Powerful, portable, expandable:

The Sharp PC-1500 pocket computer

The Sharp 1211 pocket computer was introduced two years ago. Since then there have been considerable developments in the microcomputer field and to keep pace Sharp has introduced a new pocket computer, the PC1500, a more powerful and easier-to-use version with some intriguing accessories.

by PETER VERNON

With over 100 different small computers on the market, manufacturers (and the buying public) are becoming more discriminating. Microcomputers no longer attempt to be all things to all people and a number of machines have appeared to suit specialised applications.

The Sharp PC1500 fits neatly into a niche which just 10 years ago was a dream of science fiction writers — the powerful handheld computer. Not much bigger than many calculators at 195 × 86 × 25.5mm (W × D × H) and weighing 375g, the PC1500 really can be held in one hand yet provides powerful computing facilities and an extensive Basic language.

Programs and data are entered via a 65-key keyboard with alphabetic keys arranged in QWERTY fashion. The numeric keys are grouped in a separate area on the right and above the alphabet keys are six programmable "reserved" keys which can be defined by the user to produce commonly used strings of characters. A 26-character liquid crystal display is used for read out of programs and data.

Although the key layout is close to standard the size and spacing of the keys make touch typing impossible — a point which is possibly irrelevant on a pocket computer. Several of the punctuation keys involve use of the SHIFT key, in particular the comma, semi-colon and colon. Considering the frequency with which these symbols are used, the need to use the shift key is a nuisance.

On the plus side the keyboard does provide single key entry for ten of the most commonly used. Basic statements and the interpreter itself allows abbreviations to be used for most statements, much like Level I Basic of the TRS-80. Lower case letters can also be entered using a key marked "SML" (for Small) — a facility which is unusual in a hand-held machine.

The computer is used in three modes — one for entering and editing programs, one for running programs and a third for defining the functions of the programmable reserved keys. An error message is displayed if an attempt is made to perform an action in the wrong mode and this is the most frequent source of errors until the user becomes accustomed to switching modes.

Switching between modes is by means of successive operations of a single MODE key on the upper right hand side of the keyboard, with the current mode indicated by a small annunciator on the liquid crystal display. Ease of operation of the pocket computer could be improved in this area. It would be convenient, for example, if the computer automatically switched to the programming mode when a syntax error is detected in a program.

Although the LCD readout shows 26 characters at a time program lines can be up to 80 characters long. Cursor control keys are used to scroll longer lines horizontally on the display window and to move up or down within a program. The horizontal cursor control keys have an automatic repeat feature, and with the use of the SHIFT key, activate insert and delete functions for editing program lines.

Characters are formed on a 7 x 5 dot matrix and there are no descenders on lowercase letters. Graphics are also possible, as the display can be treated as a 7 line by 156 dot matrix with each individual dot programmable. Basic statements allow the programmer to define new characters for the display by specifying which points in each column of the display will be illuminated and further statements are provided to control the position at which characters will be displayed.

Unlike the HP45C hand-held computer the Sharp PC-1500 has no provision for an output to a video monitor.

Power for the computer is provided by four AA-size rechargeable batteries, said to be good for 50 hours of continuous operation. If anything, our experience indicates that this figure is conservative. The quoted power consumption for the computer is 130mW and for those who can't put the PC-1500 down, a spare set of batteries is provided.

To conserve battery power the computer automatically switches itself off after about seven minutes without a keyboard entry (provided no program is running, of course). Power to the memory is provided whether the computer is on or off so that it is possible to store programs and data in memory between uses.

Calculator mode

A convenient feature of the PC-1500 is that it can be used as a calculator while in the run mode, without entering a program. All the mathematical functions of

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PC-1500 specifications

Processor: Sharp proprietary 8-bit CMOS CPU.
RAM 2.9K standard, 4K and 8K expansion modules can be fitted internally.
ROM: 16K.
Display: 26 character liquid crystal, upper and lower case, programmable as a 156 × 7 point array for graphics.
Keyboard: 65 keys, calculator style.
Special features: Hand held computer, battery powered with non-volatile memory.
Expansion: Four colour printer and cassette interface, RS-232C and parallel port adapter.

The Sharp PC-1500 pocket computer, shown here with the optional printer and cassette interface, provides extensive computing power in a compact package.

Basic are available together with the ability to define and recall variables by name.

Arithmetic is performed to ten significant digits with scientific notation in the range $-9.999999999 \times 10^{99}$ to $9.999999999 \times 10^{99}$.

Individual calculations can be performed by pressing the CLEAR key between each calculation. Calculations can also be carried out serially, with the result of one operation being used in the next, or as compound formulas grouped where necessary with parentheses. Comparison functions are also available in the calculator mode so that the result of two operations can be tested for equality etc.

The full range of editing functions is also available when the computer is used as a calculator, so equations can be altered with the use of the insert and delete functions.

Programming the PC-1500

PC-1500 Basic is similar to Microsoft versions of the language, with extensions to allow for the special features of the hand held computer.

The Basic interpreter resides in 16K of ROM inside the machine. A standard PC-1500 has 2.9K of usable memory including a fixed memory area for selected variables and a 188 byte area for reserved key definitions.

Internal 4K and 8K memory expansion modules are available, although it appears that there is only room for one such module inside the pocket computer. Maximum possible memory space then is around 11K bytes.

Real number variables may be identified by a single letter or by a letter followed by a second letter or a number, allowing use of over 950 separate variable names. String variables obey the same naming convention with the addition of a $ sign.

Variables identified by a single letter are stored in a special reserved area of memory which is not cleared when a program is run. By taking advantage of this feature variables from one program can be used as the input to another program or shared between a number of independent programs.

Mathematical and trigonometric functions are perhaps more extensive than other versions of the language. In addition to the standard arctan function, for example, the PC-1500 provides arcsin and arcos and there are also statements to convert back and forth between decimal degrees and degrees, minutes and seconds.

Natural and base 10 logarithms are provided together with statements to convert between degrees and radians. A STATUS command allows the user to check the amount of memory which has been used. Program testing is assisted by an extensive range of error messages, which unfortunately are identified only by a code number referring to a listing in the instruction manual. ON ERROR GOTO and the trace function TRON/TROFF are also supported.

Statements are provided to execute a program as soon as the machine is switched on and to lock the computer into one mode, so that the programmer can create software for dedicated applications which cannot be crashed by an inexperienced operator.

A full range of string functions is provided, with strings of up to 16 characters long. Longer strings, to a maximum of 80 characters can be created by linking two smaller string variables together. An error message is displayed if the new combined string exceeds 80 characters. Two dimensional arrays are also supported.

The PC-1500 includes an audible sound generator, activated by the BEEP statement. BEEP requires three parameters specifying the number of times the sound is to be repeated, frequency and duration. The volume of the sound is not adjustable but is mercifully low.

Also on board is a timer which once set maintains time and date. One peculiarity of the Basic is that there is no PRINT statement as such. PAUSE (value) is used to display the a value on the LCD readout, holding the display for around .8 of a second.

Sharp PC-1500 Basic statements

RUN, NEW, LIST, CONT, TRON, TROFF, UNLOCK, STATUS, MEM, INPUT, PRINT, GPRINT, CURSOR, PAUSE USING, WAIT, CLS, IF . . . THEN, STOP, GOTO, ON . . . GOTO, GOSUB, ON . . . GOSUB, RETURN, ON ERROR GOTO, FOR . . . TO . . . STEP, NEXT, END, DIM, LET, REM, DATA, READ, RESTORE, BEEP, AREAD, ARUN, CLEAR, RANDOM, DEGREE, RADIAN, GRAD, BEEP ON, BEEP OFF, SIN, COS, TAN, ASN, ACS, ATN, LN, LOG, EXP, DEG, DMS, RND, SQR, SGN, ABS, INT, PI, LEFT$, RIGHT$, MID$, ASC, VAL, LEN, CHR$, STR$, POINT, INKEY$, TIME, LLIST, TEST, LPRINT, TAB, LF, ROTATE, COLOR, USING, GLCURSOR, SORGN, LINE, RLINE, CSIZE, TEXT, GRAPH, CSAVE, CLOAD, CLOAD? MERGE, INPUT#, PRINT#, CHAIN, RMT ON, RMT OFF

The Sharp PC-1500 pocket computer
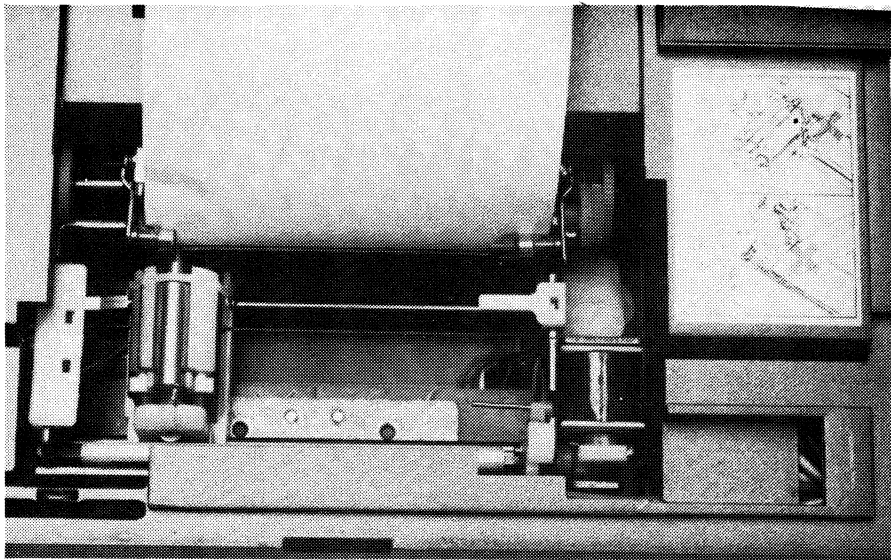
A close-up view of the printer mechanism. Four coloured pens are carried by the rotating drum while the carriage allows forward and reverse movement to print characters and plot graphics.

Also built-in are statements for handling a cassette and printer interface. Although any cassette recorder can be used with the computer, Sharp recommend their own compact model which nicely matches the size and finish of the PC-1500.

Peripherals and expansion

The Sharp CE-150 printer/cassette interface is available as an option. The pocket computer slots in to the interface to form a single unit measuring 330 × 115 × 50mm (W × D × H). The dual cassette/printer interface unit has its own battery power supply and comes with an AC plugpack adapter, cassette cable and a hard vinyl case to store the full system.

Programs can be recorded on the cassette tape (using CSAVE) and then verified by the CLOAD? statement. Data can also be recorded and recalled with PRINT#and INPUT#. Programs on tape can be combined with programs in memory with MERGE which appends the program from tape at the end of the existing program. Line numbers are duplicated by this procedure.

Once a merge is performed no changes are allowed to the program originally in memory. The appended program is identified by a label which allows programs to be linked together by use of a GOTO (label) statement. Several programs can thus be held in memory simultaneously, each called up by a reference to the appropriate label.

The CHAIN instruction can only be used within a program. Programs which are too large to fit in memory at once can be divided into sections with a CHAIN statement at the end of each section. During execution the CHAIN statement causes the computer to load the next section of the program into memory and run it.

When two cassette recorders are used one is dedicated to recording programs and the other to playing back programs. Editing of programs is simplified by this arrangement, although one cassette recorder can be used for both functions.

One of the most intriguing aspects of the PC-1500 is the compact printer built into the interface unit. The printer uses four ball-point pen tips mounted on a rotating drum to provide text and graphics in four colours. Upper and lower case alphabetic characters can be drawn in various sizes under software control and there is a graphics mode which plots on a Cartesian co-ordinate system with a resolution of 256 x 256 points.

The printer requires standard 58mm wide "tally rolls" as used in many printing calculators and cash registers, not costly metalised paper, and is fascinating to watch in action. Forward and reverse rotations of the carriage are used for vertical plotting while the drum carrying the pens moves horizontally. Colours are selected by rotating the drum carrying the pens with the COLOR statement.

In the text mode the printer produces upper and lower case letters in nine different sizes, ranging from 1.2mm to 10.8mm in height. Letters can also be rotated in increments of 90° to print messages lengthwise along the paper roll or back to front across the paper (this last capability being of limited use).

Graphics mode statements are provided to define the origin of the co-ordinate system, move the pen to any point without drawing and to draw lines bet-
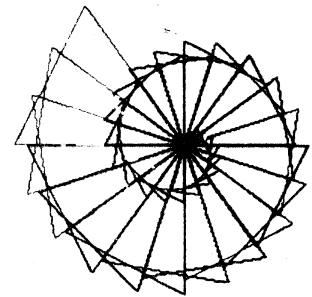

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10: "A": GRAPH :
    RANDOM
20: GLCURSOR (120,
    -200): SORGN
30: INPUT "NO. OF
    TRIANGLES="; N
40: INPUT "ANGLE="
    ; S
50: INPUT "INCREME
    NT="; K
60: T=-S: R=5
70: FOR I=1TO N
75: COLOR RND (4)-
    1
80: R=R+K: T=T+S
90: X1=R*SIN T: Y1=
    R*COS T
100: X2=R*SIN (T+60
    ): Y2=R*COS (T+
    60)
110: LINE (0,0)-(X1
    , Y1)-(X2, Y2)-(
    0, 0)
120: NEXT I
130: END
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Both the design shown and the listing that produced it were printed by the PC-1500.

ween two defined points or relative to one point. Eight different types of line are possible, ranging from solid to dashes of various lengths. The addition of "B" to the LINE statement allows plotting of rectangles based on two points which define the diagonal.

A switch on the printer interface module allows the user to make a continuous record of all data and formulas entered in the calculator mode, thus duplicating the function of a printing calculator. While this feature is convenient in some applications, it does use a lot of paper and slows down the operation of the computer.

The lack of speed of the printer may be a drawback for some. Because of the way characters are produced the maximum printing speed is 11 characters per

The Sharp PC-1500 pocket computer

second, so listings of long programs can occupy some time. Program listings are produced in the default character size (CSIZE 1) which allows a maximum of 26 characters per printed line and results in some oddly truncated words.

Maintenance of the printer in terms of changing paper and pens, is simplicity itself, with each procedure given step-by-step in the instruction booklet which accompanies the printer. A special error message (ERROR 80) indicates that the battery voltage is too low for correct operation. When this occurs the printer will suspend operation until the batteries are changed or recharged.

A combination RS-232C and parallel port adapter is also available for the PC-1500. This unit, the CE-158, allows the pocket computer to communicate with larger machines, either via a modem or a direct connection, or to use a larger printer with either a serial or parallel interface. It too has its own rechargable battery power supply and is accompanied by a comprehensive manual.

Documentation and applications

The instruction manuals provided with the PC-1500 are extensive and generally well-written. The instruction manual itself begins with a tutorial and goes on to cover use of the calculator mode, introductory programming and advanced topics, as well as use of the printer and cassette interface. Separate booklets with the interface unit provide mechanical details and connections for each device.

The instruction manual covers each statement of the Basic language and lists the error message codes and their meanings. Unfortunately while the manual is excellent for the beginner some of the more advanced topics are only sketchily covered and can be difficult to locate in the text.

Where the PC-1500 really scores is in the applications manual provided with the computer. This manual provides full listings, instructions and sample printouts of over 50 programs covering a wide variety of topics including mathematics, engineering, statistics, business and home use. Applications include the solution of quadratic and cubic equations, statistical correlations, loan and depreciation calculations and a "world clock".

Other applications programs appear from time to time in magazines, the most recent being a report in "Australian Sailing" magazine of a general purpose navigation program for yachtsmen. A range of business and professional programs is also available from Link Computer Systems, including a motor dealer's accounting package, and "electronic diary", professional time and billing program and an income tax instalments calculator. Other applications are under development by Link in conjunction with Sharp Corporation of Australia.

The software available indicates the market that Sharp is aiming at. Engineers, architects, salesmen and others who need portable computing power in a convenient, easy to use package will find the PC-1500 worth a close look.

Prices and availability

The PC-1500 pocket computer has a recommended retail price of $319, with the printer/cassette interface an additional $256. The add-on serial and parallel interface retails for $260, and 4K and 8K memory expansion modules cost $71.80 and $175 respectively.

The pocket computer is available from a number of office equipment stores or through Sharp Corporation of Australia Pty Ltd, 64 Seville St, Fairfield, NSW 2165, phone (02) 728 9111.