= Sinclair Scientific =

The Sinclair Scientific calculator was a 12 @-@ function , pocket @-@ sized scientific calculator introduced in 1974 , dramatically undercutting in price other calculators available at the time . The Sinclair Scientific Programmable , released a year later , was advertised as the first budget programmable calculator .

Significant modifications to the algorithms used meant that a chipset intended for a four @-@ function calculator was able to process scientific functions , but at the cost of reduced speed and accuracy . Compared to contemporary scientific calculators , some functions were slow to execute , and others had limited accuracy or gave the wrong answer , but the cost of the Sinclair was a fraction of the cost of competing calculators .

= = History = =

In 1972 , Hewlett @-@ Packard launched the HP @-@ 35 , the world 's first handheld scientific calculator . Despite market research suggesting that it was too expensive for there to be any real demand , production went ahead . It cost US $ 395 (about GB £ 165) , but despite the price , over 300 @,@ 000 were sold in the three and a half years for which it was produced .

From 1971 Texas Instruments had been making available the building block for a simple calculator on a single chip and the TMS0803 chipset appeared in a number of Sinclair calculators . Clive Sinclair wanted to design a calculator to compete with the HP @-@ 35 using this series of chips . Despite scepticism about the feasibility of the project from Texas Instruments engineers , Nigel Searle was able to design algorithms that sacrificed some speed and accuracy in order to implement scientific functions on the TMS0805 variation .

The Sinclair Scientific first appeared in a case derived from that of the Sinclair Cambridge , but it was not part of the same range . The initial retail price was GB £ 49 @.@ 95 in the UK , and in the US for US $ 99 @.@ 95 as a kit or US $ 139 @.@ 95 fully assembled . By July 1976 , however , it was possible to purchase one for GB £ 7 .

The Sinclair Scientific Programmable was introduced in August 1975 , and was larger than the Sinclair Scientific , at 73 by 155 by 34 millimetres (2 @.@ 9 in × 6 @.@ 1 in × 1 @.@ 3 in) . It was advertised as " the first ... calculator to offer a ... programming facility ... at a price within the reach of the general public , " but was limited by having only 24 program steps .

Both the Sinclair Scientific and the Sinclair Scientific Programmable were manufactured in England , like all other Sinclair calculators except the Sinclair President .

= = Design = =

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The HP @-@ 35 used five chips , and had a been developed by twenty engineers at a cost of a million dollars , leading the Texas Instruments engineers to think that Sinclair 's aim to build a scientific calculator around the TMS0805 chip , which could barely handle four @-@ function arithmetic , was impossible . However , by sacrificing some speed and accuracy , Sinclair used clever algorithms to run scientific operations on a chip with room for just 320 instructions . Constants , rather than being stored in the calculator , were printed under the screen .

It displays only in scientific notation , with a five digit mantissa and a two digit exponent , although a sixth digit of the mantissa was stored internally . Because of the way the processor was designed , it uses Reverse Polish notation (RPN) for inputting calculations . RPN meant that the difficult implementation of brackets , and the associated recursive logic , was not necessary to implement in the hardware , but the effort was instead offloaded to the user . Instead of an " Equals " button , there is an " Enter " button that tells the calculator when a value has been entered , and then the operators are entered in after the operands . For example , on some devices to evaluate " (1 + 2) x

3 " , the sequence entered would be " 3 enter 2 enter 1 + x . " The Sinclair Scientific entry procedure is slightly different as it lacks an enter key and has a limited number of internal registers .

To fit the program into the 320 words available on the chip , some significant modification was used . By not using regular floating point numbers , which require lots of instructions to keep the decimal point in the right place , some space was freed up . Trigonometric functions were implemented in about 40 instructions , and inverse trigonometric functions are almost 30 more instructions . Logarithms are about 40 instructions , with anti @-@ log about 20 on top of that . The code to normalize and display the computed values are roughly the same in both the TI and Sinclair programs .

The design of the algorithms meant that some calculations , such as arccos0.2 , could take up to 15 seconds , whereas the HP @-@ 35 was designed to complete calculations in under a second . Accuracy in scientific functions was also limited to around three digits at most , and there were a number of bugs and limitations .

Ken Shirriff , an employee of Google , reverse engineered a Sinclair Scientific and built a simulator using the original algorithms .

= = = = Assembly kit = = = =

The assembly kit consisted of eight groups of components , plus a carry case . The build time was advertised as being around three hours , and required a soldering iron and a pair of cutters . In January 1975 , the kit was available for US $ 49 @.@ 95 , half the price at the time of introduction a year earlier , and in December 1975 it was available for GB £ 9 @.@ 95 , less than a quarter of the introductory price .

= = = = Giant Scientific = = = =

A version of the Scientific , with all the same functionality , was made to be 30 by 68 centimetres (12 in × 27 in) , and was known as the Giant Scientific . It was powered by 240V AC , and used discrete LEDs for its display .

= = = Sinclair Scientific Programmable = = =

The Sinclair Scientific Programmable was introduced in 1975 , with the same case as the Sinclair Oxford . It was larger than the Scientific , at 73 by 155 by 34 millimetres (2 @.@ 9 in × 6 @.@ 1 in × 1 @.@ 3 in) , and used a larger PP3 battery , but could also be powered by mains electricity .

It had 24 @-@ step programming abilities , which meant it was highly limited for many purposes . It also lacked functions for the natural logarithm and exponential function . Constants used in programs were required to be integers , and the programming was wasteful , with start and end quotes needed to use a constant in a program .

However , included with the calculator was a library of over 120 programs that that performed common operations in mathematics , geometry , statistics , finance , physics , electronics , engineering , as well as fluid mechanics and materials science . The full library of standard programs contained over 400 programs in the Sinclair Program Library .

= = = Calculations Using the Sinclair Scientific = = =

The Sinclair used a slightly different Reverse Polish Notation method ; lacking an enter key , the operation keys enter a number into the appropriate register and the calculation is performed . For example , " (1 + 2) * 3 " could be calculated as : C 1 + 2 + 3 × to give the result of 9 @.@ 0000 00 (9 @.@ 0000 × 100 , or 9) . The " C " key performs a clear ; pressing it sets the calculator to a state with zero in the internal registers . Pressing " C " followed by number keys then " + " effectively adds the number entered to the zero and stores it internally to be worked on in subsequent calculations . If the " - " key is pressed instead , the number is subtracted from zero , effectively entering a

negative number .

All numbers are entered in scientific notation . After entering the mantissa part of the number the " E " exponent key is pressed prior to entering the integer exponent of the number . Respect for the order of operations is placed on the user , and there are no bracket keys . The display shows only five digits , but six digits can be entered . As an example 12 @.@ 3 * (-123.4 + 123 @.@ 456) could be entered as C 1 2 3 4 E 2 - 1 2 3 4 5 6 E 2 + 1 2 3 E 1 × for a displayed result of 6 @.@ 8880 -01 (representing 6 @.@ 8880 × 10 ? 1 , or 0 @.@ 68880) .

Four constants are printed on the calculator case for easy reference . For converting to and from base 10 logarithms and natural logarithms the natural logarithm of 10 (2 @.@ 30259) and e (2 @.@ 71828) are printed on the case . Pi (3 @.@ 14159) and 57 @.@ 2958 (180 / Pi) are also on the case for trigonometry calculations . There was not enough internal memory to store these constants internally . Angles are computed using radians ; degree values must be converted to radians by dividing by 57 @.@ 2958 . As an example , to calculate 25 sin (600 * 0 @.@ 05 °) one would enter C 6 E 2 + 0 0 5 × 5 7 2 9 5 8 E 1 ÷ ? + 2 5 E 1 × to get a result of 1 @.@ 2500 01 (representing 12 @.@ 5 which is equal to 25 sin (30 °)) . Sine is selected with the combination of the " ? " key followed by the " + " key . The " ? " (down) and " ? " (up) arrow keys are function select keys . The four operation keys (" - , + , ÷ and × ") all have two other function activated by using one of the arrow keys . The function available are Sine , Arcsine , Cosine , Arccosine , Tangent , Arctangent , Logarithm and Antilogarithm .