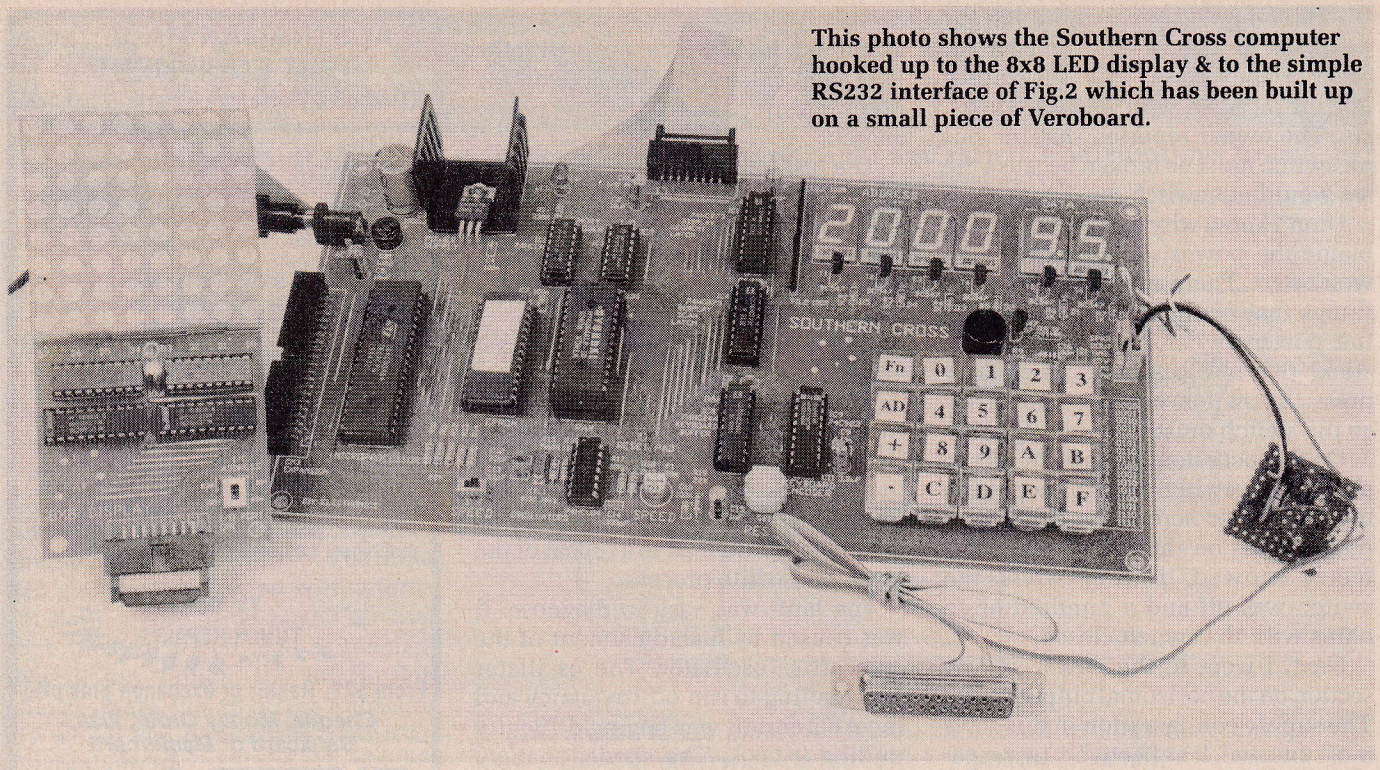


This photo shows the Southern Cross computer hooked up to the 8x8 LED display & to the simple RS232 interface of Fig.2 which has been built up on a small piece of Veroboard.

Peripherals for the Southern Cross Z80 computer

This month, we present a number of peripherals for the Southern Cross Z80 computer which was featured in the August 1993 issue of SILICON CHIP. We look at ways to connect the Southern Cross to a personal computer to make it easy to write programs, introduce an 8x8 LED Matrix display board which can produce interesting visual messages & describe an EPROM emulator.

By PETER CROWCROFT & CRAIG JONES

While it is desirable to learn how to enter machine code using the hex keypad of the Southern Cross computer, it is much easier to write these programs on a personal computer and then download them for testing.

The fast way to write such programs is to use a text editor on a PC and then use a Z80 assembler to produce a file suitable for downloading to the Southern Cross. A public domain Z80 assembler, Z8T, is supplied with the Southern Cross kit and produces what is called an Intel hex output file. This is an ASCII file with a checksum every 16 data bytes and other information to help ensure that the transmission can be checked by software at the receiving system.

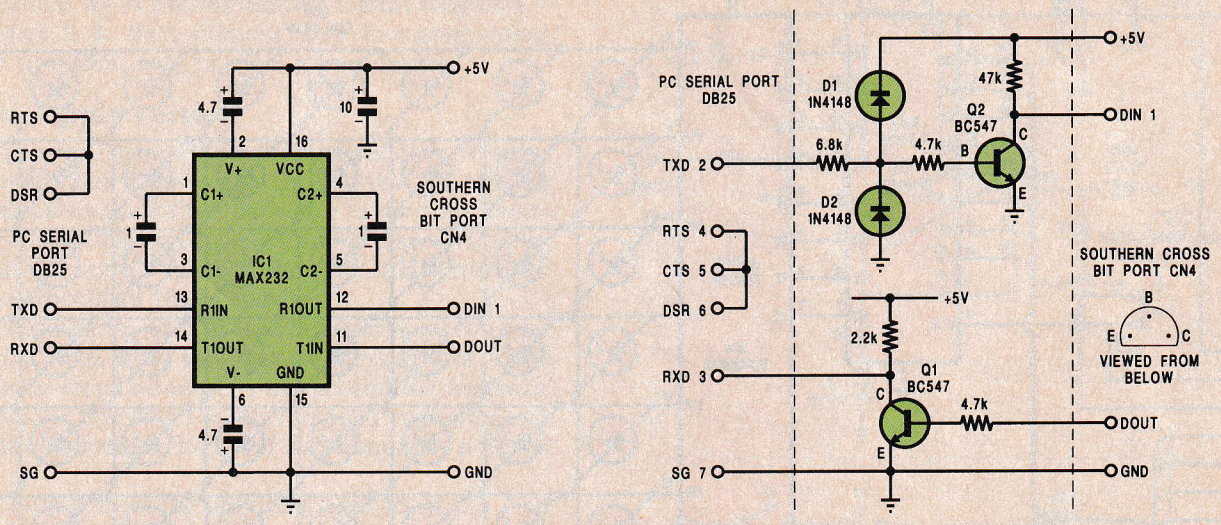


Fig.1 at left is the ideal circuit for an RS-232 serial interface as the MAX232 IC is designed for this job. However, most RS-232 applications for an RS-232 interface for the Southern Cross will be satisfied by the transistor circuit of Fig.2 (right).

There are basically two ways to connect the Southern Cross to a PC. First, you can connect it to the serial or parallel port of a PC and download the assembled program from the PC into the RAM space (2000H to 3FFFH). Second, you can use an EPROM emulator. In this case, the assembled program is moved to the emulated ROM space (2000H to 3FFFH.) The Monitor uses almost 4K of ROM so there is 4K free for you to use for your own programs.

Serial downloading

Assuming that you have written a program on your PC and have created an Intel hex file using the Z80 assembler, you will then want to download the hex file to the start of RAM (2000H) on the Southern Cross.

By the way, making the jump from a raw novice to being able to write such programs will probably take several weeks at least, assuming that you can devote plenty of time to your Southern Cross, once you have it up and running. We certainly do not make light of this achievement but we feel sure that most people who purchase the Southern Cross will do it.

The serial port on the Southern Cross is on connector CN4. Unfortunately, this cannot be connected directly to the PC serial port, since it operates on 12V while the Southern Cross operates at 5V. An interface board is required and two such interface circuits are shown in Figs. 1 & 2 – see above.

For reliable serial communications, the guaranteed way is shown in Fig.1, using a MAX232 IC. A much simpler circuit is shown in Fig.2. This should be adequate in most cases but cannot be guaranteed for all situations. It can be assembled onto a small piece of Veroboard. Three wires are required between the PC and the interface board, while four wires extend from the interface to the Southern Cross.

To download the file we must do two things: prepare the Southern Cross to receive the file and then get the PC to send the file. On the Southern Cross go to the address you want to put the file and press Function 1. The Southern Cross is now in 'ready to receive Intel Hex file' mode. To send the file from the PC you should first make sure that its serial port is not already being used by a mouse or other hardware item. Next you must set up the port with the DOS command:

MODE COM1: 4800,N,8,1

This sets the PC's port to 4800 baud to match that for the Southern Cross which is set to 4800 baud in the Monitor. Then enter the DOS command

COPY filename.hex com1:

This starts the file transfer. Alternatively, you could use a communications program, if you have one.

When the Intel hex file is fed to the Southern Cross, the Monitor checks that it has been received correctly and converts it into machine code in the correct memory locations. If the transfer was successful a 'C' is displayed. Press any key to return to the Monitor. The downloaded file should be in RAM at the address (usually 2000H) it was sent to. If an error has occurred an 'E' will be displayed. If it did not come down at all, then nothing will be displayed.

The baud rate for file transfer may be changed in software as outlined in the user manual supplied with the Southern Cross.

8 x 8 LED display

This add-on board allows you make your own moving message displays. One or two display boards may be

Parts List for the 8x8 LED Display

1 PC board, 108 x 60mm
1 CMD-58813 8x8 LED display
2 74HC273 octal D flipflops (IC1, IC2)
1 UDN2981 cathode driver (IC3)
1 ULN2803A anode driver (IC4)
1 DPDT slide switch (S1)
1 10µF electrolytic capacitor
2 18-pin IC sockets
2 20-pin IC sockets
1 16-pin box header connector
1 16-pin IDC socket connector
1 500mm length of 16-strand flat cable

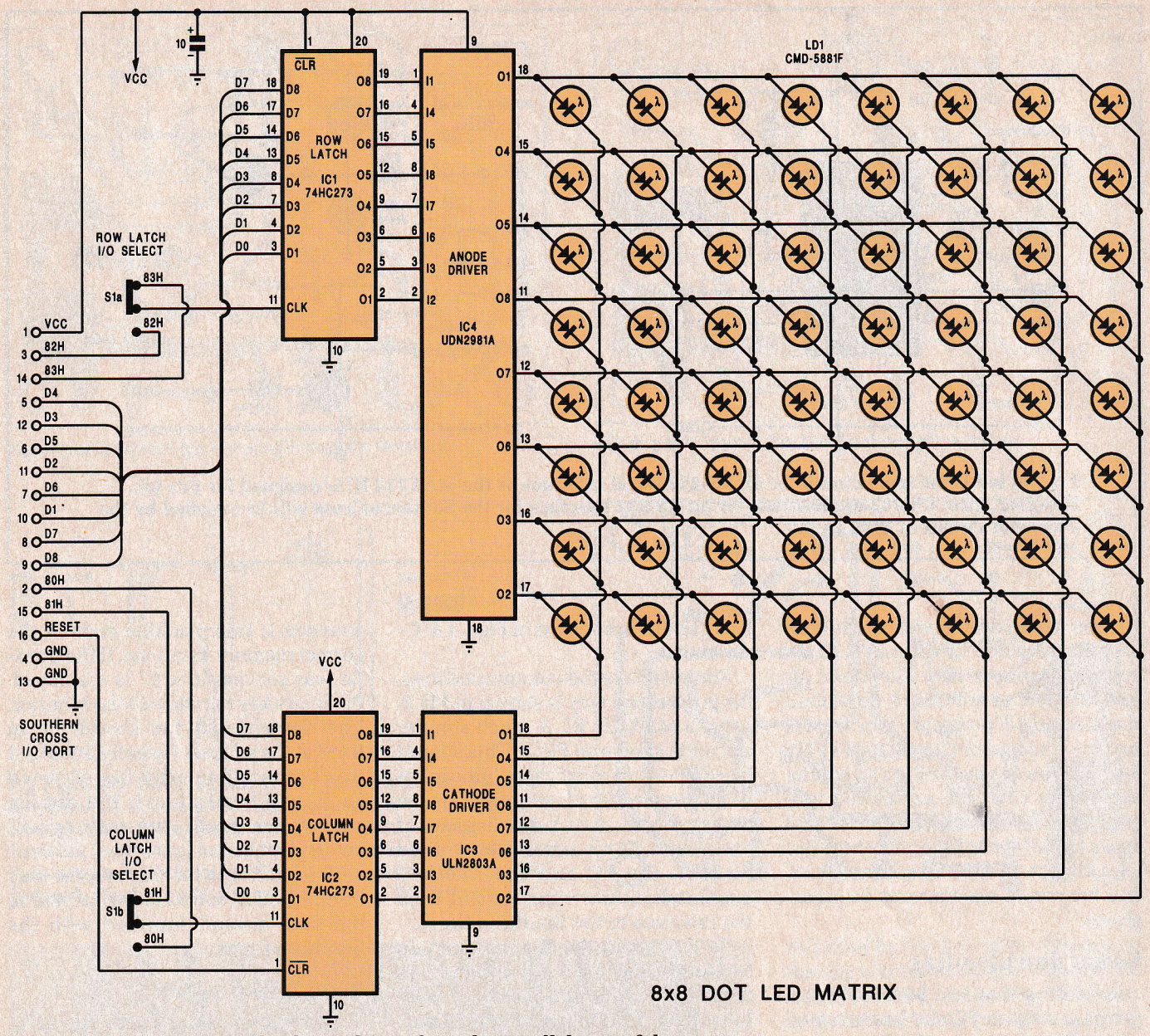


Fig.3: the 8x8 LED matrix display is driven from the parallel port of the Southern Cross computer via two Tri-state latch ICs (IC1 & IC2) & two buffer ICs (IC3 & IC4). Switch S1 switches the latches between two sets of port addresses, thus allowing two LED matrix displays to be used together.

used and they are connected to connector CN1 of the Southern Cross. Each board is designed so that the display section may be cut away from the circuit section and connected by flat ribbon cable.

The circuit of the 8x8 LED Matrix display is shown in Fig.3. It is connected to the parallel I/O port of the Southern Cross via connector CN1. Data lines D1-D8 are used to drive two 74HC273 octal D-flipflops, each used as 8-bit latches (IC1, IC2). The eight outputs of the two latches are buffered by the UDN2981A anode driver (IC4) and ULN2803A cathode driver (IC3), respectively. These drive the rows and columns of the 8x8 LED matrix display. Latch IC1 is also connected to the system Reset to ensure that the LEDs are not lit when the circuit is first powered up.

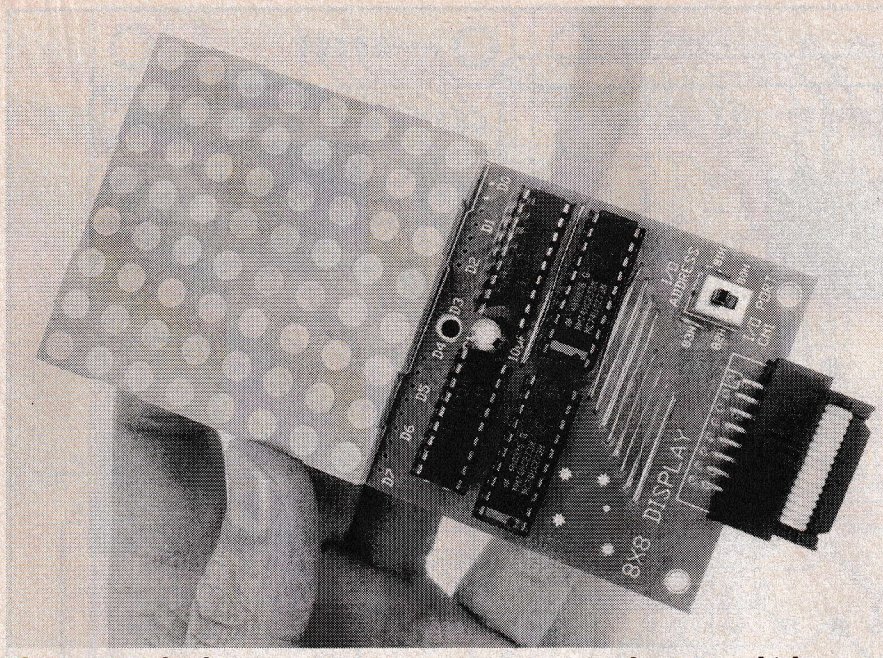
Slide switch S1 switches the latches between two sets of port addresses. In this way, two LED Matrix displays can be used together, one operating from port addresses 80h and 82h and the other operating from port addresses 81h and 83h.

The LED Matrix display is multiplexed and relies on persistence of vision to produce its complex patterns so that moving messages (for example) can be displayed. In the kaleidoscope program, each LED may seem to be on all the time but it is not. Each LED is turned on for only 15 microseconds every half a millisecond. This is a duty cycle of 3%. Peak current through the LEDs is 70mA but the average current is only 2mA.

Constructing the LED display

Assembly of the LED display board does not involve many components and should not take long at all. The component layout diagram is shown in Fig.4. First, fit the 11 wire links to the board. Some of these may be hard to spot. Don't forget the two short links, near the slide switch.

Fit the LED display so that its out-



The 8x8 LED display is, as its name suggests, a matrix of 64 LEDs which are driven in multiplex fashion from the parallel port of the Southern Cross computer. Note the slide switch to change the address of the display, so that two can be used in conjunction with each other.

line matches the screen printed outline on top of the board. This is most important because if you do it the other way around the display will be upside down and won't work.

Sockets are supplied for the four ICs and these can be soldered in next. This done, fit the 10µF capacitor, the slide switch and the rightangle flat cable connector.

You will have to make up the 16 way cable which uses IDCs (insulation displacement connectors. These are squeezed together with a vise to apply even pressure to the connector halves.

When you finish each connector, inspect the pins closely to be sure that each pin is connected to the cable strand that it is supposed to go to. It is rather easy when doing hand construction of these cables to find one pin has gone in skewed and is shorting between two adjacent V-pins. Make sure that pin 1 at one end of the cable goes to pin 1 at the other end, and not pin 16.

To check that the board is working the Southern Cross monitor has a kaleidoscope built into it. Put the switch in the up position. This will connect the two latches on the board to ports 80H and 82H. Press Function E. (To remind you – press the Reset key, then the Fn key then the 'E' key.) A pattern of randomly generated symmetric images should appear on the display. This will continue until Reset is pressed.

Programming the 8x8

Multiplexing the 8x8 can be done in several ways. One of them is to use the subroutine already written in the Monitor. In this subroutine, SKATE, one row of 8 LEDs is scanned at a time. The LEDs to be turned on in that row are given by the bit pattern of the 8 positions. A bit pattern of 10000001 (or 81h) will turn on the outer two LEDs. A pattern of 11111111 (FFh) will turn them all on.

To program this, the byte representing the top row is stored in the register pair HL. HL+1 stores the byte for the second row from the top, HL+2 the byte for row 3 etc. We can conveniently use system call 16 to scan the 8x8 display rather than re-invent the wheel and write our own code. An example will show this more clearly.

Using a piece of paper, form the letter A of your choice using the 8x8 matrix. We decided on codes 18, 24, 42, 42, 42, 7E, 7E & 42 as follows:

00011000 = 18h
00100100 = 24h
01000010 = 42h
01000010 = 42h
01000010 = 42h
01111110 = 7Eh
01111110 = 7Eh
01000010 = 42h

Do you see the capital A outlined by the 1's in the code above and how to derive the hex byte representing the 0 & 1 pattern? Hand enter these bytes into locations 2000h to 2007h of the Southern Cross. Next, enter the code shown in Table 1 at 2100h, then do Fn 0. You should have the letter "A" displayed on the LED matrix.

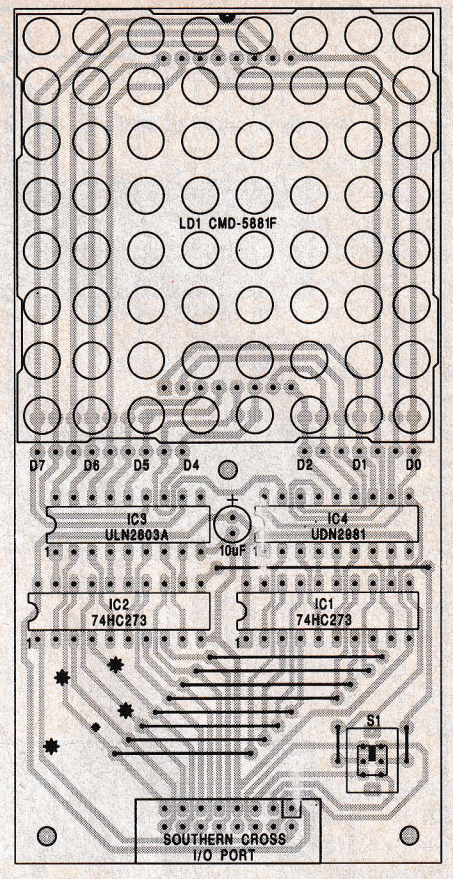


Fig.4: the component layout of the 8x8 LED matrix display. Do not omit the very short links on either side of the slide switch.

Table 1

2100	21 00 20	LD HL,2000H	;point HL to buffer
2103	0E 16	LD C,16H	;system call SKATE
2105	F7	RST 30H	;call it
2106	C3 00 21	JP 2100h	;repeat the loop