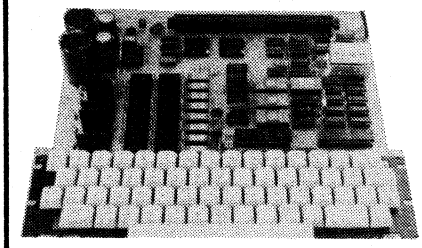
Coming Next Month*

At last! The Nova 80 Computer



Yes folks, it has finally arrived! After seeing it in the DSE catalog a year ago, after all the rumours about the "Never 80", it has materialised and we shall present the first article on this highly competitive single-board Z80 computer with BASIC interpreter in the May 1981 issue. It will have been worth waiting for!

Some of the Nova 80's features are: full-sized ASCII keyboard, RF modulator output to TV monitor, S-100 buss, up to 48K of RAM.

WIN A MARANTZ CASSETTE DECK or FM/AM TUNER!

We're having a competition and you can win either a Marantz ST-510 quartz-synthesized FM/AM tuner with microprocessor-controlled tuning or a Marantz SC-5010 stereo cassette deck. Two of these prizes are up for grabs so make sure you get your entry in.

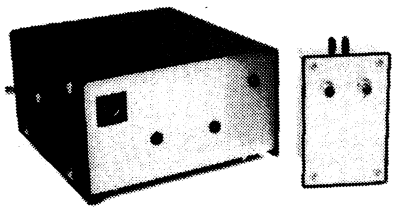
***Our planning for this issue is well advanced but circumstances may change the final content. However, we will make every attempt to include the articles mentioned here.**

ELECTRONICS AUSTRALIA

Volume 43, No. 5
May, 1981

AUSTRALIA'S HIGHEST SELLING ELECTRONICS MAGAZINE

Infrared remote control



Our new infrared remote control has two independent channels and a range of 20 metres, yet will cost you only about $65. Details on p50.

NOVA-80

Due to circumstances beyond our control, presentation of the Nova-80 computer project has been delayed. We apologise to readers for any inconvenience that this delay may cause.

On the cover

Are you good at crossword puzzles? If you are, you could win either a magnificent Marantz SD5010 cassette deck or the high-performance ST510 AM/FM tuner. The details are on p43. For a full review of the SD5010 cassette deck, turn to p46.

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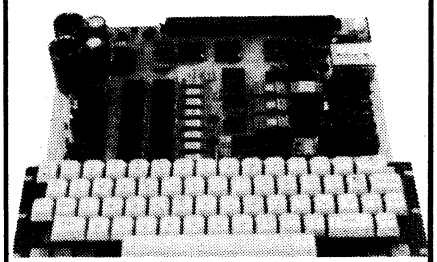
Coming Next Month*

The Super 80 Computer—at last



YES, *it's finally here (note the name change, though). Presentation of the first article was delayed, but this highly competitive single-board Z80 computer is most definitely "on", and will be introduced in the August issue.*

The Super 80 has features not found on computers costing twice as much. A powerful BASIC interpreter, up to 48K of RAM on board, a full-size keyboard, RF modulator for TV display and built-in S100 expansion capability are just some of its good points!

Musicolour IV

A rather special 4-channel colour organ, this one will really light up your music! Our new Musicolour design may be driven from a hifi amplifier or its own internal microphone, and can also be used as a sound triggered light chaser, with four distinctive patterns. It can handle a total of 2.4kW.

AND MUCH MORE – including TWO free catalogues, one from Sheridan Electronics and one from Altronics of Perth. Don't miss it!

***Our planning for this issue is well advanced but circumstances may change the final content. However, we will make every attempt to include the articles mentioned here.**

See article in this months E.A.
KIT AVAILABLE THIS MONTH

UNBELIEVABLE!

THIS MUST BE AUSTRALIA'S BEST VALUE COMPUTER!

- Full size keyboard
- Video modulator
- 9K Super Basic
- 16K RAM
- Cassette Interface
- S-100 Expandable

THE EA/DICK SMITH SUPER 80

Are you fed up with 'built up' projects? – why not build this professional quality computer & save over 50% on equivalent built units!

A FULL SIZE 16K COMPUTER KIT

You are supplied with a full board including power-on EPROM monitor, 16K of RAM, cassette interface (relay activated) for universal control of any tape recorder, TV modulator and direct video output PLUS full size professional keyboard

Above photo shows some parts which are optional — not supplied in basic kit

PROFESSIONAL QUALITY KEYBOARD

ALL THIS FOR ONLY $289.50
P&P $5.50

SHORT FORM KIT
Cat. K-3600

DON'T PAY OVER $600 FOR A BUILT UP 16K COMPUTER WITH BASIC!

THE FANTASTIC SUPER 80

EXTRAS

Transformer	M-2325	$22.50
BASIC interpreter on tape	K-3602	$24.50
IC socket set (Recommended)	K-3603	$12.50

Yes, this would make the full computer with 9K BASIC & 16K RAM

ONLY $349.00

THAT'S $50 LESS than our advertised price 12 months ago!

Supplied with re-print of EA article.
- Combined large Assembly and Technical manual $12.50 B-3600
- 'Super' Basic Reference Manual $14.50 B-3602

DICK SMITH ELECTRONICS

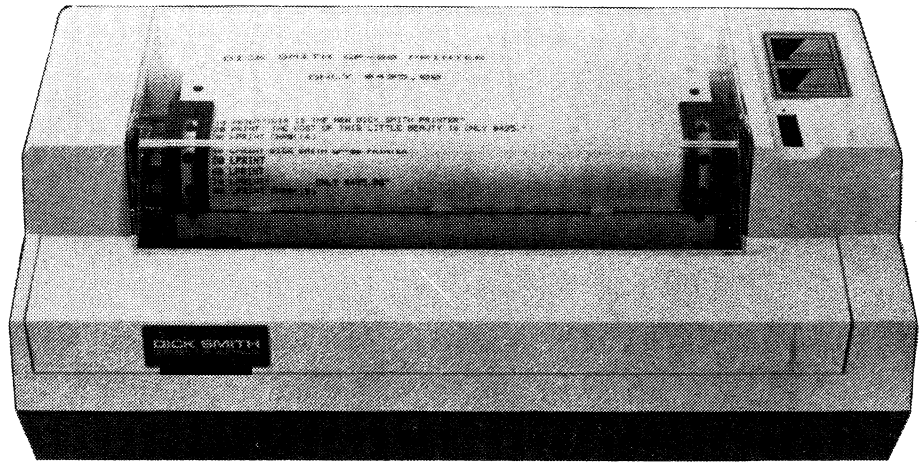
See our other advertisements in this publication for store addresses, phone numbers, post and packing etc.

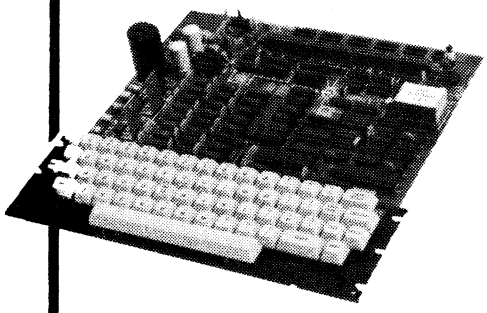
935M/AH

WIN A PRINTER!

for yourself or your school

To celebrate the runaway success of the Super-80 computer featured below, Dick Smith Electronics is sponsoring a competition with two DSE GP-80 printers as the prizes. (We reviewed this printer in our July 1981 issue and found it to be a little beauty.) If you have an interest in the Super-80 or computers in general you could win one of these nifty printers which have a retail value of $495. Win one for yourself or one for your school.





Conditions & what to do:

WRITE A PROGRAM to suit the Super-80 Computer. The program can be a game, control system, graphics display or anything you want. The program can be any length as long as it will fit into the maximum of 48K RAM on the Super-80 board.

SEND A C60 CASSETTE with one copy of your program on each side and WRITE a covering letter to tell us what it does.

COMPLETE the entry panel on this page or, in states where this requirement is illegal, make a clear, same-size photostat copy of the panel and enclose it with your program cassette. You may enter as an individual or on behalf of your school group.

POST YOUR ENTRY so as to reach our editorial office no later than 5pm on February 15, 1982.

POSTAL ADDRESS: Endorse your entry "Super-80 Competition" and post to Electronics Australia, PO Box 163, Chippendale 2008. Our street address: 57 Regent Street, Chippendale (near Central Railway).

JUDGING will be performed by the editorial staff of Electronics Australia. Chance will play no part in determining the winners. The judge's decision will be final and no correspondence will be entered into and no interview will be granted.

THE WINNERS will be notified accordingly and names will be published in the April 1982 or a subsequent issue of Electronics Australia.

THE PRIZES will be supplied to the winners, by arrangement, by Dick Smith Electronics, Cnr Waterloo and Lane Cove Roads, North Ryde, NSW 2113.

OTHER CONDITIONS:
Entry to this competition is open to all residents and school groups in Australia and New Zealand with the exception of employees and their immediate families of Magazine Promotions, John Fairfax & Sons Ltd, Dick Smith Electronics and their associated advertising agencies and publications.
You may enter as many times as you wish. All entries become the property of Electronics Australia. The prizes are not redeemable for cash.

NAME .....

ADDRESS .....

CITY ..... **STATE** .....

COUNTRY ..... **Please tick appropriate box**

☐ **Individual entry** ☐ **School entry**

HALF PRICE COMPUTER!

it had to happen!

Are you fed up with 'built up' projects? Why not build this very high quality kit computer and save over 50% on equivalent built up units!

A FULL SIZE COMPUTER KIT

You are supplied with a full board including power-on EPROM monitor, 16K of RAM, cassette interface (relay activated) for universal control of any tape recorder, TV modulator and direct video output PLUS full size professional keyboard – not a 'feel less' toy.

Any extra parts shown in illustration are sold as separate, chargeable items.

ALL THIS FOR ONLY $295

Cat. K-3600

OUR MOST POPULAR KIT EVER!

OPTIONAL EXTRAS

Transformer (M-2325)	$23.00
BASIC interpreter (tape) (K-3602)	$24.50
IC socket set (K-3603)	$12.50
BASIC in EPROM (K-3604)	$99.50
S-100 Expansion (K-3606)	$19.50

Yes, this would make the fully assembled computer with above options.

ONLY $355.00

Construction details and a full copy of the EA article is supplied with each kit. We also have available two very comprehensive manuals to assist in construction and programming:

SUPER 80 Technical Manual (B-3600) $12.50
SUPER 80 BASIC Handbook (B-3602) $14.50

This book has over 50 separate versatile commands. Features arithmetic and integer functions, user-defined functions, machine language routines, text editing, string operations. Also contains 25 error codes to assist you in programming.

THE FANTASTIC **SUPER 80**

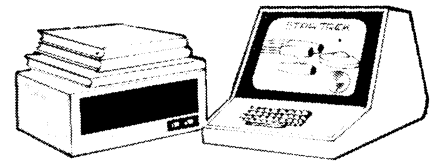
STOP PRESS ... NEW ADDITION FOR YOUR SUPER 80. Lower Case Generator Option available February '82. **$69.50.** Cat. K-3607

DICK SMITH ELECTRONICS

See our other advertisements in this publication for address details

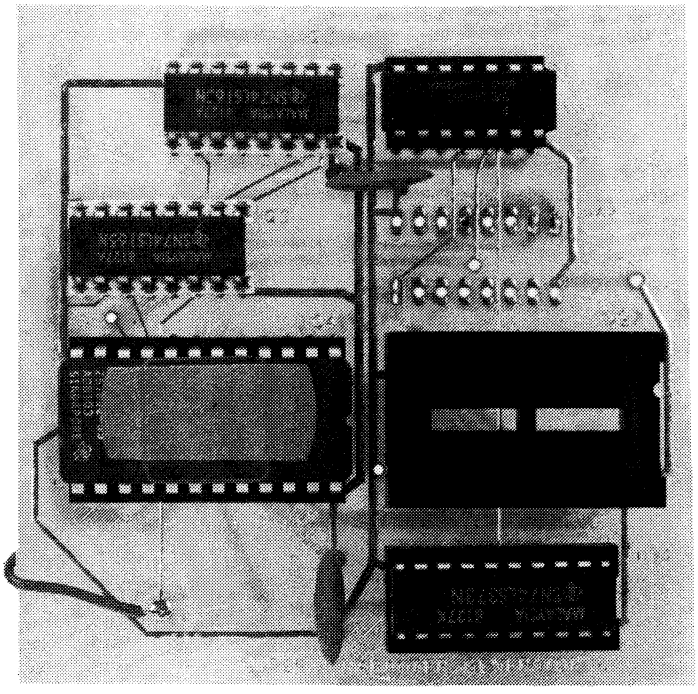
DSE/A163/PAI

Microcomputer News & Products



Lower case, inverse video for Super-80 computer

Many inexpensive microcomputers provide upper case (capital letters) only. While this is OK for programming, it is a serious handicap in many applications, such as word processing. Until now the popular do-it-yourself Super-80 computer was limited in this way — although no more! Dick Smith Electronics has come up with an ingenious add-on board for the Super-80 which provides both upper and lower case characters, and, as a bonus, inverse video.



The Super Character Generator from Dick Smith Electronics provides both upper and lower case and inverse video for the Super-80 computer.

The Super Character Generator from Dick Smith Electronics is a small printed circuit board (74mm x 74mm) which is mounted in piggy-back fashion on the Super-80 computer board. Five integrated circuits on the board provide the necessary latches and decoding circuitry to substitute a 2716 EPROM for the original character generator chip.

Programmed into the EPROM are dot patterns which provide the full upper and lower case ASCII character set and punctuation symbols, with both normal (white on black) and inverse (black on white) characters available.

In conjunction with a new Monitor EPROM, the Character Generator allows lower case letters to be entered from the keyboard and printed from Basic programs. Inverse characters can also be selected for high-lighting important information on the screen.

Installation of the board takes about five minutes, and is described in the instruction sheet accompanying the unit.

Three ICs must be removed from the Super-80 board. These are U23, U27 (the original character generator chip) and U34. Pin 11 of U35 is disconnected by removing the chip from the board, carefully bending pin 11 upwards and re-inserting the chip. If sockets have been used in the original construction this is simplicity itself.

A trailing wire from the Character Generator board is soldered to pin 11 of IC 31. It is not necessary to remove U31 from the board to make this connection. Both U23 and U34 are re-inserted in the sockets provided on the new board.

Although not apparent from the photograph, the two sockets on the lower right hand side of the board are wire-wrap types, and the board is installed by inserting the long protruding pins of the wire-wrap sockets into the sockets left empty by the removal of the original character generator and ICs from the Super-80 board. Be warned that pushing the board too far down into the sockets may short out the input leads of the video modulator, resulting in loss of picture.

To use the new Character Generator a revised version of the Super-80 Monitor is required, and this is included in the price of the add-on board. Two versions will be available, a 2716 for use in systems without Basic EPROMs and a 2532 for Super-80s which are running Basic in EPROM. The Basic interpreter is being updated for use with the lower case Monitor and the new version will be available on an exchange basis from Dick Smith Electronics.

When you have installed the Character Generator Board, switch on the power and type in a few characters. The display should be in lower case. Press the shift key to get the familiar upper case (capital) letters.

Quality of the characters displayed is very good, with full descenders (the tails on the "j", "g" etc). No eyestrain here!

To fully test the Character Generator use the Monitor to enter the following program into memory:

```
06 FF       LD B FF
CD 19 C0    CALL SOUT
10 FB       DJNZ
C9          RET
```

The first line of this program loads FF into register B of the CPU. The second line calls the Monitor routine SOUT, which prints the character in the B register on the video display. The next line decrements the B register (subtracts 1) and jumps back to the previous line if the result is not zero. If the result of decrementing B is zero, the routine returns to the program which called it (in this case, the Monitor command input routine). The result is that the entire contents of the new EPROM is displayed as ASCII characters. Note that the screen will go blank as 0C and 8C are read out the EPROM, as these are control characters which clear the display. The routine is very fast, so set V equal to about 1000 for a readable display before running the program.

Micronews con't p114

Electronics Australia/ DICK SMITH

SUPER 80 Computer Kit

NEW LOW PRICE

Production costs have now been absorbed due to fantastic response – YOU REAP THE BENEFIT!!

NEW SUPER LOW PRICES

was $289.50

NOW

$239.50

save $50

Yes, this makes the full 16K computer with 9K basic on tape, transformer and IC sockets – only – **$287**

SHORT FORM KIT (Cat. K-3600)
Designed for computer applications where 'Basic' programming is not required. Kit supplied with Eprom Monitor and 16K RAM. NOW SAVE $50 WAS $289.50 $239.50

CASE (Cat. H-3200) New and in stock $39.50

Add the following items to make a fully operating computer system to your own requirements.

Transformer to suit M-2325 $22.50

BASIC program (interpreter) on cassette
NOW SAVE $12.00 WAS $24.50 K-3602 $12.50

IC socket set (recom) K-3603 $12.50

BASIC program in EPROM (set of 3 IC's)
NOW SAVE $40 WAS $89.50 K-3604 $49.50

S-100 Expansion K-3606 $19.50

Character Generator (upper/lower case)
NOW SAVE $20 WAS $69.00 K-3607 $49.00

Construction manual SAVE $3.00 WAS $12.50 B-3600 $9.50

BASIC manual SAVE $5.00 WAS $14.50 B-3602 $9.50

48K on board (2 sets of IC's) X-1186 $59.90

Photo shows the basic board with the following options: S-100 expansion, IC sockets and a full 48K of memory.

don't wait until June

Available NOW!

OVER 1300 SOLD!

The SUPER 80 is the proven computer kit with over 1200 sold and it is available ex-stock! Why wait for others – check out our prices with the competition and whilst you are doing that check out the features too! Dick Smith Electronics have reduced the price of the SUPER 80 as the enormous design costs have now been absorbed by the superb sales of this superlative kit computer – read on. . . . .

Check the Super 80 against all others	SUPER 80	OTHER
* IS IT S-100 EXPANDABLE	☑	☐
* DOES IT EXPAND TO 48K ON BOARD	☑	☐
* DOES IT HAVE RF OUTPUT FOR TV CONNECTION	☑	☐
* WAS IT FEATURED IN ELECTRONICS AUSTRALIA – AUSTRALIA'S LEADING ELECTRONICS MAGAZINE	☑	☐
* IS IT AVAILABLE EX-STOCK	☑	☐
* HAS IT SOLD OVER 1300 AND BEEN PROVEN AGAINST TEETHING TROUBLES	☑	☐

CHECK OUT THESE FEATURES: * Relay operates cassette unit automatically * 2K Monitor program supplied * Character generator giving full 64 characters, 32 characters x 14 line screen * Spare IC positions for prototyping and user customising * RF modulator inbuilt, connects to your TV set * Optional S-100 provision * Keyboard can be remotely mounted if required * 12MHz quartz crystal * Optional 9K SUPER BASIC in ROM plug in facility * Full size professional 60 key keyboard * Inbuilt power supply * 16K RAM on board plus provision for on board expansion to 48K * Inbuilt cassette interface

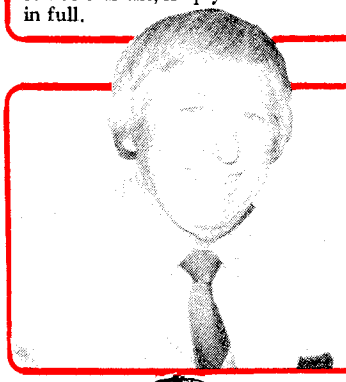
'Sorry Dick, It Doesn't Work'

DUE TO THE VERY LOW RETURN RATE (3%) WE HAVE REDUCED THE SERVICE FEE BY 50% TO ONLY $50!!!

If, after completion your Super 80 fails to operate, you may take advantage of our "Sorry Dick it doesn't work" service.
Our Service Centre will check and repair your Super 80 for the cost of $50. This fee includes necessary replacement of components etc.
If you send your Super 80 to us under the "Sorry Dick, it doesn't work" service it must have been constructed using IC sockets.

7 Day Satisfaction Guarantee

Purchase this kit and inspect it for up to 7 days. If you do not wish to go ahead and construct this kit, simply return to us in the condition supplied and your money will be refunded in full.



This is what Reg Hespe, Technical Officer of Gladesville had to say about 'Super 80'
"I enjoyed building the Super 80 project and felt it worthwhile, of immense educational value and quite easy to construct. It worked as soon as I turned it on and has provided many hours of enjoyment".

Very Advanced design – but works with any TV set!

The 'Super 80' offers a specification that we believe just cannot be bettered at the price. It uses the popular Z80 Microprocessor IC, a professional keyboard and has direct RF output so that you can use the computer with any TV set (you don't need to purchase a special video monitor).

Easy to build

Even though we would not recommend this kit to the raw beginner, it is very easy to build. Any person who can use a small soldering iron and can solder neatly should have no difficulty in construction. This is because of the unique double side board design which means there is virtually no other wiring. The board is covered with professional 'solder mask'; this makes soldering much easier without the problems of bridges, etc. Once the components are soldered onto the board in their marked positions over 98% of the construction is completed. Even if you cannot get the completed kit to work, we have a special "Sorry Dick it doesn't work" repair service to assist you.

NEW lower price, higher specification - how is it done?

Most computers sold in Australia are manufactured in the U.S.A. where extremely high labour rates prevail - and you pay dearly for this on built up units. With this computer kit, you provide the labour and therefore save a fortune. And remember, this computer does not have a small toy-like calculator keyboard but a full size professional typewriter keyboard.

Advanced programming capability

One of the most popular computers in the world (the Tandy TRS-80 Level 1) only has 4K of BASIC. The BASIC we have with this unit is a large 9K. When you consider that our popular Sorcerer computer (over 2,000 sold) only has 8K BASIC and sells for over $1,000, it is obvious that by building yourself, you are saving real money.

Electronics Australia/Dick Smith design

This is not a half baked design with no back up. The resources of Electronics Australia, Australia's most popular electronics magazine, and Dick Smith Electronics have combined to design and bring you this kit in the interests of computer enthusiasts actually building and not just buying. The design is fully Australian.

Imagine how much you will learn!

Most computer enthusiasts can program a computer but would have absolutely no idea of how to build one. By building this kit you will learn both the technical side of construction, how it works and then how to program. What a fantastic background for a future. . . . . .

Sectional construction

We have designed this kit not only for the serious computer user but also for first time users like the student or hobbyist. This is why we have a short form kit which may be added to as you build (and as you have the money!). For example, you may build the computer originally and operate it with 'BASIC on tape' and then add 'BASIC in ROM', add the S-100 and provide other parts at a later stage.

SEE OUR OTHER ADVERTISEMENTS IN THIS MAGAZINE FOR THE NEAREST DICK SMITH STORE ADDRESS AND PHONE NUMBER

S-100 board has serial & parallel ports

A printer interface for the Super-80

The long awaited Super-80 printer interface is here! Hard copy of programs and data is now easy to achieve, either with a Centronics type parallel printer or a serial input machine. Read on for details.

by PETER VERNON

Since we published the popular Super-80 computer project many readers have asked us about using a printer with the computer. Now Dick Smith Electronics has come up with a printer interface board which plugs directly into the S100 expansion slot of the Super-80. It is supplied as a complete kit of parts which can be put together inside an hour.

The big advantage of this printer interface is that is can be built in two forms: as a parallel printer port only, or as both a parallel and a serial RS232C port. Which version you build depends on the type of printer you will be using and on other capabilities required for your Super-80.

Use of the interface board is not restricted to printers. With the serial port you can use a 300 baud modem for telephone data communication, for example, or have two Super-80s linked together and transferring data to each other (great for games with a friend!).

The interface board measures 253 × 72mm. It features the familiar S100 circuit board connector at the bottom, a 34-pin section at the top to take the edge connector of a Centronics printer cable, and space for connector pins for the RS-232C interface at the right hand side. The board is double-sided with plated through holes, and the S100 pins have been gold flashed to ensure reliable contact with the connector on the main computer board.

One point is extremely important. The S100 connector on the Super-80 board is designed to take a motherboard, containing additional S100 slots. Because of this, the connector is installed "back to front", with pin 1 at the right hand side of the Super-80 board, looking from the front. The printer interface board is therefore installed with the component side towards the rear of the Super-80 board. Great sorrow will ensue if the board is plugged in the wrong way round, as the pins at the right of the S100 connector carry the unregulated +8V and ±16V, feeding the regulators on the printer board.

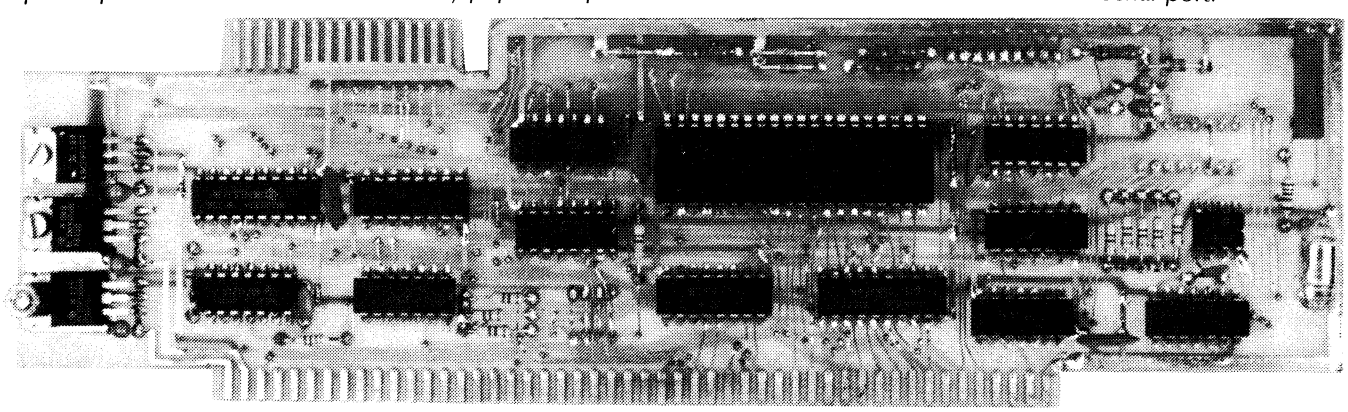
Before we go into a detailed description of how the board works, we should say that it is quite possible to construct the parallel printer interface and get it working without understanding exactly what is happening. For this reason we will describe the construction and operation of the unit first, with the circuit description following for really dedicated enthusiasts.

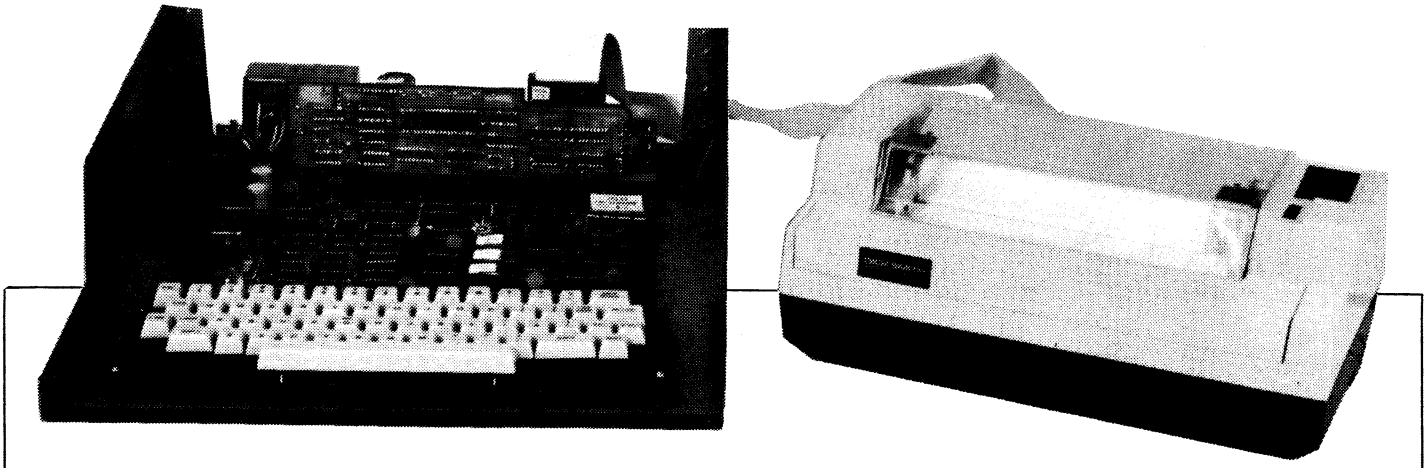
Using the serial interface is a little more difficult. There are several links to be installed which control the parameters of the serial data transmission. These links must be set to match the parameters of the receiving device. Usually the manual which comes with the device will have these details while Table 1 shows the function of each link on the board required for the serial interface circuitry.

Construction

If you haven't already done so, you will first have to assemble the S100 interface circuit on the Super-80 board. This involves installing capacitor C3 for additional power supply filtering, and five integrated circuits in the white cross-hatched area of the computer board, as well as the 100-pin S100 connector. Full details for this section of the Super-80

Super-80 printer interface board when fully populated provides both Centronics interface and RS232C serial port.





Super-80 (yes, in a case!) working with the GP80 printer. Installation in a case will be covered in a later issue.

were published in the October, 1981 issue.

Begin construction of the printer interface board with the passive components. There are 16 resistors and 12 capacitors, five of which are tantalum types which must be correctly orientated according to the component overlay. There are also four zener diodes and a multi-turn potentiometer to be installed. If you only require the parallel port, some of these components are omitted, as indicated in the parts list.

Power supply regulators are next. If you are only interested in the parallel printer interface, only U1, the +5V regulator, need be installed. Otherwise, install all three regulators, carefully bending the pins down about 5mm from the case. You may like to bolt the regulators down before soldering as a check on their fit. The 10mm threaded spacer included in the kit is fitted to the +5V regulator and serves as a heatsink. Install this regulator with the head of the bolt on the back of the board, and the spacer threaded on from the component side.

Following the regulators install the integrated circuits. For the parallel interface, install U4, U5, U6, U7, U8, U9 and U11. If you require the serial interface, install the remaining ICs as well. Note that there is a link on the underside of the board, beneath U12, which must be cut if this chip is installed. The link runs from pin 18 to pin 19, and should be left intact if only the parallel port is assembled (ie U12 is not installed). Use a 40-pin socket for the UART chip, U10.

Before using the board there are a number of links to be installed, as shown on the overlay diagram. Links J1 to J4 set the most significant half of the address of the devices on the board. For example, with all the links installed, comparator U11 will select the printer port when address lines A7 to A4 are all zero. With no links installed (as on our board), the printer board will be selected when these four address lines are "1", giving the parallel printer port an address of "FC". The software given here is designed for this address. See "How it works" for details.

The cable used to connect a printer to the interface board must have a 34-way edge connector at one end and a standard Centronics connector at the other. We used a standard cable from Dick Smith Electronics catalog number X-4014, although you can wire your own, pin 1 to pin 1, pin 2 to pin 2 etc.

Getting it up and running

With the board completed we can move on to actually using it. For our tests we used the Dick Smith Electronics GP80 dot matrix printer, a machine which is ideal for this application. It is a Centronics type printer, with the standard parallel input connector popularised by the Centronics company. A printer cable from DSE completed the set up.

With the Super-80 switched off, plug the printer interface board into the S100 connector. Remember that the component side of the interface board should face the rear of the computer. Don't use too much force to insert the printer board, as flexing the Super-80 board will place stress on the PCB tracks and socket connections. A little gentle wriggling and some patience will pay off here. It may also be an idea to include some additional support underneath the S100 connector such as two stick-on rubber feet, or similar.

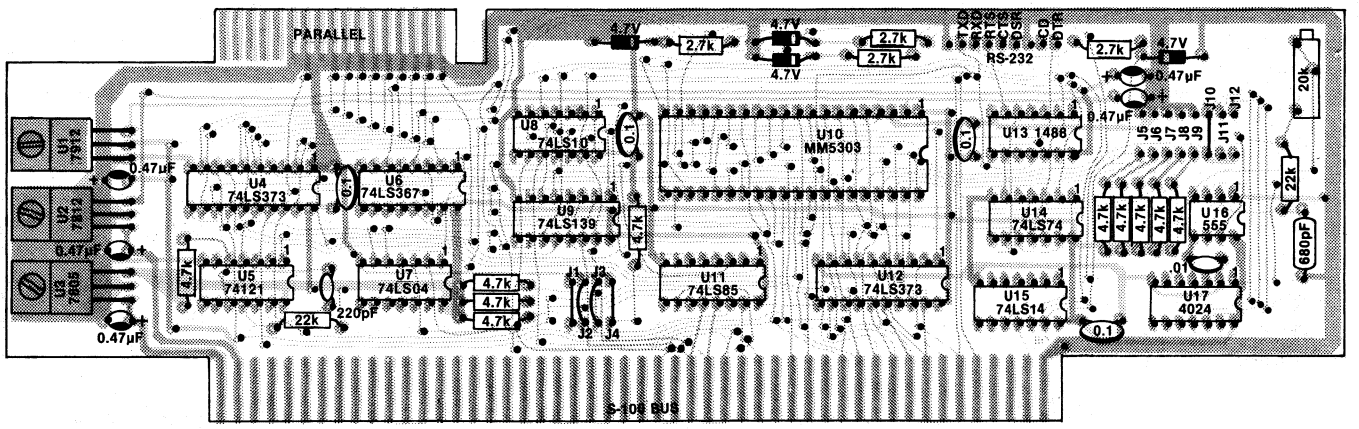
Assuming that you are using a Centronics type printer, connect the edge connector of the printer cable to the circuit board fingers at the right hand side of the interface board. The single colour-coded wire of the printer cable is "number one" and should be on the left hand side as you look towards the board. Install the Amphenol connector on the other end of the cable in the socket at the rear of the printer.

Switch on your video display and the printer, then the Super-80. The next step is to load the software for the parallel printer driver. Go to the Monitor (with the "MON" command from Basic). Use "E 0000" to enter the program in Listing 1. Begin with "55" and go on until you have entered "C9" in address location 000A. If you have left links J1 to J4 open, enter the program as shown. If you have used a different address for your printer board, change "FC" to whatever address you have used.

Return to Basic when you have finished entering the printer program. Now whenever you do an "LPRINT" or "LLIST" in Basic the printer will respond. "LLIST" is used for listing Basic programs on the printer, while "LPRINT" is used in the same way as a "PRINT" statement within a program, but instead of printing on the video screen it will direct the output to your printer.

Note that the Super-80 Basic interpreter is designed to automatically send a line feed after each carriage return. However, most printers are set up to also insert a line feed after a carriage return. The result: two line feeds at the end of each line and double spaced printing.

Fortunately, this is easy to avoid. "Automatic line feed" on most printers is controlled by a wire link or a DIP switched inside the printer. The manual accompanying your printer will have the details. Simply follow the directions to disable the automatic line feed of the printer for single spaced printing.



Note the position of the links on the overlay diagram. For a Centronics interface only some components may be left off.

How it works

There are four main functions on the printer interface board which must be accessed by the computer. These are a port for parallel printer data, a parallel printer status port, and UART data and status registers.

"UART" by the way, stands for "Universal Asynchronous Receiver Transmitter". "Aysnchronous" in the designation refers to the UART's ability to transmit and receive data without being synchronised to the device at the other end of the serial line. In other words, the two parts of the system, the computer and, say, an RS232C printer, do not share a common clock frequency. Instead, data is synchronised by the transmission of a start bit at the beginning of each data byte.

The Z80 microprocessor on the Super-80 board addresses Input/Output devices separately from memory, and provides bus control signals which distinguish between memory operations and I/0 operations. The lower eight bits of the address bus are used to specify I/0 locations, giving 256 possible port addresses. The address of each device on the interface board consists of a unique combination of these eight address lines with either SINP, the S100 bus signal which designates input to the processor, or SOUT, designating output from the processor.

The address decoding logic for the printer interface board consists of U8, part of U7 and U11, as shown on the main circuit diagram. When address lines A2 and A3 are high ("1"), comparator U11 will be enabled. The comparator will then compare the state of address lines A4 to A7 with the switch settings of links J1 to J4. If the address lines match the link settings, the comparator will produce an output labelled "BSEL" to select the devices on the printer board.

You can vary the top half of the address by closing combinations of the links. If you want the board to respond when A7 is "0", for example, close link J4 and leave the other three open. This would correspond to an address of "7C" (01111100). Open links place a "1" on the corresponding inputs of comparator U11, which produces a "true" signal when these match the four bits of the address on A4-A7.

In other words if we leave links J1 to J4 open, the comparator output will be true for an address which has all 1's for the upper 4 bits. Eight bit addresses which have bits 2 and 3 high are then FC, FD, FE and FF (convert these to binary for a check).

The Super-80 uses ports at addresses F0 to FB for its own purposes (reading the keyboard, controlling the video and cassette interface etc). Because of incomplete decoding on the board, the functions of these addresses are also fulfilled by the block E0 to EB. Addressing the printer interface board with the four upper lines set to "F" will thus use the unreserved ports in the locations in the Super-80 I/O block. Leave J1 to J4 open to do this.

TABLE 1

ADDRESS	READ FROM	WRITE TO
FC	Produces Print Status Read $\overline{PSR}$	Produces Print Data Write strobe $\overline{PDW}$
FD	Produces UART Status Read $\overline{USR}$	Produces UART Status Write $\overline{USW}$
FE	Reads data from the UART $\overline{UDR}$	Writes data to the UART $\overline{UDW}$ for transmission

TABLE 2

LINK	FUNCTION
J5	Enables parity checking if installed
J6	Installed for 1 stop bit, open for 2 stop bits
J7	J7 only installed for 6 bit data Both J7 and J8 open for 8 bit data
J8	J8 only installed for 7 bit data Both installed for 5 bit data
J9	Odd parity if installed, even parity if open, provided that parity is enabled by installing J5

Control strobes

The BSEL signal from the address comparator is gated with SOUT and $\overline{PWR}$ by one section of U8. $\overline{PWR}$ is an S100 by status signal which indicates that the processor is currently sending data to the S100 bus connector.

PWR is an active low signal, inverted by one gate of U7, so that a "1" at pin 4 of U7 indicates valid data on the processor data bus. When gated with SOUT and BSEL by U8, the output enables one half of the dual one-of-four decoder U9 to

produce write strobes to each of the interface devices. SINP and BSEL are gated together by another section of U8, and this output enables the other half of U9 to produce read strobes, indicating that the processor is requesting data from the interface.

Address lines A0 and A1 are input to both halves of decoder U9. They determine which one of the three outputs of the relevant section of the decoder becomes active, and therefore, which specific device is read from or written to. The six strobe pulses which can be produced by this part of the circuit can write data to the parallel port or to the serial port, request status information from either port, or write status information to the serial port. All the possible combinations of strobe pulses, and the addresses which produce the appropriate stobe, are shown in Table 1.

The parallel printer port

The parallel printer section consists of U4, U5 and part of U6. When the microprocessor performs a read operation from the printer port, a Printer Status Read ($\overline{PSR}$) signal is produced at pin 4 of U9. This signal is applied to the enable input (pin 15) of U6, gating the printer busy bit onto bit 7 of the data bus. When this bit is "1" the printer is busy, and no data is sent. When bit 7 goes to "0" the printer is ready for further data.

A write operation to the printer port produces a Printer Data Write $\overline{PDW}$ signal on pin 12 of U9, which triggers monostable U5 to produce a strobe pulse of the correct length for the printer. At the same time, the data on the Data Output bus will be latched into U4 and transmitted to the printer.

We are now in a position to understand the software for the printer driver (Listing 1). Initially, the character to be printed is in the A register, so first we save it by pushing it onto the stack. This frees the A register to receive the printer status, which we get by an Input instruction.

Having read the printer status we must check the state of bit 7 of the A register, and this is most easily done by rotating the contents of the register one place to the left, so that bit 7 moves into the Carry flag. If bit 7 is "1" (printer busy), the carry flag will be set, so the program loops around and checks the status again. It will keep looping until the printer status busy bit is "0".

If the carry flag is "0", the program does not loop and the next instruction is executed. This instruction "pops" the previous contents of A off the stack and places it back in the A register. This is the character we want to print. Executing an OUT instruction to the printer port will generate the Print Data Write Strobe ($\overline{PDW}$), latching the byte to be printed and sending the strobe pulse to the printer to initiate printing.

To help you understand the actual operations involved we suggest you read our series on "Programming in Machine Language". Although the articles deal with a different microprocessor they do explain the concepts of rotation, carry flags etc, and these concepts are universally applicable to microprocessor operations.

The serial interface

For serial data communication the most important part of the circuit is the UART U10. This device is designed to take parallel data from the computer's data-out bus and convert it to serial form for transmission, and to receive serial data and assemble it into parallel format bytes for the computer's data-in bus.

Various outputs of the decoder U9 are used to enable the functions of the UART. In describing this section of the circuit we will work backwards from the software, shown in Listing 2.

The first step, after saving the contents of register A on the stack (PUSH AF), is to send a Request To Send (RTS) signal, setting this line to a "1" indicating that the computer is ready to transmit data. We do this by setting bit 6 of the A register and outputting the contents of A to the UART status port, addressed at FD. Bit 6 set, and all other bits "0" is 40 in hex.

An OUT instruction to port FD generates the UART Status Write strobe $\overline{USW}$ on pin 11 on U9, which clocks the data on bit 6 of the Data Out lines through flipflop U14. The RTS signal appears on pin 8 of U14 as a +5V TTL level, and is translated to the +12V RS232C level by the RS232C driver U13.

Following request to send, we read the status of the UART from port FD, checking the Clear To Send (CTS) line. When the device at the other end of the serial link is ready to receive a new character it will set this line high. The UART Status Read $\overline{USR}$, will enable the Tri-state buffer U6 to gate this signal onto bit 6 of the Read Data (RD) line to the processor.

Note that CTS is also an RS232C level signal and is clamped by a 4.7V zener diode to convert it to TTL level. We read it by an IN operation from port FD, and test it with a BIT 6, A instruction, looping until the CTS bit is set.

Since the RS232C device is now ready to receive data we must check if the UART is ready to transmit. Inside the UART is a transmit buffer which holds the byte to be transmitted. Obviously,

PARTS LIST

1 PCB
1 74121 monostable
1 74LS04 hex inverter
1 74LS373 octal latch
1 74LS367 hex bus driver
1 74LS10 triple 3-input NAND gate
1 74LS139 dual 2-to-4 line decoder
1 74LS85 4-bit magnitude comparator
1 LM7805 +5V regulator

CAPACITORS
1 0.47μF 35VW tantalum
1 220pF ceramic
4 0.1μF ceramic

RESISTORS (¼W, 5%)
1 × 22kΩ, 5 × 4.7kΩ

MISCELLANEOUS
1 6BA 10mm bolt
1 6BA threaded spacer

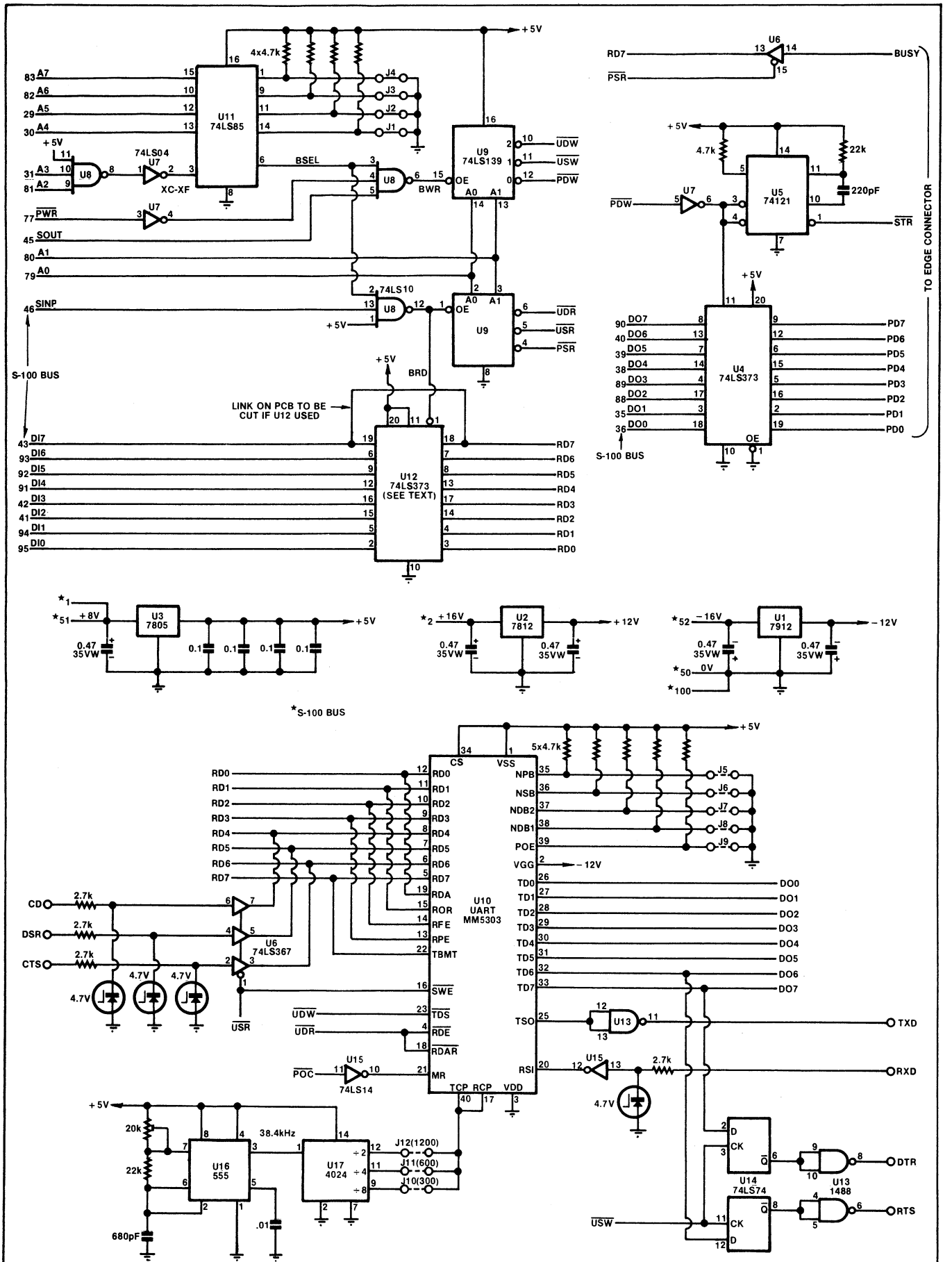
EXTRA PARTS FOR SERIAL INTERFACE
1 MM5303 or AY-3-1015 UART
1 MC1488 RS232C transmitter
1 74LS74 dual flipflop
1 74LS14 hex Schmitt trigger inverter
1 CD4024 binary counter
1 74LS373 octal latch
1 555 timer
4 4.7V zener diodes
1 LM7812 +12V regulator
1 LM7912 −12V regulator

CAPACITORS
4 0.47μF 35VW tantalum
1 .01μF ceramic
1 680pF polystyrene

RESISTORS (¼W, 5% unless stated)
1 × 22kΩ 1%, 5 × 4.7kΩ, 4 × 2.7kΩ
1 20kΩ multi-turn potentiometer

MISCELLANEOUS
2 6BA nuts and bolts
9 circuit board pins.

COST
The complete kit of parts for the Super-80 Printer Interface (DSE catalog number K3610) costs $69.50. This includes sales tax, but does not include the cost of the printer cable.



SUPER-80 PRINTER INTERFACE

we don't want to send new data to the UART until the previous data has been transmitted, so we check the status of the TBMT flag (Transmitter Buffer Empty).

As previously stated, reading from the UART status port generates the $\overline{USR}$ signal. In addition to gating the RS232C control signals onto the Read Data bus, this signal is also connected to the UART's Status Word Enable ($\overline{SWE}$) input. In response to this input the UART places the status word on the Read Data bus.

TBMT is part of the status word and is placed on bit 7 of the Read Data bus in response to $\overline{USR}$. We check the state of bit 7 with a Rotate Left instruction, which sets the Carry flag if TBMT is "1", indicating that the transmitter buffer is empty. The program loops until the carry flag is set.

With the status checks complete we can now send the character to be transmitted. Basic leaves this character in the A register before the serial driver routine is called, so we get it back from the stack with a POP AF instruction. Next we send the contents of A to the UART data port with an OUT (FE), A instruction.

The output operation to port FE generates the $\overline{UDW}$ strobe, which is applied to the UART's $\overline{TDS}$ input, pin 23, to latch the data on the data out bus into the transmit register, where it is converted to serial form and transmitted over our RS232C link.

After sending the character to the transmit buffer we clear the A register and send the contents out through the UART status port, which resets the RTS line, then return to the program which called the driver routine.

Receiving data is the reverse of the transmit process (Listing 3). First step is to read the status of the DSR input from the device sending the data. A "1" on this line indicates that the serial device has a byte of data to send. Again, the RS232C level is translated to a TTL level by a zener diode, and gated onto Read Data line 5 by the $\overline{USR}$ signal.

IN A,FD inputs the RD lines to the A register. By ANDing the contents of A with hex 20 (bit 5 "1", all others "0") the result will be non-zero only if there is a character to be received. If the result of the AND is zero the program jumps to a routine which sets up all the processor flags and returns to the calling routine.

Otherwise, we send the Data Terminal Ready (DTR) signal, by setting bit 7 of the A register and outputting it to port FD. This operation produces the UART Status Write signal which clocks bit 7 through flipflop U14 to produce the DTR. Once again, the output of the flipflop is converted to an RS232C signal by one gate of driver U13. At the other end of the line this signal can be used to initiate transmission of the data.

Next we read the UART status, looking at the state of the Receiver Data Available line. This signal from the UART is "1" when an entire byte has been received. It is gated onto bit 0 of the Read Data lines by the Status Word Enable signal generated by reading the UART status.

If bit 0 is "0" at this stage the program loops until the line goes to "1". The data byte is in the receiver register of the UART, but before reading it into the processor there are other operations to be carried out.

These operations involve checking the UART status word, bits of which indicate various errors in transmission, so we first save the status word, pushing A onto the stack. Next we clear A and output it to the UART status port to reset the DTR line, indicating that the receiving device is busy and no more data should be sent.

After resetting DTR we recover the status word from the stack with a POP AF instruction and test the error bits. Three types of error are signalled by the UART on bits 1, 2 and 3 of the Read Data lines. Bit 1 signals ROR (Receiver Overrun) which is "1" if the previous character has not been read before the present character was transferred into the receiver buffer. In this case we have lost a character.

Bit 2 of the status word is RFE, and is "1" for a "framing error", indicating that the received character does not have a stop bit, and is incorrect. Bit 3 is RPE, for "parity error", which signals an error if parity checking is enabled.

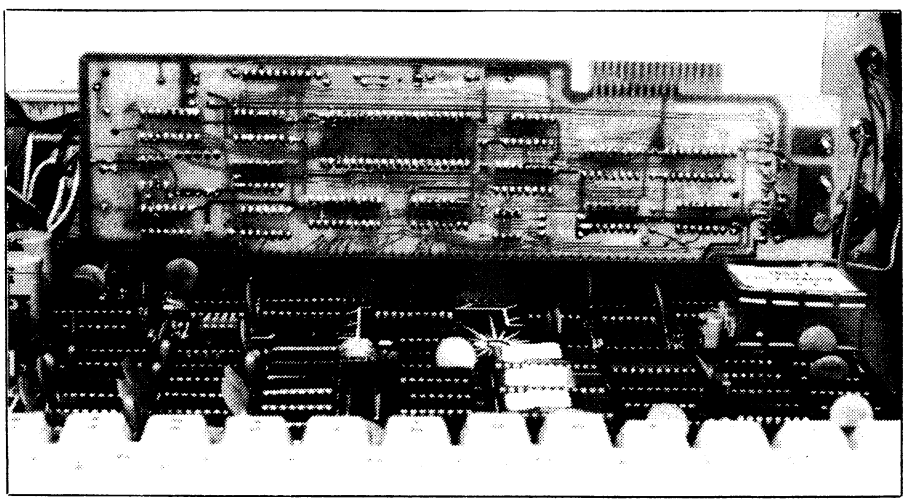
A "parity bit" is an extra bit added to the data received and transmitted data as an error check. The NPB line and the POE line are used together to select the type of parity check to be applied to the data. If even parity is selected, the UART will add all the bits in the data byte together and add 1 to the result if the sum is odd. If the sum is even nothing is added. The parity bit is stripped off at the other end of the line after the receiving device has checked the data.

When odd parity is selected, a bit is added only to those bytes which are even when summed. Obviously, when even parity is selected, a data byte arriving with an odd number of bits is an indication that some error has occurred in transmission, and vice versa. The receiving device can be programmed to take appropriate action (usually, to request that the data be re-transmitted).

We can check the status of the three error signals all at once by ANDing the status word with 0E (00001110 in binary). If the result is zero, no error has occurred, so we read the receiver buffer. Reading the receiver buffer generates the $\overline{UDR}$ strobe, which is input to pin 4 and pin 18 of the UART. Pin 4 is the $\overline{RDE}$ input (Read Data Enable) which gates the received data onto the data bus to the computer. Pin 18 is $\overline{RDAR}$, which resets the data available output of the UART, ready for the next data byte to be received.

If an error has occurred we still read the data into A, but the only purpose in doing this is to reset the Read Data Available flag, as previously described. Before returning to the calling program, A is cleared, and then ORed with itself to set the processor flags. The Z flag set indicates that no valid character has been received.

Any of the read strobes will enable U12, which is used as an 8-bit buffer.



Another view of the interface board installed in the Super-80. Again note that the component side of the board is towards the rear.

Data to be read from the interface board, either status bits or data received by the UART, will be enabled onto the S100 data in bus by this latch.

If the serial interface is not installed then U12 will not be required, as the parallel interface only produces one status bit (the printer busy signal on data line 7) and this is already gated by one Tri-state gate of U6. If U12 is installed, however, be sure to cut the printed track between pins 18 and 19 of the chip, as previously mentioned.

The procedure for reading and writing serial data may sound complex, but the software published here takes care of the details. A thorough understanding of the process is required, though, if you want to write your own software drivers.

Note that in both Listings 1 and 2, the actual driver program is preceded by a 55 (hex) byte. This is a flag which the Basic interpreter reads to determine if a printer driver is in memory. If the flag is present, Basic will use the driver in response to "LPRINT" and "LLIST" statements.

The rate at which data will be received and transmitted (known as the baud rate) is controlled by the baud rate clock inputs of the UART, pins 17 and 40. These two inputs are connected together, since we want the transmitter and receiver both working at the same baud rate, and are driven from the output of the baud rate clock generator, ICs U16 and U17.

The clock rate must be 16 times the desired baud rate. Clock pulses are produced by U16, a 555 timer IC wired in astable configuration. A 20kΩ multi-turn potentiometer allows the output of the 555 (pin 3) to be accurately trimmed to 38.4kHz. The output of the 555 is then fed to a 4024 binary counter (U17), which divides down to produce the required clock rate via link J10 (300 baud), J11 (600 baud) or J12 (1200 baud). Note

LISTING 1: CENTRONICS DRIVER

```
0000     55              Flag for Basic
0001     F5      PUSH AF Save character on stack
0002 *1  DB FC   IN A,(FC) Get printer status
0004     17      RLA     Rotate bit 7 into carry
0005     38 FB   JR C *1 If C=1 loop till C reset
0007     F1      POP AF  Get character off stack
0008     D3 FC   OUT (FC),A And send to printer
000A     C9      RET     Then return to caller
```

LISTING 2: RS232C TRANSMIT

```
0000     55              Flag for Basic
0001     F5      PUSH AF Save character on stack
0002     3E 80   LD A,10000000B Set bit 7 in A
0004     D3 FD   OUT (FD),A Send it to UART status port
0006 *1  DB FD   IN A,(FD) Read UART status
0008     CB 77   BIT 6,A Test bit 6 in A
000A     28 FA   JR Z,*1 Loop until CTS is "1"
000C     17      RLA     Put TBMT bit in Carry
000D     30 F7   JR NC,*1 Loop until TBMT=1
000F     F1      POP AF  Get character from stack
0010     D3 FE   OUT (FE),A Send it to UART data port
0012     AF      XOR A   Clear A
0013     D3 FD   OUT (FD),A Reset the RTS line
0015     C9      RET     Then return to caller
```

LISTING 3: RS232C RECEIVE

```
0000     DB FD   IN A,(FD)       Get UART status
0002     E6 20   AND 00100000B   Test Data Set Ready bit
0004     28 1A   JR Z,*1         If DSR=0 then return
0006     3E 80   LD A,10000000B  Set bit 7 in A
0008     D3 FD   OUT (FD),A      Send Data Terminal Ready
000A *2  DB FD   IN A,(FD)       Get UART status
000C     CB 47   BIT 0,A         Test Data Available bit
000E     28 FA   JR Z,*2         Loop until data available
0010     F5      PUSH AF         Save UART status
0011     AF      XOR A           Clear A
0012     D3 FD   OUT (FD),A      Reset DTR
0014     F1      POP AF          Restore UART status to A
0015     E6 E0   AND 00001110B   Test error bits
0017     28 05   JR Z,*3         No errors, jump to get data
0019     DB FE   IN A,(FE)       Clear status bits by reading
001B     AF      XOR A           Clear A
001C     18 02   JR *1           And jump to return
001E *3  DB FE   IN A,(FE)       Read UART data
0020 *1  B7      OR A           Set processor flags
0021     C9      RET             And return
```

Above: routines to use the interface board. For bi-directional communication via RS232C, Listing 3 should follow on from Listing 2 in memory.

```
00010 REM **** SCREEN DUMP ****
00020 REM
00030 B=48640
00040 FOR L=0 TO 15
00050 FOR C=0 TO 31
00060 P=B+L*32+C
00070 N=PEEK(P)
00080 LPRINT[A1 N];
00090 NEXT C:LPRINT
00100 NEXT L
```

```
00999 REM **** PRINTER DRIVER ****
01000 FOR L=0 TO 10
01010 READ A
01020 POKE L,A
01030 NEXT L
01040 DATA 85,245,219,252,23,56
01050 DATA 251,241,211,252,201
```

Above: this Basic program includes the Centronics printer routine in data statements. It will place the routine in memory at 0000-000A. At left is a Basic program which will print the contents of the video screen. Variable B should be adjusted depending on the size of memory of your system. For 32K is should be 32256, for 16K, 15872.

that only one of these links is installed, depending on which baud rate you want to use.

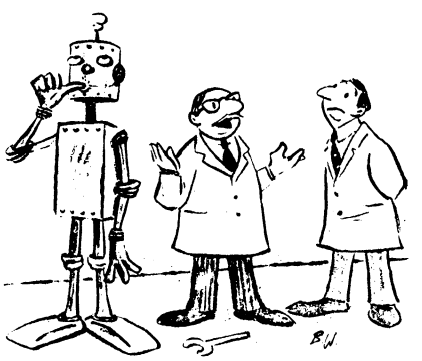
One signal yet to be discussed is the reset line, MR. This is an active high line, while the S100 Power on Clear ($\overline{POC}$) is active low. For this reason the S100 signal is inverted before being applied to pin 21 of the UART.

Five other signal lines are also important to the operation of the UART: NPB (No Parity Bit), NSB (Number of Stop Bits), NDB1 and NDB2 (Number of Data Bits per character), and POE (Parity Odd or Even). These are used to program a set of operating parameters into the UART by means of links J5-J9, which should be set to match the parameters of the serial device with which the computer is to communicate.

NDB1 and NDB2 are used to select one of four possible word lengths – 5,6,7 or 8 bits. For 8-bit data, both J7 and J8 should be left open. The NSB line selects the number of stop bits used to indicate the end of each data byte. When closed, link J6 selects 1 stop bit, and when open 2 stop bits are sent. This link should also be set to match the requirements of the device you are communicating with. The parameters selected by these links are fed into the UART by the CS line, which is tied high in our circuit.

Links 5 and 9 set the parity parameters. Insert link J5 to enable parity checking. With link J9 in place, odd parity will be selected, while leaving J9 open selects even parity. Again, these parameters should be set to match the parameters of the device you want the computer to communicate with. See Table 2.

As soon as space permits, we will describe how to install the Super-80 in the metal case shown in one of the photographs. Together with the printer interface and a lower case character generator (see P111 Feb '82), it will turn your Super-80 into a full-feature computer. Don't miss out!



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IC Socket Kit (recommended)	Cat. K-3603	**$18.50**
ROM BASIC for Super 80	Cat. K-3604	**$120.00**
S100 Expansion System for Super 80	Cat. K-3606	**$39.75**
Super 80 Character Generator	Cat. K-3607	**$109.50**

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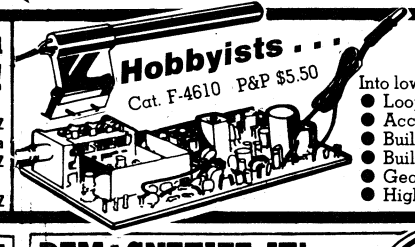

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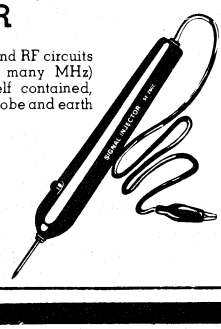

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A case for the Super 80 computer

Not many ready-built computers come with a steel case, but you can have one for your Super-80. Quite apart from the enhanced appearance of your system, the case is a useful protection against spilt coffee, the family cat etc . . . and it suppresses RF interference.

by PETER VERNON

Our article on the Super-80 printer interface showed our computer in a case (or rather, the bottom half of a case). We thought readers might be interested in how it was done, so this article covers the installation of the Super-80 computer in a steel case, which Dick Smith Electronics has had specially designed and produced for the Super-80.

First step, of course, is to get a case. The Super-80 Marviplate case costs $39.95 and is available from Dick Smith Electronics. (Marviplate, by the way, is a trade name for a specially treated steel plate protected against corrosion and finished with a cladding of black vinyl). You will also need some insulated spacers and nuts, bolts and washers of various sizes. Apart from these, the various connectors, switches etc required for the Super-80 in a case are the same as those required for the "bare board" version.

Measurements of the case are 395mm wide x 400mm deep. It is 100mm high at the rear, with a front keyboard section 25mm high. There is not much clearance inside the case and positioning the Super-80 circuit board requires some careful thought.

The most difficult part of the operation is the positioning of the keyboard. If the board is mounted too far forward or back in the case there will not be sufficient clearance for the keys in the cut-out provided for the keyboard. If keys at the top or sides of the keyboard make contact with the edge of the keyboard cut-out the keys could be forced down. In this case your Super-80 will not work. The computer will interpret the stuck key as a key which is being pressed by the operator, and will suspend processing until the key is released.

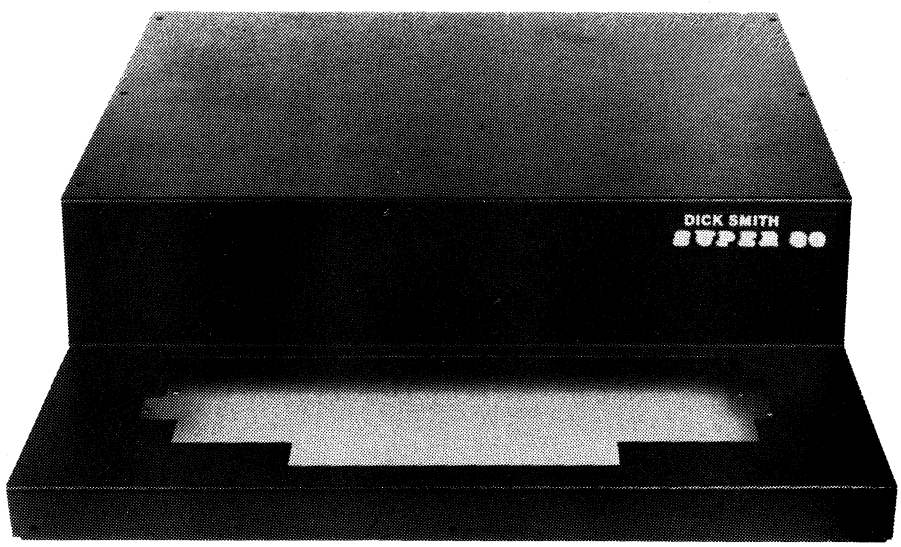
The case is supplied pre-drilled but a few extra holes were necessary in our prototype. Try a "dry run" first to establish the position of the PCB inside the case. Note the location of the two holes which must be drilled in the circuit board to match with the holes already drilled in the bottom of the case.

We found that the PCB must be drilled about 4mm in from the two rear corners of the board, but it is important to check this out for yourself and drill the holes to suit. Preferably use a hand drill, to prevent pieces of circuit board being scattered around the workings of the computer. Carefully clean up the circuit board after each hole is drilled, and make sure that no printed circuit board tracks are cut by the holes you drill.

We used four spacers, two 20mm long at the rear of the board and two 25mm types to support the metal keyboard frame at the front of the case. The metal frame is already drilled to take the screws of the spacers. It may be necessary to use extra washers to raise the keyboard to a comfortable height in the opening provided.

Once you know where the circuit board will sit in the case remove the board and prepare to mount the transformer, rear panel connections and switches.

The case is pre-drilled to take the stan-



Specially designed for the Super 80, the black vinyl finished steel case is an attractive enhancement to the do-it-yourself computer.

A complete Super 80 computer system with case, printer, and a green phosphor video monitor. ***(Monitor courtesy Paris Radio Electronics)***

dard Dick Smith Electronics transformer used by the Super-80, but we found that an extra hole must be drilled to mount the mains terminal strip so that the power cord is not kinked. If required, an extra hole should also be drilled and reamed in the left hand side rear of the bottom section of the case to take a standard 3AG fuse-holder.

Drill this hole mid-way between the top hole (where we put the power switch), and the hole provided for entry of the mains cable, then ream it out until the fuse holder can be mounted.

Use a rubber grommet to protect the power cord against chafing at the point where it enters the case. Clamp the cord securely inside the case (there is a hole provided for the cable clamp). Use an earth lug to secure the earth lead of the power cable to the case. One of the transformer mounting bolts provides a convenient earth point. Make the earth lead longer than either the active or neutral power connections, so that if any strain is placed on the power cord the earth lead will be the last to give way.

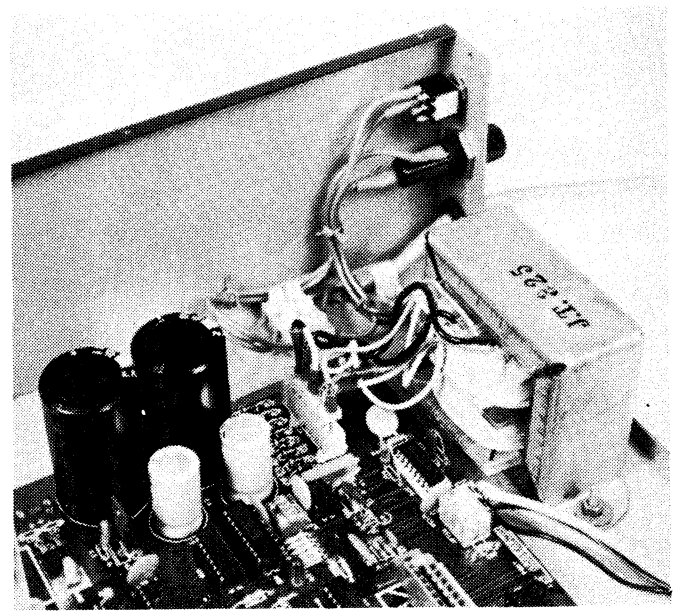
Terminate the active and neutral power lines to a mains terminal strip bolted to the bottom of the case. From the terminal strip take the neutral lead to one side of the transformer primary. The active lead goes first to the fuse-holder, if used, and then to the power switch. The other side of the power switch goes to the transformer primary.

To connect the transformer secondary to the PCB we used a Utilux connector, matching the female connector on the PCB. If this connector is unavailable though, it is quite permissible to solder the secondary leads directly to the PCB.

Having carefully checked the location of the PCB and the transformer in the case, put this assembly aside and mount the reset switch, video connector and cassette connector on the right hand side of the rear of the bottom section of the case. We put the reset switch at the top, the video connector in the centre and the cassette connector at the bottom, although this depends to some extent on personal preference. It may be necessary to enlarge some of the holes in this part of the case. Use a reamer, and make sure that no metal filings are left in the case at the completion of the operation.

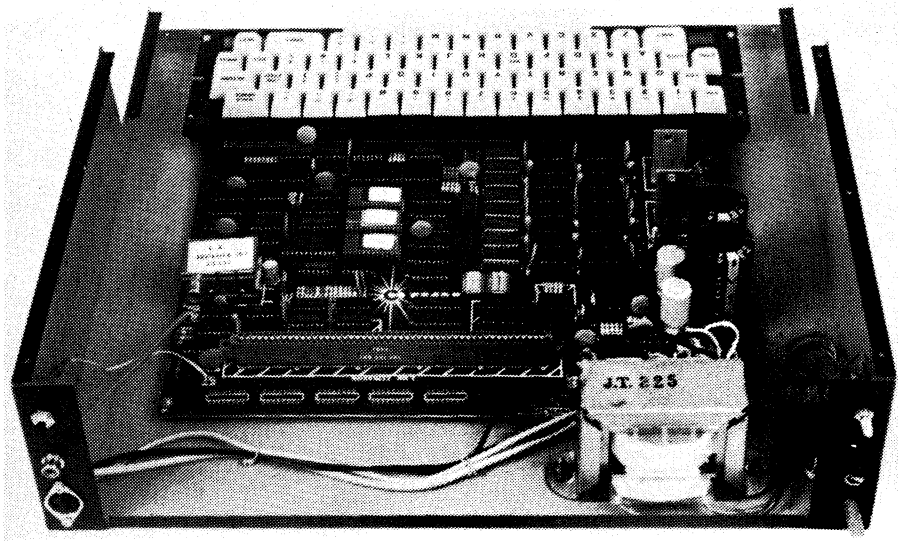
We used a 4mm diameter pushbutton for the reset switch. It was necessary to extend the leads between the switch and the circuit board before the switch could be mounted. We used a screw-in female RCA socket for the video connector. Use a length of shielded cable between the PCB and this connector.

For the cassette connections we used a 5-pin DIN socket, with the cables to the cassette recorder terminated to a 5-pin DIN plug. Earth connections for the three cassette cables (Ear, microphone and remote control) can be made to a common pin on the DIN socket, with signal connections to separate pins. Use shielded audio cable between the cassette connector and the connection points on the PCB, although this is not really necessary for the remote control signal.



A close-up of the power supply wiring. Note the use of a terminal strip and cable clamp for mains connections, and the position of the fuse-holder and power switch.

A case for the Super 80



Note the cassette and video cables and the position of connectors.

Run the cassette cables from the PCB along the rear of the case to the connector and tie them into a neat bundle. Actual connections to the DIN socket will depend on the configuration of your existing cassette cables.

There is one final step, and that is the LED on the circuit board which indicates correct loading from the cassette recorder. With the top on the case it is obviously not possible to observe this LED, so it should be moved to the front of the case.

Drill a 5mm hole in the vertical front section of the top of the case, above the keyboard cut-out. Carefully remove the LED from the PCB and connect two insulated wires in its place. These leads go to the LED mounted on the front panel, making sure that the correct polarity of the LED is preserved. Use a 5mm plastic LED mounting bezel to secure the LED in the front panel.

With all holes drilled, brush out the bottom section of the case, making sure that no metal filings are left to complicate matters when the Super-80 board is installed. Mount the transformer, fuseholder, power switch and mains cord. Mount the circuit board in the bottom of the case, again making sure that there is sufficient clearance around the keyboard when the top cover is in place.

Make the connections to the reset switch, video connector and cassette connector. Keep all wiring as short as possible without straining any connections.

Before connecting the power transformer secondaries to the Super-80 PCB check the voltages from these leads. Remember to observe the correct phasing of the 20V (nominal) secondary lines, as described in the September 1981 issue of Electronics Australia, p78.

When all is complete place the top cover of the case in position and secure it with the self-tapping screws provided. We suggest that you place screws at the front of the keyboard and at the rear top of the case. Screw these down tightly and then connect the computer to your video display and switch on. If the Super-80 does not perform as normal the most likely cause is obstruction of the keyboard by the case. Loosen the screws at the front of the case and try moving the keyboard slightly.

Make sure that all the keys are free to move up and down to their full extent. If everything is satisfactory, leave the computer on while you insert and tighten the remaining screws. If at any time the cursor stops flashing on the screen check the keyboard clearance again.

Note that there is another cut-out in the rear of the top section of the case. This rectangular opening is designed for the possible installation of an edge connector or as a convenient exit point for the cable from the Super-80 printer interface board described in a previous issue.

On the subject of the interface board, note that the case is not high enough to take a standard sized S-100 board. If you use such a board you could still use the bottom section of the case but would have to make your own arrangements for a top cover. The Super-80 serial and parallel interface board is a non-standard size S-100 board, and fits quite comfortably inside the case even with the edge connector for the printer cable in place.

That completes the installation of the Super-80 in its case. The result is an attractive unit, solidly protected from the vagaries of the environment – well worth the price of the case and a few hours of careful work.

Adding graphics to the Super-80

EL Graphix, of Croydon, Victoria, has come up with a series of graphics add-on boards for the Super-80 that will interest all users of this popular do-it-yourself computer. Double screen resolution is just one possibility!

by PETER VERNON

Three kit versions of the board are available. One provides special graphics characters ranging from card suits, lines and stick figures to quarter character cell size blocks which allow a screen resolution of 64 × 32.

Kit number two provides "chunky" graphics similar to those of the TRS80 Model 1 and the Dick Smith System 80. This kit makes possible a screen resolution of 64 × 48 blocks, but does not include the card suits and other games graphics of kit one.

A third version of the kit uses a 2732 EPROM to provide both the character sets of kits one and two. With this board either of 64 graphics characters can be selected under software control, although only one set can be used at a time. Cost of kit three is $49.50 as compared to $39.50 for kits one and two. Post and packing costs $2.

Construction and installation

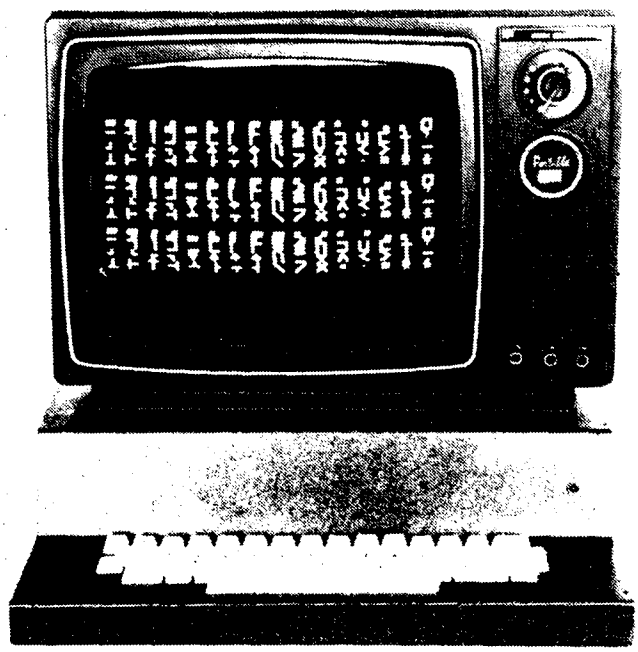
The kits replace the existing character generator of the Super-80 with a pre-programmed EPROM containing the standard alphanumerics and the new graphics characters. However, each of the graphics characters are designed on an 8 × 10 dot matrix instead of the 5 × 8 matrix of the original character generator, so the character scanning hardware must also be modified.

Each kit consists of a printed circuit board measuring 80mm × 66mm, an EPROM, a replacement for shift register U23 of the Super-80 and miscellaneous wires and sockets. Solder is provided.

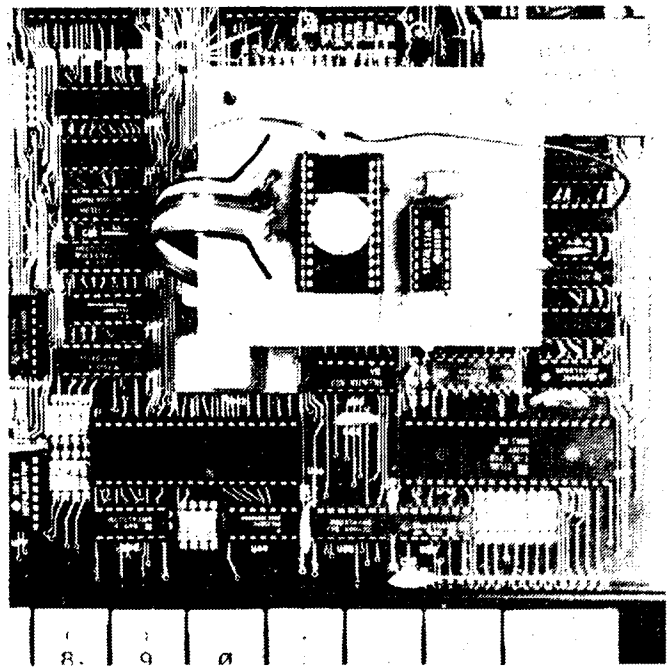
Assembly is straightforward as long as the instructions are followed carefully. A low power soldering iron with a fine tip is essential for construction.

Once assembled the graphics PCB is connected to the Super-80 board by ribbon cable terminated by two DIP headers. A 24-pin DIP header replaces the original character generator supplied with the Super-80, while a 16-pin header replaces U23 on the main board. Two other flying leads from the add-on board are soldered directly to pins of ICs on the Super-80 board.

EL Graphix suggests that the add-on board be mounted on the video modulator of the Super-80, and provide nuts and bolts for this purpose. This method of mounting places the PCB over the sockets to which it is connected, and is "crude but effective", as



This screen display illustrates three sets of the 64 graphics characters provided by EL Graphix's kit 1.



The add-on board is installed above the existing character generator socket, bolted to the top of the video modulator.

the EL Graphix instruction sheets put it.

Perhaps a better idea if your Super-80 is installed in a case is to mount the new board on a small bracket secured to the side of the case. Alternatively it could be mounted on the bottom of the case, using nuts and bolts with stand-offs.

Whatever method you use make sure that none of the tracks on the new board are short circuited by the mounting hardware, and make sure that the add-on board does not contact any part of the Super-80 PCB except for the connections specified.

Testing and examples

On switching on the Super-80 with the new board installed you should see a new cursor, a small "EL" graphic, flashing in place of the usual Basic cursor.

Use the statement PRINT [A1 160] to see the first of the new graphics characters. The 64 characters have ASCII codes from 160 to 223, and can be printed or POKEd in the same way as any other ASCII character. The instruction sheets provide a number of sample programs for testing the graphics board.

Double screen resolution

Using the 16 block graphics characters from kit one, it is possible to double the screen resolution of the Super-80; to 64 points horizontally by 32 points vertically. The second half of the assembly language program in listing 1 does this by taking a pair of co-ordinates and calculating the screen location. It then selects the appropriate graphics character to set or reset a quarter of a character block corresponding to the co-ordinates specified.

Since there are 16 possible combinations of the four points in each character cell, 16 separate graphics characters are used, selected from the table which concludes listing 1.

The origin of the co-ordinate system is in the upper left hand side of the screen, and the program as given is set up for a Super-80 with 48K of RAM. To use it in a machine with less memory, change the value at location 008D of the program from BE to 3E for 16K or 7E for 32K.

The first half of the program in listing 1 adds the capability to draw lines. Given the co-ordinates of the start and end points of the line it calculates all the points in between and calls the DOT routine to draw the line. Since this is an assembly language program, it is quite fast.

To allow us to erase dot points or lines, one byte of the program is a "flag" called MODE. When this location (196 in decimal) is set to "1" a point will be displayed. When MODE is "0" the

Double screen resolution program

```
0000          11 00 00      LD DE,START
0003          21 00 00      LD HL,END
0006          CD 10 00      CALL LINE1
0009          C9            RET


000A          11 00 00      LD DE,POINT
000D          C3 70 00      JP 0070  PLOT POINT


0010 LINE1    01 00 00      LD BC,0000
0013          C5            PUSH BC
0014          7A            LD A,D
0015          BC            CP H
0016          DA 22 00      JP C,L2
0019          C2 21 00      JP NZ,L1
001C          7B            LD A,E
001D          BD            CP L
001E          DA 22 00      JP C,L2
0021   L1     EB            EX DE,HL
0022   L2     44            LD B,H
0023          4D            LD C,L
0024          21 43 00      LD HL,I4
0027          36 3C         LD(HL),3C
0029          7B            LD A,E
002A          B9            CP C
002B          DA 30 00      JP C, L3
002E          36 0C         LD(HL),0C
0030   L3     7A            LD A,D
0031          B8            CP B
0032          CA 49 00      JP Z, L5
0035          C5            PUSH BC
0036          80            ADD B
0037          1F            RRA
0038          47            LD B,A
0039          3C            INC A
003A          67            LD H,A
003B          7B            LD A,E
003C          B9            CP C
003D          CA 44 00      JP Z, L4
0040   L6     81            ADD C
0041          1F            RRA
0042          4F            LD C,A
0043   I4     3C            INC A
0044   L4     6F            LD L,A
0045          E5            PUSH HL
0046          C3 30 00      JP L3
0049   L5     7B            LD A,E
004A          B9            CP C
004B          CA 53 00      JP Z,G1
004E          C5            PUSH BC
004F          62            LD H,D
0050          C3 40 00      JP L6
0053   G1     CD 70 00      CALL DOT1
```

listing continued ►

Super-80 graphics

specified point will be turned off. Since the dot routine is used by LINE, mode allows lines to be either plotted or erased as well.

LINE takes two pairs of co-ordinates, the starting point in the DE register of the processor and the end point in HL. The short routine at location 0000 to 0009 actually loads the co-ordinate pairs into the appropriate registers and then calls the line drawing routine.

For example, suppose that A and B are the X and Y co-ordinates of the starting point and C and D are the co-ordinates of the end point of a line. Put A in location 0002, B in location 0001, C in location 0005 and D in location 0004, then run the program from 0000. See the subroutine at line 1000 of listing 2.

To plot a single point put the X co-ordinate in location 000C and the Y co-ordinate in location 000B, then run the program from 000A. The subroutine at line 2000 of listing 2 does this. When using the assembly language program in your own Basic programs, don't forget to set "MODE" at location 00C4 (196 decimal) to display or erase.

The program in listing 2 first draws a border around the screen by reading a list of start and end points from DATA statements, then calling the subroutine at line 1000 which draws the lines. After the border the program displays 100 individual points at random co-ordinates using the subroutine at line 2000.

Going on

The programs given here are just one example of what can be done with the graphics. By drawing lines and dots and combining them with other graphics characters provided by the kit complex pictures can be built up. By plotting in two or more areas of memory and displaying them in sequence, animated scenes can be constructed.

The EL Graphix kits seem like a worthwhile addition to the Super-80. Which version you choose depends on your own particular requirements, but they are all well designed, easy to install and simple to use. They can open up a whole new range of capabilities for your computer.

For more information contact EL Graphix, PO Box 278, Croydon, Vic 3136.

NOTE: The DOT portion of the program here is similar to a program for the Sorcerer computer which appeared in the US magazine "Creative Computing", January, 1981. The workings of the LINE routine are explained in a short article in "Byte" magazine for October, 1980 called "Vector graphics for Raster Displays".

```
0056          D1              POP DE
0057          7A              LD A,D
0058          B3              OR E
0059          C8              RET Z
005A          C1              POP BC
005B          C3 30 00        JP L3
005F          00


0070 DOT1     AF              XOR A
0071          CB 3B           SRL E
0073          8F              ADC A,A
0074          CB 3A           SRL D
0076          8F              ADC A,A
0077          0E 01           LD C,01
0079          B7              OR A
007A          28 05           JR Z,P1
007C  P2      CB 21           SLA C
007E          3D              DEC A
007F          20 FB           JR NZ P2
0081  P1      67              LD H,A
0082          6B              LD L,E
0083          3E 05           LD A,05
0085  P3      29              ADD HL,HL
0086          3D              DEC A
0087          20 FC           JR NZ,P3
0089          5A              LD E,D
008A          57              LD D,A
008B          19              ADD HL,DE
008C          11 00 BE        LD DE,BE00
008F          19              ADD HL,DE
0090          57              LD D,A
0091          5E              LD E,(HL)
0092          DD 21 C5 00     LD IX,TABLE
0096  P4      DD 7E 00        LD A,(IX+0)
0099          B7              OR A
009A          28 08           JR Z,S1
009C          BB              CP E
009D          28 06           JR Z,S2
009F          14              INC D
00A0          DD 23           INC IX
00A2          18 F2           JR P4
00A4  S1      57              LD D,A
00A5  S2      3A C4 00        LD A,(MODE)
00A8          B7              OR A
00A9          28 04           JR Z,S3
00AB          7A              LD A,D
00AC          B1              OR C
00AD          18 03           JR S4
00AF  S3      79              LD A,C
00B0          2F              CPL
00B1          A2              AND D
00B2  S4      57              LD D,A
00B3          DD 21 C4 00     LD IX,TABLE-1
00B7          14              INC D
00B8          DD 23           INC IX
00BA  S5      15              DEC D
```

listing continued on p 93 ▶

```
00BB        20 FB         JR NZ,S5
00BD        DD 7E 00      LD A,(IX+0)
00C0        77            LD (HL),A
00C1        C9            RET
00C2        00
00C3        00
00C4 MODE   01 (01 TO PLOT , 00 TO ERASE)
00C5 TABLE  20
00C6        AB
00C7        AC
00C8        A0
00C9        AE
00CA        A6
00CB        AA
00CC        A7
00CD        AD
00CE        A9
00CF        A2
00D0        A1
00D1        A4
00D2        A5
00D3        A3
00D4        A8
00D5        00
```

Listing 2: Basic example program

```
00010 CLS
00012 REM DRAW A SCREEN BORDER
00020 L=0
00030 READ A,B,C,D
00032 DATA 0,0,63,0
00034 DATA 63,0,63,31
00036 DATA 63,31,0,31
00038 DATA 0,31,0,0
00040 GOSUB 1000
00050 L=L+1:IF L<4 THEN GOTO 30
00060 REM
00070 REM DISPLAY 100 RANDOM DOTS
00072 D=0
00080 X=INT(RND*63)+1
00090 Y=INT(RND*31)+1
00100 GOSUB 2000
00110 D=D+1:IF D<100 THEN GOTO 80
00120 END
01000 REM SUBROUTINE FOR LINES
01010 REM
01020 POKE 1,B:POKE 2,A
01030 POKE 4,D:POKE 5,C
01040 POKE 196,1
01050 USR(0)
01060 RETURN
02000 REM SUBROUTINE FOR DOTS
02010 POKE 11,Y:POKE 12,X
02020 POKE 196,1
02030 USR(10)
02040 RETURN
```

Attention all Super-80 owners!

A new book, "Software for the Super-80 Computer", will be available during September. Reserve your copy now.

This new book, presently at the printers, was compiled from submissions to the Super-80 Software Competition judged earlier this year. The book has 48 pages, of the same size as this magazaine, featuring 17 Basic programs in printed listing form. They represent a useful range of exercises which will be of use to all Super-80 owners. The price: $5 plus $1 for postage anywhere in Australia.

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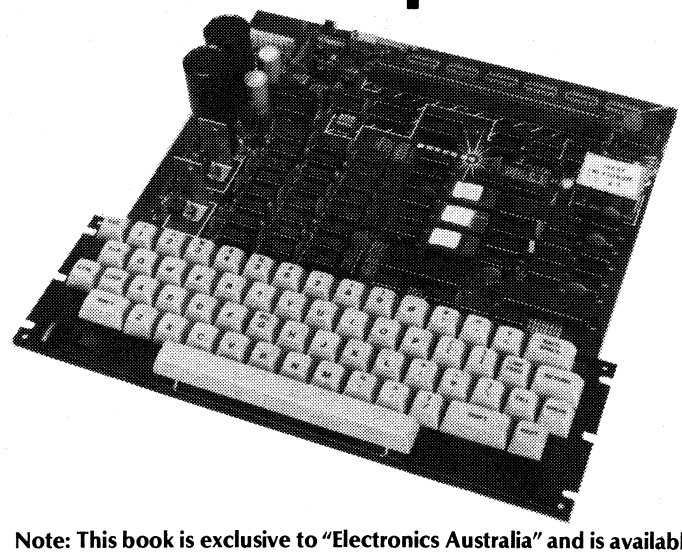

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Circuit modification gives inverse and . . .

Chunky graphics for the Super-80

This modification to the Super-80 circuit adds "chunky" graphics and inverse video characters to the character set of the computer. Although inexpensive it does involve rather extensive modifications to the circuit board. We haven't performed these modifications on our own system, and the circuit and following description is offered "as is".

By REG WORL*

Graphics can add enormous scope to computer applications. Video games such as Space Invaders use graphics symbols for those little alien monsters, bar graph displays depend on high resolution for accuracy, and plotting applications can produce neater, clearer displays with higher resolution graphics.

Another useful feature on VDUs is the inverse video capability. In normal operation using only alphanumeric characters, an inverse video feature enables key words on a page of text to be highlighted by printing them as black characters on a white background.

Both the above features can be added to the Super-80 microprocessor system. This article describes the necessary modifications and explains the way to use these features.

The changes to the Super-80 required for the inverse video feature are simple and easy to understand. However, modifications for the graphics facility are slightly more difficult and require the reader to be very careful when altering the existing Super-80 hardware.

Super-80 video display

To assist the reader in understanding how these modifications will affect the Super-80 system, a brief description of the video display format is necessary.

The video circuitry of the Super-80 refreshes the screen once every 20ms. Throughout each frame interval the microprocessor is halted for 10ms to allow the contents of the video area of memory to be transferred to the video display circuitry. The video circuitry starts to write characters onto the screen 5ms after the start of each frame and complete its operation 10ms later. The screen is blanked during the beginning and end portions of the frame.

The active region of the monitor display is organised to allow 16 rows of text to be shown. Ten scan lines are used for each row of text with the separation between rows obtained by blanking lines numbered 0, 8 and 9. The centre portion of each row of text is divided into 32 character fields each of which consists of eight columns as shown in Fig. 1.

Separation is required between characters and this is produced by blanking columns numbered 0, 6 and 7. When the blanked lines and columns in each character field are disregarded, a 7 x 5 matrix remains in which a dot pattern is used to construct a character. Fig. 1 shows how the letter "A" is constructed using seven lines of dots.

The dot pattern generated on the screen is a function of the text stored in the video RAM and the line being scanned. The dots on any given line are produced for each character field by five parallel bits from the character generator U27 and are serially transmitted by the shift register U23 to the video mixer and modulator. A dot is produced on the screen whenever a logic "1" level appears at the output of the shift register. An inverse video display can be simply obtained by inverting the dot pattern sent from the shift register.

Finally, a brief examination of the video RAM contents is necessary before the Super-80 modifcations can be detailed. The characters to be displayed on the monitor screen are stored in the video RAM as ASCII characters in the binary form 0XXX XXXX. There are 128 ASCII characters but only 64 characters can be displayed by the Super-80. Although bit 6 of these 64 ASCII characters contains either a 0 or 1, this bit together with bit 7 is not required by the character generator. Enough information exists in the remaining low-order bits, D0 to D5, to decode which of the 64 valid characters is required. Since bits 6 and 7 are unused by the character generator they are available to contain the display mode information which will be required by the circuits described below.

The circuit modifications

The additional circuits required for the modifications consist of three sections; the decoding circuit, the inverse video generator, and the graphics generator.

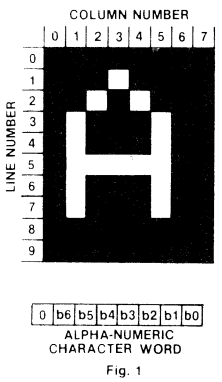

Fig. 1

Characters are built up in an 8×8 matrix.

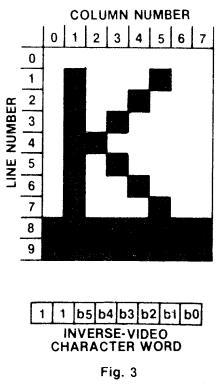

Fig. 3

Inverse characters are black on white.

*67 Conrad St, St Albans, Vic 3021.

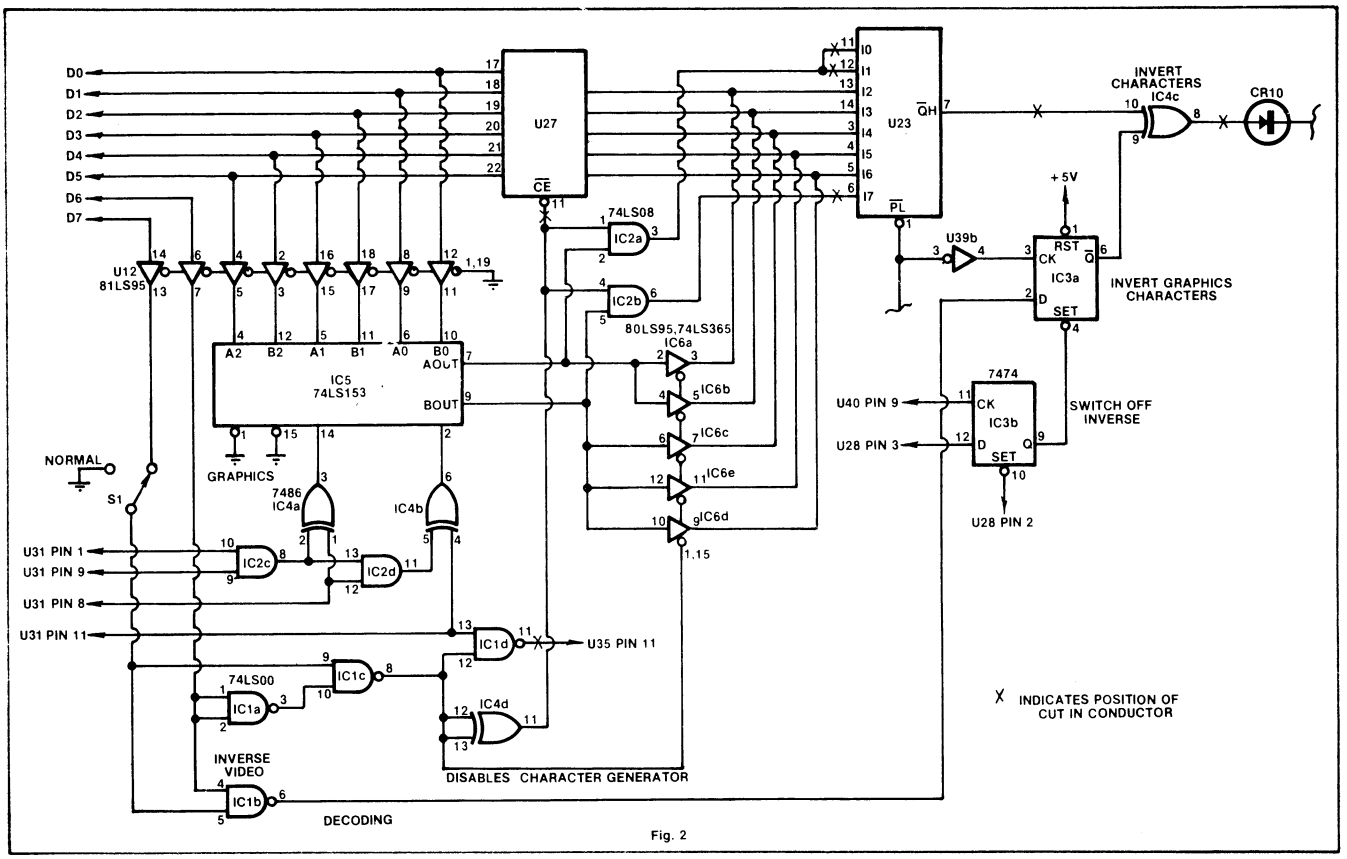

Fig. 2

"X" indicates a track to be cut on the existing board. "IC" prefix indicates a device to be added to Super-80 circuit.

The circuit diagram for the complete modifications is shown in Fig. 2.

The function of the decoding circuit is to determine from the encoded information in bits 6 and 7 of each video character word which of the three possible display modes (normal, inverse video, or graphics) is required to display that character. The selected display mode is then produced by enabling the respective circuits. The codes for the three display modes are given in Table 1 and have been so arranged that all characters written to the screen by the Monitor are displayed in their normal mode. This arrangement allows the user to retain the normal operation of the Super-80 without the need of any software changes.

The decoding circuit consists of four NAND gates and an exclusive OR gate IC4d. Gate IC1b activates the inverse-video circuit when required and gate IC1c controls the graphics circuitry. In the graphics mode the character generator is not required and is hence disabled by gate IC4d. Switch S1 is an option which may also be added although it would generally not be required. Operating this switch would completely disable the inverse video and graphics generator circuits allowing normal operation of the basic Super-80.

The inverse video generator is a simple circuit consisting of four components: the D flipflops IC3a and IC3b, an exclusive OR gate IC4c, and the inverter U39b. When this circuit is selected by the decoder circuit a logic 1 is applied to flipflop IC3a. The input signal is clocked through the flipflop at the beginning of each character field and controls the programmable inverter for the display duration of that character. Flipflop IC3b ensures that the inverse video is switched off after the last character on each row. The display produced by the inverse video generator is shown in Fig. 3.

FUNCTION	BIT 7	BIT 6
NORMAL OPERATION	0	0
NORMAL OPERATION	0	1
GRAPHICS	1	0
INVERSE VIDEO	1	1

TABLE 1

New features are accessed by setting data bits 6 or 7. Software is unchanged.

Note that the two separation lines at the bottom of the character field remain blanked.

To display a character in the inverse video mode, bits 6 and 7 of the character word must contain the code "11". Normal characters can be changed to this mode by "OR-ing" them with 1100 0000 binary or C0 hex before they are placed into the video RAM. Characters stored by the Monitor can be read and replaced by a user program to produce an inverse video display.

Graphics mode

Unlike the normal and inverse video display modes, the graphics mode uses the entire character field by eliminating the previously blanked lines and columns used for row and character separation. The line blanking is controlled by the output of gate U39b. In order to disable the line blanking during a graphics character, U39b is replaced by the NAND gate IC1d which is enabled as required by the decoding circuit. Note that U39b must have both its input and output disconnected from this circuit because it is re-used in the inverse video circuit. The grounded shift register inputs 10, 11 and 17 which cause the blank columns must also be disconnected and connected to the two AND gates IC2a and IC2b. The decoding circuit activates these gates to inhibit column blanking during the graphics mode.

Each graphics character consists of six pixels which together occupy the entire character field. The pixels are numbered as shown in Fig. 4 and are controlled by the respective bits in the character code. Since the dot patterns are now directly controlled by the character codes, the character generator U27 is no longer required and has its output replaced by the Tri-state buffers IC6a to IC6d. The 74LS153 decoder selects which of the character code pairs b0-b1, b2-b3, or b4-b5 is required for each of the 10 lines

in every row. The selected bit pair is then loaded into all eight inputs of the shift register for transmission to the screen. The gates IC2c, 2d, 4a and 4b determine which bit pair is to be selected. Note that these modifications cause the prompt placed at the left of each row by the monitor to be displayed as a graphics character.

With this modification each character cell is divided into two blocks horizontally and three blocks vertically. Since normally 16 lines of 32 characters each are displayed on the screen, the effective resolution in the graphics mode in 64 blocks horizontally by 48 vertically.

When writing programs which will require the graphics facilities, it is best to obtain the codes for the various graphics characters from a table. Table 2 has been provided for this purpose. To use this table construct the required character by selecting the necessary pixel combinations from both parts of the table. The codes given with the selected combinations are then combined to give the character code.

To ensure that these modifications do not interfere with the operation of the microprocessor due to loading or incorrect construction, the data bus is isolated from the additional circuits through the buffer U12. The additional components required for these modifications can all be installed on the existing Super-80 board. The six packages IC1 to IC6 occupy the spare pads at the rear of the microprocessor board whilst IC U12 is added to the S-100 expansion area.

Note, though, that if you elect to do this the S-100 expansion interface cannot be used, as U12 is normally used as a buffer for data to the S-100 expansion connector.

Care required

These modifications require fairly extensive "surgery" on the circuit board of the Super-80. There are nine tracks to be cut and 15 wire connections to the existing computer circuitry, apart from the inter-connection of the new ICs. This is not a project for the beginner.

The positions of the tracks to be cut or are shown by an "X" on the circuit diagram of Fig. 2.

If you are thinking of building a Super-80 but have not yet begun, finding and cutting the required tracks is relatively easy. If your Super-80 is already completed it will be necessary to remove ICs U27 and U23 to gain access to the tracks to be cut. For those who have used IC sockets a simple alternative to cutting tracks is to remove the ICs from their sockets, bend the pins to be disconnected upwards and re-install the ICs. The necessary wire connections can then be made directly to these pins.

It is suggested that 30AWG insulated wire (as used for wire-wrapping) be used for the modified connections. This wire is thin enough to allow several pieces to be twisted together and soldered to a single printed circuit pad. Care must be taken to avoid solder bridges and connections made to wrong locations.

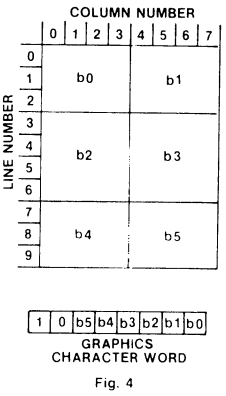

Fig. 4

Graphics are set by six lowest data bits.

Where a cut needs to be made through a conductor it is recommended that two parallel cuts 2mm apart be made across the conductor with a sharp blade. A clean, hot soldering iron is then used to heat the strip between the cuts until it lifts away from the board. This procedure ensures that a reliable cut is obtained. Ensure that enough track remains on each side of the cut to allow a link to be soldered in should the cut ever need to be repaired.

After these modifications have been completed, the Super-80 video display should appear as normal but with the Monitor prompt displayed as a graphics character. These modifications can be tested by using the Monitor "E" command to place various character codes into the video RAM buffer. For a 16k system the monitor selects the memory block from 3E00 hex to 3FFF hex as the video RAM area. Any character code placed in this area will be displayed on the screen in the display mode determined by bits 6 and 7 of the code.

For a 32K Super-80 the video RAM area is normally from 7E00 to 7FFF, while 48K machines place the video RAM at BE00 to BFFF.

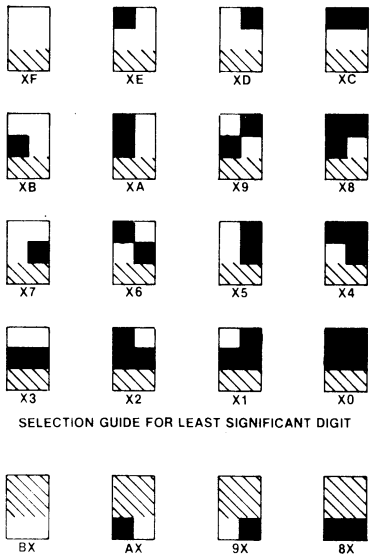

TABLE 2

Table shows each graphics shape produced.

Editorial note

Super-80 owners should be aware of two other graphics add-ons. Dick Smith Electronics offers a board containing an EPROM providing lower case and inverse video characters which is installed in place of the existing character generator, with some modifications to the circuit character clocking circuitry. This board was reviewed in EA, February 1982, p111.

EL Graphix offers a similar board with a choice of three different EPROMs, one providing quarter-character sized graphics blocks and other symbols and another providing one-sixth sized blocks. The third EPROM provides both the character sets. This board was featured in EA, August 1982.

Neither of these two boards require extensive modifications to the Super-80 circuit board. Since they use an EPROM for character storage, however, they are more expensive than the approach described here.

Software for the Super-80

Here Are The Program Headings: Poker Machine simulation, Printing Demonstration, Calendar Calculator, Othello Game, Investment Analysis, Guessing Game, List and Sort, "Fred the Shrink", Simple Maths Drill, Lotto Number Selector, Triangle Solutions, Mortar Attack Game, Caves & Monsters, Amateur Radio Q-code Tutorial, Caravan Park Directory, Super Pokey Game, Tattslotto Selector.

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Microcomputer News

Programmable characters for the Super-80

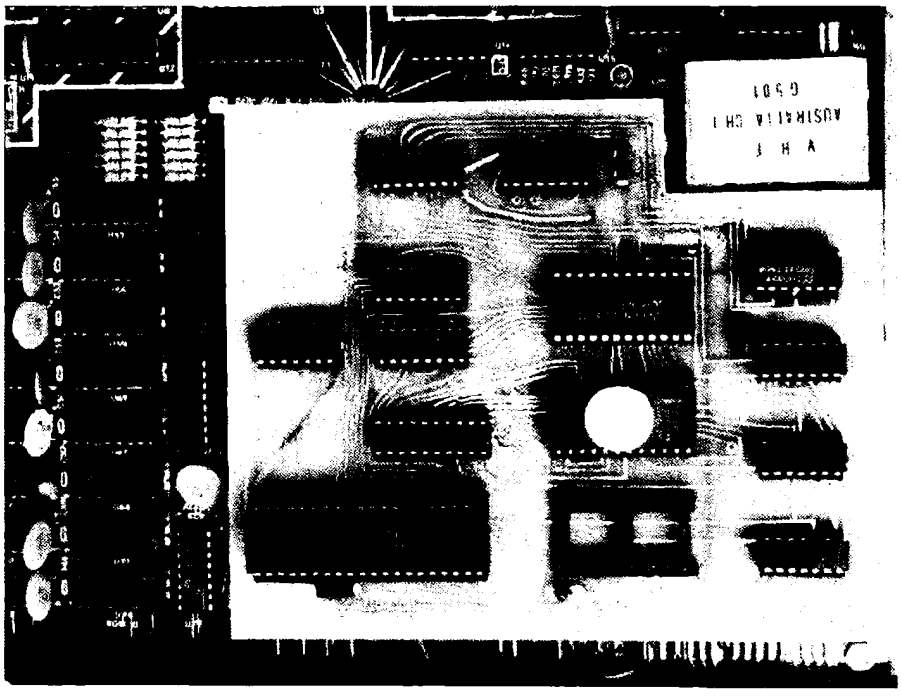
A Queensland firm, the Computer Clinic, now has available a programmable character generator for the Super-80 computer.

The character generator adds an additional 4K of memory to the Super-80 in locations F000 to FFFF and provides standard upper and lower case characters and games graphics in EPROM and sufficient RAM to contain the definitions of an additional 128 characters formed on the standard 8 × 10 grid used by Super-80 characters.

The kit arrives packed in a plastic bag with the PCB itself measuring 121mm × 145mm (less a small rectangular cut-out to clear the Super-80's RF modulator). The add-on board is well made and is double-sided with plated-through holes. All required parts are provided, including sockets for all ICs (a total of 13), a small length of solder and hook-up wire and comprehensive instructions.

The board is connected to the Super-80 by means of three wire-wrap sockets which protrude below the PCB. The pins of these sockets plug into the original socket of the Z80, video shift register and one IC in the timing chain while the chips originally on the Super-80 board are plugged into the new PCB.

The 2513 character generator provided with the Super-80 is also removed and is not used by the programmable character add-on. One wire link is required on the Super-80 board itself.



The 6116 2K × 8 RAM is provided to store programmed character definitions while standard characters are stored in a 2516 EPROM. A socket is provided for a second, optional EPROM which can be installed by the user and used to store pre-programmed character definitions which can be transferred to the RAM character generator as required.

This facility allows the user to create customised character sets and store them permanently with the use of an EPROM programmer. Needless to say, the contents of the additional RAM can also be stored on tape and reloaded for later use with the Super-80 Monitor tape routines.

A 12-page instruction sheet is included with a kit containing assembly instructions for beginners and experienced hobbyists, circuit diagram and component layout and a description of the principles of operation, with sample programs.

Assembly of the kit is straightforward although installation requires some care in ensuring that the pins of the three wire-wrap sockets are aligned and correctly inserted in the vacated sockets of the Super-80 board. This is the only tricky part of the entire operation. The kit fits without difficulty in the standard Super-80 case.

In short, an accessory which should be of interest to all users of the Super-80 computer.

Cost of a complete kit for the programmable character generator is $89.95, while the character set EPROM, PCB and instruction manual are available for $47.50. For further information contact the Computer Clinic, PO Box 68, Aspley, Qld 4034. Phone (07) 269 8573.

Super-80 Baudot teleprinter interface

Want to interface your Super-80 computer to a low-cost teleprinter? Surplus Baudot teleprinters can usually be obtained for about $200 and the interface circuitry is not difficult.

by R. W. PITCHER, VK5AN

There are two types of teleprinter available to the hobbyist. Computer teleprinters such as the well-known Teletype model ASR-33 are most commonly used in business applications. These machines communicate via a 20mA current loop, at a rate of 110 baud (bits per second) and in the ASCII code.

While machines of this sort occasionally appear on the second-hand market, they are not cheap, usually ranging from $600 up depending on condition. This is rather a lot to pay to communicate with a computer costing around $400!

In contrast with these computer-type teleprinters, large supplies of the older Baudot-type teleprinters are currently available at much lower cost from companies dealing in surplus equipment. Prices for the Teletype model 15 teleprinter, for example, are around $200.

While the price is attractive compared with the more modern ASCII teleprinters, these machines are not directly compatible with computer systems, chiefly because they use a 5-bit Baudot code rather than the 7-bit ASCII code. While the code translation can be performed by software, not all ASCII characters have a Baudot equivalent.

The original program was written to make extra use of the Baudot printer I use for radioteletype, and so prints characters out at 45.45 baud. Machines currently available run at around 50 to 75 baud unless they have been converted. To change the character printing speed it is only necessary to change the byte at location 30DA hex in the listing given here. For 50 baud operation, insert 13 (hex) and for 75 baud the figure should be 0B (hex).

These figures should be considered as a guide only, as they have not been tried with a printer but were arrived at by checking the length of the mark and space pulses at the output port.

Newer teletypes run around 110 baud, with 11 bits per character, to give an effective printing speed of around 10 characters per second. In contrast Baudot machines running at 50 baud and using 7.5 bits per character provide a maximum printing speed of around 6.5 characters per second.

In fact, because of the necessity to send special "letters" and "figures" characters interspersed with actual printing characters, the maximum rate of a 50 baud Baudot teleprinter is in practice around five characters per second.

The limitations in the character set will only be of concern when printing Basic programs. For assembly language or hex listings the range is quite adequate.

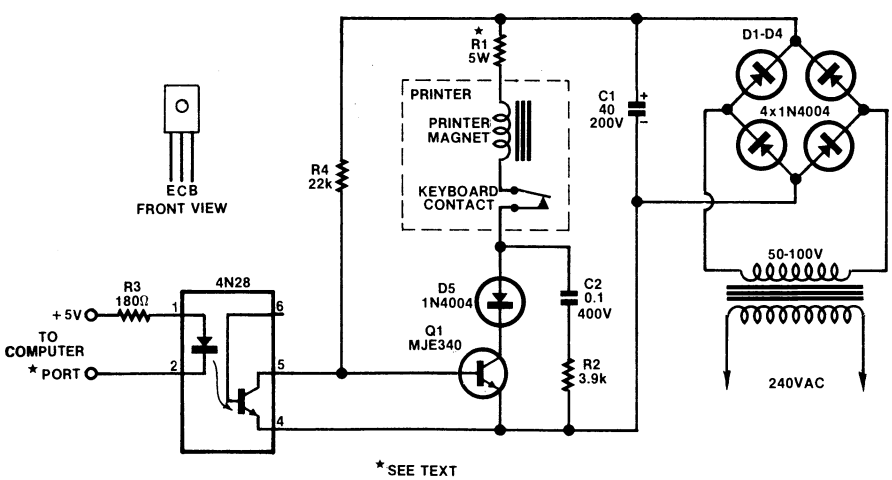


Fig. 1 LOOP SUPPLY AND COMPUTER INTERFACE

To use a teleprinter as a dedicated computer peripheral a loop supply is required. Optoisolators are used for safety and to avoid ground loops.

The program

The program uses bit 4 of output port F0 of the Super 80. A connection can be found on the underside of the board, running from pin 12 of U18. On the area marked "port" on the board, near the cassette relay, this connection is the fourth hole counting from the end marked "1".

The required software is not straightforward. The Baudot code is best considered as a 6-bit code in which the normal sixth bit is sent only when it changes value. It is sent in encoded form as a special "letters" and "figures" character shift.

To initialise the printer routine, call 3500H (CD 00 35) in the program supplying the character to be printed, or enter G3500 before using. The character to be printed is passed in the C register, and is entered at 3508H (CD 08 35). All registers are preserved by the routine.

Figures and letters shifts are inserted automatically as required, and a line feed is inserted following every carriage return. A "tab" function is included, but any other control characters are ignored, since there are no Baudot equivalents.

Lower case ASCII characters are printed as their upper case equivalent, since there are no lower case letters on

the Baudot machine. Items on the look-up table given as C0H are those with no Baudot equivalent and could be changed to print any desired character.

For instance, if you wish square brackets ([ ]) to print as normal brackets, then change location 3121H to E4H and 3124H to DEH. Any coding left as C0H sends a blank to the machine and so prints nothing.

While a character is being sent to the printer the VDU is blanked to maintain timing accuracy, so the screen is only active while the printer routine is waiting for a character. Therefore the VDU will flicker at a rate depending on the rate at which characters are fed in. If the rate is fast enough the screen appears to remain blank.

Interface circuitry

The printer will require a loop supply. If it is to be used only for program dumping, then the circuit of Fig. 1 is required. It has been found that most machines operate best with a minimum loop supply of about 70 volts, making input waveform distortion and timing errors less critical. The value of R1 is adjusted for the manufacturer's recommended loop current on "mark", (usually between 40 and 50 mA).

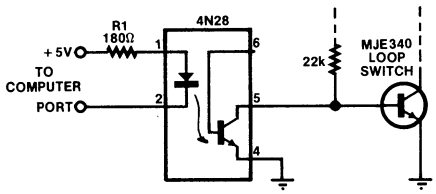


FIG. 2 INTERFACE TO SUIT RTTY TERMINAL UNIT

Circuit for use with an RTTY teleprinter.

An alternative circuit is given in Fig. 2 for those who already have an operating machine used for RTTY. In both cases, optoisolators are used to remove the risk of earth loop problems and to ensure complete isolation between the computer and any circuitry operating at high voltage.

To use the program for Basic LPRINT or LLIST, insert the following bytes from 0000H onwards:

0000H 55 4F CD 08 35 41 CD 19 C0 78 C9. Then G3500, return to Basic warm-start (GD003) and type LLIST or RUN for LPRINT. To disable the printer, change the byte at 0000H to anything but 55H. The monitor uses this routine to find out if a printer program is available and, if so, where it is located in memory.

The program has proved its worth since I can now keep a permanant record of my programs without having to copy them from the screen with its attendant risk of errors. The print out of the program accompanying this article was obtained using the same program.

Finding a teleprinter

The following companies handle second-hand computer equipment in Sydney; The Computer Exchange, 5/8 Pacific Parade, Dee Why, NSW, 2099 (02) 98 8111; CQ Electronics, Shop 9, 30 Campbell St, Blacktown, NSW (02) 698 8079.

Note that the availability of equipment is variable and depends on companies and government departments disposing of surplus equipment. It is not simply a matter of purchasing "off the shelf".

In Sydney, "The Trading Post" weekly paper often carries advertisements from individuals wishing to dispose of surplus equipment. It is a good place to start looking for a teleprinter.

The notice boards at electronics stores and computer clubs also occasionally display "FOR SALE" bulletins for teleprinters. You can also, of course, go "straight to the horse's mouth" as it were, and attend government auctions.

```
                ,45.45 BAUD PRINTER ROUTINE FOR SUPER 80
                ,COPYRIGHT 1983, R.W.PITCHER VK5AN
                ,
3500                    ORG     3500H

3500 F5         STRT    PUSH    AF          ,SAVE REGISTERS
3501 E5                 PUSH    HL
3502 C5                 PUSH    BC
3503 D5                 PUSH    DE

3504 3EFB               LD      A,0FBH
3506 D3F0               OUT     (0F0H),A ,TURN VDU OFF

3508 79                 LD      A,C
3509 E67F               AND     7FH         ,SET BIT 7 TO ZERO

350B FE60               CP      60H
350D 3802               JR      C,CR
350F D620               SUB     20H         ,SETS LWR TO UPPER CASE

                ,CR/LF ROUTINE

3511 FE0D       CR      CP      0DH
3513 2011               JR      NZ,TCOM
3515 3E00               LD      A,00H
3517 320D00             LD      (000DH),A,CHAR COUNT SET TO Z
351A 0660               LD      B,60H       ,LOC ON LOOKUP TBLE
351C CD9835             CALL    BOUT
351F 0661               LD      B,61H
3521 CD9835             CALL    BOUT
3524 1869               JR      ENDT
3526 FE09       TCOM    CP      09H
3528 2843               JR      Z,TAB
352A FE20               CP      20H
352C 0620               LD      B,20H
352E 2838               JR      Z,COUT

                ,BYPASS FOR CONTROL CHARACTER

3530 385D               JR      C,ENDT

3532 F5                 PUSH    AF          ,SAVE CHARACTER

                ,IF FIGS OR PUNCTUATION THEN JUMP

3533 FE41               CP      41H
3535 3817               JR      C,FIGS
3537 FE5B               CP      5BH
3539 3013               JR      NC,FIGS

                ,IF LAST CHAR FIGS,SEND LTRS FIRST

353B 3A0C00             LD      A,(000CH),CHAR STATUS
353E FE00               CP      00H         ,LAST CHAR LTRS?
3540 281D               JR      Z,RESC
3542 3E00               LD      A,00H
3544 320C00             LD      (000CH),A,CHAR STATUS TO LTRS
3547 0662               LD      B,62H


3549 CD9835             CALL    BOUT
354C 1811               JR      RESC

                ,IF LAST CHAR LTRS,SEND FIGS FIRST

354E 3A0C00     FIGS    LD      A,(000CH)
3551 FE00               CP      00H         ,LAST CHAR LTRS?
3553 200A               JR      NZ,RESC
3555 3EFF               LD      A,0FFH
3557 320C00             LD      (000CH),A,CHAR STATUS TO FIGS
355A 0663               LD      B,63H       ,LOC ON LOOK UP TBLE
355C CD9835             CALL    BOUT

                ,INC CHAR COUNT FOR PRINTING CHARS ONLY

355F 3A0D00     RESC    LD      A,(000DH)
3562 3C                 INC     A
3563 320D00             LD      (000DH),A,INC CHAR COUNT

                ,JUMP TO BAUDOT CONVERSION

3566 F1                 POP     AF          ,GET CHAR BACK
3567 47                 LD      B,A
3568 CD9835     COUT    CALL    BOUT        ,BAUDOT OUT
356B 1822               JR      ENDT

                ,TAB ROUTINE

356D 3A0D00     TAB     LD      A,(000DH),CHAR COUNT
3570 F5                 PUSH    AF          ,SAVE COUNT
3571 C602               ADD     A,02H
3573 E607               AND     07H
3575 D602               SUB     02H
3577 0620               LD      B,20H
3579 1E00               LD      E,00H
357B D5         TC      PUSH    DE
357C C5                 PUSH    BC
357D F5                 PUSH    AF
357E CD9835             CALL    BOUT
3581 F1                 POP     AF
3582 C1                 POP     BC
```

```
3583 D1              POP     DE
3584 1C              INC     E          ,COUNT SPACES
3585 3C              INC     A
3586 FE08            CP      08H
3588 20F1            JR      NZ,TC      ,JP TO TAB COUNT
358A F1              POP     AF         ,GET BACK COUNT
358B 83              ADD     A,E
358C 320D00          LD      (000DH),A,UPDATE CHAR COUNT
358F 3EFF      ENDT  LD      A,0FFH
3591 D3F0            OUT     (0F0H),A ,TURN VDU ON

               ,BACK TO MAIN PROGRAMME

3593 D1              POP     DE         ,RESTORE REGISTERS
3594 C1              POP     BC
3595 E1              POP     HL


3596 F1              POP     AF
3597 C9              RET

               ,GET BAUDOT EQU FROM LOOK-UP TABLE

3598 219E35    BOUT  LD      HL,LKUP-20H
359B 1600            LD      D,00H
359D 58              LD      E,B
359E 19              ADD     HL,DE      ,LOC ON LOOKUP TBLE
359F 56              LD      D,(HL)

               ,GENERATE 8 PULSES DET BY BITS IN D REG

35A0 0608            LD      B,08H      ,NUMBER OF BITS
35A2 C5        BITS  PUSH    BC         ,SAVE BIT COUNT
35A3 CB42            BIT     0,D
35A5 2004            JR      NZ,XX
35A7 3EEB            LD      A,0EBH     ,SET O/P PORT LOW
35A9 1802            JR      YY
35AB 3EFB      XX    LD      A,0FBH     ,SET O/P PORT HIGH
35AD D3F0      YY    OUT     (0F0H),A ,SET PORT

               ,LENGTH OF PULSE FOR BAUDOT SPEED

35AF 3E86            LD      A,86H      ,DELAY TO SET SPEED
35B1 0616      PD    LD      B,16H
35B3 10FE            DJNZ    $-0        ,JUMP BACK TO YOURSELF
35B5 3D              DEC     A
35B6 20F9            JR      NZ,PD

35B8 C1              POP     BC         ,RESTORE BIT COUNT
35B9 CB3A            SRL     D          ,MOVE IN NEXT BIT
35BB 10E5            DJNZ    BITS       ,KEEP GOING FOR 8 BITS
35BD C9              RET

               ,LOOK-UP TABLE

35BE C8C0      LKUP  DEFW    0C0C8H     ,(SP)
35C0 CAC0            DEFW    0C0CAH     ,' £
35C2 F4DA            DEFW    0DAF4H     ,$ %
35C4 C0CA            DEFW    0CAC0H     ,$ '
35C6 DEE4            DEFW    0E4DEH     ,( )
35C8 D2E2            DEFW    0E2D2H     ,* +
35CA D8C6            DEFW    0C6D8H     ,, -
35CC F8FA            DEFW    0FAF8H     ,. /
35CE ECEE            DEFW    0EEECH     ,0 1
35D0 E6C2            DEFW    0C2E6H     ,2 3
35D2 D4E0            DEFW    0E0D4H     ,4 5
35D4 EACE            DEFW    0CEEAH     ,6 7
35D6 CCF0            DEFW    0F0CCH     ,8 9
35D8 DCDC            DEFW    0DCDCH     ,: :
35DA E4FC            DEFW    0FCE4H     ,( =
35DC DEF2            DEFW    0F2DEH     ,) ?
35DE C0C6            DEFW    0C6C0H     ,  A
35E0 F2DC            DEFW    0DCF2H     ,B C
35E2 D2C2            DEFW    0C2D2H     ,D E
35E4 DAF4            DEFW    0F4DAH     ,F G

35E6 E8CC            DEFW    0CCE8H     ,H I
35E8 D6DE            DEFW    0DED6H     ,J K
35EA E4F8            DEFW    0F8E4H     ,L M
35EC D8F0            DEFW    0F0D8H     ,N O
35EE ECEE            DEFW    0EEECH     ,P Q
35F0 D4CA            DEFW    0CAD4H     ,R S
35F2 E0CE            DEFW    0CEE0H     ,T U
35F4 FCE6            DEFW    0E6FCH     ,V W
35F6 FAEA            DEFW    0EAFAH     ,X Y
35F8 E2C0            DEFW    0C0E2H     ,Z (
35FA C0C0            DEFW    0C0C0H     ,  )
35FC C0C0            DEFW    0C0C0H     ,: (DEL)
35FE D0C4            DEFW    0C4D0H     ,(CR,LF)
3600 FEF6            DEFW    0F6FEH     ,(LTRS)(FIGS)
3602                 END
```

```
STRT    3500
CR      3511
TCOM    3526
FIGS    354E
RESC    355F
COUT    3568
TAB     356D
TC      357B
ENDT    359F
BOUT    3598
BITS    35A2
XX      35AB
YY      35AD
PD      35B1
LKUP    35BE
```

SUPER-80 USERS . . .

Announcing the EI Graphix Lower Case/Graphics Kit 4!

Yes, after a year of waiting, this fabulous Kit 4 is now available.
As well as giving you Upper/Lower case characters, this Kit gives you a vast array of extra functions and useful subroutines. Check the following for an impressive list ...

- 9 extra monitor commands!
- 300, 600 and 1200 baud tape operation!
- Upper/Lower case alphanumerics! (The full 96 character ASCII set!)
- Can fill any video page in Ram with any ASCII character! (Great for wiping or filling blocks of memory)
- Inbuilt Centronics and RS232 printer routines!
- If you are using a non-standard printer, you can still insert your customised routine into Ram!
- All these printer routines can be software selected!
- RS232 receive routine also in Rom . . . connect a modem!
- Full range of "Chunky" Graphics; even occupying the same ASCII addresses as Tandy's TRS80 and Dick's System 80!
- Also directly compatible with the "Gluyas" Levels 2+3 Basics!
- A total of 160 versatile Graphics characters!
- Inbuilt Line/Dot routines, easily driven via variables from Basic! (Plot lines, draw curves, etc ...)
- Inbuilt Bar Graph routine, also driven via variables!
- Bar Graph resolution of 160 lines. (32 verticle bars available!)
- VDU Dump routine. Draw a picture and dump it into Ram for later use or save it on tape!
- VDU Shift/Fill/Wipe/Rotate routines ... even scrolls Diagonally!

• All this for only ... $55.50

If you have Kit 1, 2 or 3, these can be upgraded to Kit 4 for only $25.00.
Even the DSE "De luxe" kit can be converted to this versatile kit for only $27.50.
Note: This kit was designed primarily for a Super-80 fitted with 48K and Basic on Rom. Some of these routines will not work on a lesser beast!
The prices quoted are current as from May '83 and include post and packing charges. Interstate orders posted airmail at no extra charge.

Send your cheque to ...

EI Graphix

PO Box 278, Croydon 3136, Victoria, Australia
Phone enquiries (03) 725 9842 (after 7pm please!)

More graphics for the Super 80

El Graphix of Victoria has added a new product to its range of a character generator add-ons for the Super-80 computer.

The El Graphix Kit 4 consists of two EPROMs, one to replace whatever character generator chip is currently in use and the other to replace the EPROM containing the Super-80 monitor. In addition to 255 ASCII and graphics characters, nine new monitor commands are provided to enable full use of the new graphics capabilities of the Super-80.

Kit 4 supports lower case ASCII characters with a choice of keyboard formats. When the Super-80 is first switched on the keyboard produces uppercase characters as usual. Pressing the SHIFT key however gives access to lowercase characters. Alternatively pressing SHIFT and LOCK simultaneously will put the keyboard into lowercase mode, with uppercase characters produced with the SHIFT key as on a typewriter.

In addition to upper and lowercase characters the "Chunky graphics" of the El Graphix Kit 2 are provided along with most of the Kit 1 graphics set and new symbols for bar graphics, fractions, Greek letters and some "Invaders" type figures. The chunky graphics use the same ASCII codes as those of the TRS-80 Model 1 and the System-80.

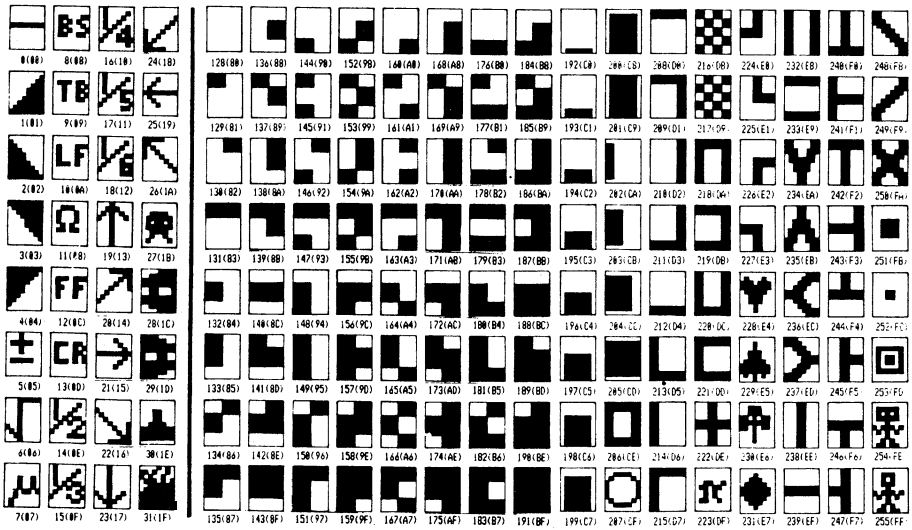
The new Monitor software should also be a major selling point of the kit. Two printer drivers are provided in the EPROM, one for a Centronics parallel printer and the other for an RS232C serial printer.

Also included in the new Monitor are nine new monitor commands to allow easy selection of 300, 600, or 1200 baud cassette operation, VDU display paging and interfaces to Basic. New commands allow plotting of lines and points by calling built-in machine language routines from Basic program, and there are also screen shift, wipe and fill routine which enable the screen to be scrolled left or right or even diagonally.

Earlier El Graphix character generators can also be upgraded with the new kit at a cost of $25.00, while the full kit for a previously unmodified machine costs $55.00. For further information contact El Graphix, PO Box 278, Croydon, Vic. 3136. Phone (03) 725 9842 (after 7 pm).

El Graphix Kit 4 Graphics Characters

With corresponding ASCII code in Decimal and (Hex)



Super-80 software and tutorials

Bemak Pty Ltd is a Canberra based supplier of software for the Super-80 computer, with a product range which includes games, programmer's utilities and a word processing program. The company is currently investigating the extent of interest in learning Z80 assembly language on the Super-80. If sufficient interest is shown Bemak plans to run a correspondence course next year to cover the ins and outs of Z80 programming.

In addition to software and the planned correspondence course Bemak has available information on overhauling and servicing the Super-80, which it will make available to customers free of charge.

For further information on software or for details of the proposed programming course contact Bemak Pty Ltd, PO Box 218, Belconnen, ACT, 2616.

Super-80 Users . . .

Announcing the El Graphix "XRAM" memory card.

This versatile and useful addition to the range of El Graphix products gives the user something that has been needed since the Super-80 was first produced.

Battery-Backed Memory!!

Yes, the El Graphix "XRAM" card gives the user 16K of non-volatile memory to store your most used programs or data in for all time.

The "XRAM" card has the following features . . .

* Contains up to 16K of extra memory.
* Uses industry standard 6116 CMOS static Rams.
* Resides in memory from C000 to FFFF.
* Block shift the existing monitor into XRAM, add your own routines and run it as your own personalised monitor.
* Save your own favourite program for instant running.
* Does not use S100 bus connector.
* Can be externally write protected.
* Double sided, plated through printed circuit board.
* Integral power-down circuit deselects XRAM within 15ms of loss of mains and protects XRAM contents.
* No modifications to the Super-80 PCB necessary to install XRAM card.
* Does not affect normal operation of computer.
* Draws microamps in standby mode.
* Backup battery is being charged whenever computer is running.
* Control circuitry provides for a second XRAM to be fitted for up to 32K storage.
* XRAM can also accept standard 2716/2516 Eproms instead.

Just think of what you could do, with 64K of Ram to play with.

Due to the several configurations in which the XRAM can be constructed, it will not be available as a complete Kit.
It will be supplied rather as a bare printed circuit board with full instructions for the construction, installation and use of the XRAM.
This allows you to construct the version you require at the lowest possible price to you.
And the price of the XRAM card with complete instructions?
Only . . . . . **$30.00** (includes postage/packing).

Don't forget the El Graphix Lower case/Graphics Kit 4.

Extensive graphics routines, 160 Graphics character, full 96 characters ASCII set, 13 extra monitor commands with Printer driver routines built into the most popular Graphics Kit on the market today.

Still available at **$55.50** for the full Kit or
To upgrade El Graphix Kits 1, 2 or 3 . . . . . **$25.00**
To upgrade Dicks "deluxe" Kit . . **$27.50**
To upgrade the Computer Clinic Kit **$27.50**

All prices include packing and postage charges. Interstate orders posted airmail at no extra cost. N.Z. customers please add $2.00

Send your cheque or money order to . . . . . El Graphix

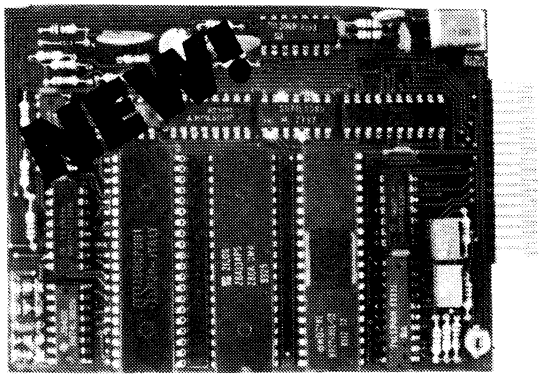
P.O. Box 278 Croydon 3136 Victoria Australia
Phone enquiries (03) 725 9842 (after 7 pm please)
****** El Graphix still supports the Super-80. ******

(Kit 4 users . . . Checkout Mastersofts ELDRAW program . . . a must for serious graphics . . . see Marketplace of this issue)

MICROCOMPUTER ENGINEERING

PO Box 258 Haymarket 2001, NSW
Phone (02) 660 2924

UNIVERSAL FLOPPY DISK CONTROLLER CARD



The UFDC has been implemented for Super-80 and System-80 computers using simple DOS. CP/M 2.2 has been implemented for Super-80 computer and supports 80/40 trk DSDD Disk Drives. Reads Telcon 388K Televideo 802 342K, DEC VT-180x 340K, IBM PC, Osborne 90K, 8" IBM 3740 formats and can be expanded. With VDUEB installed emulates ADM-31 terminal.

For more information on how to install UFDC on YOUR System, contact M.C.E.

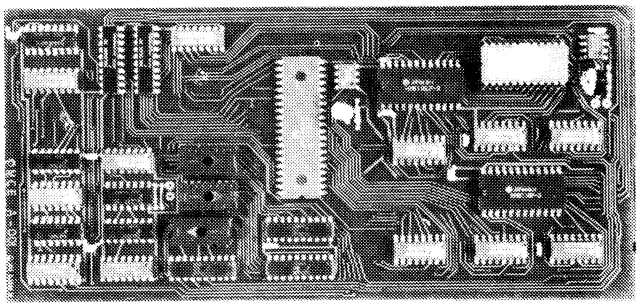
DO NOT THROW AWAY YOUR OLD Z80 BASED COMPUTER

● UFDC is designed to be "piggy backed" to Z80 socket ● suits ANY Z80 CPU based computers ● can support up to four drives in any combination of 5¼, 8 inch, SSSD or DSDD ● design around WD2793 floppy disk controller (on chip PLL data separator, write precompensation logic and programmable clock rate) ● UFDC has got Z80 DMA chip ● matches any speed of CPU and can be used for mem-to-mem transfers ● you can adjust Head Load time and Write Precompensation to your disk drive requirements ● plug compatible with Shugart 400/450 drives ● no interrupt or wait states for programming simplicity ● simple assignment of the UFDC registers to any one of 16 banks of your computer's I/O ports ● full software support ● sample of the CP/M 2.2 BIOS ● dimension 120x90mm

PRICES $299

assembled and tested
$4 P&P

SUPER-80 VDU EXPANSION BOARD



The VDUEB converts your Super-80 into a professional computer. The screen format is 80 x 25 and the raster dimensions are software programmable to 64 x 16, 32 x 16 or any other formats ● full lower and upper ASCII character set ● 32K ROM based graphics char's ● 128 fully programmable character set ● inverse character mode ● 560 x 225 dot addressable graphics ● sound routine for BELL and music ● new Monitor EPROM supplied with 1200 baud cassette interface ● fully compatible with existing BASIC and software.

PRICES $229 Assembled and tested
$169 Kit form
$99 PCB and EPROMS
$4.50 Manual
$4 P&P

SUPER-80 VDUEB SOFTWARE LIST

- CP/M 2.2 Super-80* $170
- Super-80 DOS $10
- Edit-80 ..... $20
- Debug-80 ..... $15
- EXMON monitor $8
- Z80 Disassembler $25
- Extended Monitor & Disassem $10
- Microbee Tape Loader $5
- Sprite Programmer $8
- Dot & line graph driver $20
- PACKMEN $20
- Super-80 Invaders $20
- Martian Attack $8
- Othello $10
- Adventure (two prog) ..... $
- Wordprocessors (three prog) ..... $10-$40
- Graphics tool kit $15
- Super-80 Chess $20
- Eng Progr for struc design $10
- UFDC CP/M BIOS*, only $70

Source code of all programs supplied.* **ADD $1.00 for P&P.

For more information regarding FREE software and CP/M software please contact MCE or Super-80/VDUEB USER CLUB at 15 Bray Court, North Rocks 2151, NSW. Phone (02) 871 8394.

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- PSA-2B 60VA +5V/6A, −5V/0.5A, +12V/2A, −12V/0.5A $139.00
- Controller-to-Drive Cable (supports two drives) $39.95
- Disk Drive Power Supply connectors 8, 5¼ inch $4.95
- WD2793 disk controller $76.95
- Z80A DMA $15.95

ADD $3 P&P

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Mail order: MCE, PO Box 258 Haymarket 2001, NSW. Phone order: (02) 660 2924.