Electronics Today

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May 1987

Canada's Magazine for Electronics & Computing Enthusiasts

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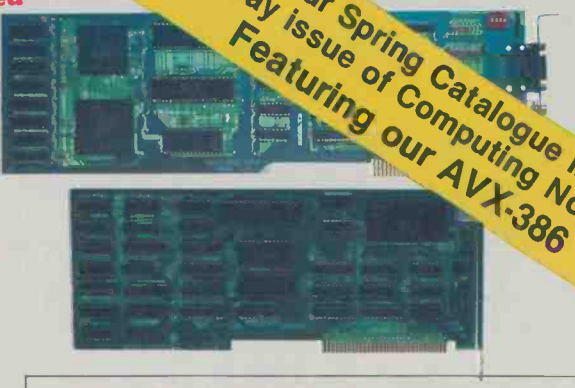

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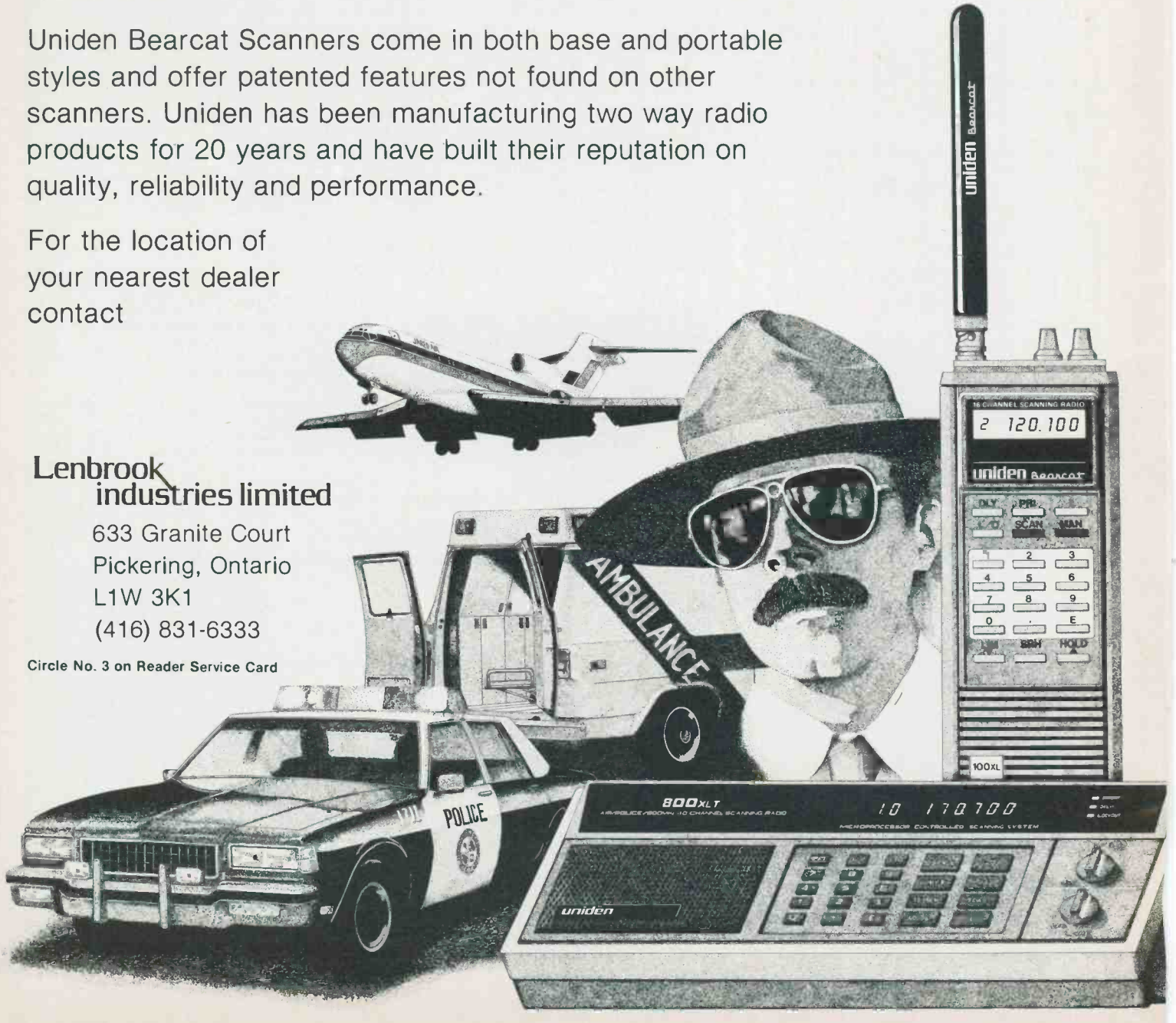

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May 1987 **Vol. 11 No. 5**

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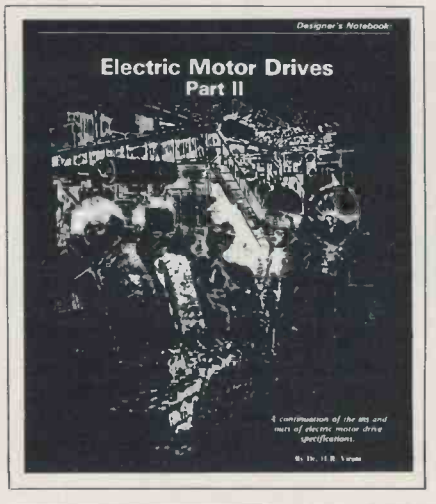
Series



Columns and Information

For Your Information

The Editor's Corner

By Bill Markwick

SOME pleas for information, most of which is of use to some of our readers. If you can supply any insight into the following problems, we'll publish your ideas in a future column and we can all breathe easier.

First, we have the hassle of trying to get GW-BASIC on an IBM compatible to echo a program to the printer during execution. If you use LPRINT, you get only the 'Lprint' statements (INPUT is ignored) and the output goes only to the printer, not to the screen as well. If you try opening a file (OPEN 'FILE' FOR OUTPUT AS 1) for printing later, it records only the Print statements. If you try opening a file named 'LPT1:', same thing.

I tried redirection through DOS (typing a right-arrow symbol and filename after typing GWBASIC). Another attempt was to type CRTL-P from DOS; this toggles the printer on, but loading BASIC toggles it off again.

One lukewarm solution is to run the program with some sort of Pause statement after one screenful and then type Shift-PrtSc for a screen dump, but this is awkward at best.

The idea of all this is to end up with a paper record of (a) what numbers you entered, and (b) what answers BASIC came up with. So far, we haven't been able to get both.

Suggestions welcomed. Best suggestion so far: use some other language.

A reader who is having trouble locating inexpensive disk drives for his Adam computer would like to know if anyone could volunteer the method for hooking up one of the low-cost disk drives available for the IBM or Apple. These are usually in the $150 area, but their track formatting may not agree with the Adam DOS system.

If you can help out, we might even be able to make a project out of this and you'll get paid for your efforts as well.

One foreseeable problem: since our reader is now using the Adam tape drives (and Adam CP/M), he'll need a way to transfer existing software to the new disk. In other words, we need a system that will let him use a disk as A: and a tape as B: or something similar.

Thank you bunches for any help you can offer.

PCs and PSUs

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software development. Contact Intepro Systems Inc., 450 Bedford St., Lexington MA 02173, (617) 863-9500.

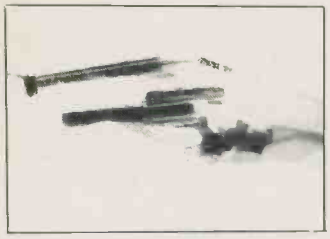
Circle No. 24 on Reader Service Card

Line Testers

Three new communications testers are being marketed by Triplett Corporation. These include the Model 310-TEL VOM, the Model 60D drop-proof VOM and the Model 8455 line-tester. These analog type testers feature solid state electronics and can withstand wide temperature extremes. The 8455 can test for DC voltage and resistance, line shorts and opens, multiple ringers and other test operations. Contact Len Finkler and Company, 80 Alexdon Road, Downsview, Ontario M3J 2B4, (416) 630-9103.

Circle No. 25 on Reader Service Card

Mini-Review: Tektron Probe



LOGIC probes are not exactly a dime a dozen; $30 each is more like it, and they're one of the basic troubleshooting tools for digital work. If you'd like to save money and have the fun of constructing your own probe, the Tektron Memory Logic probe sells for $16.80 in kit form. It consists of a clear plastic tube and end probe, a nicely made PCB and the necessary components, including a Reset button that also caps off the top end of the tube.

The probe operates from 3V to 16V, allowing it to work on either TTL or CMOS circuitry; 0 to 20 percent is defined as a logic-low and 40 to 100 percent is a logic-high. It can capture pulses as narrow as 256ns. No input protection is provided, so it behooves you not to connect the power leads to high voltages; still, the 4013 and LM324 ICs inside are fairly tolerant of abuse.

To measure something, the alligator clips are connected to Vcc and ground and the probe touched to the circuit under test. The three LEDs will indicate either low, high or a pulse burst. To measure a continuous pulse, the Reset button is held down; a pulse train will appear as a continuous light or a flashing light, depending on the pulse frequency.

The makers, Tektron Equipment Corporation, also supply a wide range of printed circuit manufacturing supplies, including chemicals, resists, drills, etchers, platers, Kepro PCB equipment and more. Their line of PCB production gear is aimed at the small-to-medium-volume producer who wants quality boards without having to buy expensive, full-scale machinery.

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Circle No. 28 on Reader Service Card

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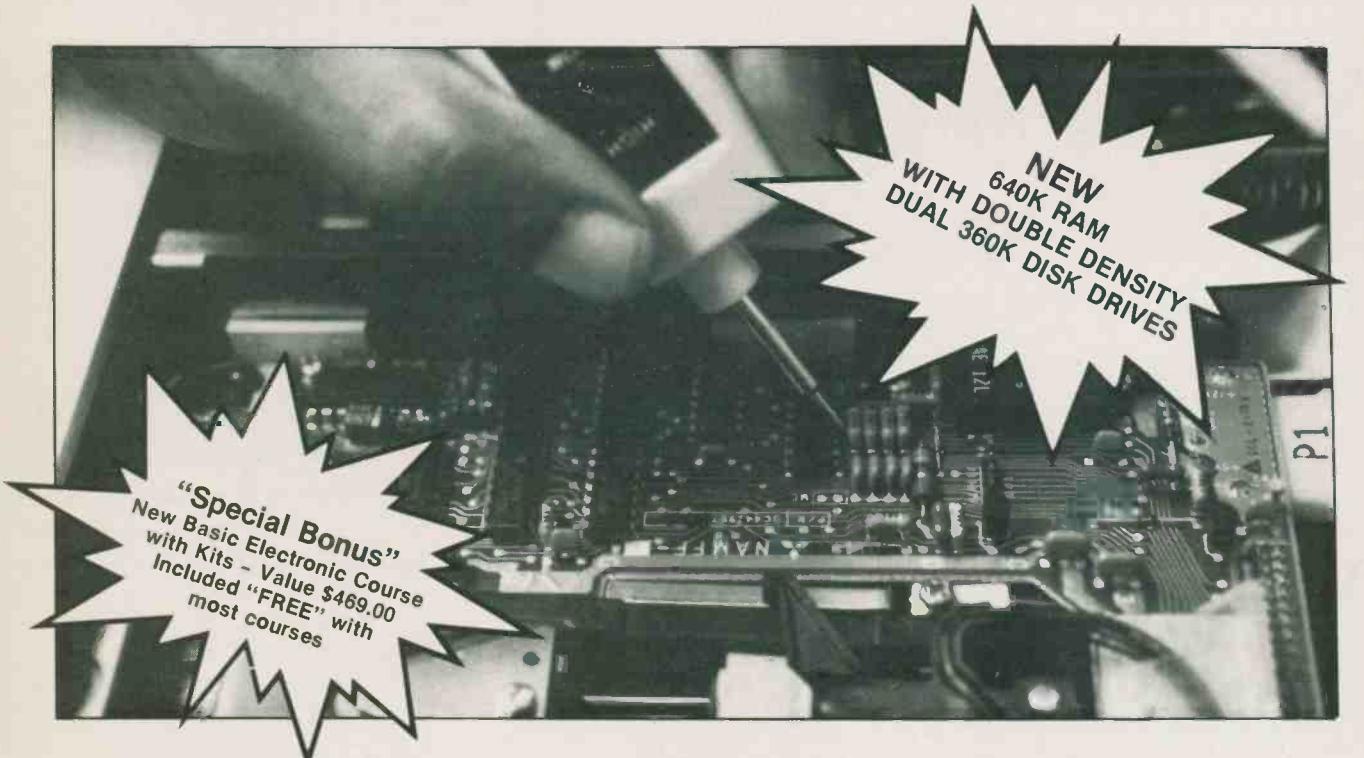

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Versatile Pulse Generator

A different approach to generating pulse waveforms using low-cost, readily available components.

By Mike Tooley

THIS UNIT provides a means of generating a wide range of pulse waveforms which can be used with all types of digital circuitry. The pulse period is adjustable from 1.4s to approximately 14μs in five decade ranges, while the pulse width is adjustable from 0.7s to approximately 7μs in five decade ranges. Two independent outputs are provided: one is TTL compatible (5V peak output) while the other is variable in amplitude over the range 0V to 8V peak.

The unit is operated from a 120V AC supply, uses low-cost readily available components and is built up on standard Veroboard.

Circuit Description

The complete circuit of the Pulse Generator is shown in **Fig. 1**. The transformer, T1, provides 9V AC input to the encapsulated bridge rectifier, D1 to D4. The DC output of the bridge rectifier (approx. 13V) is developed across the reservoir capacitor, C1. Transistor TR1 acts as a simple series regulator in which Zener diode D5 provides a voltage reference of approximately 10V. The LED provides an indication that the supply is present.

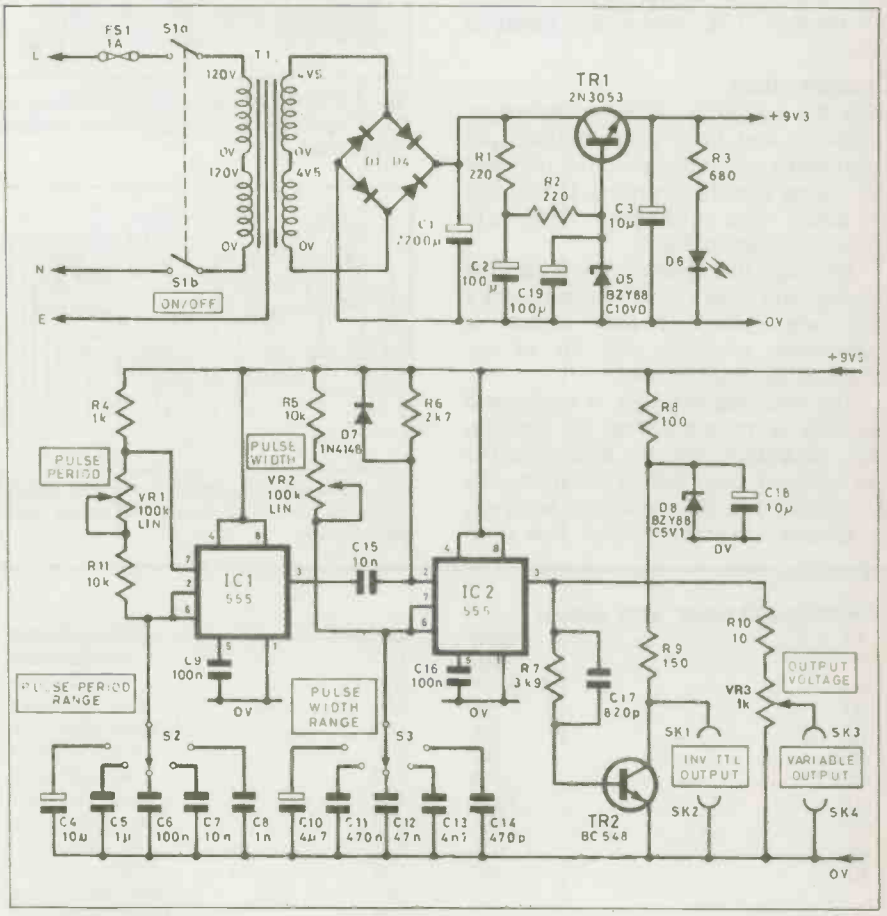

Fig. 1 Complete circuit diagram for the Versatile Pulse Generator.

Pulse Period:	Adjustable from 1·4s to 14μs in five decade ranges.
Pulse Width:	Adjustable from 0·7s to 7μs in five decade ranges.
Pulse Amplitude:	Adjustable from 0V to 8V peak
	Fixed inverted TTL output 5V peak
Rise and Fall Times:	Better than 0·5μs on all ranges.

A standard 555 timer, IC1, is connected in astable mode. Potentiometer VR1 is used to provide adjustment of the pulse repetition frequency (PRF), while switch S2 provides selection of one of five decade timing capacitors. The output of IC1 (a reasonably symmetrical square wave) is applied to trigger input of IC2 by means of the pulse forming network, C15, R6 and D7.

A second 555 timer, IC2, operates in monostable mode with the output period made adjustable by means of potentiometer VR2. Rotary switch S3 also provides five decade switched ranges of timing capacitance.

The output of IC2, comprising a pulse train of adjustable duty cycle, is fed to potentiometer VR3 which provides adjustment of the output level present at socket SK3. Transistor TR2 is an inverter and "inverts" the output signal to provide the inverted TTL compatible signal at SK1.

Construction

With the exception of the transformer, fuseholder and front panel controls, all components are mounted on a standard size matrix board comprising 24 strips of 37 holes. The stripboard component layout is shown in **Fig. 2.**

Be aware that fifteen track breaks are required and these should be made using a spot face cutter. If such a tool is unavailable, a sharp drill bit of appropriate size may be used.

The following sequence of component assembly is recommended; IC sockets, links, capacitors, resistors, bridge rectifier and terminal pins. Before mounting the stripboard in its final position, however, be advised to carefully check that components, links and the 15 track breaks have been correctly placed.

Furthermore, it is also worth checking that the polarized components (including electrolytic capacitors and the bridge rectifier) have been correctly oriented. Also, examine the underside of the stripboard for dry joints, solder splashes and bridges between tracks. Doing this may save you hours of misery later on.

When the board has been thoroughly checked, it should be mounted horizontally in the base of the case using three short insulated stand-off pillars. The IC devices should then be inserted into their sockets, again taking care to ensure correct orientation.

Controls, switches, indicators and output connectors are mounted on the front panel according to the photographs. Suggested overlays are shown actual size in **Fig. 4.** These overlays may be cut out and fixed to the front panel using appropriate adhesive. Links to the front panel mounted components should be made using short lengths of insulated wire, following the wiring diagram shown in Fig. 3.

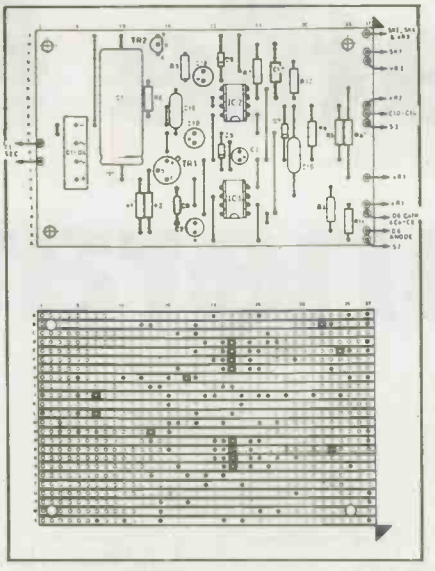

Fig. 2 Circuit board component layout and details of breaks to be made in the underside copper tracks.

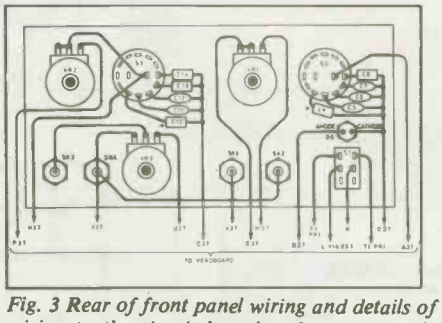

Fig. 3 Rear of front panel wiring and details of wiring to the circuit board and power supply transformer.

Testing

When complete, you should carefully check the internal wiring, taking particular care to check the fuseholder, transformer and power switch. The 120V supply can now be connected and a multimeter (switched to its DC voltage ranges) should be used to check that the voltage across C1 is in the range 11.5V to 13.5V. Having confirmed that this voltage is correct, the meter should be transferred to the positive supply rail (pin 8 of IC1 or IC2) and this should be within the range of 8.5V to 9.5V. The output of the pulse generator can then be checked using a logic probe or oscilloscope. ■

Parts List

Resistors (All 0.25W ±5% carbon)

R1 ..... 220R
R2 ..... 220R
R3 ..... 680R
R4 ..... 1k
R5 ..... 10k
R6 ..... 2k7
R7 ..... 3k9
R8 ..... 100R
R9 ..... 150R
R10 ..... 10R
R11 ..... 10k

Potentiometers

VR1 ..... 100k lin.
VR2 ..... 100k lin.
VR3 ..... 1k lin. wirewound

Capacitors

C1 ..... 2200u axial elect. 25V
C2 ..... 100u PC elect. 16V
C3 ..... 10u PC elect. 16V
C4 ..... 10u axial elect. 25V
C5 ..... 1u polyester
C6 ..... 100n polyester
C7 ..... 10n polyester
C8 ..... 1n polyester
C9 ..... 100n polystyrene
C10 ..... 4u7 axial elect. 25V
C11 ..... 470n polyester
C12 ..... 47n polyester
C13 ..... 4n7 polystyrene
C14 ..... 470p polystyrene
C15 ..... 10n polystyrene
C16 ..... 100n polystyrene
C17 ..... 820p polystyrene
C18 ..... 10u PC elect. 16V
C19 ..... 100u PC elect. 16V

Semiconductors

D1-D4 ... 200V 1.6A In-line bridge rectifier
D5 ..... 10V Zener
D6 ..... Red LED w/bezel
D7 ..... 1N4148
D8 ..... 5.1V Zener
IC1,IC2 ..... 555 Timer
TR1 ..... 2N3053 NPN med power silicon
TR2 ..... 2N5818 or BC548 NPN small signal silicon

Miscellaneous

T1 Transformer 120V primary and a 9V c.t. secondary (see below)
FS1 ..20mm 1A quick-blow fuse and panel mounting fuseholder
S1 ....DPDT mini. rocker switch rated for 120V AC use
S2,S3 ..... 1-pole, 5-way rotary switch
SK1-SK4 ..... 4mm sockets (2 black, 1 red, 1 yellow)

Case to suit; Veroboard; single-sided 1mm terminal pins (13 required); 2 low-profile 8-pin DIL sockets; insulated spacers or mounting pillars; mounting nuts and bolts.

Electro Sonic Inc. stocks a suitable Hammond transformer, 166G9. Electro Sonic, 1100 Gordon Baker Rd., Willowdale Ontario, M2H 3B3. (416) 494-1555.

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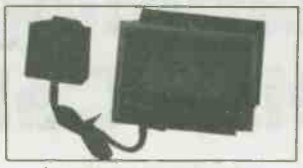

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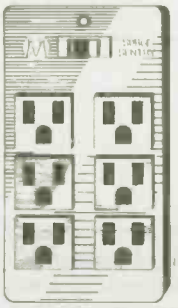

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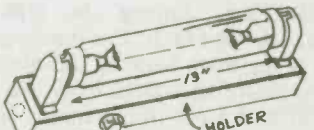

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8088 Programming: FCBs and Disk Calls

How DOS controls the disk, and how you can read or write a disk file.

By Ellery Henn

THE one thing that makes or breaks a computer is often its storage capabilities: where your program or text ends up when you've saved it. How many companies are still manufacturing tape-only computers? Even fancy tape systems like Coleco's Adam are dead and buried, though I suspect its printer aided its demise.

Disk operating systems offer fast and reasonably dependable storage and retrieval, something most users demand. The ability to access disk calls through assembler programs assuredly gives your programs versatility ... but how is it done? Much of it through the help of File Control Blocks.

A File Control Block, or FCB, is a 37-byte chunk of memory that tells DOS what to look for, and gives it a place to store file information during disk accesses. It is generally followed by a buffer of 128 bytes or so that the Disk Transfer Address, or DTA, uses. You'll need to define as many FCBs as files you intend to use. If you're reading from one file, and writing to another, two FCBs will have to be defined in your program.

Have a look at listing two, QuickDIR.COM. Among the DBs is FILECB, a defined FCB. The first byte of an FCB is the drive number. A value of zero here means that DOS is to use the default drive. A value of one means drive A:, two means B: and so on. If you were using an FCB for writing data to the C: drive only, you'd put a "3" here.

Following the drive number are 8 bytes for the filename, and 3 bytes for the extension. In the listing, I want to print all the filenames of the directory out, so question marks are placed in all 11 locations. This ensures that every file matches the criteria. If I'd placed "COM" in the last three bytes, I could write a quick utility that would search only for files ending in the .COM extension, similar to the DIR *.COM command.

The two bytes following the filename and extension are the current block pointer, which DOS uses in conjunction with the current record byte, to point to one of the 128 records in the current block. When you OPEN an FCB using function 0FH, INT 21H, these bytes are set to zero.

Next are two bytes which hold the size of the records you want to read or write. The default is 128 bytes, but you can change that if you desire, so long as you change it *after* opening the file. The next four bytes are used by DOS for the file's size. Take note that they're in reverse order ...

The date and time that the file was last written to each occupy two bytes. They're set up a little strangely. For the two date bytes, the bits are mapped as follow, going from bit zero to bit 15: DDDDDMMMMYYYYYYY. The Ds represent the day, which in binary can be a maximum of 31, or a minimum of zero. Sometimes you see a file where someone's taken that liberty. The Ms are the four bits used for month, 1 to 12. Again, zero could be inserted. The year takes up seven bits, a value from zero to 119 which DOS adds to 1980. If your great-grandchildren are still using your DOS in 2100, it's time for an upgrade.

The time is handled similarly. From bits zero to 15: SSSSSMMMMMMHHHHH. In order to place the time into 16 bits, the seconds are handled as two-second increments. The minutes fit nicely into six bits from zero to 59, and the hours fit into the last five bits, zero to 23.

DOS provides two functions under INT 21H to read, and two to set the system date and time. To set the date in your program, MOV the date (1980 to 2099) in binary to CX, the day (0 to 31) into DL, the month (1 to 12) into DH, the function call 2BH into AH and enact INT 21H. If AH holds the value of 0FFH after the interrupt, your date wasn't accepted. To get the date from the system, MOV function call 2AH into AH and do INT 21H. DOS will place the year into CX, the month into DH and the day into DL. To set the system time, MOV function 2DH into AH, the hour (0 to 23) into CH, the minutes (0 to 59) into CL, the seconds (0 to 59) into DH and the 100ths of a second (0 to 99) into DL. Then do INT 21H. You can ignore DL if you want. To set the time, MOV function 2CH into AH and do INT 21H. DOS will place the time into the above registers.

Getting back to the FCB, the next eight bytes are reserved by DOS for housekeeping. The next FCB byte is the current record byte, which acts with the current block bytes as a record pointer. If you'll be reading or writing bytes sequentially to a file, you'll have to set this before each read or write.

The last four FCB bytes are the relative record, used when randomly (as opposed to sequentially) reading or writing to a file. These bytes point to the currently selected record. If the record size is less than 64 bytes, all four bytes of the pointer are used. The first three bytes are used when the record length exceeds 64 bytes. You have to set these bytes before you accomplish a random read or write to a file.

The Disk Transfer Address, mentioned previously, is simply a buffer area

where records can be read from or written to. It must be at least as long as the largest record you're going to be either reading or writing.

The Wind Blows Where it Lists

Listing one, DOSVER.COM, is a simple 172-byte program that utilises function 30H under Interrupt 21H. Function 30H accomplishes the same thing as a VER command from DOS. When the interrupt is enacted with 30H in the AH register, the DOS version is returned within the AX register, and the OEM number is in the BH register. IBM's OEM number is zero. If you are using MS-DOS rather that PC-DOS, the OEM number may hold some interest for you.

When the AX register is inspected after returning from INT 21H, it shows the DOS version of the DOS image in memory. Register AL holds the major number -- 3, for instance -- and AH holds the minor number, that appears to the right of the version's decimal point.

It's one thing to haul the numbers up from memory's depths, but we can't display the hexadecimal numbers as we get them without converting them to ASCII. Because the major version number is a single-digit number, simply ADDing 30H to it converts it to ASCII, ready for display. I've treated the OEM number the same way, but it's certainly possible that there are more than nine OEMs who have licences to DOS. If no number or a bizarre character appears next to OEM: on your screen, I apologise.

The minor version number, as it is a dual digit, isn't as simply handled. The PROCeedure NUMBER in DOSVER. COM translates the characters into ASCII through division. NUMBER also appears in listing two, QuickDIR, to handle the file count.

QuickDIR's purpose is to print as many filenames on the screen as possible without scrolling. It's similar in function to the DIR/W function in DOS, though it's a bit faster.

One of the limitations that DOS enforces regarding floppy use is the number of files allowed in your directory. If, for reasons known only to yourself, you're using DOS version one, you're only allowed 64 directory entries before DOS springs a "file creation" error on you. Some RAMdisks are set up to appear as single-sided disks to DOS, so these will give you the same limitation. Double-sided disk users are allowed 112 directory entries. If you've got a hard drive, though, you're limited only by your media space.

Fast Food

When called from DOS, QDIR.COM clears the screen, places its title on the bot-

Listing 1

```
;;;;;;;;;;;;;;;;;;;;;;;;;
;
;       DOSVER.COM
;
; Assembled with A86.COM
; Public Domain assembler
;
;;;;;;;;;;;;;;;;;;;;;;;;;
;
DATA SEGMENT
CODE SEGMENT
        JMP GO
MAJOR   DB      '0'
MINOR   DB      '00$'
OEM     DB      '0'
NUM     DW      0
TEMP    DB      0
MSG1    DB      'DOS Version: $'
MSG2    DB      '.'
MSG3    DB      '     OEM: $'
CRLFLF  DB      ODH,OAH,OAH,'$'
;
GO:     MOV     AH,030H
        INT     21H             ;Check DOS version
        ADD     AL,030H         ;Make AL ASCII
        MOV     MAJOR,AL        ;and place in memory
        MOV     TEMP,AH         ;Store AH temporarily
        XOR     AX,AX           ;while we clear AX,
        MOV     AL,TEMP         ;recover AH into AL,
        MOV     NUM,AX          ;then plop it into NUM.
        CALL    NUMBER          ;Make minor # ASCII
A6:     MOV     AH,9
        MOV     DX,OFFSET CRLFLF
        INT     21H             ;Print RETURN & 2 LFs
        ADD     BH,030H         ;Make OEM# ASCII
        MOV     OEM,BH          ;Place it in memory
        MOV     AH,9
        MOV     DX,OFFSET MSG1
        INT     21H             ;Print MSG1
        MOV     AH,2
        MOV     DL,MAJOR
        INT     21H             ;Print ASCII # in MAJOR
        MOV     AH,2
        MOV     DL,MSG2
        INT     21H             ;Print decimal point
        MOV     AH,9
        MOV     DX,OFFSET MINOR
        INT     21H             ;Print ASCII # in MINOR
        MOV     AH,9
        MOV     DX,OFFSET MSG3
        INT     21H             ;Print MSG3
        MOV     AH,2
        MOV     DL,OEM
        INT     21H             ;Print ASCII # in OEM
        MOV     AH,9
        MOV     DX,OFFSET CRLFLF
        INT     21H             ;Print RETURN + 2 LFs
        INT     20H             ;Program terminates
;
NUMBER  PROC                    ;Hex number to ASCII
        PUSH    BX
        PUSH    DX
        PUSH    SI
        MOV     CX,2            ;2 blanks ...
        MOV     BX,OFFSET MINOR
        MOV     AX,NUM
NO:     MOV     BYTE PTR [BX],' '       ;Blank bytes
        INC     BX
        LOOP    NO              ;until both blanked
        MOV     SI,OAH          ;Move 10 into SI
N1:     XOR     DX,DX           ;Clear DX
        DIV     SI              ;Divide AX by 10
        ADD     DX,'0'          ;Change remainder
        DEC     BX              ;Do next number
        MOV     [BX],DL         ;Put DL into MINOR
        OR      AX,AX           ;Finished?
        JNE     N1              ;No. Next number.
        POP     SI              ;Yes. Pop everything
        POP     DX
        POP     BX
        RET                     ;and return.
NUMBER  ENDP
;
CODE ENDS
DATA ENDS
END
```

Listing 2

```
;;;;;;;;;;;;;;;;;;;;;;;;
;
;     QUICKDIR.COM
;    by Ellery Henn
;    1987  HennSoft
;
;;;;;;;;;;;;;;;;;;;;;;;;
;
DATA SEGMENT
CODE SEGMENT
        JMP GO
QUIT    DB      0
NUM     DW      0
ASCNUM  DB      '000$'
ROW     DB      1
COL     DB      0
MSG1    DB      'QuickDIR - 1987 HennSoft -$'
MSG2    DB      '[Hit any key to continue ... ]: $'
MSG3    DB      07H,'Too many files ... Program overextended.$'
MSG4    DB      'files in this directory.$'
MSG5    DB      07H,'NO FILES ON DISK!',0DH,0AH,0AH,'$'
CRLF    DB      0DH,0AH,'$'
FILECB  DB      0,'???????????'
        DB      25 DUP(?)
BUF     DB      128 DUP(?)
DELIM   DB      '$'
;
GO:     CALL    CLS         ;Clear the screen
        MOV     BH,0
        MOV     AH,2
        MOV     DH,24       ;Row 24
        MOV     DL,0        ;Column 0
        INT     10H         ;Set cursor position
        MOV     AH,9
        MOV     DX,OFFSET MSG1
        INT     21H         ;Print first message
        MOV     BH,0
        MOV     AH,2
        MOV     DH,24       ;Row 24
        MOV     DL,31       ;Column 31
        INT     10H         ;Set cursor position
        MOV     AH,9
        MOV     DX,OFFSET MSG4
        INT     21H
        MOV     BH,0
        MOV     AH,2
        MOV     DH,24       ;Row 24
        MOV     DL,27       ;Column 27
        INT     10H         ;Set cursor position
        MOV     AH,9
        MOV     BL,070H     ;Reverse attribute
        MOV     CX,3
        MOV     AL,' '
        INT     10H         ;Write chrs/attrs to screen
        MOV     BH,0
        MOV     AH,2
        MOV     DH,3        ;Row 3
        MOV     DL,0        ;Column 1
        INT     10H         ;Set cursor position
        MOV     AH,01AH
        MOV     DX,OFFSET BUF
        INT     21H         ;Set Disk Transfer Address
        MOV     AH,011H
        MOV     DX,OFFSET FILECB
        INT     21H         ;Search for 1st dir entry
        CMP     AL,0FFH     ;Is there a file? (0FFH = no)
        JE      NOFILE
        INC     NUM
        CALL    ROUTINE
G1:     MOV     AH,012H
        MOV     DX,OFFSET FILECB
        INT     21H         ;Search for other files
        CMP     AL,0FFH     ;Does file exist?
        JE      DONE        ;No. Finish up.
        INC     NUM
        CALL    ROUTINE
        MOV     AL,QUIT
        CMP     AL,1        ;Have we too many files?
        JE      DONE        ;Yep. Scram.
        JMP     G1          ;Continue 'til no files
NOFILE: MOV     AH,9
        MOV     DX,OFFSET MSG5
        INT     21H         ;No files message
        INT     20H         ;That's enough.
DONE:   CALL    NUMBER      ;Change Hex to ASCII
        MOV     AH,2
        MOV     BH,0
        MOV     DH,24
        MOV     DL,27
        INT     10H         ;Place # of files at R,C:24,27
        MOV     AH,9
        MOV     DX,OFFSET ASCNUM
        INT     21H         ;Print # of files there
        MOV     DX,OFFSET CRLF
        INT     21H
        INT     20H         ;Split.
;
CLS     PROC
        MOV     AH,6
        XOR     AL,AL
        XOR     CX,CX
        MOV     DH,24
        MOV     DL,79
        MOV     BH,7
        INT     10H     ;Clear the screen
        MOV     AH,2
        MOV     BH,0
        XOR     DX,DX
        INT     10H     ;Set cursor position 0,0
        RET
CLS     ENDP
;
ROUTINE PROC
        CMP     ROW,21
        JG      R1
        INC     ROW
        CMP     NUM,106     ;Full screen?
        JE      C1
        CMP     NUM,211     ;2nd full screen?
        JE      C2
R0:     MOV     AH,2
        MOV     BH,0
        MOV     DH,ROW
        MOV     DL,COL
        INT     10H         ;Set cursor position
        MOV     AH,2
        MOV     CX,8
        MOV     DI,026H     ;Offset for filename
L1:     MOV     DL,FILECB[DI]   ;point to it.
        INT     21H         ;Print one chr of filename
        INC     DI          ;and go print
        LOOP    L1          ;the rest.
        MOV     DL,'.'      ;Print period
        INT     21H
        MOV     DI,02EH     ;Offset for extension
        MOV     CX,3        ;three characters long
L2:     MOV     DL,FILECB[DI]   ;Point to it.
        INT     21H         ;Print one chr of ext.
        INC     DI          ;and go print
        LOOP    L2          ;the rest.
        RET                 ;Return
R1:     CMP     COL,64      ;Used the last column yet?
        JE      C1          ;Yes, reset.
        MOV     AL,COL      ;No, ADD 16 for the next
        ADD     AL,16       ;display column
        MOV     COL,AL      ;Go to next column
        MOV     ROW,2       ;Reset ROW
        JMP     R0          ;Go print the filename
C1:     MOV     BH,0
        MOV     AH,2
        MOV     DH,0
        MOV     DL,0        ;Reset cursor to
        INT     10H         ;top of screen
        MOV     AH,9
        MOV     DX,OFFSET MSG2
        INT     21H         ;Print 'hit any key' message.
        MOV     AH,0CH
        MOV     AL,8
        INT     21H         ;Clear kbd buffer and wait
        MOV     AH,6
        XOR     AL,AL
        XOR     CX,CX
        MOV     DH,23
        MOV     DL,79
        MOV     BH,7
```

```
            INT     10H     ;Clear the screen window
            MOV     COL,0
            MOV     ROW,2     ;Reset row and column
            JMP     RO        ;Print filename
C2:         MOV     BH,0
            MOV     AH,2
            MOV     DH,24
            MOV     DL,0
            INT     10H       ;Bottom of screen
            MOV     AH,9
            MOV     DX,OFFSET MSG3
            INT     21H       ;Too many files ...
            MOV     QUIT,1
            RET
ROUTINE     ENDP
;
NUMBER      PROC              ;Change Hex # to ASCII
            PUSH    BX
            PUSH    DX
            PUSH    SI
            MOV     CX,3
            MOV     BX,OFFSET ASCNUM
            MOV     AX,NUM
NO:         MOV     BYTE PTR [BX],' '
            INC     BX
            LOOP    NO
            MOV     SI,0AH
N1:         XOR     DX,DX
            DIV     SI
            ADD     DX,'0'
            DEC     BX
            MOV     [BX],DL
            OR      AX,AX
            JNE     N1
            POP     SI
            POP     DX
            POP     BX
            RET
NUMBER      ENDP
;
CODE ENDS
DATA ENDS
END
```

Listing 3

```
CODEX     SEGMENT PARA PUBLIC 'CODE'
          ASSUME CS:CODEX,DS:CODEX,SS:CODEX,ES:CODEX

          ORG     100H
BEGIN:    JMP     GO

; DBs and EQUs go here

GO        PROC    NEAR

; code goes here

          RET
GO        ENDP
CODEX     ENDS
          END     BEGIN
```

tom line of the screen using the function 2, INT 10H cursor positioning routine. The row is put into DH, the column into DL and the page number into BH. The next print routine following this will print at that location. Three spaces are then printed in the reverse attribute accomplished through the function 9, INT 10H routine, which prints a character and whatever attribute you want to give it. DL holds the character, BL carries the attribute. We looked at screen attributes here in the February '87 issue. A loop using CX prints the three spaces.

We then start to access the disk. Up near the top of the listing a File Control Block has been defined, FILECB. QDIR.COM pulls the directory from the default drive, so the first byte of FILECB is zero. Eleven question marks in the filename mean that every file in the directory will match, as I wish to display them all. Twenty-five blank bytes finish off the FCB ... DOS will use them.

The Disk Transfer Address is set to the 128 buffer BUF using function 1AH and INT 21H. DOS will store directory information here. Then, using function 11H and INT 21H, the program searches for the first file on the disk. If it can't find one, 0FFH is returned in AL, and the program ends with a "no files on disk" error.

Once the first file's been found, NUM is incremented so the program knows how many files there are. The PROCeedure ROUTINE is then called to print the filename onscreen, and keep track of where everything's being printed. After returning from ROUTINE, function 12H and INT 21H are used to search for subsequent directory entries. When these are found, they're printed through ROUTINE until the screen fills, we run out of directory entries, or there are too many entries too bother with (over 210).

When the screen fills up after 105 file names, it waits for you to hit a key before it clears the screen window and displays another 105. If you've got more than 210 files in your current directory, it gives up on you. When the program terminates, the number in NUM is translated to ASCII through the PROCeedure NUMBER. It is then, after cursor positioning, printed on the inverse spaces, telling you how many entries are in the directory.

QuickDIR.COM assembles into a compact 719-byte program. It doesn't tell you how much disk space you've got left, nor will it let you see what's on another drive, unless you log onto that drive and PATH back to the drive holding QDIR.COM. If you've got a hard drive, and QDIR.COM is in your main directory, type:

PATH=C:

and in theory, you should be able to get a QuickDIR of the subdirectory you're in.

Both DOSVER.COM and QDIR.COM were assembled with a public domain assembler entitled 'A86.COM'. It's extremely fast, and extremely economical, though it is feeware. I'd rate this miles above chASM, the Cheap Assembler which is also in the public domain. If you don't want to type QDIR and DOSVER in, but would like to have them, send $10.00 to:

HennSoft
208 - 2525 Bathurst St.,
Toronto M6B 2Y9

and I'll send a disk with the listings and the A86 assembler to you.

If you've got MASM, the listings may appear a little off. Ignore the DATA SEGMENT and CODE SEGMENT at the top of the listing and follow the MASM code skeleton shown in listing three.

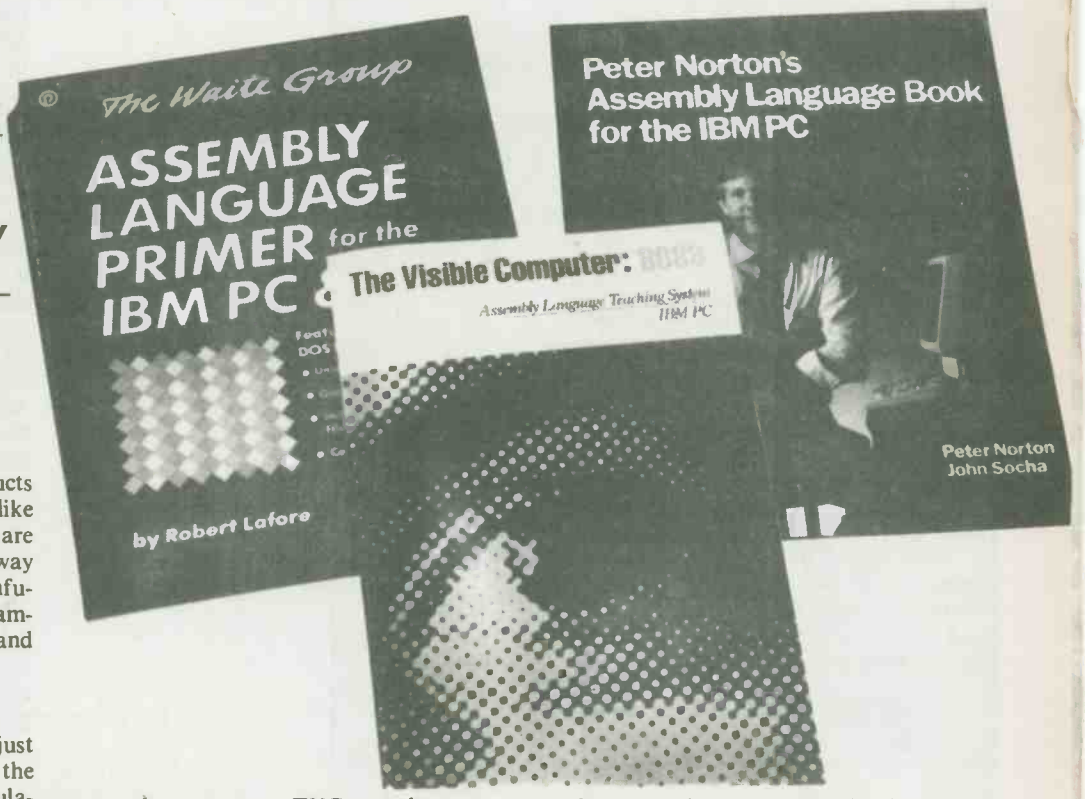
In Closing

There are a host of other beasties within DOS that space hasn't permitted this month, so we'll be looking at more disk functions of INT 21H in an upcoming issue. ■

8088 Companions

Some programming tools that make life easier for PC assembly language.

By Bill Markwick



EVERY now and then, some products happen along that are just so good, I like to do an unsolicited rave-up. Here are three such products that go a long way toward sorting out the inevitable confusion that results when you begin programming in 8088 assembler (IBM PCs and compatibles).

The Visible Computer

If you're just beginning, or if you'd just like to take a graphic look into the mysteries of the 8088 register manipulations, there can't be a better way than *The Visible Computer*. It consists of a book and a disk, but shouldn't be confused with the usual software-plus-manual approach. The book is a thoroughly enjoyable discourse on the 8088 instruction set and register handling, while the disk presents a windowed display consisting of the register contents, flag status, the instruction codes of the program being run, and a prompt line for entering commands.

The book begins with a short review of hex notation, digital logic and machine language format, and then introduces you to the structure of the TVC display and how to enter commands. The Calculator section alone makes it a good buy: it works in binary, hexadecimal and decimal, converting any number into or out of any format.

The next section plunges into segments and memory, probably the biggest hurdle to overcome in learning 8088 assembler. Once you get a basic grasp of what's going on, you're ready to run basic programs in the TVC mode, and this is where the package really shines.

First, a small machine language demo program is loaded from the disk. Next, you'll find that the majority of commands emulate the Debug set, so you don't have to learn two different systems. Next you'll run the program; TVC can be set to various speeds of operation, from full speed to the slowest demo mode. In the later mode, you step through each section of each instruction with the spacebar; the displayed registers and flags change to show you the data moving through the CPU. Nothing is left hidden; you'll see exactly how the 8088 reacts to any instruction. Once you get the hang of the internal 8088 manipulations, you can speed up the demonstration to the next level; this suppresses the display of all the hardware-level steps and just shows data going from register to register. At the fastest speed, programs are run at about the same speed you'd get from the Debug "g" command.

Continuing on through the course, you'll find the manual covers addressing, loops, arithmetic operations, stacks, string handling, interrupts and all the other

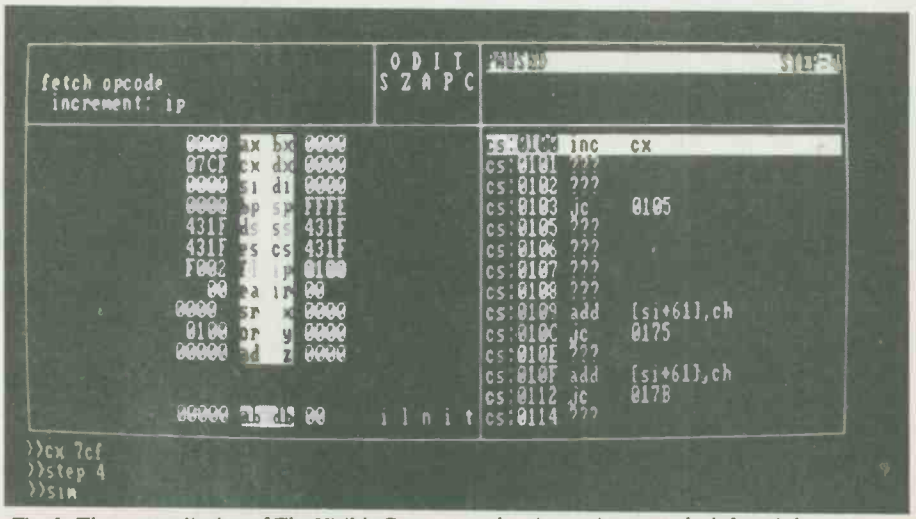


Fig. 1. The screen display of The Visible Computer, showing registers on the left and the space for the program on the right.

basics you need for assembler programming. Included on the TVC disk are demonstration programs that let you dissect commands and programs to see how it's done.

The Visible Computer is available from computer bookstores, or you can contact the publishers, *Software Masters*, PO Box 3638, Bryan, Texas 77805, (409) 822-9490. It's presently selling for $79.95US, and worth every penny.

The Primer

When it comes to computer books, there's an awful lot of dreck out there. Many of the texts are nothing more than rewrites of the IBM manual and provide little new information. That's why the books from the Waite Group came on the scene like a breath of fresh air. As far as I know, they made their mark with two of the best books ever written on CP/M, *The CP/M Bible* and *The Soul of CP/M*. Now they've done it again with the *Assembly Language Primer for the IBM PC/XT*.

The author, Robert Lafore, uses the Debug approach for most of the book, listing small programs that you can load in and run. A complete explanation is given, complete with boxed areas that explain the particular instruction code in use. Just about every area of assembler programming is covered; the MASM assembler, file handling and segmentation, for instance, are covered in depth, and such topics as graphics and interfacing with other language are covered in an introductory format. I've typed in and assembled about a dozen of the handy utilities used as examples, and all of them performed as they should.

The style of the book is a friendly conversational method, but it never gets in the way of a lucid explanation. Definitely one of the best resources for the beginning programmer.

At computer bookstores, or contact the Canadian distributors: New American Library of Canada, 81 Mack Avenue, Scarborough, Ontario M1L 1M8, (416) 699-7193.

Mr. Norton

Peter Norton rose to fame among computer users with his *Norton Utilities*, a handy disk to have if you need to unerase, fix sectors, test disks and so forth (incidentally, the new version of the Utilities has a vastly more convenient menu structure and a much faster unerase). He is also the co-author with John Socha of a book for programmers, *Peter Norton's Assembly Language Book for the IBM PC*.

This one is a lucid as the Lafore book, but takes a slightly different approach in the examples used. Each little utility that you learn to program can be linked into a larger program; the idea is that you end up with a disk of special utilities somewhat similar to the Norton Utilities. If you aren't going to follow the book step by step, you can still get all the programs on a floppy disk by sending off the postcard enclosed with the book; the disk is presently selling for $24.95US.

Since Mr. Norton is noted for coming up with performance improvements and modifications to the PC, it's not surprising that the book contains some changes to the standard DOS approach. There are little programs that modify the cursor, improve the keyboard input, enhance the display and so on. An excellent choice for those who like to tinker with DOS operation.

At computer bookstores, or contact the publishers, Brady Communications Company, Prentice-Hall, PO Box 512, W. Nyack, NY 10996. ■

Fibre Optics

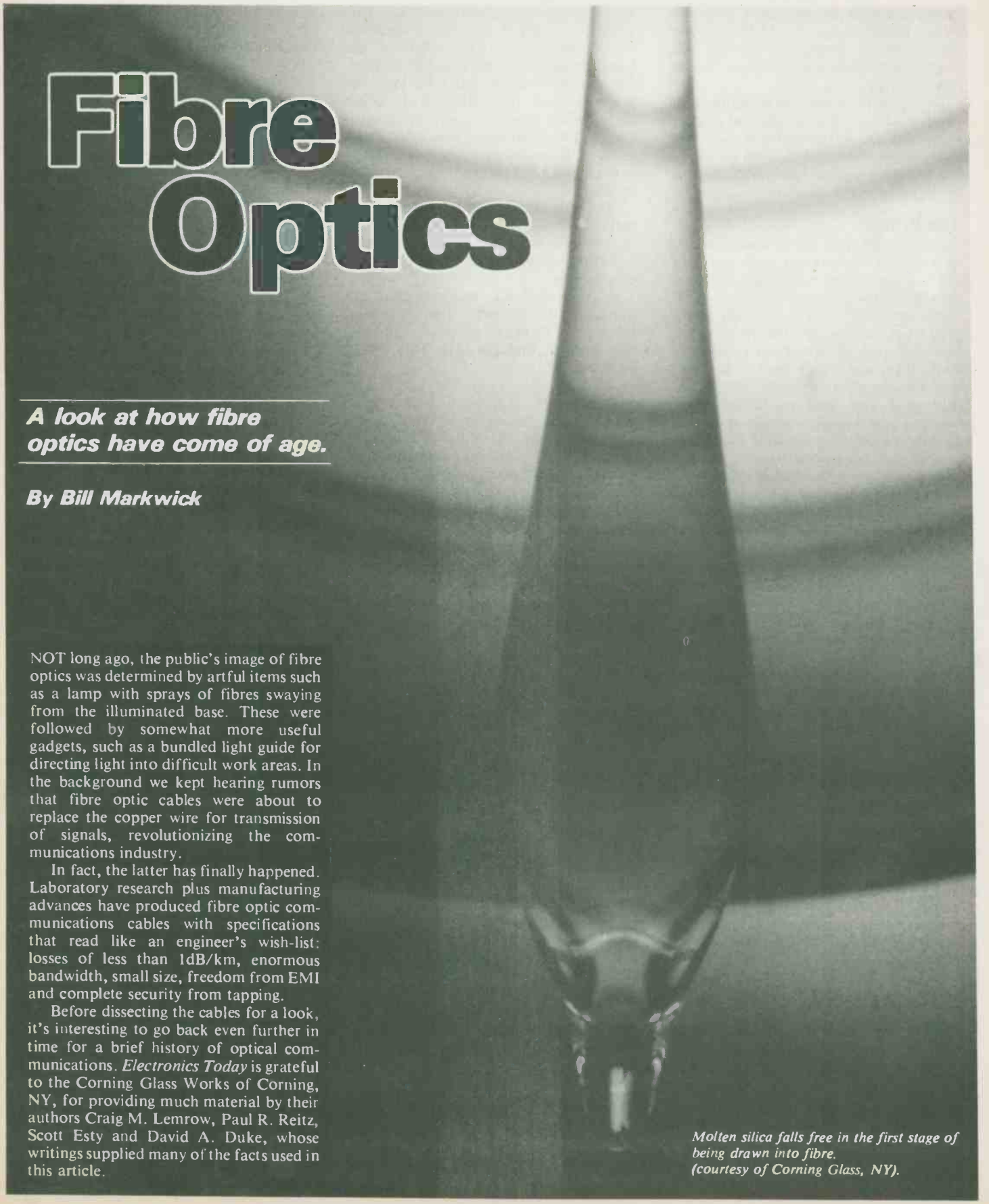
A look at how fibre optics have come of age.

By Bill Markwick

NOT long ago, the public's image of fibre optics was determined by artful items such as a lamp with sprays of fibres swaying from the illuminated base. These were followed by somewhat more useful gadgets, such as a bundled light guide for directing light into difficult work areas. In the background we kept hearing rumors that fibre optic cables were about to replace the copper wire for transmission of signals, revolutionizing the communications industry.

In fact, the latter has finally happened. Laboratory research plus manufacturing advances have produced fibre optic communications cables with specifications that read like an engineer's wish-list: losses of less than 1dB/km, enormous bandwidth, small size, freedom from EMI and complete security from tapping.

Before dissecting the cables for a look, it's interesting to go back even further in time for a brief history of optical communications. *Electronics Today* is grateful to the Corning Glass Works of Corning, NY, for providing much material by their authors Craig M. Lemrow, Paul R. Reitz, Scott Esty and David A. Duke, whose writings supplied many of the facts used in this article.



Molten silica falls free in the first stage of being drawn into fibre. (courtesy of Corning Glass, NY).

Optical Communications

The urge to improve the bandwidth, response time and simplicity of optical communications must have started when the first smoke signal fire was rained out. History is full of various examples of signalling mirrors, towers and semaphore stations; the French had a formal network of towers in the late 18th century, running 230 kilometres and used to communicate war news to Paris. The speed of transmission was tremendous for the time, at least compared to a horse and rider, and soon other countries had a version of the "optical telegraph". This is the origin of the name "Telegraph Hill" that turns up in many cities.

The susceptibility to bad weather, not to mention the need to attract the operator's attention, meant that the optical telegraph was soon to be replaced by the electrical version. However, it didn't mean a loss of interest in using light beams to replace cumbersome cabling; it's just that the practical problems involved meant that most of the work being done was limited to the laboratory.

Alexander Graham Bell came up with a device he called the Photophone in 1880. Sound waves controlled the vibration of a mirror, modulating a beam of sunlight. A selenium cell and telephone receiver at the other end was used to convert the light modulations back into audio. His apparatus worked, and in fact can be made to work today at the Smithsonian Institute. As a commercial entity, however, it never caught on, largely due to the difficulty of maintaining the proper light beam under all conditions.

British physicist John Tyndall demonstrated the principle of "light-piping" in the 19th century; he showed how a light wave could be guided through a curved stream of water pouring from a tank, since the light beam would be reflected from the air/water boundary of the pipe where two different refractive indices met. A contemporary of Tyndall's, Charles Vernon Boys, succeeded in making glass fibres from molten quartz, and though they weren't suitable for light-piping, it showed the possibility of using glass for more than window panes.

In the 1930s and 40s, proposals were made and even patents issued for various sorts of optical networks that could carry audio or video signals. None reached any sort of commercial use due to the lack of suitable hardware, and large-scale optical communications remained in the theoretical stage.

Then, in 1960, Theodore Maiman of Hughes Research in California, operated the first practical laser. Its output was narrow, monochromatic, and coherent; these characteristics, plus its small size, made it the ideal source for a lightwave transmitter. Reception at the other end was easily implemented with available photocells; the remaining task was to eliminate sending the light beam through the atmosphere, where it could be plagued by interference.

Enter Fibres

Practical optical fibres weren't new; bundles of fibres that could transmit images had been demonstrated in the 1950s, and it was suggested that they might make the ideal medium for information transmission. Unfortunately, the best fibres available in the 1960s had a loss of about 1000 decibels per kilometre, making them impractical for long-haul use. Engineers felt that if the losses could be reduced to about 20dB/km, then fibre optics would become practical for long-distance communications.

A group of researchers at Corning Glass, headed by Robert D. Maurer, set out to improve the available fibres. The new fibre would have to have a tiny inner core to reduce multiple paths, and the outer cladding would have to have a lower refractive index to ensure total internal reflection. Past attempts with compound glasses had produced very high losses due to impurities in the glass, and the Corning group decided to use fused silica, a particularly pure form of glass. Unfortunately, it also has the lowest refractive index of practical glasses, making it difficult to come up with a cladding with an index even lower.

Maurer and the Corning researchers solved the problem by making the fibre out of a single strand of pure fused silica and adding a dopant to the core. This dopant raised the refractive index in the core, producing a fibre with the required internal reflectance. The original dopant was titanium, later to be replaced by germanium, and variations on the doping method are still used today.

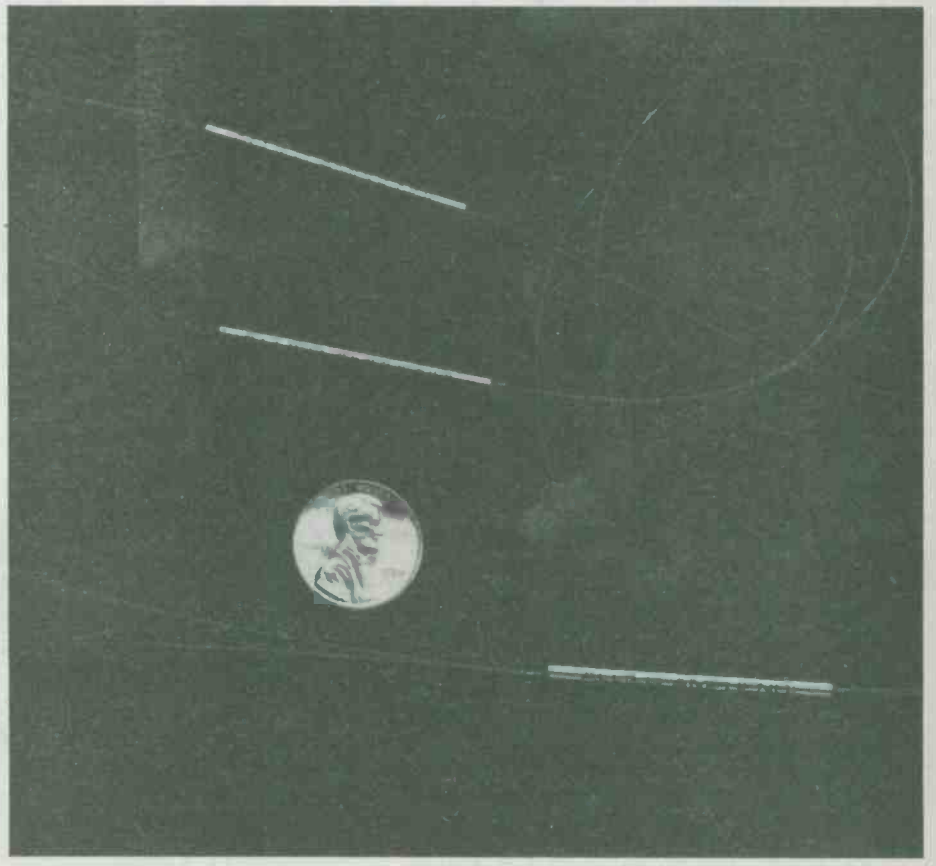


Fig. 1. New methods of making fibre optics couplers have eliminated the difficulties in splicing (courtesy Allied Amphenol).

The initial fibre out of the lab must have been staggeringly disappointing: its loss proved to be 10,000dB/km, about the transmission effectiveness of the average brick. However, refinements in the manufacturing techniques had the loss down to 17dB/km by 1970, and viable optical fibres for long-haul use were now a reality. Interestingly, Maurer points out that little was heard about fibre optics during the 60s and early 70s because "we didn't feel we had much to talk about until we reached 20dB/km."

Continued on page 74

Designer's Notebook:

Electric Motor Drives
Part II

A continuation of the ins and outs of electric motor drive specifications.

By Dr. H.R. Virani

THE SPEED of a standard induction motor is fixed by the frequency of its supply according to the formula

$$N = (120f/P) - s$$

where N = motor speed (RPM)
f = frequency of the supply (HZ)
p = the number of poles
s = motor slip in rpm (typically less than 0.05n).

For example, a normal four pole 50 HZ (1500 rpm) motor fed with 25HZ will run at 750 rpm. In most modern AC drives, the fixed frequency three phase supply is rectified to DC and reconverted to a synthesised sinusoidal three phase variable frequency waveform. This pulse width modulated (PWM) type of supply is used to drive the induction motor at variable speed.

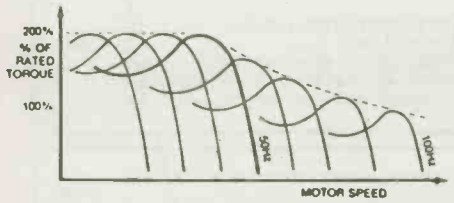


Fig. 1a (above): Torque speed characteristics at varying frequencies. Fig 1b (below). Motor torque and power versus speed characteristics.

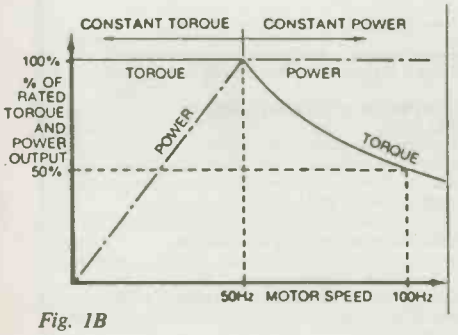


Fig. 1B

The normal three phase induction motor torque vs speed curve is shown in **Fig. 1a**. By maintaining the proper magnetising conditions in the induction motor, while varying the frequency, the curve can be transposed as shown in Fig. 1a. Below normal speed (50 HZ) full torque may be developed. However, above normal speed insufficient voltage is available to maintain the correct magnetising conditions. The available torque decreases inversely with increase in frequency. Thus, when under variable speed control, the induction motor maintains its normal torque characteristics up to 50 HZ but drops off beyond 50HZ. The power characteristic linearly increases to 50 HZ and remains flat (constant power) beyond 50 HZ **(Fig. 1b)**.

The Motor and the Load

The torque speed/curve developed under Fig. 1b is the general case. In practice the reduced effectiveness of the motor's internal cooling fan, in combination with small additional losses due to the PWM waveform, require that the continuous torque rotating of a given motor be reduced when connected to a variable speed AC drive. A set of typical motor torque derating curves (torque vs speed) are given in **Fig. 2.**

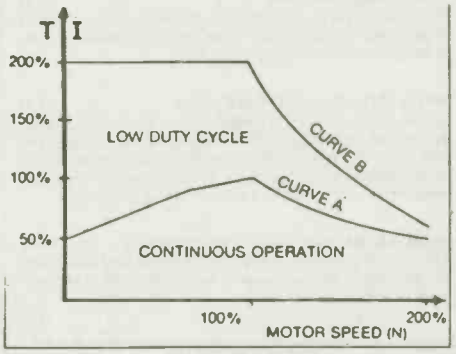


Fig 2: Torque speed motor thermal derating curves.

These curves result from experimental tests on a typical four pole induction motor. Some variation may be expected, especially for multi-pole and ventilated motors. When selecting a motor it is necessary to ensure that the continuous load torque demand lies within the motor continuous operating curve area (curve A) of Fig. 2.

Transient or overload torques must lie within the low duty cycle overload area (curve B). Note also the relationship of the motor current to the motor torque. Examples showing typical load characteristics against the derating curves are given in **Fig. 3.** The area of continuous variable speed operation are clearly defined as above curve A. The area of permissible intermittent or low duty cycle operation are found under cuve B, where the range of continuous operation is not wide enough it will be necessary to select a large motor frame size so that curve A is increased. It may not be necessary to increase the size of the AC drive if the rated drive current is not exceeded by the new motor at the specified load.

Selection of the AC Drive

The selection of a correctly sized induction motor is the first step towards a successful application. The fundamental specification of the matching AC drive is that of the current which it is required to supply the motor. The drive system will not perform satisfactorily unless the AC motor can supply enough current for all normal requirements of the motor and load.

Beyond the current specification, the technical selection of the AC drive deduces to the control and protection features which are required of the drive. For simpler applications at lower powers, lower cost drives offer essential features only, e.g. control of speed, direction of rotation, maximum speed, acceleration

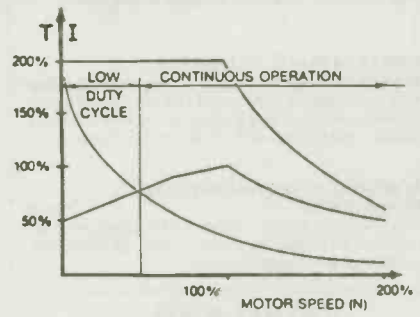


Fig. 3a: Constant power load.

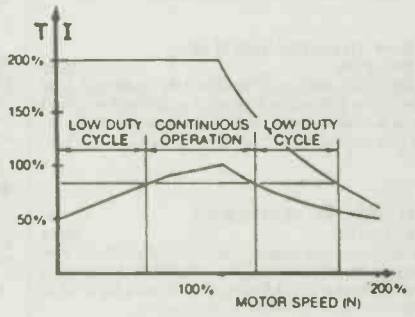
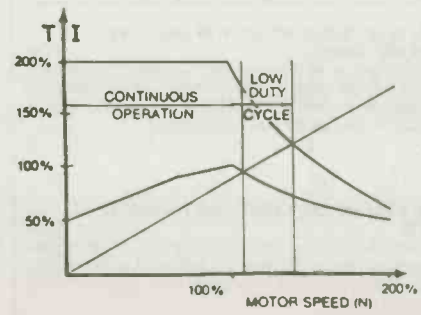


Fig. 3b: Constant torque load (P n; T=k)



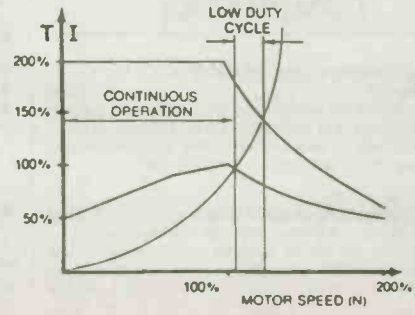


Fig. 3

Continued on page 56

NEW & REVISED

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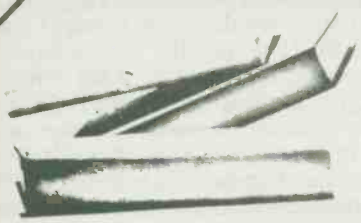

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BP53: PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE $11.80
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The popular 6502 microprocessor is used in many home computers, this is a guide to beginning assembly language.

BP225: A PRACTICAL INTRODUCTION TO DIGITAL ICs $7.00
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Although written especially for readers with no more than ordinary arithmetical 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.

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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.

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

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PROJECTS

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.

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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.

BP90: AUDIO PROJECTS $7.80
F.G. RAYER
Covers in detail the construction of a wide range of audio projects. The text has been divided into preamplifiers and mixers, power amplifiers, tone controls and matching and miscellaneous projects.

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E.A. PARR, B.Sc.,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.

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.

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.

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

BP93: ELECTRONIC TIMER PROJECTS $7.80
F.G. RAYER
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.

BP84: DIGITAL IC PROJECTS $7.80
F.G. RAYER, T.Eng.(CEI),Assoc.IERE
This book contains both simple and more advanced 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 built 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 featured in this book have been specially designed 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.

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

CIRCUITS

How to Design Electronic Projects
BP127 $9.00
Although information on standard circuit blocks is available, there is less information on combing 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.

Audio Amplifier Construction
BP122 $2.25
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.

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 OF ROBOTS $12.00
The main stumbling block for most would-be robot builders is the electronics to interface the computer to the motors, and the sensors which provide feedback from the robot to the computer. The purpose of this book is to explain and provide some relatively simple electronic circuits which bridge the gap.

BP39: 50 (FET) FIELD EFFECT TRANSISTOR PROJECTS $7.00
F.G. RAYER, T.Eng.(CEI),Assoc.IERE
Field effect transistors (FETs) find application in a wide variety of circuits. The projects described here include radio frequency amplifiers and converters, test equipment and receiver aids, tuners, receivers, mixers and tone controls, as well as various miscellaneous devices which are useful in the home.

This book contains something of particular interest for every class of enthusiast — short wave listener, radio amateur, experimenter or audio devotee.

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 non-mathematical 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.

223: 50 PROJECTS USING IC CA3130 $5.00
R.A.PENFOLD
In this book, the author has designed and developed a number of interesting and useful projects which are divided into five general categories: I — Audio Projects II — R.F. Projects III — Test Equipment IV — Household Projects V — Miscellaneous Projects.

BP102: THE 6809 COMPANION $7.80
Written for machine language programmers who want to expand their knowledge of microprocessors. Outlines history, architecture, addressing modes, and the instruction set of the 6809 microprocessor. The book also covers such topics as converting programs from the 6800, program style, and specifics of 6809 hardware and software availability.

BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS - Book 2
R.A. PENFOLD $7.60
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.

BP83: VMOS PROJECTS $7.80
R.A. PENFOLD
Although modern bipolar power transistors give excellent results in a wide range of applications, they are not without their drawbacks or limitations. This book will primarily be concerned with VMOS power FETs although power MOSFETs will be dealt with in the chapter on audio circuits. A number of varied and interesting projects are covered under the main headings of: Audio Circuits, Sound Generator Circuits, DC Control Circuits and Signal Control Circuits.

RADIO AND COMMUNICATIONS

BP177: AN INTRODUCTION TO COMPUTER COMMUNICATIONS $7.80
Connecting up an ordinary home computer to the telephone system via a modem opens up a new world of possibilities: talking to other computers, databases, networks, radio links, etc. An explanation of basic principles and practicalities in simple terms.

BP176: A TV-DXERS HANDBOOK $18.00
This book will be a practical guide for the beginner and a source of reference for the established TV-DXing enthusiast. The possibilities and problems of receiving television signals over long distances and resolving of such pictures with the minimum of distortion is discussed. Also included are many units and devices which have been designed by experienced enthusiasts.

Circuit Ideas

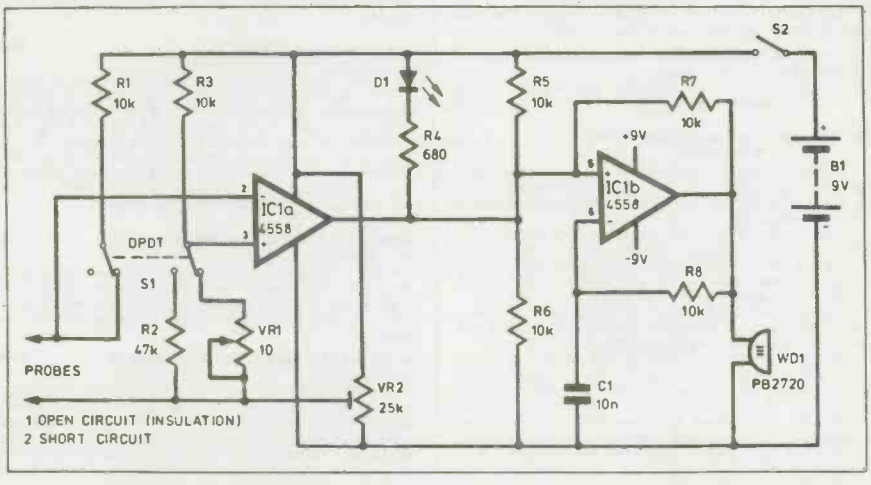
Dual Mode Continuity Tester

By R.R. Goodbourn

This audible tester, unlike most continuity testers, has specific extreme parameters to which it will work, this giving a more accurate illustration of the true nature of the material between the probes.

To start with, potentiometer VR2 has to be set up to give a ground point (which is not necessarily the midpoint), this ground point being the crux of the operation. IN the short circuit (S/C) mode, it can be used to test dry solder joints, etc., and will not buzz above one ohm. This value can be calibrated by the variable control VR1 from outside, useful when checking very long wires. Only when the resistance across the probes is less than VR1 does the output of IC1a swing high as the inverting input becomes more negative than the non-inverting input. The probe voltage is 1.6V and the current is 0.4mA.

In the open circuit (O/C) mode buzzing will occur at the slightest continuity, and the probe can be used to check insulation, O/C, etc. When tested, it was still buzzing at 30 megohms. This is because the non-inverting input is held high and the inverting input is floating. The slightest continuity to ground will quickly send pin 2 lower than pin 3 and cause the output to swing positive.



Simple Melody Synth

By Masroor Bukhari

This circuit is an interesting project for those hobbyists who have an interest in music and melody. It produces sounds containing different notes, in which the speed and frequency (pitch) can be varied.

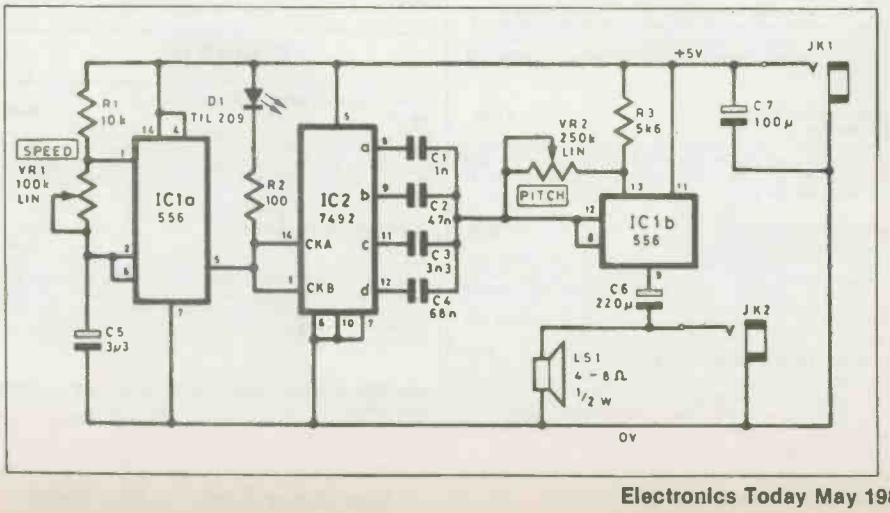
The circuit is very straightforward and uses only two ICs. One is a dual 556 timer and the other is a TTL divide-by-twelve binary counter, type 7492.

One half of the timer IC1A is used as a clock pulse generator. The duration of clock pulses is established by the values of R1, C5 and VR1; hence we can control the pulse duration of the notes. The output of this clock generator is fed to IC2. The light emitting diode D1 monitors the intervals of clock pulses.

The clock pulses are received at pin 14 (CKA) and pin 1 (CKB) of IC2. This IC is used in the pulse-divider mode, converting the pulses into a four-bit output. Capacitors C1 to C4 connect the outputs to the threshold, pin 12, of IC1b. This is used as a frequency oscillator, its frequency being determined by R3, VR2 and C1 to C4.

The pulses from IC2 charge and discharge capacitors C1 to C4 with respect to the binary counting. This develops the generation of different notes; the Pitch potentiometer VR2 is used to change the frequency of these notes.

Output from the frequency oscillator is filtered by capacitor C6, which then drives speaker LS1. ALternatively, it can be fed to any amplifier by means of jack socket JK2. This unit can be driven from a 5V regulated power supply via JK1. Changing the values of C1 to C4 alters the tone of the unit. ■



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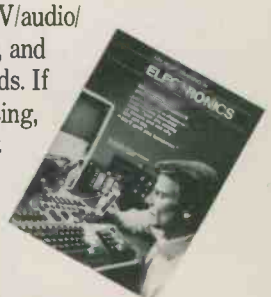

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Car Voltage Monitor

A simple and versatile voltmeter with a bargraph readout

By D.E. Cox

IT IS always desirable to keep a check on the car's electrical system to avoid the embarrassment of flat batteries and give warning of fault conditions. A voltage in the range 13-15V, with the engine running, is about right. Although designed with the motorist in mind the Car Voltage Monitor has wide applications as an add-on unit for boats, solar power cells, mobile radio and auxiliary power supplies to name but a few.

The circuit provides continuous voltage monitoring of the electrical system and conveniently derives its power requirements from this source. The display is presented in the form of a bargraph, being more robust than a moving coil meter and easily read with side vision when main concentration needs to be directed elsewhere.

Bargraph Display

The circuit makes use of the 3914 bargraph module and some remarks on its operation are appropriate here. The 3914 comes in two forms; a conventional DIL packaged IC and a module, **Fig. 1**, on which both the chip in die form and a 10 element red LED display are mounted and interconnected. It is this convenient module version that is used in the Car

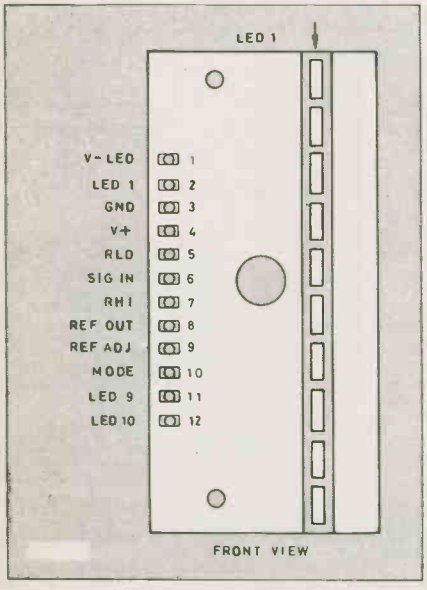


Fig. 1. the 3914 module.

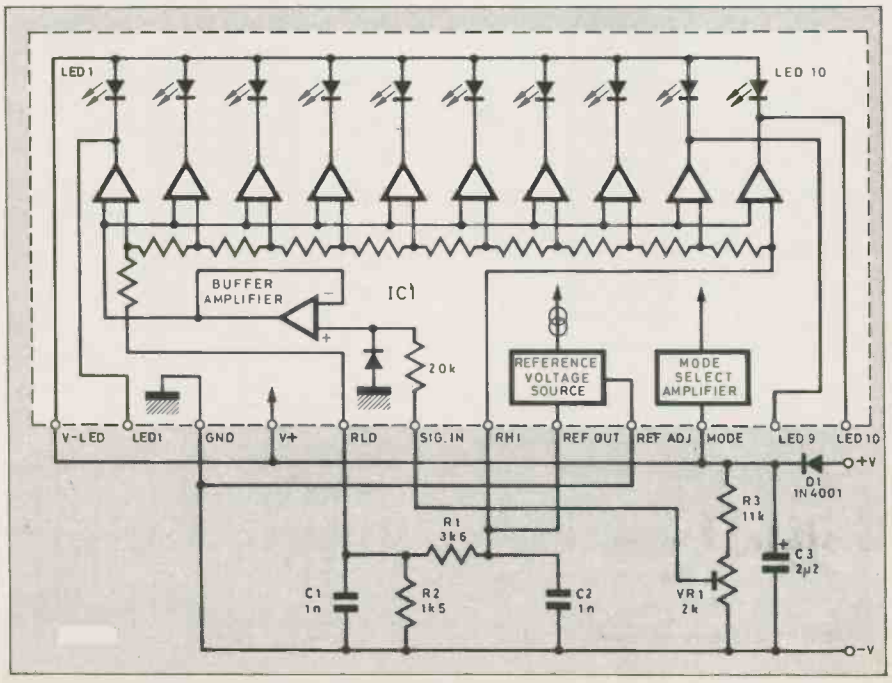
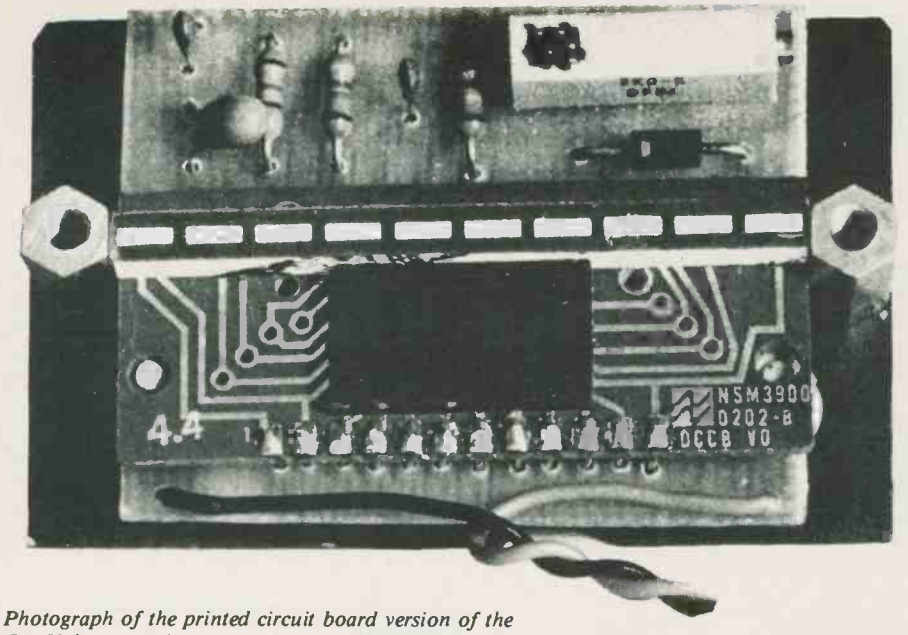
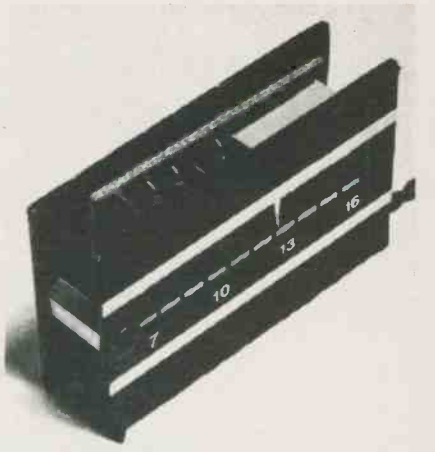


Fig. 2. Complete circuit diagram of the Car Voltage Monitor.



Photograph of the printed circuit board version of the Car Voltage monitor.



Construction of the unit.

Voltage Monitor and will be described here. Connections to the module are via twelve 0.1 inch pitch solder pads.

Referring to **Fig. 2** it can be seen that the internal circuitry of the module (IC1) contains a string of ten comparators each with its own threshold voltage set by a resistor network. The input signal and comparator divider voltage may be 15mV to within 1.5V below V+ (12V max.) The RLO of the divider chain can be set as negative as V- if necessary. The voltage set between RH1 and RLO is divided into ten equal increments and the LEDs will light as the signal input voltage matches that of the appropriate comparator.

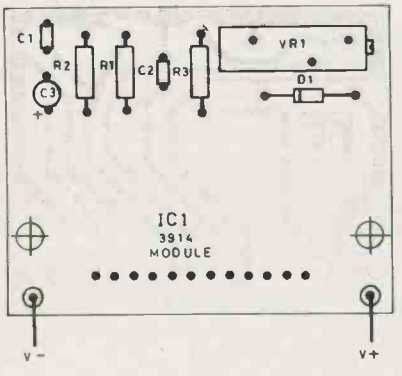
The 3914, both module and DIL forms, have an internal voltage reference for setting the divider chain voltages. The reference voltage is nominally 1.25V and is available between the REF OUT and REF ADJ connections. A further feature of this reference voltage source is that it also controls the LED brightness. The current of each LED is approximately ten times that drawn from REF OUT and is adjusted by the programming resistor formed by R1 and R2.

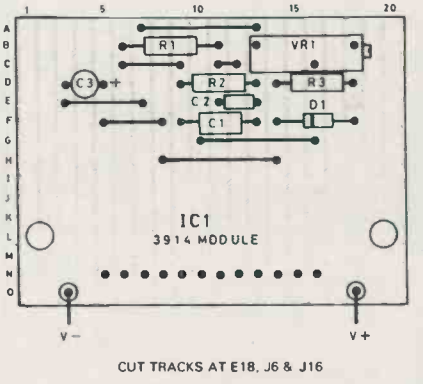
The module is very versatile and can be operated as a dot display or bargraph. For our purposes the baragraph is used, selected by linking the MODE connection to V+. Leaving the MODE connection open circuit would give the dot display.

Circuit

The circuit diagram as shown in **Fig. 2** uses the 3914 module with only eight additional components. As voltages below 7V in the car are of little interest, the meter is arranged to indicate from 7V to 16V in 1V intervals. To do this the reference voltage and a divided value of it, from the R1 and R2 resistor combination, are applied across the module resistor divider network (RLO, RHI). Thus, even at the lowest end of the working range there will still be sufficient voltage to drive the internal voltage reference (requires 3V minimum). The ratio of R1 and R2 determines the potential at which the first LED lights. If other voltage ranges are needed it must be remembered that the module resistor divider chain is in parallel with R1 when calculating these resistor values. The LED currents are set to approximately 3mA each by the combined value of resistor R1 and R2. This keeps the highest power drain with all LEDs lit, within the maximum rating (500mW) of the module.

The supply voltage, to be monitored, is then divided by R3 and VR1, with VR1 adjusted such that the maximum of 16V would just light the last LED of the display. Deriving the signal input in this way ensures that this input voltage is well below the manufacturer's recommended limit of 1.5V less than the module V+ supply. The potentiometer VR1 is necessary, rather than a fixed resistor, as the reference voltage varies slightly from





CUT TRACKS AT E18, J6 & J16

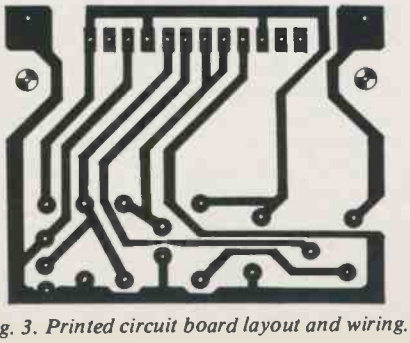


Fig. 3. Printed circuit board layout and wiring.

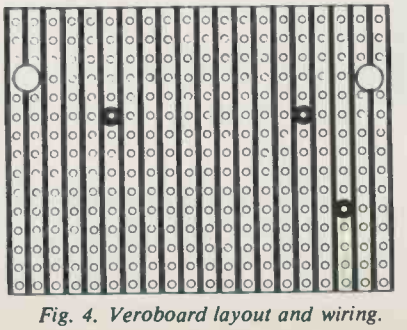


Fig. 4. Veroboard layout and wiring.

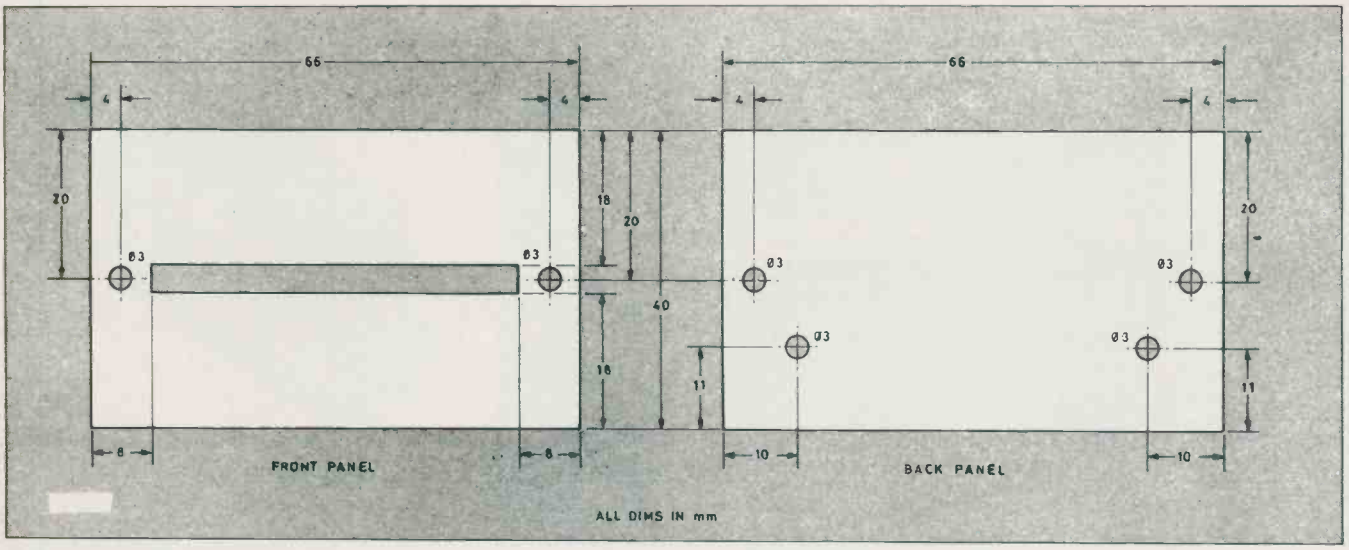


Fig. 5. Mounting panel details.

one module to another. Diode D1 provides protection from reverse transients, e.g. from operation of solenoids, while capacitors C1, C2 and C3 provide decoupling of the noise common in car electrical systems.

Construction

The printed circuit diagram is shown in **Fig. 3**. An alternative layout for a Veroboard of 20 track and 15 holes is shown in **Fig. 4**.

In either form care should be taken to ensure correct polarity of the diode and electrolytic capacitor. Solder runs between PCB conductors and between Vero strips must be checked for and corrected as necessary. Make sure all track cuts (three of them) and all the wire links (there are seven of them) are correct on the Veroboard, there are no such requirements for the PCB version.

To connect the module it is placed on the component side of the circuit board, LED side up, and separated from the PCB by a spacer such that, when the unit is finally assembled, the LEDs can protrude through the front panel without it fouling the other components. The wire links are then soldered through from the module to the circuit board conductors. Note that the module solder pads 2, 11 and 12 are not used in this application.

The front and back mounting panels can be cut from thin plastic sheet. An old PCB with all the copper removed would

Continued after supplement

Resistors

R1	3k6
R2	1k5
R3	11k

All 0.25W 5%

Potentiometers

VR1 . . . . 2k ¾ inch 20 turn Cermet trimmer

Capacitors

C1, C2	1n min. disc ceramic
C3	2u2 35V tantalum bead

Semidconductors

IC1	3914 Bargraph module
D1	1N4001

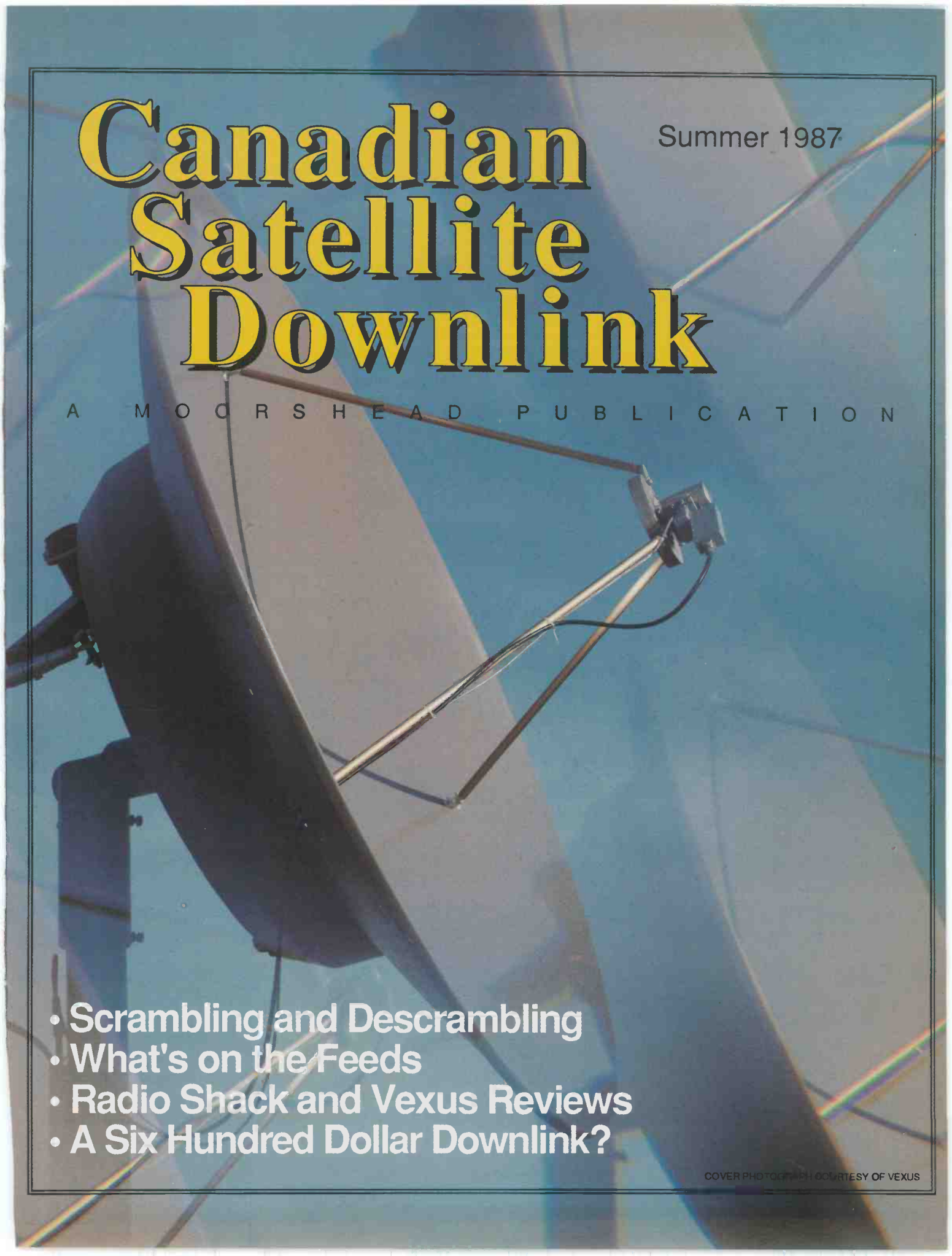
Miscellaneous

Veroboard or PCB; nuts; bolts; spacers; wire, etc.

Canadian Satellite Downlink

Summer 1987

A MOOSHEAD PUBLICATION



- Scrambling and Descrambling
- What's on the Feeds
- Radio Shack and Vexus Reviews
- A Six Hundred Dollar Downlink?

COVER PHOTOGRAPH COURTESY OF VEXUS

A FEW OF MY FAVOURITE FEEDS

All the technology aside, the real meaning in satellite television is what you can watch. You might want to check out this wander through the feeds.

by Steve Rimmer

One of the really enjoyable aspects of satellite television is being able to drift aimlessly through over a hundred video feeds just about any time you want to. If there doesn't appear to be anything on the regularly scheduled ones, you can very often come across an unlisted program on one of the more obscure satellites.

It's rare that there is really nothing to check out. If you have a downlink that can traverse the whole satellite arc... and a VideoCypher II to make sense of the scrambled signals... there is an amazing range of programs to be seen.

Recognizing that cable television also makes similar claims... and most humans have long since reached a plateau of boredom with regular broadcast stuff... we're going to have an actual dig through the feeds in this feature. Now, the things one can find with a downlink do change a lot, so you may well discover that some of these examples don't exist by the time you read this. However, they should serve to give you an idea of what you can scare up.

Now... hands on your remote controls...

Low End Of The Arc

The bottom of the arc for me... the extreme westward end... is Satcom F1R, or just F1 to my receiver. It's not the most exciting place to start, although there are some good things there. The first nominally useful effort is transponder two, which has KWGN,

an independent station from Denver. Aside from an obsession with basketball, this thing is reasonably good. It has interesting reruns of old shows from time to time, although the satellite guides seem to have a hard time getting its schedule right.

There's also KRMA... great call letters... on transponder six, which is a Denver PBS station. A Financial News Network feed is on transponder seven... deadly dull.

There's an NBC feed on transponder eight, which has regular NBC programs at the regular times. However, most of the spaces for commercials are left blank so that the local stations can infest them with their own. This is rather pleasing after you get used to it... it's like having the volume automatically shut down when the ads come on.

Transponders eleven and sixteen occasionally carry WTN, which is a feed from London to Australia, mostly news footage and so on. The audio track is a London rock station. These feeds actually come across as six hundred and twenty-five line European PAL pictures but, surprisingly, most North American tubes will show them just fine. The colour doesn't happen, however.

Also on F1 are KCNC on transponder twenty, a Denver NBC affiliate, KMGH on transponder twenty-two, a CBS station also from Denver, and KUSA on transponder twenty-four, an ABC broadcaster.

Galaxy One, the next satellite up the road, is rather more exciting... if rather more heavily scrambled. There's the Nashville Network on transponder two, which serves up wall to wall country and western music for those who can stand it. Transponder three carries WGN, a Chicago superstation. It's scrambled. Transponder four and twenty-four have Disney feeds. These aren't scrambled yet, but rumour has it that they will be shortly.

Galaxy One is rich with commercial free, first run movie channels. There's Showtime east on transponder five, the Movie Channel on transponder fourteen, Cinemax east on transponder nineteen and Home Box Office east on transponder twenty-three. They're all scrambled. I'd be hard pressed to say which of these is the best of the lot... I'm enamoured of them all.

Cable News Network and CNN Headline News live on transponders seven and eight, beaming down twenty-four hour a day news. As I've noted in the descrambling article elsewhere in this section, these are scrambled but you can get them authorized in Canada.

There are several unscrambled broadcast feeds on Galaxy as well. These include WTBS, an Atlanta superstation on transponder eighteen, and USA Network east on twenty-one, which has a lot of good flicks. There's a combination of the Discovery Channel, a sort of educational thing, and Video Mall... one of countless oppressive shopping channels... on transponder twenty- two.

The shopping channels... should you have thus far failed to stomp on your karma with one... do nothing but show you stuff to buy. Most of the time it's battery powered battery chargers, amazing machines for lobotomizing radishes, exquisite plastic reproductions of Wedgewood toenail caskets and so on. If you want something you see, you're supposed to call the station and put it on Visa. Sadly, the American ones aren't accessible to Canadians... breaks my heart, this.

The next satellite to the east is Satcom F3R. The first thing on it... transponder one... is Nickelodeon east, which is unscrambled and well worth the trip. It runs old television shows from the sixties for the most part, including things like I Spy, Mister Ed... great if you're a bit fried... as well as some of the better old flicks. A colour monitor isn't really a requirement to watch Nickelodeon.

There's more Financial News Network on transponder four, and the Learning Channel on two. Devotees of shopping channels will trip over one on transponder seven and another on twenty-two. Transponder eight has USA Network west... which, like the USA Network feed on Galaxy, features some good movies.

There are several more scrambled movie channels on this satellite. Showtime west lives on transponder ten, Home Box Office west is on transponder thirteen and Cinemax west is on transponder twenty-three. If you collect this lot and the ones on Galaxy, you can check out well over half a dozen first run, commercial free movies just about any time you want to vege in front of the tube.

There's Arts and Entertainment on transponder twenty-four, as yet unscrambled. This feed has some British television, a lot of classical concerts and some PBS style theatre. It also has incessant commercials, and, after an initial enchantment with it I found I couldn't get my head into most of what it was doing.

In more specialized areas, you'll find a CNN feed unscrambled on transponder fourteen. This is the rough feed that they make up the final CNN programs from... you get to watch the news readers scratching themselves when they think they're off camera. It's amusing at times. There's also the Weather Channel on transponder nineteen... which isn't all that much use, as it's mainly concerned with the weather in the States.

There's also MTV... ceaseless rock videos... on transponder eleven... and Video Hits One on fifteen with more of the same. There's something called the Travel Channel on sixteen, which I've

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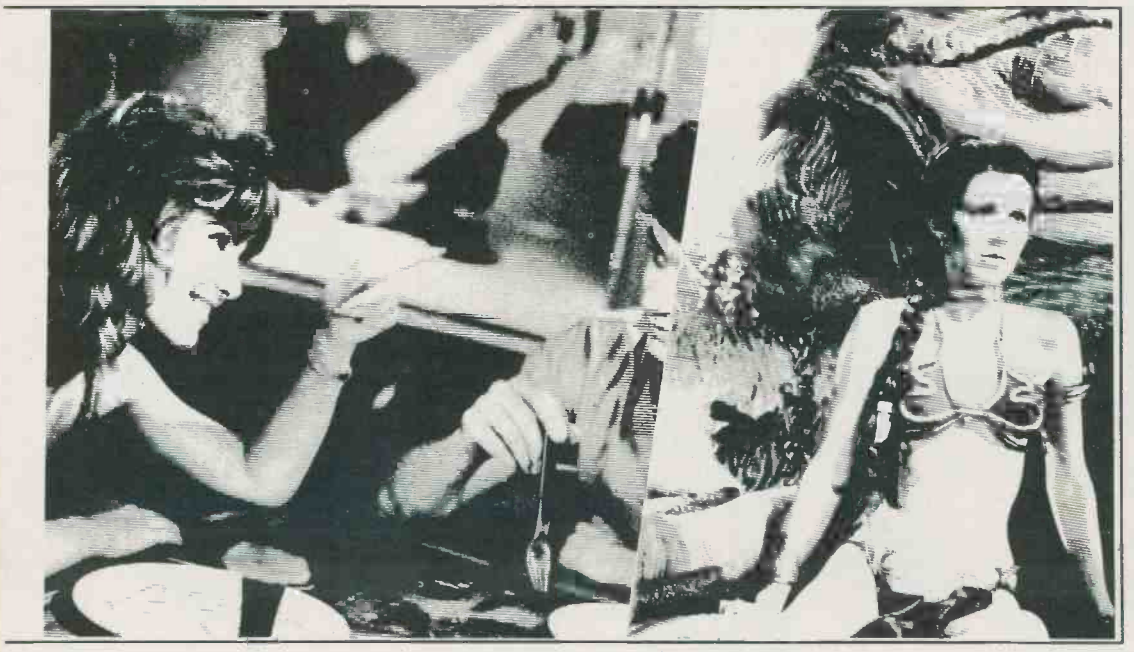
yet to look at.

Telstar 303... or just T3... is mostly used to carry non-video communications, computer data and telephone conversations. You might want to check out the December 1986 edition of Computing Now! for more about this. However, there is Country Music TV on transponder thirteen and KTVT, a Dallas broadcast feed on transponder twenty. It's pretty dull, except for the ads for cocaine addiction help. I've been told that there's something called Jazz Channel on transponder eight, but I haven't actually caught it as yet.

Westar five... W5... is a bit better, if a bit too devout for my tastes. It has the University Network on transponder two, easily the most pointless waste of a feed imaginable. I think it's associated with some church or other... it consists of a guy dressed up as a wino begging for money most of the time. It's useful for alignment, however.



Along these lines there is also a Mormon channel on transponder twenty-four.

Transponder eight has a Detroit broadcast station, and there's a CBS contract feed on seven. Contract feeds are interesting... they're used to shuttle video around the continent. You never know what you'll find on them.

Westar five is a loss most of the time.

Shades Of Blue

Spacenet One is a rather different tale... a lot of people buy satellite systems for no other reason than to point 'em at Spacenet One. There's SelecTV, a scrambled first run movie channel on transponder thirteen... although that's not what most people watch. There are also two religious stations, Baptist Television, which is scrambled on transponder twenty-one, and Christian Television on transponder five.

Right next door to Christian Television there's American Exxxtasy, which shows erotic flicks every night. Now, no one will ever admit to watching this thing, but if you take note of where S1 is in the sky it's surprising how many dishes are left aimed at it.

American Exxxtasy has a rather clever promotional thing going. Beginning at eight o'clock in the evening they show one movie unscrambled. They switch on the scrambler at ten. I think the idea is to get everyone who's watching really... uh, interested... and then hit them for some bucks if they want to stay interested. You can phone them... if you have a VideoCypher... and get back on line in a few minutes. However, at a hundred and fifty dollars American for half a year, American Exxxtasy is the most expensive feed in the sky.

The eight o'clock movies are usually fairly tame, often having been cut down from heavier films. The scrambled ones are exceedingly raunchy... one evening of them should be enough to put most people off sex for a month. I suppose there is something to be said for leaving some stuff to one's imagination.

Cruising on up from S1 there's Anik D... it's usually listed as A1 or AD1. This is Canada's contribution to C band microwaves. Much of it contains Cancom scrambled feeds which cannot be decoded with a VideoCypher. Besides, they're oppressively dull. There is also a host of CBC feeds, including the parliamentary procedures in English on transponder twenty-four, the parliament in French on sixteen, CBC north on sixteen when the parliament goes away, more CBC north on nineteen, French CBC on fifteen and CBC Labrador on transponder seven. For people who don't want to erect a two or three thousand dollar downlink just to watch the CBC, there's also Much Music... a rock channel... on six and the Sports Network on two. The latter feed has made some noises about scrambling of late.

For most practical purposes, Anik is also a bit of a loss.

Westar Four has a lot of stuff on it, although not much of it is all that interesting. In fact, W4 is behind a tree for me... the images are a bit fuzzy... so I can't claim to have gotten into it much. Aside from a few Christian stations, the only regular stuff seems to be four PBS feeds on transponders fifteen, seventeen, twenty-one and twenty-three.

Telstar One has a lot of American network feeds. There's the main CBS feed on two and a west coast feed on fifteen... CBS is also rumbling about scrambling its feeds, by the way. ABC has regular feeds on ten and twelve, with contract channels on three, four and six. Most of the other feeds have stuff on them, although one never knows what it'll be.

Telstar Two is also used by the American networks. ABC has a west coast feed on transponder ten and a contract channel on eleven. CBS has regular programs on twenty and a west coast feed on sixteen. It also seems to have contract channels on fifteen, seventeen and nineteen.

Satcom F4 is the most interesting satellite at the eastern end of the arc. It includes Bravo, on transponder two, which is a very much better Arts and Entertainment. It's not scrambled as of this writing. It lacks commercials, and has much more interesting concerts and plays. However, unlike Arts, it isn't on all the time.

There's also Nickelodeon west on four... pretty well like the one on F3, except that the programs run at different times.

Sportvision on transponder nine, Home Sports on eleven, Sports Channel on twelve, Home Team Sports on twenty-two and Sports Channel N.E. on twenty-three all have... you've guessed it... sports.

Transponder twenty-three is shared by the Silent Network, for hearing impaired viewers.

The shopping channels have grown like a some sort of orbital fungus on F4. They include Home Shopping Network on one, Value Network on five, Teleshop in six, Crazy Eddie's Shopping Service on fourteen and Cable Video Store on sixteen, the latter one mercifully scrambled.

There's also the Nostalgia Channel... real old movies... on twenty-one and Hit Video USA, with still more surrealistic rock videos, on eighteen.

Finally, for those heads who find American Exxxtasy a bit too unrefined, there's the Playboy Channel on twenty-four. This one runs a lot of the same movies as American Exxxtasy, but it also features some more cerebral sounding panel discussions and interviews. The subject is always more or less the same. Some of these are easily as bizarre as the movies... I'll leave you to decide whether people really do that sort of stuff.

At the far eastern end of the arc... at least from my yard... there's Satcom F2R. This thing was really dead for a long time, although it's been getting a bit more lively of late. There are several local stations being juggled around up there... I think someone is trying to package them up and scramble them. There's the NASA channel on transponder thirteen, which hasn't had much of late but should get a bit better when they approach the next shuttle launch. Finally, there's AFRTS on twenty-two. Don't try to pronounce that... it sounds rude. It means Armed Forces Radio and Television Service, and has a moderately good assortment of regular television programs on it.

Park The Dish

First of all, I should point out that there is a lot of stuff I've omitted here. Some of it was due to lack of space... a lot was just because I haven't really checked it out. Depending on your interests, you'll quite possibly find a wholly different crop of feeds to look at.

A satellite guide is essential... there's a feature about them elsewhere in this section. However, bear in mind that these things are rarely complete. It's worth spending an hour every so often just cruising around.

Even if the real joy of your life is tied up with breeding genetically engineered five-legged reptilian beagles it's worth getting into satellite television. Sooner or later someone will start up a feed on the subject. ●

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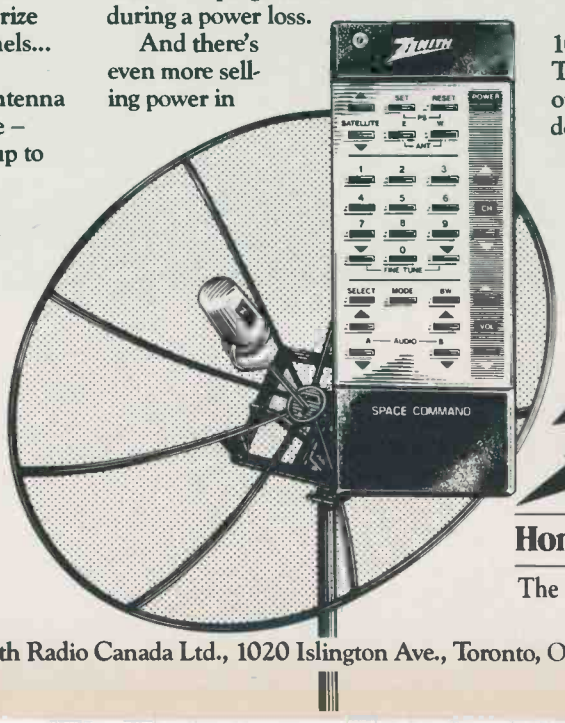

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THE RADIO SHACK SATELLITE SYSTEM REVIEW

Virtuous by its technical performance as well as its availability, the Radio Shack ten foot dish is a good system even after the assembly is complete.

by Steve Rimmer

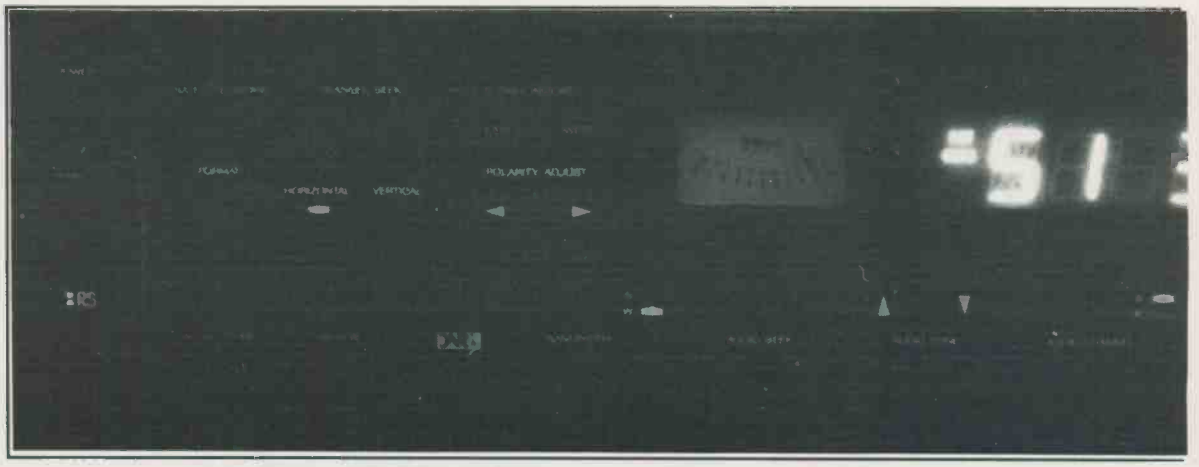
In the last edition of Downlink... in the December 1986 edition of Electronics Today... we had a look at the process of assembling the Radio Shack ten foot dish and its associated bits. This was an arduous task, one not to by missed by any video freak thinking of taking up blacksmithing as a trade. However... as you'll know if you read the previous article... the whole effort went together surprisingly smoothly and worked the first time.

After a while one's blisters heal, one's muscles start talking to one again and the system ceases to be a source of painful memories. When the dust is settled, you can actually use it.

As I write this we've had the Radio Shack downlink in the back yard for about six months. Just about anything can work right when you first uncrate it... we've had the opportunity to see the system though a really nasty winter and a lot of heavy use. It's held up remarkably well.

Plates and Dishes

The Radio Shack system consists of two principal elements, to wit, the dish and the receiver. In most cases one would buy the complete package and get 'em both in one shot. Obviously, the ultimate usefulness of the system is determined by how well both of these bits of technology work.



The primary considerations for the dish tend to be crude and mechanical. It must keep its shape and keep its act together in high winds and freezing temperatures. One is properly skeptical of equipment which has been designed in Texas for use in Canada, and all through the winter I kept expecting the dish positioning mechanism to petrify or in some other way succumb to the cold.

Not only did the whole party keep going, however... it managed to do so without requiring realignment. At least, it didn't exhibit any mechanical instability due to the cold. We did have one unusual occurrence with it in February, which I'll get to momentarily.

After six months of use the dish seems to have kept its parabolic shape pretty accurately... certainly if it has be-

come distorted, the pictures haven't been affected by it. Except for Westar four and Telstar one, the two satellites which are partially hidden by trees for us, all the feeds come in perfectly.

The mechanical aspects of the dish positioner have worked flawlessly. We had one fairly serious wind storm that managed to twist the whole dish on its pole by about five degrees, which wiped out everything. However, it was pretty simple to move it back... I tightened the bolts down a bit more securely after that. It's a good idea to scratch some marks in the post and the cap so that, if the beast does move, it can be realigned without a lot of running in and out of the house.

The dish, being mesh, does collect quite a bit of snow and ice. This doesn't seem to affect the efficiency of the dish too seriously, but the weight of it can change the alignment slightly, degrading the pictures it produces. It's a good idea to leave the dish parked at the western end of its arc... pointing to Satcom F1 for most of us... so that it's least likely to collect snow.

The Box

The receiver that comes with the system is a marvel of technology... more marvelous still if you've ever used an earlier receiver. It's run by a microprocessor, equipped with an infrared

remote control and even has good microwave specifications, something that people who design these things seem to miss a lot of the time.

The receiver is equipped for C band and, apparently, for Ku as well.. I haven't tried the system on Ku band. A fellow at Radio Shack said that by this summer they're expecting to have a Ku band feed for the dish. The receiver isn't expected to require any external boxes or retrofits.

While the principal function of the receiver is to receive, it also incorporates a really elegant dish positioner, a system to move the dish across its arc to locate the satellites with a minimum of button punching and knob twisting. In fact, there are no knobs on the thing at all.

The dish positioner makes extensive use of the microprocessor hidden away in there. It expresses the position of the dish as a linear dimension along the arc, at least to itself. As such, it can position the dish to look at any point in the sky by knowing how many "units" from one end of the arc the satellite in question lives at.

Assuming that the arc of the dish matches the arc of the satellites... check out the sidebar to this feature for more on this... moving the dish from one end of the arc to the other will theoretically have the dish look at every satellite it could possibly see. The receiver, then, need only know what unit numbers along the arc correspond to satellites, rather than empty space, to be able to position the dish.

It took me most of an evening to get all the satellites into the receiver's memory... but I insisted on digging around for a couple of really obscure ones. It's actually pretty simple, especially if one has the foresight to buy a copy of one of the satellite guides. You can usually find one of the stronger satellites, such as Anik D or Galaxy One, without too much trouble. The relative positions of the rest of the beasts are easy to figure. Having found Galaxy, for instance, one would hit the "east" button on the receiver until Satcom F3 turned up.

The receiver memorizes the satellites' names as well as their positions. Thus, having located F3, for example, and stored its position, one would subsequently call it up by requesting F3, not some arbitrary actuator number.

The receiver's remote control facilitates selecting satellites, changing channels once you have a satellite, flipping between satellite television and regular primitive broadcast television, switching a descrambler in and out, turning the power off and... cosmic wonder... turning the volume down when the commercials come on.

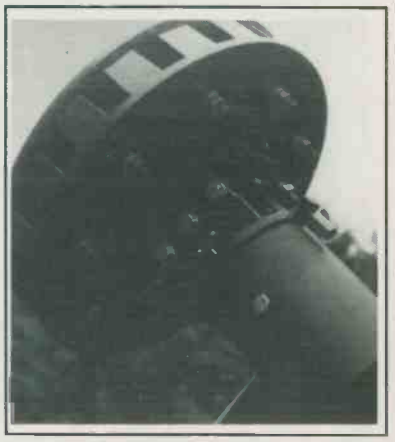
There are other niceties of the receiver at this stage. It allows you to set east and west limits for the dish. In fact, the dish has mechanical limits to keep you from damaging its motor by

Alignment

One of the few areas in the Radio Shack earth station assembly instructions which weren't as detailed as one might have liked them was the page on dish alignment. That's page, as in one. This page didn't even have a lot of type on it, and, if one's karma didn't happen to latch onto the basic idea of what they were getting at right away, one tended to get frustrated.

After a lot of trudging in and out of the house I eventually did figure out what the whole dog and pony show was supposed to be doing... with no real thanks to the book. In fact, it's pretty simple if you understand the principle behind it, rather than just blindly following instructions.

I'm going to lay the fruits of all that cursing and hammering on you



now so you can avoid walking a trench into your lawn.

The dish can be seen as having three things to adjust... simultaneously. If you imagine that the feed of the dish will describe an arc as it moves, you can adjust how high the apogee of the arc is, what direction the apogee is pointing to and how flat or round the arc is.

The first thing that one usually does upon crawling into the house when the assembly is done is to find a satellite. You'll probably manage to do this without too much sweat... it's encouraging, in that it means that the system is working, but a bit useless as far as the alignment goes.

When you get the system you should also get a printout that tells you where all the satellites are relative to your location. Among other things, this will tell you the rough inclination and declination adjustments for the dish and which is the highest satellite from your loc-

ation. I know... they're all at the same altitude. This number represents the highest look angle from your back yard.

There are two adjustments for the look angle of the dish, the turnbuckle and the big nut on the back... inclination and declination respectively. While they may seem like they both do the same thing, the turnbuckle sets the height of the arc while the big nut sets its shape. In fact, they're a bit interactive... setting one will change other a bit.

To align the dish, then, one points the dish in the direction of the highest

satellite... it was Satcom F4 for me. One then adjusts the turnbuckle until it comes in. The height of the arc is now more or less right. We now have to bend the ends of the arc up or down so that they fall on the actual arc of the satellites. To do this, we'd move the dish so that it was pointing in the direction of a low satellite, like Galaxy One, and adjust the big nut until it came in. The arc is now more or less the right shape, and moving the dish along it should bring in all the satellites.

In fact, as I noted, the two adjustments tend to affect each other and, having adjusted the big nut you'll probably have to bring the dish back up to the high point in the arc and tweak up the turnbuckle adjustment a bit. You should then roll back down to the low end and check the setting of the big nut. I went through this process three or four times until I was satisfied that the dish was tracking perfectly.

trying to run it off the end of its arc, but it's useful to have the receiver restrain it before it reaches them if it might hammer itself into a nearby tree or the side of your garage. Like the satellite positions, the dish limits are programmable and can be changed later on.

There's even a feed finder in the receiver. It's often the case that one doesn't know which transponders on a satellite are going to have something going when one is trying to find the satellite's position. The feed finder will repeatedly scan through all twenty-four channels automatically while you move the dish.

The audio section of the receiver is phenomenally sophisticated. It can be set for wide and narrow bandwidths, and has switchable dynamic noise reduction. It can be tuned to any subcarrier frequency... if you don't feel like hunting for the right subcarrier it can be set up to scan through the range of possible subcarriers to find one that has sound on it. It can demodulate all the various stereo formats, as well as plain old monoral sound. Aside from spitting its sound though the speaker of your television, it has stereo line feed jacks to drive an amplifier.

The sound quality matches the pictures... it's glorious. If you do wind up owning one of these things you really should patch it into your stereo. Especially if you've been listening to television sound through the three inch squeakers that most sets have, the effect will be awesome.

Like the satellite positions, you usually only have to set all the sound parameters once for each feed. The receiver remembers whether you've selected discrete or matrix stereo, for example, and which subcarrier it should be looking at, and fudges things accordingly.

The video, despite its being the primary circus of satellite television, is pretty uninvolved. There are few controls on the receiver which have anything to do with it. About the only thing you might want to do with it is to switch in a VideoCypher descrambler. There's a set of jacks built into the receiver for this purpose and, unlike some receivers, it does actually work properly with a VideoCypher.

There are two built in microwave traps to take care of terrestrial interference. These live on the back of the thing... they're not terribly convenient there, but, then, most receivers don't have them at all. More to the point, they tend to be set once and left. We don't seem to have any serious terrestrial microwave hassles, so I rarely touch them.

One of the niceties of the Radio Shack receiver is its signal strength meter. Most receivers omit this feature all together, or leave you with a string of LEDs. The Radio Shack box has a real moving meter, which allows you to accurately align the dish and, thereafter, to judge whether something has moved and wants readjusting. No receiver should be without one.

There is no shortage of video and audio output jacks to drive a video cassette recorder. There's also a cable feed through jack which allows you to run the cable feed to your TV through the receiver, such that the remote control can be used to decide what you're going to watch. Conveniently, the audio and video line output jacks are unaffected by what appears on the screen of your set. As such, you can, for example, watch regular television while videotaping a satellite feed. The only failing in this concerns the descrambler loop... the video output to a video recorder is always the raw video before the descrambler... you can't get a descrambled feed without some cable switching.

Our receiver is currently nested among several converters, descramblers, a feed to the computer and three video tape recorders. It still hasn't run out of jacks.

The receiver also has parental lockout, which can be used to keep your kids from watching things you'd rather they didn't. This is probably a very good idea but, having no ankle biters... the dog rarely watches television... we never really got into this feature.

Long Haul

Even after an prolonged period of use... certainly long enough to stumble upon its weaknesses... I remain impressed with the Radio Shack earth station package. It certainly ranks among the best engineered systems I've encountered, and it has survived a Canadian winter, an acid test if ever there was one. I can't say I've found much in its design that I'd change if I could.

The pictures are great, the sound is great and the dish will probably never need adjustment again unless we have an earthquake or a wave of expropriation.

There are unquestionably cheaper systems afoot. However, one does get what one pays for, and I think that if I were starting the whole party over I'd still rather pay for this one.●

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THE VEXUS 2.4 METER GOLD MEDAL TVRO SYSTEM

One of the most widely seen fiberglass dish systems, the Vexus downlink is a good choice for a high quality downlink.

by Ed Zapletal

Very often when we review a specific product for our readership, we are limited in the amount of time in which we have to do the review. Oh sure, computers and the like can be given a good going over in, say, two months, but when it comes to something as large and sophisticated as a TVRO earth station, what do you do? It's not feasible to set up sophisticated hardware for a short time only to have to tear it all down again, so we acquired a "company" satellite television system for the purposes of learning, hands on, about the world of TVRO.

The equipment under scrutiny is the Vexus Gold Medal system. Installed in August of 1986 at our offices in Don Mills, Ontario, the system has been in operation since then for at least ten hours per day, five days per week. In those eight months it has weathered the fall rains, winter snows and countless channel changes by the employees (mostly switching between Much Music and the Nostalgia Channel).

Hardware

At the heart of the system is the VX-CDR 4/12 remote control digital satellite receiver. If that seems as though it's a mouthful to say, it should be. There's a whole lot of high tech packed into the cabinet of this baby.

For starters, the unit features digital synthesized frequency feedback tuning in the video and audio sections. DFF, as it's called, gives great accuracy and makes fine tuning a thing of the past. There is, however, a video fine tune feature in the event that terrestrial interference is encountered on a particular channel, or for tuning in special transponder frequencies on the Ku band. To this date I don't recall having to fiddle with the manual tuning control at all except for tuning in to special audio feeds. Incidentally, OnSat magazine prints a monthly listing of more than seventy-five satellite audio feeds; you can listen to a wide variety of radio broadcasts from Armed Forces Radio to the Comedy Network.

Dynamic noise reduction is utilized on all narrow band audio services giving good, clean sound from even the smallest of television set speakers. Of course, to gain the full effect of the stereo sound which the unit is capable of, connection to a home stereo system would be ideal.

The programming capabilities of the CDR include storage of all audio subcarrier frequencies, audio mode, audio bandwidth, video fine tune, and polarizer skew information for each channel on up to thirty-six satellites. All information is stored in non- volatile memory and can be reprogrammed in the event one would want to delete or add particular satellites.

Antenna positioning is built-in with two modes, automatic or manual, and a separate power supply for the

positioner is supplied with the unit.

All the function controls on the front panel of the receiver serve two purposes: those which they are labelled for under normal operation, and by selecting the setup mode with a switch at the rear, they become the programming and setup controls for the unit. Also, all the front panel functions are duplicated on the infrared remote hand controller, except for manual tuning.

The picture quality is excellent, especially when you compare it to the extremely poor quality available on the various cable services. The noise usually found in the "reds" on lesser systems is virtually nonexistent with the Vexus system.

Antenna Details

The 2.4 meter VX-2400D dish which accompanied our particular system is a parabolic, single-piece fiberglass antenna mounted on a section of heavy bridge truss, measuring about three meters square. The reason for this was the location, a flat, gravel, industrial type roof where no other type of mount would really have been suitable. The approximately five hundred kilogram weight of the truss provides a good solid support for those times when there's a high wind, and the large area provides for suitable weight distribution. A variety of mounts are available, though, for whatever the particular situation.

The actual mounting configuration is an EL/AZ polar type, with absolute one hundred and eighty degree arc coverage. The actuator is the VX-300MA, a worm gear type driven by a heavy duty thirty-six volt motor with adjustable limit switches. Considering the amount of use it's had, tracking seems to remain accurate and the drive system continues to operate very smoothly.

This dish, as well as the others in the Vexus line, has been engineered for optimum performance in both the C and Ku bands, eliminating the need for upgrades down the road. According to Charles A. Pitts Jr., the president of Vexus Telecommunications, Vexus utilized the latest laser topography and CAD technology to accomplish a high, seventy-eight percent aperture efficiency.

Other characteristics of the dish include a gain of 39.3 decibels at four gigahertz, and a beam width of 2.13 degrees for three decibels at four gigahertz.

Feed Me

A typical C band satellite transponder puts out in the neighborhood of five watts of power at a distance of some thirty-five thousand kilometers above the earth. Needless to say, it's a fairly impressive piece of hardware that can capture that weak signal and translate it into a crystal clear picture on your television set. This is the job of the feed assembly.

Comprised of a feed horn, and a low noise block down converter, this feed assembly, mounted at the focal point of the dish, must convert frequencies in the 3.7 to 4.2 gigahertz band to useable UHF signals in the 950 to 1450 megahertz range for use by the receiver. The rating of the LNB is given in terms of noise in degrees Kelvin, with the lower numbers giving better noise performance. Typical ranges for this are in the area of fifty to eighty degrees.

The Vexus VX-5075 LNB which resides at the centre of our dish has a seventy-five degree rating with a gain of about fifty five decibels. The voltage required to operate the feed ranges between fourteen and twenty-three volts at sixty milliamps, and is supplied directly from connections on the rear panel of the CDR 4/12.

Upgrade Considerations

There are probably two important considerations when you're pondering the purchase of any TVRO system: the ability to upgrade and flexibility of the equipment. Will you be able to step smoothly into the world of Ku band when it comes into vogue, or will you have to scrap your current hardware and start from scratch? Will you be able to add multiple receivers in other areas of your home or will you be confined to one viewing area?

Well, to answer those questions we're back to the system we've been talking about all along. Once you've invested in the initial TVRO system, and you feel that you want to cross the line into Ku band viewing, you need only change the antenna feed. The engineers at Vexus had the foresight to make the entire system flexible enough so that the only part which would need replacing would be the feed assembly.

Early this year Vexus announced the availability of its VX-ESR-124H four and twelve gigahertz antenna feed as the basis for its Gold Medal Dual Band system. Although the system which we have been reviewing does not as yet have Ku capability, it is upgradable with the ESR-124H. As mentioned earlier, all Vexus antennas have optimized aperture efficiencies in anticipation of Ku band upgrading and the VX-CDR 4/12 is Ku band ready right out of the box.

What's It All Cost?

When making a major investment in anything, be it a car or a home entertainment system, cost is always a major consideration. Naturally you want the best possible product that will fit within your particular budget and you don't want to have to be mortgaged to the eyeballs to do it. Back to the Vexus system once again.

Take at look at the ads for TVRO systems these days and I guarantee that you'll find complete systems for as little as five hundred dollars. For the most part these are great for those who have infinite patience and a knack for tinkering, but don't forget: these are not full-featured, microprocessor controlled, state of the art systems. Be very careful when it comes to apparent bargains.

At the other end of the scale, well, there really is no other end. The sky is the limit. Multiple receiver systems with Ku capability and lots of other gadgetry can run you easily over the twenty thousand dollar mark.

Surprisingly enough, the Vexus system will not set you back as far as you'd think. After all, you're getting a quality system that you won't have to mothball when it comes time to get into Ku. The complete C band system which I described above can be had for under thirty-three hundred dollars, not including the installation cost. This price includes the VX-CDR 4/12 top of the line remote receiver, the VX-2400D dish with motorized actuator and power supply and a seventy-five degree LNB feed assembly.

The cost of the ESR-124H dual feed modification is currently around thirteen hundred dollars. However, according to David Gibbons of Davia Satellite Systems in Toronto, if the dual feed is purchased initially with the system, it works out closer to eleven hundred.

Installation costs vary depending on the particular location, but if we're talking about a standard inground drilled pier type, five to seven hundred dollars is quite normal. Some installers will even allow you to help with the work, which of course lowers the cost, and, you can also learn quite a bit about TVRO just by getting in on the installation as well.●

A SIX HUNDRED DOLLAR DOWNLINK?

The thing that does most people in when they get around to considering satellite television is the price. A complete downlink for six bills might sound attractive. Just add a television.

by Steve Rimmer

The dish I usually watch... a Radio Shack ten and a half foot system... costs about three and a half grand. It's unquestionably a first rate bit of hardware. I'd have said... at least when I installed it... that a decent downlink would have to cost about that much. On some days I still would.

If my Radio Shack dish is a Rolls Royce, the Commander Satellite six hundred dollar system is a '68 Plymouth Fury. Now, I don't say this disparagingly... I used to own a '68 Plymouth Fury, and I was very fond of it. It was funky, but it got there and back.

The first thing to note about the six hundred dollar downlink is that it really is what it claims to be. If you put down six hundred dollars in the morning you can really be watching satellite television that afternoon. The pictures might not be great and you might not be as enamoured of such a system as I am of my ten foot microprocessor controlled wonder out in the yard but, then, those old Plymouths always had their little peculiarities.

In this feature we're going to have a look at what has to be the least expensive way to get into satellite television yet devised.

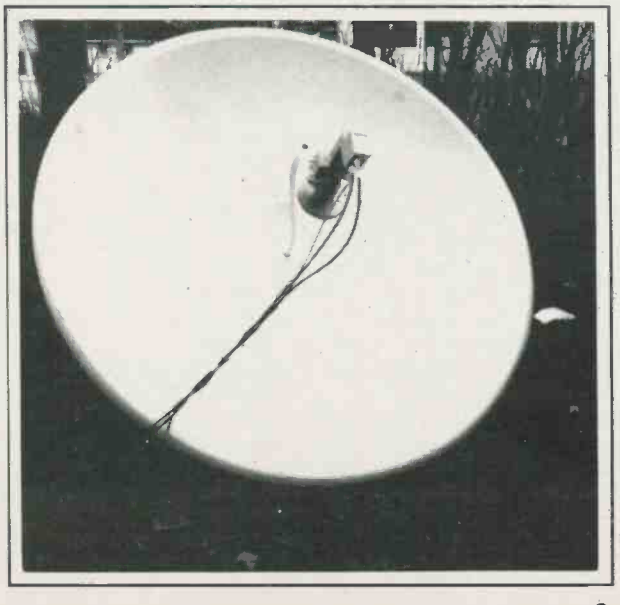
A Big Snow Saucer

The downlink consists of a number of somewhat disparate components... none of which were really designed to be used together. They all work, of course, although it may take a few moments of ingenuity to make them comfortable.

The dish itself is a six foot spun aluminum effort. It's supported by a very simple mount made of three pieces of angle iron and a metal tube. There is no actuator to bolt on, nothing much to adjust and no cement to pour. This is, of course, the first major compromise in this system... you change satellites by going out into the yard and wiggling the dish around until it points at the satellite you want to check out. This is a bit tricky, as tracking across the arc involves simultaneously moving the dish around and adjusting the metal tube that controls its elevation. Unless you have a television set in your yard you probably won't be able to see the screen to know when the thing is properly aligned.

The task becomes a bit more manageable if you can either prop up the set in a window or get someone to shout at you from within your digs when you have something on the box. Presumably, one would mark the elevation adjustment tube and the ground under the dish to allow for subsequent repositionings of the thing.

The dish itself, despite its rather primitive alignment mechanism, is well made. The mount is built of reasonably severe looking metal, and the aluminum of the dish itself is pretty substantial. The mount attaches to the dish at only three places, which seems a bit hopeful... I think I'd either want to beef this up a bit or be very careful in slinging the dish about.



The feed boom sits in a triangular shaped support in the centre of the dish. It's held in place with a hose clamp... again, it seems a bit sleazy in concept but it works well enough. The position of the feed boom, of course, is never changed once it has been set.

The feed itself consists of an eighty-five degree low noise amplifier which is connected to a seventy megahertz down converter. This is a passable LNA... the combination of a

small dish and a moderately noisy amplifier does not make for ideal pictures, although, as I'll get to, their performance isn't half bad.

There is no cover for the feed... it lives at the end of the boom exposed to whatever falls on it, sprays into it or pelts down and freezes. I'm not sure how well an exposed feed might fare in a particularly nasty winter... a feed cover might be a worth while addition to the system.

There are three cables that run from the feed to the receiver. Unfortunately, they are three separate cables, which makes them a bit of a pain to deal with. It's a good idea to tape them together at frequent intervals before you get started... they like to slither up your leg and try to drag you off for lunch if you give them half a chance.

The Wilson YM450A receiver that comes with the downlink package is a remarkable thing. It looks like it might have started life as a stereo preamplifier. It has fewer controls than a Walkman, and takes almost no time to set up. It would have been regarded as a bit crude five years ago. Once again, however, I don't mean to put the little guy down. It's rather in keeping with the grass roots level of the package as a whole.

The receiver accepts the seventy megahertz feed of the downlink and spits out baseband audio, video and a modulated VHF signal on either channel three or four, suitable for sending into a regular television set. It will also drive a video recorder or a monitor.

The dish mount... simple, ain't it...

The receiver has very few controls. The channel selector knob is a continuous tuning affair, much like the station selector on the aforementioned Walkman. It's a nice big knob, and works very smoothly, but tuning in feeds takes a bit of fiddling. In addition, of course, it only tunes in half the feeds at a time... there's a polarity switch to move the polar rotor out at the feed horn.

Likewise, the audio is also continuously tuneable, although it's not as much of a problem as the majority of feeds use the same audio subcarrier frequency.

There's also a button on the front to make the thing scan through all twelve possible feed frequencies, which is useful when one is aligning the dish. The receiver does have a signal strength meter... this is more than one can say for many much more expensive boxes, which confront one with four or five light emitting diodes.

The receiver.

In keeping with its not doing very much, the receiver is extremely small. It will fit just about anywhere. Also in keeping with rest of the system, the receiver is nicely designed... it's stable and has reasonably good specifications. It doesn't do much, but it does it well.

Some Sing, Some Dance

The downlink package that I got came with no instructions at all except for a really short leaflet attached to the receiver... I imagine that these things usually do have some documentation associated with them, although I can't say what it's like. I got it going without any need of a manual, but, admittedly, I've set up dishes before.

The really magical thing about the system was turning it on. It was unquestionably a fluke, but, having set up the dish in the yard, pointed it toward where I figured Anik D would be and plugged in the cables, I came in to find that it was pretty nearly perfectly aligned and receiving a picture. The picture was coming from Westar Four... one satellite further east than I'd planned on... and it did get better with subsequent tweaking and fiddling... but the package really did work right out of the can.

As a dish gets smaller, its tolerance for misalignment increases. Its gain decreases, of course... there's always a catch. However, this means that, while my ten foot system insists on looking right at the satellite it's supposed to be receiving, the little six foot dish allowed for quite a bit of slop before it just pulled in noise. This doesn't mean that you'd want to watch it when it's misaligned. It does make finding the satellites an awful lot easier, though.

The pictures that the six foot system can get together are acceptable most of the time. They don't compare to what comes down the wire from the Radio Shack system, but they're certainly watchable. Very strong feeds... like Anik... are just about noise free. Most of the rest of the sky has a few sparklies... noise flashes... in areas of saturated colour. I don't find these pictures any less watchable than what comes off cable television.

Of course, the system is pretty unforgiving of obstructions. Whereas a bigger dish can live with bit of foliage in the way, this system needs all the help it can get, and pretty well insists on a clear view of the sky. Being fairly portable it isn't that hard to avail it of one most of the time.

Downlinks And Upgrades

The six hundred dollar system does work... in fact, electrically it's pretty good. However, it lacks just about all the amenities. Whereas I can sit back and move the dish of my Radio Shack system with a wireless remote control... a disgusting, bourgeois practice, I know... you actually have to go outside

and bounce this thing around by hand. It would be a party in winter.

Likewise, the tuning of the receiver is a bit less than effortless... anyone who's gotten used to push button controls and automatic fine tuning will get a bit annoyed at this.

One of the things that's worth mentioning is that this package can be upgraded by its manufacturer bit by bit to a more sophisticated downlink. However, check this out... with the possible exception of the cables, every element of it would have to replaced to get it up to something approaching the state of the art.

There are some good reasons for buying this system... and some good reasons for laying down and avoiding it. If you really want to get into satellite television and it's all you can spring for, hey, it's unquestionably better than nothing. If you live out beyond the reach of decent broadcast television you will probably be a lot happier with this downlink than you will be trying to watch the radio.

If you're particularly interested in the feeds on one satellite... obviating the need to move the dish... many of the limitations of the system won't bother you. For example, you might just want to watch the Cancom feeds on Anik D, the movie channels of Galaxy One or... for the more jaded souls... whatever it is that comes in on Spacenet One.

If you're more interested in tinkering with a downlink than watching one you'll love this system. It's ideal for meddling with. After a few hours of looking at it, every old bit of metal in your basement will look like part of a home made actuator or mount.

If you're primarily up for some of the more esoteric applications of satellite feeds... such as the computer data services we looked at in the December 1986 edition of Computing Now!... this dish will do admirably. Finally, if you want to try satellite television inexpensively this is the way to do it.

One observation somebody offered me about this system is that it's a good idea for people who migrate to a cottage each summer. It can easily be picked up by two people and trucked inside when it's all by itself, keeping it out of the elements and avoiding its possible walking off.

This is not the system to buy if you want a really painless way to watch the tube. A state of the art downlink with all the bells and whistles really does cost several grand. If you object to getting out of your chair to change the channels on a conventional television, consider how much you're going to feel like going outside to do it.

The flip side of realizing that you get what you pay for is working out what you really want. If you want more than this simple downlink will give you, I'd recommend waiting until you can afford something better. This package will ultimately frustrate you and put you off satellite television for good. You'll miss a lot really good tube.

If your expectations of satellite television fall within the abilities of this system, however, you can get it together and have enough for, say, a Video-Cypher and a new television set with the difference between what it costs and what a really sophisticated downlink would set you back.

The only cheaper way to watch satellite television is to move next door to someone who has a dish and buy a lot of beer. ●

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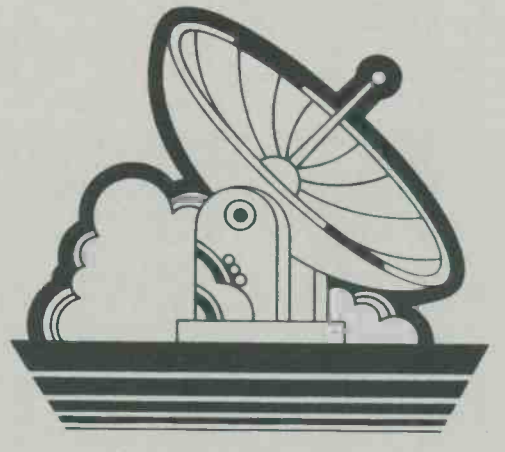
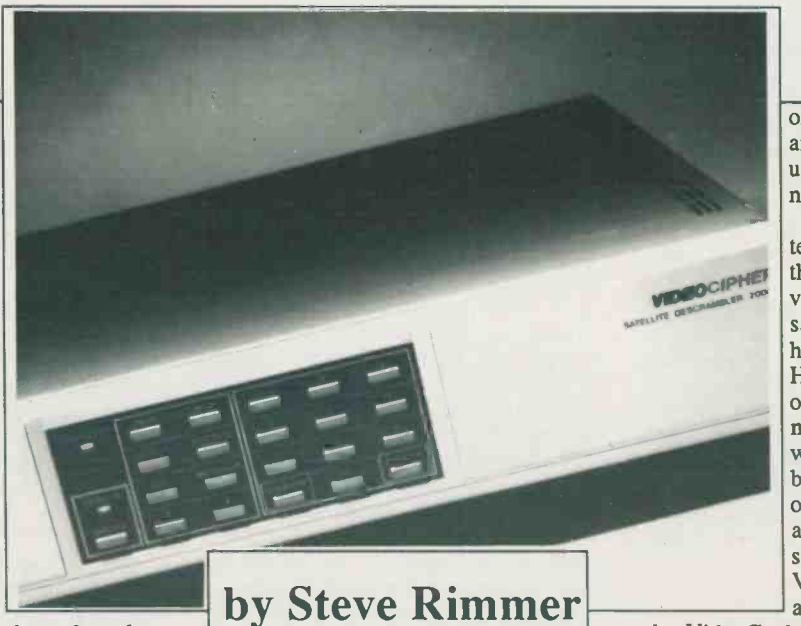


SCRAMBLING, DESCRAMBLING AND BLACK BOXES

Scrambled satellite feeds aren't really as terrifying as they seem... especially if you're north of the border.



by Steve Rimmer

One of the things that most people interested in satellite television encounter early on is the eternal werewolf of scrambling. Depending on who you listen to, almost nothing or just about everything is scrambled, and, once more depending on your sources, satellite television is either dead or thriving as a result.

Rather than speculate any further on this point, I decided to do some heavy cerebral research on the matter. To this end, I actually turned on the tube and watched it for a while. This quickly settled a large part of the ambiguity concerning scrambled signals.

There are a lot of the little monsters.

The reality of scrambling is very different from that of the science fiction that seems to surround it. It's a bit more complicated in Canada than in the States, but it's still a solvable, manageable situation if you don't freak out and use your dish as a garden umbrella.

If you're at all into the scrambling issue, you'll probably be slavering at the lips even now in the hope that this article will get into some of the more interesting aspects of descrambling. Fear not. However, before we ease into the grey areas of black boxes, clones, piracy and so on, it's probably worth having a word about the ethics and legality of these things.

I would say that, aside from being illegal, it's morally wrong to rip off scrambled satellite programs this way if you live in the States. However, as we'll see, it's all but impossible to pay for the things even if you want to up here, and it's a fine legal point whether swiping them if you can constitutes stealing at all in Canada. The ultimate decision is best left to your own head... all of the following is offered here should you decide that you won't burn in hell for doing it.

The Joy of Hacking

The central box involved in all this is something called a VideoCypher II, a very sophisticated microprocessor controlled descrambler. It gets attached to one's satellite receiver and, thereafter, can be used to unscramble signals. Possibly.

Unlike simple cable television descramblers, the VideoCypher is a very selective box. Let's say that one wanted to have it unscramble Home Box Office, one of the better American movie networks. One would call HBO's number and give the human on the other end a Visa account number, the serial number of the VideoCypher in question and an address where the VideoCypher is said to be residing. This latter detail only matters to the accounting department, by the way. HBO would then send an authorization signal over their satellite feed, buried in the picture information.

The VideoCypher would see its serial number and the turn on code for HBO and would thereafter descramble HBO's signal. It wouldn't descramble anything else. The box can be told to stop descrambling HBO in the same way... HBO sends periodic turn off signals for all the boxes which have cancelled HBO. If you deserved turning off, eventually, your box would happen to be tuned in to HBO when the turn off came and would be zapped.

Now, the prices of the various speciality services on the satellites aren't really steep for the most part. You can have a couple of American

movie channels for about the same price as First Choice and cable television... with a thunderously clearer picture and a better selection of flicks. There are a couple of catches, however.

The VideoCypher is not supposed to be sold outside Canada... at least, that's what General Instrument, its manufacturer, feels. It is available up here, but, being a somewhat shady box is pretty expensive. Selling for as little as three hundred and twenty bucks in the States, the VideoCypher II costs seven or eight bills up here. Even allowing for the general worthlessness of beaver bucks, this is a fairly substantial wallet gouge.

The second, and potentially stickier aspect of all this is that most of the more interesting satellite program suppliers won't authorize VideoCyphers which they think live in Canada. This means that you have to supply them with an American billing address and a Visa number drawn on an American bank. You also have to get someone to call the deal in from south of the border, as most of the program suppliers use American eight hundred numbers, which can't be accessed from Canada.

This is trivial if you have friends or relations down there, of course... and a bit of a pig if you don't.

If you do decide to get a descrambler and go at things this way, be warned. Some Canadian VideoCypher suppliers will sell you the box and arrange to get it authorized for you for whatever feeds you want to pay for. These are good heads, and solve a lot of potential hassles. However, at least one that I encountered will cheerfully sell you a VideoCypher, but won't help you get it turned on.

Moral Minority

It's said that anything that can be coded by one programmer can be hacked by another. VideoCyphers are no exception, and at the time of this writing some first rate VideoCypher hacks had turned up.

There are a number of ways to modify a VideoCypher to make it think it's authorized to unscramble things it's really not. They're all a bit tricky, and of varying effectiveness, and they all require that you actually own the cursed box to begin with. However, the state of the art is getting pretty good in this area.

There are several stages of VideoCypher hacks. The simplest one involves serial number substitution. Every VideoCypher has a read only memory chip in it... a ROM... with a unique serial number. One can unsolder the ROM and replace it with a "clone". A clone is a slightly modified version of the chip with the serial number of a "master" cypher having all of the services paid for. It also has some code changes that trash the Cypher's stack pointer to make it read the ROM based serial number rather than the one it has stored in its battery backed up memory... we'll get back to that memory later.

Under this arrangement, some enterprising soul sets up one master VideoCypher and makes lots of clones of it. Obviously, this approach is a bit perforated.

Cloning works... until the VideoCypher people manage to get one of the cloned boxes. Then, paid up or not, they shut down the master and all the clones go dark too. Secondly, a lot of somewhat flaky clone dealers have sprouted in the wake of this discovery. Having sold a few dozen... or a few thousand... clone chips, there's no telling how long the owner of the master VideoCypher is going to keep up the payments on its services.

A more sophisticated approach is what's called a "musketeer" chip. The name is a bit obscure... it refers to the expression "one for all and all for one". In this variation, the software in the chip is slightly altered so that getting one service authorized will turn them all on. As such, one would pay for one of the few services that can be bought in Canada without a lot of geographical head dancing... CNN, for example... and then tune in all the rest.

The advantage in this is that the VideoCypher people can't know who's using a musketeer chip and who isn't, and, as such, can't suddenly shut you down one day.

There are a lot of variations of musketeer chips. Some work, some don't... and some can be interfered with by General Instrument, if not wholly shut down. The earlier musketeer chips allowed General Instrument to cause an annoying black box to appear in the pictures generated by the hacked chips. Later versions overcame this.

There are a number of things which General Instrument is doing to find the clone users... virtually all of these are happening in the States, however. I'm told, for instance, that they're randomly turning off users who only have one inexpensive service paid for, on the assumption that most of these are using musketeer chips. When these poor souls complain about it, General Instrument tells them that there's probably something wrong with their cyphers, and that they should return them for repair. They get new serial numbers put into them... their clone chips removed... and come back with their parts encased in epoxy.

The solution to this, of course, is to pay for two feeds. It's probably not being done in Canada... there are only two services available up here, the other one of them being erotic movies.

They also look for users who have everything turned on, assuming that these are masters for clone groups. A recent generation of clones has emerged with two clone ROMs, each one representing a master group with half the services turned on. There's a toggle switch added to the VideoCypher to select which one you want to view. As such, neither master group has everything on and neither is a target for turning off.

It's probably also worth noting that some very late model VideoCyphers do come with their guts potted in epoxy right from the start and, for this reason, are a bit nasty to modify.

As far as I know, no one has yet managed to build a descrambler that doesn't require the purchase of a VideoCypher. There are lots of them that handle the picture information, which is lightly scrambled, but none that will unscramble the audio. Beware of any Cypher-less descramblers.

Warnings from Above

There are a lot of pitfalls in the VideoCypher hacking universe. I'll try to get into a few of them here.

First of all, there are a lot of real creeps out there, people who will take your money... or your VideoCypher... and vanish like shadows. I've listed a few reputable sources in this article... there are unquestionably others. However, don't send anything to someone you haven't heard of before.

The actual process of unsoldering the VideoCypher's ROM is a bit nasty. The DES encryption algorythm's checksum numbers... an integral part of the unscrambling process... live in a bit of battery backed up RAM on the main logic board. If you short the battery or otherwise disturb the RAM, the number goes away and the VideoCypher turns into a paperweight, what the clone people call "brain dead". I can't say whether General Instrument would deign to fix a hacked Cypher or not, but I would think that they'd give you a pretty hard time at best.

There are a few people who will restore a brain dead cypher, but it's fairly expensive at the moment.

It's also worth noting that General Instrument has announced that it's discontinued producing the versions of the VideoCypher II which have been successfully hacked, although there are some of them still kicking around. Its more expensive successor uses a mask programmed microprocessor which is intended to make it harder to meddle with. In a stunning display of corporate logic, a spokesman for General Instrument said words to the effect that "if you people crack it again we'll just redesign it and raise the price some more."

One gets the feeling that one is dealing with pirates no matter who one gives one's money to.

One obvious question concerns existing VideoCyphers. There are rumours which have them all going dark one day, after which time only the new... presumably unhacked... ones will work. While I have no idea if this is true, it seems unlikely. I can't see General Instrument wanting to retrofit the countless thousands of extant Cyphers at its own expense, and I wouldn't want to share the same planet with all their owners if I was the one who'd just rendered their three or four hundred dollar boxes worthless.

Sources:

VideoCypher II "modification" is available from Computer Parts Galore, 316 College Street, Toronto, Ontario M5T 1S3 (416) 928-2161 or toll free (800) 387-1385. This company is straight. They modified our cypher... successfully... and we've known them for ages. They are presently using a second generation musketeer style chip, rather than a straight clone.

VideoCypher II's are available from Banvil, 775 Main Street East, Milton, Ontario L9T 3Z8 (416) 878-8181. This company is straight... we actually got a box from them. At the time of this writing they were supplying ChannelMaster 6400 VideoCypher II descramblers, which are un-epoxied and receptive to most of the common chips.

There are probably other reputable companies... there are also a lot of creeps. Before you send a company either money or a VideoCypher, check out their reputation and references thoroughly. Bear in mind that if you do get ripped off, the police and the consumer protection groups probably won't be much help under the circumstances.

Little Details

There is another scrambling system, by the way, the Oak Orion system. This has nothing to do with VideoCyphers. It's the one that's legitimately used in Canada by Cancom to sell programs to people out of the reach of cable. These programs can be found on Anik D. They're a collection of local stations from across Canada and the States... with no movie channel as of this writing. This descrambler, too, has been cracked. However, for most people, Cancom is pretty dull and hardly worth the effort. It's also unquestionably illegal to meddle with in Canada because it is sold up here, and you can pay for it.

I should also pass along the following observation. I don't know if it's true or not... it sounds plausible enough. I'll let you decide whether you want to believe it and, if so, whether it affects your judgement as to the ethical basis of scooping scrambled programs.

The VideoCypher system is very expensive, not just for we poor fools with dishes in our yards, but also for the program suppliers. The whole existence of satellite video feeds, as far as, say HBO is concerned, is to get programs to the thousands of cable television companies across the States. As the story goes, HBO had to supply all of them with industrial VideoCypher decoders, as well as equipping itself with encoders.

Now, satellite television is a rural phenomenon for the most part. People who live in the city don't put up dishes as a rule. For one thing they have cable television, which is much cheaper and less fuss, even if the pictures look like abstract sand paintings a lot of the time. For another thing, it's hard to hang a dish out of the window of an apartment building and hope to align it.

The grey area... the number of people who could potentially erect satellite dishes and get HBO for free rather than paying for it on cable... is very small indeed. Even allowing for the revenues which HBO is now getting from satellite dish owners paying for VideoCypher'd programs, there's little financial sense in the deluge of money they sunk into the VideoCypher system in return for the trickle they're getting back. The vast bulk of a program suppliers revenues still shows up as a result of cable television subscribers.

It all makes very little sense.

The missing element is cable television itself. The large... and well entrenched... cable industry has always been a bit fearful of the satellite guys. Cable television is only able to provide a limited number of signals, and then with only mediocre picture quality at best. With the advance of satellite technology, the writing appeared to be on the wall in large fluorescent orange letters for a lot of cable.

In an effort to zap the satellite companies, the associate of American cable companies laid an ultimatum on the program suppliers, such as HBO. They said that they'd refuse to carry any signals which weren't scrambled. This would have finished HBO over night, of course, and, as such, scrambling came down.

If you accept this scenario... you probably will if you've ever had dealings with a cable television company... you may feel a lot better about using a hacked VideoCypher. You aren't really hurting the programmers, after all, who have really twisted themselves out of shape to avoid taking money from Canada. You aren't doing much to General Instrument, which gets to sell you a Cypher whether you have it hacked or not. In a somewhat distorted way you might be taking a shot at the cable industry, which unquestionably deserves it.

I'll leave the final throwing of the switch to you. ●

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Circle No. 42 on Reader Service Card

SATELLITE TELEVISION NEWS AND NEW PRODUCTS

by Ed Zapletal

Unique Sixteen Section Dish

Winegard has introduced a new sixteen-section three meter (10 foot) rolled expanded mesh dish.

The SK-165 can easily be assembled by two people in less than an hour, and is priced competitively with conventional e xpanded mesh dishes.

The rolled expanded mesh has a much smoother, flatter surface with more accurate tolerances, and smaller holes for better reflectivity, resulting in improved reception in the C and Ku bands. The sixteen panels slide into extruded aluminum ribs for maximum rigidity and resistance to strong winds. This model is completely UPS shippable in four cartons.

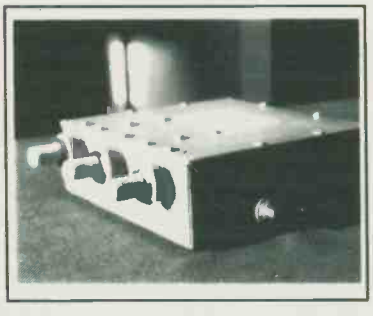
The sixteen-section three meter dish is also available in a perforated aluminum model, CK-165.

Both versions include the reflector, backup structure, buttonhook feed, minimount and shroud. Both models are part of the Winegard Pinnacle line of high quality, durable antennas and feature a corrosion resistant, tough powder coat finish in smoked chrome colour.

Circle Reader Service Card Number 50

Tunable Filter

From NYSA Satellite Systems we

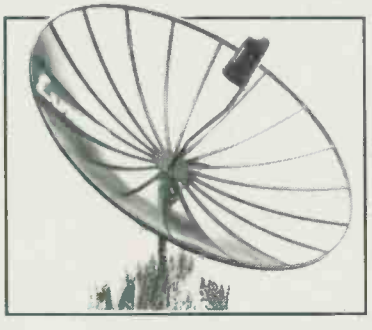


have the MF-3 tunable IF filter. The unit has a tunable range of 950 to 1450MHz (on all transponders) and three independent microwave resonators with an average notch depth of 15dB and more than 35dB if all three filters are combined.

No IF loop is necessary and T.I. is suppressed before it enters the receiver. NYSA claims that interference is completely eliminated or greatly reduced to a watchable level, even during periods of heavy interference including complete wipeouts.

Circle Reader Service Card Number 51

Luxor 10.5 Foot Dish



Luxor has introduced its new C/Ku band Mesh Satellite TV antenna featuring "deep dish" parabolic geometry for optimum signal reception.

Tightly patterned mesh offers maximum reception capabilities and an advanced eighteen-rib design provides high tech strength and easy setup in less than two hours.

The reflector comes with a newly designed polar mount equipped with an adjustable declination offset for online satellite tracking from any location. The mount has self-aligning bearings for minimal pivot point wear and can be used with a linear antenna actuator. Also included is an enclosure for an optional LNA.

Circle Reader Service Card Number 52

Uniden UST-9000

Uniden's top of the line, state of the art block down conversion satellite receiver unit combines C and Ku band compatibility with built-in antenna positioner, ninety-nine preset video and audio channels, and onscreen display with the UST-88 remote station option.

The direct access wireless remote control will select discrete or multiplex stereo. Two buttons will automatically tune your favourite program on any satellite because everything is preprogrammed including audio, skew fine tuning and parental lockout.

Circle Reader Service Card Number 53

Uniden Ku Band Converter

The Uniden UST-55 Ku band converter will allow the reception of Ku band signals with almost any C band block down conversion satellite receiver. The unit can be switched between C and Ku band satellites for a wide variety of viewing options.

Circle Reader Service Card Number 54

Chaparral System

The Sierra computer synthesized satellite receiver from Chaparral comes with full wireless remote control integrating all receiver and motor drive controls into one component. The unit offers superior video performance with computer synthesized, frequency agile tuning and a choice of direct or modulated output. An external seventy megahertz loop is included for T.I. filter installation.

The audio section offers monaural, matrix, discrete or multiplex stereo formats with direct audio outputs for connection to your home stereo or VCR.

Other features include on screen graphics, complete 4/12 GHz compatibility and preprogrammed audio, video and polarity settings for each satellite.

Circle Reader Service Card Number 55

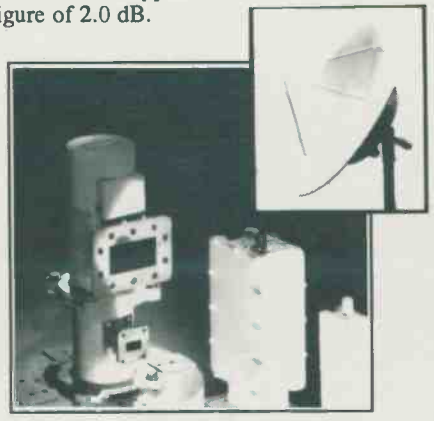
Dual Band TVRO System

Complete access to all satellite transponders in both C and Ku bands is now possible with the Vexus Gold Medal Dual Band System.

The heart of the system is the VX-ESR-124H 4 and 12 GHz antenna feed. This unique component is precisely matched to the Vexus "D" series antennas (VX-2400D shown) offering superior performance in 12 GHz band reception. C and Ku band feed apertures are co-located and skew compensation on both frequencies is controlled with a fully weatherized, surge protected servo.

System control is centralized with the VX-CDR-4/12DD microprocessor based, Remote Control Digital Satellite Receiver. The unit is fully expandable for multiple receiver and multiuser MTVRO applications, has optimized video and audio through DFF (Digital Frequency Feedback) synthesized tuning, and is fully compatible with both 4 GHz and 12 GHz DBS.

Noise temperature specifications for the C band LNB are typically 70 to 75 degrees Kelvin. The unit is designed with an isolator on the input of the amplifier, yielding excellent load and temperature stability. The Ku band LNB has a typical maximum noise figure of 2.0 dB.



The Vexus line of antennas includes 1.8, 2.4, and 3.0 meter models manufactured with ultra high tolerance molds and special metallized fibre cloth and polyester composites. This construction assures top gain performance for C band as well as aperture efficiency and RMS standards necessary to optimize Ku band reception.

In addition, Vexus also stocks a complete line of splitter and filter products for complete multiple TVRO systems.

Circle Reader Service Card Number 56

STS Receiver

The SR110 satellite receiver from STS is a full featured programmable unit offering synthesized tuning, character generation (onscreen graphics), and Ku band compatibility.

Other features include full infrared remote control, built in actuator controller, descrambler compatibility, and full stereo audio capability.

Circle Reader Service Card Number 57

Tee-Comm Receiver

The TCR8520 delivers extraordinary video quality and features found only on top of the line receivers. Complete control of your satellite system, including all motor drive and receiver functions, is accessible through one remote control. PLL Quartz synthesized audio and video tuning for precise drift free tuning of satellite transponders and audio sub-carriers.

Circle Reader Service Card Number 58

Luxor XL System

Luxor introduces its new high end, C and Ku band compatible XL system.

The new model is VideoCypher compatible and fully integrated so that all antenna, TV channel, and audio system functions are combined for easy arm chair operation using the XL's remote control.

Additional features include a new Auto Search Tuning System, factory programmed C and Ku band channels, complete built-in Dolby (TM) noise reduction, and built in V/H and C/Ku switches. Also included is a built-in programmable T.I. filter for urban terrestrial interference which is operable from the remote control.

Circle Reader Service Card Number 59

Kenwood Secondary Receiver

The KSR-900S for multiple receiver systems provides all of the basic receiver operations of the KSR-1200P, including the ability to change satellite position from the remote location.

It provides on screen graphic display just like the master receiver, automatic Ku band switching and parental lock. The unit also comes complete with a full function remote control.

Kenwood also carries a full line of accessories for multiple receiver systems.

Circle Reader Service Card Number 60

B.E.L.-Tronics Accessories

A full line of TVRO equipment is available from B.E.L.-Tronics including a new line of receivers, blockdown and low noise blockdown converters and line accessories.

At the top of the list is the B.E.L Micro Eye full featured satellite receiver. The unit comes complete with infrared remote control, memory capability and true C/Ku band compatibility. Also available are a complete dual band LNB, spun aluminum dish, antenna mount, and connecting hardware.

Circle Reader Service Card Number 61

Filter, Data And Services Catalogue

Microwave Filter Corporation has published a thirty-two page catalogue covering their total line of filters, data and services for the suppression of T.I. for C band TVROs.

The catalogue contains the first complete industry listing for over five hundred satellite receivers and how to filter them. All the aspects of T.I. suppression are covered as well as suggested filters and components for counteracting it. The catalogue lists for $1 US. For more information:

Circle Reader Service Card Number 62

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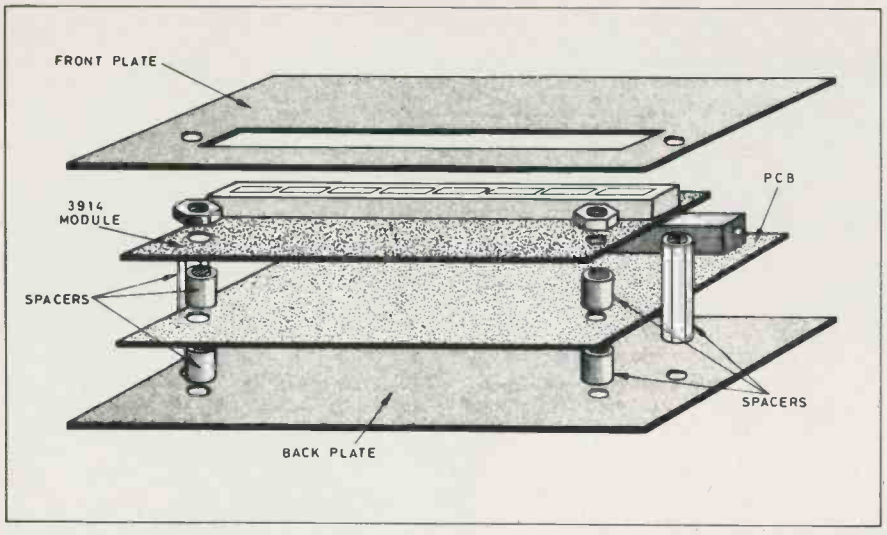


Fig. 6. Final construction details.

be suitable. Holes and dimensions are shown in **Fig. 5**. The circuit board and module are bolted to the back plate. It is most important that either plastic bolts or insulating washers are used to ensure that no accidental electrical connection is made to the conductors on the module which run close to the fixing holes.

Then, with the use of spacers, the front panel is fixed over the front of the unit. The assembly drawing, **Fig. 6**, will make these latter details clear. Finally the front panel is suitably marked with voltages and possible a reference mark to indicate at a glance the expected normal working voltage, see photographs.

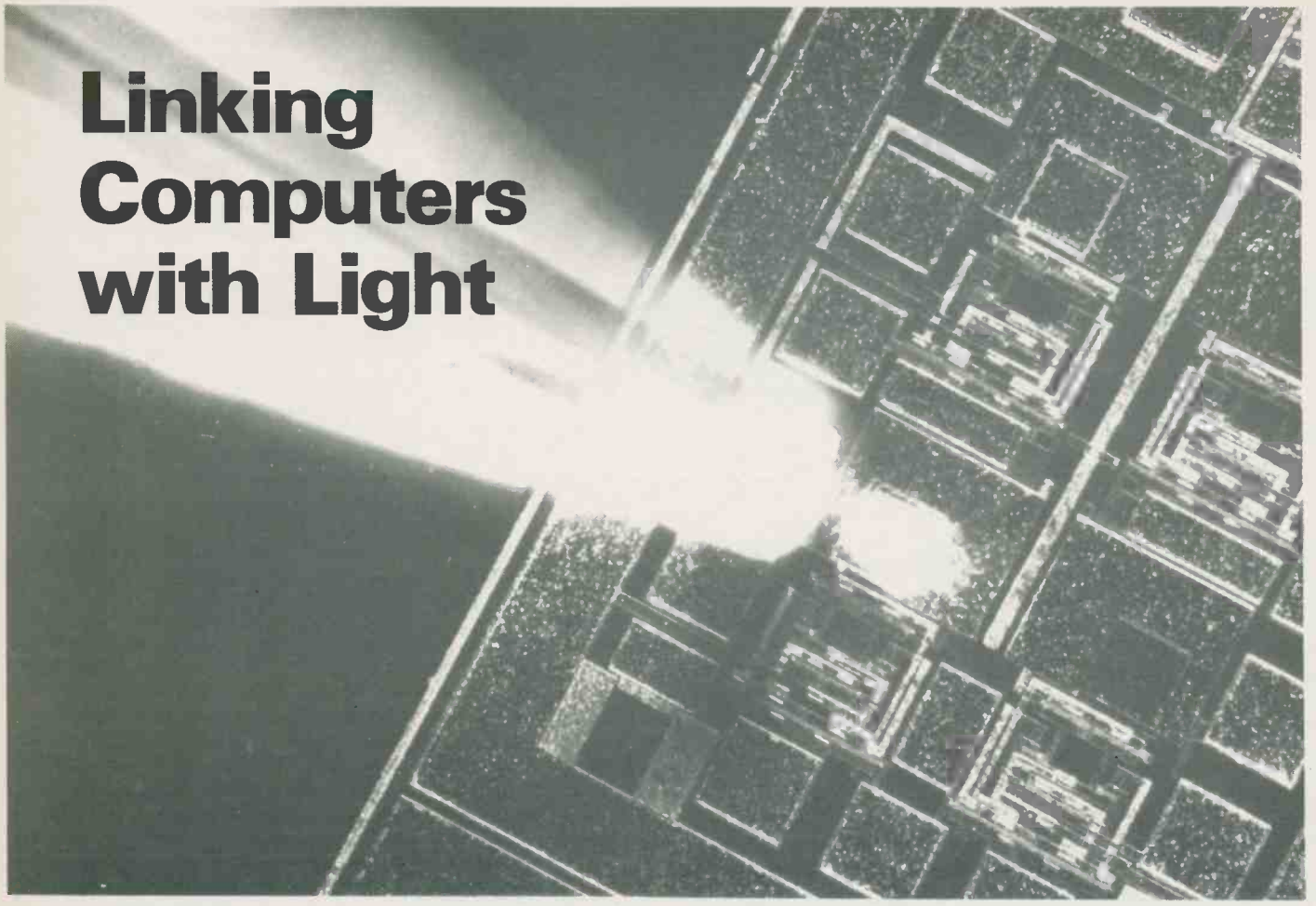
Setting Up

Calibration can be performed very conveniently if a variable voltage power supply, adjustable to 16V, and a voltmeter are available. With 16V applied across the V+ and V- connections of the unit. VR1 is adjusted until the last LED just lights. If 16V is not available then the highest voltage available in the working range should be set up with batteries and VR1 adjusted until the appropriate LED just lights, e.g. LED No. 6 for a 12V supply. a fully changed car battery which has been disconnected from its charging circuit for a while can be taken as being just over 12V output.

The unit may then be wired into a suitable outlet of the car's electrical system. The unit is equally suited to positive or negative ground wiring. For safety reasons it is essential for there to be a 1A fuse somewhere in the supply line in case the unit is damaged in an accident or has a component failure.

Once fitted the unit will be found to be very helpful for reliable and worry free motoring. ■

Linking Computers with Light



By IBM Research Division, N.Y.

IBM SCIENTISTS have demonstrated an experimental computer chip that works so fast it can "read" 40 encyclopedia volumes every second. The opto-electronic device transforms light into electrical signals that a computer can understand.

Over two times faster than any similar chip yet reported, the IBM opto-electronic receiver combines, on a single chip, the ability to read very fast light signals and the electronic ability to translate these signals into sophisticated computer language.

This achievement is an important step toward the day when computers will be able to communicate massive amounts of data at the speed of light, using fiber optic cables instead of conventional wires.

The unprecedented speed of the IBM chip results both from placing the functionally dissimilar communications and computing circuits on the same fingernail-size area and making the entire chip from gallium arsenide.

GaAs Technology

Gallium arsenide (GaAs) can move electrical signals much faster than the silicon used in most computer circuits. Since it is also much more efficient in turning light signals into electrical signals, it seems an ideal material for the light-based computer communications many scientists believe will be widely used in the future.

To make this single-chip receiver, IBM scientists forged technological innovations in Large-Scale Integration (LSI). Although conventional LSI technology is well suited for constructing transistors for efficient high-speed computer translation, it has not been very successful in building photodetectors for reading light signals on the same chip.

Previous efforts altered the LSI technology to allow boosting the power of the photodetectors. However, this unconventional LSI technology made the transistor circuits slow translators.

So the IBM scientists reversed this

approach; they altered the photodetector technology so that the photodetectors could be made alongside conventional LSI circuitry.

Technical Considerations

As communications traffic between computers climbs from millions to billions of bits per second, researchers must develop new ways to move vast quantities of data with efficiency and precision. Optical fiber transmission lines potentially provide such an interconnection technology.

The receiver is a critical link in this process. Its photodetector transforms the fiber optic light into electrical signals, and the transistor circuitry amplifies and organizes the signals so the messages are correctly interpreted by the computer.

Billions of data traffic bits create problems, however, that complicate receiver design. Electronic signals from nearby circuits can interfere with the signals in the wires connecting the photodetector to the amplifer, thereby creating errors in the data. Also, the wires that connect the photodetector to the amplifer can act to distort the electrical pulses, causing the receiver to slow.

A solution is to put the photodetector and transistor circuitry very close together on a single chip. By bringing elements closer, much microscopic wiring is eliminated and the entire receiver (photodetector and amplifier) is isolated from other electronic circuits, reducing noise and distortion.

But this introduces a new set of problems: how to fabricate two different device types on a single chip. In the case of opto-electronic GaAs receivers, processes for making photodetectors and very dense transistor circuitry were at odds.

MESFETs and Photodetectors

In the past, efficient photodetectors had been built using a specially produced, and so enhanced, GaAs crystal as a base material. Very dense transistor circuits could be made from MESFETs (MEtal Semiconductor Field Effect Transistors), typically used to make logic and memory circuits.

However, the MESFETs could not be made alongside the photodetectors; making MESFETs requires a high-temperature process called annealing, which unfortunately changes important qualities of the photodetector's GaAs base.

The IBM scientists solved the problem by altering the design and fabrication process of the photodetector, making it compatible with the high-temperature annealing process needed for the production of high-density, high-performance MESFETs.

Rather than depend on a special GaAs base to achieve the photodetector's efficiency, the IBM researchers enhanced the properties of standard GaAs by doping; a process whereby a small quantity of another material is added to the GaAs base. Since this doping process is the same as that used in high-performance MESFET fabrication, these detectors can be fabricated alongside conventional MESFET transistor circuitry.

Using these techniques the IBM researchers have succeeded in fabricating opto-electronic receivers that they believe are over two times faster than what has been achieved to date with similar integrated receivers.

Other fast LSI electronic circuits were fabricated alongside the receivers on the GaAs test wafer, confirming the compatibility of the IBM developed photodetectors with a wide range of transistor fabrication techniques. ■

Continued from page 21

and decelerant rates "voltage boost" and overcurrent trip protection. Beyond lower power levels (i.e. about 2KW) it becomes economic to include a greatly increased number of electronic functions in an AC drive. Such functions lead to both wider control and monitoring facilities, while also offering superior motor controlability especially under overload conditions. Advanced modern AC drives will continue to operate under all but the most severe overload conditions.

Additional AC Drive Features

The following features are sometimes offered with AC drives. Depending upon the application, such features may be necessary for the best operation of the AC drive system.

Slip Compensation
Slip compensation gives a small increase in the off frequency of the AC drive as motor current increases. This gives an improved degree of motor speed regulation, typically to within 18 to zero to full load.

Tachometric Feedback
Unlike DC drives, it is not usually necessary to provide tacho feedback for speed regulation of motors on AC drives. However where precise speed regulation (better than 1%) is required, tacho feedback can be applied to AC drives.

Process Follower
Process following circuits are used to allow an AC drive to follow the speed of a master process. With the addition of a sensor to monitor the speed of the master process, speed gain trim is used to match the follower speed to the process.

Special Considerations
In standard practice, it is always best to screen control cables. It is also recommended that control cables be run in separate conduits from power circuits, including the output from the AC drive itself.

Shielded Motor Cables
Due to the fast rising edges of the output voltage waveforms found on most modern AC drives, cabling to the motor should be screened. It is often recommended to run three phase, neutral screen cable (using screen as ground) from the controller to the motor. Screened cable is not usually necessary on the input to an AC drive.

Motor protection
While some series of drives have only overcurrent trips, more advanced AC drives have an adjustable motor load current level. Beyond this level, the drive will start to time out, usually on an inverse current basis. This is effectively the same as a thermal overload but takes no account of motor speed and the thermal derating necessary at low speeds.

A more effective way to protect motors is to use a thermal trip sensor (micro therm) embedded in the motor windings. Some drives have input to accept such a sensor, with operations of the sensor brought up to a latching LED fault indicator thereby stopping the drive.

Connecting More Than One Motor

Several motors may be connected to a single AC drive; this is a common technique to maintain speed relationships in production lines or for load sharing on multi motor conveyors. The total motor current should not exceed the AC drive rating. This point is often overlooked particularly in small multi motor applications where the sum of motor currents may considerably exceed the current of a single equivalent large motor. Individual motor protection should be provided, preferably, by micro therms but at least by thermal overlaods blocks.

Very Low Speed Operation

Provided the correct motor derating is observed, very low speed operation will be satisfactory. The PWM used in most modern drives gives extremely smooth low speed operation.

The power factor of most AC drives is approximately 0.96 at full load. No power factor correction is required and no power factor correct should be used with AC drives.

Special Control Systems

The majority of AC drives are incorporated in some form of automatic control system. With the more complex drives such control systems may be incorporated within the standard features (e.g. connection of a level transducer directly to the drive for tank level control). Large control systems may require custom development of control electronics. It is often best to contact specialist AC drive manufacturers, who are familiar with their products for such systems.

Service

When selecting any high technology product, consideration must be given to the aspect of servicing. In well-designed drives, ample room fault indications by LED lamps and modular design, ensure rapid diagnosis and repair. Standardization of control circuitry and boards through a manufacturer's range, allows minimum stockholding of spare parts and other materials.

Conclusion

In many processes the method of variable speed control of standard three phase induction motors by the insertion of an AC drive in the motor line is very attractive. The key to a successful application however, relies upon knowledge of the advantages and limitations of such a system. Given this information, the user can determine the best solution for his particular process. ■

ALMOST FREE
PC SOFTWARE VOLUME XXIV

AC This is a very small area code program... give it a three digit area code and it will tell you were it is. The C source is also included.

ASC This is a memory resident utility that pops up a window with an ASCII character chart.

ATTR This utility lets you meddle with the attribute bits of your files.

BAC This is a disk backup utility that's a lot less frightening than the one that comes with DOS.

BACKSCRL This recalls stuff that has scrolled off your screen. It's neat if you can't seem to reach the Num Lock key in time.

CAT This is a collection of disk utilities in one program.

CLOCK One of the nicest screen clocks we've seen, this has a built in alarm function among other things.

COVER This is a sorted disk directory that prints out all the files on a floppy in a form suitable for sticking to the sleeve.

CWEEP This is a menu driven file mover... saves typing the word COPY over and over again.

DDIR Yet another directory utility, this does a two column directory similar to the regular single column DOS version.

DELZ This wipes out files so that they can never come back... kills the sectors as well as the directory entry.

DISKCAN This one checks your disks for bad sectors... get 'em before they get you.

DOORS This lets you flip between multiple monitors without rebooting your system.

EQUIP This program tells you what hardware your system thinks it has... very often providing you with the answers to all sorts of software problems.

FASTDISK If your floppies seem a bit tedious you might want to zap 'em with this speed up program.

FDATE This changes the time and date stamps of files.

FLIP This one sets a number of otherwise tedious parameters under DOS.

FREE This returns the amount of free space on a disk without having to watch the whole directory scroll by.

GERM This is a memory resident interrupt driven telecommunications terminal.

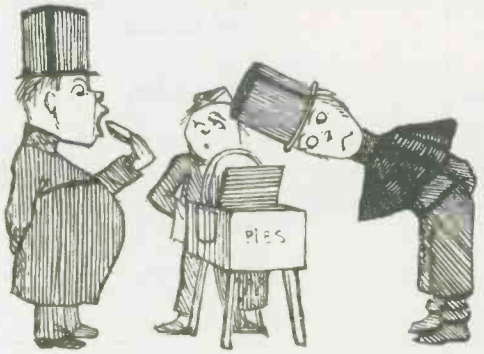
IBMSHELL This allows you to fool your system into loading COMMAND.COM from other places.

KBBUFF This is a keyboard buffer extender. No home should be without one.

KEYFAKE This allows you to "stuff" keyboard characters into an application to get past tedious introductory screens and menus.

LC This counts the number of lines in a text file.

LOCATE This scans through subdirectories checking all the files for specific text strings.



Little Programs of the Gods

This is one of the most useful disks we've ever done. It has no phosphor monsters, no pinball games, no spreadsheets and no unspeakably complex three way menu driven cranial capacity measurement programs. In their place, we've collected a plethora of utilities and bits of code. These little guys are classics... every one of them designed to make your PC a bit more useful.

There are enough DOS assistants here to create a whole new operating system, and a sufficient assortment of memory resident trolls to account for most of the alternate key combinations on your keyboard. There are a number of things here that no enlightened user should be without. Some of these programs are updated versions of things on earlier almost free PC software disks.

Despite the enormity of this list, all of this profound software... plus its attendant documentation and support files... is available for a mere

$19.95

plus seven percent Ontario sales tax.

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LOCK This is a file encryptor. Also includes UNLOCK.

MOVE This moves files between subdirectories with less typing than COPY would entail.

NDOSEDIT An updated version of regular DOSEDIT, this is a resident DOS command line editor that actually makes DOS decent to work with. Indispensible.

NO This is a strange little wild card exception thing. It allows you to create more complex file specifications than does DOS all by itself.

NPAD This is a simple memory resident note pad.

PCUTIL This is a collection of add ons to DOS.

PINHEAD This is the tiny printing press program from the June 1987 edition of Computing Now!. It can get up to sixteen kilobytes of text on a single page. Includes the C language source... works on an Epson compatible printer.

POPCAL This is a memory resident utility which will bring up a calendar for any month of any year you like.

PR This is a handy formatted printing utility.

PUSHDIR Primarily used in batch files, this allows you to change subdirectories, do something and then return to the previous directory.

REBEEP A replacement for PAUSE, this is a noisy batch file utility to attract attention when a task has been completed.

RENDIR This renames subdirectories.

SCRN This is a screen saver... it blanks all the monitors attached to your system after a specified number of minutes of inactivity to keep your phosphor from getting fried.

SETPRN This allows you to painlessly set up your printer form DOS.

SETUP This is a memory resident utility that will allow you to set up an Epson compatible printer from within any application.

SIZE This returns the number of allocation clusters a file occupies on a disk.

SOUND This makes weird noises to attract attention from within a batch file.

SP This is a really nice little print spooler.

SWEEP This allows you to execute a command in every subdirectory on your disk.

UNDEL This recovers accidentally deleted files. You may not need it now but you sure will sooner or later.

VDL This requests verification before it deletes files so you won't need UNDEL quite as often.

VOLSER This changes the value name of a disk.

WAITN This pauses for a specified time while executing in a batch file.

WHEREIS This finds files in subdirectories. It includes the C source code from the June 1987 edition of Computing Now!.

XDEL This is a menu driven file deletion utility.

Fine Print: This software has been collected from public access bulletin boards and is believed to be in the public domain. We have checked this software carefully to insure that it functions as it should. However, we cannot assist you in adapting it to your specific applications.

Moorshead Publications warrants that these programs will be readable when you get them. However, magnetic fields, cosmic rays, truck tires or the bends may adversely affect your disk in transit. If it doesn't function properly when you receive it please contact us for a prompt replacement.

Our latest software catalogue lists a variety of interesting, low cost programs. Circle reader service card number 106 for a free copy.

Satellite Feed Chart

	F2 Satcom F2R	F4 Satcom F4	T2 Telstar 302	T1 Telstar 301	W4 Westar 4	AD Anik D
1		HSN 2				
2		Jewish TV/ Bravo		CBS	Nova Satellite Network	TSN
3	WBBM (vcy)	Rock Christian		ABC (contract)		
4		Nickelodeon West		ABC (LA/NY)		Global
5		Value Network			Latter Day Saints Network	
6		Biznet		ABC (occ)		Much Music
7		Liberty Broadcasting		CBS		CBC Labrador
8		C-Span				CHCH (oak)
9		Sportsvision		WOLD Satellite	WOLD Satellite	WDIV (oak)
10		American Movie Classics	ABC (pmt)	ABC	Brightstar CNN/TVSC	WXYZ (oak)
11	WXIA	Home Sports	ABC (occ)	FBC (pmt)		CBC North
12		Sports Channel		ABC	AMSAT Horse racing (scr)	
13	NASA	New England Sports Network		Sports News Satellite	JISO	SYNSAT
14		Crazy Eddie's Shopping		FBC East		TCTV (oak)
15		Shop At Home	CBS (LA/NY)	CBS (pmt)	PBS A	CBC French
16		Cable Video Store (scr)	CBS (pmt)		CNN (contract)	Parliament French CBC North
17			CBS Toronto		PBS B	
18		Hit Video USA			Horse racing (scr)	CITV (oak)
19		WPIX (vcy)	CBS (contract)		International TV	CBC North
20		Prime Ticket FNN (alt)	CBS			CBMT
21		Nostalgia Channel	PEN		PBS C	WTVS (oak)
22	AFRTS	Home Team Sports				BCTV (oak)
23	WABC	Sports Channel Silent Network		WOLD Satellite	PBS D	WJBK (oak)
24		Playboy Channel			Bonneville Satellite	Parliament English CBC (French)

These feeds were accurate when we did up this chart... they change a lot, though. The codes are as follows: (scr) = scrambled

See Satellite Supplement in this issue.

	S1 SpaceNet 1	W5 Westar 5	T3 Telstar 303	F3 Satcom F3R	G1 Galaxy 1	F1 Satcom F1R	
1	After Dark (scr)	NCTV		Nickelodeon East			
2		University Network		Learning Channel	Nashville Network	KWGN	
3	American Extasy (vcy)			Trinity Broadcast	WGN (vcy)		
4				FNN	Disney East	Italian TV	
5	Christian TV	Brightstar		Viewer's Choice (vcy)	Showtime East (vcy)		
6				TEMPO	Univision	KRMA	
7		CBS (contract)		ESPN	CNN (vcy)	FNN (alt)	
8		PASS	Jazz Channel	Shopping Network	CNN Headline (vcy)	NBC	
9	First Run Movies (vcy)			USA Network West	ESPN		
10				Showtime West (vcy)	Movie Channel East (vcy)		
11		WOLD Satellite		Music TV	CBN Cable Network		
12				Cable Value Network	Request Television (vcy)		
13	SelecTV (vcy)		Country Music TV	HBO West (vcy)	C-Span		
14		KRON		CNN (feed)	Movie Channel West (vcy)		
15	ACTS	TVSC		Video Hits One	WOR-TV (vcy)		
16	SIN			Travel Channel	Viewers Choice 2	ITN	
17	Telstar Channels	WOLD Satellite		Lifetime	PTL Network		
18		Group W		Reuters/SpreeTV	WTBS (vcy)	Worldnet	
19				Weather Channel	Cinemax East (vcy)	Digital Radio	
20		SYNSAT/Nightline	KTVT	Black Entertainment	Galavision	KCNC	
21	Baptist TV (vcy)	Brightstar	Telebet (scr)		USA Network East		
22		WOLD Satellite		Home Shopping One	Discovery Channel	KMGH	
23	Maywood Park Racing (vcy)	CSS		Cinemax West (vcy)	HBO East (vcy)	Digital Radio	
24		Taft Broadcasting		Arts & Entertainment	Disney West	KUSA	

(vcy) = VideoCypher, (oak) = Oak Orion, (pmt) = Pacific Time, (occ) = occasional video. The blank areas often carry unscheduled feeds.

VHF Scanners

The new breed of microprocessor controlled VHF/UHF scanners makes the art of eavesdropping a cinch. But what's out there to listen in on?

By Edward Zapletal

VERY HIGH FREQUENCY scanning radios, or scanners as they are more commonly referred to, are not a new technology by any means; they've been around for some time now. Although the function of the scanner has not really changed over the years, the way in which it functions certainly has. We are all aware of how the microprocessor has found its way into virtually every gadget available to the consumer today, and scanners are no exception.

The low cost of these microprocessors and their various support chips have given VHF scanners a more streamlined look, no longer making them the huge light chasers of yesteryear.

Listening Hardware

The receivers which were the basis for this article were the Uniden Bearcat series, available in a variety of desktop and portable models.

Topping the list, and my favorite, was the 800XLT desktop/portable version. This unit is a programmable, 40-channel, microprocessor controlled scanning system which offers access to 12 bands, including the 870 to 912MHz band. The programmability feature allows for the presetting and monitoring of up to 40 channels from any of the available bands.

The basic layout of the unit is simple enough that anyone totally lacking in scanner know-how could operate the unit competently in no time flat. That's me. The twenty-three key keyboard contains the usual numeric keys, plus controls for selecting 20 or 40 channels in three blocks (1-20, 21-40, 1-40), frequency limits for the search function, and a WX key for scanning local weather broadcast channels. Other features include: Channel 1 priority selection, a 3 second delay on any channel to receive a reply transmission before resuming search and scan, and a function to lock out unwanted channels during scanning. The electroluminescent readout displays the channel and frequency, as well as an error condition if an attempt is made to enter an out-of-range frequency. Other models in the Bearcat line use LED or LCD readouts, depending on the particular model.

The unit comes supplied with two antennae: one telescoping and the other a fixed version for 800MHz band reception. Connections are provided on the rear panel for an external antenna, a 12 volt mobile power supply, external speaker and AC power. Front panel controls apart from the keyboard include volume and squelch, plus LED indicators for Priority, Delay, and Lockout.

In addition to the 800XLT we had the opportunity to try out a few other models including a 9 band, 16 channel handheld programmable model with the same basic scan/search features as the 800. This unit performed adequately, but seemed a bit restricted in its ability to receive signals indoors. However, all buildings are not alike and this should not be considered a problem in most cases.

Listen Here

After becoming familiarized with the basic controls, I set out to scan the airwaves for juicy, interesting bits of information. The trouble was that I didn't have a clue as to where to look for specific things such as fire and police etc. Just scanning and searching along the various bands seemed to produce only transmissions of answering services and couriers; not very exciting stuff to say the least. A few phone calls to people in the know though led me to Bart Veerman, of Haruteq in Stoney Creek, Ontario.

Haruteq publishes very comprehensive frequency listings for VHF/UFH radio: over 6000 frequencies in the Ontario edition, and over 5000 in the Quebec edition. (See tag at end regarding these editions.) My listening problems were now solved.

Apart from listening to police, fire, air, and taxi cabs, there's an interesting, albeit unethical, bit of eavesdropping one can engage in on the 870 to 890MHz range. Herein lives the world of cellular mobile telephones or CMT in scanner jargon. If you are so inclined, you can listen in on

business deals, private conversations etc., but beware, most of this does not provide for "on the edge of your seat" type entertainment. You're better off down in the fire and police frequencies if it's excitement that you long for. Still, all in all, what's the point in this anyway? Who really listens to this stuff?

End Users

For starters, the media is probably the single largest user of VHF/UHF scanning radios. If it weren't for scanners, much of our TV, radio and newspaper news would come to us long after it ceased to be news. Most metropolitan newspapers, for instance, have several units monitoring police frequencies giving them up-to-date information on the locations of breaking stories.

Those inclined toward nautical activities have 24 hour weather services available to them from Environment Canada on seven channels in the range of 162.425 to 162.550MHz. Weather forecasts can also be monitored via the Transcribed Weather Broadcast (TWEB), found on the aircraft band at 122.3500MHz. The MAFOR (marine forecast) weather codes are another type of broadcast transmitted by the Coast Guard stations on the Great Lakes and St. Lawrence river, between April 1st and December 31st, during the shipping season. Ten frequencies between 156.3000 and 157.425 have been allocated for MAFOR broadcasts.

Technical Specifications 800 XLT

RF Sensitivity:
0.3 microvolts 29-54 and 136-174MHz
0.8 microvolts 118-136MHz, 60% 1kHz modulation 12dB SINAD
0.5 microvolts 406-512MHz
0.7 microvolts 806-912MHz (± 3kHz dev. 12dB SINAD)

IF Selectivity:
-55dB @ ± 25kHz

Audio Output
2.0 watts, 8 ohms, 10% THD

Judging from the number of weather-related boating mishaps though, not enough people are aware of the availability, or the importance, of these services. If you are the boating type, one of the best investments you can make is in a radio capable of monitoring these weather broadcasts.

An undeterminable number of scanner users are those who listen purely for pleasure. Some listen to satisfy a strange curiosity for eavesdropping on other peoples' conversations (true on the CMT band), others find it as interesting as listening to regular AM or FM radio.

Train buffs will be interested in listening to railroad company frequencies; there are well over a hundred of these allocated across Canada.

Canadian VHF marine band frequencies offer interesting listening to those who are into monitoring intership and ship-to-shore transmissions, traffic movement, distress etc. Keep in mind that the shipping season is from April 1st to December 31st, weather permitting, and as a result, the VHF marine band lies mostly silent during the winter months.

Those of you out there who are interested in getting into amateur radio can listen in on some of the Amateur Radio Repeater frequencies. If you like what you hear and you're interested in investing into a complete ham system, contact the Canadian Amateur Radio Federation (see address below) to get the lowdown on amateur radio.

Improving Scanner Reception

An important part of your scanner equipment is the antenna; without it, reception is impossible. VHF base stations as a rule can transmit up to about 50km. Most mobile scanners are generally capable of receiving signals from 15km, and walkie-talkie types can usually bring in signals from approximately 5km. What all this means is that the antenna which most often accompanies your unit, is, for the most part, quite adequate. Desktop units are commonly supplied with telescoping antennas whereas "walkie" types usually come with a short black rubber (rubber duck) antenna.

According to Haruteq, however, you can improve the reception quality of your scanner considerably by experimenting with different types of antennas. They suggest antennas available from manufacturers such as Avanti, Radio Shack, Hustler or Larson.

The type of building you're in (if you have a desktop model) can also play a major role in a particular unit's ability to receive a signal. If it's your basic concrete/steel type of office structure, you may find that the steel components will cause you some reception grief. Most residential structures (with the exception of some apartment buildings) should allow satisfactory VHF reception.

Handheld portable models seemed to perform considerably better outdoors than in, although we had good success with the local police and fire frequencies here in our Don Mills offices.

Finally, if your particular unit has a telescoping antenna, you can try adjusting its length to suit a particular band. The Haruteq Scanner book gives complete details on how this is accomplished.

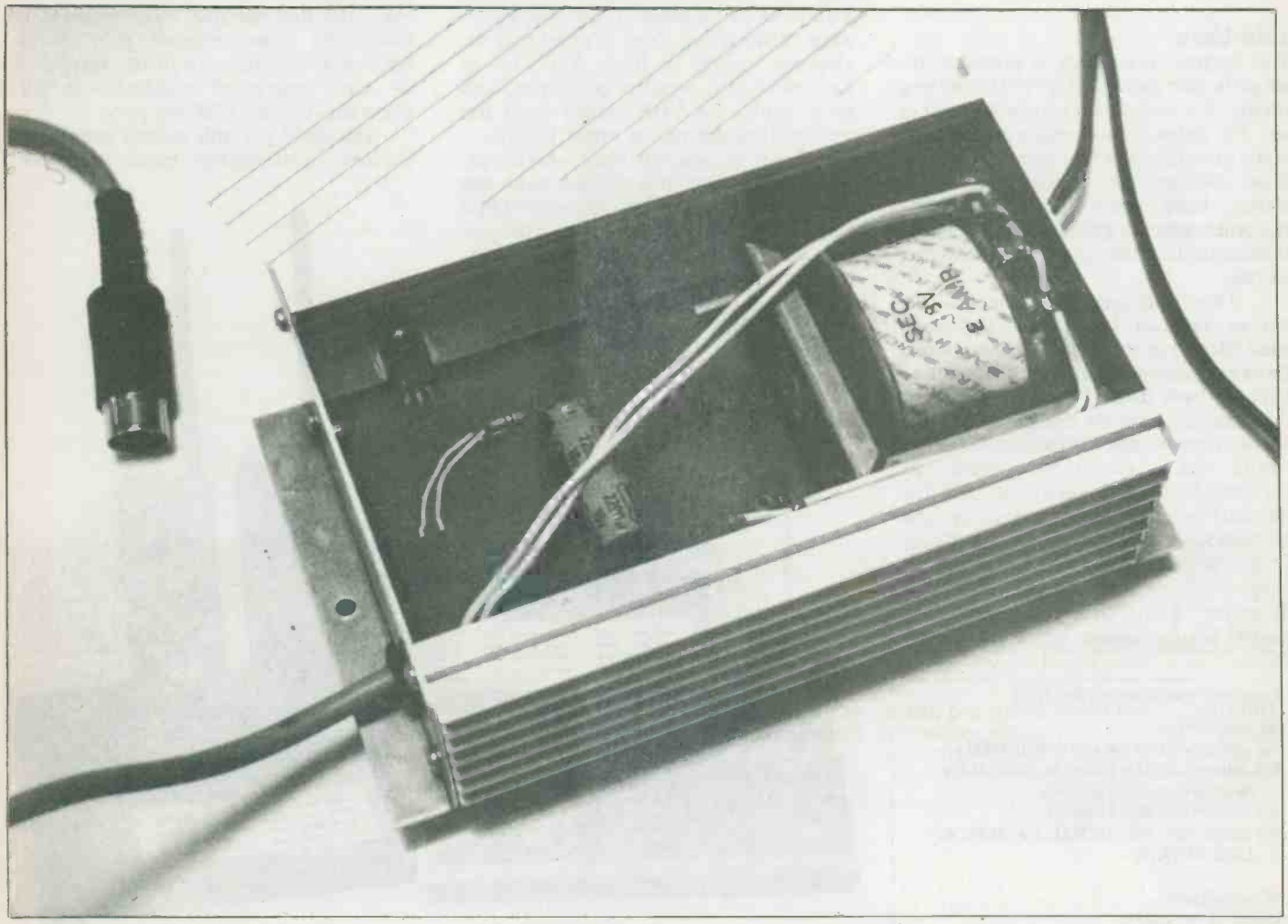
Sources

Lenbrook Industries
633 Granite Court
Pickering, Ontario
L1W 3K1
416-831-6333

C-64 Power Hack

Increase the reliability of your computer with a bigger power supply

By David Green



BEING an electronics and computer technician, I see a lot of design and failure problems in many pieces of equipment. The most common for the Commodore 64 has to be its power supply. If you are not sure what I mean, try placing your hand on the power supply unit after it has been running for 20 minutes, it gets extremely hot. This is not only hard on the power supply components, but when the supply decides it wants to croak from too much baking, it usually takes out a few chips with it. The most common of these is the RAM chips, and usually all eight of them. So now you have a Commodore 0.

After having to repair numerous power units, and seeing that they all suffer from the same fault, it is easy to determine the cause of the problem. The power supply for the 64 consists of a 5 volt regulator IC in the external pack and a 5 and 12 volt IC set in the console. The regulator IC in the pack is your common 7805 tab mount T0220 case style capable of approximately 1 amp. With a large heatsink and an input-output differential voltage of about 7.5 volts, the IC is capable of just under 2.25 amps peak. In the 64 power pack, your lucky if there is enough heatsink to

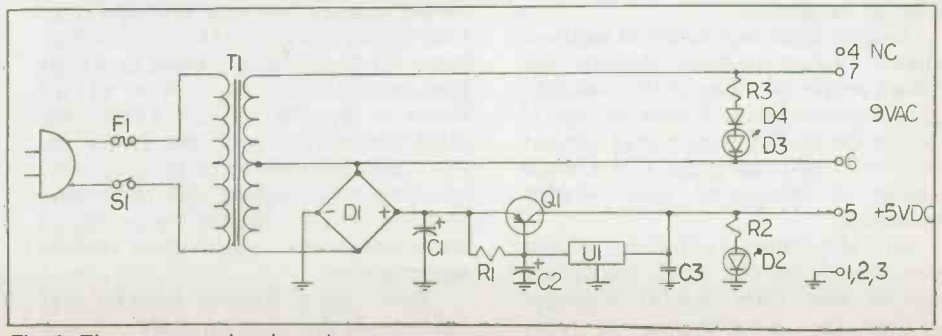


Fig. 1. The power supply schematic.

source a .5 amp draw, and the computer wants about 2 amps or so for itself to operate. This is not including any external goodies you have plugged into it, like cartridges or modems, etc.

The simplest cure for the machine is to build a new power pack. The unit I built for mine uses an aluminum enclosure originally designed for a Sprite car power amp. It is an excellent enclosure because both sides of it are large heatsinks with fins. If you have an old auto booster/equalizer, it should work perfectly. Refering to the schematic, the 7805 is replaced as the main power source by a 10 amp transistor. The 7805 is used only as a voltage reference and regulator for the pass transistor.

Almost any type of construction can be used. Mine was a perfboard, with the transistor, IC, and bridge rectifier mounted to the heatsinking side panels. The bias resistor (R), must be adjusted in value to output the correct voltage from the pass transistor, the limits are mentioned in the parts list.

Some other preventive medicine for the 64 is, construct a small heatsink for the 7812 IC regulator internal to the machine as it doesn't have one. If the RAM chips or any other at any time must be replaced, or if you figure you're good enough with a soldering iron to install sockets, socket the ICs before replacing them so future repairs are easier. Replacement of the 74LS series ICs with the 74HCT series, is a definite plus, as the HCTs draw up to 1/100 the amount of power, have a higher noise immunity (are less prone to glitch from power supply and other chip induced noises), and have a fan-in of virtually zero (they place no load on the LSI chips, so the CPU, VIC, etc. run cooler). The HCT chips are only about 30% more than the LS line in price.

When your supply is built, before connecting it to the 64, use a volt meter to check the +5 supply. It should be about +5.5 volts with no load. Place a 5 to 10 ohm 10 watt cement resistor across the +5 and ground terminals. Use the volt meter to again measure the +5 supply lead. It should be no less than +4.75 volts and preferable +5.0 volts. Tweek the value of R1 to get the loaded supply value as close as possible to +5 volts. If your output voltage is in the area of 10 to 14 volts with no load, check that R1 is good, and possibly vary the value over a broader range to find the transistor's Vbe value. A mini varipot could replace resistor R1, but I chose a fixed resistor in the design as sometimes pots get dirty and go high in resistance. This would have tremendous side effects on your 64. If the +5 supply checks OK, hook er up to the 64 and compute away. ■

Price List

C1	6800uF 16 volt electrolytic filter capacitor
C2	2u2 16 volt tantalum
C3	0.1u 16 volt disc
D1	2 Amp Bridge Rectifier
D2	LED
D3	LED
D4	1N4148 diode
F1	3AG 250 mA fuse
Q1	2SB753 PNP transistor
R1	220R 1/4 watt *adjust to Vbe of Q1 (210-230 ohms)
R2	220R 1/4 watt
R3	220R 1/4 watt
S1	SPST toggle (optional)
T1	18 vct @ 2 amp transformer (Radio Shack # 273-1515)
U1	7805 +5 volt @ 1 amp IC regulator

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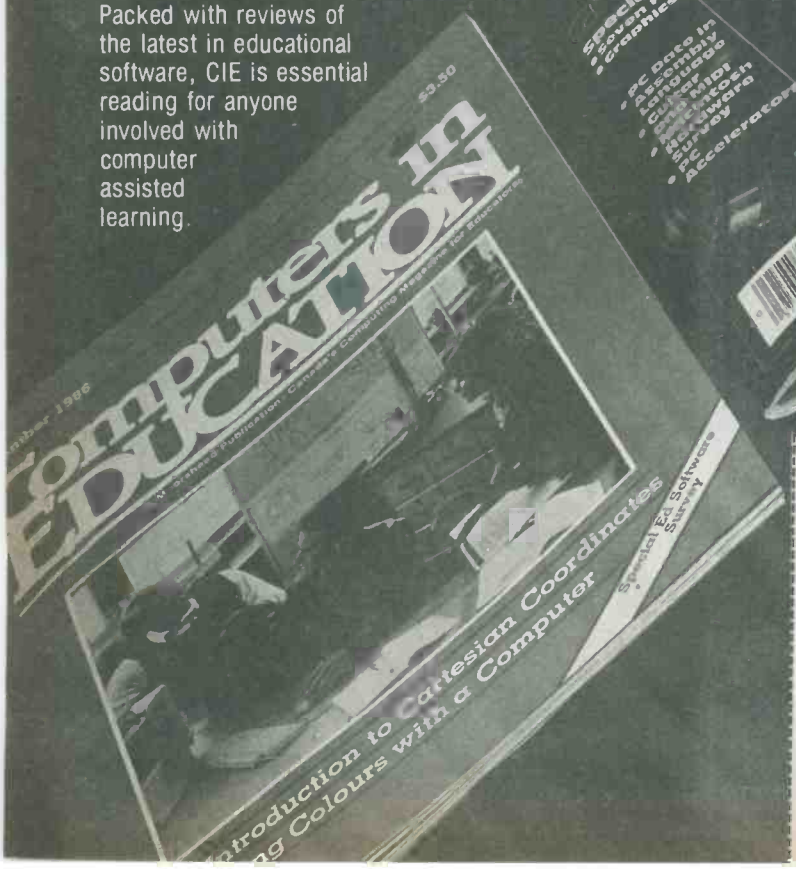

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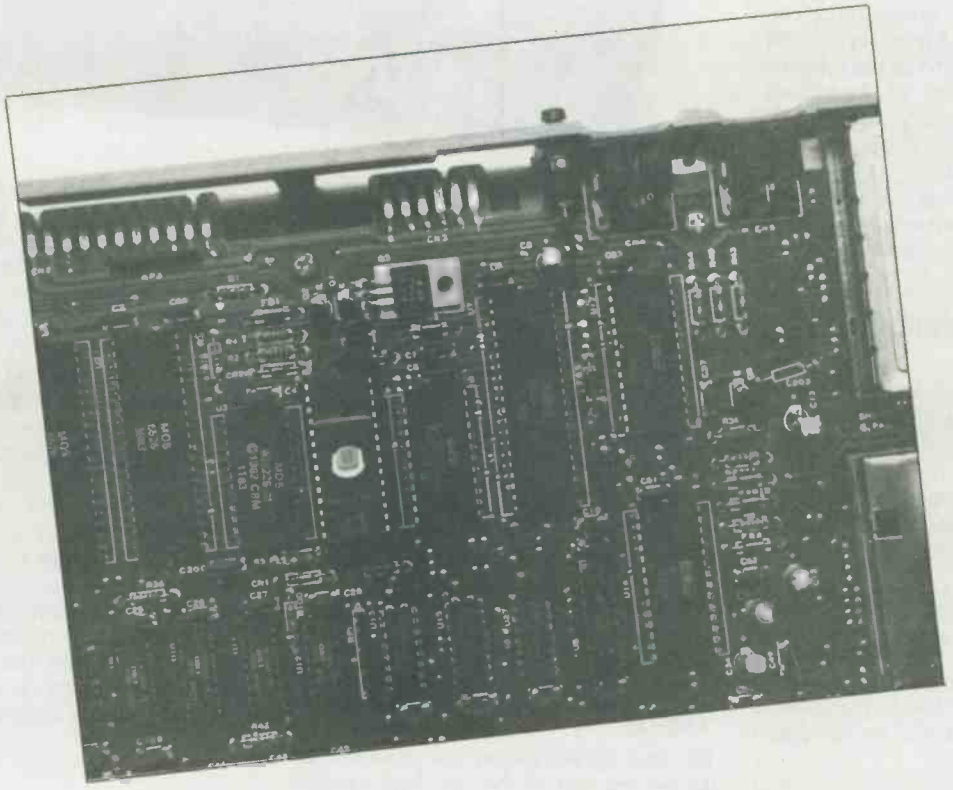
Commodore 64 Kernal MOD

Useful modifications to make the C-64 a friendlier machine.

By David Green



THE C-64, while being a reasonably decent piece of hardware, having good sound and graphics capabilities, falls short in a few areas. These being a full Basic Interpreter (instead of Peeks and Pokes for I/O etc.), very slow disk access, no reset switch, and the terrible initialized screen colors. The following article shows where some of these shortcomings are and how to improve upon them.

Table 1 shows where some of the internal initialization code is at. If you decide to modify your 64, you will need a

Table 1

ROM Location	Hex	Dec	Default
Keyboard Buffer Size	E52C	58668	
Character Color	E534	58676	OE Hex
Key Repeat Speed	E539	58681	
Vic to Register Load	E5A8	58792	
Vic to Register Data	ECB8	60600	
Border Color	ECD9	60633	OB Hex
Background Color	ECDA	60634	06 Hex
Title	E45F	58463	

2764 EPROM, two sockets, and some fine wire. Also, if you have about $25 dollars to spare and don't want to attempt building the adapter socket, Active components carries an adapter socket in their product line for adapting 28 pin 8K ROMs to fit in the 24 pin pinout. **Figure 1** shows the pinout difference of the 2764 and the Kernal ROM, and what wiring changes have to be made. Cut off the proper leads as shown, stack the two sockets, and connect the fine wires. After the modification socket is done, it should be glued so it doesn't come apart. Locate the Kernal ROM, the middle of the three on the revision B board (usually the one with a socket), carefully unsolder or unplug it, and plug or solder the modified socket into place.

If you have an EPROM programmer, change the areas you desire in the kernal, and burn a 2764 with the new information. Be sure that your programmer can read the 68766/68764 Motorola 24 pin and can burn the Intel 2764 28 pin types of EPROMS. I am graced to have two Aparat Apple EPROM cards, one modified to read and program 2764s, and the other capable of the 24 pin. If you or a friend don't have a programmer, stores such as RAE, Active, and others can program them for you at a nominal charge.

SOCKET MODIFICATION

1. Bend pins 20 and 23 of the upper socket inwards. (disconnecting CE and A11 on the 2764 from the computer.)

2. Solder a fine wire from pin 20 to pin 22 on the upper socket. (connecting CE and OE together on the 2764.)

3. Press the two sockets together. (of course).

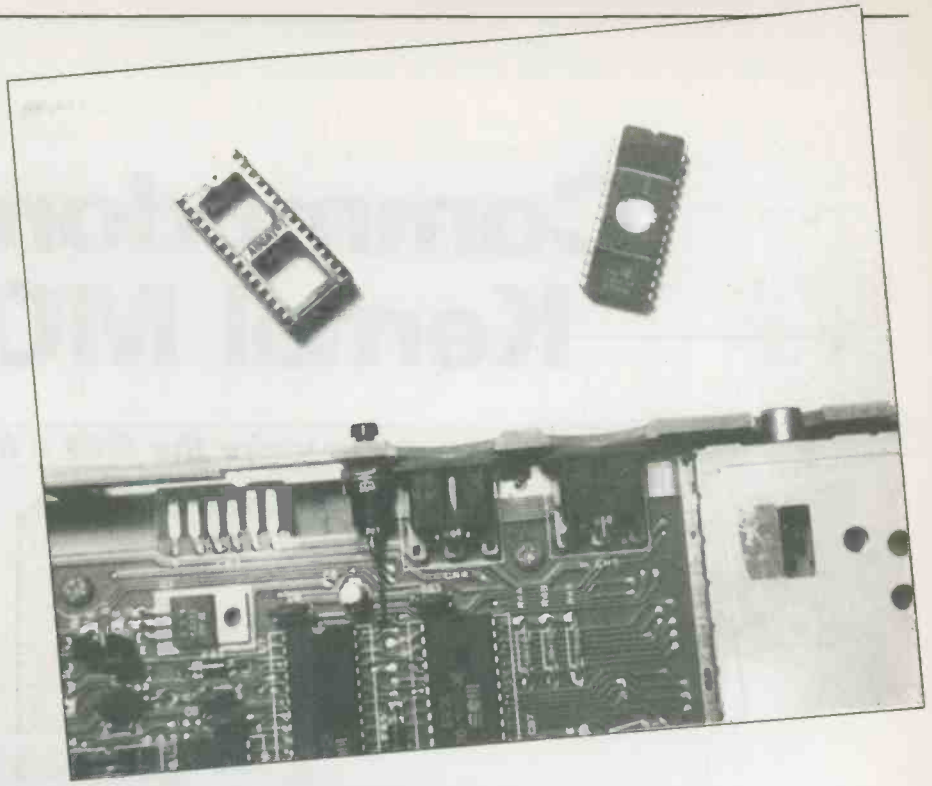
4. Solder a fine wire from pin 23 on the upper to pin 20 on the lower. (reconnecting A11 of the 2764 to A11 on the computer side.)

5. Solder a fine wire from pin 1 to 28 to 27 to 26. (connecting Vpp, Vcc, PGM, and NC to Vcc on the computer side.)

6. Solder a fine wire from pin 2 to pin 23 on the lower (connecting A12 of the 2764 to A12 on the computer side.)

Power up your 64 with no peripherals plugged in and check for hot ICs. If any are burning your fingers, turn off the machine and try to locate the problem.

While you have the machine apart, you might want to install a reset button.



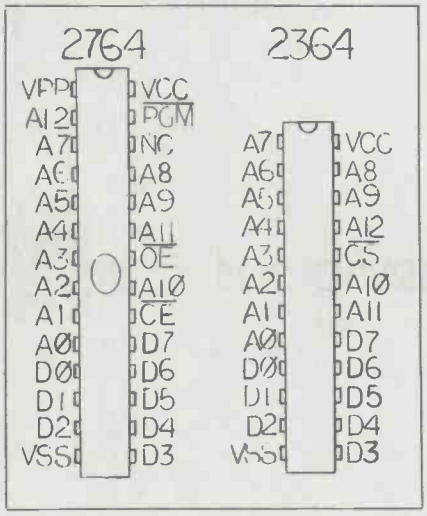


Fig. 1. Pinout details of 2764 and 2364 EPROMs.

The reset button shown here is located on the bottom half of the case. Many people put theirs on the upper half, and that requires running long flexible wires to the PC board, which get in the way when you need to pull the machine apart. Drill a hole slightly smaller than the thread pattern on the switch, to the left of the 6 pin serial connector. Thread the switch into the plastic as if it were a bolt, adjusting it so that the two solder terminals are one above the other. Directly beneath the lower terminal, is a foil run connecting to pin one (closest to the serial connector) of the cassette interface connector CN3. Carefully bend the lower switch terminal towards the PC board with a small pair of pliers, and solder it to the above mentioned foil run. Using an ohm meter and the Photos, locate the foil run that is connected to pin 40 of the 6510 CPU, and trace it on the top of the board to where it stops at a solder-hole (about a quarter for an inch to the right of CPU pin 40). Solder a piece of solid hookup wire from the upper switch terminal to this solder-hole.

Note that the 64 Kernal doesn't have a warm reset like the Apple computers have. Pressing this reset button only eliminates having to always turn the computer off to change programs. It will not allow you to reset out of a program hangup, or a terminal error in BASIC, and gain access to the program listing again. The reason for this is that every time the 64 resets, it defaults all of its pointers, vectors and flags, to a cold reset state. ■

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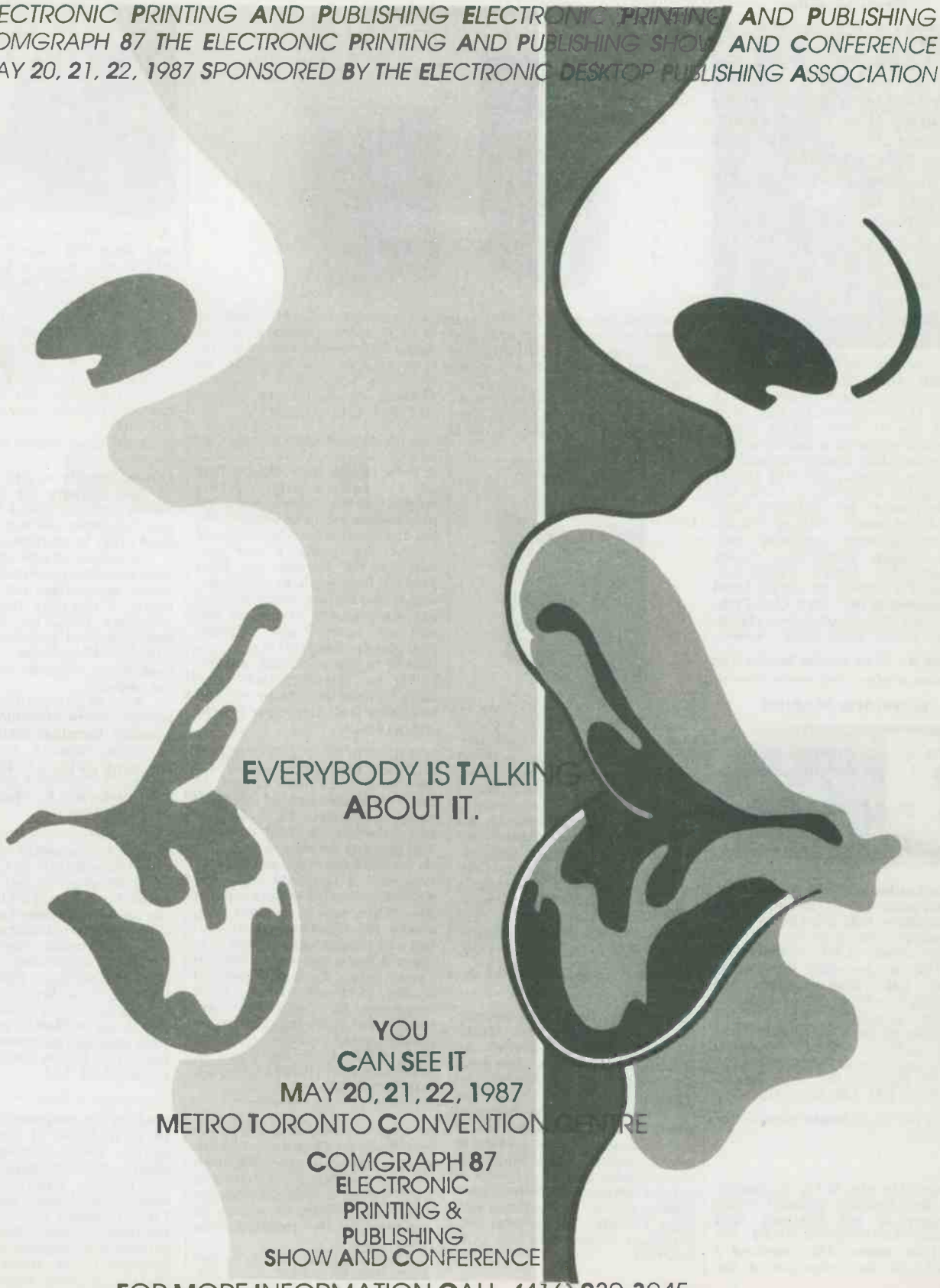

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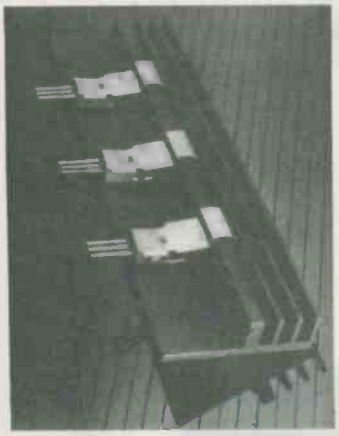
Continued from page 7

For Your Information

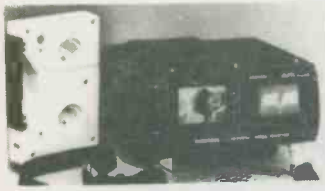
Heatsink Clips



A new series of heatsink clips has been introduced by Aavid Engineering. Used with TO-218 and TO-220 devices, the clips allow the use of many plastic power devices on the same extrusion. The clip can slide along a grooved fin on the heatsink, allowing greater positioning flexibility. Aavid will manufacture new extruded heatsinks or modify existing designs. From Canadian distributors such as Carsten Electronics, Future Electronics, Queale Electronics, Rush Electronics, or contact Aavid Engineering Inc., One Kool Path, PO Box 400, Laconia, New Hampshire 033247-0400, (603) 524-4443.

Circle No. 29 on Reader Service Card

Waveform Monitor



The Leader MVM-5863A is a portable audio and waveform monitor that allows field checking of video cameras and recorders. The 2.6 inch colour CRT displays the NTSC picture while the companion CRT displays 2-line and 2-field waveform displays. An IRE filter simplifies lens opening checks; power is from battery belts or 12VDC vehicle electrical systems. Contact Omnitronix Ltd., 2410 Dunwin Dr., Mississauga, Ontario L5L 1J9, (416) 828-6221.

Circle No. 30 on Reader Service Card

Oops! The triac in Fig. 4, page 82, of the Optically Isolated Switch project in our February issue should be designated CSR1, not IC1 as shown. Also, terminal 2 (MT2) is the center pin of this device.

Portable Fault Locator

The Canadian-made CCR-1 Cable Radar set simplifies location and identification of faults on twisted pair and coaxial communications cable. The CCR-1 implements microcomputer technology to provide menu-driven functions, online help, and the ability to detect shorts, opens and taps ranging up to 4800 metres. Readings can be stored in non-volatile memory for later analysis. Contact Clic Instruments Ltd., Suite 202, 151 Holland Avenue, Ottawa, Ontario K1Y 0Y2, (613) 722-2547.

Circle No. 31 on Reader Service Card

Master

The new 1987 IC Master has 11 Master Selection Guides grouped by application, organizing all standard products by type, function and key specifications. New features include expanded Microcomputer Board coverage, VLSI/LSI Macrocell listings, an expanded Military Products section and a larger Design Automation section. The IC Master is updated three times a year, and is available exclusively in Canada from Future Electronics, 237 Hymus Blvd, Pointe Claire, Quebec H9R 5C7, (514) 694-7710.

Circle No. 33 on Reader Service Card

International Rectifier announces the new third-generation Hexfet III power MOSFET devices. All Hexfets now feature improved avalanche current capability and dynamic dV/dt ratings better than 5.5 V/ns. This means increased reliability in applications such as motor controls and switching power supplies, where MOSFETs are subjected to rapid changes in applied voltages. For further information, contact International Rectifier Canada, 101 Bentley St., Markham, Ontario L3R 3L1, (416) 475-1897.

A press release from the US firm of Ferrantl Semiconductors reports that the company had a 150 percent increase in business in the last few months of 1986 compared to the same period a year ago. Some of the increase was from product lines such as data converters and surface mount devices, but the majority of benefit was said to come from orlginal-equipment-manufacturer confidence in the upcoming market. OEMs are extending their schedules to three months or so, and increasing lead time from zero to several weeks.

D.W. Electrochemicals announced the North American launch of their expanded line of products based on Stabilant 22, a chemical that enhances electrical contacts. The polymer behaves as if it were an amorphous semiconductor in that once a threshold voltage is reached, it slowly becomes conductive. When used in contacts it increases the effective area of contact and reduces signal losses. It is claimed that it can cut connection-caused failure by up to 90 percent in any electronic system, from computers to automotive electronics. For more information on packaging and availability, contact them at 9005 Leslie St., Unit 106, Richmond Hill, Ontario L4B 1G7, (416) 889-1522.

Masuko International Corp. has established its Electronics Division as an independent operation under the name of Masuko Electronics. Dave Tebbit is General Manager and Doug Newton has joined the company in the technical sales department.

Their new head office is located at 385 The West Mall, Suite 261, Etobicoke, Ontario M9C 1E7. (416) 621-9120.

Static Sensor

A new static sensor for locating and measuring static voltages on objects and surfaces is available from 3M. When held one inch from a target, the electronic Model 709 provides an LCD readout in two range settings: up to 1990 volts (low) and up to 19,900 volts (high). It operates on one 9V battery. Contact 3M Canada Inc., Static Control Systems, PO Box 5757, London, Ontario N6A 4T1, (519) 451-2500.

Circle No. 32 on Reader Service Card

Olivetti Canada recently announced that software for the Acorn microcomputer, Model BBC B, is now available through Olivetti's head office in Markham, Ontario.

A variety of educational software as well as general interest and leisure applications for all Acorn users. Elementary through to secondary levels are supported, and specialized programs such as "Digital Electronics" are also available in computer-based training packages.

Anyone interested in software for the Acorn computers should contact Dorothy Netherwood, Marketing Support, Acorn Computers, at (416) 477-8250 or by writing to Olivetti Canada Ltd., 3190 Steeles Ave E., Markham Ontario L3R 1G9.

Duncan Instruments Canada Ltd., have released their new '50 More Great Reasons To Buy Duncan" product brochure. This latest Duncan product brochure covers more than 50 different instruments for use in electronic, electrical and computer applications. Included are: oscilloscopes, digital multimeters, function generators, calibrators, and much more. Copies are available upon request from Duncan Instruments Canada Ltd., 121 Milvan Dr., Toronto, Ontario M9L 1Z8.

Looking for component suppliers? Hi-Tech Sales of Mississauga feature Thomson-Mostek capacitors and ferrite cores, Speciality Electronics connectors, pin headers and lithium cell holders, Tyton Canada's cable tie systems and connector line, Chapman Corporation's electrostatic meters and eliminators and others. Contact Hi-Tech at 1640 Bonhill Road, Unit 5, Mississauga, Ontario L5T 1C8, (416) 672-0284.

Continued on page 72

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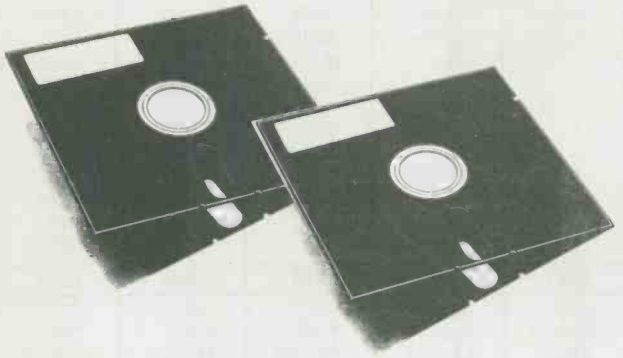

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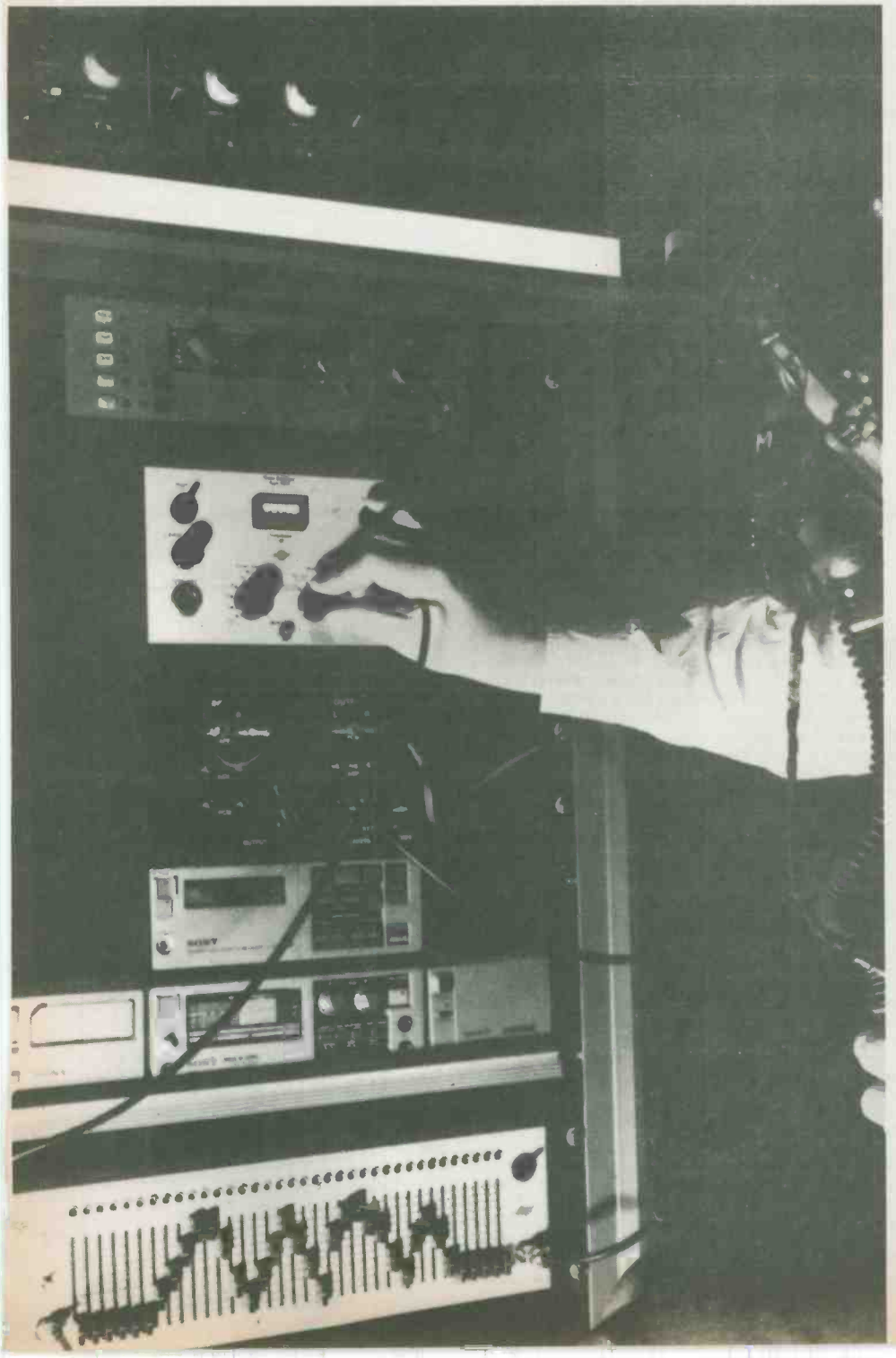
The Listening Computer

By Martin Redfern,
BBC External Services

Using an acoustic simulator to test a speech recogniser in a background noise field.



A MACHINE that can recognise and react to the human voice has long been a dream of scientists. Now a major research programme in Britain is making that dream seem possible.

The sound patterns of human speech are incredibly complex. Different accents and intonations, different ways of saying the same thing and the tendency to run one word into another make speech recognition by computer a very complex problem.

Simple systems exist, but they are not true voice recognition. They range from toys that simply respond to sound – a handclap is as good as a command – to machines that recognise only a limited vocabulary in ideal conditions. Several factors make it hard to improve matters. Accents differ between individuals and, even for the same person, depend on conditions and meaning.

Two Areas

In Britain, the government sponsored Alvey program of research towards the fifth generation computers is looking into voice recognition for two main areas – the office, and the aircraft. They pose some very different problems.

In the modern electronic office, someone dictating directly into a computer can use a fairly constant voice, and there will be little background noise. However, there will be the need to use a large vocabulary of words which often run one into another. Even so, a few errors are not too serious and can be corrected at the proof reading stage.

Office voice input is a challenge being tackled under the Alvey programme by Professor John Laver and his colleagues Edinburgh University, in conjunction with other universities and organisations. Success will not happen overnight, but it probably does lie within the possibilities of the latest processors.

Direct Voice Input

Much nearer to a practical system is a direct voice input (DVI) for a jet fighter aircraft. Smiths Industries Aerospace and Defence Systems displayed a demonstration system at the recent Farnborough Air Show.

The cockpit of a modern jet fighter represents the worst environment for such a system. Very high background noise levels are often coupled with extreme

stress for the pilot, his voice altering as a result both of psychological stress and physical forces such as acceleration. Those are some of the probelms now being tackled by Smiths Industries Speech Technology Group.

The need for DVI is great. The highest performance jet fighters have a single seat, and the days when the pilot used just his ears and eyes as sensors and his hands and feet to control the plane have long gone.

In its place are complex computerised navigation and flight management equipment, radar, infrared and radio sensors, automatic targeting and manoeuvring systems and so on. The pilot is, in effect, no longer flying the plane but managing all the electronics.

Video Information

Cockpits are no longer being equipped with scores of separate dials and displays. Modern displays consist of just two or three video screens on which a wide range of information can be presented as and when needed.

Present systems have touch-sensitive screens so the pilot can point to the information he requires on a menu display. But during high speed flight at low level, he must keep his hands on the controls to hug the ground safely.

For this reason - display selection is being developed as the first direct voice input system. Later, it might be extended to more complex functions such as manoeuvring or selecting weapons systems, but clearly for such functions it must be made 100% reliable.

The first stage in the research was to analyse the sounds of various words and break them down into their component frequencies. Then the computer could be programmed to spot key differences.

Each pilot has a different speech pattern and in a practical system they would each carry a tag like a credit card with which to programme the plane to their own voice.

Recognition Of Instructions

It is relatively easy for a computer to recognise a small number of words spoken separately, without background noise. The Smiths Industries system can recognise groups of instructions in rapid sequence, and can cancel much of the background noise and compensate for the effects of an oxygen mask on the speaker.

The demonstration system has a vocabulary of about 100 words, but an operational system with 1000 words is being developed. In either case, a limit can be made to the words in use at any one time.

The computer is programmed with a syntax system so that, at any instance, there is a choice of no more than 20 words that would make sense. For example, if the pilot selects a route map on the screen and instructs the computer to mark a point along the route, the next thing it would be programmed to expect would be the digits of a coordinate.

This means that, if the pilot is interrupted by, say, a radio message, the computer ignores his radio conversation and waits for the next instruction that makes sense to it. It involves a degree of understanding approaching artifical intelligence.

There is still a lot of progress to be made before pilots are using DVI in the air, but many of the first problems have been overcome. Such a system could become standard equipment on the jet fighters of the 1990s, on planes such as the new European Fighter now on the drawing boards. By then, voice recognition systems will have to be both intelligent and reliable enough to safeguard pilot, plane and weapons. ■

For Your Information

Silicone Limits Signal Aberrations

By David Dempster

Tektronix, Inc., a major producer of electrical testing instrumentation used worldwide, has found a cost-effective way to maintain the integrity of microelectrouic circuity in humid environments. A silicone fluid can be used to dramatically reduce the aberration in the response to high-impedance circuits caused when humidity forms a water film on capacitors and resistors.

Laboratory testing conducted by the Hybrid Components Operation's engineering staff in Tektronix' industrial complex near Beaverton, Oregon, revealed that the silicone fluid (Dow Corning's 1107), typically used as a water repellent on metals, plastics, paper and fabrics, reduces wetting of substrate materials as well. This property provides consistently higher operating performance regardless of relative humidity. The discovery may eventually lead to wettlng repellent applications involving printed circuit boards and high-impedance integrated circuits.

The silicone fluid works much like a car wax by increasing the 'wetting angle' on object surfaces. For instance, water will form a thin layer on an unwaxed car. However, if the car's surface is waxed, the wetting angle is sharp and spread is limited. Similarly, when applied to a circuit the wetting angle is roughly doubled by the treatment, minimizing component value drift due to adsorption of water. The result is a repeatable response in all environmental conditions, regardless of relative humidity.

Tektronix' main concern in this area has been with their portable testing instruments. These products are subjected to extreme environmental conditions, from arctic cold to desert heat. At Tektronix, for example, moving an oscilloscope from the trunk of a cold vehicle into a room with a high relative humidity causes water vapor to condense on the electronics. During warmup, when the instrument is still below room temperature, response distortion results if the oscilloscope parts are untreated and adsorption occurs. Instead of an expected square wave, for instance, there might be overshoot of the trace.

Aberrations in the response of high-impedance circuits have been a problem in electronics for many years, but now, as electronics become more miniaturized, response distortion becomes more pronounced.

Tektronix first tested this colorless, essentially nontoxic silicone fluid about two years ago. The fluid has a positive impact on electrical response, but Tek's engineering staff wanted to know why. Considerable time was spent looking beyond electrical response to consider chemical properties of the surface and material in electrical components.

Tektronix engineers discovered that any change in relative humidity, including blowing on the part, would cause an aberration in response distortion. Their objective was to devise a standardized method of testing by controlling relative humidity.

By mixing dry and saturated gas in a sample chamber - coupled to an oscilloscope, square-wave generator and charge amplifier to compare impedance of the sample to a reference capacitor - Tek's engineers were able to adjust relative humidity on the tested circuitry.

The hybrid circuits were dipped in the fluid, one part silicone fluid mixed with 99 parts solvent (chlorethene), and allowed to cure at 150 degrees C for 15 minutes. Adding a dye enabled the engineers to see the consistency of surface coverage.

Individual measurements were then collected on thick-film capacitors and thick-film attenuators. Results bore out the theory that silicone-coated parts deliver greater performance based on an ability to withstand fluctuations in humidity. For example, various untreated materials will adsorb different levels of water at 80 percent relative humidity. As circuits adsorb more water, electrical response aberration increases as the water molecules are polarized, thus creating a distortion in the electrical loss of fidelity in incoming signal.

Tektronix also tested additional water repellent elements and ruled out several other treatments because of their lack of flexibility, difficulty in mixing and application, and cost.

The 1107 fluid is easy to use, it doesn't degrade any of the properties on the circuit, and the film is easily broken to allow electrical contact to the metallization. As well, it also allows soldering.

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Continued from page 19

Modes and Indices

The original fibre design picked by the Corning Group was called *single-mode.* The light-carrying core had a diameter of only a few micrometers, close to the wavelength of light. This prevents the light from reflecting along multiple paths; the light is said to be transmitted in a single mode, analogous to millimetre waveguides, cutting losses and maximizing the bandwidth. Unfortunately, the tiny core and the required precision of the cladding present manufacturing difficulties.

One option is to make the core much larger, on the order of 50um. This simplifies manufacturing and increases the light-gathering ability; the trade-off is restricted bandwidth because the light pulses can take multiple pathways through the larger core. These fibres are known as *multimode* types, and the abrupt change from core to cladding is known as *step-index* cladding.

It was theorized that if the cladding's refractive index could be made to change gradually rather than in a step, the light pulses could use refraction as well as reflection to keep all the light in the core, increasing bandwidth while keeping the advantages of the larger multimode core. These are called *graded-index* fibres. By 1972, Corning produced a graded-index fibre with a loss of only 4dB/km.

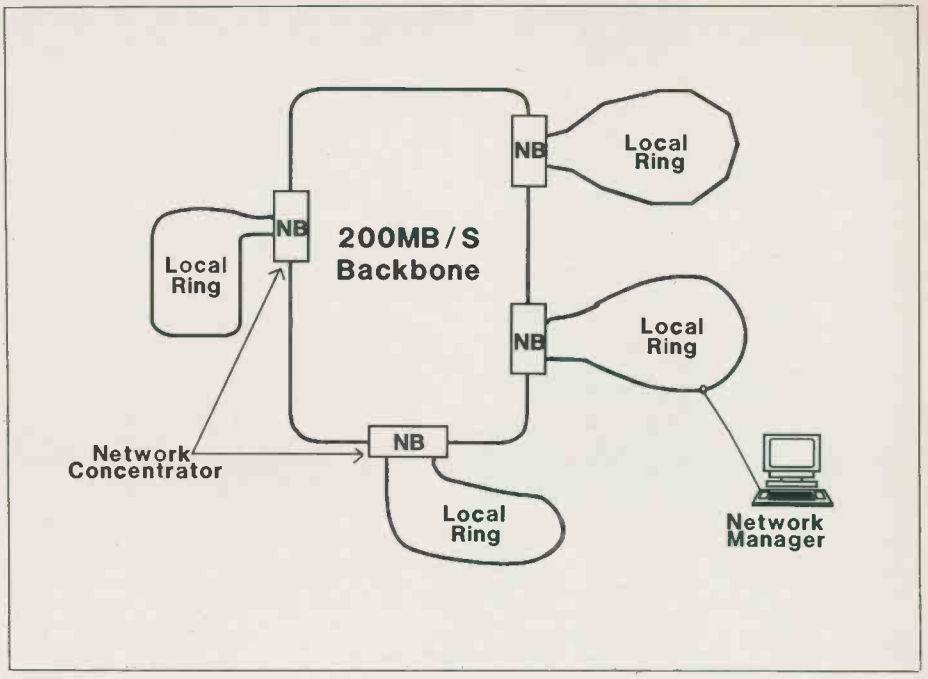

Fig. 2. The layout of the FiberWay optical network discussed in the text.

Drivers

The original gas and crystalline lasers were difficult to modulate, but this problem was solved with the introduction of the semiconductor laser. Its small size was ideal for matching to 50um graded-index fibres, and by 1977, reliable lifetimes of over one million hours could be expected.

The LED is another driver, ideal for applications involving short distances or limited bandwidth. The light from the LED tends to be lower in power and is not coherent like the laser, but the lower cost of the LED is appealing for smaller installations.

First Systems

Since fibre optic systems are a natural for the telephone industry, it's not surprising that the first field tests were carried out by GTE in California and Bell Systems in Chicago, both in 1977. GTE's went 9km at a rate of 1.5 megabits/second, and Bell's spanned only 2km, but at 45Mb/sec. To transmit a voice channel, about 67 kilobits/second are used, or just over 8 kilobytes/second. At a transmission rate of 45mb, it's possible to multiplex 672 voice channels onto a single fibre.

Do-Everything Systems

With such a huge bandwidth available, it's only natural that someone came up with the interactive system. Fibre optic cables are used to feed individual homes, not just long-haul "backbones", and the subscribers can access a wide range of video, database information, shop-at-home services and so on. The first system of this type was in Japan, on trial from 1978 to 1982. About the same time, a second system was started in rural Manitoba. It didn't have the interactive features, but included a single-party telephone line for each subscriber.

These systems, whose gadgetry is now obsolete, provided much technical information for the future design of such systems.

Improvements

The first generation operated at a wavelength of 800 to 900 nanometers, a figure set by the diode lasers available at the time. A somewhat longer wavelength is desirable, largely because longer wavelengths minimize losses due to a phenomenon called wavelength dispersion. The refractive index of glass varies with wavelength, and even a semiconductor laser emits a narrow range of frequencies. The varying refractive index causes light of one wavelength to travel faster than another, causing a pulse to spread out and limiting bandwidth.

Fortunately, due to the physics of the fibre, dispersion losses fall to zero at 1300 nanometers, and when transmitters became available, a cable with a loss of only 0.5dB/km was produced in 1976. By 1982, a single-mode fibre running at 1550nm showed a loss of only 0.16db/km.

If a loss of 20dB in a transmission is

considered an acceptable figure, then a fibre optic line could theoretically run for 125km without a repeater station. In practice, splices and other losses limit the distance to somewhat less than this, but even so, it demonstrates one of the many advantages over metallic cable.

The single-mode fibre running at the longer 1300nm wavelength has a bandwidth largely dependent on length. An equation from Corning gives an approximate value of 540MHz for a 50km line. Since an optical communications system has a bandwidth-to-bit-rate conversion of about 1:1, this line could operate at about 540 megabits per second. You could theoretically send the contents of your 50-meg hard disk in about one second, assuming that you weren't sharing the cable with other channels for that one second.

deposits on a rotating mandrel inside a sealed chamber. The soot preform is then fired to a transparent glass and drawn into fibres. The result is the desired cable with two different refractive indices for the cladding and the core, this difference resulting from the germanium dopant.

Computer Links

The low-loss and immunity to interference make fibre optic cables a natural for computer networking. In general, the single-mode fibres are used for long-distance linking because of the very high bandwidths available, and the multi-mode is used for shorter runs because splicing is easier and LED drivers can be used. There are also applications for fibre optics in plant security, inter-office local-area-networks, process controls and so forth. The market for this type of interconnection is expected to reach $78 million by 1990.

As an example, American Photonics has released a fibre optic network that allows expansion of the Ethernet system to 3km without remote or local repeaters, more than adequate for large LANs. The unit serves as an interface between a standard Ethernet transceiver cable and the optical cable. Called the RL5000 Model 2, the unit can also be used for linking mainframes or bridging two networks together. For more information, contact them at 71 Commerce Drive, Brookfield Center, CT 06805.

Another networking approach is the FiberWay, a 200MB/S that can link local network rings together into a high-speed integrated system. Protocols supported include Ethernet, IBM Token Ring, RS232 and others. More information is available from the manufacturer, Artel Communications Corporation, PO Box 100, West Side Station, Worcester, MA 01602, (617) 752-5690.

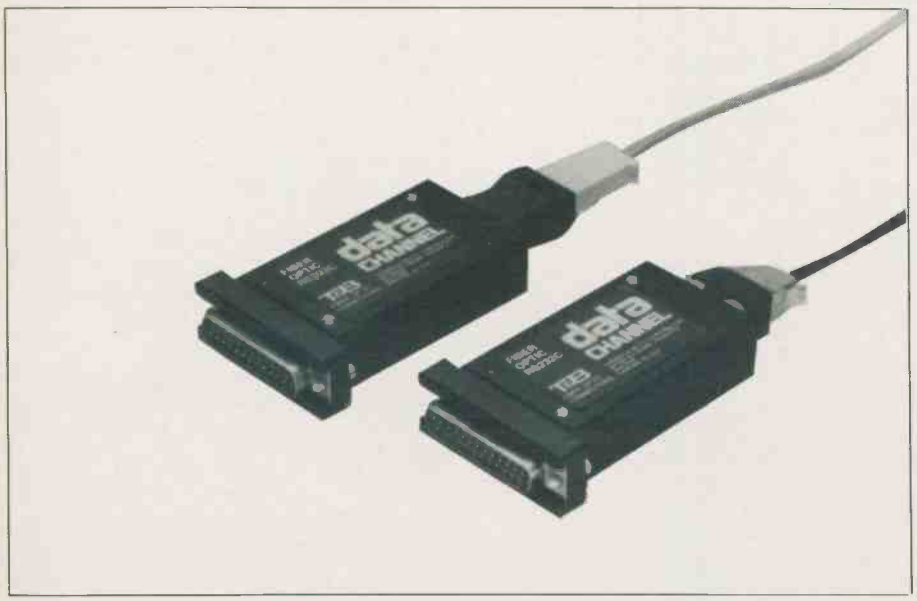

Fig. 3. an interface unit which adapts an RS232 port to a fibre optic cable (courtesy Thomas and Betts).

Manufacturing

Some idea of the popularity of fibre optic communications links can be gathered from the fact that Corning's North Carolina plant will have an annual output of 1.2 million kilometres of fibre. The purity of this fibre, measured in parts per billion, is essential for low-loss transmission. As an example, if you put a light signal into a medium and measure the distance at which the output falls by three decibels, you'll get a distance of one inch for window glass, ten feet for high-quality optical glass, and about 13 miles for optical waveguides.

The fibres are made under clean-room conditions, in which silicon and germanium fibres are heated to the vapor stage, resulting in a white "soot" that

Major Installations

Telecom Canada is installing a 7,000km transcontinental fibre optic network linking the provincial telephone companies. The system will operate at 565Mb/s and the first portion will be completed by early 1988.

A $1 billion network will link Australia, New Zealand and North America, and is said to be the largest fibre optic project of its kind in the world. The first phase, a link between Australia and New Zealand called TASMAN-2, will be operational by 1991.

The Future

Orders for single-mode long-haul lines are now running into the hundreds of millions of dollars as telephone companies everywhere expand their carrier capacities. The wide bandwidth of the fibre optic cable means that it can even be used as a replacement for or addition to satellite links on heavily-used routes.

As the improved technology reduces prices and increases availability, fibre optic links will likely replace coaxial cable as the carrier for cable-TV distribution, greatly increasing the information that can be carried.

Fibre optics have been used to replace the cumbersome and expensive cable harness in cars. Once the required solid-state controllers and switches become cheap enough, we can probably forget the tangle of wires and fuses common today; only a single power wire and a single fibre optic command link would be needed.

It's always hazardous to predict the distant future because of technological changes; 30 years ago no one could foresee the improvement and success of fibre optic cables, and almost anything could happen in the next 30. However, it isn't unrealistic to say that the remarkable performance of fibre optics could lead to a whole new industry of photonics, just as the transistor and IC created a new approach to electronics. ■

VHF Scanners

Continued from page 61

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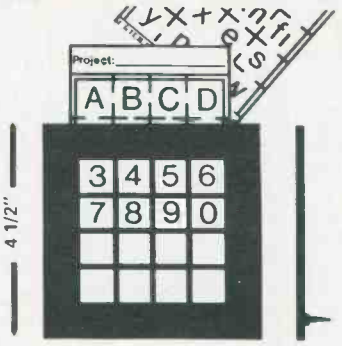

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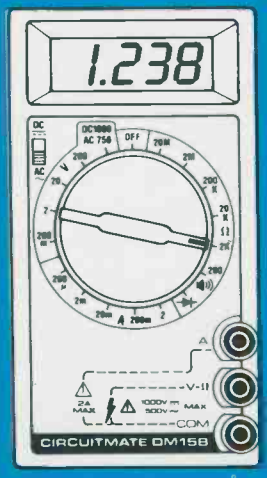

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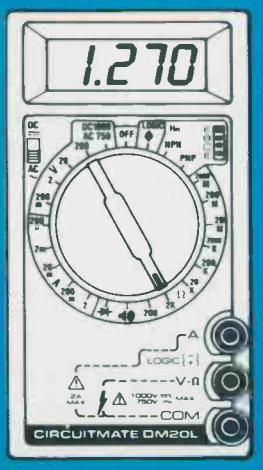

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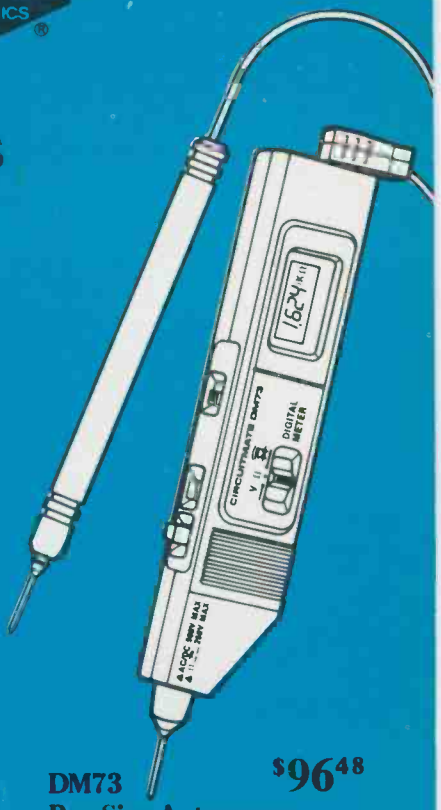

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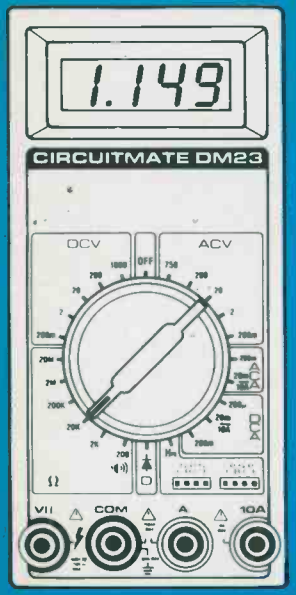

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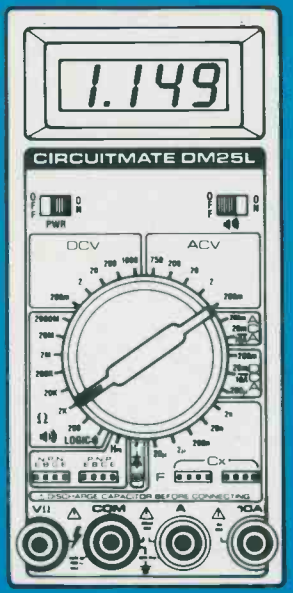

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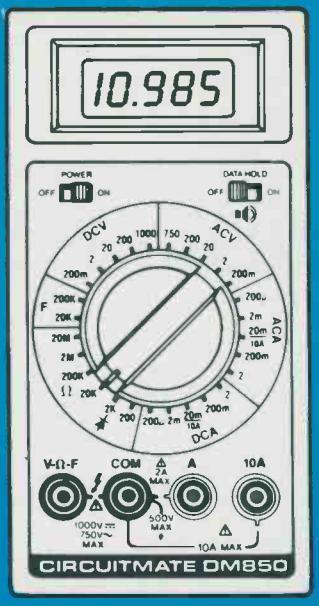

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