Sharp PC-1600

The Sharp PC-1600 is certainly one of the smallest computers around today, justifying its designation as a 'pocket computer'. Although it is small enough and light enough to fit in a pocket, more likely the PC-1600 will be found nestling discreetly in the back of brief cases, forgotten until called upon on the spur of some moment. Ian Davies pulls it out for a test run.

Sharp seems to alternate between calling it a computer and a calculator, but there is no doubt in my mind that the little box is wholeheartedly a computer. Sure, the distinction is difficult with programmable calculators, but when the item in question includes all the features of the PC-1600, it's just got to be a computer.

Indeed, this is the most impressive aspect of the PC-1600. Although it really is small (the same weight, and just a little bigger than my old SR-56), it is also amazingly full-featured — not only in software, but also interfaces and expansion capability.

The other major distinctive quality of the PC-1600 is that it is one of the very

few machines released in recent years which is not either an IBM clone, or a foray into new technology. Sharp would disagree with that statement, as they describe the PC-1600 as being "an electronic package of world technological firsts". It probably is, but the technology has gone into creating a full computer in a smaller package, not the usual application of technology we generally see these days: high resolution screens, icon-based operating systems, advanced graphics and so on.

Hardware

The PC-1600 consists of the core computer, plus a series of peripherals. The PC-1600 itself is a package not much larger than a programmable calculator, containing the CPU, keyboard, display, RAM, ROM and I/O ports. The peripherals are mounted in and around the 'printer' interface, a comparatively large unit about the size of the smaller 'brief case' portables, but significantly lighter. The printer interface is purely optional, as the PC-1600 remains fully functional without it.

The machine is based on a SC7852 CPU chip, which is functionally identical to the old Z80A, but is a CMOS version, and therefore draws much less power. The chip is driven at 3.58MHz, and is backed by a 1.3MHz LH5803 'slave CPU', and a LU57813P 'Sub CPU' running at 307.2kHz. What these other CPUs do remains somewhat of a mystery, but I suspect that the Sub CPU is responsible for driving the display.

The display itself is a non-backlit LCD unit with adjustable contrast. In provides four lines of twenty five characters, and can also be placed in a graphics mode delivering a resolution of 156 by 32 dots. The display quality isn't terrific, but then LCD displays rarely are. All things considered, the PC-1600 supplies a display quality about as good as many of the lap-tops, but does it in the palm of your hand.

The keyboard has 69 chicklet-style keys, and is not the sort of thing to compose documents on. The arrangement of the keys is different, to say the least. With a basic qwerty layout, the PC-1600 uses the right hand portion of the key area as a calculator style pad, providing the digits and four arithmetic function symbols. This area of the keyboard can be shifted to provide access to punctuation characters. Some of the common punctuation characters, however, are found running underneath the display. These are called "function keys" by Sharp, and can be redefined to character strings accessed through


It's all there, in miniature form

pressing the DEF key, followed by the punctuation key. On the upper right side of the keyboard are the backspace keys and a second shift key, as well as the power off and power on/break keys.

The shift key itself is a little unusual, as it operates as a toggle on the next character to be keyed. For example, to access the ':' symbol, you must first press the shift key and release it, and then press the '*' key. If you change your mind having pressed the shift key, you can un-shift by pressing it again. This is rather neat, as it allows for complete one-finger operation, but it might have been

nice if Sharp also allowed the shift key to be held down while keying the desired character, just to cater for those of us for whom that has become a habit. Surprisingly, however, it doesn't take long to become accustomed to the shift key as a toggle, presumably because the key area is so small and it is rather hard to get two hands going simultaneously.

Capital letters are the default with the PC-1600, but pressing a button marked 'SML' (small characters), reverses this default. The space bar is a slightly enlarged key in the usual place, flanked by scroll keys. All keys can either be
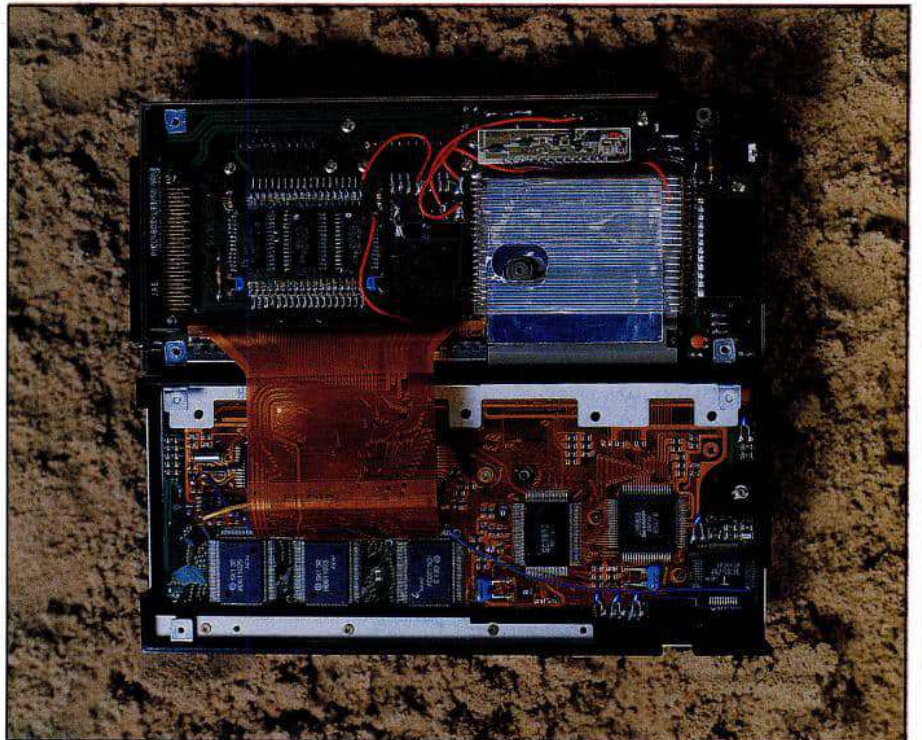
Not surprisingly, the PC-1600 sports a compact PCB

selected to click or not click, and key repeat is also optional.

Along the top row of the display, and etched in rather than consuming a valuable display line, are a gaggle of mode indicators. These include useful things such as the shift and control states, a busy flag, mode indicators, and so on. These are rather crucial indicators, and include a rather clever low battery flag, which can either indicate the state of the PC-1600 internal batteries, or those of the peripherals.

The PC-1600 operates on four AA type non-rechargeable batteries with a power consumption of 0.48 watts. Sharp estimates battery life at 25 hours for a normal operating profile of 10 minutes processing time and 50 minutes of display time each hour. This is presumably because of the extra power required to alter an LCD display, as against just displaying static information.

The PC-1600, however, is never really 'off'. Programs and data remain in memory when the power is off, and the Basic includes a command to actually switch the machine on. This is rather clever, as it can be combined with a WAKE command to tell the PC-1600 to switch itself back on and perform some command at a particular time and date.

The Basic provided with the PC-1600 is very full featured, being not quite as good as the current Microsoft Basic, and about the level of the old TRS-80 Level II Basic. It is implemented in 96k of ROM, which includes many of the intrinsics to operate the peripherals — more on the software situation later.

The PC-1600 also comes standard with 16k of RAM, of which 12k are usable after the Basic work space is claimed. The RAM is actually upgradable to a maximum of 80k, implying a total of 176k on a Z80A, which is, again, pretty clever. Memory upgrades are physically connected through the two expansion slots on the rear of the unit.

Calling them "expansion slots" is stretching the imagination a little. How can anything which is about half the size of a match box be called an "expansion slot"? Nevertheless, that's what it is. Into each slot can be inserted a 32k RAM module. These modules are extremely well engineered. They are removed by unclipping a retaining brace and sliding the module back. As it slides back, it disconnects from the memory bus, and a small protective sleeve appears to protect the edge connector. Each module contains its own backup battery, a 3v lithium disk which lasts for two years on the shelf, or five years in the machine. Additionally, each module includes a write protect switch. You don't find

engineering of such quality in desk top machines, yet here we are talking about a module which weighs about two ounces and would fill half a match box!

It was not possible to actually get inside the memory modules to see what type of technology is being used, as most of the module package is taken up by the battery, and the rest is moulded plastic.

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Each module can be used either as Basic expansion memory, or as a RAM disk.

Inside the main PC-1600 casing, more fine engineering is revealed. A main PCB supports the keyboard matrix and LCD display on one side. On the other side of the PCB run the tracks and a few LSI chips. Overlayed on the main PCB is a plastic 'PCB'. This is entirely plastic with conductive tracks running through it. Four VLSI custom ICs are soldered to the 'PCB', and the 'PCB' runs across to the other half of the unit to connect with the batteries and interface circuitry. Since the 'PCB' is plastic, it provides a flexible connection between the two halves. The interface board is another double-sided PCB, again with VLSI chips. It shows that Sharp is justified in talking about the high technology which has gone into the PC-1600.

The PC-1600 is riddled with I/O ports. In addition to the two memory expansion

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ports on the rear, the unit has a bus expansion socket on the side for connecting with the printer and disk drive. An adaptor interface for running directly from mains power (via a transformer) is found on the rear of the box. On the other end to the printer interface are the contrast knob, and a plethora of ports.

First, there is an RS-232C port. Now, I know I have used these pages in the past to complain about manufacturers who implement the standard RS-232C port in such a way that it isn't really a standard at all, well the PC-1600 is another machine with a 'Claytons' RS-232C port — but one must make some allowances for a machine of this size. For a start, the RS-232C port has physical incompatibility. It isn't a 25 pin D type connector. It isn't even a 9 pin or 15 pin D type — none of these would fit inside the case. To be honest, I don't quite know what you would call it, except "small". The good news, however, is that Sharp can supply an interface cable with a normal RS-232C connector on one end. The other incompatibility is electrical. True RS-232 uses +12v and −12v signal levels, and there is no way Sharp can generate these levels from a 6v power source. I'm sure that the average user would not be keen on carrying around a couple of car batteries just to generate the correct signal levels. This means that once you have purchased the 'Sharp RS-232C to real RS-232C' adaptor cable, you still may have some trouble communicating with another machine or with a modem. The safest thing would be to ensure that your intended communicant accepts TTL levels in place of true RS-232C. Many devices do this, including Sendata modems. Other devices including most PCs, require at least something close to the standard voltage levels.

A so-called 'serial I/O' port is also provided, which is specifically for optical fibre communications, and can run at up to 38.4k/sec. Since few users would, as yet, be into optical fibre, this may only be of limited use. Interestingly, the third port is an analog input, and the PC-1600 contains a built-in analog to digital converter. The port can handle a maximum input of 4v, and can register voltages in the range 0 to 2.495v. The analog input is converted to a byte value, thereby providing 256 discrete levels. Accuracy is 3%, which is pretty good, considering the whole thing is built into a hand held computer. The Basic, which we will be looking at later, includes interrupt support for both the communications ports and the analog port.

The PC-1600 comes complete with a soft case, batteries and operations manual.

Peripherals

External expansion starts with the addition of a printer and cassette interface. This unit is smaller than most lap-top computers, and acts as the harness for all additional expansion.

The PC-1600 itself slots into and becomes an integral part of, the printer interface. The reset button found on the rear of the PC-1600 is duplicated on the rear of the printer interface, since the rear of the PC-1600 becomes inaccessible once mounted on the interface. Again, well engineered, except for the fact that if you turn the printer interface upside down to get at the reset button, the paper falls out of its mounting and runs all over the floor. Oh well.

The printer interface itself weighs just 1.6 kg, and includes its own rechargeable batteries. The most distinctive feature of the interface is that it's just about empty!

In many portables, the batteries are the largest and heaviest item. In the printer interface, you actually have to look hard to find them. Sadly, this also says something about battery life. With a fully charged battery the printer has enough juice to print 250 full lines of text. Not much, but with an average print speed of 5 cps, this equates to 30 minutes of continuous use. Fortunately, the printer can run directly off the recharger provided, as incidentally, can the PC-1600 itself.

The printer is actually a four pen plotter with bi-directional paper feed, which means you can also use it for charts and diagrams. All of the firmware for the printer is in the PC-1600, which means that the Basic supports the printer rather well. Character size is selectable from 17 to 160 characters per size, with heights from 1.2 to 10.8 mm. Resolution of the print head is 0.2 mm, with good horizontal repeatability, and slightly worse vertical repeatability. The printer mechanism itself is really just a couple of motors and a few pens — all the rest is in the PC-1600.

Printer controls on the top of the case include a paper feed switch, reverse feed, pen change and printer off switch, all of which are also accessible under software.

The interface also includes a cassette interface, which provides the standard 'mic/ear/remote' jacks to a normal cassette recorder. This might be a good cheap alternative form of data storage for many users, but after years of using cassette based storage mechanisms, I can safely say that there's nothing like a disk drive. Once again, the cassette interface is almost nothing — just a relay, a couple of diodes and a few resistors. It is almost surprising that Sharp did not squeeze these into the PC-1600 — there are a spare couple of millimetres!

The printer/cassette interface comes complete with a carrying case, recharger, paper, four pens, cassette cable and paper holders.

I really doubt that anyone will actually use the cassette interface, as there is a very reasonably priced disk drive available for the machine. A tool pocket on the printer interfaces is unclipped and thrown away to allow mounting of the disk drive. The drive takes its power from the rechargeable batteries in the printer interface and as seems usual for this gear, contains almost nothing except the drive mechanism and modulator. All the smart bits are in the PC-1600.

'The manual even implies that you're on your own when it comes to software.'

The drive is a 2.5 inch microfloppy, and is the smallest capacity microfloppy around, holding a meagre 64k. Since it is unlikely that the PC-1600 will be used for running corporate databases, this low capacity may not prove to be a problem. The drive formats to 16 tracks/side, and since the drive is only single sided, economically minded owners could use 'flippies' — that is, a floppy which you take out and flip over. This is generally a bad idea, however, as causing the disk to rotate in both directions can increase wear and dust distribution.

The disk drive consumes 2.5 watts (when in use), and weighs in at just 470 grams. The disk runs at quite a respectable speed, with most programs loading in just a couple of seconds. Unfortunately, the disk cannot be connected directly to the PC-1600, it must run in conjunction with the printer/cassette interface.

Both the printer/cassette interface and disk drive take their power on/power off cue directly from the PC-1600. That is, neither has its own power switch. Turning the PC-1600 on automatically turns on the peripherals.

Software

This is about the only area in which the PC-1600 falls down, and is the reason so many people are coming out with PC clones, or at least MS-DOS machines.

The PC-1600 runs only Basic, and the operating system is integrated with the Basic interpreter. No other software is provided with the machine (although the review machine did have some rather dubious demo software) and, to my knowledge, no software is available. The manual even implies that you're on your own when it comes to software. Due to the rather neat RAM expansion ports, however, I wouldn't be too surprised if some plug-in application packs started to appear in the near future.

The Basic interpreter is really very good, supporting the available hardware to the full. As well as providing all the usual Basic facilities, plus a calculator mode, the PC-1600 also has 22 disk commands, 15 communications commands, including interrupt driven I/O, 3 analog port commands, including an interrupt upon 'out of range' statement and 20 commands for the printer.

The Basic also includes full facilities

The PC-1600 slides neatly into its printer interface

In perspective

In many ways, the Sharp PC-1600 is a step into the past. Its Basic interpreter seems about 1978 vintage jazzed up with some peripheral support; it's lack of error messages dates back to a time when 96k of ROM was unheard of; it makes radical departures from the emerging standards; and it offers no software.

Sure, the lowliest PC clone is better in every way, except you can't fit it in your pocket.

It is a firm law of technology that only yesterday's state of the art is available today in low power versions, ultra-small or ultra-cheap. You can even see this in the evolution of VLSI chips, how the number of support chips required oscillates every two generations. First they build a really clever chip which needs lots of support components; then next generation they get even smarter and fabricate the support components on the same chip; then in the next generation they want to add all sorts of functionality so the support components get thrown off the chip into separate packages again. And so it goes on.

Two years from now, a machine the size of the PC-1600 will be running MS-DOS and Lotus 1-2-3. But technology will have moved on, and we'll all stand around looking at it, shaking our heads, criticising the dreadful 200 by 640 graphics, and the limitations of 16 colours. We'll all have desk top machines with million point graphics and 32,000 colours. Two years after that, the handhelds will have million point graphics, and the desk tops will have billion point graphics. And so it goes on.

It's life. You can either utilise today's technology by having lots of extras on the top of your desk, or by having yesterday's proven technology in the palm of your hand. It depends on your needs.

The PC-1600 must be one of the most powerful and most portable computers around today, and if that's what you need, then the PC-1600 is for you. It will cost you, however, nearly as much as a good PC clone.

If you want a computer to have and to hold, then the PC-1600 is probably not for you. It isn't really a pleasure to work with — the keyboard is very small, as is the screen. It's not the sort of computer you feel entirely comfortable with.

I can see the PC-1600 used by large organisations as data acquisition units, going around in the field accumulating information in its non-volatile memory to pass to some larger computer back at headquarters. I can also see it being used as a black box for field operators, programmed by head office so that the man in the field can plug in two or three factors and get an answer on the spot. I can also see it being purchased as a status symbol. However, I can't see it being bought by individuals who want a computer for the sake of having a computer — one to play with and one to learn on. I also can't see someone buying it to run accounts or prepare articles remotely. This is most definitely the travelling man's computer.

Would I buy one? No way — I prefer the extras on the top of my desk, and am prepared to live without the luxury of carrying my extras around in my pocket. However, there would be many engineers, sales reps and estimators who have to perform 'on-site' who will be drooling over this machine.

for making use of the graphics ability, both on the printer and screen. The only negative aspect of the Basic is that it seems a little behind the times in some of its intrinsic features. For example, variable names are only significant to two characters, and arrays may only be a maximum of two dimensions. It looks to me like a very old Basic which has been jazzed up to support the PC-1600 hardware. If this is the case, Sharp has done an extremely good job of it, as the Basic seems so full featured that some of its 'less progressive' aspects are barely noticeable.

One very annoying feature, however, is that the Basic is always in one of two modes: Run or Program. In Program mode, you can't run programs. In Run mode, you can't list programs to the screen or edit them. It is constantly necessary to switch between modes, and you're forever in the wrong mode. I can see no reason for this mode switch, as it merely seems to switch off the facilities which would be available in the other mode, not reassign keys or commands. It ends up being a pain in the neck, even though you do get used to it eventually.

Additionally, no communications software is provided with the machine. This is a real pity, as in most applications for which the PC-1600 would be used, communications would play a vital role. Of course, it's easy enough to write your own communications software, especially with the excellent Basic, but it would be better if Sharp produced a plug-in applications pack.

One last negative is that no error messages are produced. I find this really quite surprising in a 96k ROM, but only error codes are displayed. Whenever anything goes wrong, such as a syntax error, trying to run a program from Program mode, or trying to edit a program in Run mode, the Sharp PC-1600 only gives you a two digit error number, and it is necessary to run off to the appendices to look it up. I thought those days were over.

Finally, the Basic is not terribly fast, as

Technical specifications

Processor:	Z80A compatible running at 3.58 Mhz
RAM:	16k standard, expandable to 80k
ROM:	96k
Keyboard:	63 key
Display:	25x4 lines, text mode
	156x32 dots, graphics mode
I/O:	RS-232C
	Optical Fibre
	Analog
	System expansion bus
Language/OS:	Basic
Size:	195 × 86 × 25.5 mm
Weight:	390 grams including batteries
Peripherals:	Disk drive
	Printer/plotter
	Cassette

Benchmarks

BM1	3.5
BM2	12.7
BM3	37.1
BM4	37.7
BM5	40.4
BM6	61.1
BM7	85.7
BM8	531.4
Average	101.2

For a full listing of Benchmarks see End Zone.

you can see from the benchmark timings. This is partially unavoidable since the interpreter does not support integer type variables — just real numbers and strings.

Documentation

The documentation is generally excellent. Separate manuals are provided for the PC-1600, printer/cassette interface and disk drive. Really only the PC-1600 manual is essential, as it seems to cover everything in the other two. More, in fact.

Full sections are provided on each peripheral, with introductory sections on general care and running of the machine. The largest section is the Basic language reference, an alphabetical description of every command and function. No space is given to the general topic of programming, and this is a little strange when one considers that people will not be buying this machine to run canned applications. Essential for any machine with non-standard ports, the manual includes full pin-out specifications.

The only thing which could really be added is a quick reference guide. The manual is far too big to fit in your pocket, but since the error codes are in it, it really

becomes necessary most of the time. A small pocket size reference card with syntax summaries and the error codes would be a welcome addition.

Prices

The PC-1600 itself costs $650, with another $650 for the printer/cassette interface. The disk drive is quite cheap at $395, and the 32k memory modules sell for $295 each — a lot to pay for 32k, but probably the smallest 32k you'll see for quite a while.

Conclusion

Sharp has certainly done something rather clever with the PC-1600. The company has all this high technology carefully hidden inside the case and entirely focused on making the machine small enough to fit in your pocket.

If you need truly pocket size computing power, the Sharp is well worth a look.

END

'I think it's found the formula, sir.'