The Pocket Calculator Marketplace

AN OVERVIEW

by John Hiley

When I set out to supplement the article on pocket calculator routines. which appeared in the last issue, with a detailed review of the available models, I was astonished at the number of differences which appeared. Rather than falling into a few well-defined groups, it seems that every machine has some feature which sets it apart from its fellows. It appears then that a model by model comparison is far too complex a project, especially with the rapid changes in the industry.

This then is a review of some of the features to watch for, based on a fairly comprehensive study of some 20 different models whose common denominator was the availability of trig. functions and a price tag under $100.00.

The following functions or operations were also found to be common to all: +, —, x, ÷, +/—, e^x, ln, 1/x, $\sqrt{x}$, operation in degrees or radians, at least one memory register, and a numerical keyboard. With a few exceptions all machines also came with log and x^y (or y^x) functions.

Now for the Differences:
Logic

Two logic systems are in general use. Algebraic logic is by far the most common, being the system which is most familiar to virtually all users. Simply, if the problem is 2 x 3=6, the entry sequence is just that, i.e. press the keys 2 x 3= and the displayed answer is 6.

Some models include one or two parentheses for more complex algebraic operations such as 2(3 + 4)=14. For this the entry sequence is 2 x (3 + 4)=.

The models using algebraic logic can be distinguished by the appearance of an = key.

The RPN (Reverse Polish Notation) logic system is well known to any users of Hewlett-Packard calculators and is easily identified by the absence of an = key. Instead there will be a data entry key usually denoted by an upwards arrow or ENT. This system also involves the use of an operational "stack" consisting of 3 or 4 data registers. The mathematical operation is performed **after** the entry of the data rather than between as in the case of algebraic logic. i.e. to perform 2 x 3=6, the entry sequence becomes 2 ↑ 3 x.

The problem 2(3 + 4)=14 is entered thus: 2 ↑ 3 ↑ 4 + x.

The algebraic systems generally do not handle more complex problems of this nature as well as the RPN systems, which can execute fairly difficult hierarchies without resorting to storage and retrieval or extraction and re-entry of intermediate results.

Of the calculators included in this study, only 3, the Novus Mathematician, Philips P-35 and APF Mark 55 were of the RPN variety.

Keyboard Layout

Some calculators employ the one button - one function principle. Others have almost every button doing dual duty by means of a "2nd function" button (usually denoted by F), which activates the "junior" function of the next key. This function is printed above or below the button. Most employ a mixture of single and double function keys.

Other things being equal, it must be considered something of an advantage to press one key rather than two in order to perform an operation. However, if each key is made to perform two functions then obviously there will be either fewer keys (and hence a smaller machine) or more functions (and hence a more powerful machine).

In general, watch for the trig. functions and memory access to be single (or at least primary) keys. The inverse trig. functions, however, are almost always second functions.

Memory

Most of the machines reviewed were limited to one memory register. Exceptions were the Commodore SR-1800 and SR4148R, with two memories, and the APF Mark 55 which has 10 memory registers plus a four level operational stack.

There are a wide range of methods of access to the memory which range from a simple two button "store" and "recall" system on the Qualitron to an eight key system on the Rockwell 63R. This particular system includes: store, recall, clear memory, memory exchange (exchanges contents of the memory with the displayed number), Mx, M÷, M+, M-, which latter 4 cause the displayed number to perform the appropriate operation on the contents of the memory. It should be noted that these are all "2nd functions", which is some indication of the additional calculating power which can be gained at the expense of operating convenience.

For survey calculations a reasonable compromise is found on the Brother 863 which includes as single function keys M+, memory exchange (frequently denoted by x↔M), memory recall and clear memory. Of particular importance is the x↔M key which allows for easy manipulation of entered data. This is very useful in conjunction with the x↔y operation discussed below.

x↔y Exchange

This operation is a real sleeper and is well worth watching for. All the algebraic logic calculators have two data registers, one which holds the first entry as a constant (the y register) and the display (x) register. The ability to manipulate this data is extremely important in developing routines for repetitive calculations, such as those previously published. However, 6 of the models reviewed did not have this capability and 3 others relegated it to "2nd function" status.

The combination of x↔M and x↔y operations permits the manipulation of 3 data entries. It should be noted that with the RPN calculators the ability to juggle the data in the stack is vital and therefore these units invariably have an exchange key.

Polar-Rectangular Conversion

This is, of course, of paramount interest to surveyors and seems to be appearing on more and more calculators in the under $100.00 bracket. Of those reviewed the following incorporated this feature: Commodore SR-1800, Commodore SR 4148R, APF Mark 55, Lloyds Accumatic 335.

Degree-Minute-Second Conversion

This is another important feature from the surveyor's viewpoint and appears on the Lloyds Accumatic 335. This, however, is not quite as attractive as it may seem at first glance. The conversion is not direct, as in the case of the Hewlett-Packards, but requires a separate keystroke after each data entry, i.e.: 56° 45' 23" requires the following sequence: 56 $\overrightarrow{\text{Deg}}$ 45 $\overrightarrow{\text{Deg}}$ 23 $\overrightarrow{\text{Deg}}$.

Since the majority of calculators do not have this feature, a mental calculation which should be within the reach of most surveyors or technicians reduces the conversion to about the same number of keyboard strokes. If the seconds are mentally converted to the nearest half tenth of a minute, then no entry will be incorrect by more than 1 second. This number is then mentally added to the minutes and entered, divided by 60 and added to the degrees. The above example then is entered as follows: 45.4 ÷ 60 + 56=56.756666. If the number had been 56° 45' 22" the entry would have been: 45.35 ÷ 60 + 56= 56.755833.

With an RPN stack the entry is 56 ↑ 45.4 ↑ 60 ÷ +.

No. of Digits

Most of the cheaper models have an 8 digit display which seems to be

adequate for the majority of calculations encountered by the land surveyor but can pose some problems in calculations involving the sin or tangent of a small angle.

For this reason, the 10 digit models offer some advantage. Of those reviewed, the APF Mark 55, Texas SR-50A, and Commodore SR4148-R have 10 digit and scientific notation capability.

Degree-Radian Conversion

Although all models reviewed calculate in degrees or radians (and 2 in grads as well) only four have a direct degree radian conversion capability. These were the Rockwell 63R, APF Mark 55, and the two Commodores.

This function is rather useful in curve calculations involving arc, radius and central angle.

Power Source

Electrical power is supplied in three ways:
Replaceable dry cell batteries; rechargeable nickel-cadium batteries; and AC-DC transformer for use with standard 110v outlets.

Generally, the lower priced units come with replaceable batteries only. The AC-DC adapter is extra at a cost of $5.00, more or less. The more expensive units usually come complete with Ni-Cad. batteries and charger-adaptor.

Unless extended use away from a power source is indicated, it is recommended that rechargeable batteries and a charger-adaptor system be used. Rechargeable batteries can be purchased separately and installed in most units and can be recharged by the adaptor.

Automatic Display Fadeout

Some calculators are equipped with an automatic display suppression which shuts off the power consuming digital display after a short period of time (15 sec., more or less). The display is returned by pressing a specific key which does not disturb the existing data. This feature is particularly valuable on units with non-rechargeable batteries, prolonging battery life considerably. On units not so equipped, battery life can be extended by clearing the display register between calcs. so that only one digit of the display is consuming power.

Statistical Capability

With land surveyors becoming increasingly active in control work the ability to quickly and accurately determine the mean and standard deviation of a series of measurements is a useful function for a small calculator. This capability is found on the two Commodores and the APF Mark 55. A single memory calculator would appear to be unable to handle this type of computation automatically.

It is hoped that this brief review of some of the features available on the low-priced pocket calculators will be of some assistance in guiding the potential purchaser through the sometimes bewildering calculator marketplace.

With the rapid developments and falling price in the calculator field it seems that today's wonder kind is tomorrow's commonplace. Certainly though, at the time of writing, the APF Mark 55 is by far the best value of those reviewed in terms of calculating power. However, if your requirement is for a simple, cheap unit for your field parties, then there are many at half the price which will be perfectly adequate.