

The Sphere system

Of the many microcomputer systems based on the Motorola 6800 microprocessor chip family, perhaps those which have aroused the most interest are the systems produced in the US by the Sphere Corporation. No doubt this is because Sphere has integrated their basic system with a video display and keyboard, and is selling the resultant package for little more than the cost of a basic video terminal.

In appearance, a basic Sphere system is very similar to a conventional video terminal. It has a video screen and a full ASCII-type keyboard, mounted in a well-styled and solid terminal case. But inside the case is a complete microcomputer as well as the display and keyboard.

The Sphere 320 system comprises a total of four modules: a CPU module, a CRT interface module with video monitor assembly, a keyboard module complete with keyboard, and serial interface module.

The CPU module provides a complete 6800 microcomputer system, on a single PCB measuring 200 x 250mm. It includes 1k bytes of PROM with a resident debug and monitor program, 4k bytes of RAM for user programs, a bidirectional 8-bit I/O port, 2 interrupt lines, serial interface port, and fully buffered system bus.

The CRT interface module is on a single PCB of the same size as the CPU. It is designed to provide a display of 16 lines, each 32 characters long, using a standard 5 x 7 dot matrix character set. The module includes its own 512-byte RAM for refresh servicing, so that the CPU can operate at full speed.

The CRT module has both video and modulated RF outputs. Its output is normally fed directly to the inbuilt video monitor, but can be directed to an external monitor or TV receiver if desired. Up to 8 CRT modules can be operated in a system if desired.

The keyboard module has a full ASCII keyboard, together with the appropriate encoding logic.

Finally the serial interface module or "SIM" provides flexible serial interfacing facilities, to allow the system to communicate with a variety of serial peripheral devices. These include single and dual tape cassettes, a modem, or a cassette and modem combination.

All of these fit into the basic Sphere case, measuring 460 x 320 x 485mm. The only external item is the power supply, which is also supplied.

For those wanting a more powerful

system than the 320, Sphere also markets the model 340. This provides all of the facilities of the 320, together with two further modules: a memory board with 16k of additional memory, and a parallel I/O module.

The 340 memory board is the same size as the CPU and CRT modules. It has provision for a total of 16k of dynamic RAM devices, and in the 340 system it comes fully populated. However further modules are also available, populated in any desired 4k increment from 4k to 16k.

The parallel I/O module comes again on a PCB measuring 200 x 250mm. It has four PIA devices, providing a total of 64 bits of parallel I/O interfacing, together with handshaking logic for interfacing to peripheral devices such as a line printer and floppy disc drive.

To mate with the more powerful 340 system, Sphere market both a line printer unit and a dual floppy disc drive. The line

printer is a bidirectional impact printing mosaic type, operating at a rate of 110 chars/sec and 65 lines/minute. It uses tractor-fed paper, and prints in 80 columns.

The dual floppy disc unit uses IBM-type initialised diskettes, and provides storage of 256,256 bytes per diskette.

Software available for the 340 system includes extended BASIC, and a disc operating system.

Literature supplied with the Sphere 320 and 340 systems is at present rather sparse, consisting mainly of basic information on the 6800 microprocessor system. There is very little in the way of operating or programming information on the Sphere systems as supplied; however we understand that this deficiency will be rectified in the very near future.

In view of their availability as compact, fully assembled systems which are easily expanded as required, both the 320 and 340 Sphere systems seem likely to be of considerable interest in Australia.

The sole distributors for Sphere in this country are Paradio Electronics Pty Ltd, of 7A Burton St, Darlinghurst, NSW, 2010, who currently have 320 systems in stock.

(J.R.)



Apart from the power supply, the Sphere 320 is fully self-contained.

We test a powerful new 6809 system

Sphere computer for business and hobby use

Recently we put the Sphere microcomputer through its paces. Sphere is a new product by a Sydney company, and is based on the 6809 microprocessor with the SS-50 bus. In addition to solid packaging and a great capacity for expansion, the Sphere offers a powerful, moderately priced computer system for hobbyists, small businesses and software developers.

by **PETER VERNON**

Physically, the Sphere is impressive. It is housed in a rugged aluminium cabinet 400mm wide x 182mm high x 512mm deep, with the top, sides and base anodised blue. The front panel is bare except for two illuminated pushbuttons, the Sphere logo and a narrow decal of orange and black stripes. At the rear is a power switch, fuse holder, mains cord entry point and the cooling fan. As a first production model our machine was marred by a rather noisy fan but we have been told that a new, quieter fan will be used for subsequent production.

The rear panel is partly composed of eight individual strips held in place by self-tapping screws. These panels can be removed and replaced with similar strips

incorporating cut-outs for connectors to peripheral equipment. The motherboard inside the case is arranged so that peripheral controller boards are adjacent to the back panel, with connectors mounted directly on each peripheral board and readily accessible on the rear panel.

Inside, the impression of solid construction and attention to detail is confirmed. A heavy duty, 2.5mm thick epoxy motherboard provides support and interconnections for all boards in the system. The motherboard is plated through and solder masked on both sides, with Schmitt trigger buffers for all address, data and control lines. Eight slots are provided for full size (50 pin)

SS-50 processor and memory boards and eight 30 pin "I/O slots" are available for peripheral controllers. On the motherboard itself are a baud rate generator and DIP switches for assigning addresses to each I/O board.

Power supply arrangements are relatively simple, as each SS-50 board incorporates its own regulators. Total capacity of the supply is 10A at 8V and 2A at $\pm 16V$. A computer grade mains interference filter is fitted.

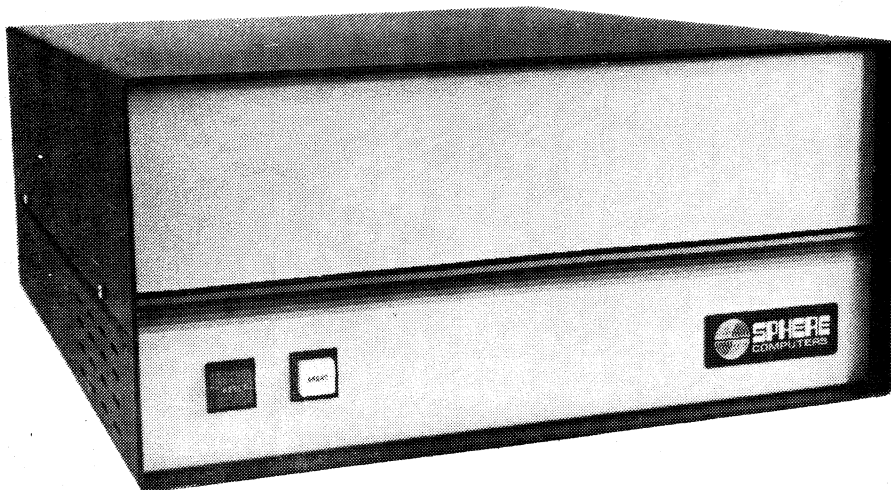
The SS-50 bus

For those who haven't heard of it, the SS-50 bus is a system is a simple, standardised interconnection scheme specifically designed for 6800 systems. Its reliability and ease of use have made it the standard bus for such systems. There is no shortage of boards available either, with over 20 manufacturers producing processors and add-on equipment, all basically to the same standard. The Sphere computer uses the SS-50C bus, which is compatible with earlier versions but includes additional features to take advantage of the 6809's multi-tasking capabilities (more later).

A feature of this bus system is the separation of I/O boards from processor and memory boards. Separate 30-pin slots are provided, bringing out the data and address buses and sufficient control signals to allow input/output facilities to be implemented with a minimum of fuss. The 6800 series microprocessors provide input and output by memory mapping, without the separate I/O features of the 8080 family. In most systems part of the upper 8K of address space is set aside to accommodate peripheral controllers.

Up to eight I/O boards can be installed, while still leaving the main 50 pin bus available to accommodate eight full-sized boards.

As supplied, the Sphere system is provided with a 6809 processor board, 8K, 16K or 64K of memory on another board and a single serial port on a 30 pin board. This means, of course, that a



Heavy duty aluminium cabinet conceals a powerful multitasking computer system. For the hobbyist, kit versions of processor, memory and I/O boards are available.

serial terminal is required to communicate with the computer. We used an 8212 terminal, assembled in Australia from a US design, and set to operate at 9600 baud.

Total cost of a working system is increased considerably by the need to purchase a terminal — especially when compared to an “all in one” microcomputer such as the TRS-80. However, the comparison is really not valid. Multi-user versions of the Sphere can support a number of terminals, providing each work station with the use of processor, memory, disk storage and printers, at less than the cost of providing a complete computer system to each user.

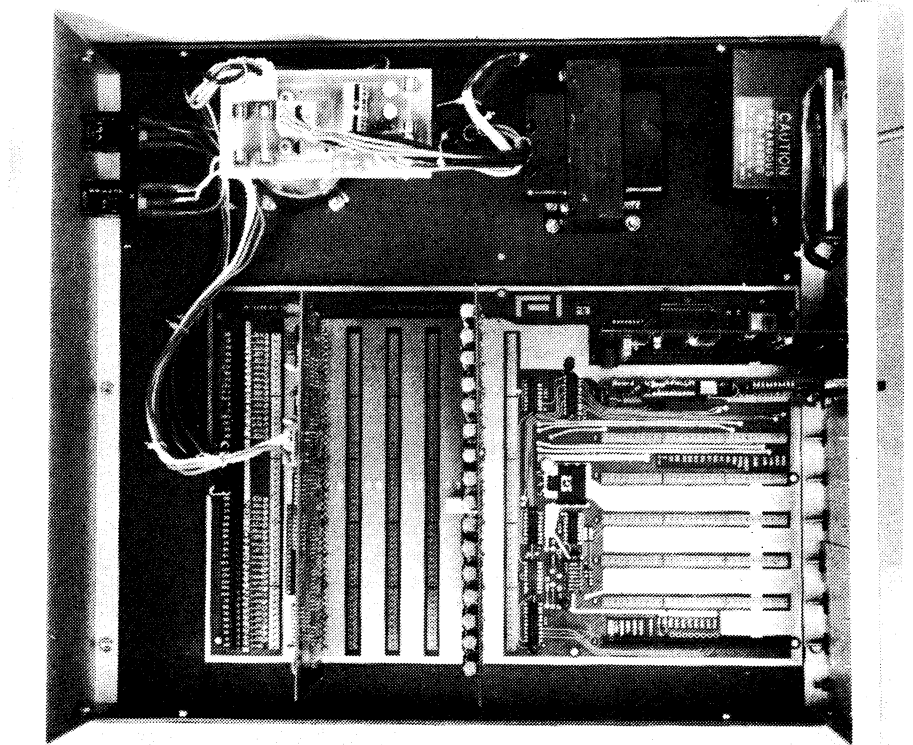
6809 microprocessor

Our review system included a processor board by a United States manufacturer, functionally equivalent to the Sphere MP-09 board. This board uses the 68B09, rated for operation at 2MHz clock speed. At this speed the 6809 processor performs a 16-bit by 16-bit multiplication, for example, in 82 microseconds as compared to 267 microseconds for a 4MHz Z80. Other processor operations show similar speed advantages.

Address translation circuitry is also included on the processor board. This circuitry allows areas of memory to be assigned to different “logical addresses” under software control. While seemingly over-sophisticated for single-user applications, address translation is an integral part of multi-user and multi-tasking systems, and although rarely found on inexpensive computers allows the user to take full advantage of the power of the 6809 microprocessor.

Also on the processor board is a 2K ROM containing the SBUG Monitor from South West Technical Products and three empty sockets which are configured to take 2716 EPROMs. DIP switches on the board allow these EPROM sockets to be assigned addresses in the processor's address space. They are primarily intended for use with a processor board in “stand alone” operation, such as a machine controller.

The processor board also includes buffers for data, address and control lines and a baud rate generator for serial communication when the board is used in the stand-alone mode. Connectors are provided for the front panel Reset and Abort switches. “Reset” re-initialises the system, returning to the Monitor cold start point. “Abort” generates a Non-maskable Interrupt which jumps to a routine in the Monitor which displays the contents of the processor's registers and



Seen from above, with 6809 processor board and 64K memory board in place. High quality motherboard has eight slots for main boards and another eight for I/O. The board at the top of the photo holds fuses, and hides 100,000uF filter capacitors.

exits to the Monitor command input routine. It is intended to assist assembly language programmers in debugging by halting a runaway program with all registers and memory contents preserved.

Supplied with the system we reviewed was the Sphere MB-64 64K RAM board. This board uses the MM5290 16K x 1 bit dynamic RAM chip with an access time of 250ns. Use of 16K RAM chips provides savings in cost and component procurement time over the new 64K chips, at the expense of greater power dissipation and increased board complexity. A Motorola MC3242 memory address multiplexer and refresh counter chip on the board simplifies the circuitry, however. The memory board is well designed and laid out, and we experienced no problems with its use.

Also available for the Sphere is an 8K RAM board, and a 16K board. As the disk operating system occupies 8K of memory, however, this board is of limited use, although it can be expanded to 32K. All round, the 64K board seems to be the most economical solution in the long term.

With the addition of a memory management board, also forthcoming from Sphere, memory can be expanded to 768K bytes for use with multi-user systems.

In Port 0 of the 30 pin I/O section of the

board the Sphere requires a serial board for communication with a terminal. The machine we reviewed contained a serial board by another manufacturer, again functionally equivalent to the Sphere serial board. As supplied, this board provides one RS-232C interface, with a baud rate generator programmable for data transmission speeds between 110 and 9600 baud. The board is designed to be expanded to a dual port serial interface with the addition of the necessary ICs.

A floppy disk controller board was also supplied, in Port 1 of the motherboard. This controller board provides the necessary circuitry to control two 14cm minifloppy drives, and is almost an essential requirement for the Sphere, for reasons which will emerge when we look at the software available.

A wide range of other peripheral controller boards is available, both from Sphere and other manufacturers of SS-50 products. 20cm disks floppy disks and Winchester type hard disk controllers, parallel and serial printer interfaces and optically isolated relay switching boards for appliance control are just some of the equipment which can be added to the Sphere.

A standard configuration for the Sphere system assigns address space from 56K to 60K to I/O boards. The disk controller board occupies memory from

60K to 62K, and the system Monitor ROM is at 62K to 64K. This arrangement leaves 56K of memory space available to the user. A minimum configuration would require at least 16K of RAM. The actual physical addressing of this memory is not important, because the system Monitor automatically locates and all RAM plugged into the system, translating the physical addresses to a continuous area of "logical addresses".

Extensive software available for the Sphere

Extensive software is available for the 6809. In its bare form the Sphere includes version 1.7 of SBUG-E (a trademark of SouthWest Technical Products Corporation). This is quite an extensive Monitor, allowing the user to display and alter the contents of all registers and address locations, to set up to five breakpoints in a program and to read and write MIKBUG (TM) format cassette tapes. A memory test routine, stack display and bootstrap routines for both 14cm and 20cm disks are also included. Calling addresses of Monitor routines for inputting and outputting characters and strings to a serial terminal are given in the user's guide.

The Monitor user's guide is eight pages long, including a three page section for advanced programmers. It is adequate for experienced users, but is in no way an introductory manual.

All other software for the system is on disk. First off and most important is the FLEX09 disk operating system (FLEX is a trademark of Technical Systems Consultants Inc). It is an extensive operating system which has gained great popularity among users of the 6800. This version has been re-written (not just re-assembled) to take advantage of the more powerful instruction set of the 6809. It contains 51 commands for manipulating disk files, many of them with alternate forms and users.

Among other functions, the optional clock calendar available for the computer is fully supported, routines for driving an EPROM programmer are provided, and parallel and serial printer drivers are included. A utility program on the FLEX disk called TTYSET allows the user to customise the operating system to suit his particular terminal, redefining control codes, display formats and data transmission speed.

Disks can be formatted, copied (either in whole or part) and files renamed, deleted, protected and inspected by dumping each sector to the terminal. A further command supports the use of a head cleaning disk. A hard disk system (the Calcomp Marksman Winchester

disk) is also supported, and another utility program allow both 14cm and 20cm disk drives to be used in the same system.

All round, the DOS is powerful, efficient and easy to use, giving the programmer complete control access to all files and file handling operations. One particularly important feature is the EXEC command, which is used to process a text file as if it was a list of commands typed in from the keyboard. This command allows very complex disk handling operations to be built up as a command file and executed by simply loading the file.

FLEX is provided on a 14cm disk. The comprehensive operating manual provides procedures for modifying the system to add special features, a listing of the basic 6809 disk driver routines and a full description of each command.

Other software is available to run under FLEX, including a 6809 assembler, TSC's Extended Basic and text editor, Pascal, Fortran, Cobol, C, and Forth. For business use there is an inventory program, mailing list manager and word processing programs. Basic compilers and Uniflex, an operating system which combines the best features of UNIX (trademark of Bell Laboratories Inc) and FLEX is also available, as is UniFlex multitasking Basic and UniFlex Pascal.

As an alternative to FLEX, a multitasking operating system, OS-9, from Microwave System Corporation is available. Multitasking is the ability to execute more than one program at a time, switching the resources of the computer between "task" or programs so quickly that to the user it appears that all the programs are being executed simultaneously.

OS-9 can be used in many ways, from a small "kennel" in ROM controlling a machine tool to a fully expanded timesharing system for business, scientific or educational applications. Two versions are available, Level I for 56K systems (Sphere Mk I), and Level II for systems with up to one megabyte of memory (Sphere Mk II).

With Level II a fully expanded Sphere Mk II can support up to 16 terminals at once.

Forth for the 6809

For this review we were supplied with a copy of Forth, by Talbot Microsystems, written for the 6809 and running under FLEX. Forth was originally developed by C. H. Moore of the National Radio Astronomy Laboratory in the US, and was intended as a replacement for assembly language in the design of real time control programs. In May 1979 the Forth Interest Group (FIG) published a set of standards which have become the

model for all implementation of the language.

Forth is a combined compiler, interpreter, assembler and operating system. It runs at almost the same speed as assembled code and uses less memory space. It is renowned for the speed with which programs can be developed. Forth consists of "words" and related groups of words called "vocabularies". Forth words are developed interactively, and when compiled consist of lists of addresses which point to machine code routines which do the actual work.

Individual words are either pre-defined or built up by the user by editing blocks of 1024 characters called "screens" using the built-in editor (itself a vocabulary of Forth words). Once defined and compiled these words can be used by subsequently defined words. The equivalent in Basic would be writing a program by writing all the subroutines first and gradually building up to bigger and bigger subroutines, until finally writing one program which simply calls the subroutines under it.

The architecture of the 6809, with its two stack pointers, 16-bit arithmetic and extensive addressing modes is ideally suited to implementing Forth. 6809 indirect and auto increment addressing modes mean that the NEXT loop in Forth – the most used routine which steps through the list of addresses that make up a word – can be written in only 4 bytes, taking 14 machine cycles to execute. Forth is a fast language in any event (from 15 to 20 times faster than Basic in typical cases), and this version of Forth is one of the fastest available.

What does it cost?

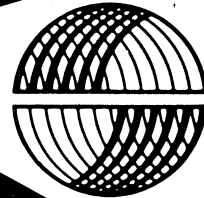
With 8K of RAM, the Sphere 6809 system costs \$850, with 16K systems at \$950. A 6809 with 64K memory board costs \$1495. These prices do not include sales tax. An 8212 serial terminal is priced at \$1295, with 14cm dual disk drives at \$1395. Total cost of the system we reviewed here would be around \$4185 plus sales tax, and not including the price of the software.

A copy of "6809 Microcomputer Programming and Interfacing", from the Blacksburg education series is included with each computer.

For the constructor, cabinets and motherboards are available separately, and kit versions of the necessary boards to construct a single-user system can also be supplied.

Sphere computers are distributed by Paris Radio Electronics, 7a Burton Street, Darlinghurst, NSW, 2010, and J. H. McGrath, 208 Little Lonsdale Street, Melbourne, 3000. Postal address is Sphere Computers, PO Box 380, Darlinghurst, NSW, 2010. ☺

INTRODUCING SPHERE



AN ADVANCED SYSTEM BASED ON THE 6809 MICROPROCESSOR

* EFFICIENT



* EXCELLENT
SUPPORT

* SUPERB
SOFTWARE

* VERSATILE

* MK2
MULTI USER AND
MULTI TASKING

MK 1 and MK 2 SPECIFICATIONS

PROCESSOR

The heart of the system is the Motorola 6809 CPU and considered to be the most powerful 8 bit Microprocessor available today. The CPU board is fitted with Memory Management hardware which allows it to directly address up to 1 Megabyte of memory using a 20 Bit address bus. The system is provided with a 2716 compatible 2k Monitor ROM or EPROM.

MEMORY

A 64K Ram board is provided as standard. However the system may be provided with as little as 8k if desired and more added later.

INPUT/OUTPUT

8 I/O Boards slots are provided, each of which may be fitted with a dual serial or dual parallel interface board using DB-25 "D-TYPE" Connectors. Many other types of interface Boards are also available.

PERIPHERALS

Additional VDUS, Dot Matrix Printers, Daisy Wheel Printers, 8" and 5" Floppy Disk Systems, and a hard disk drive of up to 40MB may be connected to the system. Interface boards and software are available to support all these devices in a singular or multi-user environment.

POWER SUPPLY

Provides 8.5V, +12V, -12V unregulated supply to the buss. All components are P.C. board mounted and fuses readily accessible.

CABINET

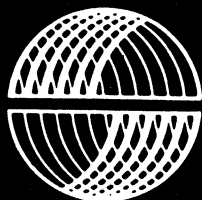
The Cabinet is made of heavy gauge (approx 1/8") Aluminium Anodised in Delightful blue.

SIZE

Approx: 16" wide by 20" deep by 7.5" high.

WEIGHT

Approx. 10KG. (including supply, CPU, 64K RAM, and I/O board).
A/C POWER INPUT 115-240 VOLTS A/C
+/- 10%, 50-60Hz.



SPHERE COMPUTERS

Box 380 Darlinghurst NSW 2010

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