Electronics & Technology Today

$2.95
MM70924

Canada's Magazine for High-Tech Discovery

October 1988

Reviews!

GW 543 Scope

Nissei Portable Fax

Stabilant Contact Enhancer

PLUS

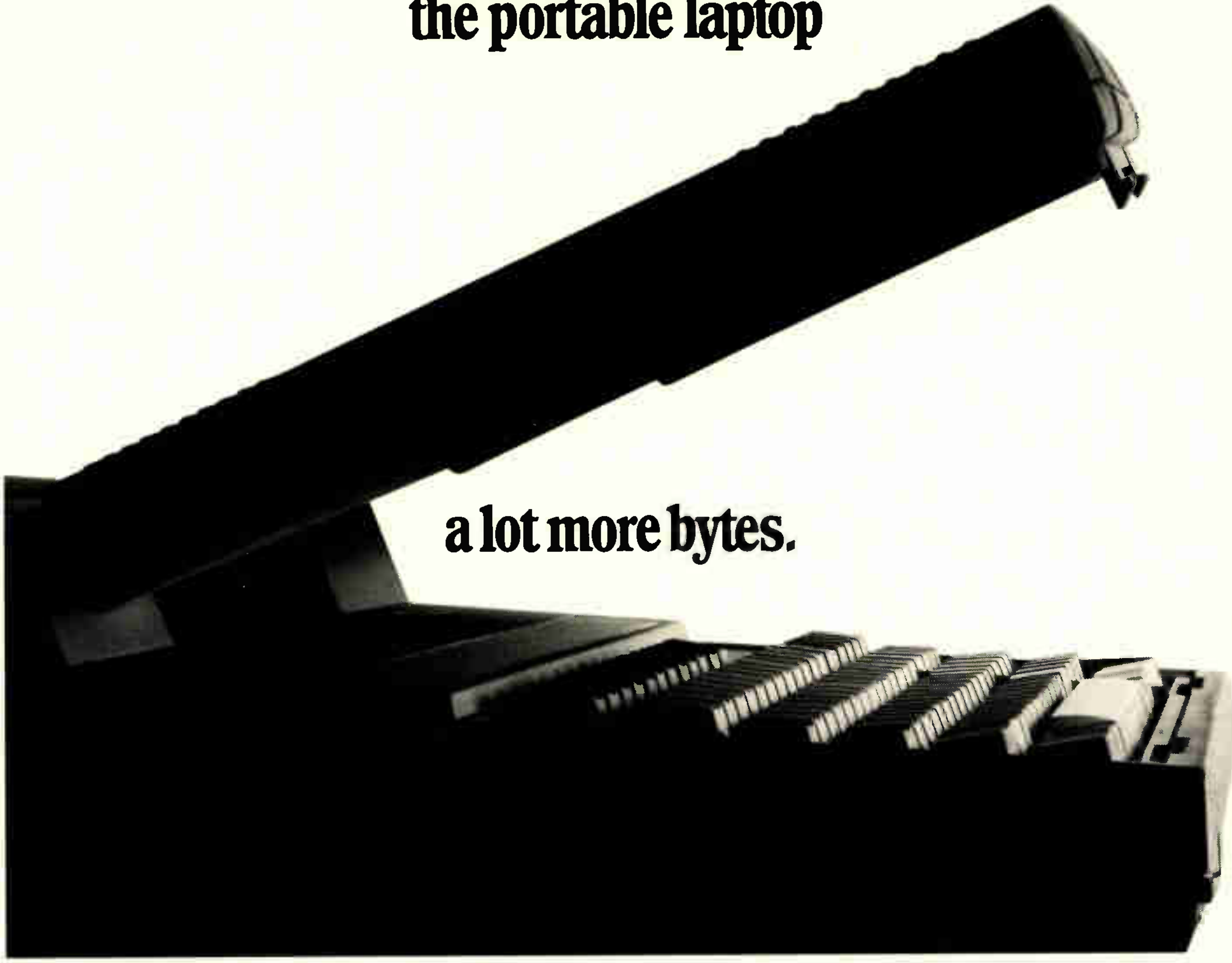
Isolink Optocoupler!

Satellite TV Update!

Sony CDP707 CD Player

0 57438 70924 10

Toshiba has just given the portable laptop



a lot more bytes.

Introducing the exciting new Toshiba T3200. The portable laptop computer designed to take a big bite out of the desktop AT market.

While you're chewing over that data, consider some other major features of the T3200. It's a portable laptop that comes standard with one and one-half internal IBM*-compatible slots for hardware expansion and a fast 40-megabyte internal hard disk drive.

The T3200 moves fast too, with an 80286 microprocessor running at 12MHz. It's also very easy to read, with a superb Gas Plasma screen which is EGA (Enhanced Graphics Adapter) compatible. And it has even more bytes with the standard one megabyte of RAM, upgradable to four megabytes. There's also a separate numeric keypad within the full standard keyboard, for real ease of use. And with all this, there's the added advantage of true portability.

To learn more about the multi-purpose T3200, place a call to your authorized Toshiba re-seller, or call Toshiba direct at 1-800-387-5645. Ask for a demonstration. Once you've had a taste of the new T3200, you'll be spoiled for any other PC, desktop or portable.

The best keep getting better!

TOSHIBA

WE MEAN BUSINESS

INFORMATION SYSTEMS DIVISION

*IBM is a registered trademark of International Business Machines Corporation.

Circle No. 1 on Reader Service Card

Electronics & Technology Today

Electronics & Technology Today
is published 12 times a year by:
Moorshead Publications Ltd.
1300 Don Mills Road,
North York, Toronto,
Ontario M3B 3M8
(416) 445-5600
FAX: (416) 445-8149

Editor: William Markwick
Editorial Assistant: Beverley Bennett
Director of Production: Papu Leynes
Art Direction: Kevan Buss
Circulation Manager: Sharon Cernecca
Advertising Manager: David Stone

President: H.W. Moorshead
Publisher & Executive Vice-President: V.K. Marskell
Vice-President - Sales: A. Wheeler
Vice-President - Finance: B. Shankman
Production: Catherine Dalziel, Naznin Sunderji, B. Zurek
Office Manager: P. Dunphy
Reader Services: R. Cree, J. Cardoni
Advertising Services: Heather Brooks

Newsstand Distribution: Master Media,
Oakville, Ontario

Subscriptions:
$22.95 (one year), $37.95 (two years).
Please specify if subscription is new or a renewal.

Outside Canada (US Dollars). U.S.A. add $3.00 per year. Other countries add $5.00 per year.

Postal Information:
Second Class Mail Registration No. 3955.
Mailing address for subscription orders, undeliverable copies and change of address notice is:
Electronics & Technology Today,
1300 Don Mills Rd.,
North York, Toronto,
Ontario M3B 3M8.

Printed by Heritage Press Ltd.,
Mississauga, Ontario ISSN 07038984

Moorshead Publications also publishes Pets Magazine, Computing Now!, Computers In Education, Business Computer News and Government Purchasing Guide.

Circulation independently audited by MURPHY & MURPHY Chartered Accountants.

Electronics & Technology Today is indexed in the Canadian Magazine Index by Micromedia Ltd. Back copies are available in microfilm form from Micromedia Ltd, 158 Pearl St., Toronto, Ont. M5H 1L3
(416) 593-5211

Electronics & Technology Today

Canada's Magazine for High-tech Discovery

Volume 12, Number 10 **October 1988**

FEATURES

TECHNOLOGY

PROJECTS

PRODUCT REVIEW

INFORMATION

Sony CDP-707ESD Compact Disk Player

The top-of-the-line 18-bit player from Sony.

TIMOTHY B. PALMER-BENSON

With its true 18-bit sampling the Sony CDP-707ESD represents a new generation of compact disc players. The unit is Sony's flagship player and it is expensive, but it is probably one of the best players that you can get. As such, the price of this unit, around $2,200.00, will be too rich for many people. So why bother to read any further if you can't afford it? The answer to this is that the 707ESD represents new technology that will most likely appear later in lower-priced CD players.

The 707ESD is one of the heaviest CD players I've encountered. It weighs a staggering 18kg and measures 47 x 12.5 x 37.5 cm (W x H x D). Broadcasters and studio engineers take note that these dimensions mean that it is impossible to fit the unit inside a standard 19-inch rack without removing its highly polished and classy looking wooden sides. As you can imagine, the 707ESD is impressive to look at as well as touch. From the shape of the controls to the solid chassis, everything about it has that chunky feel. No flimsy disc player drawer here – the drawer is as solid as any I've seen and has that slick, well-oiled sound to it.

Current Japanese thinking with high end CD players seems to place a great deal of emphasis on protecting the chassis from vibration, and Sony is no exception. The bottom plate is made out of a plastic resin and calcium carbonate, reinforced with glass fibre. The material is bonded to a steel plate to give even more rigidity. The laser pickup assembly and its attendant motor are mounted in a double suspension system and the twin transformers of the power supply section are well isolated from the rest of the chassis. Components are laid out with military precision on good quality circuit board. Most of the chips are Sony. I couldn't tell if the 18-bit D/A converter chips are of Sony manufacture because their identification codes are covered by a small piece of brown slate-like material which is glued to the back of each chip.

For the consumer, the CDP-707ESD offers a number of superlative refinements; these include "Disc Memo," "Custom Index" and "Program Bank." "Disc Memo," makes it possible to enter a message of up to 10-letters that is keyed to whatever disc that is in the machine. Once it is entered the message will appear in the front panel fluorescent display every time you load that particular disc. It is possible to have messages keyed to as many as 226 discs. "Custom Index" is a system for memorizing up to six index points on a particular disc. Like "Disc Memo," "Custom Index" remembers your keyed-in index points every time you load that particular disc and again, you can program up to 226-discs in this manner. "Program Bank" works in a similar fashion except that it stores track numbers. (This features cannot be used simultaneously with "Customer Index.") These programming systems are not "written" to disc as a computer does but stored by the unit in its non-volatile memory. Since every CD ever made has its own special code, the player can identify which message or program commands have been entered for that particular disc.

The remaining features of this player are what you'd expect to find on a top-of-the-line unit. There are optical as well as digital outputs, and, there are fixed and variable analogue outputs. It is possible to program automatic pauses between tracks and to play tracks back in any particular order. Track access time is less than one second.

Now to the 18-bits. The CDP-707ESD is a true 18-bit player using eight times oversampling. Although CDs are recorded with a 16-bit system, the extra two bits in the Sony system and eight times oversampling offers the possibility of improved resolution. Many first generation CD players sampled incoming digital information at the rate of 44,100 times a second. Later came two times oversampling in which each discrete event or piece of digital information was looked at 88,200

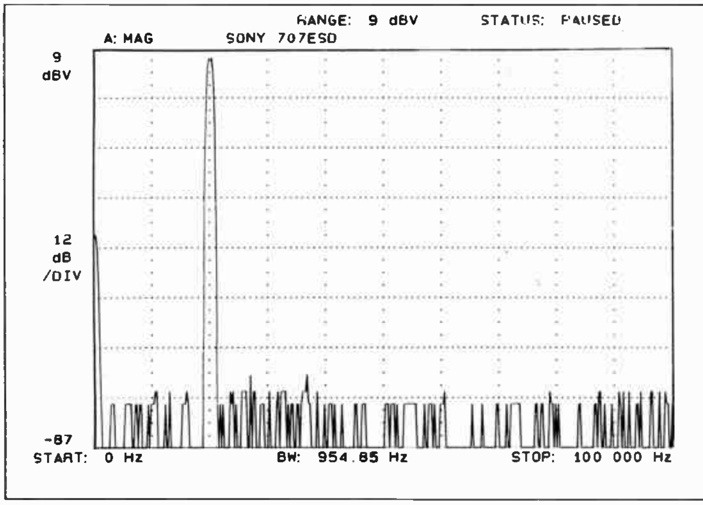


Fig. 1. A spectrum analysis of the player's output at 19,974Hz indicates no aliasing in our out of the audio band.

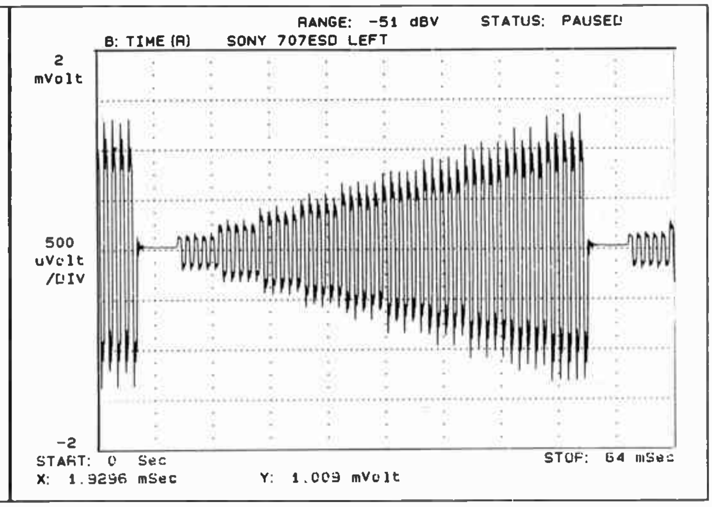


Fig. 2(a). A trace of monotonicity for the left channel; a perfect A/D converter would produce a perfectly uniform cone.

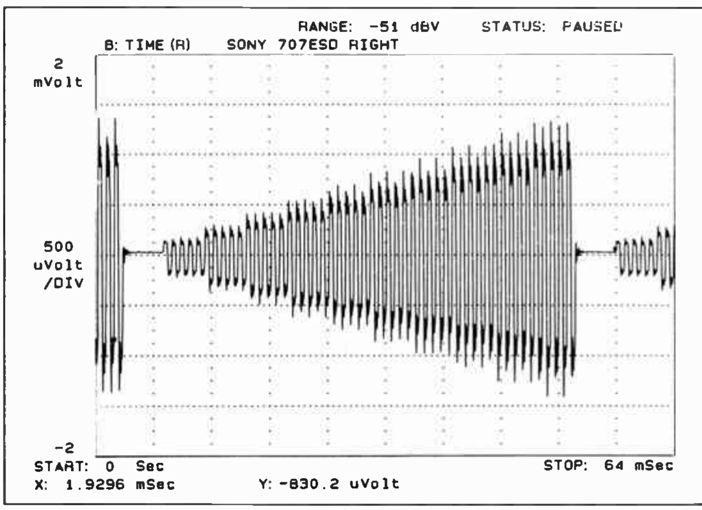


Fig. 2(b). A trace of monotonicity for the right channel (see Fig. 2(a)).

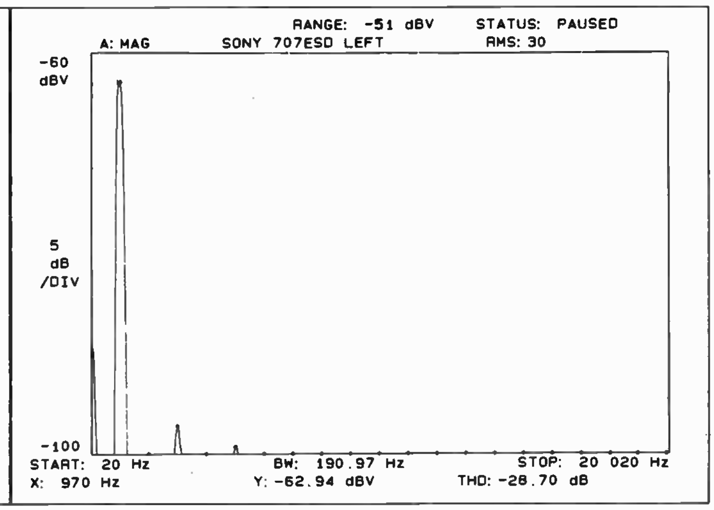


Fig. 3(a). Distortion readings for a -70dB, 997Hz signal in the right channel. This indicates state-of-the-art performance.

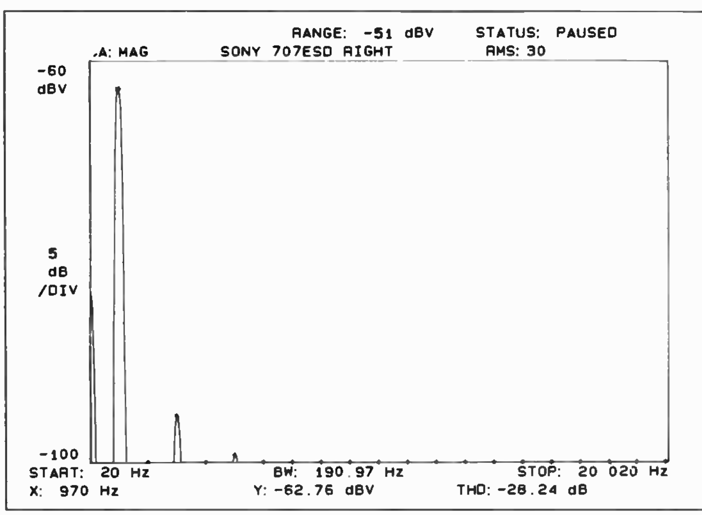


Fig. 3(b). Distortion reading for the right channel (see Fig. 3(a)).

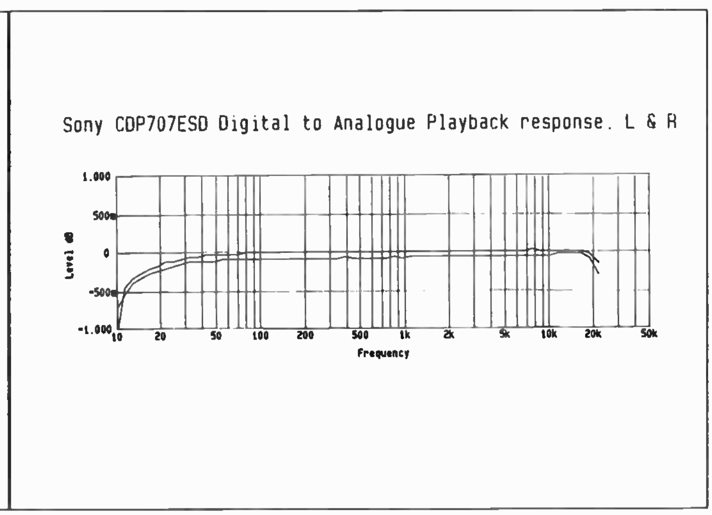


Fig. 4. The D-to-A playback response is flat within 0.25dB from 20 to 20kHz.

times a second. Many of the better players today sample at the rate of 176,400 times per second or 176.4kHz. The CDP-707ESD goes much further by sampling at the rate of 352,800 times per second! This places any spuriare related to the sampling rate much further out-of-band and makes it possible to use a gentle analog filter on the output of the player. (Steep analog filtering can cause phasing abnormalities.) As can be seen in the spectrum analysis of the player's output, (fig. 1) no aliasing effect is visible either in or out of the audio band when playing back a 19,997Hz tone.

The CDP-707ESD's 18-bit D/A converters must handle an immense data stream. They must also be highly accurate if the benefits of 18-bit conversion — lower noise and distortion and increased dynamic range — are to be realized. The converters, which can be adjusted to optimum with four trim pots, are capable of selecting not 65,536 possible quantization values as with 16-bit converters, but 262,144. In a way, 18-bit converters in CD players are an attempt to fool a system which is actually only 16-bits. The 18-bit converters with the associated oversampling "synthesize" more discrete levels. They get more steps out of the waveform than were actually there when the signal was put into 16-bit digital form. But an 18-bit converter must produce voltages that are monotonic. In reproducing a waveform, the individual voltage steps must either progress straight up without any hiccups or progress straight down and for hi-fi they must be accurate to 1 LSB (least significant bit).

How well the Sony does in this regard can be seen in the accompanying traces of monotonicity (Fig. 2a — left channel, Fig. 2b — right channel). The cone shaped traces come from track 21 of the CBS CD-1 test disc. They are actually 1,102.5Hz square waves bunched up together, starting at digital zero and ending up to 10 LSBs. The tip of each cone is digital zero. Then the traces moves up by one LSB every five cycles to a maximum of 10 LSBs. A DAC that is functioning perfectly will show uniformity on either side of digital zero. The level changes between each increase in LSBs should be the same. Any lack of uniformity will cause distortion. As you can see both channels of the 707ESD do very well, although things are not absolutely perfect. Even a slight error in linearity produces distortion. For example, I obtained distortion readings of 3.87% on the right channel and 3.67% on the left channel when a -70dB, 997Hz signal was played back into my spectrum analyzer. Some 16-bit systems that I have measured have done slightly better. Nevertheless, it should be noted that this is almost state of the art in consumer CD as the spectrum analysis plots show (Fig. 3a — left & Fig. 3b — right).

Fig. 4 shows the playback response of the CDP-707ESD. Playback level is accurate to within 0.25dB from 20Hz to 20kHz using the Denon CD test disc. Output level from a 0dB 1kHz test tone measured 2.16 volts on the left channel and 2.18 volts on the right which is why there is a slight offset in the playback response traces! Left to right and right to left channel separation was in excess of 100dB at 1kHz, 125Hz, 4kHz, and 10kHz. At 16kHz left to right separation was 97.7dB. The signal to noise ratio of this player was 95.8dB as measured using track 4 of the CBS CD-1 test disc. Intermodulation distortion (SMPTE Twin Tone method) was 0.005%.

It should be clear to anyone listening to this unit over a good system that it is one of the better players around. There are differences between CD players, as measurements show. This unit takes us one more step towards perfection. Its sound is smooth without causing what I might be called "the bleeding ears syndrome." If you are in any doubt about the sound of this player, try the fade to noise with dithered noise test on the CBS- CD disc using a pair of good quality headphones and a quiet room! This test begins with a -60dB, 500Hz tone that fades to -120dB over a period of 30 seconds. As the tone slides into the noise, there should be no apparent change in level nor should the character of the noise or the tone change in any way. The noise should not appear to come up and meet the tone. You should be able to feel that you are following the tone down into the noise just as you might follow the sound of a rustling leaf on a still day in a forest or bush. You'll find that although the reproduction is not absolutely perfect, the sound comes pretty close to perfection. For the music lover it translates into more faithful reproduction of what is on a disc. You'll find very little harshness with the 707 except if it is on a disc. The player should provide years of professional use as well as for the discriminating listener. ■

Portable Fax. Small Wonder.

Imagine a Fax that's very small, very light, and built to travel absolutely anywhere business takes you.

What you've just imagined is the remarkable new Nissei FAX-305, the world's first truly portable Fax.

Now, for the first time ever, you can take the convenience of Fax with you wherever you go, because this incredibly small and light weight system connects quickly to any telephone.

It even works perfectly with your cellular telephone, right in your car.

The FAX-305 is suitable as a personal office Fax, and it's ideal for the times when business takes you away from the office. No matter where you are — in a hotel room, at a client location, in your car, or at home — the FAX-305 lets you work as efficiently as though you were back at your desk.

It even doubles as a personal photocopier!

In fact, we've made the versatile FAX-305 so painlessly portable, there's no reason to ever be without all the benefits of Fax. Right at your fingertips.

So, no matter where business takes you, take the Nissei FAX-305. Call 1-800-263-4378.

NISSEI

Interconnect
Equipment Systems

Vancouver (604) 738-3030 Toronto (416) 475-0282 Ottawa (613) 723-2756 Montreal (514) 630-4888 Halifax (902) 835-9897

NEW PRODUCTS

RFI/EMI-Shielded Indicator Lights

Dialight introduces a line of indicator lights that retains shielding continuity when installed in EMI- and RFI- shielded enclosures. The new indicators were developed in response to unshielded penetration holes produced in metal-shielded enclosures. Radiation can enter the enclosure, disrupting the function of the electronic device inside. Dialight has placed a metal mesh shield within the indicator to absorb the radiation as it fills and blocks the hole in the enclosure. Light emission is barely affected by the metal mesh, even lower power indicator lights provide a highly visible light source. Currently available in all standard mounting holes sizes.

Circle No. 7 on Reader Service Card

IEEE-488 Device Driver

National Instruments introduces the NI-488 OS/2 software driver for the MC-GPIB, a high speed, full-function IEEE-488 interface card for the IBM Micro Channel Personal System/2 Models 50, 60 and 80 personal computers.

The NI-488 Os/2 handler is a binary device driver which is easily installed as part of the OS/2 operating system, supports multitasking and offers powerful easy-to-use interface. The IEEE- 488 driver function can be accessed through the standard I/O functions of program language. Compatible with the NI-488 MS-DOS and UNIX packages, it eliminates the need to rewrite current application programs to operate under OS/2. The NI-488 OS/2 software provides all the required libraries, macros and definitions for C. Basic, Pascal,and FORTRAN in source code. Represented in Canada by Allan Crawford Associates Ltd.

Circle No. 8 on Reader Service Card

LX-101 Digital Lux Meter

KB Electronics announces the addition of the LX-101 Digital Lux Meter to its line of Electronic Test Equipment. This lightweight meter measures 0 - 50,000 lux across 3 ranges. The large 3 digit LCD display provides a clear readout under all conditions with a 2% accuracy rating. The unit operates on a standard 9v battery.

Circle No. 9 on Reader Service Card

Continued on page 33

Train with NRI for a high paying career servicing computers.

Get started now by building this fully PC compatible computer

Now you get it all . . . training for today's fastest growing career opportunity . . . training to service all computers . . . training on the newest total computer system, the Sanyo 880. Only NRI can give you the well-rounded training you need, because only NRI gives you a complete computer system . . . computer, monitor, disk drive, software, even test instruments like a digital multimeter and logic probe to work with and keep. It all adds up to training that builds the knowledge, competence, and ability you need to succeed as a computer service specialist.

Get inside the newest Sanyo Computer —fully compatible with the IBM PC*

As an NRI student, you'll get total hands-on training as you actually build your own latest model Sanyo 880 Series computer from the keyboard up. It's fully compatible with the IBM PC and, best of all, it runs programs almost twice as fast as the PC. As you assemble the Sanyo 880, you'll perform demonstrations and experiments that will give you a total mastery of computer operation and servicing techniques. You'll do programming in BASIC language—even run and interpret essential diagnostic software.

Understanding you get only through experience

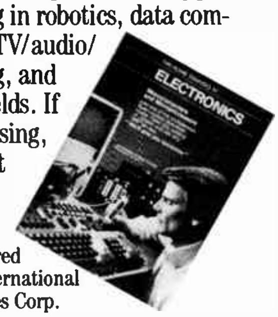
You need no previous knowledge to succeed with NRI. You start with the basics, rapidly building on the fundamentals of electronics with bite-size lessons. You perform hands-on experiments with your NRI Discovery Lab and then move on to master advanced concepts like digital logic, microprocessors, and computer memories.

Learn at home in your spare time

You train in your own home at your own convenience, backed at all times by your own NRI instructor and the entire NRI staff of educators and student service support people. They're always ready to give you guidance, follow your progress, and help you over the rough spots to keep you moving toward your goal.

100 page free catalog tells more . . . send today

Send the postage-paid reply card today for NRI's 100 page catalog that gives all the facts about computer training plus career training in robotics, data communications, TV/audio/video servicing, and many other fields. If the card is missing, write to NRI at the address below.



*IBM is a registered trademark of International Business Machines Corp.

NRI SCHOOLS

McGraw-Hill Continuing Education Center
330 Progress Avenue
Scarborough, Ontario M1P 2Z5
or telephone 416-293-8787

We'll give you tomorrow

Stabilant 22 Contact Enhancer

A unique liquid semiconductor that eliminates contact and connector problems.

BILL MARKWICK

Connectors and movable contacts are the Achilles Heel of electronic equipment, having reliability far below that of the components they serve. The demands put on connectors are severe: they're expected to provide a zero-resistance path forever, despite contamination, oxidation, temperature, humidity, physical impacts, and of course, plugging and unplugging by the user.

The most obvious problem is the open circuit; the contacts are either physically separated by mechanical failure, or coated with non-conductive corrosion products. A more insidious and frustrating case occurs when the contacts become partially conductive because of a thin oxidation layer. Sometimes they work and sometimes they don't. The trouble can sometimes be cleared by removal and reinsertion of the connector, but this only buys time until the oxide layer reforms. In the worst case, the layer becomes conductive only when the signal voltage is high enough to break it down; some of your signal gets through and some of it doesn't. This adds audible distortion to sound equipment, unpredictable behaviour to computers, and erroneous readings to test equipment, not to mention a loss of temper to the person trying to track down the fault.

Stabilant 22 is a liquid polymer that becomes conductive in the presence of an electrical field, minimizing contact resistance. It's nonconductive away from the contacts, so you can safely apply it to edge connectors. It's stable and lasts for years, and stops erratic behaviour in audio, medical, computer, military, industrial and test equipment. If it sounds like a magic elixir that's too good to be true, here's how it works and how it was developed.

Serendipity

Many inventions are the result of an accidental discovery while something else was being investigated, and Stabilant 22 is one of these. William "Mike" Wright, of the famed Dayton-Wright speaker firm, was looking for some sort of coating that would conduct the required electric charge in an electrostatic speaker. One promising chemical was a block polymer of the glycol family. During trials, it exhibited an odd behaviour: its resistance never measured the same value twice, and would even change as you measured it.

It turned out that the variables affecting the resistance were the applied electric field and the distance between the probes. Mike Wright realized that this had great potential in curing the woes of connectors and contacts, and after much research time and investment, the result was Stabilant 22. D.W. Electrochemicals was formed to package and sell the new creation.

How It Works

The polymer, which is dissolved in isopropyl alcohol, is applied to connector pins, card edge contacts, etc. The liquid causes no trouble if it bridges across pins or card fingers because it's normally nonconductive. However, when metallic contact is made and current flows, the Stabilant 22 in the microscopic gaps will switch on in the area of the contact, reducing the resistance. It remains conductive for some time, so its resistance value doesn't follow the signal variations. Since the liquid is very stable and has low vapour pressure, there is no appreciable loss due to evaporation. It doesn't form compounds with other plastics or cause "varnishing".

Applications

Stabilant 22 is now being used by NATO, hospitals, audio console manufacturers, video switcher users and others who require very high reliability. It is also sold to audio and computer enthusiasts in the US as *Tweek*.

If corroded contacts in an audio system are causing low-level rectification of the audio signal, then audible distortion is created in much the same manner as crossover distortion in Class B power amplifiers, though at a much lower level. Stabilant 22 eliminates this effect, even when the voltage is at the microvolt level (as it would be with some phono cartridges).

Computers, with their many edge connectors and IC sockets, are a natural for conductivity problems, and the worst of them would be the intermittent types that crash a program at unpredictable times. Stabilant 22 on the edge fingers and sockets is said to greatly improve operational reliability.

I tried Stabilant 22 on two problems that had plagued me. The first was a noisy 1/4" phone jack in an electric guitar, and thc second was a hum from my phono cartridge because the ground pin in the cartridge shell kept going high-resistance. A tiny amount of Stabilant applied with a toothpick cured both problems, and despite plugging and unplugging the guitar, it's remained noise- free for three months now.

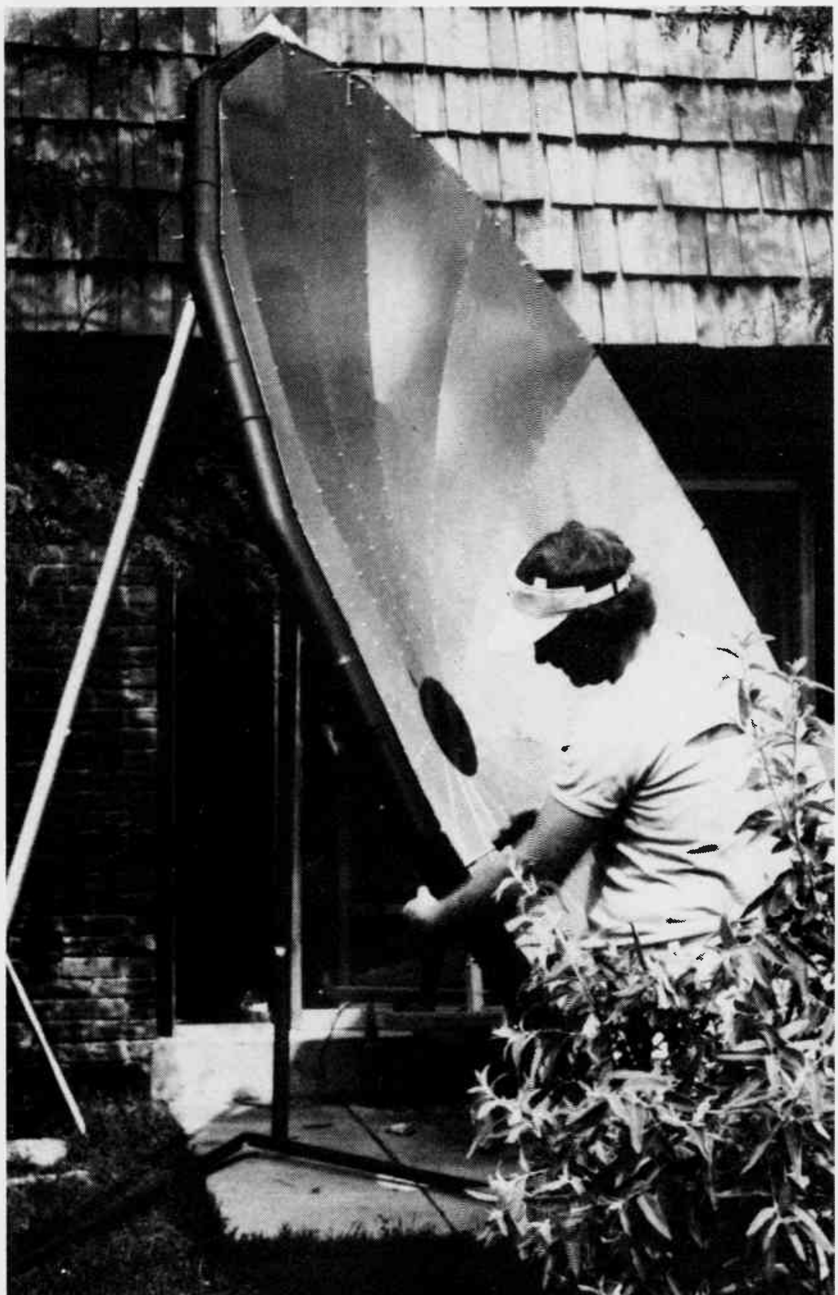
There are two cases where Stabilant is not recommended: contacts which may arc, which would cause loss of the Stabilant, and contact groups where the voltage exceeds 100 volts.

Stabilant 22 is not inexpensive, with the 15ml service kit retailing for $51.20, but a little goes a very long way (not to mention the saving in time and temper). There's the added benefit that the alcohol (which is only a carrier) will provide a certain amount of cleaning effect, and the Stabilant itself also acts as a lubricant. For further information, contact D.W. Electrochemicals, 9005 Leslie St., Unit 106, Richmond Hill, Ontario L4B 1G7, (416) 889-1522. ■

Satellite TV Update

What's become of the satellite TVRO business?

S.R.FERRYBRIDGE



Satellite television isn't dead... it isn't even limping. However, in some respects it has become more a political issue than a technical one. That's where most things start getting complicated... and this one's no exception.

In order to understand what has become of satellite television, and, more to the point, what it can still do for you, it's important to recognize who's really playing the game and what has been deliberately scrambled. To be sure, this extends far beyond the mere scrambling of programs.

The reality of satellite television is that it's still every bit as healthy as it used to be. In fact, it's more so... there are more interesting feeds pouring out of the sky than ever before. However, it has also been the object of quite a lot of propaganda, with the result being that it has become something of a well kept secret amongst those who still tune into the microwaves.

Unlike most secret cliques, this one is real easy to crash. All you need are the right boxes.

The Politics of Waves

The technology of a home satellite downlink... the receiver, the dish and the various bits between them... has more or less stabilized at a point wherein everything works well, is easy to use and doesn't cost too much.

I've been using the Radio Shack dish and receiver for about two years now. It's a fairly representative downlink, with a fully microprocessor controlled receiver, an horizon to horizon dish mount and a well thought out design over all. In addition, because it's designed to be installed by mere humans, rather than by mysterious service trolls, I can realign the beast myself when the ground shifts in the spring.

At two thousand bucks for the eight foot version, the Radio Shack system represents an excellent value in downlink technology. However, I should point out that virtually all of the major systems available have pretty well this level of sophistication and technical quality. There are quite a few which will produce amazingly good pictures with little more technical involvement than is required to operate a normal television set.

Because the people who sell these things like to have new features to talk about, satellite receiver design is constantly changing... perhaps "mutating" would be closer to the reality of it. A recent system from Toshiba, for example, featured a large liquid crystal display which drew a picture of the arc of the dish to show you where it was positioned. Several recent receivers have included built in descramblers. As we'll get to, this latter innovation is not at all to be desired for most potential satellite system owners.

The other element of a useable downlink is a VideoCypher II descrambler. Anyone who tells you that everything worth having up there is scrambled is correct, but this box will unscramble well over ninety five percent of the interesting feeds. However, there's a lot of intrigue involved in it. We'll get into it in more depth shortly.

A VideoCypher II costs in the range of twelve to thirteen hundred dollars in Canada...that's about seven hundred for the box itself and the rest for some custom modifications. However, with the price of the basic antenna and receiver part of downlink having fallen so dramatically in the past year or so, you can actually buy a VideoCypher for the difference and still have a little left over for popcorn and beer.

The programming available to the owner of a satellite television system is thoroughly awesome. The picture quality is stunning, the sound is godlike... actually doubly godlike, as it's most often found in stereo... and the range of stuff falling from the heavens requires a half inch thick book to list it each month. This includes Home Box Office, Cinemax and other first run movie feeds, sports channels, cultural channels, family services like Disney, non-family services like American Exxxstasy (the hard core pornography feed), uncounted numbers of music channels, shopping channels, educational channels and finally, quite a few feeds of local stations from around North America. If there's nothing on tonight it can only be because someone's unplugged the set.

We'll dig into this in a bit more depth shortly.

The technical requirements of owning a downlink are pretty tame. First of all, you'll need the bucks to buy one. This is your own problem. Secondly, you'll need a suitable site. In order to receive everything that's up there, your dish will require a clear view of the sky from about due south to almost due west. The exact angle of elevation and such requires a site survey to establish... something you can handle by yourself or get whoever is going to install your dish to get together for you.

Finally, you'll need a large, evil looking pair of wire cutters to slash through your current cable television feed if you happen to have one at present. You may think you'll still want cable now, but you won't if you get a dish.

One might wonder why satellite television has found so little acceptance despite its clearly superior technology and vastly more interesting programming. There are a number of reasons for this. To begin with, people living in the urbs usually can't erect dishes on their apartment balconies, which lets them out of it. To be sure, satellite television is more expensive than conventional tube fare, although what you get is arguably worth it. However, the thing which has kept satellite television in the ground of late has largely been the myth of scrambling.

The cable television industry is a large and firmly established group of suits with a well developed sense of self preservation. Some time ago it realized that if everyone got into satellite television, cable would dry up and blow away. Much of the subsequent propaganda about satellite television, some of the now defunct legislation against it and even, some say, the scrambling issue itself can be traced to pressure from the cable television companies.

While we'll get into all the grotty details of scrambling in a bit, it seems worthwhile to note here that the scrambling of nearly all the good American satellite feeds in no way makes them unwatchable, particularly in Canada. The aforementioned VideoCypher descrambler can be "chipped" or modified to allow it to descramble almost everything up there, all without the further payment of any fees. More to the point, it's not even illegal, so far as I know, in that you can't buy the programming in Canada even if you want to. The programmers have gone to some lengths to make this so: to subscribe to Home Box Office, for example, you must call an eight hundred number which can't be accessed from Canada, pay for the programming using a credit card drawn on an American bank and supply HBO with a valid American billing address.

What's Up

In order to properly convince yourself of the true splendor of satellite television, you should probably buy a copy of one of the satellite program guides. There are a number of these, including OnSat, a weekly one, Orbit, an imported effort and Satellite Entertainment Guide, the latter of which features complete program listings for a hundred and five feeds over a whole month. It's frequently inaccurate and a bit funky in other respects, but it's easily available on most news stands.

In the mean time, let's a have a brief look at the highlights of the spectrum. This stuff is true now, as I write this, but some of the more tenuous feeds change quite often, so a few inaccuracies may creep in before you get a chance to read this magazine.

Starting in the western end of the sky... for me, anyway... there's Satcom F1. This carries a number of local stations from Denver and one from Los Angeles. There's a religious station, a shopping channel, a news channel and a feed for Financial News Network. You can also check out a raw feed for NBC.

Next over is Galaxy One, one of the hottest satellites in the sky. It carries a host of movie feeds for Home Box Office, Showtime and The Movie Channel. There's also Ted Turner's super station, USA network, a sports channel, Arts and Entertainment and two feeds of the Disney channel.

Satcom F3, to the east of G1, carries west coast versions of many of the movie feeds on G1. This means that if you miss a flick on G1 you can see it a few hours later of F3. This satellite also carries the Fashion Channel, the Learning Channel, quite a few loathsome shopping channels, the Travel Channel and a religious feed.

Westar Five, next door, is a bit of a dead issue at the moment. It has a highly peculiar religious feed, an agricultural channel, a business news channel and a number of other specialized things which happen sporadically.

Spacenet One is a rather odd blend, carrying quite a few religious channels and American Exxxstasy, the latter of which carries six totally raunchy, uncut, hard core porn flicks each night. One of their ads went something like "a subscription to American Exxxstasy is money well spent, and you will be too." It's hard to improve on that, and the publisher here will likely freak if I try.

Anik D2 carries First Choice. This is one of the few services which is scrambled with the VideoCypher and can be legally subscribed to in Canada. In fact, it must be, as this is one case wherein watching this feed through a chipped VideoCypher does constitute a theft of service in Canada. There isn't much else on AD2.

Anik D1 has quite a few local Canadian stations on it, but they're all scrambled with the Oak Orion system, requiring a wholly different descrambler. It also features the CBC and Much Music... unscrambled... and the proceedings of the house of commons.

Westar Four has some PBS feeds on it, Japanese television, some religious feeds and a Los Angeles station which specializes in computers and technology. We never watch this satellite because there's a tree between it and our dish.

Telstar One and Two are used primarily for network feeds. You can watch normal broadcast television on them with about half the commercials missing. Unfortunately, they're replaced with long silences so that local stations can put in their own ads. There are also numerous feeds which the networks use sporadically to shuttle video around the planet. These two satellites are kind of useless for serious entertainment.

Galaxy Three has been waking up of late. It includes several rock channels, several pay per view movie channels, Nickelodeon... a family channel... and C-Span, the channel of the American Congress.

Galaxy Two carries Tuxxedo Network. This is run by the same company which does American Exxxstasy...notice the profusion of X's. This feed is raunchy flicks with most of the really raunchy bits removed. While still pretty wild at times, you can actually watch it and live to tell of it later.

Satcom F4 is really lively. It has Bravo... sort of Arts and Entertainment with class... several religious feeds, several dreadful shopping channels, some sports channels, some movie channels, a few rock channels, a few local channels and the Playboy Channel... often called the rabbit channel by its detractors... which features still tamer erotica interspersed with weird panel discussions and the like, all mostly about the same thing.

I've left out a bucket of stuff here, but this should give you an idea of what there is to watch up there. It makes the offerings of even a really good cable system look pretty tame. A few weeks ago, when we had some technical problems with our dish... and were reduced to watching cable exclusively... we really got a feel for what television is like for people without dishes. It doesn't even bear thinking about.

VideoDecypher

The spaniel in the works of satellite television is, of course, scrambling. In order to be able to even think about watching most of the feeds I've just described, you'll need a seven to eight hundred dollar box called a VideoCypher II. If you happen to live in the States... not likely, as this is a Canadian magazine... you could call the program providers for the feeds you like, tell them that you have a VideoCypher... and a Visa card... and they'll switch you on for their feeds. The meter starts running at this point. The feeds can run up to thirty five bucks American a month.

This option is not available to people living north of the border. You would need a credit card drawn on an American bank, a legitimate American billing address and some way of accessing American eight hundred telephone numbers in order to get authorized for the likes of Home Box Office or Cinemax. This has to do with the legalities of the distribution rights of the movies these channels carry.

As such, with the exception of the very few feeds which are up for Canadian subscribers... First Choice, American Exxxstasy and Cable News Network, so far as I know... you can't subscribe to the American scrambled feeds even if you want to. You can, however, get them all for free.

It's possible to confuse a VideoCypher such that it will descramble almost everything it gets. This is usually called "chipping" the beast. A VideoCypher is actually a dedicated computer, and modifying it in this way involves changing the program in its PROM to one that's a bit more accommodating.

Because you can't actually buy the American feeds in Canada, this doesn't involve actually stealing anything. In the case of the one legitimately available Canadian movie channel, First Choice, one could rip it off with a chipped Cypher, of course, but it takes only a rudimentary level of conscience to either subscribe to the beast or not watch it. I'd recommend that you do spring for a legitimate subscription to First Choice... aside from supporting a Canadian satellite service, it makes you all squeaky clean and legal, and no one can accuse you of stealing anything.

Now, as I mentioned a while ago, there's a lot intrigue involved in all this chipping and cyphering. I had a long chat with a representative of dB Associates, pretty well the most knowledgeable authority on VideoCyphers in Canada. He noted that there is, at various times, a fairly large underground of amateur Cypher chippers about, and that most of them barely know which end of a soldering iron to hold onto. The art of chipping is not a casual thing, as it turns out.

Once chipped, a VideoCypher may stay chipped for an indefinitely long time or it may get shut down by General Instrument, the company which handles all the signal encryption, if GI discovers how the chip works. Much of the length of time that a chip stays working is determined by how clever the chipper is. Thereafter, whether or not you get back on line is determined by his scruples and how well he has kept up on the latest new chips.

The few professional chippers around, said dB Associates, warrant their work, and they've been in business for several years. If their chips get shut down by GI they'll rechip your Cypher for a nominal fee. As such, once having invested in a chipped Cypher from a legitimate company it will stay chipped, one way or the other.

Some chippers charge as little as fifty dollars for a chip. Such chips often last less than two weeks before they're shut down. By this time, the chipper is usually history.

The professional chippers can cost ten times this much, but their fixes work and they stand behind them. They also modify VideoCypher boards in a reasonably professional manner. The boards which dB Associates gets in to repair frequently bear the marks of amateur hackers, who have desoldered their PROMs with propane torches or ground them off with power tools.

A good chipper will also be able to do service work on a VideoCypher. This is very important, because, if your box dies a natural death you can't very well send it to General Instrument for service. They will actually fix it for you, but they'll de- chip it in the process, crack the chip to see how it works and finally pot your circuit board in epoxy to make it difficult to re-chip. Unfortunately, chippers who can fix VideoCyphers are pretty thin on the ground because of the requirement for a number of hard to get parts and custom chips.

The man from dB Associates related an interesting story about the VideoCyphers and their chips. When the Cyphers first appeared... before anyone had successfully cracked them... they were selling very poorly. Their sales only took off when it became commonly known that they could be beaten. Since then, General Instrument has, on occasion, figured out how the boxes had been chipped and shut them down. However, the ways around this always seem to leak out quickly enough, and the chipped systems got back on line.

It has been estimated that anywhere from sixty to ninety percent of the VideoCyphers in North America have been chipped.

There are rumours, amongst knowledgeable chippers, that General Instrument itself may be leaking the chip fixes to the chippers to keep the market for VideoCyphers viable. After all, they don't really care what happens to them after they're paid for. According to these rumours, General Instrument is obliged to shut down a few systems now and again to keep the program providers, like Home Box Office, reasonably happy. However, they're primarily up for selling boxes, not subscriptions.

As I said a while ago, satellite television is very much a matter of politics.

Up the Down Link

If you deal with a reputable chipper you can be assured of more or less uninterrupted service and no serious expenses beyond the initial chipping fee. I've had a chipped Cypher going for almost two years, and it's only been shut down once. In this case, it was back up in a couple of days with the infusion of some new silicon.

The technology of satellite television really has come of age, and it has never been more affordable. The programming up there is without equal.

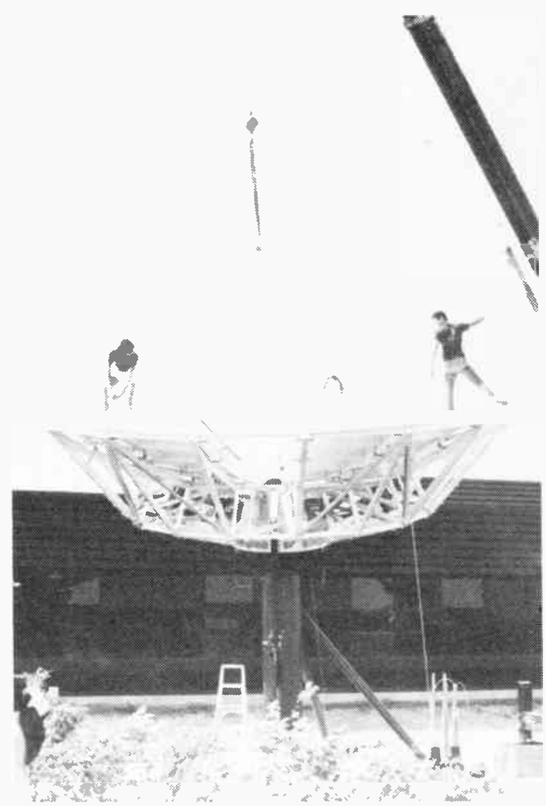
If you have a clear view of the sky and can scare up the bucks, you should seriously consider planting a dish in your yard. You can join the society of video heads who have discovered that television can be more fun than its creators ever imagined, and more exciting than conventional terrestrial broadcasters will ever hope to make it. ■

FOR YOUR INFORMATION

Satellite Control Centre

CANCOM/SATLINK, a division of Canadian Satellite Communications of Mississauga, Ontario, has opened its VSAT Satellite Master Control Centre (Hub) for cross-Canada data communications and business television services. The 24-foot dish in Mississauga provides two-way interactive data communications between a company's branch offices and its main computer facility or headquarters.

Each branch office is equipped with a Very Small Aperture Terminal (VSAT) which includes a 6-foot dish, usually on the roof of the office. When data is sent or requested, it is transmitted up to the satellite and received by the Hub's 24-foot dish, then directed over landlines to the company's headquarters. Contact CANCOM at (416) 272-4960.



Circle No. 3 on Reader Service Card

Super RISC Chip

McDonnell Douglas of California has demonstrated the world's fastest 32-bit reduced instruction set computer (RISC) processor. The single chip microprocessor, dubbed the MD-484, has been clocked at almost 60 megahertz and produces an output every 17 nanoseconds. The chip uses gallium arsenide technology, with 21,606 junction FETs. A single-board computer, to be completed by 1990, will perform at over 100 million instructions per second.

The chip was developed for military space applications as part of SDI.

Circle No. 5 on Reader Service Card

HDTV

High-definition television has more viewer appeal than the best systems now on the market, and consumers would be willing to pay more for the improved quality, according to tests sponsored by Communications Canada. The improved sharpness, color and depth were the most important features; availability of programs and quality of reception would be major factors. Most people expected to pay $300-$400 more than current high-quality sets; above this, interest declined.

Circle No. 6 on Reader Service Card ■

Circle No. 4 on Reader Service Card

Nissei Portable FAX

Send or receive documents anywhere there's a phone line.

BILL MARKWICK

Back in the 1950s, when futurists and science fiction writers were predicting that we'd live in domed cities and fly personal helicopters by 1970, one far-sighted writer pointed out that it should be possible to make a facsimile machine compact and inexpensive enough that every home could have one. The news could then be sent directly to the subscriber, and computers could even select the items into categories chosen by the user.

Well, we'll have to wait and see about the news, but the technology is here. The Nissei FAX-305 can send and receive documents up to 8 1/2" wide over any telephone line. It's battery-powered and includes an acoustic coupler for telephone handsets so that it works anywhere, even in a car equipped with a cellular telephone.

Features

The 305 measures 386 by 184 by 80mm and weighs in at 3.3kg. Operating controls are limited to Start and Stop touchpads, plus a pad marked Fine, which can double the resolution of transmitted documents.

On one end is the carrying handle, power connector for the recharger/adaptor and an undocumented RS232 port; this port is used by the dealer for entering the header line that appears on your document. On the other end are the standard in/out modular telephone jacks for direct connection to a telephone line, plus the jack for the included acoustic coupler, which is for use when direct connection isn't possible (cellular phone, etc.). This is basically a microphone and speaker mounted on a bar; the adjustable bar and Velcro strap allow it to be fastened to any telephone handset.

Sending

Operation of the unit is straightforward. If you have modular jacks, the unit is connected to the wall jack, and the telephone connected to the FAX; suitable cables come with it. If you can't get at the phone line, the acoustic coupler is used.

Set the document into the slot, dial the number, and when you hear the tone that indicates that the distant FAX is ready, press Start. The document will trundle through the 305 in about 45 seconds. If you're using the coupler, you listen for the tone and then strap the coupler to the handset. I found that it worked flawlessly, but if you have a number of documents to send to different destinations, you have to keep strapping and unstrapping the coupler, unless you're confident that you haven't accidentally reached a wrong number or busy signal. A small speaker in the 305 would let you monitor the signal without unstrapping.

Receiving

This couldn't be easier. The automatic feature of the 305 takes care of everything. Your documents will just feed out continuously from the internal roll of paper. The roll of thermal paper is good for about 60 to 70 11" sheets (if someone sends a longer sheet, such as 14" legal size, no problem; the 305 just spools it out).

There is also a switch for manual operation in case you want to take care of answering the phone yourself.

Other Functions

The 305 can be used for photocopying as well. Any document is inserted in the slot and 45 seconds later you have a copy. You wouldn't want to do a suitcase full of copies, but it's more than adequate if you're travelling.

The quality of the 305's output is as good as the best — not quite up to the best photocopier, but adequate for anything but reproducing photographs or other continuous-tone artwork. The resolution is 203 by 196 lines per inch.

The 305's batteries are good for sending or receiving about 25 pages; recharge time is about 30-45 minutes. You can also use the recharger to operate directly from the AC outlet if the batteries are dead.

The Nissei FAX-305 is beautifully made and functions flawlessly; the operating instructions are a bit sketchy if you want to do special functions, such as using the built-in baud rate switch or RS-232 port. The 305 is available with or without NiCads starting at $2395, from Interconnect Equipment Systems, 750 Cochrane Drive, Markham, Ontario L3R 8E1, (416) 475-0282, or from their regional offices in Vancouver, Ottawa, Montreal, and Halifax. There's a toll-free number you can call for information: (800) 263-4378. ■

MARKETPLACE

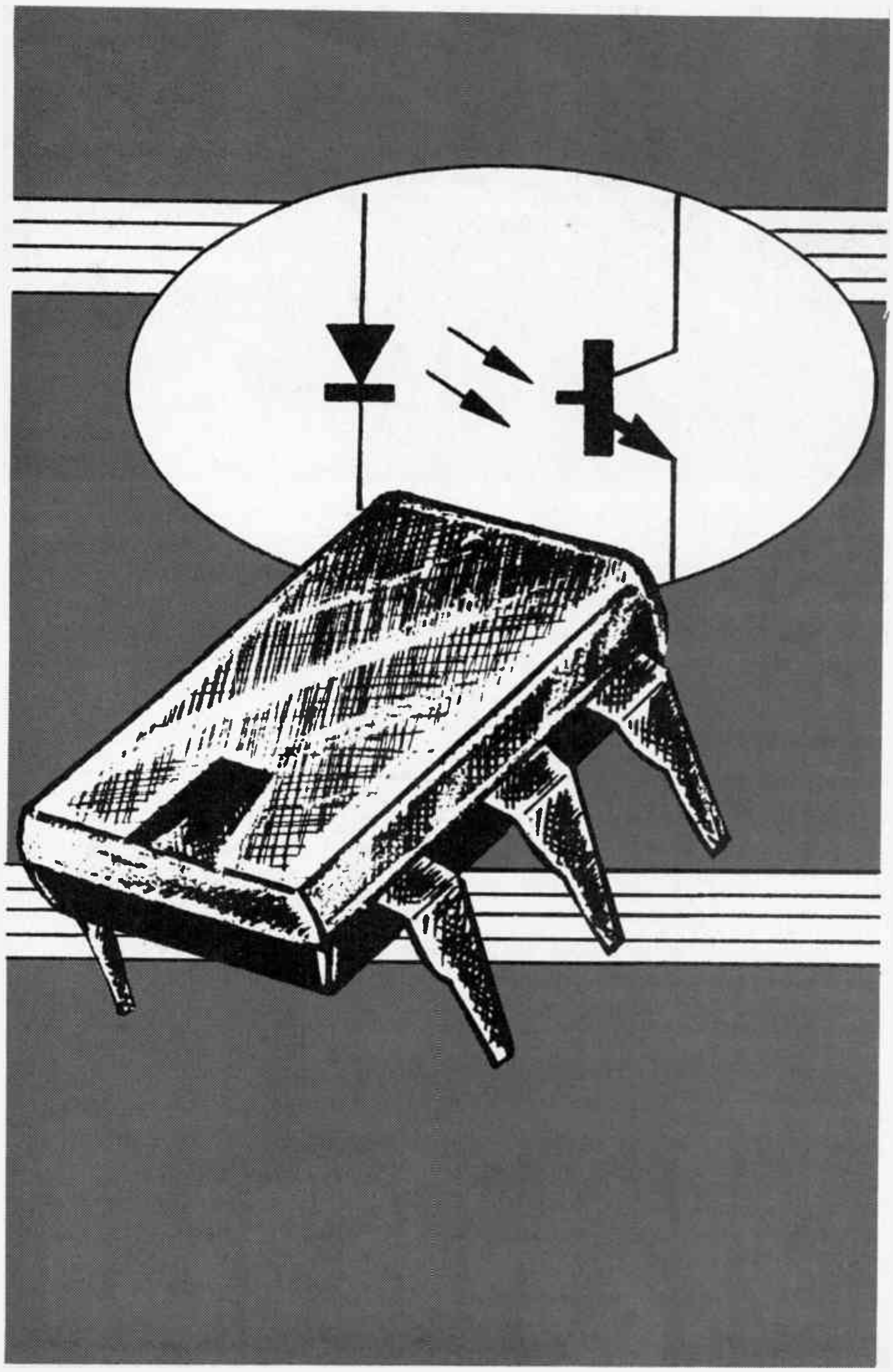
CLASSIFIEDS

Where Buyers Find Sellers

Isolink

Circuit connections without contact.

ANDY FLIND



The Isolink conducts voltage signals from DC to around 30kHz between its input and output terminals. "Amazing", you might say, "but surely two bits of wire can do that?"

Well, yes, but the Isolink does offer some significant advantages over wire. For a start, it will withstand high voltages between the input and output connections without passing current, allowing measurements to be made on normally inaccessible circuits such as those connected directly to live AC mains.

The capacitance between input and output, due mainly to stray coupling, is less than 10pF. As this presents an impedance greater than 300 megohms at 60Hz it enables investigation of sensitive battery-powered circuitry by mains powered test gear with virtually no coupling of hum.

This has obvious applications in many areas of electronics, but should be of especial interest to biofeedback enthusiasts. The prototype was in fact designed to assist with the development of a brainwave monitor circuit.

Optoisolator

An optoisolator device was chosen as the basis for this project as it offers efficient signal transfer with low supply current. Most other methods require tens of milliamps (at least) of transmitter drive current, and it was intended from the outset that this circuit would be battery powered.

Another factor in this choice was avoidance of the need to encode signals for transmission. Fibre optic and infrared systems usually employ frequency or pulse width modulation, but these involve an extra oscillator which might interfere with sensi-

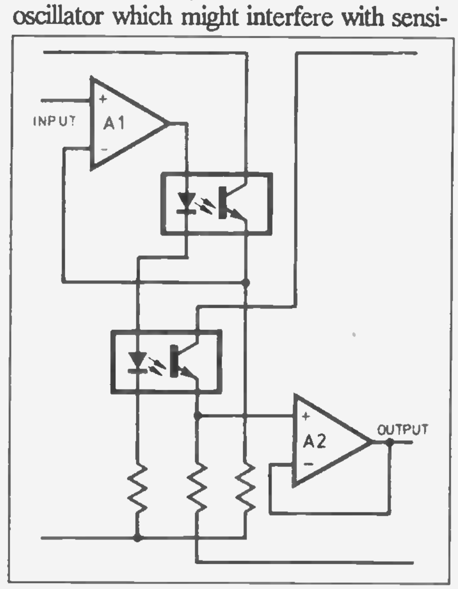


Fig. 1. Simplified representation of the optolink circuit stage.

tive biofeedback circuitry. Although optoisolators are not totally linear, the problem is quite easily overcome, as will be seen.

A simplified version of the circuit appears in Fig. 1. The input is applied to one side of amplifier A1. The output from this amplifier is routed through the input LEDs of two similar opto isolators in series, so that both receive exactly the same current, and feedback taken from the output of one of them is fed back to A1. This enables the amplifier to compensate for most errors in the isolator response, so both of the isolator outputs should be accurate copies of the input. The signal from the second isolator is buffered by A2.

Circuit Description

Of course, it's not quite that simple, as a glance at the full circuit diagram (Fig. 2) of the Isolink will show. To begin with, the input may be alternating voltage. There must therefore be a quiescent current in the isolators which can both rise and fall, and the input and output "grounds" must be placed somewhere between the supply rails. IC1b with resistors R3 and R4 set the input ground to about 1V.

Stability caused a few design headaches. There seems to be a brief delay between the application of a signal to an isolator input and its appearance at the output, possible due to charge storage in the transistor. At any rate, if the transistor is the sole source of feedback the circuit bursts into uncontrollable oscillation, so much HF feedback is provided from the input side through capacitor C1.

As it is taken after the LEDs, at least their errors will be compensated for. Low frequency and DC feedback is derived entirely from an isolator output, so the performance here is excellent and even temperature-induced drift is mostly cancelled out.

The isolator type specified for this project has a stated transfer ratio of 100%, meaning that for each milliamp of input a milliamp should be conducted by the output transistor. In practice there is a fair degree of variation between individual devices, so preset adjustment is necessary to compensate for this.

Starting with the high frequency compensation, if the ratio between the two feedback paths is adjustable, it is possible to trim the circuit for optimum high frequency response. This is carried out by preset VR1 which varies the ratio between the return resistances from the isolator inputs and the transistor in IC2.

Next, the transfer ratios of the two isolators probably won't be exactly the same, so gain adjustment with preset VR3 sets the correct output level. The "ground" connection on the output side is also offset to permit negative signal swings and, as the DC outputs of the two isolators are unlikely to be exactly the same, preset VR2 gives a small range of compensatory adjustment.

Power Supply

Regulated supplies are essential for both sections of the circuit, these being provided by two 5V 100mA "78" series regulators. As the circuit is battery operated, a warning of impending supply failure on either side is a worthwhile addition.

Two 3130 op amps, IC3 and IC7, compare voltages derived from the battery and the stabilized 5V rails. With the resistor values given, the LEDs will light when the supply voltage has dropped to about 8V.

Note that the 3130's have no compensation capacitors, this being unnecessary in a switching comparator application. Also there are no series limiting resistors in their outputs, as these effectively limit the current to about 8mA anyway.

Construction

Despite the apparent complexity this circuit is quite simple to construct on a small printed circuit board. The component layout and full size copper foil master pattern is shown in Fig. 3. Sockets are recommended for all ICs except regulators IC4 and IC8, as this assist the test procedure. The PCB has been designed to accept 8-pin sockets for the isolators although these are 6- pin devices, the reason being that 6-pin sockets are fairly hard to find. The isolators are fitted at the tops of these, leaving the bottom two holes unused. Do not fit any ICs at this stage as they will be added later whilst setting up.

The LEDs can be connected to leads just long enough for the final installation in the case. Lengths of screened lead can be connected to the input and output points at this stage, long enough to allow easy ac-

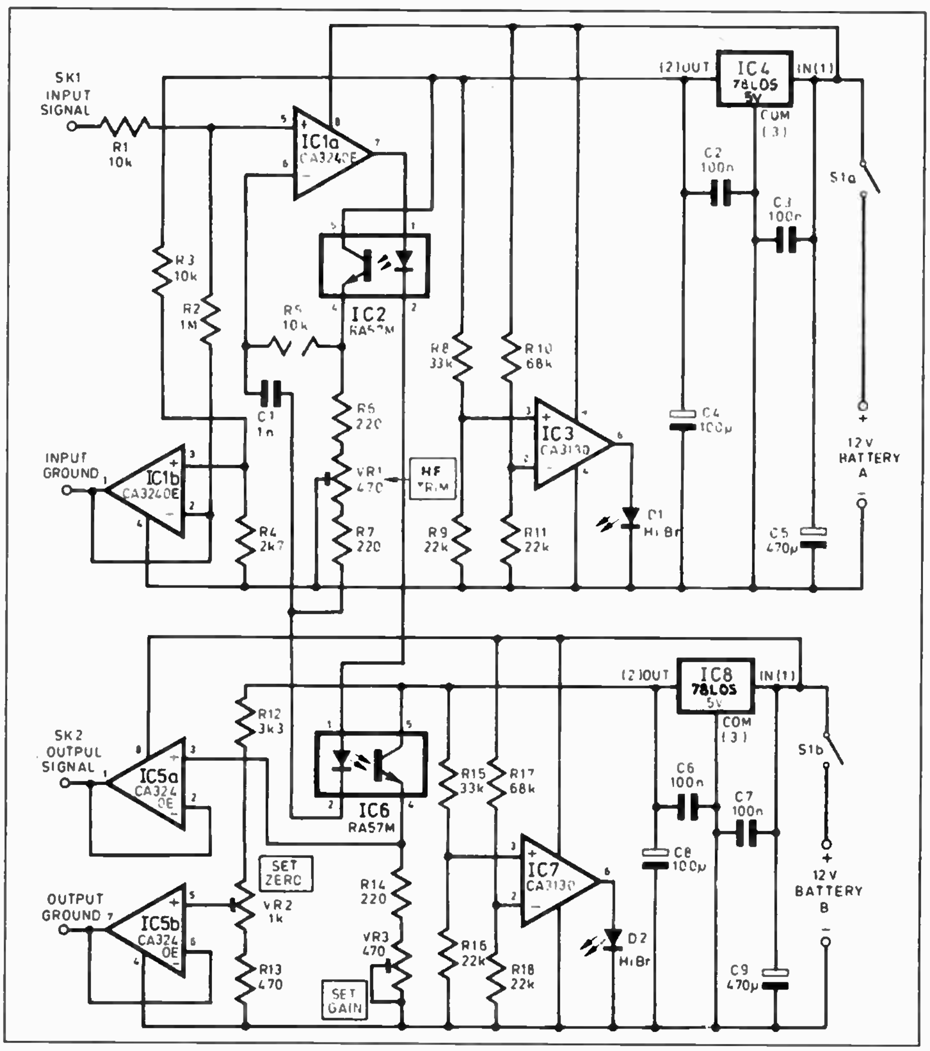


Fig. 2. Complete circuit diagram for the Isolink.

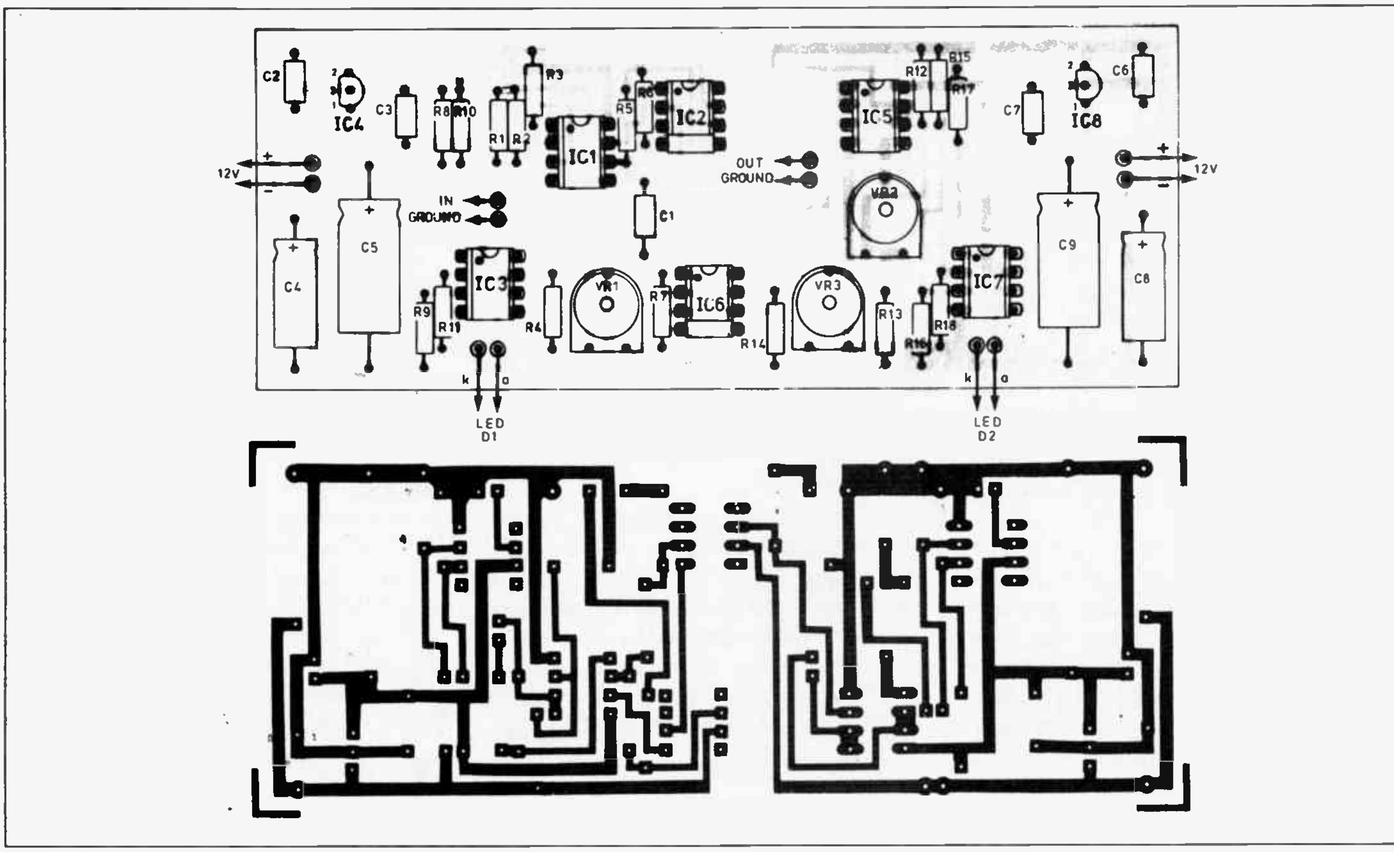


Fig. 3. Component layout and full size printed circuit board copper foil master pattern. Note that 8-pin IC holders have been used for the isolator chips IC2 and IC6. The ICs should be plugged into the top section of the holders as indicated.

cess for testing. They can be cut short for termination to the sockets when the project is completed.

The "low supply voltage" indication is optional, by the way; if it is not required then the two 3130's (IC3/IC7) and their eight associated resistors may be omitted.

Resistor R2 provides a DC path to "ground" for the input so that when this is open circuit the output is zero. About one megohm is a reasonable choice of input resistance but it can be higher, lower or even omitted altogether if required.

Setting Up

Setting up requires the use of an oscilloscope, as this is the only viable way to set up the HF trimmer preset VR1. As this is essentially a project intended for use with a scope this should not pose problems to most constructors.

Before starting, set all three preset trimmers to midposition. Power the "in" side of the circuit with a voltage between 9V and 12V and check that the 5V regulated supply appears across the capacitor C4.

The current drain at this stage should be about 4mA. If this is correct, fit IC3, a 3130. If the supply voltage is now gradually reduced, the LED (D1) should light at around 8V. This process should be repeated for the "out" side of the circuit.

When the power supplies have been checked for both sections, testing of the signal processing areas can proceed. Fit IC1, the "input" 3240, and both optoisolators, IC2 and IC6 (at the tops of the sockets, as described above).

Power the "in" side and check the current taken, which should not be about 16mA. The input "ground" should be about 1V positive of the negative supply rail, and pin 4 of IC2 should also be at about 1V.

If this seems correct, fit the other 3240, IC5, to the "out" side, power up and check current drain, again about 16mA, and measure the output "ground", which should be adjustable from about 0.5V to 1.75V (with respect to negative supply) with preset VR2.

If all seems well at this stage, it's probably a good idea to test the complete board and try setting it up before installation. The procedure is to power both sides, apply a 1V peak-to-peak squarewave to the input, and observe the output on a scope. To avoid problems it is best to have both sections of the circuit operating from independent battery supplies at this stage to avoid problems if the "grounds" become connected through the scope and signal generator.

Preset VR1 is adjusted for best squarewave output; on one side there will be marked overshoot on the leading edges, on the other excessive rounding in both directions. This can be done at 1kHz, though the effect is easier to see at 10kHz.

Next, with frequency set to 1kHz, preset VR3 is adjusted for an output amplitude exactly equal to the input. Finally, with the signal removed, preset VR2 should be adjusted to remove any DC potential across the output.

As there is a fair degree of tolerance spread between individual optoisolators it may be worth swapping them over and setting up again to see which arrangement gives the best performance. This applies especially if VR1 or VR3 is near the end of its range when the settings appear correct. Experiments with four different isolators in the prototype produced overall frequency responses ranging from 10kHz to nearly 30kHz, so the benefit of some patient experiment is obviously worthwhile.

Interwiring

Most of the space is taken up by the battery packs. Batteries are a matter for the individual constructor; the circuit *will* operate from 9V, and indeed two 9V batteries could be used. However, as it is intended as a design tool it may be used for fairly long periods so the additional life given by packs of AA cells seems advisable.

The maximum signal amplitude that can be handled depends on the supply voltage and the characteristics of the optocouplers, and in the worst case a 1V RMS signal will start clipping when the supply falls to 8V. In view of this 12V supplies were fitted to the prototype with indication of impending failure at 8V.

Packing this lot into the specified case is something of a shoehorn job. The PCB is attached inside the top with double-sided tape, and the sockets, LEDs and switch S1 fit alongside it.

This leaves just sufficient space for the two battery packs. A piece of foam plastic topped with stiff cardboard is placed between the board and batteries.

A larger case could be used, the only rule being that it *must* be a plastic type, both for safety and to minimize stray capacitance between the two sections of the circuit. A larger case would allow the inclusion of extras such as switched input attenuation, which might be preferred by some users.

A final check of the adjustments should be carried out after completion. If the unit is to be used for safety isolation, a check with a "Megger" between input and output "grounds" is advisable to ensure the insulation is sound.

The Isolink is designed to handle signals up to about 1V peak-to- peak. The lower limit is governed by the inherent circuit noise, which is less than 5mV. The input impedance is about one Megohm, whilst the output impedance is low, a couple of hundred ohms.

The frequency range extends from DC to at least 10kHz, on the prototype it is around 30kHz. This means that most audio frequency signals will pass through it virtually undistorted, and squarewaves will still look reasonably square at 1kHz.

If it is required to handle larger signals a simple resistive attenuator can be used. The input is protected to some extent by the 10k resistor R1 and the internal protection diodes of IC1, but external diode protection is not provided as it was found that this caused some signal degradation. Suitable precautions should be taken to avoid possible overload where this might occur.

In Use

The way in which Isolink should be used depends upon the actual application. The most obvious use is investigating signals in circuitry at potentials other than ground.

The optoisolators specified are quoted as "High Voltage", this being specified as 7500V peak, 5300V RMS. While it might be inadvisable to operate at this sort of voltage, it is quite in order to, for example, insert a low value resistor in the live lead of an AC appliance and, through Isolink, inspect the voltage developed across it with an grounded oscilloscope.

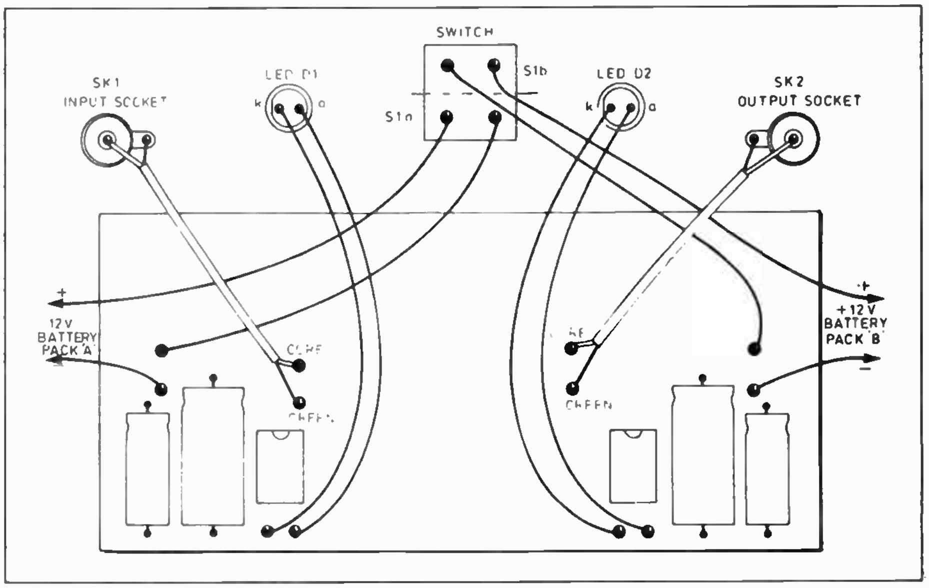


Fig. 4. Interwiring from the circuit board to the switch, LEDs and sockets mounted on one side of the plastic case.

This will give an indication of the current flow. Similarly, low voltage signals in sections of high voltage circuitry could be measured. *Always be very sure you know what you are doing and check connections carefully before switching on* with this kind of work, though.

At a lower level, it can be used to take measurements across points that could otherwise be hard to access as neither end is grounded, and connecting them to ground through, say, the ground side of a scope would cause faulty operation or damage.

In the case of sensitive battery operated equipment, grounding of any point of the circuit will often introduce a high level of mains hum, making test measurements with mains-powered equipment difficult or even impossible. Biofeedback circuits are a classic example of this.

The stray capacitance between the two sections of the prototype was measured with a bridge and found to be in the region of 10pF, which will offer an impedance of more than 300M to 60Hz signals. This should greatly attenuate the hum problem, but the actual manner in which the Isolink is used should be considered carefully in such an application. If you are measuring a signal from your own body, for example, it would be better to place the isolator on your lap than on the workbench close to mains powered equipment, where it might pick up a lot of hum in the input circuit through capacitive coupling. ■

PARTS LIST

Resistors

R1,3,5	10k
R2	1M
R4	2k7
R6,7,14	220
R8,15	33k
R9,11,16,18	22k
R10,17	68k
R12	3k3
R13	470

All 1% metal film

Potentiometers

VR1,3 470 submin horiz. preset
VR2, 1k submin. horiz. trim

Capacitors

C1	1n
C6,7	100n
C4,8	100u axial elec. 10V
C5,9	470u axial elec. 25V

Semiconductors

D1,2	LED red
IC1,5	CA3240E dual op amp
IC2,6	High-sensitivity, high voltage optoisolator, 4N35 or equivalent
IC3,7	CA3130 op amp
IC4,8	78L05 5V 100mA positive voltage regulator

Miscellaneous

S1	DPST toggle switch
SK1,2	chassis phono sockets

Case, 150 x 80 x 50mm; PCB; 8-pin DIP sockets; 12V battery holders (for 8 AA cells each); interconnecting wire, solder, etc.

SUPERDISK SOFTWARE FOR THE PC

SUPERDISK 1

EBL This is the latest version of the Extended Batch Language, an easy-to-use program that lets you customize hard disk and floppy disk systems for less experienced users. Create custom menus and make your system idiot-proof — without the need for a complicated DOS shell program.

TIRED You may want to save this one for April 1st. Sneak it into a friend's BATCH file, or run it from DOS (while your friend is at the coffee urn). Spectacular, but harmless results.

BREAKON Ever need to exit from a program in a hurry? Or do you get frustrated when your computer hangs up because of a software problem. You could press the RESET button, or try running BREAKON. This little beauty works with many popular programs.

PKARC If you want to keep archive copies of important, but rarely needed data files or programs, an archiving program is an inexpensive alternative to buying more floppy disks. Archive files with PKARC and extract them with PKXARC. These utilities are fast, accurate and they'll help save on disks.

DSIZ DSIZ is a utility that will provide information on the size of the various directories on a hard disk system.

CONVER An-easy-to-use unit conversion utility. This provides imperial, metric and U.S. conversions for all common units of measurement — and many uncommon ones as well. Provides well over 200 conversions.

CUTE TIME Friendlier than a clock program, but not as accurate, running QT gives on an English approximation of the time. "It's about half past two", for example.

DRAIN Another April Fool's program. Run DRAIN to remove the water from your disk drive. Keep 'em rolling in the aisles.

XEQ This utility is designed to let you manage those small but useful programs that tend to clutter up disks. Files can be added, removed and run from XEQ.

ORDER Use ORDER to change the order in which files appear in the directory on your disks. This utility will create order out of chaos in large directories. Great for hard disks.

TSR For SideKick, ProKey and SuperKey users — or anyone who uses co-resident software. This utility lets you remove co-resident programs (such as those mentioned above) from memory — without rebooting your computer!

SUPERDISK 2

BLOCKADE Play with up to two human and five computer players. This territorial game will generate hours of excitement. This version lets you select a number of game parameters such as strategy and speed. Win by blocking the paths of your opponents in order to gain territory.

DALEKS A game of skill and logic based on the Dr. Who television series. Use your talents to rid the universe of the dreaded Daleks.

RLOGIC Save the world from nuclear annihilation. This one is trickier than you might expect.

CAVERNS OF GINK A strange name for a strange game. Explore the Caverns and see what you'll find.

LETFALL A great way to learn touch typing and have fun too. This one lets you work on tricky key combinations and reports on your progress.

WIMPS Maneuver your spaceship and blast away at marauding wimps. A great zero gravity simulation.

FLIGHTMARE As an Omegan jet fighter ace, your job is to protect your factories from dessert hordes.

PYRAMID Hop on each triangle in the pyramid and score points, but watch out for the snakes!

HI Just run Hi from DOS or from within a BATCH file and be prepared for a daily dose of inspired wit and wisdom. From Confucius to Murphy, this program has it all.

SUPERDISK 3

DSCAR This is the "dBase Source Code Analyzer and Reporter", a utility that lets you pretty up and document your dBase programs. This program is very flexible in analyzing your files. You can even edit the reserved word list so that it will work with future updates of dBase III as well as with dBase compilers such as Nantucket's Clipper.

SET COLOUR A simple, but well written routine that can be called from within any dBase program. This one lets you install screen colours.

DB-CHECK Check the logical flow of your dBase programs and have this handy utility indent your programs so that they are more easily read and debugged. This one is fast!

FLOW A quick program flow checker that matches up DO's and END-DO's, IF's and ENDIF's and DO CASE's and ENDCASE's. It makes those hard to find errors easy to find.

DB3TOPAS Not an everyday utility, DB3TOPAS creates Turbo Pascal routines that can access dBase III files.

LBARGEN This is a simple dBase III Light Bar menu generator. Just enter the options for your application and LBARGEN will generate a .PRG file, saving you the time and energy required to do it yourself.

DL1B This is a shareware Clipper library which can be linked with any Clipper program. There are all sorts of great routines in this one — everything from screen handling functions to financial formulae and a phone dialer for modem users. A powerful addition for all dBase/Clipper programmers.

BEEPER Another Clipper utility. Assemble with MASM and link BEEPER with any Clipper program and you'll gain control over the PC's speaker. Alter pitch and duration and add sound to your programs.

HELP There are many good books on how to use dBASE III, but these 7 text files provide dozens of "power user" tips that are often overlooked. These files contain a host of information on using dBase with Lotus 123, backing up large data files, printing, indexing and generating labels. Just use the DOS TYPE command or any ASCII word processor to read the files.

SUPERDISK 4

TREND is an easy-to-use program that lets you make projections based on past historical data which the use enters. The program can display both line and bar-graphs.

EE2 is a handy "Environment Editor" that lets you make quick changes to DOS PATH and SET commands. The few simple commands needed to run this utility are explained in a small help screen. Requires DOS 3.1 or higher.

PCSTYLE A public domain program which tests your prose and provides a quick test for readability. While not a substitute for a competent English teacher, PCSTYLE can help you improve your writing style by providing statistics on word and sentence length, percentage of action verbs, etc.

PLANIT is an interesting appointment reminder program. By keeping all of your important dates in a text file (created with your word processor), PLANIT will check the file and tell you if you have any important engagements. A host of options enable you to set up messages which repeat weekly, monthly and yearly. It even warns you of important dates before they arrive!

CPU2 is a speed checker/benchmark program. It measures the speed of your IBM PC compatible system against a standard IBM XT configuration. The assembly language source code is included, so you can see how it's done.

EXPENDIT is good expenditure tracking program. Designed primarily for personal use, EXPENDIT lets you set up various categories for your monthly expenses to help you see where all the money goes. A variety of printed reports can also be generated.

MAKEREAD is a simple, and somewhat strange utility that converts text files into programs. When one of these programs is run, it prints the text contained in it on your screen. An odd program, but it could be useful for generating help short messages for inexperienced users.

REMINDER is a good on-screen clock/reminder utility. Press ALT-R to see the time. You can also enter daily appointments and REMINDER will chime when the time is at hand.

FORTUNE is a complete text simulation of one of TV's most popular game shows. All that's missing is Vanna and the commercials.

FIRE is a great little game which simulates a forest fire. You devise complex strategies using water bombers, etc. in order to quench the flames.

BLORTII is a fast-paced colour graphics game. You have to be quick with this one!

SUPERDISK 5

DR.COM Need to look at a file, or copy it - fast! Call the DR! DR.COM is a small assembly language program that lets you quickly call up the files in a directory. You can display files in order by name, date or size. Files can be viewed, copied, renamed, or deleted with a little help from the DR.

SIMCGA is the newest version of an indispensable utility for users with Hercules-type graphics cards. This one lets you flip back and forth between Hercules and Colour Graphics programs with two tiny utilities which can be run from DOS or Batch files. Yes, you can run CGA games with your Hercules card!

DATASCAN is a shareware

ORDER YOUR SUPERDISKS AT $19.95 EACH FROM MOORSHEAD PUBLICATIONS, 1

ADD $1 FOR SHIPPING & HANDLING. VISA, MASTERCARD AND AMERICAN EXPRESS

SUPERDISK Software has been carefully collected from Public Access Bulletin Boards across Canada and the United States. All programs are b
It is believed to be safe and compatible with all IBM PC/XT/AT and compatible computers. We cannot

FROM MOORSHEAD PUBLICATIONS

program which is designed to give scientists, statisticians and business users a quick overview of the relationships between the variables in their data. When you load a data file, DATASCAN plots an array of small scatter-graphs, showing the various relationships of up to nine variables. The user can "zoom in" on any graph for more detailed information. You can extract a variety of statistical information such as correla-

tion coefficients, and plot linear regression lines. DATASCAN is not intended to replace any of the more powerful statistical programs such as SAS, but it is powerful enough to enable you to detect statistical correlations within your data. This will pace the way for more indepth study. Requires a Colour Graphics Display. DATASCAN also works with EGA displays and Hercules compatible graphics cards using the SIMCGA utility included on this disk. Graphs can be printed on most dot-matrix printers if GRAPHICS.COM or replace graphics driver has been loaded. DATASCAN works with Lotus 1-2-3 .PRN files, or you can enter data direct.

ZENCALC is a small but powerful spreadsheet program which performs many of the mathematical operations available with commercial spreadsheets. Extensive on-line help is available by pressing the "?" key. ZENCALC is perfect for fast number-crunching.

PC-FLOW Flowcharting as a planning tool is often under used, simply because the use of templates can be very tedious. PC-FLOW is a flow chart designing program which makes flowcharting easy and fast. PC-FLOW lets you manipulate a variety of symbols and lines using either a mouse or the keyboard. Requires a color graphics card. A special file has been included that will let you PC-FLOW with a Mouse Systems Mouse.

SUPERDISK 6

YAHTZEE This is a great version of a classic game. Pit your wits against several other players, including the computer. Keeps track of high scores and has a good on-line help screen.

MAROONED — High adventure in space. Your ship has crashed on an alien planet and you must escape.

BLACKJACK — Lots of excitement and nothing to lose, this game plays a strong, but honest hand. Learn the strategy behind this diversion.

MAYAKDM2 is an enlightening text (with ASCII graphics) adventure game. You need a creative soul and a searching intelligence to escape the materialistic — and deadly — Mayan Kingdom. But greater and more meaningful pleasures can be yours if you can cross the ocean to freedom.

3DTICTAC Just like the name says, this is a 3- dimensional Tic-Tac-Toe game. And a mean game it is too! Just you and your computer in an all out battle of wits.

ICBM Save a city from nuclear annihilation. Blast those ICBM's before they blast you. Requires a colour graphics (CGA) card or equivalent.

CRSWRD is nice little program which lets you create your own crossword puzzles. It lets you enter words and clues, edit them, save them — and print them.

ROBOT is a clever game of strategy in which you maneuver a small creature around the computer screen. A number of robots will try to attack you. If the converge on you, the game ends. With careful maneuvering, you can cause the robots to destroy each other. There is also a teleport key — just to add a little more excitement.

SUPERDISK 7

ASTRO is an astronomy simulation program which graphically demonstrates planetary motion around the sun. It also performs a number of calculations such as lunar phases, sunrise and sunset times. Requires an EGA display.

TOFHANOI This is a nice implementation of a classic logic problem. The object of the game is tomove a tower of disks from one platform to another. But you can't place larger disks on top of smaller disks. Requires an EGA display and a logical mind.

TICK is a classic Space Invaders-type game - with a frightening twist. Maneuver a tank at the bottom of your screen and try to eliminate the giant bugs that are trying to get you. Just to keep things interesting, you can also take aim at the occasional rat. Requires a CGA display and fast reflexes.

SOPWITH2 lets you battle the Red Baron in a vintage World War I airplane. The program has realistic flight simulation - it will even stall and crash if you fly too high or too slowly. Requires a CGA display.

GOMOKU is an easy game to play, but a difficult game to win. Enter coordinates from the keyboard to place an X on the screen and try to place 5 Xs in a row. The computer will try to stop you - and you must use your wits to keep the computer from winning.

FOOTBALL is an nice NFL football simulation. It is very complete, allows you to choose any two teams you like and even includes details such as a coin toss to see which side kicks off. Choose each play from a huge "play book" and "make one for the Gipper".

HIQ is brilliant computerized version of a classic peg-jumping game. On a cross-shaped board you try to eliminate all of the "checker pieces" by jumping over them. The object is to clear all but one piece from the board. No special hardware requirements.

KILLER is a well-executed graphics-game that lets you shoot down the "killer bees". Requires a CGA display.

SUPERDISK 8

HAVE is a nice little system information utility that will provide you with information such as the number of installed serial ports, parallel ports, type of graphics adapter, number of floppy and hard drives and amount of memory. HAVE even draws a picture of your computer with extended ASCII characters, complete with printer, monitor and keyboard. Its a nice touch.

HANDLES is a small utility that shows you how many files DOS will allow open at the same time. The assembly source code is included to in case you want to see how it is run.

WCD is a nice little program that calculates flying times between world cities. Select any two international airports and you get a display showing their longitudes and latitudes and an estimated flying time. Distances in Miles and Kilometres are also shown. Handy for frequent flyers.

HLPURSLF is a resident help screen system. A series of HLP and MNU files are included to help you set up your own custom Help system. A great way to help new users learn about their computers.

UNIX has absolutely nothing to do with the operating system of the same name. This UNIX is a fast and furious pinball game. It does a great simulation of the real thing. Saves on quarters too.

VDE is a small full-screen text editor that could make a great programming editor. It's also good for "quick and dirty" text editing for BATCH files, etc. It only needs 11K of RAM, but it still boasts WordStar compatible commands and comes with an installation program to it can be customized for your own needs.

EP is a PATH editor which lets you quickly add or remove paths from your PATH statement. Small and fast, EP's program screen incorporates a complete list of editing commands to make altering you PATH statement quick and easy.

TAO is, well TAO just is, that's all. Based on the TAO of Programming, this program displays a random gem of wisdom from the Master Programmer every time you run it. More food for your AUTOEXEC file.

SUPERDISK 9

TAX87ONT is a comprehensive Lotus worksheet (version 1.X) for Ontario tax returns (unfortunately, we could not locate a similar worksheet for other provinces). TAX87ONT is an elegant worksheet which even includes all tax schedules. A split screen window lets you see whether you owe tax or vice versa. It's simple and easy to use.

BANKRUPT is a good worksheet for investors and potential investors. It lets you calculate the likelihood of a publicly traded corporation going bankrupt using "The Bankruptcy Predictor Formula", a formula was devised by Edward I. Altman, a financial economist at New York University's Graduate School of Business.

LOTUSX is proof that computers have been taken over by practical jokers. Run LOTUSX and an innocent looking worksheet is displayed. Press any key and the worksheet will actually "crumble" before your eyes! Slip it into a colleagues AUTOEXEC.BAT file.

HANGMAN is a competent version of the Hangman word game written as a 1-2-3 worksheet! It comes complete with simple ASCII graphics.

OIL is a simple worksheet which forecasts oil prices from a number of historical factors.

123LEARN is a menu-driven macro creation worksheet. Using Version 2.00 or higher, you can use 123LEARN to record keystrokes in order to create complex macros.

CHKBKC2 is a personal finance management worksheet which lets you balance monthly income and expenditures. You can even customize it to suit your specific needs.

TMPDOOM is a series of mystery adventure games created as a series of 1-2-3 worksheets. Because of the medium, TMPDOOM is not as extensive as most dedicated, commercial adventure games, but it is fun! Solve the mysteries by using your skill with Lotus commands. A great teaching tool.

,DON MILLS ROAD, NORTH YORK, ONTARIO M3B 3M8 (416)445-5600 FAX:416-445-8149.

DERS WELCOMED. ONTARIO RESIDENTS, PLEASE ADD 8% PROVINCIAL SALES TAX.

to be in the Public Domain. This software has been tried on a variety of computers, including XT's and AT's with and without hard disks.
ee that each program will work on every PC. SUPERDISKs can be exchanged for a full refund if you are not satisfied.

Automotive Test Equipment

What today's sophisticated analyzers can do.

RON C. JOHNSON, C.E.T.

Picture yourself driving your 1989 Corvette through an automated car wash when suddenly a short in the electrical system creates a blinding flash. An arc jumps from an electrical box to the body of your car. You are temporarily stunned. Blinking, you open your eyes to find yourself in a dingy garage. Through the windshield a greasy mechanic looks up from the Model T coupe he is repairing and his jaw drops. On the wall across the room the everpresent 'girl-in-a-bathing-suit-calendar' testifies that you are in 1927.

"I don't think we're in Kansas anymore, Toto."

As the mechanic pulls himself together and heads your way, your first thought is to get out of there. You reach for the key and turn it. Nothing. A light on the dash indicates 'Check engine'. What does it mean?

"What the tarnation is that?" A greasy hand leaves prints on the paint. He sticks his face up to your window.

"My new car, but it won't start. Do you think you can help me?"

"Wul, I ain't never seen one like that, but let's take a look under the hood."

You pop the catch and open the hood. Your automotive technician's eyes bulge. The corner of his mouth twitches. He grips a pair pliers in one hand and a crescent wrench in the other. Taking a deep breath he reaches under the hood. "Well, let's see what we have here..."

You say: "I don't have to travel back in time to run into that situation, I met that guy last week down at the dealership."

Unfortunately this is all too often the case, but that situation is changing. In the face of the burgeoning use of electronics both inside the car, and the service shop, the mechanic who is becoming an automotive technician has the edge. Given the competitive nature of the job market and the automotive service industry in general, investing in the most efficient tools, both human and machine, becomes a necessity of survival. The shop with an automotive analyzer and technicians competent in using it is the one likely to succeed.

"Well, what is an automotive analyzer? And what can it do that I can't do with my Canadian Tire timing light and a new set of spark plugs?"

The following is an overview of the equipment currently used for engine analysis as well as a description of the parameters measured.

Analyzer Basics

The latest analyzers being offered on the market all do basically the same functions using the same raw data, regardless of the manufacturer. Some boast that they have developed new techniques of doing those functions, which gives them the edge in speed, accuracy or efficiency, but overall they try to determine whether the engine is operating properly in a number of different areas. The manual scope can provide the same measurements and displays but the interpretation of the data is up to the technician. In the case of the computerized analyzer the machine prompts the technician to follow certain steps to provide the analyzer information from the engine. As the procedure progresses the analyzer makes decisions to zero in on problems and at the end will inform the technician of the condition of the engine and where possible problem areas may exist. It also makes recommendations for possible repairs or adjustments.

The signals measured and displayed are: battery voltage, current, coil primary, No. 1 cylinder sync, coil secondary, vacuum, exhaust gas concentrations and on-board computer data. These signals can be displayed as oscilloscope waveforms in various configurations or in digital or graphic forms. Oscilloscope patterns will either be displayed in real time or as reconstructed facsimiles from memory. Vehicle specifications are stored in computer memory and can be recalled for comparison. Also, the computer can do performance analysis against other parameters of the same vehicle. (For instance, comparing the efficiency of one cylinder to another.) Some manufacturers even claim a degree of artificial intelligence due to the computer's ability to make diagnostic decisions based on data acquired. Given a certain set of conditions the computer will branch into a different or more intensive set of program steps to further narrow the problem. Problem areas reported by the owner can be entered before testing which will also narrow and direct the analysis.

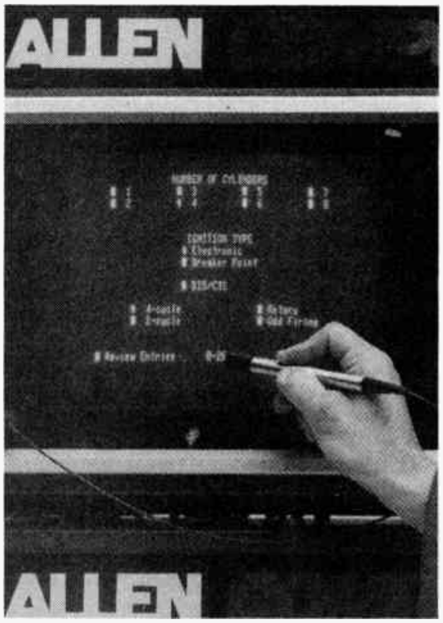
For the smaller automotive shop, or in some cases where all the bells and whistles of the automatic analyzer are not needed, manual scopes are often used. Despite their manual functions and lack of diagnostics, microprocessor technology still plays a major part in their operation. Total on-screen information displays sharing space with analog pattern information do away with the older analog meter movements. With a manual scope the onus is on the technician to make the diagnosis by observing the information available.

"And what is that information?" Let's take a look at what the vehicle can tell us.

Electrical

Battery Voltage: Sounds simple, and it is. But you can learn more from measuring the voltage under specific conditions than first meets the eye. For example, during cranking how quickly does the voltage drop? How quickly does it recover after the engine starts? Does it return to its former voltage? Higher? Lower?

Battery Current: This is usually measured using a Hall Effect type clamp on current probe. Its value in conjunction with the voltage tests is fairly obvious but this input can also give a signal to the oscilloscope screen to monitor the waveform created by the alternator diodes. The same signal can be used as a RPM signal during cranking. Instantaneous current readings sampled during the compression cycle of any cylinder during cranking give a good comparative indication of the compression of that cylinder.



Coil Primary: The Primary side of the coil has the signal obtained from the points, or in the case of most newer cars, the electronic ignition module. From this signal we derive RPM, DWELL and a signal for the scope display. By shorting the coil primary to ground we can inhibit the engine from starting while we check the battery output. Using a bit of digital logic and some additional signals we can, repetitively short the coil to ground only during the time a specific cylinder is to be fired. The decrease in RPM then gives an indication of how much power that cylinder was contributing to the engine. Hence, the functional description: cylinder balance.

No. 1 Cylinder: This is a pulse obtained from the spark plug wire connected to the No. 1 plug. It is obtained by a clip on inductive pickup using a small number of windings around U shaped ferrite core. When the clamp closes, around the spark plug wire, a straight core completes the U and a pulse is induced into the coil everytime the plug fires. This is the sync pulse for the whole system and is used for cylinder balance, timing and sometimes RPM.

Secondary: The coil secondary produces spikes in the order of 30KV. To obtain this signal usually a clamp on capacitive pickup is used. The signal is used for display on the scope and can provide RPM and DWELL when necessary. Observing this signal on screen can tell much about the condition of spark plugs, wires and the coil.

Vacuum

On the newer analyzers a small hose is attached to the vacuum line going to the carburator. A transducer converts the signal to a usable voltage signal. In conjunction with other information this can help diagnose carburation problems.

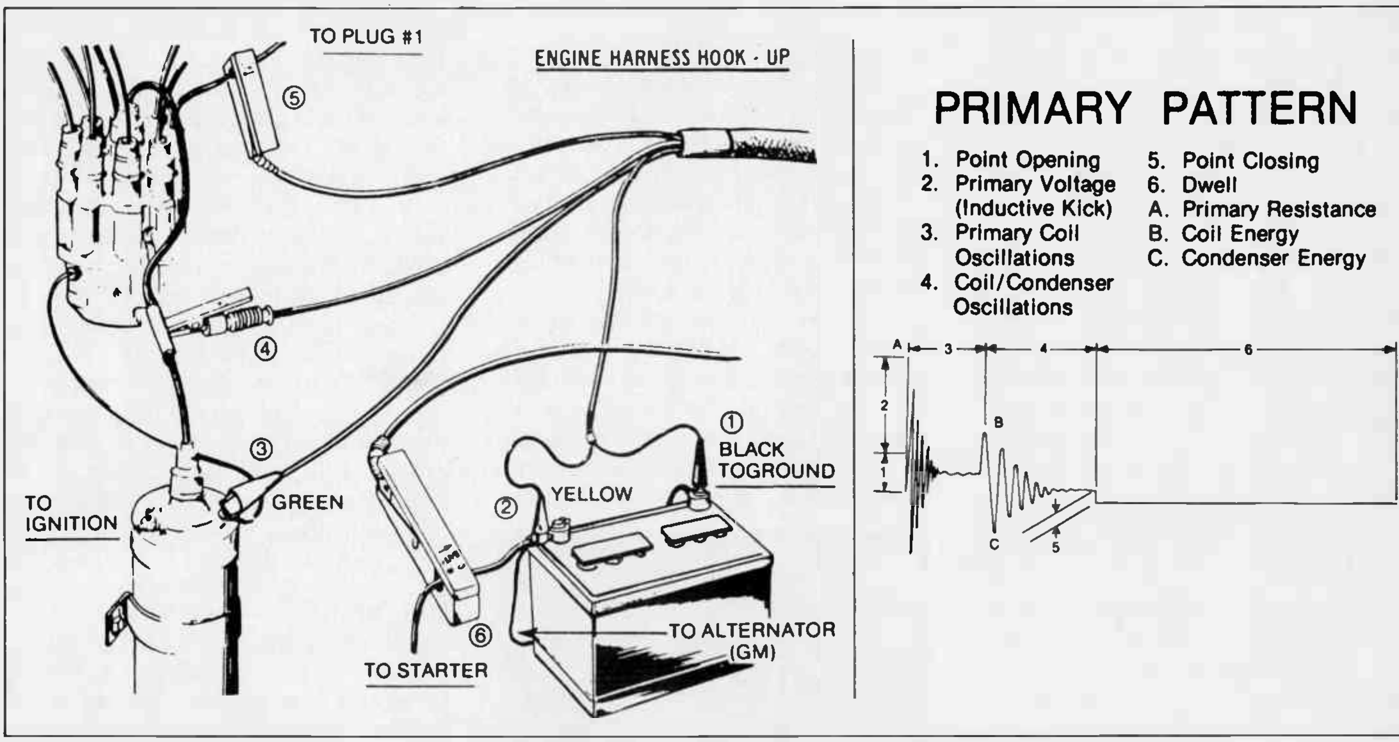
Timing: A measurement of the timing and the subsequent adjustment is very important in maximizing performance. We are all familiar with the standard xenon timing light used for this task but the automotive scope adds a couple of refinements which can be helpful. By adding an adjustment pot on the timing light and an indication on the scope (plus the necessary circuitry) the flash can be delayed by a known offset from the No. 1 sync pulse. In doing so we can bring the timing mark precisely to Top Dead Centre and read the offset displayed on the scope. Another refinement dispenses with the timing light completely by utilizing a magnetic probe pickup which is placed in a slot against the timing pulley. A gap in the pulley induces a pulse into the pickup.

The timing can be determined by comparing this pulse to the No. 1 sync pulse.

Volt/Ohm Lead: Most scopes, whether manual or automatic have a set of leads used for low level voltmeter and ohmeter measurements. On some these same leads are used as general purpose scope input leads.

Computer Interface

Almost every automobile manufacturer is using some kind of an on-board computer system. And they are all different. And every year they all come out with a few new and different systems on their vehicles. This keeps the R&D boys at the



The basic hookup of the ignition analyzer, and the CRT display showing some of the many parameters that can be checked.

scope manufacturers hustling to keep up the demand for the latest interface electronics, cables and software needed for diagnosis. Thus, computer analyzers generally come equipped with an assortment of cables and interface boxes which connect the vehicle to the analyzer.

One of the great things about connecting up to the on-board computer is that, unlike most of the less expensive handheld devises available, all the information can be displayed on screen at once. In addition, a data recorder can dump information obtained during a road test onto the screen for close examination. The on-board computer screen shows information such as fault codes indicating problems picked up by the computer. It also displays coolant temperature, RPM , timing retard/advance, vacuum, manifold absolute pressure, oxygen sensor output, and much more. These are inputs and outputs from the computer which control such things as the air to fuel mixture and whether the engine is running in closed loop mode. There is much more which can be said on the subject however, an in-depth examination of on- board computer data is beyond the scope of this article.

Exhaust

The components of the exhaust gas issued from the engine can provide a wealth of information used in engine diagnosis. The exhaust gas analyzer, usually a separate unit which interfaces with the main analyzer's computer, samples the exhaust through a probe inserted in the exhaust pipe. After the larger particles are filtered out the gas is cooled and water condensed out. The sample is then circulated through chambers which have infrared sources at one end and detectors at the other. Optical filters are used to isolate the wavelength of light blocked by specific gases. This allows the detector to give an indication of the concentration of that particular gas. The gases measured are carbon dioxide, carbon monoxide and hydrocarbon. Oxygen is also measured using electrochemical detectors similar to that used in blood gas analyzers.

Exhaust gas information can give clues to the state of carburation or fuel injection, efficiency of the engine to burn its fuel and even whether the exhaust system has holes in it. Coupling this information with other tests allows for very precise diagnosis of the condition of the engine.

"So now I have all these cables hooked up to the engine of my car, a hose is stuck in the exhaust pipe, and the on-board computer cable is connected. I did everything the computer said to do. It printed out a diagnosis of all the problems I have. What do I do now?"

"Wul, that's obvious. You get out your pliers and your crescent wrench and you fix it, of course!"

Of course. Well, it may not be quite that simple but at least you have gained a wealth of information about the vehicle in a short period of time. Now it is the technician's chance to show his stuff and get that vehicle out the shop door at a profit. And overall that is good for the shop, the technician and for the customer.

Conclusion

Much of the data obtained using an automotive analyzer can be acquired using various handheld and stand-alone pieces of test gear. However, with an analyzer, not only is all the information available in one place, but the diagnostic capabilities of the computer can be put to use. The newest machines can now do an all-systems test on a vehicle in less than five minutes. Even so some of the time spent involves the technician carrying out the instructions given by the analyzer. A piece of equipment which carries out all these functions quickly can be a valuable tool in the market place.

So where does this leave our poor grease monkey with his pliers and crescent wrench? Well, if he wants to stay in the business, it leaves him, at some point, in a classroom learning about the latest technology used in the automotive trade. But that is nothing new; he will be there anyway learning about on-board computers and anti-lock braking systems and so on. As the salesmen say: "An automotive analyzer won't make a poor mechanic good, but it'll make good one money." ■

HIGH TECH PORTFOLIO

Receive instant information on these High-Tech products. Use the enclosed Reader Service Card.

EGAWONDER 800 Any Software. Any Monitor. Any Time

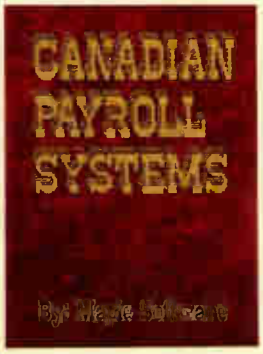
Displaying twice the resolution of EGA, this graphics card displays 800 x 560, 752 x 410 and 640 x 480 high resolution graphics on MultiSync monitors. It offers wide flexibility as it is able to display all of the major software standards, EGA, MDA, CGA and Hercules on any popular monitor types. Supports TTL Monochrome Monitor, RGB Colour Monitor, MultiSync Monitor, Polaroid Palette, Internal Monitor of the Compaq Portable and the Internal Monitor of the IBM PC Portable. Provides 132 column support for Lotus 1-2-3, Symphony, SmarTerm, VTerm, Wordstar, and WordPerfect. The EGAWONDER 800 includes drivers for Lotus 1-2-3, Wordstar, GEM, Ventura Publisher, AutoCAD, Windows, Page Maker and Symphony. It is designed to work with IBM PC/XT/AT, PC Portable, PS/2 Model 30 and 100% compatible personal computers. Supports flicker free scrolling, RF Modulator and Light Pen interfaces. Available from ATI Technologies Inc.

Circle No. 74 on Reader Service Card

OKIDATA Microline 390/391 The Reliable 24-pin Desktop Printer

A 390/391 delivers so much productivity at such a reasonable cost. It's meticulous about text quality on executive documents and graphically detailed for charts. It makes short work of any printing you do with features you'd expect from a higher-priced printer. Features include simple push-button operation, alternative font types, paper park, built-in tractor and is capable of producing high-resolution solid graphics and charts for business presentations. Quick-change ribbon cartridges pop in place easily and the optional single-bin cut-sheet feeder gives you more time for other work during long sheet-fed print runs.
Built to go the distance, the Microline 390/391 is the reliable choice — from Okidata.

Circle No. 75 on Reader Service Card



PAY-CALC (Payroll)
NEW !! IMPROVED !!

Now, at reduced cost, everything you'll ever need in a payroll...Very easy to run...none better.

* Auto Install
* Tutorial
* Prog. tailoring
* Audit trail
* Chq. reconcile
* Empl/Co. History
* Auto year-end
* Full refund policy...
* Menu Driven
* Full manual
* Colour/Mono
* Data backup
* Cheques/stubs
* YTD reports
* Un-posting
* Prints T4's
* And much more

Maple Software Ltd.,
38 Inniswood Drive, Scarborough, Ontario M1R 1E5
Tel: (416) 757-1729

Circle No. 76 on Reader Service Card

PC FRIENDS COMPUTER CLUB
BYTE BACK

- An international non-profit club sharing the knowledge for mutual benefit. (From COM 64 & MACS to large microstations) We especially help beginners.
- Employers are already asking for computer as well as technical experience. Are you prepared? Members train each other FREE
- Member services include the ability to buy hardware and software up to 30% off retail prices. Obtain computer literacy through hands-on assistance, our 100 page newsletter and tutor disks.
- Membership restricted to individuals.
- Mail $25 one year membership to PC Friends

Name: ______
Address: ______
Phone No: ______

c/o Rod St. Jacques
RR #1 Erin, Ont. CAN., N0B 1T0 Tel: (519) 927-5841

Circle No. 77 on Reader Service Card

TOSHIBA PageLaser 12

- Desktop Laser Printer
- 12 pages per minute
- Duty cycle of 25,000 pages/month
- Product life of 600,000 pages: extendable to a full 1.2 million pages with an optional service kiit
- 512K memory upgradable to 2MB
- Feeds up to 750 sheets from 3 bins optional HP Laserjet 500+ emulation standard
- Front panel display and control (16 digit LCD)
- Output jogger/collator optional

Circle No. 78 on Reader Service Card

TOSHIBA T3200

Portable Personal Computer
The desktop computer that is never desk-bound
Full desktop performance with a 12MHz 80286 microprocessor

- Internal IBM - compatible slots
- Internal 40MB hard disk
- Up to 4MB of memory
- Built-in EGA capabilities
- Separate numeric keypad on full size keyboard
- Designed to save valuable work space
- Handle transparencies, labels, envelopes
- New font card technology for additional fonts and emulations.

Circle No: 79 on Reader Service Card

Microsoft

Only One Company Does It All

Intel or Macintosh • English or French • Standalone or Networked
Applications • Languages • Systems • CD-ROM • Books

WORD 4.0
The fastest word processor for IBM® PS/2™, PC and compatibles

- Lightning-fast word processing with professional-looking results
- On-screen formatting, style sheets, the best laser printer support
- Glossaries, Spreadsheet Linking, Macro Recorder, quick edit keys, on-line help, built-in tutorial

EXCEL FOR WINDOWS
The most powerful spreadsheet for powerful personal computers

- Integrated spreadsheet, graphics, database
- Power, speed, professional-looking results
- Designed for 80286/386 systems and Microsoft Windows, the industry standard graphic user environment
- Revolutionary features, such as Dynamic Linking and Dynamic Data Exchange

Circle No. 80 on Reader Service Card

Circle No. 81 on Reader Service Card

TORONTO COMPUTER SYSTEMS- Desktop Publishing Professionals

LASER 286/M

Features a two-year warranty and a forty eight hour turn around time (Freight paid) • Perhaps the fastest and most powerful AT-Compatible ever! • Parallel and serial port • Floppy drive and hard drive controller card • Processing speed al 6MHz or 12MHz, switchable • Optional 80287 mathematic co-processor socket • Real time clock/calendar with on-board battery back-up • Detachable keyboard with 101 keys (separate cursor pad and numeric pad • Eight expansion slots for add-on cards • Optional CGA, HGC or EGA display adapt • Optional high quality TTL display • Two years parts and labor warranty including hard drive • CSA Approved system

2615 Danforth Ave. Ste.9 Toronto, ON
Tel. 698-7161

Circle No. 82 on Reader Service Card

The GENICOM 1040 printer gives you the speed and flexability your business demands — 432 cps at 12 cpi; 360 cps at 10 cpi; or 90 cps letter quality at 10 cpi. The 1040 handles cutsheet and fanfold paper, and with the optional dual bin sheet feeder, even envelopes. If your business requirements include colour, you can choose that as an option too.
the 1040 also provides you with interface and emulation flexability.

Genicom. Ideas that work as hard as you do.

GENICOM CANADA INC.

5170-B Timberlea Blvd., Mississauga, Ont. L4W2S5 Phone: 416-625-0770 Telex: 06-960249
FACSIMILE 416-625-5906

Circle No. 83 on Reader Service Card

Merlin Express Elite Doesn't Cost, It Pays.

Surprisingly, you get all this from a machine that'sno larger than a briefcase. Weighs only 9-1/2 pounds. And is so easy to use that anyone in your office can learn to create professional quality Merlin lettering in minutes, without previous instruction.

Merlin lettering costs far less than commercial typesetting. And you control your job priorities.

Since anyone can operate the Merlin Express Elite system with the same high-quality results, professional staff time is never wasted doing mechanical lettering. You'll utilize all your personnel more efficiently. And spend your time doing what you do best. Building your business.

All your work not only looks better, it costs less to produce. And takes a lot less time.

Circle No. 84 on Reader Service Card

Presenting The Best In Professional Computer Projection

Sharp is proud to introduce the QA-50, the panel which brings overhead projection into the computer age. It can be used as an effective educational and communication tool incorporating state-of-the-art LCD and shading controls. Lightweight, portable, and user-friendly; the QA-50 is easy to set up and operate but requires no special software! Also features super high contrast display, versatility and reliability. Colour graphics and text can be presented in 8 shading patterns. An infrared wireless remote control unit is also included. The QA-50 is designed to work with the IBM PS/2, PC/XT/AT or compatibles.

SHARP QA-50

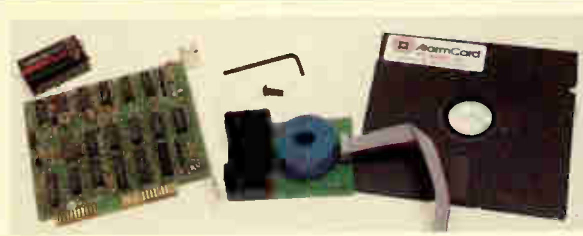
Circle No. 85 on Reader Service Card

The Panther II Telephone System -More Power Than Ever Before

Presenting Panther II — the newest addition to a long line of Trillium Business Telephone Systems. The Panther II has all the features you'd expect and more e.g. call forwarding, line queuing, multiple attendant capability, fax and voice messaging interfaces, smdr, replaceable memory modules enabling cost effective feature upgrades.The Panther II Liquid Crystal Display Set option is the ultimate in telephone technology. In addition to standard, pre-programmed messages, you can create your own personal messages.

Whatever your communications need, Panther II has the flexibility and equipment selection.

Circle No. 86 on Reader Service Card



Alarm Guards Against PC Theft

Rectec Computer Remarketing of Toronto has announced AlarmCard, a user-installable, plug-in board which secretly protects your PC against theft or unauthorized access to data. AlarmCard guards your investment with onboard password protection, and a penetrating 85dB beeper which is activated when the integrity of the system has been breached. Alarm-Card provides on-screen diagnos-tics, complete documentation, a one year warranty and is compatible with all PCs, XTs, ATs and PS/2 models 25 and 30.

Tel. 321-2360

Circle No. 87 on Reader Service Card

CCS

ACCOUNTCHECK

Accountcheck was developed by Xerox Canada for small to medium-sized business. It is a comprehensive proven accounting system that will allow your company to automate its invoicing, receivables, sales analysis, payables, general ledger, and financial statements.

Easy to learn and use. Companion payroll available.Professional support and training nationwide.

Send for our demo disk and let us convince you.

Accountcheck. $975. For PC's. Dealer enquiries invited.

Tel: (416) 864-0982

Circle No. 88 on Reader Service Card

If you are looking for people who want to hear about High-Tech products... we already found them!
For advertising information call (416)445-5600
FAX 416-445-8149

MOORSHEAD PUBLICATIONS
1300 Don Mills Road, North York, Toronto, Ontario M3B 3M8

Circle No. 90 on Reader Service Card

THE SCIENTISTS TELL ME

DAVID P. DEMPSTER

Future Artificial Ear

A small, portable sound processor for a multichannel experimental artificial hearing system that enables the profoundly deaf to understand speech is undergoing clinical testing at the University of Utah. The system, a 13-ounce, battery-powered sound processor, is called the INERAID and is small enough to be worn on a belt. It is connected by a slender cable to six tiny electrodes implanted in the inner ear, and preforms the hearing- related functions that were once generated by a room-sized computer.

Researchers at the U of U Institute of Biomedical Engineering have designed the Ineraid artificial ear in cooperation with Kolff Medical, Inc., a Salt Lake City, Utah, firm that has licensed the Jarvik-7 total artificial heart and the Ineraid artificial ear from the University of Utah. The goal of artificial hearing is to turn the acoustic waveforms of speech into electronic forms, says Dr. Donald K. Eddington, director of the artificial hearing program. The electronics stimulate nonfunctioning nerve fibres and the brain recognizes speech.

Deaf volunteers, who have been tested with the artificial hearing system, recognize approximately 70-80 percent of random, two- syllable word lists without being able to see the speaker. The volunteers carry on essentially normal conversations when they use lip-reading skills.

The artificial hearing system is designed for the thousands of people whose deafness is related to a sensory loss, for example, when microscopic hair cells in the inner ear are destroyed by disease, old age, or exposure to loud sounds or drugs. For the artificial hearing system to work, "nerve pathways from the inner ear to the brain must be at least minimally functional and processing areas within the brain must be intact." Says Eddington.

In normal hearing, sound waves entering the ear travel through the ear canal and wiggle the eardrum, explains Eddington. The mechanical motion of sound is transferred to the spiral-shaped cochlea, or inner ear, by three small connecting bones. Nerve fibres, or hair cells, along the cochlea then selectively "fire," depending on the sound's pitch or frequency.

"High-pitched sounds fire nerve fibres at the front of the cochlea and low-pitched sounds stimulate fibres at the far end," he explains. "Complex sounds, such as speech, generate a complicated pattern of activity over the whole array of nerve fibres. These signals are then transferred through the auditory nerve to the brain, which interprets them as speech."

The experimental, multichannel electronic hearing system has six equally spaced electrodes implanted along an inch of the cochlea. Hair-thin, Teflon-coated platinum wires attached to the electrodes are drawn through a graphite button that crosses the skin just behind the ear.

A tiny microphone picks up incoming sounds. The sound processor then converts these sounds into a pattern of electrical impulses which are transmitted to the electrodes, stimulating specific nerve fibres along the nerve array as intelligible speech, says Eddington.

During the last eight years, the researchers have used a large computer and deaf volunteers to define the multiple functions needed for an effective, portable hearing system. The goal has been to transmit useful information, not simply noise, says Heff Orth, the engineering project manager for the artificial hearing program.

Normal hearing covers a dynamic range of approximately 100 decibels, which is a measure of sound level, says Orth, and normal ears automatically accommodate soft and loud sounds. All incoming sounds for cochlea implant patients are compressed into about six decibels, which the patient controls, so suddenly loud sounds are not uncomfortable.

A useful feature build into the Ineraid artificial ear is a control that adjusts background noise. Loud sounds can be blocked or soft sounds, such as music from a radio, can be amplified.

"If a patient walks in the woods and wants to listen to birds or animal sounds, he can adjust for that quiet environment," says Orth. "But if a hunter should fire a gun nearby, the circuits would dampen the sound automatically so it isn't overbearing."

The opposite is also true. For noisy environments, such as a cafeteria, the patient adjusts the controls to eliminate the background noise to hold a near-normal conversation with a companion.

David Columpus, 52, a vocational counselor for the deaf in San Diego, California, has been a volunteer with the University of Utah hearing program for six years. His hearing was irreparably destroyed approximately 15 years ago. Columpus has used the Ineraid hearing device since April 1983. Preliminary test results, taken only two weeks after he got his portable system, indicate that his speech recognition is excellent. For example, Columpus recognized about 80 per cent of group of unrehearsed words spoken by a person he could not see. When he faced the speaker and could, therefore, use his lip-reading skills, he carried on an essentially normal conversation.

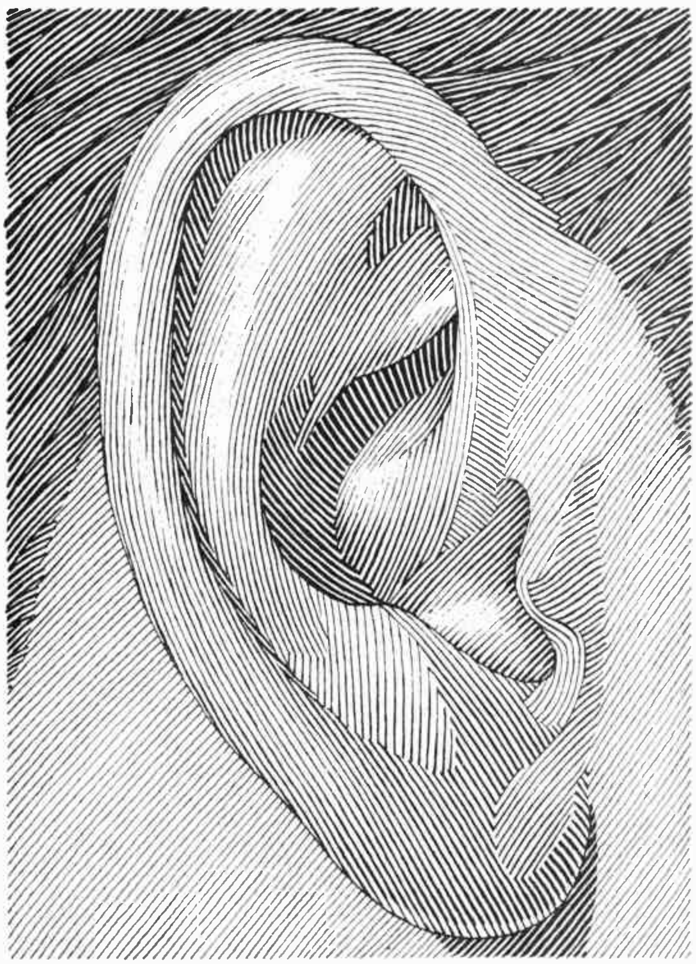
According to Columpus, the sounds he hears are not like the artificial voices generated by some computers. He distinguished between male and female voices, recognized simple tunes, enjoys vocal solos and discerns variations in pitch and tone.

The researchers have begun working on a smaller, lighter, next- generation sound processor. Over the next several years, microcircuit technology will be used to miniaturize the device further so it will weigh only two ounces. A further advance will be to develop a method to transmit the electrical signals through the skin, eliminating the need for the dime-sized button behind the ear.

Eddington is now at Massachusetts Institute of Technology developing computer models of the auditory nerve fibre responses to speech stimuli. The complex signals of speech are intricately encoded on the auditory nerve, he says, and the system will likely be improved once it is understood.

Kolff Medical officials estimate that two groups of people might benefit from the Ineraid artificial ear. About two-thirds of those who have extensive damage to their sensory hair cells, and who cannot be helped by hearing aids or other means, may benefit from an artificial ear. Another group, even larger than the first, suffer from partial hearing aid to understand speech. The portion of this group that may benefit would be based on analyses of cost, risk and benefit.

Surgical implants for the artificial hearing research project have been performed by Dr. James L Parkin, professor of surgery and head of the Division of Ear, Nose and Throat in the Department of Surgery, University of Utah School of Medicine. ■



BABANI book offer

Exclusively available in Canada from Moorshead Publications.

EXCELLENT GIFT!

NEW RELEASE

BP239: GETTING THE MOST FROM YOUR MULTIMETER **$9.00**
This book is aimed at beginners and those of limited experience of electronics. Using the simple component and circuit testing techniques in this book the reader should be able to confidently tackle servicing of most electronic projects.

BP:53 PRACTICAL ELECTRONIC CALCULATIONS AND FORMULAE **$11.75**
A book that bridges the gap between complicated technical theory and the 'cut and try' method. A good reference book.

BP 174: MORE ADVANCED ELECTRONIC MUSIC PROJECTS **$12.00**
Complementing Book BP74, "Electronic Music Projects", BP174 provides more advanced projects, such as a flanger, a phaser, mini-chrous and ring modulators, percussion synths, etc. Each project has an introduction circuit diagram and constructional notes.

BP 113: 30 SOLDERLESS BREADBOARD PROJECTS-BOOK 2
R.A. Penfold **$9.00**
A companion to BP107. Describes a variety of projects that can be built on plug-in breadboards using CMOS logic IC's. Each project contains a schematics, parts list and operational notes.

BP92: ELECTRONICS SIMPLIFIED - CRYSTAL SET CONSTRUCTION **$5.25**
This is a book written especially for those who wish to participate in the intricacies of electronics.

BP192 **$8.00**
More Advanced Power Supply Projects, by Robert Penfold. A companion to BP76, this book covers switched mode supplies, precision regulators, tracking regulators, computer-controlled supplies, etc.

BP197: AN INTRODUCTION TO THE AMSTRAD PCs **$20.00**
Recently introduced to Canada, the Amstrad PC is an MS-DOS computer for general and business use. This book explains all you need to know to start computing.

BP:150 AN INTRO TO PROGRAMMING THE SINCLAIR QL **$7.80**
Helps the reader make the best use of the Sinclair QL's almost unlimited range of features. Complements the manufacturer's handbook.

BP48: ELECTRONIC PROJECTS FOR BEGINNERS **$7.80**
F.G. Rayer, T. Eng. (CEI), Assoc.IERE
Another book written by the very experienced author — Mr. F.G. Rayer — and in it the newcomer to electronics, will find a wide range of easily made projects. Also, there are a considerable number of actual components and wiring layouts, to aid the beginner.

BP135: SECRETS OF THE COMMODORE 64 **$5.85**
This book is intended as a beginner's guide to the Commodore 64.

BP155: INTERNATIONAL RADIO STATIONS GUIDE **$9.00**
An invaluable aid in helping all those who have a radio receiver to obtain the maximum entertainment value and enjoyment from their sets.

BP130: MICRO INTERFACING CIRUITS - BOOK 1 **$9.00**
Aimed at those who have some previous knowledge of electronics, but not necessarily an extensive one, the basis of the book is to help the individual understand the principles of interfacing circuits to microprocessor equipment.

BP51: ELECTRONIC MUSIC AND CREATIVE TAPE RECORDING **$5.85**
This book sets out to show how Electronic Music can be made at home with the simplest and most inexpensive equipment.

BP222: SOLID STATE SHORT WAVE RECEIVER FOR BEGINNERS
R.A Penfold **$7.80**
In this book, R.A. Penfold has designed and developed several modern solid state short wave receiver circuits that will give a fairly high level of performance, despite the fact that they use only relatively few and inexpensive components.

BP110: HOW TO GET YOUR ELECTRONIC PROJECTS WORKING
R.A. Penfold **$7.80**
We have all built circuits from magazines and books only to find that they did not work correctly, or at all, when first switched on. The aim of this book is to help the reader overcome just these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

BP74: ELECTRONIC MUSIC PROJECTS **$10.00**
R.A. Penfold
Although one of the more recent branches of amateur electronics, electronic music has now become extremely popular and there are many projects which fall into this category. The purpose of this book is to provide the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as a Fuxx Box, Waa-Waa Pedal, Sustain Unit, Reverberation and Phaser-Units, Tremelo Generator etc.

BP 234: TRANSISTOR SELECTOR GUIDE **$15.00**
Listings of British, European and eastern transistor characteristics make it easy to find replacements by part number or by specifications. Devices are also grouped by voltage, current, power, etc., includes surface-mount conversions.

BP50: IC LM3900 PROJECTS **$4.25**
The purpose of this book is to introduce the LM3900 to the Technician, Experimenter and Hobbyist. It provides the groundwork for both simple and more advanced uses and is considerably more than just a collection of simple circuits or projects.

BP233: ELECTRONIC HOBBYIST HANDBOOK **$15.00**
A single source of easily located information: colour codes, pinouts, basic circuits, symbols, etc.

BP101: HOW TO IDENTIFY UNMARKED IC's **$1.95**
An unusual and fascinating chart that is highly recommended to all those interested in electronics and which will hopefully pay for itself many times over, by enabling the reader to use IC's that might otherwise have been scrapped.

BP121: HOW TO DESIGN AN
YOUR OWN PCBs
The purpose of
familiarise
ple
boards.
book is very
practical aspects of
cuit board design and con-
uction.

TEMPORARILY OUT OF PRINT

BP180: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS **$9.00**
Shows how home computers can easily be applied to the control of model railroads and other quite sophisticated control. A variety of projects are discussed as well as circuits for train position sensing, signal and electric points control etc.

BP185: ELECTRONIC SYNTHESISER CONSTRUCTION **$9.00**
With this book a relative beginner should be able to build, with the minimum of difficulty and at a reasonably low cost, a worthwhile monophonic synthesiser and also learn a great deal about electronic music synthesis in the process.

BP115: THE PRE-COMPUTER BOOK **$5.85**
Aimed at the absolute beginner with no knowledge of computing, this entirely non-technical discussion of computer bits and pieces and programming is written mainly for those who do not possess a microcomputer but either intend to one day own one or simply wish to know something about them.

BP72: A MICROPROCESSOR PRIMER **$5.25**
In an attempt to give painless approach to computing, this inexpensive book will start by designing a simple computer and then the shortcomings of this simple machine will be discussed and the reader is shown how these can be overcome. A glossary of microprocessor terms is at the end of the book.

BP78: PRACTICAL COMPUTER EXPERIMENTS **$5.25**
The aim of this book is to enable the reader to simply and inexpensively construct and examine the operation of a number of basic computer circuit elements and it is hoped gain a fuller understanding of how the mysterious computer "chip" works.

BP86: AN INTRODUCTION TO BASIC Programming Techniques **$5.85**
This book is based on the authors own experience in learning BASIC and also in helping others, mostly beginners to programming, to understand the language.

BP42: 50 SIMPLE L.E.D. CIRCUITS **$5.85**
Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and freely available components.

BP85: INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE **$9.00**
This book is designed to help the user find possible substitutes for a popular user-oriented selection of modern transistors and includes devices produced by over 100 manufacturers.

BP140: DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS **$15.00**
Shows equivalents and pin connections of a popular user orientated selection of Digital Integrated Circuits. Includes European, American and Japanese devices.

BP131: MICRO INTERFACING CIRCUITS - BOOK 2 **$9.00**
Intended to carry on from Book 1, this book deals with practical applications beyond the parallel and serial interface. "Real world" interfacing such as sound and speech generators, temperature and optical sensors, and motor controls are discussed using practical circuit descriptions.

BP100: AN INTRODUCTION TO VIDEO **$5.85**
This is a book for the person who has just, or is about to buy or rent some video equipment but is not sure what it is all about.

BP125: 25 SIMPLE AMATEUR BAND AERIALS **$5.85**
This book describes how to build 25 amateur bank aerials. The designs start with the simple dipole and proceed to beam, triangle and even a mini-rhombic.

BP136: SIMPLE INDOOR AND WINDOW AERIALS **$7.00**
People living in apartments who would like to improve shortwave listening can benefit from these instructions on optimising the indoor aerial.

BP141: LINEAR IC EQUIVALENTS AND PIN CONNECTIONS
ADRIAN MICHAELS **$23.80**
Find equivalents and cross-references for both popular and unusual integrated circuits. Shows details of functions, manufacturer, country of origin, pinouts, etc.,. Includes National, Motorola, Fairchild, Harris, Motorola, Intersil, Philips ADC, AMD, SGS, Teledyne, and many other European, American, and Japanese brands.

BP156: AN INTRODUCTION TO QL MACHINE CODE **$10.00**
The powerful Sinclair QL microcomputer has some outstanding capabilities in terms of its internal structure. With a 32-bit architecture, the QL has a large address range, advanced instructions which include multiplication and division. These features give the budding machine code programmer a good start at advanced programming methods. This book assumes no previous knowledge of either the 68008 or machine code programming.

See order form in this issue.

BP7: RADIO AND ELECTRONICS COLOUR CODE AND DATA CHART **$3.00**
Opens out to Wall Chart approximately 584 x 457 mm. Includes many Radio & Electronics Colour Codes in use in UK, USA, Europe and Japan. Covers Resistors, Capacitors, Transformers, Field Coils, Fuses. Battery Leads etc.

BP144: FURTHER PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE **$15.00**
This book covers many aspects of electronics where a knowledge and familiarity of the appropriate formulae is essential for a fuller understandings of the subejct. An essential addition to the library of all those interested in electronics be they amateur, professional or student.

ELEMENTS OF ELECTRONICS - AN ON-GOING SERIES
F.A. WILSON, C.G.I.A., C.ENG.,
BP62: BOOK 1. THE SIMPLE ELECTRONIC CIRCUIT AND COMPONENTS **$11.70**
BP77: BOOK 4 MICROPROCESSING SYSTEMS AND CIRCUITS **$11.80**
Although written especially for readers with no more than ordinary arthmetical skills, the use of mathematics is not avoided, and all the mathematics required is taught as the reader progresses.

Each book is a complete treatise of a particular branch of the subject and therefore, can be used on its own with one proviso, that the later books do not duplicate material from their predecessors, thus a working knowledge of the subjects covered by the earlier books is assumed.

BOOK 1. This book contains all the fundamental theory necessary to lead to a full understanding of the simple electronic circuit and its main components.

BOOK 2. This book continues with alternating current theory without which there can be no comprehension of speech, music, radio, television or even the electricity utilities.

BOOOK 3. Follows on semiconductor technology, leading up to transistors and integrated circuits.

BOOK 4 A complete description of the internal workings of microprocessor.

BOOK5 A book covering the whole communication scene.

BP180: ELECTONIC CRICUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS **$9.00**
The projects in this book consists of various types of controller, including a high quality pulse type, as well as circuits for train position sensing, signal and electronic points control and many more.

BP194:: MODERN OPTO DEVICE PROJECTS **$9.00**
This book provides a number of practical designs for beginners and experienced project builders. These projects utilize a range of modern opto-electric devices, including such things as fibre optics, ultra bright LEDs and passive IR detectors.

BP37: 50 PROJECTS USING RELAYS, SCR's & TRIACS **$7.80**
F.G. RAYER, T.Eng.(CEI),Assoc. IERE
Relays, silicon controlled rectifiers (SCR's) and bi-directional triodes (TRIACs) have a wide range of applications in electronics today. This book gives tried and practical working circuits which should present the minimum of difficulty for the enthusiast to construct. In most of the circuits there is a wide latitude in component values and types, allowing easy modification of circuits or ready adaptation of them to individual needs.

BP147: AN INTRODUCTION TO 6502 MACHINE CODE **$10.00**
The popular 6502 microprocessor is used in many home computers; this is a guide to beginning assembly language.

BP225: A PRACTICAL INTRODUCTION TO DIGITAL ICs **$7.00**
This book deals mainly with TTL type chips such as the 7400 series. Simple projects and a complete practical construction of a Logic Test Circuit Set are included as well as details for a more complicated Digital Counter Timer project.

BP47: MOBILE DISCOTHEQUE HANDBOOK **$7.80**
Divided into six parts, this book covers such areas of mobile "disco" as: Basic Electricity, Audio, Ancillary Equipment, Cables and Plugs, Loudspeakers, and Lighting. All the information has been considerably subdivided for quick and easy reference.

BP59: SECOND BOOK OF CMOS IC PROJECTS **$7.80**
This book carries on from its predecessor and provides a further selection of useful circuits, mainly of a simple nature. the book will be well within the capabilities of the beginner and more advanced constructor.

BP71: ELECTRONIC HOUSEHOLD PROJECTS **$7.00**
R.A. PENFOLD
Some of the most useful and popular electronic construction projects are those that can be used in or around the home. The circuits range from such things as '2 Tone Door Buzzer' intercom, through Smoke or Gas Detectors to Baby and Freezer Alarms.

BP44: IC 555 PROJECTS **$10.00**
E.A. PARR, B.Sx., C.Eng., M.I.E.E.
Every so often a device appears that is so useful that one wonders how life went on before without it. The 555 timer is such a device included in this book are Basic and General Circuits, Motor Car and Model Railway Circuits, Alarms and Noise Makers as well as a section on the 556, 558 and 559 timers.

BP82: ELECTRONIC PROJECTS USING SOLAR CELLS **$7.80**
A collection of simple circuits which have applications in and around the home using the energy of the sun to power them. The book deals with practical solar power supplies including voltage doubler and tripler circuits, as well as a number of projects.

BP95: MODEL RAILWAY PROJECTS **$7.80**
Electronic projects for model railways are failry recent and have made possible an amazing degree of realism. The projects covered include controllers, signals and sound effects: striboard layouts are provided for each project.

BP93: ELECTRONIC TIMER PROJECTS **$7.80**
Windscreen wiper delay, darkroom timer and metronome projects are included. Some of the more complex circuits are made up from simpler sub-circuits which are dealt with individually.

BP94: ELECTRONIC PROJECTS FOR CARS AND BOATS **$7.80**
R.A. PENFOLD
Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarm, Depth Warning and Shaver Inverter.

BP49: POPULAR ELECTRONIC PROJECTS **$10.00**
R.A. PENFOLD
Includes a collection of the most popular types of circuits and projects which, we feel sure, will provide a number of designs to interest most electronics constructors. The projects selected cover a very wide range and are divided into four basic types. Radio Projects, Audio Projects, Household Projects and Test Equipment.

BP84: DIGITAL IC PROJECTS **$7.80**
F.G. RAYER, T.ENG (CEI), Assoc.IERE
This book contains both simple and more adanced projects and it is hoped that these will be found of help to the reader developing a knowledge of the workings of digital circuits. to help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams. Also the more ambitious projects can be build and tested section by section and this should help avoid or correct faults that could otherwise be troublesome. An ideal book for both beginner and more advanced enthusiast alike.

BP99: MINI - MATRIX BOARD PROJECTS **$7.60**
R.A. PENFOLD
Twenty useful projects which can all be built on a 24 x 10 hole matrix board with copper strips. Includes Doorbuzzer, Low-voltage Alarm, AM Radio, Signal Generator, projector Timer, Guitar Headphone Amp. Transistor Checker and more.

BP103: MULTI-CIRCUIT BOARD PROJECTS **$7.80**
R.A. PENFOLD
This book allows, the reader to build 21 fairly simple electronic projects, all of which may be constructed on the same printed circuit board. Wherever possible, the same components have been used in each design so that with a relatively small number of components and hence low cost, it is possible to make any one of the projects or by re-using the components and P.C.B. all of the projects.

BP107: 30 SOLDERLESS BREADBOARD PROJECTS - BOOK 1 **$9.00**
R.A. PENFOLD
A "Solderless Breadboard" is simply a special board on which electronic circuits can be built and tested. The components used are just plugged in and unplugged as desired. The 30 projects featued in this book have been specially deisgned to be built on a 'Verobloc" breadboard. Wherever possible the components used are common to several projects, hence with only a modest number of reasonably inexpensive components it is possible to build, in turn, every project shown.

BP127:HOW TO DESIGN ELECTRONIC PROJECTS $9.00
Although information on stand circuit blocks is available, there is less information on combining these circuit parts together. This title does just that Practical examples are used and each is analysed to show what each does and how to apply this to other designs.

BP122: AUDIO AMPLIFIER CONSTRUCTION **$6.75**
A wide circuits is given, from low noise microphone and tape head preamps to a 100W MOSFET type. There is also the circuit for 12V bridge amp giving 18W. Circuit board or stripboard layout are included. Most of the circuits are well within the capabilities for even those with limited experience.

BP106: MODERN ON AMP PROJECTS **$7.80**
R.A. PENFOLD
Features a wide range of constructional projects which make use of opamps including low-noise, low distortion, ultra-high input impedance, high slew-rate and high output current types.

BP98: POPULAR ELECTRONIC CIRCUITS, BOOK 2 **$9.00**
R.A. PENFOLD
70 plus circuits based on modern components aimed at those with some experience.

BP179: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL ... ROBOTS
The main stumbl... would-be rob... tronics ... to th... s which ... the robot to ... e purpose of this ... plain and provide some ... y simple electronic circuits which bridge the gap.

TEMPORARILY OUT OF PRINT

BP195: AN INTRODUCTION TO SATELLITE TELEVISION **$15.00**
For the absolute beginner or anyone thinking about purchasing a satellite TV system, the story is told as simply as such a complex one can be in the main text.

BP108: **$7.00**
Cross-references European American and Japanese diode part numbers. Besides rectifier diodes, it includes Zeners, LEDS, Diacs, Triacs, SCRs, OCIs, photodiodes and display diodes.

BP88: HOW TO USE OP AMPS **$11.80**
E.A.PARR
A designer's guide covering several op amps, serving as a source book of circuits and a reference book for design calculations. The approach has been made as nonmathematical as possible.

BP65: SINGLE IC PROJECTS **$6.00**
R.A. PENFOLD
There is now a vast range of ICs available to the amateur market, the majority of which are not necessarily designed for use in a single application and can offer unlimited possibilities. All the projects contained in this book are simple to construct and are based on a single IC. A few projects employ one or two transistors in addition to an IC but in most cases the IC is the only active device used.

BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS - BOOK 2 **$7.60**
R.A. PENFOLD
This sequel to BP117 is written to help the reader create and experiment with his own circuits by combining standard type circuit building blocks. Circuits concerned with generating signals were covered in Book 1, this one deals with processing signals. Amplifiers and filters account for most of the book but comparators, Schmitt triggers and other circuits are covered.

ORDER BY TELEPHONE (416) 445-5600 OR FAX: 416-445-8149 OR WRITE TO: MOORSHEAD PUBLICATIONS 1300 DON MILLS RD., NORTH YORK, ON., M3B 3M8

See order form in this issue.

GW Instruments GOS-543 Oscilloscope

An economical 40MHz dual-trace workhorse for the testbench.

BILL MARKWICK

The GW Instrument company produces a complete line of test equipment from Taiwan, recently introduced to Canada by Duncan Instruments. The GOS-523 is a 40MHz, dual-channel model that should serve well as an all-purpose oscilloscope for troubleshooting, production or design work.

Basics

The two vertical channels have a sensitivity of 2mV/division, with a 1-2-5 ratio 10-range switch. The sensitivity can be boosted to 1mV/division with the x5 MAG switch, though this reduces the 40MHz vertical bandwidth to 20MHz. Risetime is approximately 8.75ns, with an input impedance of one megohm.

The display modes for the two inputs are the usual CH1 alone, CH2 alone, both displayed by alternating the sweep, both displayed by chopping the sweep (at 250kHz), and the two inputs added algebraically, with either sum or difference available.

The input coupling switch is DC, AC with a lower cutoff of 10Hz, and Ground for setting the trace location. The maximum allowable input voltage is 400Vp-p, so you'll need the attenuator probes if you work with voltages in this area.

The horizontal section has sweep times adjustable from 0.2us to 0.5s per division, with a 20-position switch. The triggering options are comprehensive, and include the usual CH1, CH2, line, external, HF filtered (50kHz cutoff), TV sync and AC/DC. The TV setting feeds the trigger signal to a sync separator circuit, which picks off the sync pulses, making TV or video display very stable. The slope can be changed from positive to negative-going, and automatic triggering can be set. To lock on to difficult signals, there is a Holdoff control, which lets you move the trigger point away from the start of the trace into a more stable area, and a delayed-sweep control, which lets you display the CH1 waveform on CH2 with a large amount of sweep magnification.

The sweep circuit also has a one-shot function (single sweep).

Nifty Features

On the rear panel is a BNC input for the Z axis (brightness). A 3Vp-p signal will modulate the brightness at rates of up to 5MHz. Another BNC provides a 50-ohm CH1 output at 100mV/division for driving chart recorders, counters, etc. I especially liked the four plastic pegs on the back panel; they let the scope stand vertically for field troubleshooting, and also take up the power cord. There's a carrying handle on the side, which I found much better than a top-mounted type, and a wire bail near the front lets the unit tilt up for bench use.

There's an intensity control that has a little trim pot beside it for adjusting the relative brightness of CH1 and CH2. The focus knob includes a trace rotation trim, and GW claims their circuitry prevents any loss of focus during brightness adjustments; we certainly found all the display settings rock- steady and free of interaction.

A 2Vp-p squarewave is available on a front panel test point for calibration. It's a 2kHz squarewave with an amplitude accuracy of 2%, a nice feature both for checking the validity of amplitude measurements and for checking the accuracy of the probe compensation setting.

The 543 has the usual x10 switch for speeding up the trace and thus magnifying the waveform, but you've no doubt noticed when using this method that the trace loses brightness and even disappear. To increase the magnification beyond ten, and prevent the loss of brightness, the 543 has a special display control. First, the signal is displayed on CH1 (A). Then the sweep time is increased for the B sweep. A portion of the display will be highlighted, and when the display control is switched to B, the highlighted portion fills the screen. The start of the magnified section can be changed by means of the continuously variable sweep delay control.

Others

The 543 includes two sets of probes which have x1 and x10 switches (it seems as though they should be called 1 and 1\10) for use with high-voltage sources.

A temperature-compensating circuit is used to prevent any drift of base lines and DC balance. Although we didn't find out how this worked, the display was stable from a cold start through two days of continuous operation.

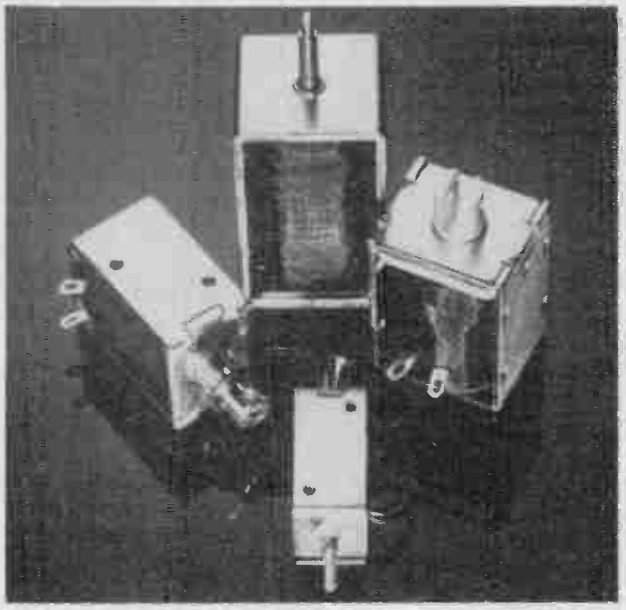
The switches and pushbuttons have a light, quality feel to them. Your scope won't skate across the bench when you adjust something.

At $1125, and with a 40MHz bandwidth, the GW GOS-543 is a fine bargain for all-around use. It's sold in Canada by Duncan Instruments, 121 Milvan Drive, Toronto, Ontario M9L 1Z8, (416) 742-4448. ■

Industrial Digital Temperature Calibrators

Beckman Industrial Digital Temperature Calibrators use custom VLSI ICs to deliver exceptional accuracy (0.1%), high reliability and up to 500 hour battery life. These portable models calibrate temperature controllers, recorders, and other field or lab instruments with ease. Models 473 and 475 feature an exclusive mA input making these the ideal value for calibration of temperature transmitters.

Circle No. 17 on Reader Service Card

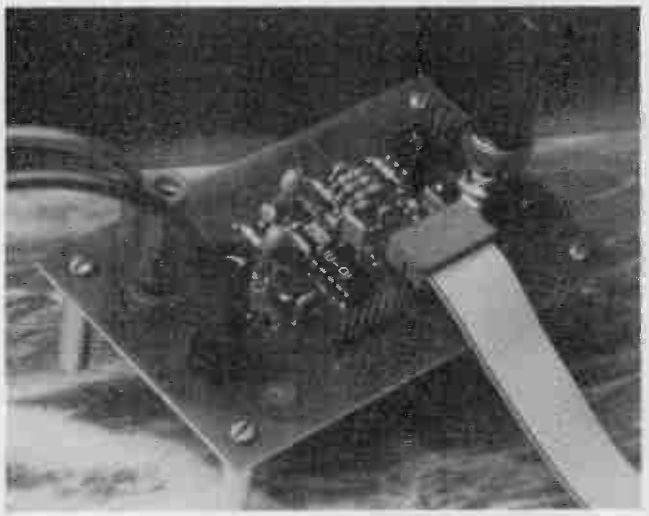


DC Box Frame Solenoids

Oak Switch Systems, Inc. presents its DC box frame solenoids with pull force .02 to 13lbs. in a power range of from 2 to 15 watts with standard shaft diameters. Acceptable Quality Level (AQL) available is 0.1% on such inspection items such as dielectric strength, insulation resistance, R-DC, pull strength, reverse polarity, short circuit, etc.

Applications for the STC series include appliances, office equipment, vending/game machines, computer peripherals, audio equipment and industrial controls. Custom designed solenoids are available.

Circle No. 18 on Reader Service Card

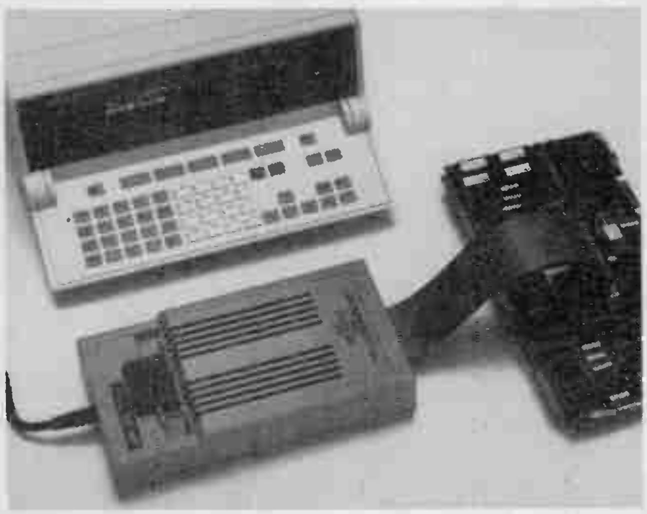


Long Line High-Speed Serial Data Receiver

Precision Monolithics Inc. introduces the LIU-01, a high-speed serial data receiver capable of operation on line lengths of over 6,000 feet. The LIU-01 is ideal for ISDN and high speed LAN applications.

The device is a single-chip solution for applications requiring the recovery of data and clock from the end of serial data transmission lines. It internally separates the data and transmitted clock of the incoming signal and presents both as TTL/CMOS outputs for direct interfacing to the receiving microprocessor-based system. The LIU-01 automatically compensates for variable transmission line lengths of from 0 ft. to over 6,000 ft. at data rates of up to 4Mb/s.

Circle No. 19 on Reader Service Card



Functional Memory Tester

HyperTEST, a method of fast functional memory testing (patent pending), is now available from Fluke Electronics Canada Inc., for 9100A Digital Test System and 9000 Series MicroSystem Troubleshooter. The HyperTEST algorithms for testing RAM and ROM reside in the microprocessor interface pod for the 9000/9100 memory tests. ROM tests are performed at approximately five times the present speed.

The amount of time saved is proportional to the total memory size. The original 80286 microprocessor interface pod using the built-in 9100 RAM test and pod interpreter requires three minutes to test 512 Kbytes of memory in an IBM PC-AT. The new 80286H pod enhanced with the HyperTEST algorithm takes less than 5 seconds to test RAM in the same Unit Under Test (UUT).

Circle No. 20 on Reader Service Card

Continued on page 40

Solder Pastes for Electronics

An old technique renewed for microelectronic applications.

DR.H.VIRANI

Solder pastes have been used in the assembly of products such as radiators and car bodies. However, these pastes are not acceptable for electronic assembly, particularly in semiconductor and microelectronic applications.

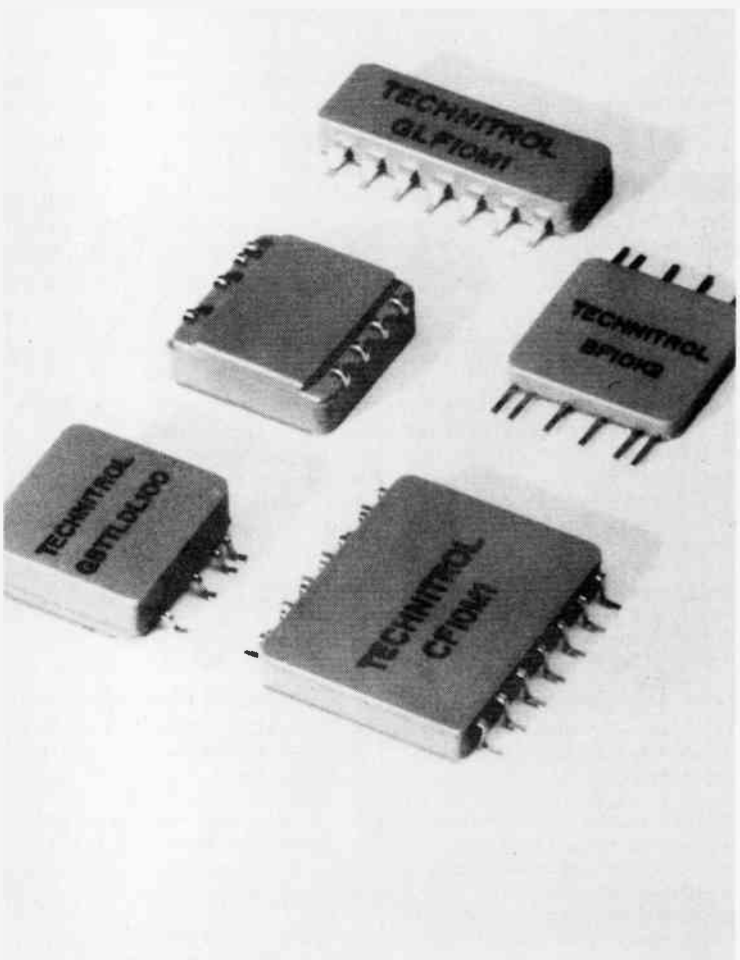
The early approaches to soldering semiconductors primarily used solder preforms placed and held mechanically in location. With the advent of thick film microelectronics, solder preforms were not effective as it was normally impossible or not feasible to locate and hold them.

Solder dipping by immersion in a molten bath was used and eventually abandoned by most due to problems such as leaching, heat variability and dross.

Solder paste started to be used, but it too had limitations; the solder powder settled out within a short time after mixing, there were rheology (flowing) problems and solder ball generation. The factors affecting the chemicals as well as the processing were not well understood. The potential for solder paste was recognized but sufficient experience and major improvements were required. Some of the early applications of solder paste were for attachment of both active and passive devices – including flip chips (used for example in the auto voltage regulator and chip capacitors) the flip chip requirements of high printing resolution, high repeatability and minimum solder ball generation caused significant improvement which allowed expansion of solder paste applications in electronic component assembly.

As a result, solder pastes (also commonly known as solder creams) have become an essential part of electronic packing today. A new manufacturing method, surface mount technology (SMT), is now a major part of electronic assembly; with this technique ICs and chip carriers, S10s chip resistors, chip capacitors and other electronic components are attached directly in high volume, using only metallized pads on the components, with high reliability and low cost. Components may be attached to one side or both sides of the board, which may in turn be outboarded on other boards. To meet increasing demands, new improved reflow systems have been developed, including vapour phase and laser soldering, although of course, the basic methods for solder reflow are still being used; for example hot plates, heat guns and convection ovens. Solder paste provides many benefits for electronics assembly. It can be efficiently incorporated into complex automatic handlers and processors, especially for high volume operations. It can be used in selective areas, and at particular times in the process where other techniques such as wave soldering are impossible.

Solder paste may replace the use of preforms in many operations since it is easier to handle, and it has enabled improvements in space – saving and reliability to be made.



Solder paste solves the difficulties in soldering surface mount packages.

Basic Standards and Compositions

There are no standard methods of applications, reflow, or flux removal, but the "standards" which the solder paste user expects, regardless of how the solder paste is used, are that the resultant solder joints are mechanically strong and cleanable. A wide array of metallurgical compositions is available, according to requirements, and the choice of solder paste composition is governed by the same considerations of physical and chemical properties that apply to the selection of "bulk" solder. It should be noted that there may be benefits in using multiple compositions, utilizing successively decreasing melting points. Thus the scenario may start with 95 Sn/5Pb (melting point 250°C) to attach selected components, followed by a 62 Sn/36 Pb/2 Ag or a 60 Sn/40 Pb system (melting point 183°C).

A short system summary is given here:

Tin/lead

This group of alloys comprises the latest category of solder pastes used. The near-eutectic compositions, 60 Sn/40 Pb, 63 Sn/37 Pb (m.p. 179°C) are used extensively (eutectic refers to the alloy percentage with the lowest melting point). The 50 Sn/50 Pb system has poor wetting. The 5 Sn/95 Pb and the 10 Sn/90Pb are inexpensive systems (due to their very high lead content) and are used for high temperature applications, such as chip capacitor coating by the manufacturer.

Tin/Lead/Silver

These systems were primarily designed to be used with silver bearing materials such as thick film conductors or chip capacitor end terminators. They exhibit good tensile and sheer strength. The silver in the solder is intended to reduce the dissolution of silver from the thick film (leaching). There is now direct evidence which supports this.

Tin/Silver

Typically, 95 Sn/5 Ag or the eutectic composition 96.5 Sn/3.5 Ag (melting point 221°C) are used not only for higher melting temperatures but also for superior wetting and higher joint strength (when compared to the basic tin/lead systems). Tin/silver and tin/antimony have been rated as the most thermal fatigue resistance alloys.

Tin/Antimony

Basically antimony improves the tensile and shear strength of solder, and is responsible for a 20-30% improvement in creep strength. Alloys such as 99 Sn/1 Sb (m.p. 235°C) are preferred for high creep conditions. Tin/Silver/antimony alloys have been found to have better thermal fatigue resistance than soft solders.

Lead/indium and tin/indium

The lead/indium systems exhibit slower crack propagation than 63 Sn/37 Pb. A system used for lower melting conditions is the 50 Pb/50 in system which has 180°C solid and 209°C liquid. This system is usable as a fuse or for other specialized conditions. The military prefers indium systems because of failure modes related to tin in tin/lead/indium systems. The tin/indium systems have typically lower melting points and have excellent wettability. The 48 Sn/52 in has a 118°C melting point.

Other low temperature systems

These alloys have very selective applications such as fuses. Examples are 65 Sn/35Bi (melts at 150-188°C) 42 Sn/58Bi (m.p. 138°C) and 40 Sn/40 Pb/20 Sb which has melting range of 121 – 130°C.

With increasing emphasis on high reliability, especially with new technologies such as surface mounting, there is a real need to develop a significant body of mechanical property data to allow designers to select the optimum solder compositions.

Solder Paste Constituents

Basically solder pastes consist of solder powder plus complex organics. High quality solder powder is essential, and the numerous factors affecting this can be summarized:

(i) The metallic impurities must be low, with attention paid to those constituents which create metallurgical problems. Individual particulate debris must be eliminated.

(ii) One of the major impurities related to solder powder is oxide. Many workers have discussed the need to have oxide-free powder, which when examined, means less than 0.5% or is undefined. Residues such as oxygen, carbon and carbonates on the surface can be very detrimental. However, most of the data report surface contaminants which are those of actual concern rather than bulk. While some authors have reported (bulk) oxygen as high as 2%, an extensive analysis of numerous powder manufacturers found that all were less than 0.5% (bulk) oxygen. However, some of these produced unacceptable pastes. The key is not the bulk but the surface contaminants – carbon, carbonates and oxygen.

(iii) The particle size must be extremely carefully controlled to assure the proper range for the deposition system.

(iv) Particle shape is a factor when if it affects rheology or application. For example, extended "dog bones", "bent bananas" are not desirable, but pure spheres are not required and may not necessarily be preferred.

The organic systems used with solder powder are complex. In the early history of solder paste, simple systems were used. These systems required some type of mixing prior to use to rehomogenize the power which had normally settled. In some of the systems, settling occurred within a 24-hour period as evidenced by a significant quality of visible flux floating on top of the system. In some cases, a skin or crust actually formed on top of the paste, and caused major application problems. Organic systems contain resins, sometimes a combination of resins, which serve primarily as a carrier and normally have low cleaning efficiencies. Many synthetic resins are available. Resins have a wide array of combinations of melting temperature, acid numbers etc.

Solvents are used primarily to adjust the rheology – basically to lower the viscosity. Some pastes used multiple solvent systems. The choice of solvents is critical to assure extended use time. The addition of inappropriate solvents can destroy the paste with no recovery possible.

Solder Paste Designations

In solder pastes, the flux system cleans the metal film to be soldered as well as removing oxides and other surface contaminants from the solder powder surface during wetting. Since the resin does provide minimal cleaning of the metal surfaces, a wide variety of chemicals are used to achieve improved cleaning and solder wettings.

Inability of the flux system to completely clean and maintain the surface will result in solder balls. Generally, chemicals classified as activators, surfactants and chelators are used. The latter are sometimes referred to as stabilizers. There are also foam and viscosity controllers.

Basically, solder pastes are categorized as follows, based on the overall activity of the ingredients:

- R Unactivated
- RMA Mildly activated
- RA Fully activated
- OA Higher activation

Typically R fluxes are primarily resin-based and are the least cleaning efficient. RMA pasters are used extensively for thick film micro electronics applications where high reliability is a concern. The typical activating chemicals are a amines, amine hydrochlorides and organic acids. The RA fluxes are termed fully active, and used for surfaces difficult to wet such as nickel. Normally polar amine salts, hydrohalides and inorganic acids are used. RA and OA systems are rarely used in micro electronics, due to the higher corrosiveness. Normally this broad area of activators are cleaners and controllers is a major key to solder systems and is therefore very proprietary. The choice of flux depends on the metal being soldered, soldering temperature, cleaning solvents or systems, method of dispensing and shelf- life. Other key factors include evaporation rates and thermal decomposition temperature. These affect lifetime stability, dry conditions and key processing factors.

Deposition Techniques

There is no standard method for deposition of solder paste. Application methods can be very simple or extremely sophisticated and are discussed here.

(A) Hand applications – Uses spatulas and syringes for applications where exact location and controlled thickness are not improved. Viscosity controls are not too critical. Fluidity, settling and tack are of concern. Evaporation rates are important.

(B) Syringe Use – Syringes are used for high volume production applications where location and quantity are not critical. There are many types of syringes – needles, application tubes, etc., and there is a wide range of orifice sizes. Syringes are often used, when the surface is irregular and not suited for screen or stencil printing. Gang syringe systems are often used on wet multiple locations and assemblies. Most syringes rely on pneumatic systems for controlled force and duration. There are many manufacturing problems using syringes – such as differences in syringe system tolerances.

Needles and tubes may become clogged. Settling is a concern for some paste system tolerances. Often production operators try to adjust fluidity by adding solvent directly into the syringe; this can create very serious problems. (C) Screen printing – this is the same basic technique used to deposit thick film materials in microelectronic processing particularly SMT. The normal screens used are 80,100 and 200 mesh. The 200 mesh screen is used to deposit thinner solder. These mesh screen can typically deposit about 5-7 mils of wet paste and is normally used for SMT. It tends itself to high volume usage in which a uniform deposit of paste is rather intricate patterns is achieved. Solder is deposited for attachment of both active devices and passive devices. Typically the solder is deposited on the pads oversized – such that some solder is deposited on non-wettable surfaces. (D) Stencil – this is basically the same as screen printing except that instead of a screen mesh, a sheet of metal is used with appropriate cut-outs. This is usually selected for depositing solder on pads and less complex designs. Variations in solder thickness deposited depend on the thickness of the sheet material used. The viscosities used are similar to screen printing, often at the higher end of the viscosity range. Stencils usually have a long life than their screen counterparts.

(E) Combinations – for some applications, screens and stencils are combined. For example, for an automotive assembly, screen print areas are used for high resolution areas and stencils are used for thicker depositions.

(F) Automatic transfer – (Dip and dab or in-deposit). Pins are used to deposit small spot in an array, often complex especially where syringe stoppage is unacceptable. The transfer pins may have recess cups to pickup and hold the solder during transfer to the workpiece.

(G) Roller coaters – Here the solder is applied by literally rolling the paste on to the part. This allows for high volume with coverage upon contact; "painting" is a variant. Drying characteristics of the paste and settling of the paste are important concerns. These are some of the major techniques. Many others can be used such as dip-coating and spraying, because of the flexibility of the material and the diverse application requirements.

A feature associated with the deposition of solder paste is its ability to hold a component such as a chip carrier or formed axial lead IC module until the paste is reflowed.

A major consideration during deposition is the ambient temperature. Assuming no organic losses, the viscosity decreases with temperature. For example, there is an 80% decrease at 35°C as compared to 20°C.

High temperatures, however, tend to cause thickening due to solvent losses. Thus temperature can significantly affect the functioning and reliability of solder paste. As indicated, temperature can prematurely break down critical organic ingredients.

Reflow Methods

The term "reflow" is generally a misnomer; solder paste normally is not reflowed as such, but is usually deposited on the circuit or component and melted. The heating methods used for solder paste vary form basic to moderately complex, and are summarized here:

Hot plates and heated surface – there are many different systems relying on heat from a heated surface. The Browne reflow unit has a multiple hot plates set at different temperatures to achieve a heating profile. A major limitation is that residual flux can cause components to adhere to the moving belt. Heated metal tracks with automatic index mechanisms (walking beams) may have application to high volume operations. A problem is the effective removal of organic flux vapours. Maintenance of these systems is essential – for example, by timely changing of filters.

Gas or heat guns – these can be used for high volume operations but sputtering can be a problem. Heat guns have had limited acceptance.

Ovens – Ovens are used for both drying and reflow. Temperature variations and volume throughout are limitations. Forced air heaters are often placed above and below a conveyor. This is not normally used for SMT.

Induction (or RF) – induction or RF coils are used to solder unusual contours. Diode caps have been readily attached to bases with this technique, for example:

IR – infrared systems are used for both drying and reflow either separately or in combination. Systems vary from small open systems to large complex units. Both diffused and focused systems are utilized.

The technique is not new, but notable improvements in design have led to IR systems gaining acceptance: it is the primary technique used in Japan. One of the historic problems was that of volatile flux fumes collecting on the heater elements and drastically affecting the heating. The new systems avoid this through and improved air circulation system.

Resistance – in this technique, a specially shaped heater tip mounted in a resistance welding head is momentarily heated by a pulse of energy from a power supply. In some cases the work itself rather than a separate heater is used as the resistance heating element. The heaters have a variety of shapes and sizes and must be appropriately used.

Vapour Phase – vapour phase or condensation soldering is relatively new but rapidly gaining major acceptance by both military and commercial users. It is the primary method used in the U.S.A. for SMT. Soldering with condensation heating was developed to provide a precise, temperature controlled, non- oxidizing and non-flammable system. A major key is that it produces quality solder joints which are essentially independent of product geometry. It is possible with vapour phase to solder a great range of components and substrates. At first, the method was limited to solder that melted below 215°C, but the introduction of new soldering fluids allows the use of 95 Sn/5/Ag alloy and other compositions that melt up to 250°C. ■

NEXT MONTH IN

Electronics & Technology Today

The Basic Testbench!

We discuss the pros and cons of what you need to start up the basic testbench for electronics, including how to get the best from your gear.

Fluke's New Multimeter!

The Model 80 series of multimeters is probably the most comprehensive handheld test instrument available. It includes a capacitance meter, frequency counter and even an internal recording memory.

Canada's Hi-tech Show!

Coverage of the acres of new equipment displayed at the September show, from computers to industrial machines.

Plus, of course, the usual projects, articles and news!

Subscribe today!

For advertising or subscriptions,
please call (416) 445-5600, FAX 445-8149.

SUBSCRIBE TODAY!

Be sure of your issue each month

Moorshead Publications

1300 Don Mills Road, Toronto, Ontario M3B 3M8

SUBSCRIPTIONS: ☐ NEW SUBSCRIPTION ☐ RENEWAL

Electronics & Technology Today

☐ One year (12 issues) $22.95 ☐ Two years (24 issues) $37.95

Computing Now!

☐ One year (12 issues) $22.95 ☐ Two years (24 issues) $37.95

Computers in Education

☐ One year (10 issues) $25.00 ☐ Two years (20 issues) $45.00

Outside Canada (US Dollars)

For U.S. please add $3.00 per year ☐ Other countries add $5.00 per year ☐

NAME ______________________

ADDRESS ______________________

TOWN/CITY __________ PROVINCE/STATE __________

CODE __________ DATE __________

POSTAL CODE ______________________

☐ Cheque enclosed DO NOT send cash

☐ MasterCard Account No. ______________________

☐ Visa Account No. ______________________

☐ American Express Account No. ______________________

Expiry Date ______________________

Signature ______________________

To order Books, Back Issues, Binders, Software and Special Publications, see over.

ORDER FORM

Software

		$
		$
		$
	Sub Total	$
	Tax (Ontario Residents) 8%	$
	Postage	$
	Total Enclosed	$

Bookshelf

CODE (e.g. BP12)	TITLE (Short form acceptable)	PRICE
		$
		$
		$
		$
		$

Special Publications

ITEM	QUANTITY	AMOUNT
		$
		$

Binders

ITEM	QUANTITY	AMOUNT
Moorshead Publications $9.75 each (Ontario Residents add 8% P.S.T.)		$

Back Issues

$4.00 each. Ontario residents add 8% P.S.T. Some issues may be out of stock. Please call the Reader Service Department at (416)445-5600 or enclose a self-addressed, stamped envelope for a complete list of available issues.

Orders from the Bookshelf are tax exempt.
Please add $1.00 for postage.
Ontario residents add 8% P.S.T.
for Specials and Software.

Frequency Range Extended to 46 GHz

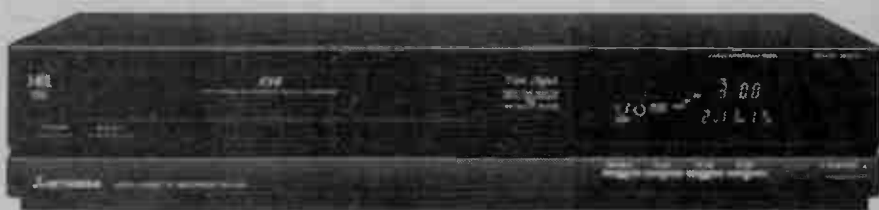
A new frequency-extended option for the Hewlett Packard 5352B microwave frequency counter that extends the counter's range to 46 GHz without the need for an external mixer is available. The counter's sensitivity of -30 dBm at 26.5 GHz, linearly decreasing to -15 dBm at 46 GHz, allows manufacturers of EHF satellite communication systems to accurately measure weak signals to 46 GHz without using external amplifiers and filters.

Circle No. 21

HS-U20C Video Cassette Recorder

Mitsubishi Electric Sales Canada Inc. introduces their newest video cassette recorder, the HS-U20C. HQ circuitry is combined with Mitsubishi's exclusive Twin Digital Tracking - a combination of their previous Digital Fine Tracking (digital control for special effects) with the Digital Trutracking (digit control of normal playback). This fail-safe automated tracking control system ensures that a full 100% of the video signal is reproduced.

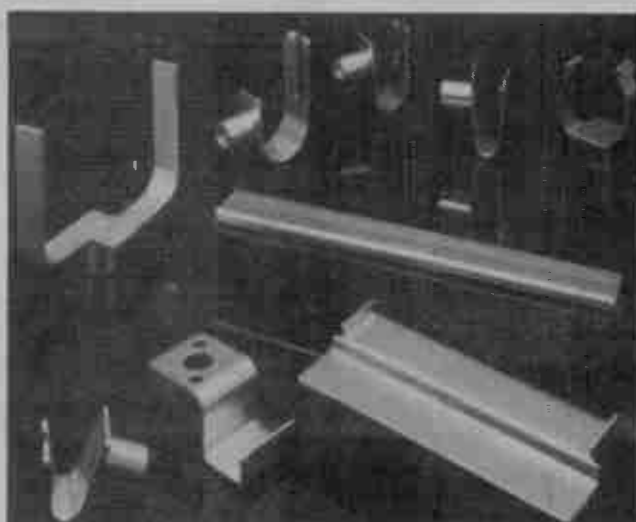
Circle No. 22



Instrument Cases

Hammond Manufacturing are expanding their 1598 series of plastic instrument cases. Five new sizes are added to the offering to bring the total number of sizes to nine, all with the option of EMI/RFI shielding. Cases are molded in flame retardant ABS plastic with a matte textured finish. They come complete with brushed aluminium front and rear panels, two piece tongue and groove construction, and are available in a choice of colours. The EMI/RFI shielded version offers the same material and featured with an interior conductive coating.

Circle No. 23 on Reader Service Card



Cable Hangers

Electrovert Ltd., manufacturers of Cantrough cable tray and Cantruss cable support systems have expanded their range with the addition of tapped cable hangers for marine applications. Designed for heavy-duty cable support, these hangers are available in three types; crimp; plate and tubular, manufactured from heavy-gauge mild steel or type 304 or 316 stainless steel they are screwed onto a 3/8" dia. stud welded to the overhead deck or bulkhead. The crimp type is offered in 5 styles depending on the number of cable runs to be supported: single; double; triple; four stacked double (2x2) and four stacked (in-line).

Circle No. 24 on Reader Service Card

Continued on page 54

COMPULIT®

Entering " The Profession of the 80s"... and beyond
Computer Literacy Home -Study Diploma Program

MOST POWERFUL COMPUTER OFFERED IN HOME STUDY COURSES!

1. IBM PC/XT* COMPATIBLE PACKAGE (Minimum Specs.)
• Mother Board (8088 micro-processor,4.77 MHz, 512K RAM memory minimum, ExpansionSlots,(BIOS included.) • Monochrome Adapter Card andParallel Printer Adapter (hi-res text,80 x 25, with compatible graphics.) • Disk I/O Card for two disk drives. • 2 Floppy Disk Drives (DS/DD,360K, half-height)• Monochrome Monitor • 135W Power Supply.

2. DOT MATRIX PRINTER
80 columns, draft and near letter quality modes.

PHONE FOR FREE COLOUR BROCHURE (416) 842-8383

• All Diploma Programs 100% tax deductible.
• Monthly payment Plan available.

* IBM is a Registered Trademark of IBM Corporation

. SOFTWARE SPECIFICATIONS

• MS-DOS : The general purpose operating system by Microsoft.

• GW-BASIC: An IBM PC and XT* compatible programming language by Microsoft that provides capability to program and run applications.

• DBASE III™(Educational version) : A state-of-the-art relational database that is widely used in business and industry.

• SUPERCALC™(Educational version) : An electronic spreadsheet program.

• WORDSTAR™ (Educational version) : An easy-to-use word processing program which makes it possible to arrange text on the screen as you want it to appear when printed.

NTS
TRAINING THE WORLD FOR THE 21ST CENTURY

National Technical Schools
517 Bohemia Cres, Oakville, Ontario
L6J 2K7 (416) 842-8383

School Head Office: 456 W.Martin Luther King Jr.Blvd., Los Angeles, CA 90037

Introducing Microprocessors Part 8

Dealing with programming, including flow charts and languages.

MIKE TOOLEY

The general learning objective for Part Eight is that readers should understand simple assembly language programs used to control external devices connected to the parallel port of a microprocessor-based system.

The specific objectives for Part Eight are as follows:

6.1 Languages

6.1.1 Explain the need for programming languages and distinguish between high level and low level languages.

6.1.2 State the desirable characteristics of programming languages for each of the following applications:

real-time control systems
data processing
systems and application
software.

6.2. Assembly Language Programming

6.2.1 Describe the logical procedure which must be adopted in order to create a satisfactory program.

6.2.2 Describe algorithms and draw flowcharts relating to simple problems.

6.2.3 Identify and use common flowchart symbols.

6.2.4 Explain what is meant by assembly language.

6.2.5 Describe, with typical examples, the use of mnemonics in assembly language programs.

6.2.6 Write, hand-assemble, enter, test and debug simple programs using a subset of the instruction set of any common 8-bit CPU. to:

a) add two eight-bit data values from RAM and place the result in a third RAM location

b) operate an external relay or LED in a pre-defined on/off sequence.

Programming Languages

In order to simplify the process of producing working programs, the software developer may use one (or more) of a number of programming languages to simplify the task of producing a working program. The choice of language depends essentially upon several factors including the application concerned, the degree of familiarity which the programmer has with the language concerned, and the availability of the necessary development software for the microprocessor system to be used.

Languages which are well suited to producing software in fields such as data processing are generally not well suited to producing software for such applications as real-time control. Furthermore, a programmer who is competent in a language such as Pascal may be very much out of his or her depth with Forth.

Happily, a range of languages is available to most modern microcomputers and the final choice of language will take into account such factors as compactness (i.e. size of program code generated), speed of execution, ease of use, portability (i.e. ability to transfer code easily from one system to another), and ease of maintenance.

The desirable characteristics of languages for three typical applications (real-

	Real-time control	Data processing	Applications software
Speed of execution?	MUST be very fast	not generally critical	as fast as possible
Size of code	MUST be very compact	not generally critical	should be reasonably compact
Portability	not generally critical	should be reasonably portable	MUST be highly portable
Availablity of data structures	not generally critical	MUST offer a range of powerful data structures	should offer a range of data structures
Example language	Assembly language	Pascal	C

Table 1. Characteristics of programming languages for three typical applications.

time control, data processing and applications software) are listed in Table 8.1

High and Low-Level Languages

Programming languages are often classified as "high level" or "low level". High level languages are generally those which are "procedure oriented" and are written in structured English such that programs are easily readable. Each program statement in a high level language will normally have a recognizable function and, furthermore, will be equivalent to several assembly language instructions.

Low level languages are those which are "machine oriented" and are thus close to the binary "machine code" which is executable by the microprocessor. Assembly language is an example of a low level language which uses mnemonic operational codes (opcodes) and symbolic addresses (instead of actual memory locations). The individual program statements in a program written in a low level language may not in themselves, be particularly meaningful and therefore comments are generally added to clarify the action of the statements.

Assembly Language Programming

In Part Three we briefly mentioned that assembly language was a low-level language in which the instructions are presented in mnemonic code for later translation into the binary code acceptable to the microprocessor. Readers will doubtless recall that this process is normally carried out by means of an assembler program.

The assembler acts upon a text file written in mnemonic assembly language code (known as "source code") and generates a binary code (known as "object code") within the microcomputer's memory. Thereafter, the object code constitutes a directly executable program i.e. we simply load the Instruction Pointer or Program Counter with the entry (start) address of the code and execution commences.

Some assemblers produce intermediate programs in hexadecimal format such that the mnemonic source code is first translated into a hexadecimal file. This file may be subsequently stored on disk (as a "hex, file") or loaded into the microcomputer's memory ready for execution.

Alternatively, where programs are extremely short, it is possible to dispense completely with the services of an assembler and resort to "hand assembly". This, somewhat tedious process, involves first writing the program in assembly language mnemonics and then translating each instruction (operation code and operand) into hexadecimal code which is then loaded into an appropriate region of memory prior to execution. Hand assembly requires the services of a machine code "monitor" or "debugger". Alternatively a rather more specialized "hexadecimal code loader" may be used.

At this point, it is worthwhile reminding readers of the simple example

Address (hex)	Contents (hex)	(binary)
1800	3E	00111110
1801	01	00000001
1802	06	00000110
1803	02	00000010
1804	80	10000000

which we used in Part Three. We wished to add together two bytes of immediate data (stored in RAM as part of the program) using our hypothetical microprocessor (IMP). This task involved three instructions. The first loaded the first operand (in this case a byte of immediate data) into the accumulator (A). The second loaded the second byte of data into the B register. Finally, the third instruction added together the contents of the A and B registers and placed the result back into the accumulator.

Assuming that the data bytes have hexadecimal values of 01 and 02 respectively the program takes the following form:

```
LD A,01
LD B,02
ADD B
```

Its hexadecimal representation may be found by referring to the instruction set as follows:

LD A,01 is represented by 3E (the opcode) followed by the byte of immediate data (in this case 01)

LD B,02 is represented by 06 (the opcode) followed by the byte of immediate data (in this case 02)

ADD B is represented by 80 (the opcode) and there is no operand

The hexadecimal representation of the program is thus:

```
3E 01
06 02
80
```

Assuming that the program is to commence at an address of 1800H, the contents of IMP's memory would be as shown in the table below:

After execution of the program the Instruction Pointer (Program Counter) will have reached 1805H and the A and B registers will contain 03 and 02 respectively. Note that, if we wished to test the program it would be necessary to halt the microprocessor at address 1805 otherwise it would continue to execute whatever code it came across. This is a potentially dangerous situation as the microprocessor cannot distinguish between random data and program code (the former may cause the system to lockup in an endless loop or even overwrite the program with spurious data).

Now let's consider a more complex example. Suppose that we wish to add together two eight-bit data values stored in RAM (not as part of the program) and place the result into a third RAM location. We will assume that, in both cases, the bytes of data are stored in memory locations 1900H and 1901H and that the result is to be deposited at address location 1902H. To make life easier, we will ignore the possibility of an overflow occurring (as would be the case if the sum of the two bytes were to exceed 255 decimal or FFH).

The assembly language program, and corresponding hexadecimal machine code, will be different for different microprocessors. Indeed the programmer may have to adopt slightly different techniques due to the constraints imposed by the instructions and addressing modes (i.e. methods of locating the data used by an instruction) available with the microprocessor concerned.

The following routines for the Z80 and 6502 illustrate this point:

Z80 Code

```
LD A, (1900H) ;get first byte
LD B,A   ;transfer to B
LD A, (1901H)  ;then get the second  byte
ADD B   ;find their sum
LD (1902H),A  ;and store the result
```

6502 CODE

```
CLC ;first clear carry flag
LDA $1901 ;get second byte
ADC $1900 ;and add to first
STA $1902 ;then store the result
```

Problem 8.1

Use implied addressing (with register pair HL acting as a pointer) to produce an alternative Z80 program which will have the same effect. (NB: A subset of the Z80 Instruction Set appeared on Data Card 4.)

Assembly Language Programming Technique

Regardless of the processor involved, a number of techniques can be used to improve the overall efficiency of a

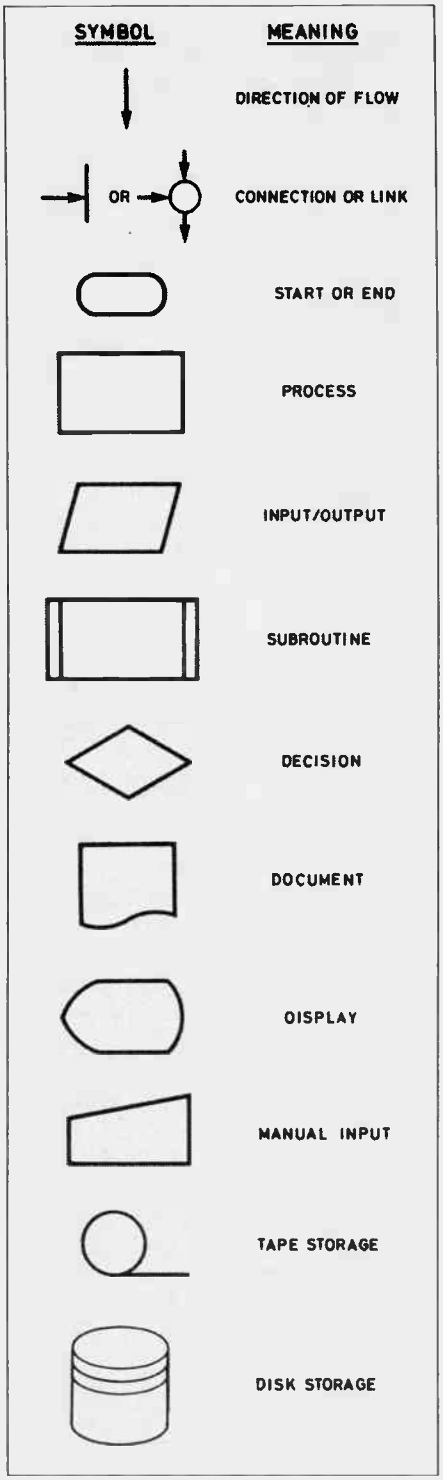


Fig. 8.1. Flowchart symbols.

program and also make it easier to maintain. Many of these techniques are easy to implement and merely require a little forethought and self- discipline on the part of the programmer.

Programs will invariably comprise a number of smaller modules each having an identifiable function. The overall structure of the program should be defined at a very early stage and no attempt should

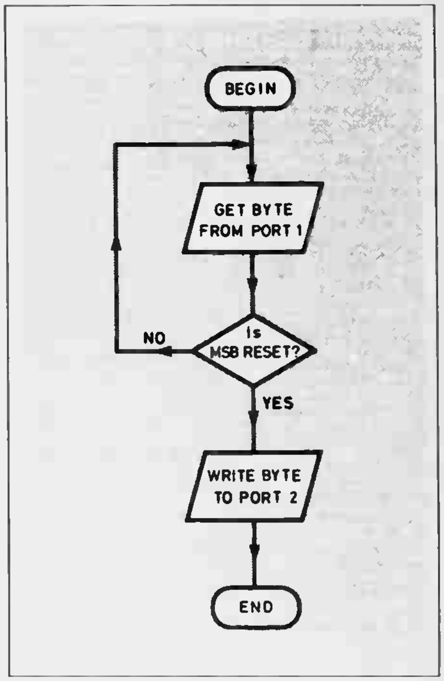


Fig. 8.2. Flowchart for a simple I/O program.

be made at coding any of the modules required by the program until the overall program structure has been finalized.

An algorithm is a method of describing the sequence of operations which should be followed in order to solve a problem. An algorithm is often expressed using a diagram to show the sequence of events. This diagram is known as a flowchart and a standard set of symbols (Fig. 8.1). These symbols indicate the type of process involved and the flowchart is annotated with brief explanatory comments which are inserted within the symbols to which they refer.

The overall structure and flow of a program should be defined using one, or more, flowcharts at an early stage. Alternatively (or in addition to a flowchart representation) the sequence of the program may be described by a series of statements written in a form of structured English. In any event, the overall flow of the program should be sequential, there should be only one entry and one exit point, and all transfers of control (i.e. jumps and calls) should be explicit.

As an example of using flowcharts and structured English statements, consider the case of a simple routine which reads a set of switches connected to an input port, loops until the switch connected to most significant bit (MSB) is closed and then transfers the byte read from the switches to an output port.

A flowchart for the process is shown

```
; READ BYTE FROM PORT1, LOOP UNTIL MSB RESET,
; THEN TRANSFER BYTE TO PORT2
;
; EXIT: A = (PORT1), BC = PORT2, ZF = reset
;
; REGISTERS AFFECTED: A, B, C, F
;
GETBYTE:   LD    BC,PORT1        ; Get byte from
           IN    A,(C)           ; PORT1
           BIT   7,A             ; Is MSB reset?
           JR    Z,GETBYTE       ; No, keep trying
           LD    BC,PORT2        ; Yes, send byte
           OUT   (C),A           ; to PORT2
           RET
```

Fig. 8.3. Simple Z80 I/O subroutines.

in Fig. 8.2. Alternatively, we could express the problem in terms of the following structured English statements:

Begin
Repeat
Get byte from PORT 1
Until MSB of byte is reset

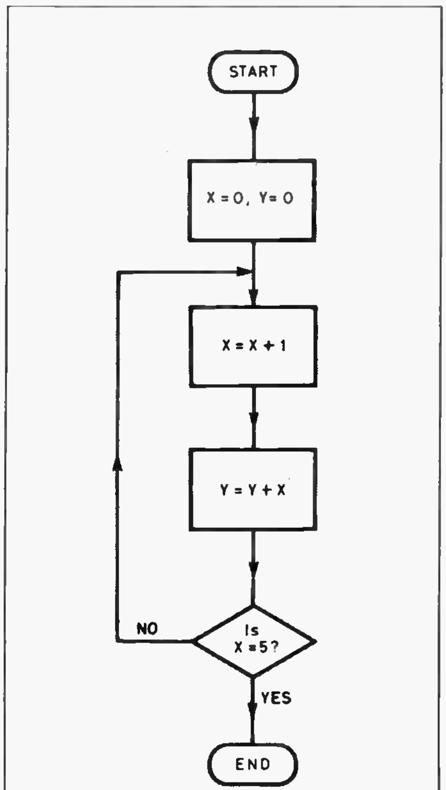


Fig. 8.4. See Problem 8.3.

Output byte to PORT 2
End

Armed with one or other of the foregoing algorithms, it is a relatively simple matter to develop the code. A particular solution based on the Z80 microprocessor, is shown in Fig. 8.3.

Problem 8.2

Sketch a flowchart to describe the steps in finding the sum of two data values (taken from memory) and place the result back into memory.

Problem 8.3

The flowchart in Fig. 8.4 indicates a process. Determine the values of the variables X and Y upon exit.

Subroutines

The fragment of code shown in Fig. 8.3 constitutes a subroutine. This is a section of code which may be called from various points in the main program (using the CALL instruction) and returned to (by means of the corresponding RETurn) instruction. If desired, both the CALL and RETurn instructions can be made conditional on the contents of the flag register. Furthermore, a subroutine may have several conditional RETurn statements.

The CALL instruction saves the old value of the Instruction Pointer (or Program Counter) in the stack before replacing it with the value of the subroutine start address. On returning from the subroutine, the Instruction Pointer (or Program Counter) is loaded with the value saved on the stack so that the main program can be resumed at the point at which it was left.

Parameters can be easily passed to and from subroutines by simply placing them in one or more of the CPU registers. Alternatively, parameters may be passed using the stack or by reserving an area of memory in which parameters can be deposited before making the call

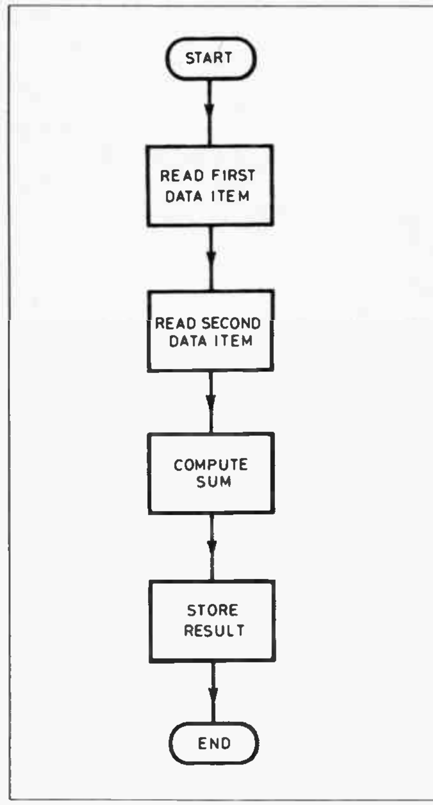


Fig. 8.5. Answer to Problem 8.2.

and recovered after the call has been made. This allows the passing of a much greater number of parameters than would be possible using just the CPU registers.

Care must be taken to preserve the contents of any CPU registers that may be modified as a result of executing a subroutine call and that are required in subsequent processing. It is thus essential to have a knowledge of the effect of a subroutine on the CPU registers (in any event, this should be clearly indicated in the source code). Furthermore, subroutines should be designed so that they minimize usage of the CPU registers, thus keeping things simple for the programmer and reducing any potential overhead associated with storing and retrieving register contents.

The use of subroutines makes programs easy to maintain and allows modules to be easily transferred into other programs without having to rewrite an entire program. This is an important point and one which can save the programmer a great deal of time.

Programming I/O Devices

Readers may recall that we concluded last month's instalment by describing a representative output driver arran-

Advertisers' Index

gement based on a programmable parallel I/O device. We also stated that the external devices could be easily operated by simply writing an appropriate data byte to the port in question. As an example a binary value of 11000111 (hex. C7) written to Port A will illuminate the three LEDs connected to PA0, PA1 and PA2 and operate the relays connected to PA6 and PA7. To turn the LEDs and relays off, a binary value of 00000000 (hex.00) should be sent to Port A.

Readers may recall from Part Six that a microprocessor employing memory mapped I/O (such as the 6502) can simply write data to an output port using an instruction of the form; STA address (the accumulator must first be loaded with the requisite byte of immediate data). In the case of a microprocessor which uses port I/O (such as the Z80), the accumulator is again first loaded with the requisite byte a data and then an output instruction of the form OUT (port), A is used.

In either case, it will usually be necessary to configure the programmable I/O device (this will often be a 6502 PIA or 6522 VIA in the case of 6502 CPU or a Z80-PIO or 8255 PPI in the case of a Z80 CPU) before I/O can commence. The configuration routine will be very much dependant upon the hardware configuration and type of I/O device fitted. @SUBHEAD = Problem 8.4

A microprocessor based system is fitted with one input and one output port. The input port is connected to eight switches and the output port is connected to eight LEDs. Devise a simple assembly language program which will continuously read the switches and operate the respective LEDs in each of the following cases:

(a) Using a 6502 CPU memory mapped with the following port addresses: Input, 8002H Output, 8005H

(b) Using a Z80 CPU employing port I/O with the following port addresses: Input, FBH Output, FDH

Answers to Problems

8.1 Either of the following programs would prove satisfactory:

(a) LD HL, 1900H
LD, B, (HL)
INC HL
LD, A, (HL)
INC HL
ADD B
LD (HL), A

(b) LD HL, 1900H
LD A, (HL)
INC HL
ADD (HL)
INC HL
LD (HL), A

Note that the program in (b) is one byte shorter than that in (a)

8.2. See Fig. 8.5

8.3. X = 5, Y = 15

8.4. (a) LDA $8002; get byte from switch bank

STA $8005; and send it to the LED

(b) IN A, (FBH); get byte from switch bank

OUT (FDH), A; and send it to the LED

Glossary for Part Eight

Algorithm

The sequence of steps (presented in a clearly understandable form) which describe the procedure used to solve a problem.

Call

An instruction to jump to a subroutine. A jump to the specified address is performed, but the contents of the Instruction Pointer (or Program Counter) is saved so that the (calling) program can be resumed when the subroutine has been completed.

Flowchart

A graphical representation of program logic. Flowcharts enable the software developer to visualize the steps and logical flow within the program.

Hand assemble

The process of translating a program presented in assembly language mnemonics into machine code without the aid of an assembler program.

High level language

A problem oriented programming language (as distinguished from a machine oriented language). The syntax of a high level language is usually similar to English.

Program

A procedure for solving a problem coded into a form suitable for execution by a computer. Often referred to simply as "software".

Subroutine

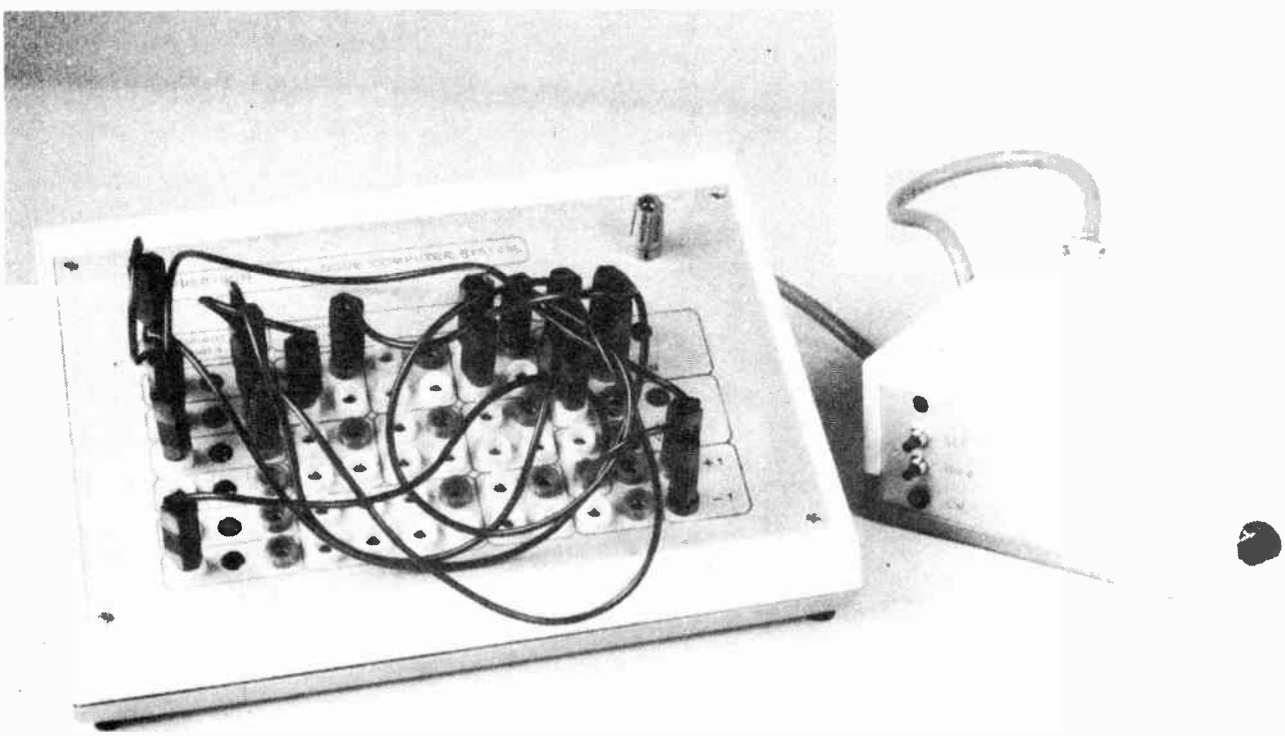
A routine or subprogram which is separated from the main body of the program and which is executed by means of a CALL instruction (or its equivalent in a high level language). At the conclusion of the subroutine, control reverts to the main (calling) program at the point at which it was left. ■

PROJECT

Analog Computer, Part 2

Continuing the construction and use of the analog circuit.

PAUL CUTHBERTSON



Last month I described the construction of the analogue computer's power supply. This month it is the turn of the main computer unit itself.

The suggested front panel layout is shown in Fig. 1. Use a punch to mark the centre of each hole and a hand drill to drill a 2mm pilot hole at each position. Hold the panel firmly in a vice near the hole position (with a clean piece of rag in the vice to prevent marking the panel) to prevent it bending. With a little care good results can be had. Be particularly careful with the potentiometer holes as these have the edges showing.

Drill 6.5mm holes for the green terminal and the LEDs. 8mm for the 4mm sockets and large holes up to a limit of 8mm or 9mm for the pots. If in doubt drill a hole too small, try it out and then work up. Use an instrument file or similar to cut a small slot in the edge of the hole for the spigot on the terminals.

Fit and tighten all the panel components except for the yellow sockets at the top and bottom of the coefficient multiplier section. A 3/8in socket spanner held in the hand can be a good tool to use here. Don't overtighten them as the threads can strip.

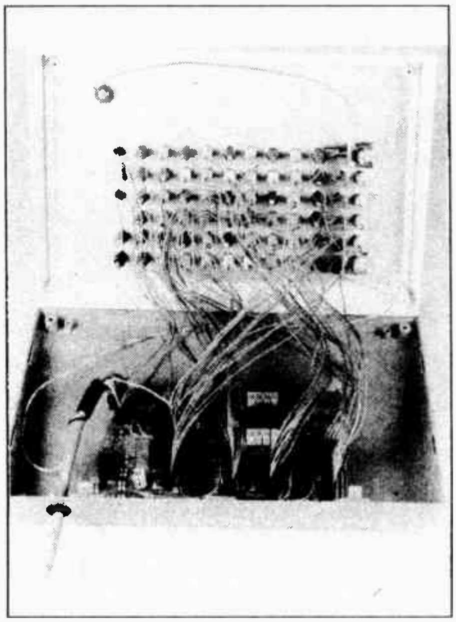
Now solder the six potentiometers in place on the pot board (Fig. 2). To fix the pot board to the front panel, you'll need a couple of special brackets made from scrap aluminium – see Fig. 3. There's a left handed bracket and a right handed one.

No precise measurements are given because these will depend on your exact front panel layout. The last two yellow sockets tighten down on the fork, and the pot board then screws down to the small

Solder a 15-way D-plug on the end of the 15-way cable trapping the braid in the cable clamp for earthing.

Drill a hole in the back right of the case, no further than 50mm from the end of the case for the 15-way cable. Use a grommet. Solder a length of earth wire to the braid and either trap the other end of this between the bracket and the pot board or use a solder tag onto the bolt which secures a pot board. Trim all but the – 10V REF wire down to about 40mm length. Strip and crimp tags to the ends of the wires and push them into a 10-way cable shell in accordance with Table 1 (connections 63-72).

The +7V wire (position 63) needs a 8in piece of wire to reach the overvoltage indicator (LED2). The -7V wire (position 67) needs a slightly longer piece in with it. The 0V wire (position 72) needs a piece of wire about 250mm inserted with it. The -10V REF wire goes to the next cable shell at position 61 which is why it is longer than the rest.



Begin populating the main board by fitting all the connectors and all the IC sockets as shown in Fig. 4. Next fit all the links using insulated single stand wire.

Fit all the other components as shown in Fig. 4 making sure all the diodes and the translator are the right way round. Don't fit the ICs yet.

Several points on the board (labelled A-I) must be connected with insulated wire on the underside of the board. Some of these are corrected mistakes, some are there because there is no room elsewhere on a single sided board and others are an attempt to preserve the designers sanity.

1	Summing amplifier input 1,1
2	Summing amplifier input 1,2
3	Summing amplifier input 1,3
4	Summing amplifier input 1,4
5	Summing amplifier input 1,5
6	Summing amplifier input 1,6
7	Summing amplifier input 1,7
8	Summing amplifier input 2,1
9	Summing amplifier input 2,2
10	Summing amplifier input 2,3
11	Integrator input 4
12	Integrator input 3
13	Integrator input 2
14	Integrator input 1
15	Integrator initial conditions 4
16	Integrator initial conditions 3
17	Summing amplifier output 1
18	Summing amplifier output 3
19	Summing amplifier input 3,1
20	Summing amplifier input 3,2
21	Summing amplifier input 3,3
22	Summing amplifier input 4,1
23	Summing amplifier input 4,2
24	Summing amplifier input 4,3
25	Summing amplifier output 4
26	Summing amplifier output 2
27	Summing amplifier output 7
28	Summing amplifier output 5
29	Summing amplifier input 5,1
30	Summing amplifier input 5,2
31	Summing amplifier input 5,3
32	Summing amplifier input 6,1
33	Summing amplifier input 6,2
34	Summing amplifier input 6,3
35	Summing amplifier output 6
36	Summing amplifier output 8
37	Integrator output 1
38	Integrator output 4
39	Integrator initial conditions 2
40	Integrator initial conditions 1
41	Integrator output 2
42	Integrator output 3
43	Summing amplifier input 7,1
44	Summing amplifier input 7,2
45	Summing amplifier input 7,3
46	Summing amplifier input 8,1
47	Summing amplifier input 8,2
48	Summing amplifier input 8,3
49	Coefficient multiplier input 1
50	Coefficient multiplier output 1
51	Coefficient multiplier output 2
52	Coefficient multiplier input 2
53	Coefficient multiplier input 3
54	Coefficient multiplier output 3
55	Coefficient multiplier output 4
56	Coefficient multiplier input 4
57	Coefficient multiplier input 5
58	Coefficient multiplier output 5
59	Coefficient multiplier input 6
60	+ 10V Reference output
61	– 10V Reference input
62	Coefficient multiplier output 6
63	+ 7V Supply
64	Overvoltage warning LED
65	NC
66	SET
67	– 7V Supply
68	HOLD
69	– 15V Supply
70	+ 15V Supply
71	– 10V Reference output
72	0V

Table 1. Connections to the main computer board.

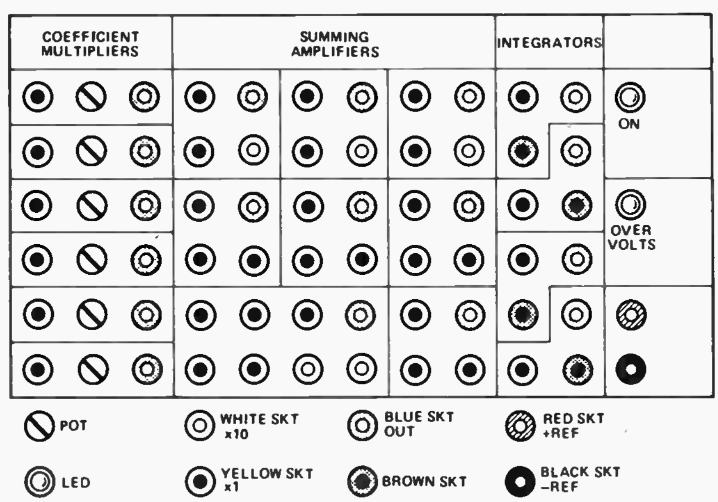


Fig. 1. The front panel layout.

Connect the pads with the same letters. There are two of most but five each of pads B and C and three each of D and E.

Testing

Most parts of the system can be tested at this stage before the front panel wiring goes in. Don't insert the ICs into their sockets yet but plug the leads from the power supply into the board.

Switch on the supply and quickly check that all supplies are present in the

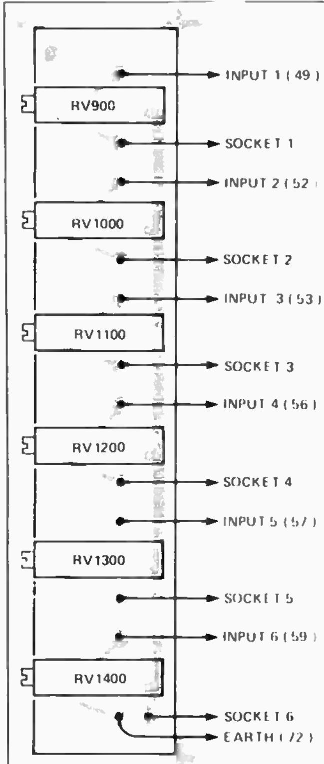


Fig.2 The component overlay for the pot board

Parts list

Resistors

(1/4W, 5% unless noted)

R25,29,31,107,111,114,207,208, 214,307,308,314,407,408,414,507-509, 514,607-609,614,707709,714, 807-809,814,1502,1508,1509, 1602,1608,1609,1702,1708,1709, 1802,1808,1809 ....1m 1%

R30 ....470k

R32-35,39,40,41,1503,1505....................100k

R36,38 .... 33k

R37....................180k

R42,1504,1604,1704,1804....................1M

R43 ....22k

R44.................... 680

R100-106,200-202, 300-302, 400-402,500-502,600-602,700-702,800 ,802,1507,1607,1707,1807 ....10k

R112,113,209,309,409....................100k 1%

R115 ....39k

R215,315,415 ....82k

R515,615,715,815 ....330k

R1500,1501,1600,1601,1700, 1701,1800,1801 ....4k7 1%

R1506,1606,1706,1806 ....470k

RV6,7,900,1000,1100,1200,1300, 1400 ....10k multiturn pot

RV1500,1600,1700, 1800 ....1k multiturn pot

Capacitors

C1500,1501,1600,1601,1700,1701,1800, 1801 ....470n

Semiconductors

IC6,7,100,500,900,1500, 1502,1503 ....LM324 quad op amp

IC1700 4066 ....CMOS quad switch

Q5 2N3904 ....or equiv

D1-1804 ....1N4148 or 1N914 (39 total)

LED1,2 ....red LED

Miscellaneous

15-way D-type plug (PL1), stacking 4mm plug (PL2-22), green socket (SK1-4), white socket (SK5-9), blue socket (SK10-27), yellow socket (SK28-50), green socket (SK51). Case, IC sockets, 2 x 6-way PCB connectors).

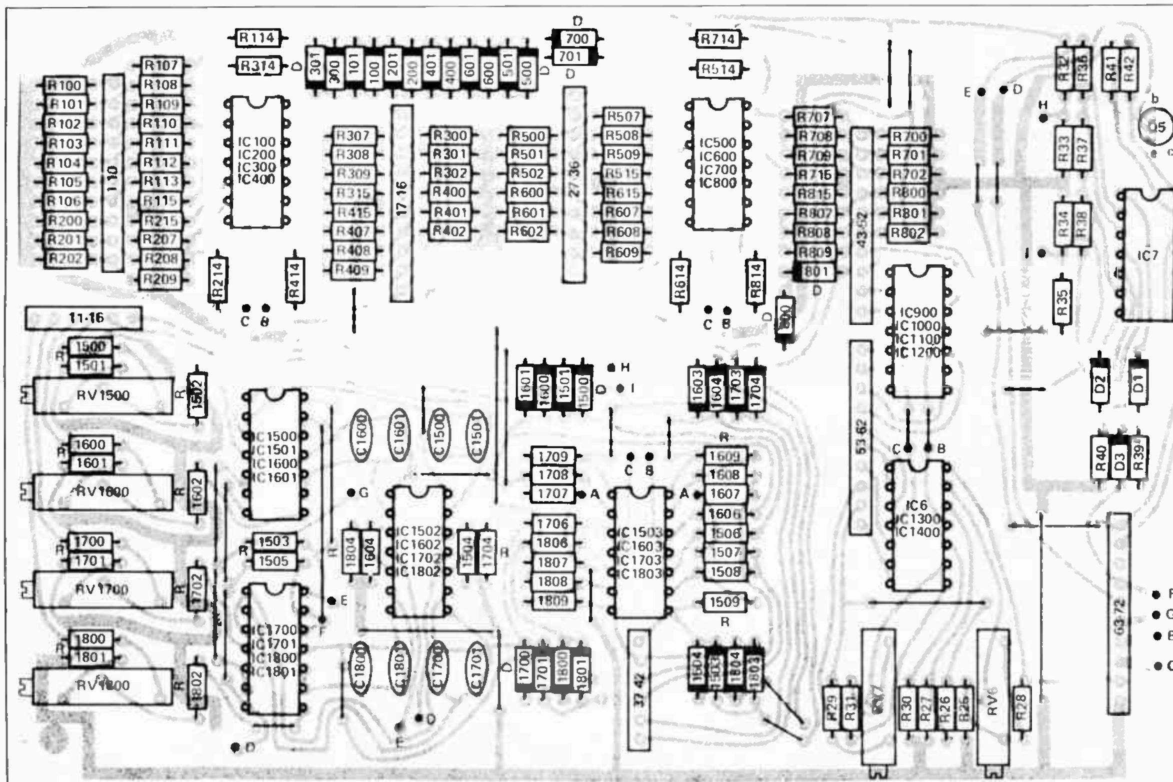


Fig.4 The component overlay for the main board

right places. If not, switch off immediately and investigate.

A rather strange property of all the ICs used in this project is that they are symmetrical. If the supplies are present but the wrong way around, you can plug the IC in upside down rather than rewiring!

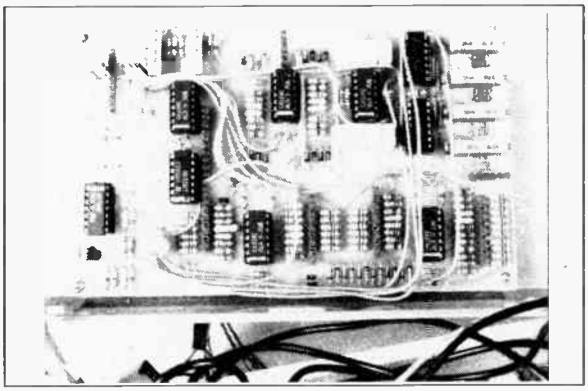
Make yourself a couple of test links by crimping tags onto 200mm or so piece of wire. Bare about 10mm at the other end. Now you can push each of these into a six way cable shell or other test position as appropriate to apply signals to the various parts of the circuit. Refer to Fig. 3 and Table 1 to see whereabouts you are and to Table 2 to see which quarter of the op amp is responsible for different functions.

Insert IC6/1300/1400. Power up and check you have about +/- 10V at each of the corner pins on the right of the IC. Then adjust the two pots at the bottom of the board to give precisely 10.00V. Look at the 10V master reference too to see it hasn't changed. Power down each time before inserting the next IC.

Insert the top left IC (IC100-/200/300/400) into its socket. Power up and check that all the outputs are at OV by probing the corner pins of the IC. (In reality you may expect up to about 10mV either way — about 0.1% full scale). Now apply each of the +/- references to each input in turn, monitoring at the output connector pin +10V in should give -10V out, and vice versa. The outputs should be well within 1% of full scale, for x 1 inputs. Applying this input to a x 10 input will result in about 14V output or so but it does mean the inputs is connected properly. Strange results can be due to misconnection, solder bridges or a reversed diode.

Insert IC7 into its socket. This is the window comparator and latch. Remember this one is reversed relative to the rest (unless you've reversed any others yourself). By applying +/-10V to a x 10 input of a summing amp or the +/-15V supply to a x 1 input, you should be able to see the leftmost corner pins of the IC dropping negative. They should be positive normally and respond momentarily to overrange outputs. It isn't necessary to test all the inputs this way incidentally, just one for each summing amp.

Next monitor pin eight of IC7. It should be positive if SET has not been pressed since the last overvolt condition. Press SET and check it goes negative.



The prototype showing the wiring over the board.

Insert IC500/600/700/800 and use the same procedure for each summing amp — checking for zero, checking all inputs and finishing with an overvolt check on one input of each amp.

Now insert IC1500/1501/1600/-1601.IC1700/1701/1800/1801 and IC1502/1602/1702/1802. These form the heart of the integrators. Power up, press SET and see that the four corner pins of the LM324 go close to 0V. You can expect a good 30mV here actually — about 0.3% full scale. Release SET. The op amp outputs should drift very slowly. (In an ideal world this drift would be zero).

Apply +/-10V to the integrator input at the connector pin. The op amp output should attain -5V in a second (approximately). Press SET a few times to verify the op amp output returns to zero and ramps from there each time. It may be easier to monitor this on a scope or an analogue meter rather than a DVM. While this is in progress check the overvolt system responds to the op amp output voltages.

Check HOLD by attempting to catch the op amp halfway through its headlong rush. When in HOLD the integrators do drift — in an ideal world they would not — and this looks quite bad on a DVM (the drift rate can be about 50mV/s) but look at it with a scope and I would defy anyone to see it drifting from moment to moment.

On the plus side, the integrators behave very well if you apply 0V to the inputs — drifting about 1mV/s — so left to their own devices they will take about two hours to drift up to an overvolt condition! It is wise not to use HOLD for extended periods of time but see my comments on performance improvements below.

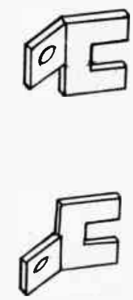


Fig. 3. Brackets to hold the pot board to the panel.

PIN	FUNCTION
	IC100/200/300/400
1	Summing amp output 1
2	Summing amp output 2
8	Summing amp output 4
14	Summing amp output 3
	IC500/600/700/800
1	Summing amp output 5
7	Summing amp output 6
8	Summing amp output 8
14	Summing amp output 7
	IC7
1	This output not used
7	Latch output (drive to overvolt LED)
8	Upper (+ve) comparator
14	Lower (-ve) comparator
	IC1502/1602/1702/1802
1	Integrator 2 first stage output
7	Integrator 4 first stage output
8	Integrator 3 first stage output
14	Integrator 1 first stage output
	IC1503/1603/1703/1803
1	Integrator 3 output
7	Integrator 4 output
8	Integrator 1 output
14	Integrator 2 output
	IC900/1000/1100/1200
1	Coefficient multiplier 2 output
7	Coefficient multiplier 3 output
8	Coefficient multiplier 4 output
14	Coefficient multiplier 1 output
	IC6/1300/1400
1	Coefficient multiplier 5 output
7	Coefficient multiplier 6 output
8	+10V reference output
14	10V reference output

Table 2. Useful test point locations.

Insert the last IC (IC1503/1603/-1703/1803) and check the outputs follow those of the previous stage (x2) and that when an input is applied to the IC (initial conditions) connector position this voltage appears inverted at the output. Keep SET asserted for this, using a shorting link if you like, as it is easier to see what's going on.

Also put +/-15V in at the initial condition inputs (without SET asserted) to check the action of the overvolt connections. Calibration of the integrators must wait until the internal wiring is installed.

Wiring

Drill holes in the base of the case and bolt in the board, using spacers. The board should lie right at the back of the case where it just clears the 4mm sockets nicely.

Use small lengths of bare single strand wire to connect each of the yellow coefficient multiplier sockets to the clockwise end of each potentiometer on the pot board. Trim down the anode (long) leads of both LEDs and solder a 680R resistor between them. Lay the front panel face down with the back edge just learning on the front of the case, so that it can't 'hinge' back into position when the time comes.

Starting with those sockets and connections at the back, which would be awkward to reach with the rest of the wiring in place, cut and solder an appropriate length of wire to the socket. Refer to Fig. 3 and Table 1 continuously. I have chosen to number the inputs to the summing amps starting at the top left working right, then bottom left working right. The really essential thing is that groups of connections to one amp or integrator are kept together and a white (x10) socket always connects to an input with a 100k resistor.

The coefficient multipliers are numbered one to six from top to bottom. Connect a wire from each pot wiper pad to the input connector. The outputs go direct to the blue sockets. Connect a wire between the thick 0V track on the pot board and the green terminal. Connect the 0V wire from position 72 to the green terminal as well. Trim and connect the overvolt LED cathode to the appropriate connector position. Trim and connect the power LED cathode to the -7V position. Connect +7V position to the overvolt LED anode along with the 680R resistor which is already in place.

Lower the panel into position. Now is a good time to make up the patch leads. Two meters of extraflex wire will make ten leads of various lengths; I used six 0.25m lengths and four 0.125 ones. Connect 4mm plugs on both ends of each lead.

More Testing

All that remains is to check the summing amp and coefficient multiplier connections by applying inputs, checking outputs and by checking the integrator wiring and calibration of the integrators. Calibrate the integrators by applying a 0.50V signal derived from a voltage reference passed through a coefficient multiplier. Use your nice new patch leads to do this.

Using a stop watch, release SET, wait for 20 seconds and press HOLD. Make a quick mental note of the voltage attained before it wanders too far off. Adjust the integrator, using one of the four pots at the left edge of the board, using the 20s check each time an adjustment is made, until the integrator reaches ten volts plus the offset apparent when SET is asserted. That's the simplest method. If you've stuck with the wiring scheme outlined, you'll see that the pots are numbered one to four from back to front.

If you have a pulse generator which will give you a good pulse of known and stable amplitude and duration, you could use it to pulse the integrator and adjust the potentiometer to give a known final voltage. A +1V pulse for one second should result in -1V on the output. The important thing is that the integrators are the same. The only reason for having adjustment here, and not for any other circuit, is to remove the effects of the tolerance of the capacitors (5%) and to account for using two 470n rather than 1u0.

Improvements

The LM324ICs used in the computer are the biggest source of error, particularly in the integrators where their bias currents cause drift in the HOLD mode and very slight asymmetric operation and drift when running.

If any improvement is considered necessary, the biggest single step would be to replace those op amps in the critical positions of summing amplifier and integrator. Some possibilities might be the LF347 which offers vastly improved bias currents or the OP400 with its very low offset voltage of 150uV maximum. If selecting an improved op amp, do not be concerned with bandwidth or slew rate for this application.

There are no other easy or relatively cheap roads to improvement. The next item on the list is perhaps the capacitors but closer tolerance types at 1u are likely to be bulky and expensive. Using 100n instead of the 1u in the prototype will speed up the computer by a factor of ten but will also express drift rates tn times faster. The important resistors could be relaced by 0.1% types but these are likely to be expensive too.

Having said all this, the computer is still more than adequate for control experiments and dare I say it, a lot better than certain offerings I have come across recently.

Further Uses

The individual building blocks of the computer can be used for many other purposes. Variable and fixed gain amplifiers are easily implemented. There are sufficient integrators to build two rather fine, high Q state variable filters, although the range of operating frequencies may be restricted.

Don't be afraid to use external components in the patching. For example, a 10k resistor in series with any input will attenuate the signal by a factor of two, 90k by a factor of ten. This can be used to slow down integrators.

A very low frequency sine wave generator is another possibility, with the added advantage of quadrature, outputs and high spectral purity (since it is a 'proper' sine wave and not something cobbled up from a triangle wave) but the amplitude will change slowly. Set up a state variable filter with a damping of zero for this.

The whole computer can be easily expanded adding further main boards operating off the same power supply unit. Wiring up further D-connectors in the power supply is the way to do this.

Other functional blocks could also be added either to this main board or to an additional one. The possibilities are almost boundless. One thing is certain. Once the analogue computer is built, you will never again look at a digital computer with quite the same admiration. ■

OnSat is the *"Top Gun" of the Satellite TV World

As programming comes and goes, and as issues rise and fall in the high-tech world of home satellite TV, you need a guide that gives you up-to-date information. OnSat is your prime connection between the satellites and your viewing pleasure.

OnSat®

Canada's Weekly Guide To Satellite TV™

Easily the most convenient programming guide available, OnSat gives you great features like: Specialty Show listings, Prime-time Grids, Alphabetical listings for several hundred movies and sports events, Articles, Cancom listings, and the ever popular OnSat Mailbag. Be sure to get the best in programming—get OnSat!

*** Top Gun © Paramount Pictures**

Cut On Line

NAME ______________________________

ADDRESS ______________________________

CITY ______________________ PROV __________ ZIP __________

How did you hear about OnSat? ______________________________

Dealer Name ____________________ Dealer ID# ____________________

City ______________ Zip ______________ Other ______________

Do you wish to receive/continue to receive OnSat? Yes_____ No_____

☐ Send me 1 full year (52 issues) of OnSat for only $59.00.*
☐ Send me 2 years (104 issues) of OnSat for only $104.00.*
☐ Send me a Sample Copy for $2.00.*
☐ 1st class mail for only $99.00/year.

Please allow 4 weeks for delivery of first issue.
*All prices in canadian funds.
Method of payment (For Subscription orders)
☐ Check or Money Order Enclosed (Sorry, we are unable to bill) ☐ Visa® ☐ MasterCard®

Card Number ☐☐☐☐ - ☐☐☐☐ - ☐☐☐☐ - ☐☐☐☐ Exp. Date _____

You can call toll-free for Visa® or MasterCard® orders (subscription orders only) 1-800-387-2412.

OnSat • 9780 Bramalea Rd N / Suite 303 Brampton, Ontario, Canada L6S 2P1

 Continued from page 40

PC Acoustics Tester

Ariel Corporation, in an agreement with AT&T, is marketing SYSid, an acoustic measurement system for PC/MS-DOS computers. SYSid provides a sound source, then analyzes the room response, displaying magnitude, phase, distortion, impulse response, noise, etc. Cost is $2995 (US).

Circle No. 25 on Reader Service Card

Software Calculator

BV Engineering of California announces the release of a new version of TEKCALC, a programmable scientific calculator for PC/MS- DOS computers. It features regular, hyperbolic and complex functions, curve fitting, statistics, graphics and more. Watch for a review in a future E&TT.

Circle No. 26 on Reader Service Card

Color Watchman TV

Based on new developments in LCD technology, the Sony 2.7-inch pocket-sized TV combines all the features of their Watchman B&W TV with color and a built-in AM/FM stereo radio. The FDL-320 Watchman utilizes a newly developed Active Matrix LCD. Each of the display's 86,000 pixels is controlled by its own transistor to produce higher contrast and more distinct colors. The screen is lit by a miniature fluorescent bulb. Full VHF/UHF reception and three modes of power are provided. At Sony dealers.

T&M Catalog

The 1989 Test and Measurement Instrument catalog has just been published by Transcat, a division of Transmation Canada. The free 480-page catalog describes more than 500 instruments and accessories from 200 manufacturers, and includes 50 new products. Instruments are available for virtually all physical quantities, and all products in the catalog are available by mail or telephone order. The catalog can be ordered by calling 1-800- 268-4739, or by circling the Reader Service Card number below.

Circle No. 27 on Reader Service Card

Liability — no responsibility whatever is accepted for failure of projects to perform for any reason, and no responsibility is accepted for any injury or damage caused by any fault in design.

EDITORIAL QUERIES — written queries must be accompanied by a stamped, self-addressed envelope, relate to recent articles and must not involve research.

We cannot answer telephone queries.

PCB Suppliers — we do not supply PCBs or kits or keep track of stocks. Please contact the following:

B-C-D Electronics, PO Box 6326, Stn. F., Hamilton, Ont. L9C 6L9.

Danocinths Inc., PO Box 261, Westland, MI 48185 USA.

Spectrum Electronics, 14 Knightwood Crescent, Brantford, Ont. N3R 7E6.

Circle No. 28 on Reader Service Card

WIN AT THE AD GAME

Advertising . . . it's an adult's game. Winners enjoy increased market share and higher sales while lowering promotional costs. Losers spin their wheels, digging themselves further into the "I can do it all myself" rut.

If you're in the game – play to win. Know the rules. Use your players: advertising agents; film houses; media reps; and printers. They can all help you win . . . if you ask the right questions and provide the right information.

If you interact with media reps, printers, film houses, or typesetters, then this dynamic, four hour, evening seminar is designed for you. Learn how to: analyze strategies; isolate your unique selling points; target your audience; select media; work with film and pantone colours; pick typestyles; and more. Understand the five elements of a print ad. Know the basics of creating effective, consistent support material.

Seminar Leader

Robert Cohen, author of the "The Ad Game . . . Recreating Creativity To Sell", has a BBA and an MBA and has completed two years of Doctoral work in strategic marketing. He is President/CEO of The Cohen Group Inc., Marketing, Advertising, Public Relations. Mr. Cohen was a Professor at Trent University and in York University's MBA program.

Upcoming Seminars:

Date: September 20, 1988 City: Toronto
Date: October 18, 1988 City: Toronto
Date: November 1, 1988 City: Vancouver
Date: November 2, 1988 City: Calgary
Date: November 15, 1988 City: Peterborough

It's your move!

For more information call The Cohen Group (416) 226-6267. To register ($95 per registrant) call CCH Canadian Limited toll free at 1-800-268-4522; in Toronto dial 441-2992.

toronto business magazine

Moorshead Publications

LIGHT WISE The Studio, Inc.

CCH

THE COHEN GROUP

CLIFFORD/ELLIOT

CANADIAN BUSINESS LIFE MAGAZINE

cko 99.1 FM

B·PAA Business/Professional Advertising Association