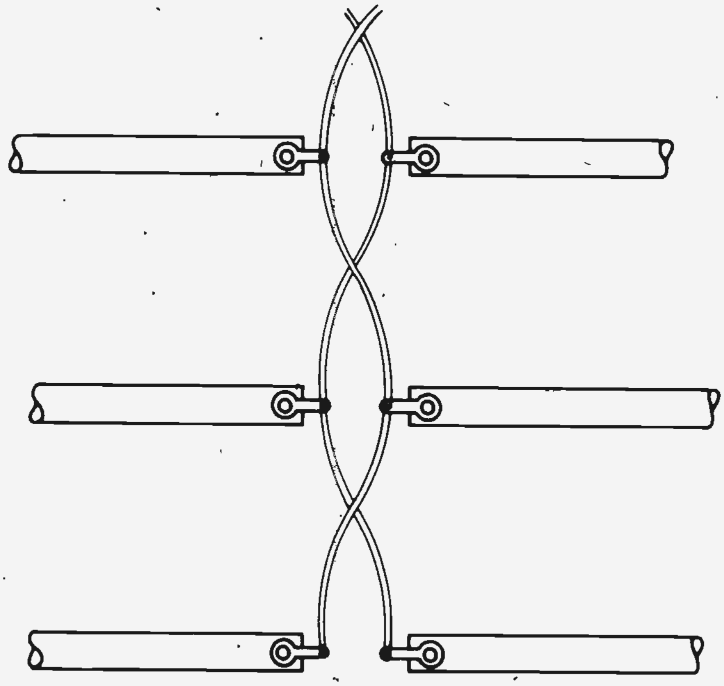
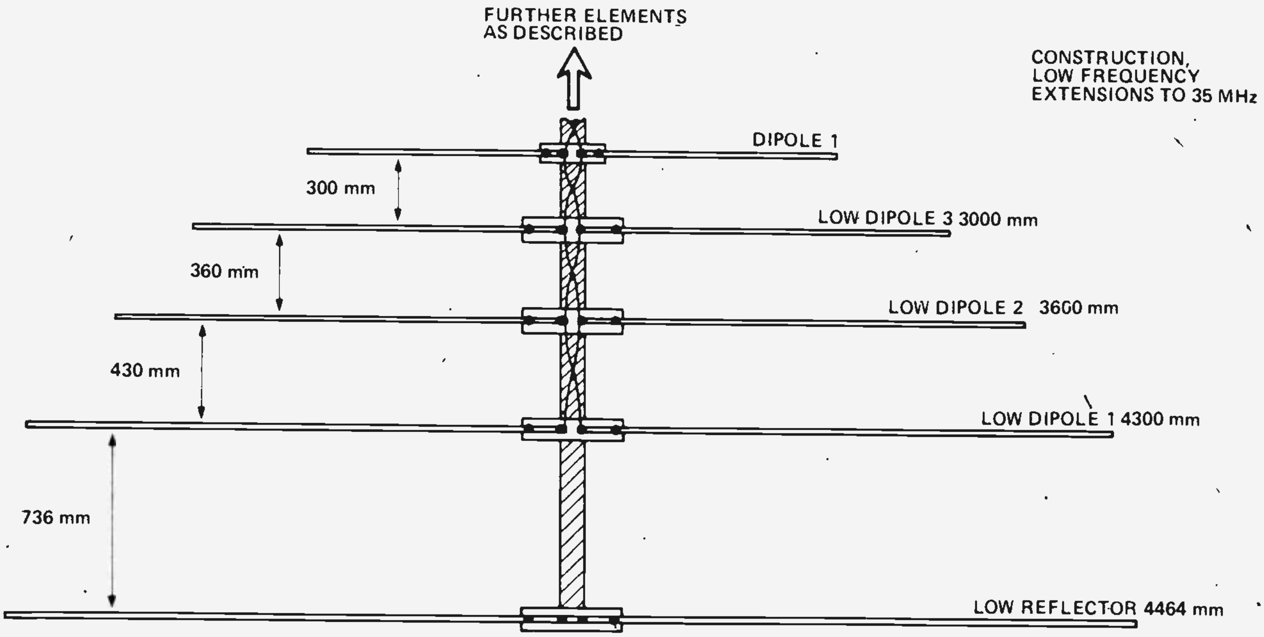


Fig. 6. Construction of the low frequency extensions to 35 MHz.



each element on the boom, commencing with either the reflector, or dipole 10.

FEEDLINE CONNECTIONS

The feedline connections are illustrated in Fig. 5. Each individual dipole feed-point is cross connected with the succeeding one.

The connections can be made with light-gauge hook-up wire, obtainable from most electronic component suppliers. Carefully solder each joint.

The balun transformer is mounted on the end of the boom, adjacent to, or beneath, dipole 10. Short connecting leads run from the balun input connections (balanced) to the feedline connection lugs of dipole 10.

LOW FREQUENCY COVERAGE

The 40 to 250 MHz model requires a longer boom, of larger cross-section, and has a total of fourteen elements. The dimensions of the extra three elements are given in Figure 6. They are mounted to the rear of dipole 1, and the original reflector is not used.

A boom 3.3 m long and about 1½" x 2½" dressed size cross-section brackest can be made of 1" x 2" dressed timber as before. A total length of 3.35 m (including cutting allowance) will be needed, as shown in the dimension in the table of Figure 2.

Plumbers delight construction can also be used for this model; construction is the same as described previously.

The longer low frequency elements in this model necessitate obtaining longer lengths of aluminium tubing, otherwise the shorter lengths will need pieces attached to the ends in order to make up the required lengths of the dipole halves. This can be done by slipping a 40 mm length of the next largest size tubing over the two pieces at the joint, and securing with small self-tapping screws. The feedline connections to the dipoles are as described previously.

Next month we shall continue with balun designs and further details on installation.

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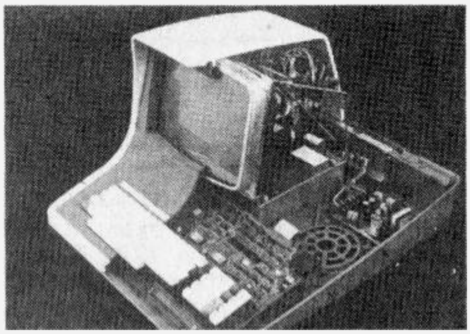

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Transducers in measurement and control

This article is the first part of a series on all kinds of transducers, which first appeared in ETI Australia. It was written by Dr. Peter Sydenham, and the series has been edited into book form, to be published later this year in England by Adam Hilger as "Transducers in Measurement and Control". Adam Hilger's address is: Techno House, Redcliffe Way, Bristol, BS1 6NX UK, and we will have details of North American availability when the book is printed.

A TRANSDUCER, is a device that converts (transduces) one physical variable into another. Transducers are not restricted to electrical signal conversion techniques, but in the main these predominate as electrical methods are universal, and provide a common interconnecting method for an engineering system or a scientific experiment.

This series will describe the proven practical methods (and this includes economic sense, as cost is important) now used to produce, in the main, electrical signals from the original physical effect to be measured.

Transducers provide convenient signals for measuring a process, for automatically recording these measurements when needed and, finally, for providing a signal that can be used to control. It is not possible to control without measuring and so the fundamental basis of automation is the transducer. The transducer is also able to provide gain by amplifying weak original signals before they are used. Amplification factors of a million are commonplace.

Often, more than one basic transducer principle is used to produce the required output. Units are cascaded. Consider the fuel gauge of an automobile, shown diagrammatically in Fig. 1. The first stage is known as the primary or input transducer, following are the secondary or intermediate stages and, finally, there is an output transducer.

In the fuel tank a float transduces the fuel level to an equivalent rotary motion. This drives a rotary potentiometer which provides a voltage proportional to the angle of rotation. Sometimes there is a calibration or adjustment stage in the chain. At the dashboard the voltage is turned back to a rotary displacement in the fuel gauge meter movement. The advantage of the electrical signal is that it avoids the need for a complicated mechanical linkage between the fuel level and the gauge. In a control application an electrical measurement output signal also enables in-line correction, compensation and computation to be made before the signal is used. Recording is also made most easily with electrical plotters.

In principle, a transducer is a simple device. In practice, however, simple schemes invariably suffer from defects that limit the ability of the device to provide repeatable and accurate values. They may suffer from wear as time proceeds: environmental factors such as temperature, pressure, humidity and shock, for instance, may be a significant problem. Consequently, at first sight, the developed transducer system usually appears quite complicated. But if treated systematically, it can be broken up into separate sub-systems that perform distinctly different tasks, each being joined to produce a satisfactorily reliable and accurate device.

A list of all the different transducers yet devised would be never ending, for the basic physical effects that could be used are beyond complete classification. Each may be used for many different purposes. For example, a light spot moving across a photo-cell can be used to measure position, alternatively, the movement might be used to change the sound level of a radio receiver by varying the voltage applied to the receiver output stage.

Nevertheless some transducers have emerged that are well developed for specific tasks. Thus a brief list can be made of primary devices, and those quantities measureable by the use of intermediate stages.

Linear Movement: From this are also derived thickness, velocity, acceleration, force, wear, vibration, hardness, stress, strain, pressure, gravity, magnetic field, level and position, by the use of secondary devices.

Angular Movement: Angular vibration, tilt, torque, position are obtained with angular transducers.

Temperature: Flow, turbulence, heat conductivity, remote sensing and displacement can be obtained by use of this basic measurement.

Illumination: Length, force, strain, torque, frequency, and light distribution have been measured using illumination.

Time: Speed, counting, frequency and position rely on time measurement.

Force: Weight, density, stress, torque and viscosity use force indirectly.

It is many years since James Watt thought of using the speed indicator of an early steam engine automatically to control its speed, and so producing what was probably the world's first industrial feedback control system.

In that case, a centrifugal governor was used to change the difficult-to-detect shaft speed into an equivalent mechanical displacement. It was, in fact, what is now called a transducer.

Since the time of the industrial revolution, machines and processes have developed at an ever quickening rate and the need to convert difficult-to-use effects into alternative physical forms has grown rapidly.

Late in the 19th. century, electricity became available to industry and science. Then the electronic discipline emerged. Electronic techniques, allied with those of mechanical, optical, thermal and acoustic origin — the list is never-ending — enabled a vast array of transducers to be developed to fulfil the needs of sophisticated measurement and control.

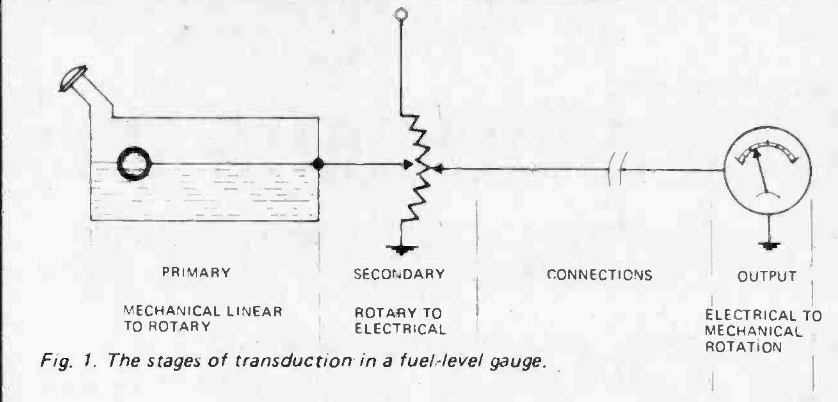

Fig. 1. The stages of transduction in a fuel-level gauge.

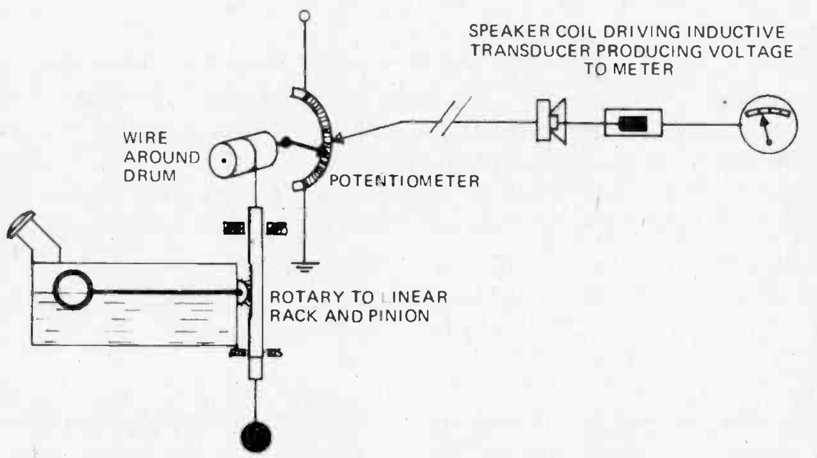

Fig. 2. A circuitous solution to a problem.

This list is not complete but it does illustrate the variety of possibilities open to the designer. A problem can be solved by circuitous means (Figure 2 is a fuel gauge arrangement with redundant use of transducers) but economic and reliability factors decide which way is acceptable in reality.

Transducers may provide the transduction in one of two basic ways. It may, firstly, control the available source of energy as a tap lets water through or a variable resistance controls the current flow from the power source in a circuit. Secondly, the transducer may actually convert the original energy form into another more appropriate form. An example is the use of a photo-voltaic cell in which light radiation energy generates

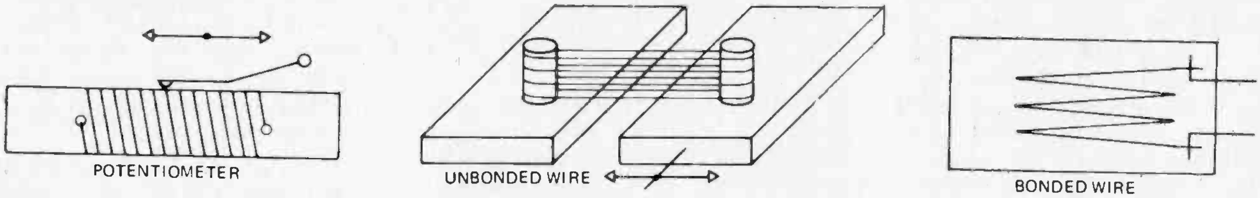

Fig. 3. Resistive displacement principles

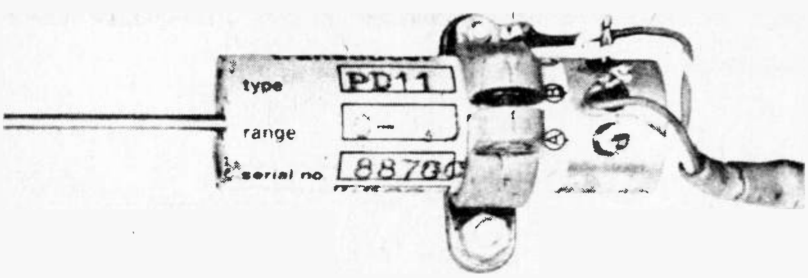

Fig. 4. A linear wire wound displacement transducer having 25µm resolution.

electrical energy. Transducers may also provide mechanical energy from the available electrical source as happens in the moving coil loudspeaker.

An interesting fact is that the dynamic and static behaviour of mechanical, acoustic and electrical systems are each described by similar mathematical equations. This analogy, as it is called, enables the behaviour of large machines to be simulated by inexpensive electrical networks. For example, the internal-combustion engine can be simply represented by a resistor and a capacitor at speeds above idling. So for research purposes, once the value of R and C are determined, it is possible to study the performance of that engine in a computer.

Some transducer applications need only a slow speed static response but often the need is for rapid conversion. The frequency response is, therefore, of interest. Mechanical systems are generally incapable of the same high speeds obtainable in electrical devices. For this reason there is a trend toward total electronic techniques if possible. This is not always a prudent way to solve the problem as many mechanical devices have been extensively developed to provide reliabilities of years (or millions of operations). A simple example is the choice made when several independent circuits have to be switched together. A bank of reed-relays is inexpensive, simple to design and capable of excessive overloads. A solid-state equivalent circuit is more expensive to develop and more prone to overloads. Each case should be considered on its merits.

Several terms, commonly used in measurement are often misunderstood and misused. The first is the repeatability of measurement. If repeated measurements are made of a static process by an instrument with sufficient sensitivity there will be a scatter of the values around some mean value. This scatter represents the uncertainty of the measuring process used. The most commonly used method of expressing this scatter is by what is known as the standard deviation (σ). This is found by a simple statistical mathematical formula. The important thing to realise is that there is a 68% chance of the true value lying between plus and minus 1 σ. For example, if a voltage is measured 100 times and its mean value found to be 100V with a standard deviation of 2 volts this means that 68 times it will lie between 98 and 102 volts and 32 times it will be outside these limits. In practice, one-σ limits are not tight enough. For $\pm 2\sigma$ limits it is 95 times out of 100 and for $\pm 3\sigma$ limits 99.7 out of 100 times within. Repeatability is the first requirement of a transducer for without it accuracy has no meaning. (The standard deviation of any transducer or precision measuring instrument is almost always quoted by the manufacturer.)

The **resolution** of a measuring instrument is the smallest quantity that it can detect. But to have extreme resolution does not imply that it will repeat each time nor be accurate. A screw-thread micrometer could have a drum of enormous diameter enabling extremely small distances to be gauged, but the screw friction and error would produce scatter and inaccuracy.

Precision is the term used to describe how well the instrument measures and gives a reliable value. The smallness of the standard deviation, therefore, is a measure of precision.

Accuracy is the most difficult factor to obtain. An instrument may be precise, always giving the same value, but to be accurate, that value must be true to the established standards. For example, a voltmeter may indicate

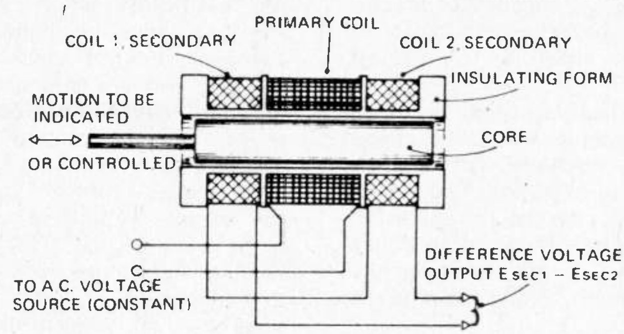

Fig. 5a. Linear variable differential transformer.

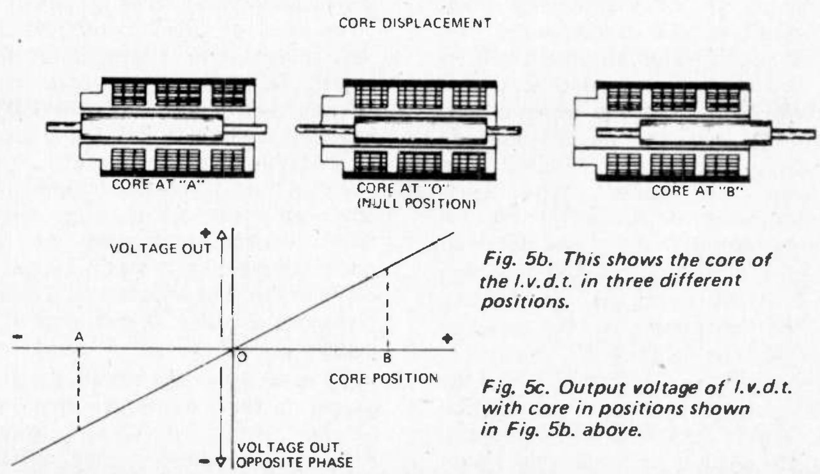

Fig. 5b. This shows the core of the l.v.d.t. in three different positions.

Fig. 5c. Output voltage of l.v.d.t. with core in positions shown in Fig. 5b. above.

10.1 volts repeatedly but if the pointer is bent or the multiplier resistor incorrect, the actual voltage may be only 9.5. There is no way of establishing accuracy without resorting to another measurement device. Often, accuracy is added to a precision instrument by resorting to calibration. In transducer applications, this must usually be automatic, or built into the device, as a human link is undesirable.

So much for a general basis of transducer technology. We will now continue by discussing various measurements in turn starting with the methods used to transduce displacements.

This initial article deals with small displacement transducers ranging in capability from a few millimetres down to hundredths of the diameter of atoms. These devices are particularly useful in obtaining derived quantities as well as direct measurements (as will be seen later). In the second article we shall discuss the industrial displacement range, that is, from millimetres to several metres, and then the surveying range from hundreds of metres to the size of the Earth and larger.

MICRODISPLACEMENT TRANSDUCERS

Displacement is measured directly with resistive, inductive and capactive methods and, indirectly, by optical means.

Resistive: The simplest way to transduce movement into electrical signals is to mechanically vary the properties of a resistance. This can be realised by direct mechanical movement of the tapping point, as in a potentiometer, or by straining the resistance element, as in a strain gauge, (Fig. 3).

Potentiometers, whether linear or rotary, consist of a resistance track upon which slides a contact wiper. The earliest precision potentiometers used fine resistance-wire wound around a toroidal former. As the wiper moved over the turns, the output changed abruptly and this limited the resolution. A modern type linear potentiometer is shown in Fig. 4. Infinite resolution has been obtained by using a continuous slider running longitudinally along the wire (it may also be obtained by the use of composite-material track). Repeatibility is limited by the precision of the wiper contact position and slight variations in electrical contact. Due to relatively poor repeatibility and reliability, and because of the high operating force, it is unusual for a resistance potentiometer of this type to be used for applications where high resolution is required.

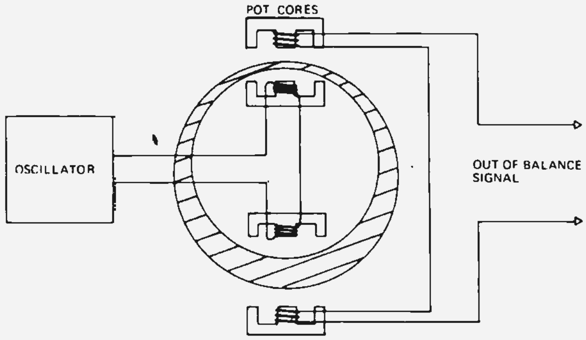

Fig. 6. A differential arrangement using two variable reluctance transducers for monitoring tube eccentricity.

An unusual type of resistance potentiometer is that whereby a tightly coiled tension spring is stretched to open the coils and increase the resistance. The required displacement-output signal characteristic is determined by the method of hard-coiling the spring.

The sensitivity of resistive methods is limited by the allowable self-heating of the element, for temperature changes alter the resistance value.

Strain gauges are resistances that are strained bodily so as to alter their physical cross-section and length. Resistive types are made as wire, or stamped foils of thickness around 20 μm, and are arranged to obtain multiple elongations connected in series. Adhesives are used to attach the gauge to the member to be measured. This ensures faithful movement with the parent. Typical resistance values range from ·10 to 10 000 ohms. Self heating and temperature effects limit the sensitivity of these devices but absence of mechanical moving contacts enables resolutions of better than 1 microstrain to be obtained.

The ratio of strain to proportionate resistance change is termed the gauge factor. This is usually quoted by the manufacturer. For linear resistance gauges it is close to 2.0. Calibration is necessary for precision work.

Wheatstone bridges, of simple and advanced form, are used to measure the resistance changes of both potentiometers and strain gauges. To compensate for temperature, a dummy resistance is used in one arm of the bridge.

The main advantage of resistive strain gauges is their extremely small size, ranging from 2 mm upwards. Frequency response exceeds 50 MHz for special, surface deposited types.

Solid-state strain gauges are also available. If a semiconductor element such as silicon is strained, it also shows a change in resistance. Their gauge factor is not constant but depends upon instantaneous strain magnitude and temperature. Gauge factors of 100 are typical.

The main disadvantage of resistive strain gauges is their fragility, and this requires them to be mounted on a more substantial element. For fixed applications, it is practicable to mount the gauge between the two moving members in what is known as an unbonded arrangement.

Strain gauges are used extensively in civil and mechanical engineering testing. Gauges are glued to the structure in many places. A data-logger reads each in turn recording the strain at that time. This data is then processed to produce the required information.

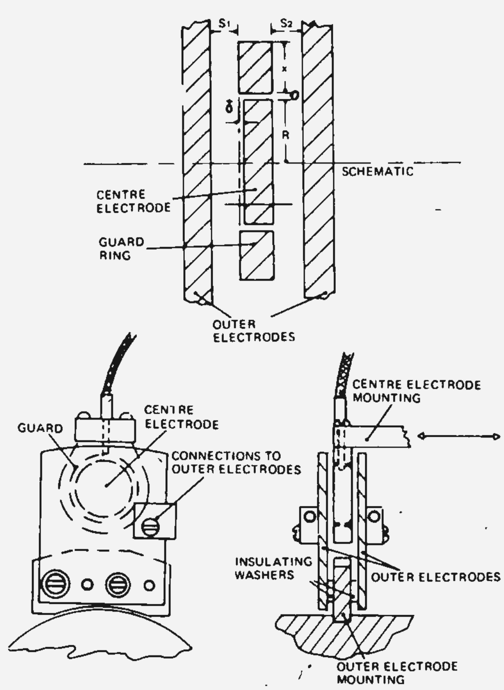

Fig. 7. Differential parallel plate capacitance transducer.

Inductive: Electromagnetic and electrostatic fields can be utilised for displacement sensing, each having practical advantages. Alternating current excitation can be employed and dissipative circuit elements are kept to a minimum (factors which enhance sensitivity and reduce drift). Inductive methods use, in the main, either the linear variable differential transformer (l.v.d.t.) principle, or operate on a reluctance variation concept.

The l.v.d.t. consists of a spatially centre-tapped solenoid in which moves a magnetically-hard steel core, (Fig. 5). The coil is energised either by a separate primary coil or by direct connection across the winding. As the core moves relative to the winding the flux-linkages cutting each half of the winding vary, resulting in amplitude unbalance between the halves. The degree of unbalance is linearly related to the core's displacement from the coil centre.

One method of sensing the unbalance is to connect the sensing coils in opposition and measure the output voltage. It is necessary, however, in this simple method, to determine the phase relationship between the excitation and output in order to decide the sign of the displacement. A superior technique uses a phase-sensitive detector, the output then being a bi-polar dc voltage which is linear with displacement.

Linear variable differential transformers are used extensively in industry in weighing machines, pressure transducers and load cells; and in science in earth strain-meters, tilt meters and seismometers. A major manufacturer offers over 2000 different models. In these applications resolution required is rarely less than 5 μm.

The principle is also used in some industrial dimensional metrology gauging heads where 100nm is the best resolution needed.

The core and winding are mounted to avoid mechanical contact, but perpendicular movement to the core's axis is not possible. Axial core travel can be over very large distances and the zero position can be set electronically at any point along the length of the winding. Humidity, even liquids, do not affect the operation. Magnetic shielding is used to isolate the winding from external fields.

The other main inductance technique employed is known as the reluctance transducer. If the air-gap of a magnetic circuit is varied, the magnetic circuit reluctance changes. As the majority of the circuit reluctance is produced across the air-gap the response is reasonably linear. In practice the iron circuit can be made from a pot-core as shown in the tube gauge (Fig. 6). This contains the sensing coil and a freely moving limb which completes the circuit. The device is directly energised and may be sensed by similar methods to l.v.d.t.'s. A differential arrangement is often used to balance the effects of temperature and stray fields.

Reluctance transducers have been employed for measuring tube eccentricity as shown, for measuring dynamic lubricant film thicknesses, and in pressure gauges. Sensitivities of these small range inductive methods can be as high as 200 mV/μm. Frequency response is limited by the excitation frequency used (10-10 kHz) and mechanical factors.

Capacitive: The most favoured extreme precision sensing method is known as capacitance micrometry. In its simplest form it consists of measuring the capacitance changes resulting as the separation between two plates of a capacitor is varied. As capacitance is inversely proportional to gap distance, the displacement/output characteristic is a non-linear hyperbolic. A guarding is used to control fringing of the electrostatic field existing between the

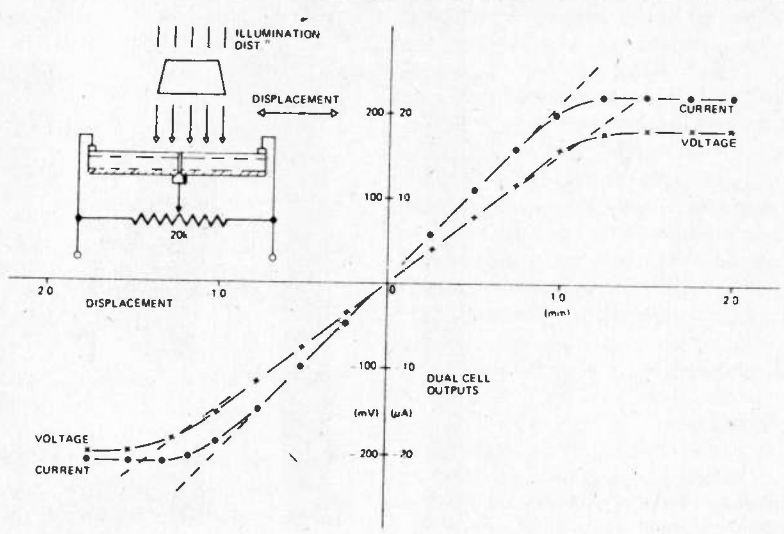

Fig. 8. Dual cell position-sensitive optical transducer.

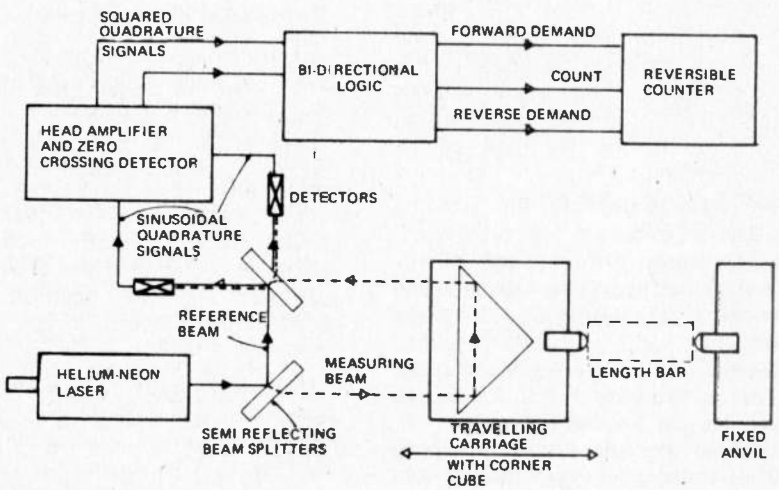

Fig. 9. One form of industrial laser length measuring interferometer.

Fig. 10. Testing the corrosion thickness of a pipe with an ultrasonic gauge.

plates and to reduce the effect of lead strays which shunt the small variable-capacitance limiting the attainable sensitivity. Linearization has been achieved in one manufactured gauge by placing the sensing capacitance in the feedback of an operational amplifier.

The magnitude of the sensing capacitance is only a few picofarads. Reactive bridges can sense to 10^{-5}pF, or a little better, using tap changing inductive transformers. As the capacitance value is proportional to plate area and inversely to separation, highest sensitivities result for largest plate sizes and smallest gaps.

Practical considerations of plate flatness and degree of parallelism limit the gap size to around 100 μm or more. Plate diameters in use range from millimetres to centimetres. In most applications the sensitivity of the method to stray capacitance is reduced by using a differential capacitance mechanical layout. A central plate moves between two fixed sensing electrodes, the plate being earthed. Any temperature effects and air dielectric changes occur equally in each arm of the arrangement. If sensed by a bridge circuit, these effects are largely cancelled.

Capacitance gauges have been used in geophysical instruments such as gravimeters, tilt meters and strain meters. They are also used in industrial gauging and machine tool control.

Optical: Mechanical displacements of interest can be converted into movements of a light beam which can then be sensed with a position-sensitive optical detector. Rotations can be magnified using an optical-lever if space permits.

In simple arrangements the radiation beam is either split into halves, each half feeding a separate photocell or alternatively, the beam may impinge directly onto a photo-device with position-sensitive characteristics. In each case a differential bridge arrangement is usually incorporated giving zero output if the beam is truly centred. This null position can be conveniently displaced by electrical means.

In brief, static arrangements use position-sensitive photo cells or passive optico-mechanical arrangements (beam splitting mirrors, prisms) and dynamic methods use optico-mechanical devices (rotating prisms and wedges, vibrating apertures) or electrodynamic devices (image dissector tubes, magneto-optical and wavefront shearing).

Numerous possibilities exist, but for simplicity and cheapness, solid-state position-sensitive photo-cells will usually be the first choice considered. The simplest method uses two (or four for 2 axis measurement) silicon solar cells, about 10 mm square, which are mounted adjacent to each other. This is illustrated in Figure 8. A rectangular light spot is traversed across the junction. If central, each produces an equal signal which cancel if they are differentially-connected; this is the null position. Displacement from the null gives a proportional output until the spot moves entirely onto a single cell where a saturated displacement characteristic occurs.

In 1957 a lateral-effect position-sensitive photocell was reported in which the output is logarithmically related to the spot displacement as it moves between two ohmic contacts made on the junction surface. Extensive research was concentrated on these cells for tracking of military targets such as the plume of a missile.

A third form of position sensitive cell uses the light-spot as a contact 'wiper'. Its effectivity shorts a low-impedance, via a photo conductive strip, to a position along a high-impedance potentiometer track.

In most of these optical position-sensing methods it is paramount that the beam intensity remains constant as output away from the null (at the null point intensity is less important) is proportional to the luminous flux falling on the cells. This in turn, is decided by the total beam flux and its distribution.

Another way to detect position is to have an array of photo-diodes, interrogating them to find the position of a spot or a pattern illuminating them. Arrays containing 2500 diodes have been made.

These optical methods can detect movements perpendicular to the beam's axis. Interferometry can detect movements along the axis to extreme precision.

If a coherent radiation source is split into two paths, each being optically mixed upon return from reflectors, the position of the interference fringes resulting is a direct measure of length differences between the two arms. If one arm is fixed as a reference length, displacements in the other arm can be measured by monitoring the fringe movements. A unit developed in Britain is shown in Figure 9. Suitable radiation wavelengths range from millimetres to micrometres, so in most cases the monitoring task involves whole fringe counting and then fringe width subdivision or interpolation. The shortest practical wavelength is around 500 nm, which in the simplest interferometer accounts for 250 nm displacement of the measuring arm.

One well-used method of interpolation is to produce two signals from the fringes which are 90° spatially separated. Digital operation on these dc coupled signals will yield a divide by 4 factor. This technique was developed simultaneously in 1953 for interpolation in an interferometer and in Moire grating use for industrial control by Ferranti. A number of totally electric methods have been

devised to obtain improved resolution from dc quadrature-phase signals. These include mechanically activated sine and cosine potentiometers driven to balance, use of resistance networks to produce a set of different phase triangular signals which can be divided by trigger levels and super-position of the signals on to an ac carrier which then enable phase-sensitive detection to be used. At the best, however, only 1% precision can be obtained.

Another way to interpolate the fringes is to drive the return mirror so as to maintain the fringe in a constant position. This method has been used in the University of Cambridge laser earth strain meter. In all cases of fringe monitoring, however, it is possible for optical and electronic noise to displace the fringe too rapidly for the system to record, thus losing or gaining an integral number of error counts.

Laser interferometers are used in industry for the exacting calibration of jig boring mills and the like. With the industrial units, the effects of the air (that is the change in temperature, humidity and pressure) limit the precision to around 1 part in a million. This is improved by feeding back data on the conditions using appropriate transducers. In some applications, notably earth strain interferometers, the complete system is contained in an evacuated tube to avoid these errors. In such cases, precisions of around 1 part in 10 000 million are realised if the wavelength of the laser is stabilised.

Miscellaneous:

The above are the most popular methods for sensing small displacements. There are many other ways to solve the problem and each has its particular attributes which make them suited to special applications. Here are just a few.

Radiation Gauging – Here a source of short wavelength radiation (α, β and γ) is located on one side of the (thin) material to be measured. The degree of absorption, measured by a radiation counting detector on the other side, is a measure of thickness. A number of variations exist on this, for example, shuttered absorbers are used to measure axial displacement in turbines and one-side gauges have application in continuous thin plastic-film measurement. The measurement precision depends upon radiation count integration so accuracy is increased by averaging the count over a longer period.

Ultrasonic Gauging – If the velocity of propagation is known, the transit time of an acoustic wave within a material is a measure of thickness. Sound waves travel at about 300 m/sec in air, 1500 m/sec in water and 5000 m/sec in metals. This principle has been used for small distance gauging. The slower velocity of acoustic waves, compared with electro-magnetic radiation, enables finer resolution to be obtained for a given technological limit on transit time measurement. Ultrasonic micrometers have been developed that resolve to 2 μm. Ultrasonics have been successfully employed for engineering component thickness measurement, corrosion thickness measurement in pipes, (see Fig. 10), and for medical applications in which foreign objects are located, growths discovered and probes guided.

Laser Beam Diffraction – Coherent radiation diffracts around a small object to produce an interference pattern beyond it. This has been used to gauge wire size diameters down to 10 μm. The position of the chosen diffraction fringe, (best produced by a laser source) can be monitored by a position sensitive photocell to enhance the resolution. This method is capable of size measurement at very high speed.

Sub-millimetre Waves – In many applications of interferometry the wavelength of the source is too short compared with the surface finish to be gauged against, and a mirror must be added. An interferometer using sub-millimeter waves of wavelength 50-1000 um has been developed. Their device has been called the Teramet. It can measure to normal tight engineering tolerances (2 μm) but needs no specially provided reflector as in laser interferometry.

Other lesser known techniques include vibrating-wire strain gauges in which the tension of a continuously vibrated wire is varied. (The resonance frequency is then a measure of length change causing the tension change); piezo-electric crystals in which a force (accompanied by very small proportionate compression or extension) produces an electric charge flow which can be calibrated as displacement; pressure sensitive paints and semiconductors that exhibit resistance changes as they are deformed mechanically; and the use of a television pick up tube (usually the vidicon) to produce serial electrical signals of an optical shape enabling amplification to be achieved and an electrical output to be obtained.

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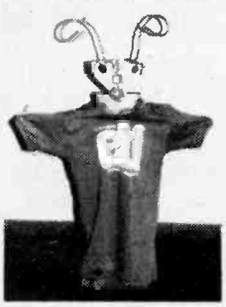

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Trig in Ft, Ins, and Fractions

Just in time for the switch over to metric, Boyd Ray of Edmonton has a program which lets you do trigonometry in feet and inches.

PERSONS WHO DEAL with decimal or metric units of length can do no better than to perform their trigonometric computations on one of today's hand calculators. Unfortunately, the math is only half of the problem for some of us. There remains the conversion of the decimal units (in our case, feet) into the standard form of expression. Our right triangle problem has known sides of three feet, four and thirteen-sixteenths of an inch and seven feet, eleven and a half inches. We anticipate a third side of eight feet, seven and twenty seven - thirty seconds of an inch. We would have optimum performance if we could converse with our hand calculator in this uncompromised standard form of expression. There are several programmable calculators that feature a pause function which can be programmed to this end.

The following is a multi-purpose program for solving right triangles and doing arithmetic in this format. It is written for the Texas Instruments TI-58 and 59.

The program is initiated by pressing A'. The known values are both entered and then identified by pressing one key. This will run the program, produce a solution and store the natural tangent of the smaller acute angle for use in solving any subsequent similar triangles. The tangent is replaced by another each time two known sides are entered thus defining a new triangle. Always enter the smaller of the two sides first.

Entering a known side consists of the following series of keystrokes: a, enter feet (or zero if none) and press R/S; b, enter inches (or zero if none) and press R/S; c, enter the fraction's numerator (or zero is no fraction) and press R/S; and d, enter fraction's denominator and press R/S. Omit step d, if there is no fraction. The program converts these values into decimal feet, stores the side and returns a zero to indicate readiness for the next operation.

It is possible to perform the entry series faster than each number is processed. Be certain, therefore, that each number returns to the display before keying the next. With practice, and optimum entry speed of about two seconds per side can be realized.

Fractional accuracy is usually relative to the project. And/or it's construction tolerances. This program indulges an accuracy of plus or minus one sixty-fourth of an inch, therefore displaying increments of one thirty-second on an inch. It derives the lowest common denominator of the fraction and displays a negative numerator if the displayed value was rounded up from the decimal value. This enables the user to do a little intelligent rounding of his own if so desired.

Fractional values entered may have any denominator. Furthermore, sides may be entered in any decimal form, if necessary. For example, 15.3976 R/S (ft), 0 R/S (fract), or 32 R/S (ft), 8.3341 R/S (in), and 0 R/S (fract), or 0 R/S (ft), 0 R/S (in), and 325 R/S, 16 R/S (fract). Thus any combination may be entered. The solutions, however will be conventional feet, inches and fraction in lowest common denominator to an accuracy of .015 inch.

The user may modify output accuracy by changing the 32 at steps 284 and 316 to the desired denominator and the value of 384 at step 257 to twelve times the desired denominator (including a NOP if only two digits).

In one lexicon, it is the convention to refer to the sides of a right triangle as; a, the RISE – that side opposite the smaller acute angle; b, the BASE – that side opposite the larger acute angle; and c, the SLOPE – that side opposite the 90 degree angle. The angle itself is referred to as the BEVEL, which is the length of the RISE on a similar triangle having a BASE of exactly twelve inches or one foot. It is said thus; "a BEVEL of three and one-quarter inches to twelve". The following operation format employs these conventions.

This program will solve problems with any of several combinations of known values. Press A' once, to initiate.

FUNCTION 1: Enter known RISE and BASE – Press D to solve for the SLOPE and BEVEL. Continue at function 6 or enter a new problem.

FUNCTION 2: Enter known RISE or BASE and known SLOPE – press E to solve for other side and BEVEL. Continue at function 6 or enter a new problem.

FUNCTION 3: Enter known natural tangent Press D' and continue at function 6.

FUNCTION 4: Enter known angle* (in degrees.minutes-seconds) press E' and continue at function 6.
*or decimal degrees, INV D.MS (This is the tangent angle, i.e. the smaller actue angle).

FUNCTION 5: Enter known BEVEL and continue at function 6.

FUNCTION 6: With natural tangent previously determined (functions 1 through 5) — enter known side and press:

A if it is the RISE of a similar triangle, or; B if it is the BASE of a similar triangle, or; C if it is the SLOPE of a similar triangle, and solve for the unknown sides. Repeat function 6 as required for subsequent similar triangles, or enter a new triangle via functions I through 5.

After performing functions 1 or 2 — press B' to display the natural tangent, and/or C' to display the smaller acute angle. Continue at function 6 or enter new triangle via functions1 through 5.

Have a pencil ready — the solutions will be displayed as entered — at a rate of about one half second per number.

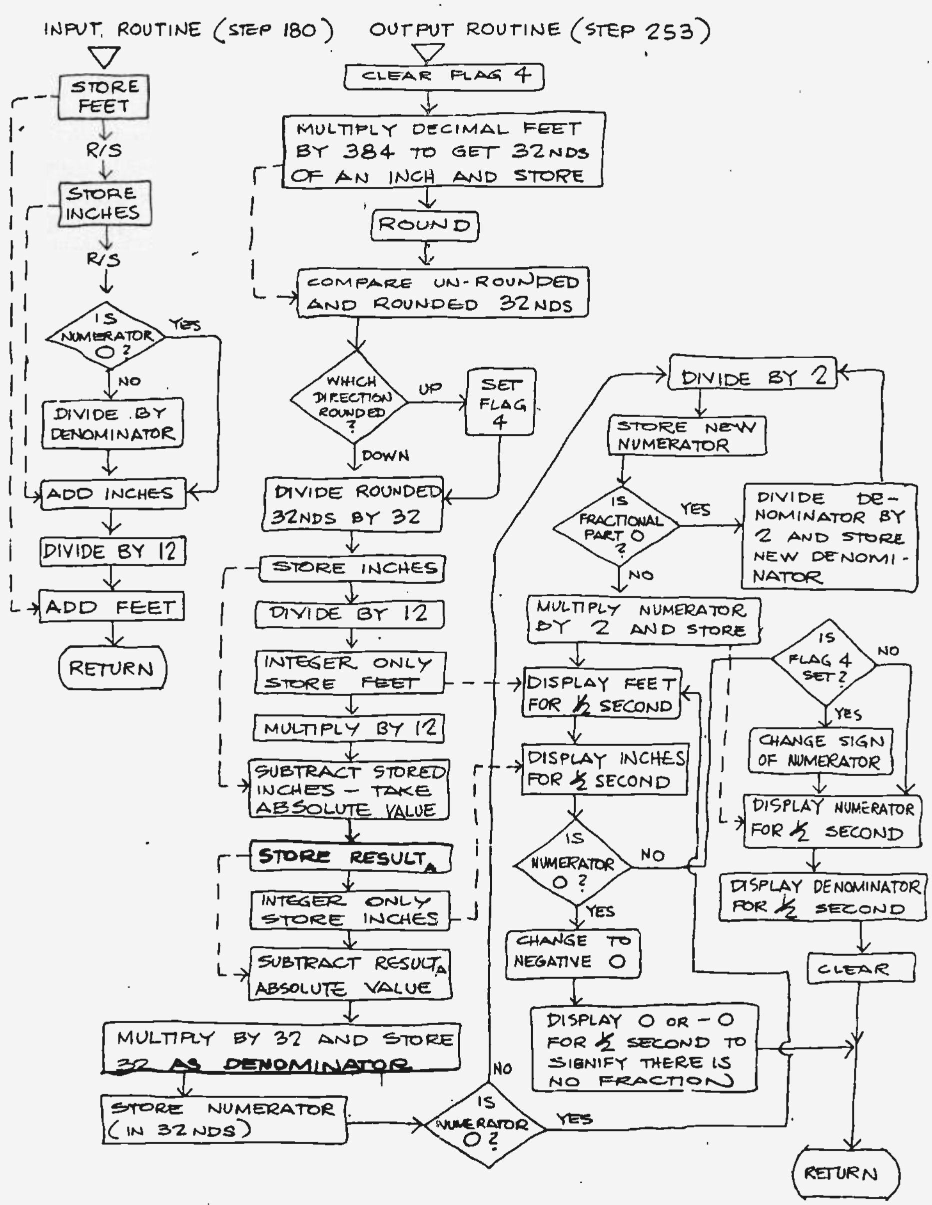
A sample problem would be keyed in thus; a known RISE of 15 R/S ft, 11 R/S ins, 1 R/S numerator and 8 R/S denominator (15ft 11 1/8 ins) and a known SLOPE of 32 R/S ft, 0 R/S ins, and 0 R/S no fraction (32ft). Pressing E, we observe the base of twenty seven feet, nine and one sixteenth of an inch and a BEVEL of six and seven eighths to twelve. If we desired our base to the nearest eighth, then the negative sixteenth would indicate rounding down, to twenty seven feet, nine inches even. A positive sixteenth would suggest rounding up, to twenty seven feet, nine and one eighth inches. Pressing B', we observe the natural tangent of 0.57385 and/or pressing C' we find the smaller acute angle to be 29 degrees, 50 minutes and 58 seconds. Proceeding to solve a similar triangle with a known BASE of 0 R/S feet, 0 R/S inches 15 R/S numerator, and 16 R/S denominator (15/16 ins) and pressing B we obtain a RISE of seventeen thirtyseconds of an inch. These might be rounded to five eighths and one inch respectively. The two unknown sides are always returned just as known sides are entered, i.e. the smaller first.

If you realise an error after R/S or a flashing display obtains, press clear, reset and A' then re-enter the problem. If you were distracted as one of the answers flashed by, you may review the first by pressing RECALL 03 SBR 253. If the second value was the BEVEL, press RECALL 01 SBR 253.

The program doubles as an adding machines in this format. Press SBR SUM, once, for this mode. Enter a dimension, ft, R/S, in R/S, N/, R/S, /D, R/S then press +, -, x, or ÷ and enter the next dimension or a multiplier or divisor and press SBR = for the result. Long strings of additions or subtractions may be performed, pressing SBR = last, or often as a sub total. The decimal equivalent of each operand is displayed after its entry. Similarly, the sub total, in its decimal form, returns to the display after conversion to format. Be certain you practice using this routine awhile. The omission of a R/S keystroke or the accidental addition of a clear key stroke in the series can render the operation useless and require starting again from the top. Try a few strings using values which yield a known result. Press A' to return to the trigonometry problem mode.

The program may be modified for trigonometric operations in metric. However, this defeats the primary purpose and the revision would not be as efficient as a program dedicated to metric.

FLOW CHART



PROGRAM

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000  LBL =          MATH
     =              ROUTINE
     STO 4
     SBR 256
     RCL 4
010  LBL SUM
012  R/S
     SBR 180
     GTO 012
019  LBL D          GIVEN RISE
     SBR 231        AND BASE
     SBR 253
     GTO 057
030  LBL E
     ST FLG 3
     SBR 231
     SBR 253
     RCL 3          GIVEN ONE
     STO 2          SIDE AND
     - RCL 1 =      SLOPE —
     x≥t 057        DISCRIMINATES
     RCL 1          RISE AND
     EXC 2          BASE AND
     STO 1          ORGANIZES
                    REGISTERS
                    APPROPRIATELY
057  RCL 1
     ÷ RCL 2 =      TAN = a/b
     STO 1
     SBR 253
     INV ST FLG 3
     GTO 137
074  LBL A
     RCL 2
     ÷              GIVEN RISE
     SBR 207        WITH TAN
     SIN =          PREVIOUSLY
     STO 4          ESTABLISHED
     SBR 253        b = a/TAN
     GTO 137        c = a/SIN
092  LBL B
     RCL 2
     ×              GIVEN BASE
     SBR 207        WITH TAN
     COS =          PREVIOUSLY
     STO 4          ESTABLISHED
     SBR 253        a = b TAN
     GTO 137        c = b/COS
110  LBL C
     SBR 223
     SIN =          GIVEN SLOPE
     STO 3          WITH TAN
     SBR 253        PREVIOUSLY
     SBR 223        ESTABLISHED
     COS =          a = c SIN
     STO 4          b = c COS
     SBR 253
     GTO 137
```

```
135  LBL A'
     RCL 1          INITIATION
     STO 2          ROUTINE
     R/S            PROGRAM
     SBR 180        IDLES HERE
     EXC 2
     EXC 1
     GTO 141
153  LBL E'         TO ENTER
     D.MS           ANGLE ° ' "
     TAN
157  LBL D'         TO ENTER
     GTO 139        NAT TAN
162  LBL C'
     RCL 1          TO DISPLAY
     INV TAN        ANGLE ° ' "
     INV DMS        (AFTER COMPUTATION)
     GTO 142
173  LBL B'         TO DISPLAY
     RCL 1          NAT TAN
     GTO 142        (AFTER COMPUTATION)
180  STO 9          INPUT
     R/S            CONVERSION
     STO 8          ROUTINE
     ( ( (
     R/S
     x=t 195
     ÷
     R/S
194  + RCL 8 )
     ÷ 12 )
     + RCL 9 )      RESULTS ARE
     INV SBR        DECIMAL FEET
207  RCL 1
     =
     STO 3
     SBR 253
     RCL 2
     ÷ RCL 1
     INV TAN
     INV SBR
223  RCL 2
     × RCL 1
     INV TAN
     INV SBR
231  RCL 2          c = √(a²+b²)
     x²             OR
     STO 3          a = √(c²−b²)
     RCL 1
     x²
     INV IF FLG 3
     245
     +/-
245  + RCL 3 =
     √x
     STO 3
     INV SBR
```

```
253  INV ST FLG 4   OUTPUT
     × 384 =        CONVERSION
     STO 9          ROUTINE
     FIX 0
     EE INV EE      CONVERTS
     INV FIX        DECIMAL
     EXC 9          FEET TO
     - RCL 9 =      HALF-SECOND
     x≥t 281        DISPLAYS
     ST FLG 4       OF FEET,
281  RCL 9          INCHES,
     ÷ 32 =         NUMERATOR
     STO 5          AND DE-
     ÷ 12 =         NOMINATOR
     INT            OF FRACTION
     STO 7          OR ZERO
     × 12 =         WHEN NO
     - RCL 5 =      FRACTION
     |x|
     STO 5
     INT
     STO 8
     - RCL 5 =
     |x|
     × 32
     STO 6
     =
     STO 5
     x=t 339
326  ÷ 2 =
     STO 5
     INV INT
     x=t 375
     2 PRD 5
     RCL 7
     PAUSE
     RCL 8
344  PAUSE
     RCL 5
     INV x=t 362
     INV IF FLG 4 358
     0 +/-
358  PAUSE
     GTO 385
     INV IF FLG 4 368
     +/-
368  PAUSE
     RCL 6
     PAUSE
     GTO 384
375  2 INV PRD 6
     RCL 5
     GTO 326
     CLR
385  INV SBR
```

Chord Generator

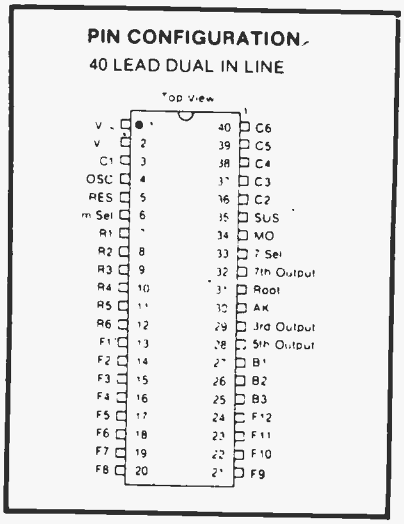
Easy way to generate chords and various fancy musical functions. The General Instruments Microelectronics AY-5-1317A.

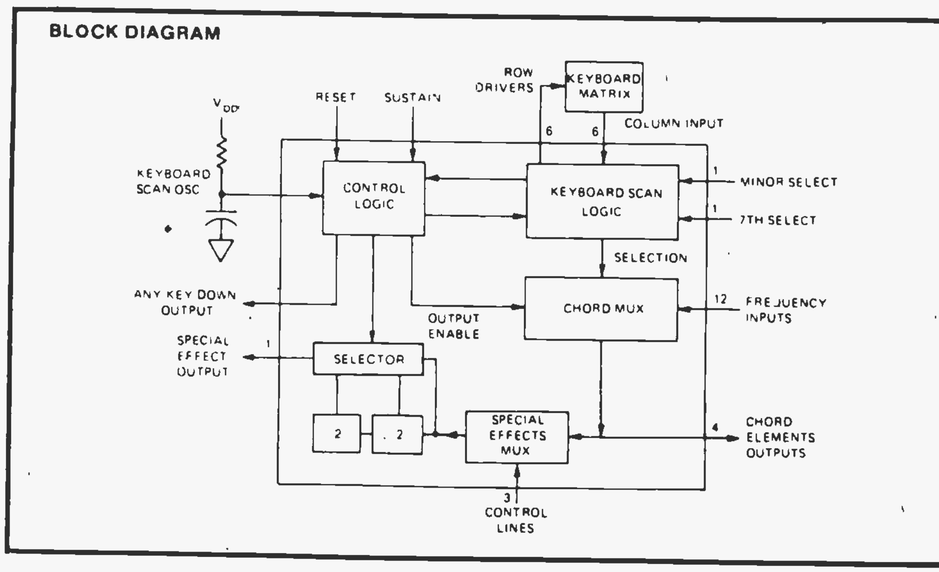
FEATURES

- ROOT, 3rd, 5th, 7th Chord Elements
- Additional output for special effects
- Sustain capability
- Top key priority
- Self-contained oscillator circuit
- Operated with single pole, single throw switch matrix

DESCRIPTION

The AY-5-1317A is a P-Channel MOS IC which accepts twelve basic frequencies (one full octave) and outputs the notes necessary to form Major, Minor and Seventh chords. This is the only known standard chord generator IC that performs these functions. The chord elements (ROOT, 3rd, 4th, 5th, 6th and 7th) can be multiplexed internally to perform special effects such as walking bass, rhythm arpegio, alternating bass, etc. The AY-5-1317A will operate in conjunction with and, through the KEY DOWN output, synchronize a rhythm generator such as the General Instrument AY-5-1315. The AY-5-1317A has a keyboard priority system with the C Major chord having the highest priority.





ELECTRICAL CHARACTERISTICS

Maximum Ratings*

V_{DD} with respect to V_{SS}	−20V to +0.3V
Logic Input Voltages with respect to V_{SS}	−20V to +0.3V
Storage Temperature	−65°C to +150°C
Operating Temperature (T_A)	0°C to +70°C

Standard Conditions (unless otherwise noted)

V_{DD} = −15V ±3V
V_{SS} = 0V (substrate voltage)
Operating Temperature (T_A) = +25°C

*Exceeding these ratings could cause permanent damage. Functional operation of this device at these conditions is not implied —operating ranges are specified below.

Characteristic	Sym	Min	Typ**	Max	Conditions
Input Logic Levels					
Logic 0	VIL	V_{DD}	—	−8.5	
Logic 1	VIH	−1.0V	—	+0.3V	
Input Capacitance	CIN	—	—	10 pF	
Note Outputs					
Logic 0	R_{OFF}	160KΩ	—	—	
Logic 1	R_{ON}	—	—	500Ω	
Row Drivers Output Impedance		—	750Ω	—	V_{DD} = −15V
Control Input		10K Ω	—	1000K Ω	
Keyboard Row Input Impedance		24KΩ	—	100KΩ	
Keyboard Scan Frequency		—	25KHz	—	500 pF, 750K, V_{DD} = −15V

**Typical values are at +25°C and nominal voltages.

Information on this and other G.I. Music products, along with details on where to get them in your area, is available from GI's Canadian representative: Pipe-Thomson Ltd., 83 Cumberland Drive, Mississauga, Ont. Phone (416) 274-1269.

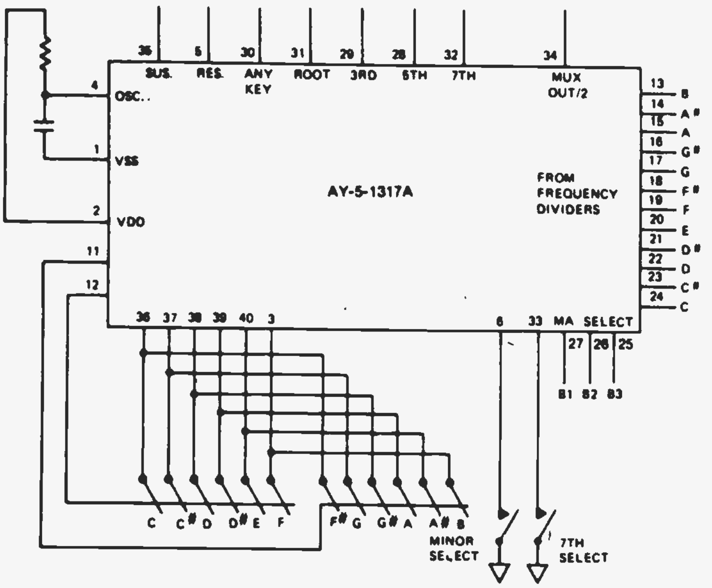
Pin No.	Name (Symbol)	Function
1	Ground (V_{SS})	Ground
2	Power Supply (V_{DD})	Negative Supply
3, 36-40	Column Inputs (CI-C6)	Column inputs from Keyboard Matrix
4	Oscillator Input (OSC)	R/C network connection for keyboard scan oscillator
5	Reset (RES)	A logic '1' (ground) will reset the keyboard scanner, and the memorized key
6	Minor Select (m Sel)	A Ground on this line changes the 3rd output from Major to Minor
7-12	Row Outputs (R1-R6)	Row outputs to Keyboard Matrix
13-24	Frequency Inputs (F1-F12)	These are the input lines for the 12 frequencies (one full octave B thru C) used to generate the chords.
25-27	Control Inputs (B3-B1)	These 3 lines will be internally latched and decoded to select either the ROOT, 3rd, 4th, 5th, 6th, or 7th frequency as the special effect output. B1 B2 B3 Selection 0 0 0 No change from last selection. 0 0 1 ROOT 0 1 0 5th 0 1 1 3rd 1 1 1 7th 1 1 0 4th 1 0 1 6th
28	5th Output (5th)	This line will output the 5th frequency element of the selected chord.
29	3rd Output (3rd)	This line will output the 3rd frequency element of the selected chord. Minor 3rd will be provided if a Minor chord is selected. Major 3rd will be provided if a Major or 7th chord are selected.
30	Any Key Down (AK)	This line goes to a logic '1' whenever a chord selection key is depressed.
31	Root Output (Root)	This line will output the ROOT frequency element of the selected chord.
32	7th Output (7th)	This line will output the 7th frequency element of the selected chord if a 7th chord is selected otherwise the output is logic '0' (voltage).
33	7th Select (7 Sel)	A ground on this line turns the 7th output on.
34	Special Effect Output (MO)	This line will output one of the six frequency elements as programmed by the control lines B1-B3. The 7th chord element frequency will be provided independently of the chord selection.
35	Sustain (SUS)	A logic '1' on this line will activate the memory circuit which memorizes the last key played.

TRUTH TABLE FOR SPECIAL EFFECT OUTPUT

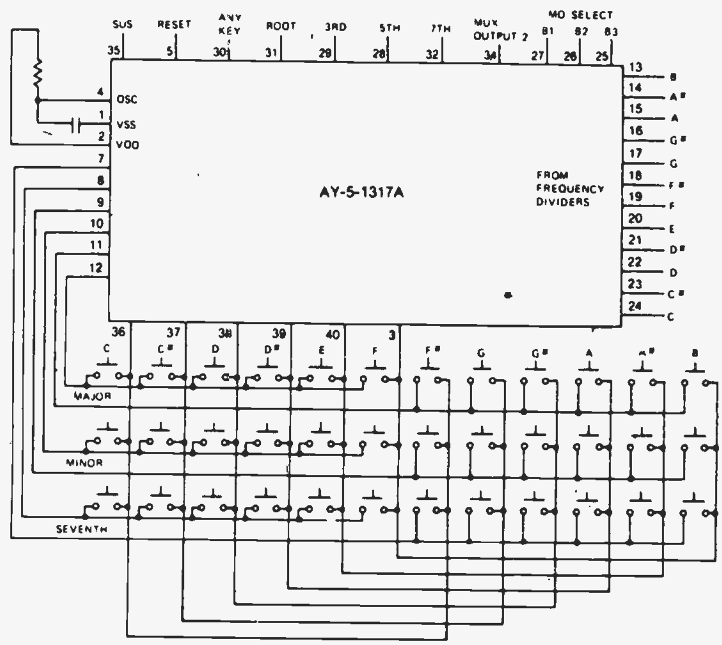
FREQUENCY OUTPUTS

Chord Selection	Root	3rd Minor	3rd Major	4th	5th	6th	7th
C	C (÷2)	D# (÷2)	E (÷2)	F (÷2)	G (÷2)	A (÷2)	A# (÷2)
C#	C# (÷2)	E (÷2)	F (÷2)	F# (÷2)	G# (÷2)	A# (÷2)	B (÷2)
D	D (÷2)	F (÷2)	F# (÷2)	G (÷2)	A (÷2)	B (÷2)	C (÷1)
D#	D# (÷2)	F# (÷2)	G (÷2)	G# (÷2)	A# (÷2)	C (÷1)	C# (÷1)
E	E (÷2)	G (÷2)	G# (÷2)	A (÷2)	B (÷2)	C# (÷1)	D (÷1)
F	F (÷2)	G# (÷2)	A (÷2)	A# (÷2)	C (÷1)	D (÷1)	D# (÷1)
F#	F# (÷4)	A (÷4)	A# (÷4)	B (÷4)	C# (÷2)	D# (÷2)	E (÷2)
G	G (÷4)	A# (÷4)	B (÷4)	C (÷2)	D (÷2)	E (÷2)	F (÷2)
G#	G# (÷4)	B (÷4)	C (÷2)	C# (÷2)	D# (÷2)	F (÷2)	F# (÷2)
A	A (÷4)	C (÷2)	C# (÷2)	D (÷2)	E (÷2)	F# (÷2)	G (÷2)
A#	A# (÷4)	C# (÷2)	D (÷2)	D# (÷2)	F (÷2)	G (÷2)	G# (÷2)
B	B (÷4)	D (÷2)	D# (÷2)	E (÷2)	F# (÷2)	G# (÷2)	A (÷2)

STANDARD INTERCONNECTION FOR A SINGLE ROW KEYBOARD WITH SEPARATE KEY FOR MINOR AND SEVENTH



STANDARD INTERCONNECTION FOR A 3×12 KEY MATRIX



Who's Where on When

John Garner guides the listener on a Europe trip via radio.

MOST EUROPEAN COUNTRIES broadcast in English to North America. Even those that don't have specific programs beamed to North America can usually be picked up here under good reception conditions. I will give a brief run-down of each of these stations with times in GMT, frequencies in kilohertz and their addresses so you can send them your reception reports and program comments. International broadcasters change some of their frequencies from time to time to suit propagation conditions and since there is a time lag from the time I prepare this report and the time you read it, some of these frequencies may be changed. You should be able to hear twenty-five or more Europeans without too much effort. Good luck!

ALBANIA

Radio Tirana, Rua Ismail Quemal, Tirana, Albania. This station is quite well heard here in English at 0000-0030, 0130-0200, 0230-0300, 0330-0400 and 0430-0500. Try these frequencies 9750, 7065, 7300, 6200, and 9480. Much propaganda is featured on this station.

ANDORRA

Radio Andorra, B.P.1, 66720 Andorra-la-Vielle, Andorra. I don't believe Andorra is broadcasting in English at the present time but they have been heard here in French around 0600 GMT on 6215 kHz with American and French pop music.

AUSTRIA

Austrian Radio, Short Wave Service, A-1136 Vienna, Austria. Some good programming appears on Austrian Radio but unfortunately many of their frequencies are blocked by powerful stations from the USA. Try at 0130-0200 on 6155 or 9770. Also from 0330-0400 on the same frequencies. From 1230-1300 on 21530 is another possibility.

BELGIUM

Radiodiffusion-Television Belge, International Service, QSL Bureau, P.O. Box 26, 1000 Brussels, Belgium. This station may be heard from 0015-0045 on 6080 and from 1715-1800 on 17740. Reception here has been rather poor lately.

BULGARIA

Radio Sofia, 4 Bd. Dragan Tsankov, Sofia, Bulgaria. Fair reception here most days at 0000-0100 on 9705, from 0430-0500 on 7115 and from 2130-2200 on 5915 and 7115.

RADIO SOFIA
BULGARIEN
BULGARIE
BULGARIA

CZECHOSLOVAKIA

Radio Prague, Prague 2, Czechoslovakia. This is an easily heard station in North America with English at 0100-0200 and 0300-0400 on 5930, 7345, 9540, 9630 and 11900. Radio Prague has some nice picture post card type QSLs and verify correct reports fairly quickly.

CSSR
RADIO PRAHA
PRAGUE 2, CZECHOSLOVAKIA

DENMARK

Radio Denmark, Kortolgeafdeiningen, DK-1999, Copenhagen, Denmark. Danish law forbids foreign language broadcasts from Denmark but an English identification is given at about 1600 hours GMT on 15165. Radio Denmark welcome reception reports from foreign countries and will verify with a QSL card even if you can only make out their identification.

FINLAND

Finnish International Radio, Box 95, Helsinki 25, Finland. (formerly known as Radio Finland). Finland transmit in English from 1300-1330 and from 1430-1500 on 15400 and from 2330-2400 on 11800 and 9565. On Sundays only the 1300 broadcast is extended to 1430 for "Radio Finland In It's Sunday Best" which is a repeat of some of their other programs during the week. Reception here is usually good.

YLE
RADIO
FINLAND

FRANCE

Radio France International, B. P. 9516, F-75016, Paris, France. RFI have only one English transmission per day and it is directed towards Africa but is usually well heard here in North America. "Paris Calling Africa" is aired from 1705-1755 on the following frequencies 21620, 21580, 17860, 17850, 17795, 17735, 15425, 15360, 15300, 15210, 11930, 11845, 11735 and 11705. French programs to North America are transmitted from 1200-1700 on 15265, 15440, 17780.

GERMAN FEDERAL REPUBLIC

Deutsche Welle, P. O. Box 10 04 44, Cologne 5, Federal Republic of Germany. Deutsche Welle (the Voice of Germany) have several relay stations around the world making their transmissions easy to pick up. They broadcast in English to North America at 0130-0150 on 6040, 6075, 6085, 6100, 9545, 9565, 9605, and 11865.

GERMAN DEMOCRATIC REPUBLIC

Radio Berlin International, Nalepastrasse 18-50, Berlin 116, Democratic Republic of Germany. This is another station with a lot of propaganda broadcasts. They are on in English to North America from 0100-0145 on 9730; from 0230-0315 on 9730 and from 0330-0415 on 6080 and 11890.

Radio Berlin International
RBI
The Voice of the German Democratic Republic

GREAT BRITAIN

British Broadcasting Corporation, Box 76, Bush House, WC2B 4PH London, England. The BBC World Service is on for 24 hours a day and with relay stations all around the world it is possible to listen at any time of the day. I will just list a few times and frequencies here: 2000-0315 on 15260, 2115-2300 on 9580, 2115-0430 on 5975, 2245-0330 on 7320, 2300-0330 on 9510, 2300-0030 on 9510, 2300-0730 on 6175, 2300-0430 on 6120, 0500-0630 on 9510, 1100-1330 on 3990, 1500-1745 on 9580. You can also find the BBC by twisting the dial a bit — they use many frequencies.

GREECE

Voice of Greece, Director — Technical Services, P.O. Box 19, 16 Mourouzi Street, Aghia-Paraskev, Athens, Greece. Reception from Greece is usually fair here. Try them at 0015-0030 and 0215-0230 on 11730 and 9760, from 1215-1230 and from 1515-1530 on 17830, 15345, and 11730.

HOLLAND

Radio Nederland, P.O. Box 222, Hilversum, Holland. This is one of the first Shortwave stations many listeners hear and verify. English is aired to North America at the following times and frequencies: 0230-0325 on 6165, 9590, 0530-0625 on 6165 and 9715. The broadcast to Africa is also well heard here at 2030-2120 on 11730, 11740, 17810 and 21640.

RADIO NEDERLAND
P.O. BOX 222 · HILVERSUM
HOLLAND
RN

HUNGARY

Radio Budapest, Brody Sandor 5-7, H-1800, Budapest, Hungary. English to North America at 0200-0230 (except Monday) on 15220, 11910, 9833, 9585, 6105, 6000. Also from 0300-0330 daily and from 0400-0415 on the same frequencies.

ICELAND

Rikisutvarpid (Voice of Iceland), P.O. Box 120, Reyjavik, Iceland. A program for Icelandic Seamen is transmitted in their language at 1200-1300 on 12175.

ITALY

Italian Radio & Television (RAI), Caselle Postalle 320, Rome, Italy. Italy transmit in English to North America at 0100-0120 on 9575 and 6010. French follows the English transmission from 0120-0135 on the same frequencies and Italian is aired from 1400-1425 on 17755, and 21690 and from 2230-0100 on 6010, 9575, 9630, 9710 and 11905.

LUXEMBOURG

Radio Luxembourg, Compagnie Luxembourgeoise de Telediffusion, Villa Louvigny, Luxembourg. An English language program fairly well heard here from time to time is on from 0000-0200 on 6090.

MALTA

Xandir Malta, Telemalta Corporation, P.O. Box 83, Valetta, Malta. "Malta Calling" is on in English form 2045-2115 on Saturdays only on 6010. Germany's Deutsche Welle can also be heard relaying from Malta at 0130 on 9565. Use D-W's address for this.

MONACO

Trans world Radio, P.O. Box 141, Monte Carlo, Monaco. TWR, a religious broadcaster is on in English at 0725-0900 on 7105, and from 0900-1100 on Sundays on 9610.

NORWAY

Radio Norway, BH. Bjornsons Plass 1, Oslo, NOrway. Norway broadcast in English on Sunday only, at 1400-1430 on 17840, 1600-1630 on 15175, 17715 and 21730, 1800-1830 on 11895, 2200-2230 on 9590 and 9645. On Mondays (GMT) at 0000-0030 on 6015, 9590 and 11870, 0200-0230 on 6005, 9590, 9645, 0400-0430 on 6015, 9550, and 9645.

NORSK RIKSKRINGKASTING

POLAND

Radio Warsaw, P.O. Box 46, 00-950 Warsaw, Poland. Reception of Polish Radio is rather poor here although sometime it is very good. They have English at 0200-0400 combined with Polish on 15120, 11815, 9525, 7270, 7145, 6135, 6095.

PORTUGAL

Radio Portugal, Rua do Quelhas 21, Lisbon, Portugal. Fairly well heard here at 0300-0330 and 0500-0530 on 6025 and 11935, in English.

ROMANIA

Radio Bucharest, P.O. Box 111, Bucharest, Romania. Reception of Radio Bucharest here is rather poor. It is usually better in the summer. There are English broadcasts at 0130-0230 on 15255, 11940, 9690, 9570, 11840, 6155, 5990 and from 0400-0430 on the same frequencies.

SPAIN

Radio Exterior de Espana (Spanish Foreign Radio), Apartado (P.O. Box 150 039), Madrid, Spain. Very well heard here at 0000-0200 on 11880 and 9630 and from 0515-0615 on 9630 and 6065. These broadcasts are in English. Spanish Foreign Radio are broadcasting Spanish lessons at 0055 and 0610. A new course for beginners will start in October.

SWEDEN

Radio Sweden, S-105 10, Stockholm, Sweden. Another well-heard station in English at 0030-0100 on 11905, 0230-0300 on 11705 and 9695, 1400-1430 on 21505 (usually the best heard here) and from 2300-2330 on 11705 and 9695.

SWITZERLAND

Swiss Radio International, Overseas Service, CH3000 Berne 16, Switzerland. English to North America at 0145-0215 on 6135, 9660, 9725 and 11715, 0430-0500 on 6045, and 9725, 1315-1345 on 9765, 15350, 17790, 21520 and 21630, 1530-1600 on 15385, 17830, 21570 and 21585. Very good at 1530 on 21570.

USSR

Radio Moscow, Moscow, USSR. This is a powerhouse. You can hear Radio Moscow in English on many frequencies throughout the day. Radio Moscow use many transmitter sites throughout the USSR so when writing to them for QSLs ask them to include the transmitter site on your card — you can obtain quite a few this way. A few of the many times and frequencies follow: 2200-2300 on 7115, 7165, 7195, 7440, 9665, 9800; 2100-2300 on 15140, 15180, 15455, 17720; 0330-0730 on 9500 and 15140; 1100-1500 on 15150; 1100-1800 on 11770 and many other frequencies and times.

Also heard from the USSR are Radio Station Peace and Progress in English, at 1500 on 15520 and 17765. Radio Baku, Radio Khabarovsk, Mayak Radio and others in local languages. Well heard in English are Radio Kiev at 0030-0100 on 7150, 15100 and 17870; Radio Vilnius (Latvia) at 2300-2330 on 7150, 7215 and 15100. I will have a more complete report on stations in the USSR in a future issue.

VATICAN CITY STATE

Vatican Radio, Vatican. Vatican Radio broadcast in English from 0100-0115 on 11845, 9605 and 6015 and from 1200-1215 on 21485. Reception here is fair.

YUGOSLAVIA

Radio Yugoslavia, External Broadcasting, Box 880, Belgrade, Yugoslavia. Reception of Radio Yugoslavia is poor here but may be heard under good conditions in English at 2200-2215 on 6100, 7240 and 9620.

I hope this short summary will help you to hear some of those European countries that you may have been looking for.

Comments and questions about shortwave listening are always welcome. If a personal answer is requested please enclose a self-addressed stamped envelope. My address is Shortwave World, P.O. Box 142, Thunder Bay, Ontario, P7C 4V5. This is also the address for Canadian S-W-L International, a club devoted to shortwave listening. Write to the same address for information about the club.

EQUIPMENT REVIEW

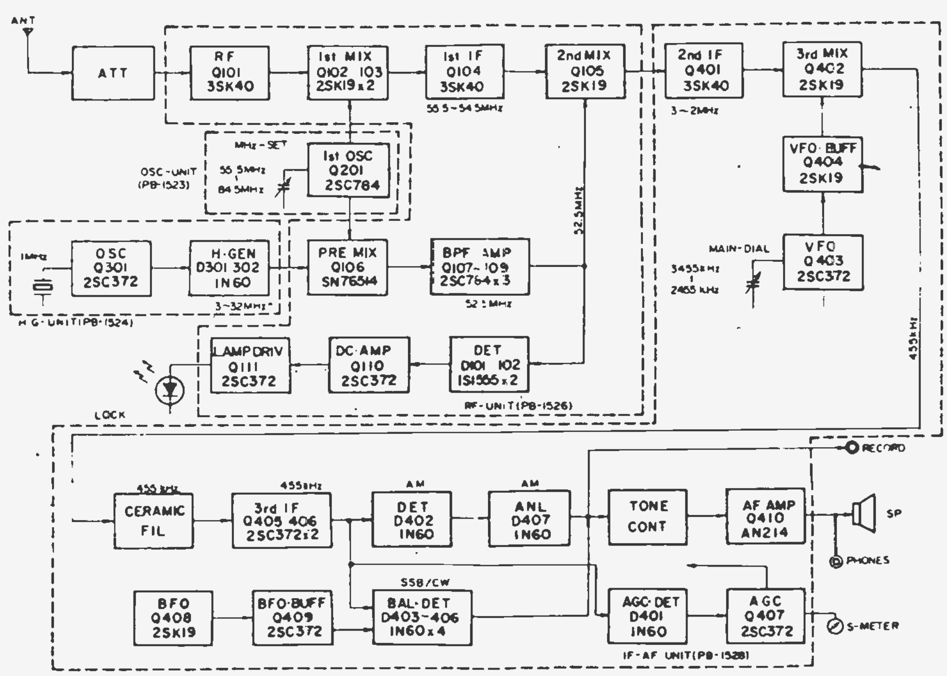
THE YAESU MUSEN COMPANY, Ltd. in Japan has been well-known for many years for their fine line of Amateur Radio equipment. About three years ago Yaesu introduced a receiver especially for shortwave listeners and that receiver soon became one of the most popular in North America. This was the FRG-7. I purchased one shortly after it appeared in Canada and have been well-pleased with its performance. More recently Yaesu introduced a newer model — the FRG-7000. This month we will discuss the features of these two receivers.

FRG-7 This is a precision built high performance communication receiver designed to cover the band from 0.5 to 29.9 MHz. Its state of the art technology offers an unprecedented level of versatility.

The Wadley Loop System (drift cancellation circuit) coupled with a triple conversion super heterodyne system guarantees an extremely stable VFO equipped with precision dial mechanism permits 5 kHz direct dial readout, thus permitting presetting of dial for your desired station even when not on the air with assurance of "on the target" reception. It features receiving modes of ssb (USB and LSB) for two way communications, CW for Morse Code communication and AM for general broadcasting stations. The ceramic filters guarantee sufficient bandwidth and high selectivity by rejecting unwanted signals and interferences. Other features include automatic noise suppression circuit, three position tone selector, distortion and fade free reception. The receiver can be operated on A.C., D.C., or internal battery supply. When two or more power supplies are connected it automatically selects the most economical. For internal battery operation 8 D cells are required.

The FRG-7 measures 340 mm wide x 153 mm high x 285 mm deep and weighs 7 kg without batteries.

Here's what the FRG-7 looks like outside, and below the insides.



Who's Where on When

FRG-7000 Yaesu's latest development for shortwave listening features most of the same items as mentioned for the FRG-7 with some exceptions; coverage of this set is from 0.25-29.9 MHz. A digital frequency is displayed giving resolution to 1 kHz using bright, large LEDs for maximum readability. A built in digital clock can be set for your local time plus GMT. Just a flick of a switch for selecting the desired time. A clock timer is also built in to enable recording a program when you are not in. This set operates only on AC power supply which limits its usefulness to some extent. Even the clock is not equipped for battery operation making it a necessity to reset the time if you move the set.

The FRG-7000 is 360mm wide x 125mm high x 295 mm deep and weighs approx. 7 kg.

Prices for the above sets in Canada are now about $500 for the FRG-7 and about $1000 for the FRG-7000. In a recent comparison test we found that the FRG-7 performed as well as the FRG-7000.

I feel that although the FRG-7000 offers the benefits of a digital readout and clock, most purchasers would find the FRG-7 a better choice when balancing their needs and budgets.

Until next month 73 and good listening.

Yaesu's FRG 7000 with digital dial is handy for hitting a station dead-on.

QRM QRM QRM

The radio spectrum is quickly getting clogged up with users, even up at UHF, but Bill Johnson VE3APZ hopes the government lets him keep some.

In its recently-published document regarding future use of the 406-960 MHz part of the spectrum, Communications Canada dropped a bombshell on the amateur community. In March of this year we were formally told that we no longer have the use of the 420 to 430 MHz portion of the 75cm amateur band. In return, we have been given the 902-928 MHz band to play with, as a secondary service with land mobile and radiolocation services.

On the one hand, it might seem that the government is trying to force us into bigger and better things, but I think that the pressure may have been from a different direction entirely. It's no secret that commercial channels in the bigh cities are as scarce as the proverbial hen's teeth, and that both the U.S. and our own governments are doing their very best to alleviate the pressure from the people who have a legitimate business need for spectrum space. The fact that the government's latest move is not anti-amateur is clearly exemplified by the case right here in Toronto where a TV station that 'boldly went where no man has gone before' a few years ago, CITY-TV (79) will be forced to move to channel 41, since the world above channel 60 has been turned over to the land mobile service (police, taxis, etc.).

It is not the fact that the sub-band has been taken away from us that annoys me, but the fact that, according to ComCan there were no comments received by the government on the proposals when they were published in the Canada Gazette a few years ago.

None of the amateur organisations that claim to represent us in Ottawa noticed? Or maybe they decided it was worthless to pursue it because they thought that nobody uses that band anyway? While I cannot see every amateur in Canada running to their local office of the Queen's printer every week to scan every one of the hundreds of legal announcements, I would have expected at least one of the provincial or federal organisations to have been vigilant enough to pick it up. This is why I belong to a Federal organisation, and why I used to belong to a provincial one before I got fed up with them. This is why these organisations claim that every amateur in Canada should pay annual membership dues to them — so that they can be represented in Ottawa. Where are our so-called representatives on this issue. Why was there no protest filed against this removal of our frequencies from our use? Do the provincial and federal radio societies really represent us, or is it all just a lot of talk. I think it's about time that the amateurs of this country finally got organised and submitted a united front on issues of concern.

The other question that comes to mind is, 'Do the amateurs of Canada really care ?' How many are really affected by this change ? I, personally, being the Technical Director of Canada's largest FM club, am very concerned about anything that goes on above 50 MHz. Our club makes extensive use of the 450 MHz band. This change will mean our club will have to change crystals on at least five links that are presently located between 420 and 430 MHz. That's $60 in parts alone, let alone the cost of driving to all the sites and changing them. In our club, whose membership totals 500, we have one person other than myself who regularly goes to the club sites to service our repeaters, and we are very busy at the present time trying to better the state-of-the-art in amateur communications by installing microcomputers at all of our sites — we hardly have time to run around changing crystals and retuning cavities.

The only solution, I feel, to the lack of monitoring of government notices by our radio societies, is for ComCan to mail out individual notices to all amateurs in Canada on any topic that is 'gazetted' that relates to amateur radio. Even if this took the yearly license fee to $20, it would be well worth it, at least in my opinion.

LESSON OF THE MONTH

Starting with this column, I am introducing a new feature in QRM. It will consist of a few notes on items of technical interest, operating procedures, amateur terminology, etc. Sometimes it will be a pet peeve that somebody has written in about, sometimes something somebody has heard being done incorrectly on the air, or sometime whatever little snippet of information comes to mind as I am writing the article. Q) What is the proper way to send your callsign and the callsign of the person to whom you are talking ?

A) A very good question, and from listening to some local amateurs talking, one that begs to be answered. While we have no specific regulation in Canada, standard international practice dictates that the distant party's callsign should be sent first, followed by the spoken words 'this is', or the telegraphic separator 'DE', then followed by the callsign of the calling station. Sending them the other way around, even if one changes the separator to 'calling' does not make sense and can only add to confusion. One might hear this method used by police and fire depts., taxis and CBers, but remember these operators are not as highly-trained as we amateurs are supposed to be.

QRM LETTERS

Dear QRM letters,

Nowadays you always hear about ships being saved because they could get their distress call out by radio and thus get help. But was this always the case ? Did ships have radios when the equipment was big and bulky?

D.B. Edmonton

Dear D.B,

Yes, they certainly did. Marconi spent a lot of time on his yacht, 'Electra', doing experiments. Because of the isolation of ships at sea, ship-to-shore communications were one of the first exploited commercial uses of 'wireless'.

As for distress calls, the first recorded incident of a ship calling for help by 'wireless' occured on April 28, 1899, when the steamship 'R.F. Mathews' out of London rammed the East Goodwin lightship anchored off the East Coast of Kent, in southern England . The East Goodwin lightship sent a distress call a distance of twelve miles for help. Interestingly enough, it was not an SOS call, since that signal was not associated with distress until the Madrid radio conference in 1932.

73 'till next month,
Bill, VE3APZ

Service News

MANUFACTURERS. . DISTRIBUTORS . . ,REPRESENTATIVES . . . . SERVICE ORGANISATIONS. . . . Send us your news releases on upcoming seminars, new products, ideas for the successful shop. Address them to Service News, Electronics Today Magazine, Unit 6, 25 Overlea Blvd, Toronto, Ontario, M4H 1B1. Please note that your information must be received at least six weeks before the first of the month of the issue in which it is to appear. Any material published at our discretion.

Frank Drea asks "Who's going to regulate?"

A MEETING of the local chapter of OETA was held on February 28, 1979 at the Airport Holiday Inn in Toronto. The main attraction was an address by Mr. Frank Drea (Ontario's Minister of Consumer and Commercial Relations) the subject of some form of Government legislation of the domestic electronic servicing industry. This of course has always been one of the goals of the OETA.

Mr. Drea in his usual forthright fashion went right to the point with opening remarks of "Are you prepared to look after your own industry, or do we, the Government, have to do it for you?" He went on to say that although the attendance was somewhat smaller than he had expected, he knew those present to be extremely knowledgeable and, more to the point, he knew what they stood for. Mr. Drea's speech was extremely short and he did reiterate that the Government was quite prepared to legislate the industry if necessary. So after some reminiscing about the stormy birth of the MTTSA he called for questions.

The president of the Ontario association, Mr. Hank Steenhuysen, immediately stated how pleased he was that the Government was apparently prepared to let the Association regulate the industry, and then asked what should be the next step.

To sum up, a meeting was arranged for the following Thursday, March 8th, to take place at Mr. Drea's office. He asked for 3 representatives of the Ontario Association to attend (I was not invited).

After a vote of thanks by the members Mr. Drea left for parts unknown, and the meeting got down to the second item on the agenda, namely election of officers for the coming year. There were no dramatic changes in the electorate, the only change being an increase in the number of officers.

On March 9th, the day after the private meeting between Mr. Drea and the Association, I had a long talk with the president, Mr. Steenhuysen. He seemed extremely elated with the results of the meeting. He stated that they had been asked to come up with some sort of proposal and to have it in the Minister's hands within two months. Mr. Drea further expected them to publicize what was going on and hopefully see proof of a larger membership. Mr. Steenhuysen and other officers of the Association have all told me they feel that the membership should now increase rapidly. They certainly intend to contact all past members and try to corral that elusive 50% of the industry who never seem to have time for anything but their own immediate business.

I decided that some research on my part might not be a bad idea, and I proceeded to contact a number of independents and also two of the leading manufacturers. I was pleasantly surprised when both Electrohome and Zenith could see no obvious fault with some sort of legislative body under the auspices of the Government but primarily controlled by practising technicians, as both felt it could only do good. The independents I have contacted were for the most part indifferent, feeling that this had all been talked about before, and I got the impression that they would like the wagon to start rolling before climbing aboard.

During the conversation with Mr. Glen Andrews of Zenith, he mentioned that perhaps I should get in touch with the other organization, CEASA (Canadian Electronic Appliance Service Association). I personally had had no previous contact with this organization, and I am delighted to say that Mr. Bill White, the general manager, and the very recently elected new president, Mr. Alan Brooks, gave me a great deal of their time, discussing the state of the industry, the need for associations, and their objectives. After listening to these gentlemen I must admit some surprise that the OETA had not already linked up with this already national association. They seem to have a great deal on the ball. Mr. Brooks did inform me that they had had a number of meetings with the Ontario Association directors. I hope to devote a column to CEASA in the near future. They seem to have some fine ideas which should be of interest to all technicians.

COMMENTS:

The turnout at the original meeting of February 28th was most disappointing to all concerned, and I find it extremely difficult to understand why so many of the members did not make a special effort to attend, particularly when a speaker of Mr. Drea's stature was to be guest of honour. I was told by one of the directors that the meeting had been well publicized, and in view of Mr. Drea's earlier efforts on the part of the Association I fully expected to see an attendance in excess of 100. I looked for familiar faces, and to my surprise previous directors and very prominent members were absent. It must surely be apparent to all members that if aims of the Association are to be realized, the members must get behind their extremely hard-working executive and give them the support they deserve and urgently require.

All the best.
Richard H. Cartwright.

Tech Tips

Tech Tips is an ideas forum and is not aimed at the beginner. ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible, and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to ETI Tech Tips, Unit 6, 25 Overlea Blvd., Toronto, Ontario, M4H 1B1

HF TTL OSCILLATOR

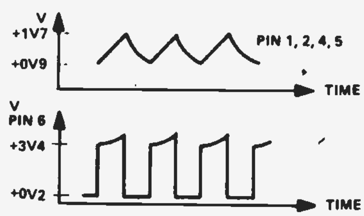
A squarewave oscillator with complementary outputs and with a frequency range of 20 Hz to 10 MHz can be made from one IC, a 7413 which is a TTL dual Schmitt trigger. The oscillator is always self starting and runs from a 5 V supply, current drain 20 to 30 mA. The 7413 is a Schmitt trigger with hysteresis levels (at its input) of +0.9 V and +1.7 V. That is, when the input level exceeds +1.7 V the output jumps to a low condition (+0.2 V). When the input voltage is lowered it needs to fall below +0.9 V before the output jumps back to a high condition (+3.4 V).

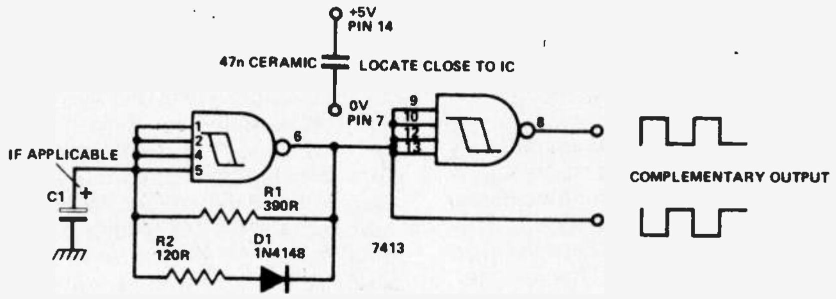
When the Schmitt trigger is connected up as shown in the diagram the device will oscillate. Imagine the output is high. C1 is charged up via R1. When the voltage on C1 reaches +1.7 V, the output falls to +0.2 V. C1 is now discharged via R1 in parellel with R2 (D1 is now forward biased) until the voltage on C1 reaches +0.9 V. Then the output jumps to a high state and the process repeats itself. The second Schmitt trigger merely inverts the squarewave output. The frequency of operation is given by the formula:

$$F_{osc} = \frac{2\times10^{-3}}{C1}$$

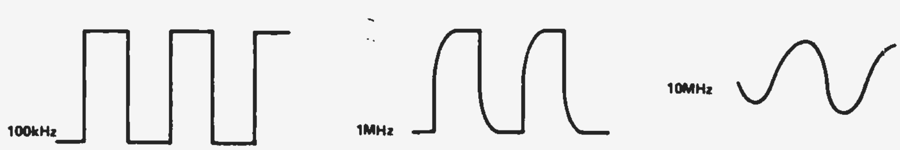
where F_{osc} is in Hz and C1 is in Farads.

therefore for:
10 MHz, C1 = 220 pF (polystyrene or ceramic)
1 MHz, C1 = 2200 pF (polystyrene)
100 KHz, C1 = 22 nF (polyester)
10 KHz, C1 = 220 nF (polyester or electrolytic)
1 KHz, C1 = 2.2 uF (electrolytic)
100 Hz, C1 = 22 uF (electrolytic)
20 Hz, C1 = 100 uF (electrolytic)



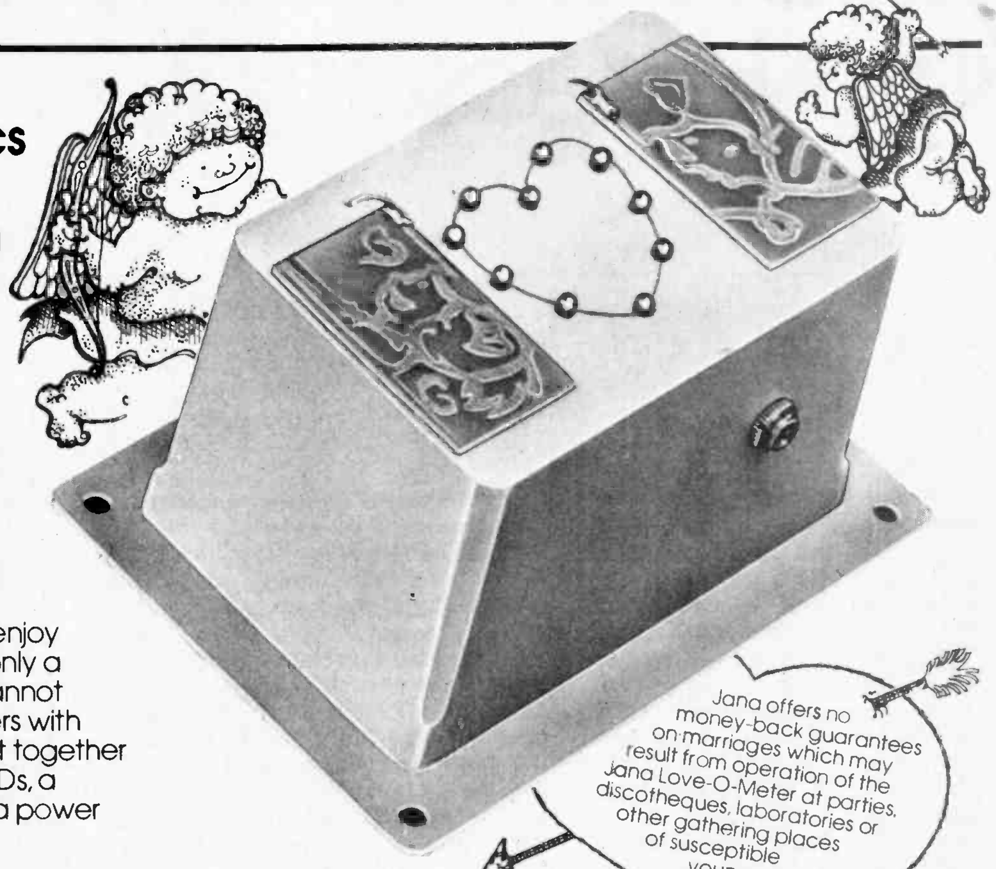


WAVEFORM DEGRADATION



Love-o-Meter

Another **Jana** Quality Kit



Learn Electronics (and how to play cupid) with this clever and entertaining Jana Kit.

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Research Here—Dead But Necessary?

Jim Essex discusses the dependence of industry on a bit of research and initiative.

"LOOK TO YOURSELVES", — goes the old Biblical saying, suggesting that we ourselves, have the only means to resolve our dilemma of high unemployment and a gradually diminishing manufacturing base. Look what's happening to our industry. We now find once prosperous industries literally falling over themselves in order to rid themselves of inventory painstakingly built up earlier when our cherished dream — "we could manage our own research" brought us to international prominence following the war in 1945. But the dream was short-lived! When we tried to develop products peculiar to our country, we flourished. When we ignored this dictum, we got into trouble. Now, merely three decades later, we once more face becoming mere "hewers of wood and drawers of water"! A few examples will suffice.

The early years of TV in this country found our rural areas poorly served, due to sparse population and equally sparse TV transmitters. This was also true in our cities, where, prior to having our own TV stations, we relied on border U.S. stations for programs. Consequently, we required TVs with unusually high gain, — designed specifically for our market. Compared with the relatively low-gain, U.S. manufactured TVs which suited the high populated centres common in that country, we needed special research and a few more vacuum tubes. This was costly; but ignoring the cost-profit margin for the time being, Canada persevered and came up with TVs which did the job. In so doing, we also provided jobs, and several native TV industries were launched successfully, of which companies such as Electrohome in Kitchener prospered.

Refinements were added — including a better sound system for TVs — confounding the pundits who said no one would pay the premium. They did, and the company flourished. To further illustrate they didn't lack enterprise nor imagination, they designed a chassis to go with the TV — not only pleasing in appearance, — but offered a bonus to the technician who enjoyed servicing with an easier-to-get-at chassis! This beat out the competition from firms like Canadian Westinghouse — where, although manufacturing in Canada, their research came from the U.S., successfully proving, in this one instance at least, Canadian research could pay off. Comparison is interesting; the one flourished, building a large industry on TVs alone, while the other dropped out of making TVs in Canada, altogether. And while this one company thrived, ancillary services thrived also. These included a host of local firms who manufactured — in Canada — components needed to build the TV's, as well as a huge cabinet manufacturing plant that employed local labor. Now, only the cabinet plant remains and a skeleton crew necessary to install Japanese — made TV's into these same boxes. With this change, we've lost all our ancillary services, except, perhaps the locally manufactured power transformers which are too heavy and therefore too costly to "fly in" from Japan. In jobs lost, a rough estimate shows 200 from the shut-down of only one supplier, alone, with another 800 or more from the parent plant. In terms of pride and self-respect, the cost is incalculable!

Recently, Canada's finance minister, Jean Chretien speaking in the same town where this took place, and viewing Canada's worsening economic condition, feared he's "watching the end of Canada". And he wasn't talking about the present impasse in National Unity.

It's been an issue of increasing concern that the level of research in Canadian industry is, relatively speaking, now too low. And it's not likely to recover because one of the major reasons for it is the extent of foreign control over our industry.

How did this come about? Again, the foregoing is as good an example as any. In the lush days of the early '70s, we saw TV production reach its peak in Canada. With this, solid-state appeared on the horizon offering more efficient and reliable chassis. However, before our research could effectively iron out the "bugs", attendant on any new development, we "ran scared" and threw in the sponge. Perhaps management can't be blamed altogether, for at this plant alone, rejects were running as high as 16%, and you can't stay in business long with 16 out of every 100 TVs needing servicing BEFORE THEY WENT INTO THE BOX!

Labor must assume some responsibility for this, I believe. Concentration on greater economic gains without the corresponding production efficiency have always been false economics but which most union members fail to recognize. It goes without saying that if we all want a cottage and the 36 hour week, — someone else, inevitably, will do the work for us! Which is exactly what's happening in Canada today. Labor intensive products, exemplified by TVs as only one example, are going elsewhere to be built. But research can't go scot-free from blame, either. Canada's market has changed, and recognizing this fact could have led to a product development more in keeping with our needs, and costs. What did we do? Instead of cutting costs and designing chassis peculiar to our times, we continued making "Cadillacs" for a "Ford" market. Most areas where coloured TVs are sold today, for example — the urban market, — the raison d'etre exists now for making TVs more suitable for the high-signal-level Cable lines which exist nearly everywhere. Instead, we continued to manufacture ultra-sensitive, and costly receivers with their attendant high cost. A "Volkswagen" TV, stripped down except for essentials would likely have sold just as well, and at a cost attractive to our needs. How many TVs do you know of, for example, have expensive UHF tuners gathering dust for want of use, while the cable feeds many of the available UHF stations, via conversion, to the regular VHF channels 2 — 13?

However, before serious research was done in this direction, lethargy set in and the now familiar defeatist attitude, so typically Canadian where technology is concerned, started the erosion process. When the "pit-falls" accompanying the new solid-state technology found production wanting, this was the time to make research pay and find out why. Instead, we threw out the baby with the bath water!

Could help have been found? I think it could, especially where this one industry has the University of Waterloo just across town which boasted research facilities second to none, paid for with tax-payer's money! When the first winds of change began to blow, we should have looked at our alternatives first, before running to Japanese technology to bail us out. It was perhaps much easier to look at the enviable record of the Japanese, built at much risk and hard work incidentally, and hitch our star to Japan's apparent ascending electronic expertise. (I'm sure some of these same people are having second thoughts with our devalued dollar making Japanese imports more expensive.)

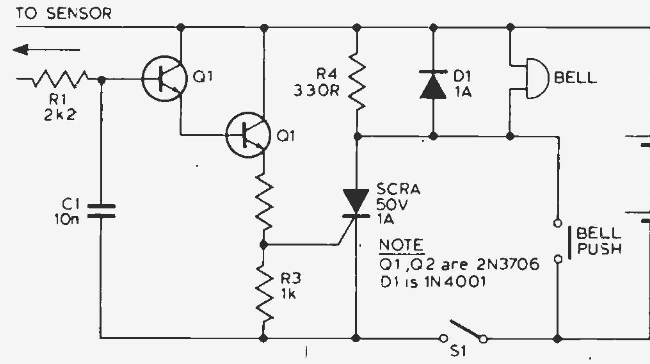
Is it too late? The Science Council of Canada, said recently following careful study that foreign ownership contributes more to our industrial problems than the level of relief offered by tariff protection, arguing that there is a close link between foreign ownership and the low level of research in Canadian industry!

And this is not likely to change until we do something about it.

Tech Tips

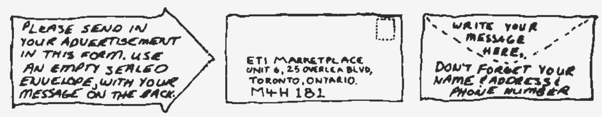
Rain Alarm/Door Bell

S. Lamb



With S1 open the circuit function as a doorbell. With S1 closed, rain falling on the sensor will turn on Q1, Q2 and the thyristor will trigger activating the bell. R4 provides the holding for the thyristor while D1 prevents any damage to the thyristor from back EMF in the bell coil. The sensor is made from 3 square inches of copper clad board with a razor cut down the centre. C1 prevents any mains pickup in the sensor leads.

ETI MARKET PLACE



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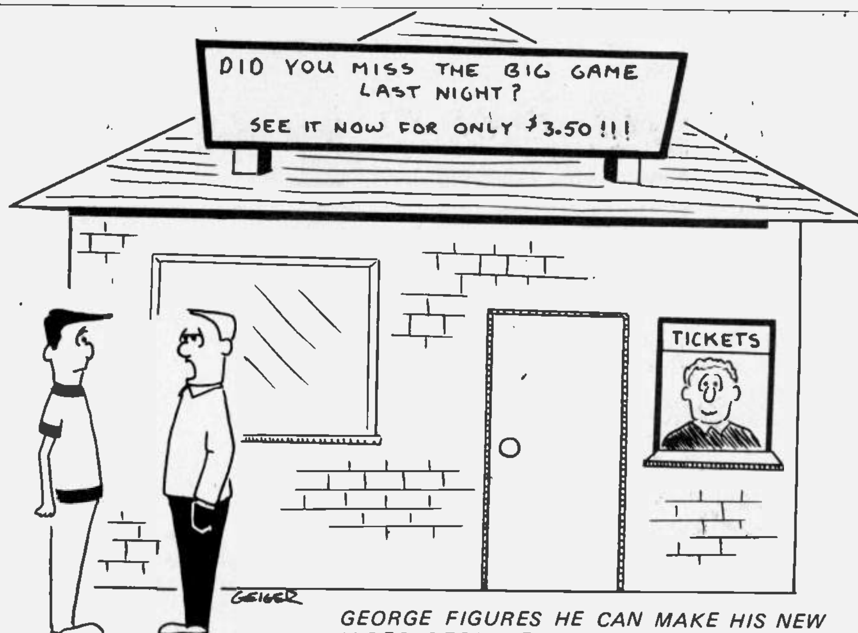
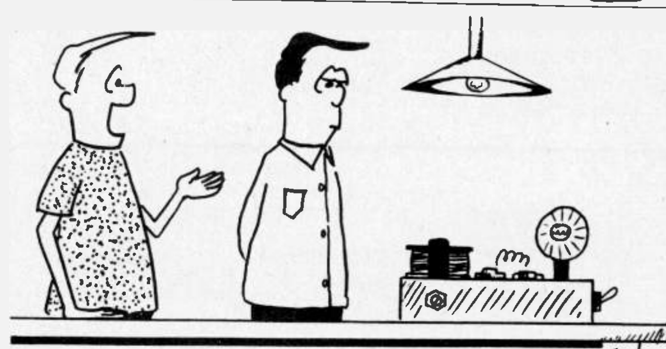
The Fun of Electronics



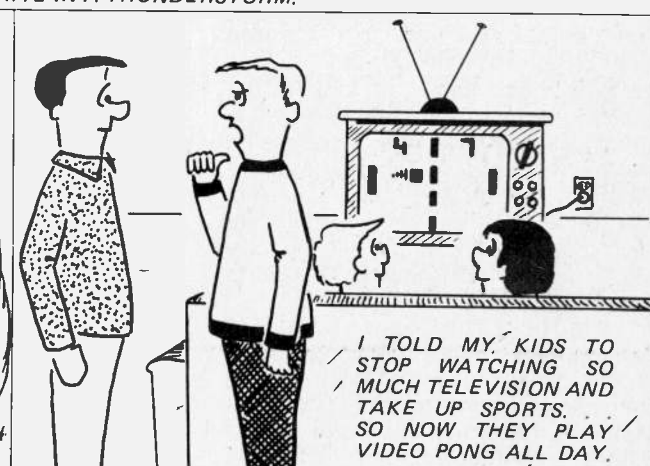
GEORGE FIGURES HE CAN MAKE HIS NEW VIDEO RECORDER PAY FOR ITSELF IN A FEW WEEKS.



. . . IT EMITS A BRIGHT FLASH OF LIGHT EVERY 5 SECONDS – I'M THINKING OF MARKETING IT AS A HAZARD WARNING LIGHT OR A STROBE FOR A SENIOR CITIZENS' DISCO.

BENJAMIN FRANKLIN FLIES A KITE IN A THUNDERSTORM AND DISCOVERS ELECTRICITY – I FLY A KITE IN A THUNDERSTORM AND DISCOVER THAT IT'S STUPID TO FLY A KITE IN A THUNDERSTORM.

WE'RE IN LUCK, FRED; IT'S A WARNING THAT THE PLACE IS PROTECTED BY A BURGLAR ALARM, WHICH MEANS THE OWNER WAS TOO CHEAP TO BUY A BURGLAR ALARM, SO HE BOUGHT A WARNING STICKER INSTEAD.



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NEW Class A Amplifier Kits: (A) 140W class AB (class A at low output) Pre-Main Stereo Amplifier with regulated power supply (transformer extra), and speaker protector. Superb sound quality. Freq. response D.C. to 100Khz, T.H.D. 0.01%, Damping factor 100. Kit: $129.00 Ass'd: $159.00. (B) 60- -100W R.M.S. Class A mono power amplifier. T.H.D. 0.01% at 50W output, Freq. response 0Hz - 100Khz, Damping Factor 100, Input Gain 0.8V (22K ohms). Kit: $58.00 Ass'd: $73.00. (C) 18 Steps Stereo Power Level Display. Works as a pair of VU meters. 36 colour L.E.D's. Kit: $49.00 Ass'd: $59.00. MONEY BACK GUARANTEE. FREE REPAIR SERVICE. Send order with cheque or money order plus 7% sales tax (Ontario residents only) and 10% (5% for order over $100) shipping and handling charges to: **AUDIO-VISION SERVICE**, Box 955, Stn. B, Willowdale, Ont. M2K 2T6.

KIT of 625 Ceramic Capacitors. 2.2pf to 20000pf 1000 VDC. 25 each of 25 diff. values. $25.00. Kit of 200 Tantalum Capacitors 1uf to 100uf (15 to 35 VDC) 20 each of 10 diff. values. $25.00. Free flyer & sample on request. **SURPLUS ELECTRO QUEBEC**, 2264 Montee Gagnon, Blainville, P.Q. J7E 4H5.

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FREE. Unusual Canadian and American parts and surplus catalogs. Hundreds of bargains. ETCO, Dept 087, 183G Hymus, Pointe Claire, Que.

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YOU need it? Chances are we sell it! Send us your parts list for free price quotations. Don't forget, our lists and flyers come out regularly. Don't miss out! **BRYAN ELECTRONICS**, P.O. Box 2068, Bramalea, Ontario. L6T 3S3.

FREE CA3140 with all orders of $5.00 or more. SN76477N Complex Sound Generator IC. $2.95 or 2/$5.50. LM317T 1.5 Amp Adjustable Positive Voltage Regulator. $2.95 or 2/$5.75. Include $1.00 for shipping-handling. Make all checks payable in U.S. Funds. Send for FREE catalog. **KEY ELECTRONICS**, Box 3506E, Schenectady, NY 12303 U.S.A.

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 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.

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.

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

Component Notations and Units

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

ISSUE DATE	ARTICLE
Mar 78	Hammer Throw
June 78	Neg.
Feb 79	Note:C,D
Mar 78	True RMS Meter
Apr 78	Neg.
Jan 79	Note:N
Feb 79	Note:N
Mar 78	Home Burglar Alarm
Apr 78	Computer PSU & Neg.
Apr 78	Audio Delay Line & Neg.
Apr 78	Gas Alarm & Neg.
May 78	White Line Follower
June 78	Neg.
Apr 79	Note:C
May 78	Acoustic Feedback Eliminator
June 78	Neg.
May 78	Add-on FM Tuner
June 78	Neg.
June 78	Audio Analyser
June 78	Ultrasonic Switch & Neg.
June 78	Phone Bell Extender & Neg.
July 78	Proximity Switch
Aug 78	Neg.
July 78	Real Time Analyser MK II (LED)
Aug 78	Neg.
July 78	Acc. Beat Metronome.
Aug 78	Neg.
July 78	Race Track
Aug 78	Neg.
Aug 78	Sound Meter & Neg.
Dec 78	Note: N
Aug 78	Porch Light & Neg.
Aug 78	IB Metal Locater & Neg.
Aug 78	Two Chip Siren & Neg.
Sept 78	Audio Oscillator
Nov 78	Neg.
Sept 78	Shutter Timer
Nov 78	Neg.

ISSUE DATE	ARTICLE
Sept 78	Rain Alarm
Oct 78	CCD Phaser
Nov 78	Neg.
Oct 78	UFO Detector
Nov 78	Neg.
Oct 78	Strobe Idea
Apr 79	Note:N
Nov 78	Cap Meter & Neg.
Nov 78	Stars & Dots
Nov 78	CMOS Preamp & Neg.
Dec 78	Digital Anemometer
Feb 79	Neg
Mar 79	Note:C. D
Dec 78	Tape Noise Elim
Feb 79	Neg
Dec 78	EPROM Programmer
Feb 79	Neg
Jan 79	Log Exp Convert.
Feb 79	Neg
Jan 79	Digital Tach.
Feb 79	Neg
Jan 79	FM Transmitter
Feb 79	Neg
Feb 79	Phasemeter & Neg
Feb 79	SW Radio
Feb 79	Light Chaser & Neg
Mar 79	Tape-Slide Synch
Mar 79	Synth. Sequ.
Mar 79	Dual Dice
Apr 79	Solar Control
Apr 79	Audio Compressor
Apr 79	Wheel of Fortune
May 79	Light Controller
May 79	AM Tuner
May 79	VHF Ant.

ETI Project Chart

Canadian Projects Book

Audio Limiter
5W Stereo
Notes N, D May 79
Overled
Bass Enhancer
Modular Disco
G P Preamp
Bal. Mic. Preamp
Ceramic Cartridge Preamp
Mixer & PSU
VU Meter Circuit
Headphone Amp
50W-100W Amp
Note N May 79

Metal Locator
Heart-Rate Monitor
GSR Monitor
Phaser
Fuzz Box
Touch Organ
Mastermind
Double Dice
Reaction Tester
Sound-Light Flash
Burglar Alarm
Injector-Tracer
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)

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 100R, 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 LETTERS AND QUESTIONS

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.

CANADIAN PROJECTS BOOK FIVE WATT STEREO

Since CPB went on the newsstands in recent months, a number of people have contacted us about the 5W Stereo project. For this project there is a pcb which accomodates a 14 pin LM379, while the circuit diagram and parts positioning diagram are for a 16 pin version of the same IC. The problem is that after the time the circuit and parts diagram were done, National decided that they liked a 14 pin IC better and thus we have an appropriate pcb. Nowadays only the 14 pin one is available, and all you have to do is stick it in the pcb with pin 1 next to the dot. For those not wishing to use the pcb, the new pin numbers are as follows: Pin 3 becomes pin 5 on the new chip, 8 is 7, 7 is 6, 16 is 14, 2 & 4 &13 & 15 are 4 & 11, 10 is 9, 9 is 8, 14 is 10, and 2 & 13 are not used. Pin 1 is still pin 1. Pins 3 & 12 are "signal ground" for each channel, and can be connected in our circuit with pins 4 & 11 to the negative supply.

50/100 AMPLIFIER

Repeating for those who missed it before: Q6 is incorrectly shown as a 2N4250, it can be replaced by a 2N3904.

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	1979
February	~~January~~	January
May	February	February
June	March	March
July	April	April
September	May	May
November	June	
	July	
	August	
	September	
	October	
	November	
	December	

LOOK! We found some more!

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.

Advertisers' Index

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