commodore

PR 100

Scientific Programmable Calculator

Owner's Manual

INTRODUCTION

Thank you for selecting our new scientific programmable calculator.

The Commodore PR 100 is one of a powerful range of advanced machines and is virtually three calculators in one.

Firstly, it comprehends all the functions of an advanced scientific calculator including trigonmetric, hyperbolic, logarithmic and exponential functions, powers and roots, linear regression, mean and standard deviation all programmed for ease of use.

Secondly, it has the ability to store 72 sequential programme steps for automatic repetition of lengthy and complex problems, thereby eliminating the need for re-entering long key sequences, with the consequent likelihood of error. Additionally, it has facilities for branching, skipping and halting giving you, the user, great flexibility of use and making the PR 100 the ideal machine for all applications.

Thirdly, it can be used as a standard calculator with its simple algebraic entry and logic which, coupled with the 10 independent memories and memory arithmetic, makes the PR 100 ideal for the manipulation of numbers in any situation. From the simplest to the most complex problem, the PR 100 offer high value for money coupled with ease of use which solves all your everyday and specialist calculating needs.

KEYBOARD LAYOUT

BACK	STEP	R/S	GOTO	SKIP
CLR	SINH	COSH	TANH	CA
F	SIN	COS	TAN	C/CE
CLR	e^x	10^x	$^x\sqrt{Y}$	1/X
(INV)	Ln	log	Y^x	$\sqrt{X}$
C↔S	d↔r	SLOPE	INCPT	n!
R↔P	hms	C_i	C_s	π
FRAC	INT	delxn	Δ%	x↔m
M	MR	xn	%	x↔y
P^n_m	C^n_m	S	$\overline{X}$	S^1
7	8	9	(	)
DEG.	RAD	GRAD	MX	M÷
4	5	6	X	÷
SCI	FP	ENG	M+	M–
1	2	3	+	–
(°F) °C	(in)cm	(gal)l	(lb)kg	9M
O	•	EE	+/–	=

FIGURE 1 – KEYBOARD

CONTENTS

DISPLAY FUNCTIONS

DISPLAY FORMAT

The PR 100 uses a 12 digit light emitting diode, display. Eight of these digits are used to display the mantissa of the number and two for the exponent. The other two digits are used for the sign of mantissa and sign of the exponent.

− 1 2 3 4 5 6 7 8 − 9 9

8 digit mantissa — 2 digit exponent

The calculator operates, automatically, in floating point notation, with two places to the right of the decimal point. If the working notation is not specified the calculator will show all results between 10^7 and 10^{-2} in this format. Outside this range the result will be displayed as a mantissa, with two significant figures, and an exponent.

MANTISSA ENTRY +/–

Depressing any numbered key will enter the number into the calculator. Use of the decimal point key will place the point where required, although after an arithmetical operation the limitations in the last section apply. A negative mantissa may be entered by using the [+/–] key *after* a number has been entered.

EXPONENT ENTRY EE

If [EE] is depressed any following number keyed will be displayed as an exponent. If the change sign key is used after the [EE] key then the exponent sign only is changed.

DISPLAY NOTATION SCI, FP, ENG.

Three types of display notation are available using the FP., SCI or ENG keys. For fixed decimal point notation, by pressing FP, n (where n is a number key) the display will show "n" places to the right of the decimal point. If SCI n is keyed, the display will revert to Scientific notation – displaying n decimal places plus an appropriate exponent. Engineering notation (ENG, n) will show 3+n digits in the mantissa plus an exponent showing the nearest power of 3. The latter may be used to show answers in standard units, e.g. Milliamps (10^{-3}) Micro-amps, e.g.,

Example	Key	Display	
Machine switched on		0.00	
	π	3.14	
FP	6	3.141593	
FP	2	3.14	
SCI	4	3.1416	00
X		3.1416	00
10		10	
=		3.1416	01
SCI	7	3.1415927	01
ENG	4	31.41593	00
X		31.41593	00
100		100	
=		3.141593	03
ENG	1	3.142	03

FRACTION/INTEGER FRAC/INT

The **FRAC** key allows the calculator to display only the fractional part of the number displayed. **INT** causes the calculator to display only the integar portion. If **FRAC** is used the integer part is lost. Similarly if **INT** is used the fractional part is lost.

CLEAR OPERATIONS C/CE, CA

The clear key will clear the last entry (displayed) only when depressed once, but all working data when depressed twice. Storage registers are not affected. A single depression of [C/CE] will clear *both* working registers after any function has been used.

The clear all key **CA** will clear all working and storage registers. Turning the machine 'off' and then 'on' will have the same result.

If the function key (F) or the inverse key (INV) are pressed by mistake, a second press of the same key will cancel the effect. This is indicated by the letters CLR above each key.

The F key (or second function key) if used to obtain the upper-case functions above the keys shown in gold. Please note that where one of these functions e.g. SINH is shown in the book it should be preceded by one press of the F key. This does not apply to the five programming keys.

ARITHMETIC FUNCTIONS

The PR100 operates in alegebraic logic which means that problems are entered in the same order as they would be written down. Chain calculations (where operations are entered sequentially) are possible, and each time an arithmetic function is pressed, all preceding such operations are executed and the temporary answer is displayed. e.g.,

Example: 1 + 2 + 3 + 4

Key	Display
1	1
+	1
2	2
+	3
3	3
+	6
4	4
=	10
Now to divide by 5	
÷	10
5	5
=	2

Multiplication and subtraction is performed in a similar manner.

Memory Operations M, MR, M+, M–, Mx, M÷, 9M, X↔M

Ten addressable memories are provided on the PR 100 for intermediate results or frequently used constants. Separate keys are provided for access to or manipulation of this memory register data.

These 10 registers are addressed 0 thru 9 and are accessed by depressing a single digit key after the memory operation key has been depressed. For example, the key sequence [M] [7] would store the value shown in the display into memory register 7. The key sequence [MR] [5] would extract the value in memory register 5 and display it. The key sequence [M+] [0] would add the value in the display to the value in memory register 0 and store the result in memory register 0. Similarly [Mx] [0] would multiply the value in memory register 0 by the value in the display and store the result in memory register 0.

If any other than a number key (0-9) is depressed the memory command is ignored.

It is possible to manipulate all ten memory registers by the same factor. Use of the **9M** key after a memory arithmetic key will perform that operation on all stores.

Example:

Key	Display	
1	1	
M	1	
0	1.00	Store 1 in 0
C/CE	0	
MR	0	
0	1.00	Recall 1 from 0
3	3	
Mx	3	Multiply contents of 0 by 3
0	3.00	
MR	3.00	
0	3.00	Recall 3 from 0
1	1	
M	1	
1	1.00	Store 1 in 1
2	2	
M	2	
2	2.00	Store 2 in 2
3	3	
M	3	
3	3.00	Store 3 in 3
15	15	
M+	15	
9M	15.00	Add 15 to all memories
MR	15.00	
1	16.00	Recall 1
MR	16.00	
2	17.00	Recall 2
MR	17.00	
3	18.00	Recall 3
14	14	
x ↔ m	14	
0	18	Exchange display for contents of 0

CONSTANT OPERATION

The execution of add, subtract, multiply, and divide functions are accomplished such that the first factor of a multiply and the second factor of addition, subtraction, division, and exponentiation are stored by the calculator logic after execution is complete. This stored constant factor may be used in repeated operations of the same function.

The function x^2 is generated by using the constant facility.

Example

Key	Display	
2	2	
X	2.00	
3	3	
=	6.00	
4	4	
=	8.00	
5	5	
=	10.00	2 is the constant
6	6	
÷	6.00	
3	3	
=	2.00	
12	12	
=	4.00	
15	15	
=	5.00	3 is the constant
7	7	
—	7.00	
4	4	
=	3.00	
5	5	
=	1.00	
10	10	
=	6.00	4 is the constant

Key	Display	
8	8	
+	8.00	
3	3	
=	11.00	
4	4	
=	7.00	
6	6	
=	9.00	3 is the constant
4	4	
y^x	4.00	
3	3	
=	64.00	
5	5	
=	125.00	
8	8	
=	512.00	3 is the constant

PARENTHESIS ( )

A complex problem may be executed using up to four levels of parenthesis to define specific variables prior to execution of function commands.

Example: $((a+b)\,y^x\,2)-((c+d)\,y^x\,2)=\sqrt{x}\;1/x\;\sin\;y^x\;3=$

derives the function:

$$\left(\sin\frac{1}{\sqrt{(a+b)^2-(c+d)^2}}\right)^3$$

It should be noted that parenthesis keys are operated in precisely the order in which a problem would be written or stated. As each new parenthesis is opened, the prior result and prior function are stored until that particular level of parenthesis is closed at a later point in the problem.

Efforts to open more than four levels of parenthesis will cause an error interrupt message. Further calculation is not permitted until operation of the clear key.

Actuation of the [=] key operates to close all prior parenthesis in succession even though the operator has neglected to actuate the [)] key.

Note: A function key must be used between successive parenthesis operations. There is no inferred multiplication produced by the key sequence: (a−b) (c+d) = Instead, the problem must be written (a−b) x (c+d) =.

Example: 10 (((3 + 2) ÷ (4 + 5) − 1) + 6)

Key	Display	
10	10	
x	10.00	
(	0.00	
(	0.00	
(	0.00	
3	3	
+	3.00	
2	2	
)	5.00	
÷	5.00	
(	0.00	
4	4	
+	4.00	
5	5	
)	9.00	
−	0.56	
1	1	
)	-0.44	
+	-0.44	
6	6	
)	5.56	
=	55.56	to 2 places.

MATHEMATICAL FUNCTIONS

EXCHANGE x ⟷ y

This exchanges the contents of the 'x – register' with the contents of the 'y – register'. On single variable functions the exchange facility reduces key strokes for certain problems.

Example 3/ (4 + 5)

Key	Display	
4	4	
+	4.00	
5	5	
÷	9.00	9 in y register
3	3	3 in x register
x ⟷ y	9.00	exchange
=	0.33	to 2 places
FP 7	0.3333333	to 7 places

SIMPLE FUNCTIONS $\sqrt{x}$, $\frac{1}{x}$, y^x, $x\sqrt{y}$

$\sqrt{x}$ and $\frac{1}{x}$ operate on the 'x register' (display) only. The desired key is depressed after the number has been entered into the display; either from the keyboard or as a partial answer.

[y^x] and $x\sqrt{y}$ ([F] [y^x]) work on both registers

Example 3^2

Key	Display	
3	3	
y^x	3.00	'3' into y register
2	2	
=	9.00	ANS

Example $3\sqrt{2}$

Key	Display	
2	2	
$x\sqrt{y}$	2.00	'2' into y register.
3	3	
=	1.25	to 2 places
FP 7	1.2599210	to 7 places

It is possible to chain these operations together.

Example

$$3\sqrt{2^3 + 3^3 + 4^3}$$

2	2	
y^x	2.00	
3	3	
+	8.00	
(	0.00	
3	3	
y^x	3.00	
3	3	
)	27.00	
+	35.00	
(	0.00	
4	4	
y^x	4.00	
3	3	
)	64.00	
=	99.00	
$x\sqrt{y}$	99.00	
3	3	
=	4.63	to 2 places
FP 7	4.6260650	to 7 places

OTHER FUNCTIONS π, %, △%

The constant pi can be obtained directly by using the [π] key. Percentage operations may be performed using the [%] and △% keys. Discount, mark-up and percentage difference calculations may be performed.

Example: £12.30 + 8%

Key	Display	
12.30	12.30	
+	12.30	
8	8	
%	0.98	(8% of 12.30)
=	13.28	to 2 places
FP 3	13.284	to 3 places

Example: A product bought for £11.21 is sold for £15.40 what is the percentage profit and mark up.

Key	Display	
15.4	15.4	
△%	15.40	
11.21	11.21	
=	-27.21	PROFIT *27.2%*
11.21	11.21	
△%	11.21	
15.4	15.4	
=	37.38	MARKUP *37.4%*

Example: 125 is 25% of what?

Key	Display	
125	125	
÷	125.00	
25	25	
%	500	Ans

LOGARITHMIC FUNCTIONS logx, lnx, e^x, 10^x

These keys allow logarithms to base 10 or base e to be computed, and their inverses. The keys are depressed after the number has been entered. Again these functions can be chained.

Example: ln 3 + ln 2

Key	Display	
FP 7	0.0000000	
3	3	
ln	1.0986123	
+	1.0986123	
2	2	
ln	0.6931472	
=	1.7917595	ANS

Example: $e^3 + e^2$

Key	Display		
SCI 7	0.0000000		
3	3		
e^x	2.0085537	01	
+	2.0085537	01	
2	2		
e^x	7.3890561		
=	2.7474593	01	ANS

TRIGONOMETRIC FUNCTIONS sinx, cosx, tanx, (inv) hms, **d — r, deg, rad, grad**

Entry format is automatically in decimal degrees unless the calculator is directed to compute otherwise. The [hms] key allows angles in degrees, minutes and seconds to be converted to decimal degrees, and vice versa. Calculations can be made in radians or grads by using the **rad** or **grad** keys. The [(INV)] key allows inverse trigonometric functions to be calculated. Conversion from degrees to radians, and vice versa is caused by use of the **d ⟷ r** keys.

Example: Find sin 55°

Key	Display		
55	55		
sin	0.82	(to 2 places)	
SCI 7	8.1915204-01	(to 7 places)	ANS.

Example: Find cos 1 (rad)

Key	Display	
rad	0.00	
1	1.00	
cos	0.54	
SCI 7	5.4030231-01	ANS.

Example: Find tan 10.3 (grad)

Key	Display	
grad	0.00	
10.3	10.3	
tan	0.16	
SCI 7	1.6321869-01	ANS.

Example: Find arc sin 0.8124 in degrees/minutes/seconds.

Key	Display		
0.8124	0.8124		
(inv)	0.8124		
sin	54.33	(to 2 places)	
hms	54.20		
FP 5	54.19519 or 54° 19′ 51.9″		ANS.

N.B. The format for degrees, minutes and seconds is DD.MMSSSS . use of the [(INV)] key will allow conversion from d.m.s. to decimal degrees.

Example: Convert 31° 21′ 32″ to decimal degrees.

Key	Display		
31.2132	31.2132		
(inv) hms	31.36	(to 2 places)	ANS

Example: Convert 25° to radians.

Key	Display	
25	25	
d ⟷ r	0.44	(to 2 places)
SCI 7	4.3633231 -01	(to 7 places)

Example: Convert 1.03 radians to degrees.

Key	Display	
1.03	1.03	
(inv)	1.03	
d ⟷ r	59.01	(to 2 places)
FP 6	59.014653	(to 6 places)

HYPERBOLIC FUNCTIONS sinh, cosh, tanh, (inv)

The functions are obtained in a similar way to the trigonometric functions, the function required being pressed after entry of the number. Inverse functions may be obtained by using the inverse key before the function required.

Example: sinh 7

Key	Display	
FP 5	0.00000	
7	7	
sinh	548.31612	ANS

Example: arc cosh 100

Key	Display	
FP 7	0.0000000	
100	100	
(inv)	100	
cosh	5.2982924	ANS

GRAPHICAL FUNCTIONS R ↔ P, C ↔ S

It is possible to convert from rectangular co-ordinates to polar co-ordinates using the [R ↔ P] key. [(INV)] [R ↔ P] will allow the opposite conversion. Similarly by using the c ↔ s key it is possible to convert from cartesian to spherical co-ordinates, and vice versa.

For rectangular to polar conversion, x, y = r, $\angle\theta$, the formulae $r = \sqrt{x^2 + y^2}$, $\theta = \tan^{-1} \frac{y}{x}$ are used.

Example: Convert the rectangular co-ordinates 3, 4 to polar form.

Key	Display		
4	4		
M9	4.00	Store y in 9	
3	3	enter x	
R ↔ P	5.00	r	
MR9	53.13	θ	(to 2 places)
FP 6	53.130102	θ	(to 6 places)

N.B. If θ were required in radians the **d ↔ r** key should be depressed. If the **rad** key were used **before** the conversion θ would automatically be in radians. The polar co-ordinates r $\angle\theta$ are converted to the rectangular co-ordinates x, y using the formulae $x = r\cos\theta$, $y = r\sin\theta$.

Example: Convert 36, $\angle 40^\circ$ to rectangular co-ordinates.

Key	Display	
FP 6	0.000000	
40	40	
M 9	40.000000	Store 0 in 9
36	36	enter r
(inv) R ↔ P	27.577600	x
MR 9	23.140354	y

* **N.B.** As store 9 is used for this calculation, it must not be in used at the same time for other calculations.

The cartesian co-ordinates x, y, z are converted to spherical co-ordinates r $\angle\theta, \emptyset$ using the formulae $\theta = \tan^{-1}(\frac{y}{x})$, $\emptyset = \cos^{-1}(\frac{z}{r})$, $r = \sqrt{x^2 + y^2 + z^2}$

Example: Convert 3, 4, 5 to spherical co-ordinates.

Key	Display	
FP 6	0.000000	
5	5	
M 8	5.000000	Store z in 8
4	4	
M 9	4.000000	Store y in 9
3	3	x
C ↔ S	7.071068	r
MR 9	53.130102	θ
MR 8	45.000000	Ø

Spherical co-ordinates r /θ, Ø are converted to cartesian co-ordinates using the formulae

$x = r \sin \theta \cos Ø,\ y = r \sin Ø,\ z = r \cos \theta$

Example: Convert 20 /35° 65° to cartesian co-ordinates.

Key	Display	
FP 6	0.000000	
65	65	
M 8	65.000000	Store Ø in 8
35	35	
M 9	35.000000	Store θ in 9
20	20	r
(inv) **c ↔ s**	14.848078	x
MR 8	8.452365	y
MR 9	10.396736	z

*As stores 8 and 9 are used for these calculations they must not be in use at the same time for other calculations.

FACTORIAL FUNCTIONS n!, P^n_m C^n_m

The number of permutations of n different objects taken m at a time, is denoted by P^n_m, and the number of combinations of n different objects taken m at a time, is denoted by C^n_m. The keys labelled **P^n_m** and **C^n_m** allow computation of these two functions directly, using the formulae.

$P^n_m = \frac{n!}{(n-m)!}$ and $C^n_m = \frac{n!}{m!(n-m)!}$

Memory 9 is used for this calculation, and must be cleared before entry. Factorial n is available directly using the n ! key.

Example: How many ways can 13 cards be dealt from a Pack of 52.

Key	Display			
FP 7	0.0000000			
13	13	Store m in 9		
M 9	1.3000000		01	
52	52	n		
C^n_m	6.3501355 x		10''	ANS

Example: What is the probability that any 2 people out of 10 have a birthday in the same month (The formulae used in $P = P^n_m \times \frac{1}{n^m}$ where n = 12, m = 10).

Key	Display	
FP 6	0.000000	
10	10	m
M 9	10.000000	
12	12	n
P^n_m	2.395008 08	P^n_m
x	2.395008 08	
(	0.000000	
12	12	n
y^x	12.000000	
10	10	m
+/-	10	-m
)	1.615056 -11	
=	0.003868	P

The probability = (1 − P) x 100% = *99.6%.*

***N.B.** m and n must be less than 100.

STATISTICAL FUNCTIONS Xn, del x n, S, $\overline{X}$, S[1] 'Ci, Cs, **slope, intcp**

The mean and standard deviation functions assume a normal distribution.

A linear regression analysis program is also available, allowing the slope and intercept of the closest fitting line to be computed for a number of given points. If only one co-ordinate of a point on that line is known then the calculator can compute the other.

MEAN AND STANDARD DEVIATION

This program uses the formulae

mean = $\bar{x} = \frac{\Sigma x_n}{n}$ where Σx_n is the sum of n sample values.

Standard deviation $S = \sqrt{\frac{\Sigma (x_n - \bar{x})^2}{(n-1)}}$

and

variance, $S^1 = \frac{\Sigma (x_n - \bar{x})^2}{n}$

Memory 9 is used to count n
Memory 8 is used to calculate Σx_n and
Memory 7 is used to calculate $\Sigma x^2{}_n$

These memories may be accessed at any time during the calculation and must be cleared before use. (Up to 99 points may be entered, this is true for all these calculations). As the "n – 1" formula is used, the normal limitations on its accuracy with small samples applies. The Xn key is used to enter sample values.

Example: The numbers of eggs laid per day, on a certain farm, are tabled below. What was the average number laid during the week, and how certain is the average.

Day	1	2	3	4	5	6	7
Eggs	150	141	162	120	180	157	148

Key	**Display**	
150	150	
Xn	1.00	1st number
141	141	
Xn	2.00	2nd number
162	162	
Xn	3.00	3rd number
120	120	
Xn	4.00	4th number
180	180	
Xn	5.00	5th number
157	157	
Xn	6.00	6th number
148	148	
Xn	7.00	7th number
$\bar{x}$	151.14285	mean
S	18.569048	standard deviation
S[1]	295.55104	variance

Therefore, the average number of eggs is 151 and, using the normal distribution curve, there is a 68% certainty that between 170 and 133 eggs are laid each day.

Wrong entries may be deleted using the **delx$_n$** key.

LINEAR REGRESSION AND TREND ANALYSIS

A series of points, on a graph, may be approximated to the straight line $y = mx + c$ where m is the slope and c the intercept.

Using the PR 100 it is possible to calculate the values of m and c by entering the data points x_i, y_i.

Memories 5, 6, 7, 8 and 9 are used in this calculation and must be cleared before data entry. Up to 99 points may be entered.

The formulae used in this calculation are:

$$m = \frac{n\,\Sigma x_i y_i - \Sigma x_i y_i}{n\,\Sigma x^2 - (\Sigma x_i)^2}$$

and

$$c = \frac{\Sigma y_i \Sigma x_i^2 - \Sigma x_i \Sigma x_i y_i}{n \Sigma x_i^2 - (\Sigma x_i)^2}$$

where n is the number of data points. The value of n_i at any stage in the calculation is shown in the display after x_i and y_i have been entered.

Using these values of m and c the calculator is then able to compute any value of y_s for any given entry x_s and vice versa.

During this calculation memory 5 stores $\Sigma x_i y_i$, memory 6 stores Σy_i, memory 7 stores Σx_i^2, memory 8 stores Σx_i and memory 9 stores n. These may be accessed at any time during the calculation.

Example: The relationship between two variables X and Y is measured experimentally, and the results given in the table. If X and Y are assumed to have a linear relationship of the form $Y = mX + c$, calculate the values of m and c to 2 significant figures.

X	3	2.7	3.5	2.9	2.4	3.1	3.0	2.9
Y	20	21	28	22	19	22	23	20

Key	Display	
3	3	x_1
C_i	3.00	
20	20	y_1
C_i	1.00	n_1
2.7	2.7	x_2
C_i	2.70	
21	21	y_2
C_i	2.00	n_2
3.5	3.5	x_3
C_i	3.50	
28	28	y_3
C_i	3.00	n_3
2.9	2.9	x_4
C_i	2.90	
22	22	y_4
C_i	4.00	n_4
2.4	2.4	x_5
C_i	2.40	
19	19	y_5
C_i	5.00	n_5
3.1	3.1	x_6
C_i	3.10	
22	22	y_6
C_i	6.00	n_6
3.0	3.00	x_7
C_i	3.00	
23	23	y_7
C_i	7.00	n_7
2.9	2.9	x_8
C_i	2.90	
20	20	y_8
C_i	8.00	n_8
SLOPE	7.50	m
INTCP	−0.14	c

The equation relating X and Y is **Y = 7.5X-0.14.**

The function ,x, may be a function available on the calculator. For example, if we know that the relationship between X and Y is exponential, i.e. $Y = Ae^{kX}$, then the values of A and k can be calculated directly. Similar problems can be solved for trig. functions and other functions of x.

Example: If the relationship between x and y is of the form $y = ae^{kx}$, evaluate values of a and k if the table below gives experimental data.

X	0	1	2	3	4	5
y	1.47	29	600	1.2×10^3	2.44×10^5	4.9×10^6

Key	Display	
0	0	
C_i	0.00	
1.47	1.47	
ln	0.39	
C_i	1.00	
1	1	
C_i	1.00	
29	29	
ln	3.37	
C_i	2.00	
2	2	
C_i	2.00	
600	600	
ln	6.40	
C_i	3.00	
3	3	
C_i	3.00	
1.2×10^3	1.2	03
ln	7.09	
C_i	4.00	
4	4	
C_i	4.00	
2.44×10^5	2.44	05

Key	Display		
ln	12.40		
C_i	5.00		
5	5		
C_i	5.00		
4.9×10^6	4.9	06	
ln	15.40		
C_i	6.00		
slope	2.94		k
intcp	0.16		ln a
e^x	1.17		a

$\therefore \quad y = 1.17e^{2.94x}$

Example: For a value of y of 10^3 in the previous example, calculate a value of x (assuming previous data is still in the calculator).

Key	Display		
1×10^3	1	03	Ys
Ln	6.9077553	ln	Ys
(inv) Cs	2.295772	Xs	ANS

Conversely if the value of ys is required, depression of C_s will give this value if x_s is in the display.

CONVERSIONS

The PR 100 has four useful conversion constants programmed in. Most of these are used to perform metric to Imperial (US) conversions. Any quantity entered into the display can be converted using the function indicated on the appropriate numeral key.

Example: Convert 10lb into kilogrammes.

Key	Display		
10	10		
(lb) kg	4.54	(to 2 places)	ANS
FP 6	4.535924	(to 6 places)	

Similarly inverse conversions may be performed.

Example: Convert 25 cm into inches.

Key	Display		
25	25		
(inv) (in)cm	9.84	(to 2 places)	ANS
FP 6	9.842520	(to 6 places)	

Conversion constants used are shown below.

Key	Converts	to	using
(°F)°C	Fahrenheit	Centrigrade	(°F-32) ÷ 1.8
(gal) L	US gallons	litres	3.785411784

Note. 1 US gallon = 0.83269 Imperial gallons.

(lb) kg	pounds	kilogram	0.45359237
(in) cm	inches	centimetres	2.54

Special Problems

Activation of the [RCL] [M+] [X↔Y] or [π] keys, any of the immediate execution function keys (x^2, sin, etc.) or the [)] key causes a special operating mode within the calculator logic. Should any of these keys be followed directly by an entry key (number key, point key, [EEX] key), the entry will be accepted and will *replace* the current contents of the display/entry register.

ERROR CONDITIONS

Result Errors

A calculation may be performed which produces an intermediate or final result outside the permissible range of the calculator. These errors may be referred to as overflow if the magnitude of the result is greater than $(10 - 10^{-7}) \times 10^{+99}$ or underflow if the magnitude of the result is smaller than 1×10^{-99}.

In either case, the result is displayed with the error ⌈ if the result is a positive number or ⊧ if the result is a negative number. The value of the exponent is correct if the operator inserts a "1" before the exponent digits as displayed.

Example: ⊧ 1.23 – 22 should be read -1.23×10^{-122}

Overflow and underflow display will occur when the operation performed is addition, subtraction, multiplication, or division. The occurrence of overflow or underflow will cause the display of the result with the error symbol, calculation is not permitted until depression of the clear key.

Input Argument Errors

Two forms of error may occur as a result of an input variable keyed by the operator.

Input Argument Overflow

Entry of a number larger than $(10 - 10^{-7}) \times 10^{+99}$ (e.g. $999.9 \times 10^{+99}$) will cause an immediate interruption to calculation and a display of the error message (⌈).

Illegal Input Argument

Specific functions cannot be executed over the full range of numbers which may be entered from the keyboard or developed as intermediate results during calculation. Table 1 provides a summary of the permitted range of arguments for each of the functions performed by the calculator and lists the action taken by the calculator when the argument falls outside the permitted range.

In all cases, the appearance of an error symbol on the display causes interruption of further calculation and requires operation of the clear key to continue operation.

TABLE 1

Function	Excepted Range	Error Display
$x + y$	None	
$x - y$	None	
$x \times y$	None	
$x \div y$	$y = 0$	Γ 0.
$^1/_x$	$x = 0$	Γ 0.
$\sqrt{x}$	$x < 0$	F $\sqrt{x}$
$\ln x$	$x \leqslant 0$	Γ 0.
$\log x$	$x \leqslant 0$	Γ 0.
e^x	$x \geqslant 100 \ln 10$	Γ 0.
$\sin x$	None	
$\cos x$	None	
$\tan x$	$\lvert x \rvert = n\ (\pi/2\ \text{RAD})$ or $n\ (90^\circ)$	Γ 0.
$\sin^{-1} x$	$\lvert x \rvert > 1$	Γ 0.
$\cos^{-1} x$	$\lvert x \rvert > 1$	Γ 0.
$\tan^{-1} x$	None	
y^x	$x > \frac{100 \ln 10}{\lvert \ln y \rvert}$	Γ 0.
	or $y \leqslant 0$	Γ 0.
$n!$	$n < o$	Γ 0.
	$70 \leqslant n < 100$ n non-integer	F n! 0.

TABLE 1 – INPUT ARGUMENT RANGE

ACCURACY

The following points should be observed when considering the accuracy limits of the calculator.

Roundoff Error

The following functions ($+, -, \times, \div, ^1/x, x^2, \sqrt{x}$) are subject to a roundoff error of ± 1 count in the least significant digit of an 8 digit result. This error results when an internal 10 digit mantissa is rounded off to display an 8 digit result. Roundoff errors are cumulative and may produce successively larger error with each additional operation.

Algorithmic Errors.

All other functions are accurate to ± 2 counts in the eighth digit. The exact methods for deriving more complex functions are subject to specific errors inherent in the process. These errors may be contributed to by the limited precision of constants used in the process, combined with truncation errors and scaling errors.

Certain functions become less accurate as a specific argument within the input range of the variable is approached. (Example: tan $(90^\circ - \Delta)$).

OPERATING LIMITATIONS

There are limitations on the use of certain functions. These have been mentioned in the text where necessary. A table of the more important ones are given below.

$n!$	n	$\leqslant$	69	for chain calculations
	n	$\leqslant$	99	
sin, cos, tan	$\lvert x \rvert$	$\leqslant$	$10^{\pm 100}$	
sinh, cosh, tanh			$\lvert x \rvert \leqslant 230$	
e^x	$\lvert x \rvert$	$\leqslant$	230	
10^x	x	$\leqslant$	99	
$C^n_m\ P^n_m$	n, m	$\leqslant$	69	
C_i	99 entries		$\lvert x_i \rvert \leqslant 10^{\pm 49}$	
$S, \bar{x}, S^1$	$\lvert x_n \rvert$	$\leqslant$	$10^{\pm 49}$	

PROGRAMMING FUNCTIONS Back, Step, R/S, Goto, Skip

Calculate mode

With the slide switch on the 'RUN' position the system will react in 'real-time' to depressions of the normal calculator keys. The display will provide a normal presentation of entry and result data.

Program Load

With the slide switch in the "load" position, the PR 100 will memorize a series of keys in the order depressed by the operator. These keys may include the normal calculator keys or special keys provided to insert special control characters into the stored program (R/S, Skip, Goto). While keys are being stored in the Load Mode, the calculator display provides an indication of line number (00 to 71). As each new key is entered, the line number will be incremented by one. A 99 will be displayed in the key code location during the initial loading of a program, assuming the program memory has been previously cleared prior to entering the program.

Program Clear

With the slide switch in the "Clear" position, the operator may clear the entire stored program by depressing the [R/S] key. Alternatively, he may clear individual steps of the program by depressing the [Back] or [Step] keys.

Program List/Edit

With the slide switch in the "Load" position, the operator may list a previously stored program. Prior to selecting the "Load" mode, the operator selects the starting point for the listing by depressing the [Go To] key followed by a two digit line number([Go To] 22). Next, the slide switch is placed in the "Load" position and the display will show the selected line number (22) and the key code for the key stored in that location.

The operator may now step forward or backward to list the stored programme using the [Step] or [Back] keys. The display will continue to show the current line number and key code.

To modify or edit the program, the operator simply steps to the desired line number and depresses the desired new key. The code for the new key replaces the previously stored key code at that line number and the program counter increments to the next step causing a display of the next line number and key code.

Program Execute

Stored programs may be executed with the slide switch in the "Run" position. The operator may select a variety of methods for program execution.

a) Depression of the [R/S] key causes execution of the stored key program from the current line number to the next "halt" character.

b) Depression of the [STEP] key causes execution of *one* stored key and a display of the result. Using this technique, the operator may "single-step" the program execution to allow rapid debugging of a new program.

c) Depression of the [SKIP] key causes the program to advance (without executing) to the step following the next "halt" character.

d) The [Go To] key followed by a two numeral line number ([Go To] 22) causes the program pointer to be set to the selected line number. A depression of the [R/S] key now will cause program execution from the selected starting point through the next "halt" character. In this way, the operator may store several unrelated programs and select which of several is to be executed.

Program Format

A stored key program may be entered by the operator and may include up to 72 key positions. Each of the 72 locations may be used to store either:

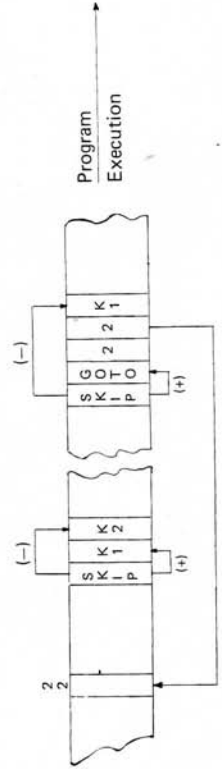
a) Normal calculator keys.

b) Special program keys as defined by operator depression of special keys. These include:

RUN/STOP – R/S (HALT) a special character used either to create a "pause" in program execution to allow the operator to enter new variable data or to define the end of a complete program. The "Halt" character occupies one program location.

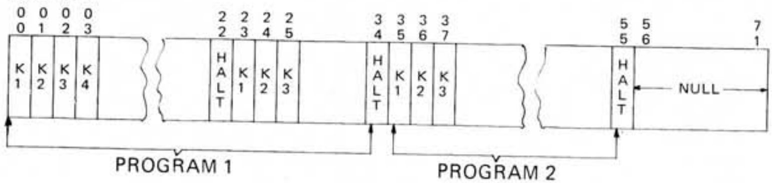
GO TO – a special character causing direct branching within a program. The [Go To] character is always followed by two stored numeral characters to define the line number of the program to which the branch is to occur. Therefore, each direct branch consumes three program locations.

SKIP – a special character causing a conditional branch if the currently displayed number on the calculator is a *negative* number. If the number if positive, the program executes the next stored key. If the number is negative, the program skips the next key and proceeds to the second succeeding key for execution. If the key to be skipped is a Go To character, the program will skip not only that key but the two succeeding line number keys and will proceed to the fourth succeeding key after the SKIP character.

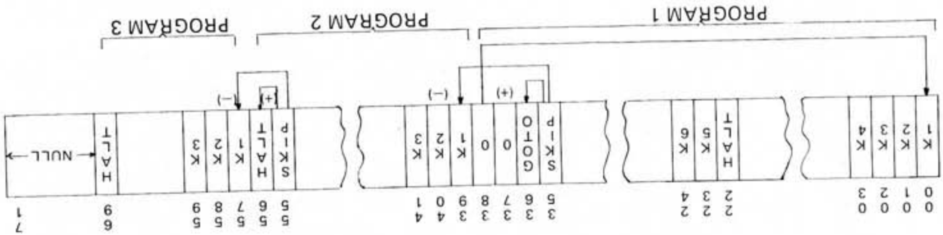


NULL – a special character inserted into the program to cause "no operation". One or more of these characters may be inserted by the operator to allow future changes to the program. Also, after initial application of power or after the "clear program" operation, the key memory will be completely filled with "null" characters.

Example 1



– the example shows two independent stored programs. Program 1 is stored in locations 00 to 34. A halt character has been inserted at location 22 to allow the operator to insert variable data and a second halt character exists at location 34 to define the end of the program. Program 2 has been stored in locations 35 to 55 with a single halt character at location 55 to define the end of the program. Locations 56 to 71 are not used and are filled with null characters.



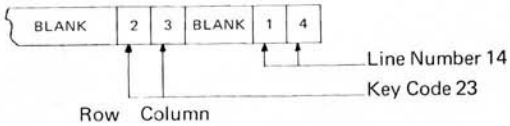
– the example shows three connected programs. Program 1 (from location 00 to 38) will re-execute due to the stored SKIP character (35) until the calculated number has become negative. The Go To (36, 37, 38) redirects the program back to location 00. During each execution of Program 1, the program will pause at location 22 because a halt character has been inserted at this location.

– when the calculated number has become negative, the program will skip from location 35 to location 39 and will execute Program 2 stored in locations 39 to 56. At the end of Program 2 is a conditional halt due to the storage of SKIP in location 55. If the calculator number is positive, the program will halt. If the calculated number is negative, the program will skip the halt character at location 56 and begin immediately to execute Program 3 (locations 57 to 69). Program 3 terminates unconditionally at the halt character of location 69.

Display Format

During the normal calculate mode, the program does not interfere with the operation of the calculator and the display format is as specified in the first part of the instruction booklet.

Whenever the Load or Clear position of the slide switch is selected, the PR 100 provides a special display to assist in the storage or editing of a program. The display consists of two numerals (00 to 71) presented in the two right most digits of the display to indicate the program line number. A blank display character exists to the left of these digits. To the left of the blank character, two additional numeral digits are presented. These numbers are used to define a specific stored key or character in the program memory. These numbers specify the row and column of the key to the keyboard.



The specific key codes included on the PR 100 are shown in Figure 1.

NOTE: During initial program entry in the Load Mode, the key code position of the display will show a constant value of 99 (assuming that the program memory has been previously cleared), as the program step-counter automatically steps on after each key depression. To ascertain the last entry into program memory, the Back Step key should be used.

COLUMN

ROW	1	2	3	4	5
1	BACK (11)	STEP (12)	R/S (13)	GOTO (14)	SKIP (15)
2	CLR / F (21)	SINH / SIN (22)	COSH / COS (23)	TANH / TAN (24)	CA / C/CE (25)
3	CLR / (INV) (31)	e^x / Ln (32)	10^x / log (33)	$\sqrt[x]{Y}$ / Y^x (34)	1/X / $\sqrt{X}$ (35)
4	C↔S / R↔P (41)	d↔r / hms (42)	SLOPE / C_r (43)	INCPT / C_s (44)	n! / π (45)
5	FRAC / M (51)	INT / MR (52)	delxn / xn (53)	Δ% / % (54)	x↔m / x↔y (55)
6	P^n_m / 7 (61)	C^n_m / 8 (62)	S / 9 (63)	$\overline{X}$ / ((64)	S^1 /) (65)
7	DEG. / 4 (71)	RAD / 5 (72)	GRAD / 6 (73)	MX / X (74)	M÷ / ÷ (75)
8	SCI / 1 (81)	FP / 2 (82)	ENG / 3 (83)	M+ / + (84)	M− / − (85)
9	(°F) °C / 0 (91)	(in)cm / o (92)	(gal)l / EE (93)	(lb)kg / +/− (94)	9M / = (95)

FIGURE 1 – KEYBOARD

Operating Characteristics

Keyboard Definition

A three position slide switch defines the operating mode of the system. Five keys are used by the operator to control the actions taken by the PR 100 for each of the system operating modes.

Key [R/S]
- in the Run Mode, causes execution of a stored program from the current line number to the next halt character.
- in the Load Mode, causes insertion of the halt character into the stored program at the current line number.
- in the Clear Mode, causes a total clear (inserts Null characters) in all locations of the program memory.

Key [Go To] [N_1] [N_2]
- in the Run Mode, causes the program pointer to be set to the location specified by N_1 N_2.
- in the Load Mode, causes storage of the Go To character and the two numeral characters into the next three locations of the program memory.
- in the Clear Mode, this key is ignored.

Key SKIP

- in the Run Mode, causes the program pointer to advance to the location following the next halt character. (H + 1). Stored keys are not executed during this "skip" operation.
- in the Load Mode, causes the insertion of a "Skip-on-Negative" character into the stored program.
- in the Clear Mode, this key is ignored.

Key STEP

- in the Run Mode, causes the next stored program key to be executed.
- in the Load Mode, causes the program pointer to be advanced by one.
- in the Clear Mode, inserts a null character in the location specified by the program pointer and advances the program pointer by one.

Key BACK

- in the Run Mode, this key is ignored.
- in the Load Mode, causes the program counter to be decremented by one.
- in the Clear Mode, inserts a null character in the location specified by the program pointer and decrements the program pointer by one.

FORMATION OF A PROGRAM

One of the best ways to obtain the most efficient program for a set problem is to draw a flow diagram. In this example, the complete formation of a program to convert decimal to binary numbers is shown:

Example:

DECIMAL 25
BINARY 11001

a — Any number (n) can be expressed as 2^x, where x is the logarithm to base 2 of n. Therefore, the integer part of x is the highest power of 2 that will go into n

$n=2^x \qquad \log n = x \log 2$

highest power of 2 in N is x =

$$\text{INTEGER PART OF } \left(\frac{\log n}{\log 2}\right)$$

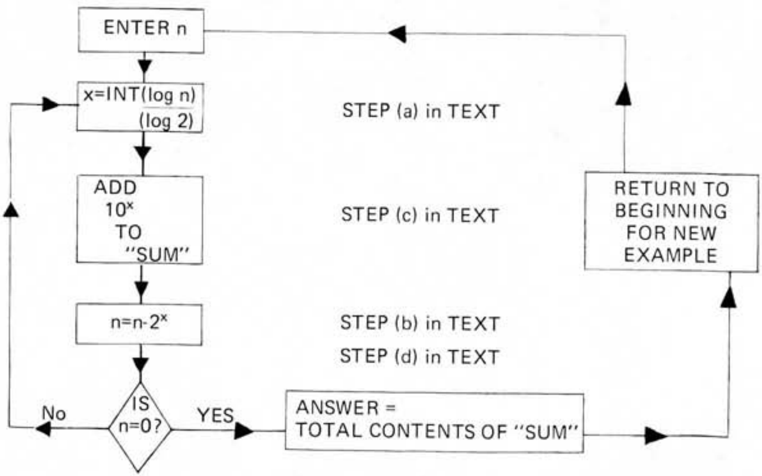
b — If 2 is now raised to this power and subtracted from (n), a new remainder is obtained, and the process may be repeated for the next highest power of 2.

In the above example, 2 is the highest power in 25 i.e. 10000 in binary, however this appears similar to 10^4 i.e. 10000 in decimal and this fact can be used in the program.

c — Therefore, having obtained the highest power (say x) we raise 10 to the power of x (i.e. anlilog it) and sum it into the total answer. The program is then returned to the beginning for operation on the new remainder.

d — A conditional skip must be used to halt the program when all the powers of 2 contained in n have been recorded i.e. when the remainder or new n is = 0. If the program were to take the log of 0 an error would arise and this must be avoided.

FLOW DIAGRAM OF BINARY CONVERSION PROGRAM



PROGRAM ENTRY STEPS

0	M		21	2	41	GOTO	
1	0		22	x↔y	42	0	
2	MR		23	=	43	2	
3	0		24	—	44	MR	
4	log		25	MR	45	2	
5	÷	a	26	0	46	R/S	
6	2		27	x↔y	47	GOTO	
7	log		28	=	48	0	
8	=	—	29	M	49	0	
9	F		30	0	50		
0	INT		31	—	51		
1	M		32	1	52		
2	I		33	=	53		
3	F	c	34	⌐	54		
4	10ˣ		35	INT	55		
5	F		36	+/−	56		
6	M+		37	SKIP	57		
7	2		38	GOTO	58		
8	MR		39	4	59		
0	Yˣ		40	4	60		

INSTRUCTIONS

F CA — To clear calculator
Mode switch to load
Key in Program
Mode switch to ROM
F FPO — 0 decimal places
GOTO 00
Enter number e.g. 25
Press R/S — Answer displayed 11001
FCA
New Number
R/S
etc.
A further adaption of this program may be used to convert any number to any base 1-10

METHODS OF ENTERING AND RETRIEVING DATA

A variety of different methods may be used, according to how much program space is available and how much time the operator is prepared to use before the program is run.

1. One piece of data is entered, the program is run and halts. This is the simplest method.
2. All data is entered into respective memories and recalled by the program — this method is most convenient when several pieces of data are needed.
3. For two inputs only, the x and y registers may be used. However, program space is then needed to put the data into memories before using it.
4. Advanced programming allows all the data to be put on one display e.g. either side of the decimal point or each digit a separate entry.

   Examples of each method on a simple program to add two numbers e.g. 15 and 7.

Step	Method 1	Method 2	Method 3	Method 4
00	X	MR	M	M
01	R/S	1	1	1
02	=	X	ẋ-y	F
03	R/S	MR	X	FRAC
04		2	MR	X
05		=	1	1
06		R/S	=	EE
07			R/S	4
08				X
09				MR
10				1
11				F
12				INT
				=
				R/S

INSTRUCTIONS

FCA Switch to Load Key in Program Switch to run Goru 00.

3	3M1	3	
R/S	4M2	x-y	3.0004
4	R/S	R/S	R/S
R/S			
(12 Displayed)	(12 Displayed)	(12 Displayed)	(12 Displayed)

The advantages and disadvantages of each method can now be seen.

By using each method in reverse the answers may be obtained in a similar fashion.

N.B. with method 4, numbers up to 10^4 may be entered. Careful use of x10 10FIMr, and F FRAC enables entry of several pieces of data including decimal numbers.

FURTHER USE OF THE SKIP FACILITY

Combining this function with others, enables a number of conditional tests on two numbers N_1, N_2 to be performed e.g. to skip on the following conditions, program thus:

$N_1 = N_2$: $N_1 - N_2 = x^2$ +/−=Skip($N_1 = N_2$) ($N_1 = N_2$)
$N_1 > N_2$ $N_2 - N_1$ =Skip ($N_1 \leqslant N_2$) ($N_1 > N_2$)
$N_1 = 0$ $N_1 x^2$+/−Skip (N=0) (N=0)

Operating Procedures

An example will help to illustrate the operating procedures to be followed when using the PR 100 for the solution of real problems.

Assume that the quadratic equation

$$y = x^2 + 3x - 5$$

is to be solved for all integer values of x where:

$$0 \leqslant x \leqslant 5$$

Storing Programs

The operator elects to program the problem according to the flow chart (Fig. 2) and prepares the listing of program steps (Fig. 3). To store the program, the following procedures are used:

1. Place the slide switch in the Clear position and depress the [R/S] key to clear all previous programs.
2. Move the slide switch to Load.
3. Enter the keys as shown in Fig. 3 in the precise order shown. As the keys are executed, the display will provide the line number indications shown in Fig. 3.

Executing Programs

Once the program is loaded, the operator may now proceed to execute all or any portion of the stored program. The following procedure is used:

1. Move the slide switch to Run.
2. Return to the 00 start point of the program using either [Go To] 00 or [SKIP].
3. Depress the [R/S] key. The program will run and then halt to display the first value of "x".
4. Depress the [R/S] key a second time. The program will run and then halt to display the computed value of "y".
5. Repeat steps 3 and 4 (see Fig. 4) until all values of "x" and "y" are computed.
6. The program is written so that it will repeat indefinitely as long as the [R/S] key continues to be depressed.

Had the operator elected to "single-step" the program for purposes of debugging, he would follow the following procedure:

1. Place the slide switch in the Run position.
2. Return to the 00 program start position.
3. Depress the [STEP] key to execute each step of the program. Fig. 5 shows the contents of the display for each depression of the [STEP] key during the initial loop of the program.

If the operator now elects to solve the same quadratic equation but for a different value of x, he might proceed as follows:

1. Place the slide switch in the Run position.
2. Enter the desired value of x.
3. Enter [Go To] [0] [2]
4. Press [R/S]. The program halts to display the entered value of x.
5. Press [R/S]. The program halts to display the computed value of $y = x^2 + 3x - 5$.

Note that the operator has entered the stored program at an arbitrary point (02) and forced execution of the program from that step forward.

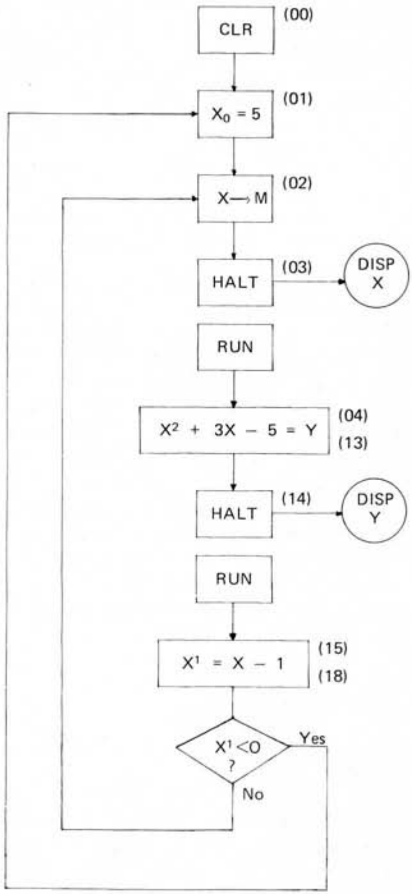


FIGURE 2 – FLOW CHART (Sample Problem)

FIGURE 3 – PROGRAM LISTING (sample prog.)

Step #	Enter Key	Display	Remarks
00	C/CE	25. 00	Clear Calculator.
01	5	72. 01	Set $X_0 = 5$
02	M	51. 02	Store X in Memory.
03	0	91. 03	
04	R/S	13. 04	Halt Display X
05	×	74. 05	
06	=	95. 06	Calculate X^2
07	+	84. 07	
08	(	64. 08	
09	3	83. 09	
10	×	74. 10	
11	MR	52. 11	
12	0	91. 12	
13	)	65. 13	
14	−	85. 14	
15	5	72. 15	
16	=	95. 16	Execute $Y = X^2 + 3X\text{-}5$
17	R/S	13. 17	Halt Display Y
18	MR	52. 18	
19	0	91. 19	
20	−	85. 20	
21	1	81. 21	

Step #	Depress Key	Display		Remarks
22	[=]	95.	22	Decrement X
23	[SKIP]	15.	23	Check for $X < 0$.
24	[GO TO]	14.	24	Continue if $X > 0$
25	[0]	91.	25	
26	[2]	82.	26	
27	[GO TO]	14.	27	Repeat Program if $X < 0$
28	[0]	91.	28	
29	[1]	81.	29	

Note: The key codes shown will appear whenever the indicated line number is displayed. However, during initial program entry and assuming the program memory has been cleared previously, a 99 will appear in the key code position of the display as each new key is entered in the Load Mode.

FIGURE 4 -- PROGRAM EXECUTION (Sample Problem)

Press Keys	Display	Action
Go to 00		Index to Program start
RUN/STOP	5.00	Display $x_0 = 5$
RUN/STOP	35.00	Display y_0
RUN/STOP	4.00	Display $x_1 = 4$
RUN/STOP	23.00	Display y_1
RUN/STOP	3.00	Display $x_2 = 2$
RUN/STOP	13.00	Display y_2
RUN/STOP	2.00	Display $x_3 = 2$
RUN/STOP	5.00	Display y_3
RUN/STOP	1.00	Display $x_4 = 1$
RUN/STOP	−1.00	Display y_4
RUN/STOP	0.00	Display $x_5 = 0$
RUN/STOP	−5.00	Display y_5

FIGURE 5 – STEP PROGRAM EXECUTION
(Sample Problem)

Step #	Depress Key	Display	Remarks
00	[Go To]	00 0	Clear calculator
01	[STEP]	5	Enter $x_0 = 5$
02	[STEP]	5	Store x_n in memory
03	[STEP]	5	Halt to display x_n
04	[STEP]	25	Compute $x_n 2$
05	[STEP]	25	Enter [+] function
06	[STEP]	0	Enter [( ] function
07	[STEP]	3	Enter 3
08	[STEP]	3	Enter [x] function
09	[STEP]	5	Recall x_n from memory
10	[STEP]	15	Enter [ )] and compute $(3 x_n)$
11	[STEP]	40	Enter [−] and compute $x_n{}^2 + 3x_n$
12	[STEP]	5	Enter 5
13	[STEP]	35	Compute $x_n{}^2 + 3x_n - 5 = y$
14	[STEP]	35	Halt to display y
15	[STEP]	5	Recall x_n from memory
16	[STEP]	5	Enter [−] function
17	[STEP]	1	Enter 1
18	[STEP]	4	Compute $x_n - 1$
19	[STEP]	4	Check for $(x_n - 1) < 0$

Step #	Enter Key	Display	Remarks
20	STEP	4	Read Go To
21	STEP	4	Read Go To address # 1
22	STEP	4	Read Go To address # 2
02	STEP	4	Store $x_n - 1$ in memory
(etc)			

Editing and Modifying Programs

If the operator now desires to modify the problem he has previously programmed, he may proceed as follows:

Assume that a new equation is to be solved.

$$y = x^2 + 6x + 2$$

for $0 \leqslant x \leqslant 8$.

1. Press [Go To] [0][0]
2. Place the slide switch in Load Position.
3. Press [STEP] to advance to step 01.
4. Enter 8 to change the x_0 value from 5 to 8.
5. Press [STEP] until line number 09 appears on the display.
6. Enter 6 to modify the factor 3x to 6x.
7. Press [STEP] until line number 14 appears on the display.
8. Enter [+] to change the previous subtract command to an add command.
9. Enter [2] to change the previous constant 5 to the new value 2.
10. Place the slide switch in Run position and the new program may now be executed.

Next assume that the operator decides to eliminate the halt in the program so that each depression of the [R/S] key will cause a solution of the equation and a display of "y" without first pausing to display the value of x.

He should proceed as follows:

1. Place the slide switch in the Run position.
2. Press [Go To] 04 (the step number of the halt character to be deleted).
3. Place the slide switch in the Clear position.
4. Press the [STEP] key *once*.
5. Return the slide switch to the Run position and execute the program as desired.

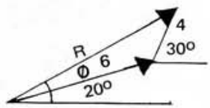
Note that the [STEP] key has inserted a null or "no-operation" character at line number 04 thus eliminating the previously stored halt character at that location.

Applications

APPLICATIONS

A. CALCULATED EXAMPLES

1. Vector Addition. Find the resultant of two vectors $6 \angle 20^\circ$ and $4 \angle 30^\circ$

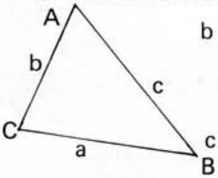


The method used involves finding the respective rectangular co-ordinates, and adding these to give the rectangular co-ordinates of the resultant.

Key	Display	
20	20	θ_1
M9	20.00	
6	6	$\lceil 1$
(inv) R ↔ P	5.64	x_1
M1	5.64	Add to ST01
MR9	2.05	y_1
M2	2.05	Add to ST02
30	30	θ_2
M9	30.00	
4	4	$\lceil 2$
(inv) R ↔ P	3.46	x_2
M+ 1	3.46	Add to ST01
MR 9	2.00	y_2
M+ 2	2.00	Add to ST02
MR 2	4.05	Σy
M 9	4.05	
MR 1	9.10	$\Sigma \chi$
R ↔ P	9.96	r
MR 9	24.00	θ

ANSWER: Resultant is 9.96 $\angle 24^\circ$

2. Cosine Rule. In triangle ABC, a = 10, b = 13, $\hat{C} = 110^o$ Find c



$$c = \sqrt{a^2 + b^2 - 2\ ab \cos C}$$

Key	Display		
10	10	a	
y^x	10.00		
2	2		
+	100.00	a^2	
(	0.00		
13	13	b	
y^x	13.00		
2	2	b^2	
)	169.00		
—	269.00	$a^2 + b^2$	
(	0.00		
2	2	2	
X	2.00		
10	10	9	
x	20.00	2a	
13	13	b	
x	260.00	2ab	
110	110	$\hat{C}$	
cos	−0.34	cos C	
)	−88.93	2abcosC	
=	357.93	C^2	
$\sqrt{\ }$	18.92	C	ANS

3. Hypergeometric Distribution. What is the probability of getting 3 kings in 5 draws from a 52 card standard deck?

The method used employs the formulae:

$$H\ (m,n,a,b) = \frac{C^a_m \times C^{\ b}_{n-m}}{C^{a+b}_n}$$

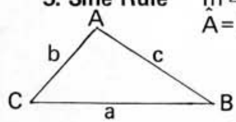
where m = 3, n = 5, a = 4 and b = 48

and n − m = 2, a + b = 52.

Key	Display		
3	3		m
M9	3.00		
4	4		a
C^n_m	4		C^a_m
M1	4		
2	2		n − m
M9	2.00		
48	48		b
C^m_n	1128.00		C^b_{n-m}
Mx 1	1128.00		
5	5		n
· M9	5.00		
52	52		a + b
C^n_m	2.60	06	C_n
M÷1	2.60	06	
MR1	1.7	−03	H

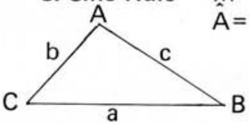
ANS. H= 0.17 %

5. Sine Rule In △ ABC a = 10, b = 12, $\hat{A}$= 50° 33′ Find $\hat{B}$



Formula $\sin B = \frac{b \sin A}{a}$

5. Sine Rule In △ ABC $a = 10$, $b = 12$, $\hat{A} = 50^\circ\ 33'$ Find $\hat{B}$



Formula $\sin B = \dfrac{b \sin A}{a}$

Key	Display	
50.33	50.33	
(inv)hms	50.55	$\hat{A}$
sin	0.77	sin $\hat{A}$
X	0.77	
12	12	
÷	9.27	bsinA
10	10	a
=	0.93	arc sin B
(inv)sin	67.91	$\hat{B}$ decimal
(inv)hms	67.54	B´d.m.s.
FP4	67.5447	

ANS $B = 67^\circ\ 54'\ 47''$

6. Physical Electronics. The breakdown voltage V_B for an abrupt p – n junction, is related to the energy gap, Eg, and the background doping, N_B, by the following expression.

$$V_B = 60 \left(\frac{E_g}{1.1}\right)^{3/2} \times \left(\frac{N_B}{10^{16}}\right)^{-3/4} \text{ volts.}$$

where Eg is in eV and N_B in cm^{-3}

For silicon with Eg 1.13 eV and N_B 10^{15} cm^{-3} calculate the breakdown voltage.

Key	Display			
60	60			
X	60.00			
(	0.00			
(	0.00			
1.13	1.13		E_g	
÷	1.13			
1.1	1.1			
)	1.03		$E_g/1.1$	
y^x	1.03			
1.5	1.5			
)	1.04			
X	62.47		$60 \left(\frac{E_g}{1.1}\right)^{3/2}$	
(	0.00			
(	0.00			
1×10^{15}	1	15	N_B	
÷	1.00	15		
1×10^{16}	1	16		
)	0.10		$\frac{N_B}{10}$	
y^x	0.1			
0.75	0.75			
+/–	–0.75		$\left(\frac{N_B}{10^{16}}\right) - 3/4$	
)				
=	351.30	V_B		ANS

B. SAMPLE PROGRAMS

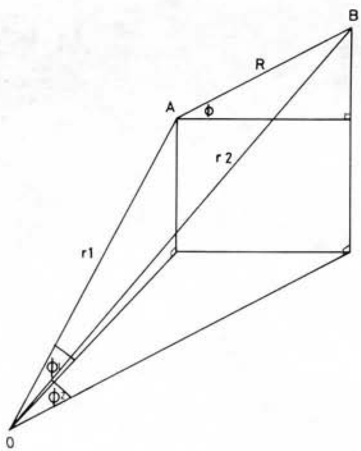
COMPOUND INTEREST. Given any 3 of A, P, r, n to determine the other.

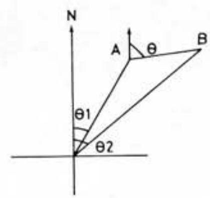
PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	81	1		25	34	y^x		50	81	1	
01	84	+		26	52	MR		51	91	O	
02	52	MR		27	91	O		52	91	O	
03	81	1		28	65	)		53	95	=	
04	54	%		29	95	=		54	13	R/S	displays r
05	95	=		30	13	R/S	displays P	55	52	MR	
06	51	M		31	64	(		56	83	3	
07	81	1		32	64	(		57	75	÷	
08	13	R/S	displays $1+\frac{r}{100}$	33	52	MR		58	52	MR	
09	52	MR		34	83	3		59	82	2	
10	81	1		35	75	÷		60	95	=	
11	34	y^x		36	52	MR		61	33	log	
12	52	MR		37	82	2		62	75	÷	
13	91	O		38	65	)		63	64	(	
14	74	x		39	34	y^x		64	52	MR	
15	52	MR		40	64	(		65	81	1	
16	82	2		41	52	MR		66	33	log	
17	95	=		42	91	O		67	65	)	
18	13	R/S	display A	43	21	F		68	95	=	
19	52	MR		44	35	1/x		69	13	R/S	display n
20	83	3		45	65	)		70			
21	75	÷		46	65	)		71			
22	65	(		47	85	–					
23	52	MR		48	81	1					
24	81	1		49	74	x					

Registers	
0	n
1	r $\rightarrow 1+\frac{r}{100}$
2	P
3	A
4	
5	
6	
7	
8	
9	

Notes
$A=P(1+r/100)^n$
A=Amount
P=Principal
r%=rate per period
n=No. of periods





Given Line of sight distance OA = r_1 of point A
Bearing (from N) θ_1 relative to O
Angle of elevation $\emptyset_1$ A

and Line of sight OB = r_2 of B
Bearing θ_2 relative to O
Angle of elevation $\emptyset_1$

Programme calculates AB = R
Bearing of B from A A = θ
Angle of Elevation of B from A = $\emptyset$

AREA OF A TRIANGLE GIVEN 3 SIDES

PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	13	R/S		25	74	x		50			
01	52	MR		26	52	M		51			
02	81	1		27	91	O		52			
03	84	+		28	95	=		53			
04	52	MR		29	35	$\sqrt{x}$		54			
05	82	2		30	14	GOTO		55			
06	84	+		31	91	O		56			
07	52	MR		32	91	O		57			
08	83	3		33				58			
09	95	=		34				59			
10	75	÷		35				60			
11	82	2		36				61			
12	95	=	$s=\frac{a+b+c}{2}$	37				62			
13	21	F		38				63			
14	85	M–		39				64			
15	21	F		40				65			
16	95	9M		41				66			
17	52	MR		42				67			
18	81	1		43				68			
19	74	x		44				69			
20	52	MR		45				70			
21	82	2		46				71			
22	74	x		47							
23	52	MR		48							
24	83	3		49							

Registers	
0	-s
1	a–» a-s
2	b–» b-s
3	b–» c-s
4	)
5	)
6	)–s
7	)
8	)
9	)

Notes

AREA OF TRIANGLE GIVEN 3 SIDES

USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All Memories		F	CA			
2	Set Display FP/Sci/Eng						
3	Mode Switch to LOAD						
4	Enter Program						
5	Mode Switch to RUN, press R/S twice to begin program		R/S	R/S			
6	Enter a into M1	a	M1				
	Enter b into M2	b	M2				
	Enter c into M3	c	M3				
7	Press R/S to execute programme						
8	Area left on display						
	Enter new data via step 7						

CIRCUMFERENCE & AREA OF CIRCLE — PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	13	R/S		25				50			
01	52	MR		26				51			
02	91	O		27				52			
03	74	X		28				53			
04	45	pi		29				54			
05	95	=		30				55			
06	51	M		31				56			
07	63	9	πr in M9	32				57			
08	74	X		33				58			
09	82	2		34				59			
10	95	=		35				60			
11	51	M)	2πr	36				61			
12	81	1)	in M1	37				62			
13	52	MR		38				63			
14	63	9		39				64			
15	74	X		40				65			
16	52	MR		41				66			
17	91	O		42				67			
18	95	=		43				68			
19	51	M)	πr^2 in	44				69			
20	82	2)	M2	45				70			
21	14	GOTO		46							
22	91	O		47							
23	91	O		48							
24				49							

Registers	
0	r
1	2πr
2	πr^2
3	
4	
5	
6	
7	
8	
9	

Notes

CIRCUMFERENCE & AREA OF A CIRCLE — USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Set Display (FP, SCI or ENG. n) e.g.		F	FP	n		
3	Mode Switch to Load						
4	Enter Program						
5	Mode Switch to Run						
6	Press R/S twice to begin program		R/S				
			R/S				
7	Enter radius in M0	R	M	0			
8	Press R/S to compute answer		R/S				
9	Display area (also in M2)						Area
10	Display circumference from M1		MR	1			Circumference
	Enter new radius via. step 7.						

AREA OF A FILLET, LENGTH OF ARC, AREA OF SECTOR PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	13	R/S	(a) Program	25	13	R/S	(b) Program	50			
01	52	MR		26	52	MR		51			
02	91	O		27	63	9		52			
03	74	X		28	21	F		53			
04	95	=		29	42	d–r		54			
05	74	x		30	52	M		55			
06	64	(		31	63	9		56			
07	81	1		32	74	x		57			
08	85	–		33	52	MR		58			
09	64	(		34	91	O		59			
10	45	Pi		35	95	=		60			
11	75	÷		36	51	M	Length of Arc	61			
12	71	4		37	82	2	Stored in M2	62			
13	65	)		38	74	x		63			
14	65	)		39	52	MR		64			
15	95	=		40	91	O		65			
16	51	M		41	95	=		66			
17	81	1		42	51	M	Area Stored	67			
18	14	GOTO		43	83	3	in M3	68			
19	91	O		44	14	GOTO		69			
20	91	O		45	82	2		70			
21	99	NULL		46	72	5		71			
22	99	NULL		47							
23	99	NULL		48							
24	99	NULL		49							

Registers	
0	R
1	Area of Fillet
2	Area of Arc
3	Area of Sector
4	
5	
6	
7	
8	
9	O in Radius

Notes

O entered in degrees & Program Converts

Line of sight distance, bearing and angle of elevation of B from A. PROGRAM LIST

Loc. Adr. Adr.	Code Kode Code	Key Taste Touche	Comments Bemerkungen Commentaires	Loc. Adr. Adr.	Code Kode Code	Key Taste Touche	Comments Bemerkungen Commentaires	Loc. Adr. Adr.	Code Kode Code	Key Taste Touche	Comments Bemerkungen Commentaires
00	51	M		25	81	1		50	52	MR	
01	61	7		26	52	MR		51	91	O	
02	13	R/S		27	63	9		52	85	–	
03	85	–		28	51	M		53	52	MR	
04	63	9		29	82	2		54	81	1	
05	91	O		30	52	MR		55	95	=	
06	95	=		31	62	8		56	21	F	
07	94	+/–		32	51	M		57	41	P⟷S	
08	51	M		33	83	3		58	13	R/S	
09	63	9		34	13	R/S		59	63	9	
10	13	R/S		35	14	GTO		60	91	O	
11	85	–		36	91	O		61	21	F	
12	63	9		37	91	O		62	85	M–	
13	91	O		38	51	M		63	21	F	
14	95	=		39	91	O		64	95	9M	
15	94	+/–		40	52	MR		65	81	1	
16	51	M		41	83	3		66	94	+/–	
17	62	8		42	21	F		67	21	F	
18	52	MR		43	85	M–		68	74	MX	
19	61	7		44	62	8		69	21	F	
20	31	INV		45	52	MR		70	95	9M	
21	21	F		46	82	2		71	13	R/S	
22	41	P⟷S		47	21	F					
23	13	R/S		48	85	M–					
24	51	M		49	63	9					

Registers Register Memoires	
0	Used
1	Used
2	Used
3	Used
4	
5	
6	
7	Used
8	Angle of Elevation.
9	Bearing Angle.

Notes Anmerkungen Notes

Line of sight distance bearing and angle of elevation of B from A, where B & A are given in distance, bearing and angle of elevation from a common point.

Line of sight distance, bearing and angle of elevation of B from A. **USER INSTRUCTIONS**

Step Schritt Sequence	Procedure – Prozedur – Procedure	Enter Eingabe Introduire	Press Befehl Appuyer Sur				Display Anzeige Affichage
1	Clear All		F	CA			
2	Set display to n dec places.		F	FP	n		n treated as 2 for rest of display.
3	Mode switch to LOAD.						
4	Key in Programme.						
5	Mode switch to RUN.						
6	Goto 00		GTO	0	0		
7	Enter r_1 (1st range say 5m)	eg. 5	R/S				5.00
	θ_1 (1st bearing angle say 30°)	eg. 30	R/S				60.00
	$\emptyset_1$ (1st angle of elevation say 45°)	eg. 45	R/S				1.77
	At this stage x_1 is on display, y_1 in M9 – z_1 in M8						
8	Press R/S		R/S				3.54
	This transfers (x_1 y_1 z_1) to (M1, M2, M3)						
9	Enter r_2)	eg. 7	R/S				7.00
	θ_2) as in Step 7	eg. 40	R/S				50.00
	$\emptyset_2$)	eg. 40	R/S				3.45
10	Go to 38 R/S		GTO	3	8	R/S	
	Line of sight distance of B from Ad						2.20
11	R/S		R/S				
12	Bearing of B from A		MR	9			58.08
13	Elevation of B from A		MR	8			25.98
	N.B. Angles are entered and recovered in decimal degrees.						

DAY OF WEEK **PROGRAM LIST**

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	52	MR		25	52	MR		50	85	–	
01	82	2		26	61	7		51	52	MR	
02	85	–		27	15	SKIP		52	73	6	
03	83	3		28	14	GTO		53	84	+	
04	95	=		29	83	3		54	52	MR	
05	51	M		30	71	4		55	72	5	
06	61	7		31	81	1		56	75	÷	
07	15	SKIP		32	82	2		57	61	7	
08	14	GTO		33	84	+		58	95	=	
09	81	1		34	81	1		59	21	F	
10	72	5		35	84	+		60	51	FRAC	
11	81	1		36	52	MR		61	74	x	
12	21	F		37	82	2		62	61	7	
13	85	M–		38	74	x		63	95	=	
14	83	3		39	52	MR		64	13	R/S	
15	52	MR		40	62	8		65	14	GTO	
16	83	3		41	95	=		66	91	0	
17	74	x		42	21	F		67	91	0	
18	52	MR		43	52	INT		68			
19	63	9		44	84	+		69			
20	95	=		45	52	MR		70			
21	21	F		46	71	4		71			
22	52	INT		47	84	+					
23	51	M		48	52	MR					
24	71	4		49	81	1					

Registers	
0	
1	day eg 10
2	Month 3
3	year 1921
4	temporary
5	Century Remainder
6	2
7	temporary
8	30.6
9	365.25

DAY OF THE WEEK USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Set Display		F	FP	0		
3	Mode Switch to LOAD						
4	Enter Program						
5	Mode Switch to RUN						
6	Enter Constants 2 in M6	2	M	6			
	30.6 in M8	30.6	M	8			
	365.25 in M9	365.25	M	9			
7	Press R/S to begin program		R/S				
8	Enter Date e.g. 10.3.1921 →	Day eg. 10	M	1			
	→	Month eg. 3	M	2			
	→	Year eg. 1921	M	3			
9	Enter Century Remainder						
	Either 14th Sept. 1752 to 28th Feb. 1800 →	2	M	5			
	or 1st Mar. 1800 to 28th Feb. 1900 →	1	M	5			
	or 1st Mar. 1900 + →	0	M	5			
10	Press R/S to compute answer		R/S				
	Result Displayed 0 – Sunday						Result
	1 – Monday						
	2 – Tuesday						
	Enter new date 3 – Wednesday						
	From Step 8 4 – Thursday						
	and continue 5 – Friday						
	6 – Saturday						
	Program does not work for dates prior to the introduction of the Gregorian Calendar on						
	14.9.1752 but is correct for dates up to 28.2.2100.						

COMPOUND INTEREST. Given any 3 of A, P, r, n to determine the other. USER INSTRUCTIONS

	Step	Procedure	Enter	Press				Display
	1	Clear All		F	CA			
	2	Fix Display FP/Sci/Eng		F	FP/Sci/Eng	n		
	3	Mode Switch to LOAD						
	4	Key in Program						
	5	Mode Switch to RUN						
A	6	Given P, r, n to find a						
		GO TO 00		GOTO	0	0		
		Enter n in MO	n	M	0			
		r in M1	r	M	1			
		P in M2	P	M	2			
	7	Press R/S to execute		R/S				1. or displayed
	8	Press R/S		R/S				A displayed
B		Given A, r, n to find P		F	CA			
	9	GO TO 00		GOTO	0	0		
	10	Enter n in MO & r in M1 as before						
		Enter A in M3	A	M	3			
	11	Press R/S		R/S				1. or displayed
	12	GO TO 18		GOTO	1	8		
	13	Press R/S		R/S				P
C		Given P. A & n to find r		F	CA			
	14	Enter in same registers as before						
	15	GO TO 30		GOTO	3	0		
	16	Press R/S		R/S				r

COMPOUND INTEREST *Continued*

USER INSTRUCTIONS

	Step	Procedure	Enter	Press				Display
D		Given P A r to find n		F	CA			
	17	Enter in same registers as before						
	18	R/S		R/S				1.or
	19	GO TO 54		GOTO	5	4		
	20	R/S		R/S				n

LOAN REPAYMENTS

PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	13	R/S		25	85	–		50			
01	81	1		26	52	MR		51			
02	21	F		27	74	4		52			
03	84	M+		28	95	=		53			
04	91	O		29	51	M		54			
05	52	MR		30	61	7		55			
06	91	O		31	13	R/S	displays outstanding debt	56			
07	21	F		32	52	MR		57			
08	82	FP		33	63	9		58			
09	91	O		34	13	R/S	displays total interest paid	59			
10	13	R/S	displays no. of period	35	14	GTO		60			
11	21	F		36	91	O		61			
12	82	FP		37	91	O		62			
13	82	2		38				63			
14	52	MR		39				64			
15	61	7		40				65			
16	84	+		41				66			
17	52	MR		42				67			
18	81	1		43				68			
19	54	%		44				69			
20	21	F		45				70			
21	84	M+		46				71			
22	63	9		47							
23	13	R/S	displays interest	48							
24	95	=		49							

Registers	
0	No of repayment
1	interest Rate x
2	
3	
4	repayment
5	
6	
7	outstanding debt
8	
9	Total interest

Notes

*interest rate
r % p/a
or r/12% per month
program uses
American annuity
method, i.e.
interest is
calculated per
period before
payment is made.

LOAN REPAYMENTS **USER INSTRUCTIONS**

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Mode Switch to LOAD						
3	Key in Program						
4	Mode switch to RUN, press R/S twice to begin program		R/S	R/S			
5	Enter Amount borrowed in M7	C	M	7			
	r % per annum or r/12% per month	r or r/12	M	1			
	Repayment p.a. or per month	P	M	4			
	0 in MO	O	M	0			
6	Press R/S to start execution						number of repayment
7	Press R/S to continue						Interest this period
8	Press R/S to continue						outstanding debt
9	Press R/S to continue						Cumulative interest
							paid
NB	If re-running with new data be sure to clear all memories before step 5.	F	CA				
NB	If r% the annual interest rate, and n repayments are made in the year,						
	r/n must be entered in M1 in step 5						

No. OF DAYS BETWEEN DATES **PROGRAM LIST**

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	81	1		25	21	F		50	71	4	
01	94	+/−		26	52	INT		51	84	+	
02	51	M		27	51	M		52	52	MR	
03	73	6		28	71	4		53	81	1	
04	52	MR		29	52	MR		54	84	+	
05	82	2		30	61	7		55	52	MR	
06	85	−		31	15	SKIP		56	72	5	
07	83	3		32	14	GTO		57	74	X	
08	95	=		33	83	3		58	52	MR	
09	51	M		34	62	8		59	73	6	
10	61	7		35	81	1		60	95	=	
11	15	SKIP		36	82	2		61	21	F	
12	14	GTO		37	84	+		62	84	M+	
13	81	1		38	81	1		63	91	0	
14	63	9		39	84	+		64	82	2	
15	81	1		40	52	MR		65	21	F	
16	21	F		41	82	2		66	84	M+	
17	85	M		42	74	x		67	73	6	
18	83	3		43	52	MR		68	13	R/S	
19	52	MR		44	62	8		69	14	GTO	
20	83	3		45	95	=		70	91	0	
21	74	x		46	21	F		71	71	4	
22	52	MR		47	52	INT					
23	63	9		48	84	+					
24	95	=		49	52	MR					

Registers	
0	Result
1	Day
2	Month
3	Year
4	Temporary Use
5	Century Remainder
6	Skip Digit
7	Temporary Use
8	30.6
9	365.25

Notes

No. OF DAYS BETWEEN DATES **USER INSTRUCTIONS**

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Set Display		F	FP	0		
3	Mode Switch to LOAD						
4	Enter Program						
5	Mode Switch to RUN, press R/S to start program.						
6	Enter Constants M8	30.6	M	8			
	M9	365.25	M	9			
7	Enter 1st date i	Day	M	1			
		Month	M	2			
		Year	M	3			
8	Enter Century Remainder 14.9.1752 – 28.2.1800	2	M	5			
	OR 1 Mar 1800 – 28.2.1900	1	M	5			
	OR 1 March 1900 +	0	M	5			
9	Press R/S for 1st date		R/S				2
10	Repeat steps 7, 8 & 9 for 2nd date						2
11	Press M R O for result		MR	0			Result
	Continue examples from step 8						
	Programme works for dates from the beginning of the Gregorian calendar on						
	14th September 1752 to the 28th February 2100.						

AREA OF FILLET (a) LENGTH OF ARC (b) AREA OF SECTOR **USER INSTRUCTIONS**

Step	Procedure	Enter	Press				Display
(a) 1	Clear All		F	CA			
2	Set Display (FP. Sci. Eng).						
3	Mode Switch to LOAD						
4	Enter Program						
5	Mode Switch to RUN. Press R/S twice to begin program.		R/S	R/S			
6	Enter Radius in Mo	R	M	0			
7	Press R/S to execute Program		R/S				
8	Area of Fillet displayed (Also in M.1)						Area of Fillet
							$=R^2$ (1-Pi/4)
	ENTER NEW RADIUS AT STEP 6 -						
(b) 9	Mode Switch to RUN		GOTO	25			
10	Mode Switch to LOAD						
11	Enter Program						
12	Mode Switch to RUN. Press R/S twice to begin program.		R/S	R/S			
13	Enter radius in MO	R	M	0			
14	Enter angle in M9 in Deg. Min. Sec. eg	42deg 35' 18"	M	9			42·3518
15	Press R/S to execute						
16	Display Area of Sector (Also in M3)		MR	3			Area of Sector
17	Length of Arc in M2		MR	2			Length of Arc
	Enter new R & Θ in steps 13 & 14						
	(Program converts Θ to radians & Stores in M9)						

AREA & APPROX. PERIMETER OF ELLIPSE OF AXES 2a & 2b PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	13	R/S		25	74	x		50			
01	52	MR		26	82	2		51			
02	81	1		27	95	=		52			
03	74	x		28	35	$\sqrt{x}$		53			
04	52	MR		29	74	x		54			
05	82	2		30	45	Pi		55			
06	74	x		31	95	=		56			
07	45	Pi		32	51	M		57			
08	95	=		33	62	8		58			
09	51	M		34	14	GOTO		59			
10	61	7		35	91	O		60			
11	13	R/S	Halts to Display Area	36	91	O		61			
12	64	(		37				62			
13	52	MR		38				63			
14	81	1		39				64			
15	74	x		40				65			
16	95	=		41				66			
17	84	+		42				67			
18	64	(		43				68			
19	52	MR		44				69			
20	82	2		45				70			
21	74	x		46				71			
22	95	=		47							
23	65	)		48							
24	65	)		49							

Registers	
0	[illegible]
1	½majoraxis = a
2	½minoraxis = b
3	
4	
5	
6	
7	Area
8	Perimeter
9	

Notes

AREA & APPROX. PERIMETER OF ELLIPSE WITH AXES 2a & 2b USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Set display (FP/Sci/Eng)						
3	Mode Switch to LOAD						
4	Key in Program						
5	Mode Switch to RUN, press R/S twice to begin program		R/S	R/S			
6	Enter a into M1	a	M	1			
	Enter b into M2	b	M	2			
7	Press R/S to begin execution		R/S				
8	Area Displayed (Also in M7)						Area
9	Press R/S to continue		R/S				
10	Approx. perimeter Pi $\sqrt{2(a^2 + b^2)}$ displayed						Perimeter
	(Also in M8)						

AREA OF REGULAR POLYGON OF EVEN No. OF SIDES — PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	13	R/S		25	91	O		50			
01	52	MR		26				51			
02	81	1		27				52			
03	74	x		28				53			
04	95	=		29				54			
05	74	x		30				55			
06	52	MR		31				56			
07	91	0		32				57			
08	95	=		33				58			
09	51	M		34				59			
10	82	2		35				60			
11	45	Pi		36				61			
12	75	÷		37				62			
13	52	M		38				63			
14	91	O		39				64			
15	95	=		40				65			
16	21	F		41				66			
17	72	rad		42				67			
18	24	tan		43				68			
19	74	x		44				69			
20	52	MR		45				70			
21	82	2		46				71			
22	95	=		47							
23	14	GOTO		48							
24	91	O		49							

Registers	
0	No. of sides n
1	½ approx. flats – r
2	(intermediate result)
3	
4	
5	
6	
7	
8	
9	

Notes

AREA OF REGULAR POLYGON WITH EVEN No. OF SIDES — USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear all memories		F	CA			
2	Set display (FP/Sci/Eng)						
3	Mode Switch to LOAD						
4	Key in Program						
5	Mode Switch to RUN, press R/S twice to begin program		R/S	R/S			
6	Enter Semi across-flats measurement in M1	r	M	1			
7	Enter No. of sides in MO	n	M	0			
8	Press R/S to execute program		R/S				
9	Area left on display						Area
	New data entered by steps 6 & 7						
	Note: If r = 1 and becomes large the area approximates to the area of a circle of unit radius i.e. Pi						

SURFACE AREA & VOLUME OF A SPHERE — PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	13	R/S		25				50			
01	52	MR		26				51			
02	91	O		27				52			
03	74	X		28				53			
04	95	=		29				54			
05	74	X		30				55			
06	45	Pi		31				56			
07	74	X		32				57			
08	71	4		33				58			
09	95	=		34				59			
10	51	M		35				60			
11	82	2		36				61			
12	74	X		37				62			
13	52	MR		38				63			
14	91	O		39				64			
15	75	÷		40				65			
16	83	3		41				66			
17	95	=		42				67			
18	51	M		43				68			
19	81	1		44				69			
20	14	GOTO		45				70			
21	91	O		46				71			
22	91	O		47							
23				48							
24				49							

Registers	
0	Radius
1	Volume
2	Surface
3	Area
4	
5	
6	
7	
8	
9	

Notes

SURFACE AREA & VOLUME OF A SPHERE — USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Set Display (FP. SCI or Eng n)						
3	Mode Switch to LOAD						
4	Enter Program						
5	Mode Switch to RUN, press R/S twice to begin program		R/S	R/S			
6	Enter Radius in MO	R	M	O			
7	Press R/S to start program execution						
8	Display Volume (Also in M1)						volume
9	Display Surface Area from M2		MR	2			Surface
	Enter new radius via STEP 6						

Curved Surface Area, Total Surface Area & Volume of a Cone **PROGRAM LIST**

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	13	R/S		25	74	X		50	91	O	
01	64	(		26	95	=		51			
02	52	MR		27	74	x		52			
03	61	7		28	45	Pi		53			
04	74	x		29	95	=		54			
05	95	=		30	51	M		55			
06	84	+		31	63	9		56			
07	64	(		32	84	+		57			
08	52	MR		33	52	MR		58			
09	62	8		34	81	1		59			
10	74	x		35	95	=		60			
11	95	=		36	51	M		61			
12	65	)		37	82	2		62			
13	65	)		38	52	MR		63			
14	35	$\sqrt{x}$		39	63	9		64			
15	74	x		40	74	x		65			
16	52	MR		41	52	MR		66			
17	61	7		42	62	8		67			
18	74	x		43	75	÷		68			
19	45	Pi		44	83	3		69			
20	95	=		45	95	=		70			
21	51	M		46	51	M		71			
22	81	1		47	83	3					
23	52	MR		48	14	GOTO					
24	61	7		49	91	O					

Registers	
0	
1	$\pi R\sqrt{R^2+H}$=CA
2	Tot. Area = 2 × CA + pi R
3	V=$\frac{1}{3}$ Pi R^2H
4	
5	
6	
7	Radius R
8	Perp. H R
9	Pi R^2

Notes

Curved Surface Area, Total Surface Area & Volume of a Cone **USER INSTRUCTIONS**

Step	Procedure	Enter	Press				Display
1	Clear All Memories		F	CA			
2	Set Display F.P. Sci or Eng. (n)						
3	Mode Switch to LOAD						
4	Enter Program						
5	Mode Switch to RUN, press R/S twice to begin program.		R/S	R/S			
6	Enter Radius R in M.7	R	M	7			
7	Enter Height H in M.8 (NB Perp. Ht)	H	M	8			
8	Press R/S to execute Program		R/S				
9	Volume is displayed (also in M.3)						Volume
10	Curved Surface Area in M.1		MR	1			Curved S. Area
11	Total Surface Area in M.2		MR	2			Total S. Area
	Enter New Data via STEPS 6 & 7						

VOLUME & CURVED SURFACE AREA OF PARABOLOID OF REVOLUTION PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	13	R/S		25	95	=	$p=r^2/2h$	50	34	y^x	
01	52	MR		26	51	M	formed & Stored	51	83	3	
02	81	1		27	91	O	in MO	52	65	)	
03	74	x		28	64	(		53	95	=	
04	95	=		29	52	MR		54	74	x	
05	74	x		30	81	1		55	82	2	
06	45	pi		31	74	x		56	74	x	
07	74	x		32	95	=		57	45	Pi	
08	52	MR		33	84	+		58	75	÷	
09	82	2		34	64	(		59	83	3	
10	75	÷		35	52	MR		60	75	÷	
11	82	2		36	91	O		61	52	MR	
12	95	=	$\pi r^2 h/2$	37	74	x		62	91	0	
13	51	M		38	95	=		63	95	=	
14	61	7		39	65	)		64	51	M	
15	13	R/S	pause to display vol.	40	65	)		65	62	8	
16	52	MR		41	34	y^x		66	14	GOTO	
17	81	1		42	81	1		67	91	0	
18	74	x		43	92			68	91	0	
19	95	=		44	72	5		69			
20	75	÷		45	95	=		70			
21	82	2		46	85	−		71			
22	75	÷		47	64	(					
23	52	MR		48	52	MR					
24	82	2		49	91	0					

Registers	
0	$p=r^2/2h$
1	r = radius
2	h = depth
3	
4	
5	
6	
7	Vol.
8	Area
9	

Notes

VOLUME & CURVED SURFACE AREA OF PARABOLOID OF REVOLUTION USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Fix Display (FP/Sci/Eng)						
3	Mode switch to LOAD						
4	Key in Program						
5	Mode Switch to RUN, press R/S twice to begin program.		R/S	R/S			
6	Enter r in M1	r	M	1			
	Enter h in M2	h	M	2			
7	Press R/S to execute						
8	Halts with Volume displayed (Also M7)						Volume
9	Press R/S to continue						
10	Halts with Surface Area Displayed (Also M8)						C.S. Area
	Re-enter data at step 6						

VALUES OF THE POLYNOMIAL $P(x) = a_0+a_1x+a_2x^2+a_3x^3+a_4x^4+a_5x^5+a_6x^6$ for x, (h) x_2 PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	52	MR		25	52	MR		50	61	7	
01	73	6		26	82	2		51	95	=	
02	74	x		27	74	x		52	15	SKIP	
03	52	MR		28	52	MR		53	14	GOTO	
04	6	7		29	61	7		54	91	O	
05	13	R/S	displays current value of x	30	84	+		55	91	O	
06	84	+		31	52	MR		56	63	9	
07	52	MR		32	81	1		57	63	9	
08	72	5		33	74	x		58	63	9	
09	74	x		34	52	MR		59	63	9	
10	52	MR		35	61	7		60	63	9	
11	61	7		36	84	+		61	63	9	
12	84	+		37	52	MR		62	63	9	
13	52	MR		38	91	O		63	63	9	
14	71	4		39	95	=		64	13	R/S	
15	74	x		40	13	R/S	displays current value of P(x)	65			
16	52	MR		41	52	MR		66			
17	61	7		42	62	8		67			
18	84	+		43	21	F		68			
19	52	MR		44	84	M+		69			
20	83	3		45	61	7		70			
21	74	x		46	52	MR		71			
22	52	MR		47	63	9					
23	61	7		48	85	−					
24	84	+		49	52	MR					

Registers	
0	a_0
1	a_1
2	a_2
3	a_3
4	a_4
5	a_5
6	a_6
7	Initial value x1
8	Step h
9	Final value x_2

Notes

VALUES OF THE POLYNOMIAL $P(x) = a_0 + a_1 x + a_2 x^2 + a_3 x^3 + a_4 x^4 + a_5 x^5 + a_6 x^6$ for x_1 (h) x_2 USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
	Polynomial is $P(x) = a_0+a_1 x+a_2 x^2+a^3x^3+a_4$						
	$x^4+a_5 x^5+a_6 x^6$. If P(x) is, say, of degree						
	3 then $a_4 = a_5 = a_6 = 0$ x, is initial						
	value of x, h is incremental step						
	x_2 is final value of x						
1	Clear all		F	CA			
2	Set display FP/Sci/Eng						
3	Mode Switch to LOAD						
4	Key in Program						
5	Mode Switch to RUN, press R/S once to begin program		R/S				
6	Enter coefficients	a_0	M	0			
		a_1	M	1			
		⋮	⋮	⋮			
		a_6	M	6			
7	Enter initial value of x	x_1	M	7			
8	Enter incremental step	h	M	8			
9	Enter final value of x	x_2	M	9			
10	Press R/S		R/S				x_1
	Press R/S again		R/S				$P(x_1)$
11	Press R/S		R/S				$x_1 + h$
	Press R/S again		R/S				$P(x_1+h)$
	Continue with step 11 until x_2 and P(x) are displayed						
	Pressing R/S again causes a row of 9's to be displayed		R/S				99999999
	indicating end of run. If $P(x_1)$ only is required omit						
	steps 8, 9, 11.						

NUMERICAL SOLUTION OF P(x)=0 BY NEWTON RAPHSON METHOD   PROGRAM LISTING

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	52	MR		25	21	F		50	51	M	
01	91	O		26	85	M–		51	82	2	
02	13	R/S		27	91	O		52	14	GTO	
03	14	GTO		28	52	MR		53	91	O	
04	83	3		29	62	8		54	73	6	
05	73	6		30	15	SKP		55			
06	52	MR		31	14	GTO		56			
07	81	1		32	91	O		57			
08	75	÷		33	91	O		58			
09	52	MR		34	35	Pi		59			
10	82	2		35	13	R/S		60			
11	95	=		36		ENTER		61			
12	51	M		37		Key Steps		62			
13	81	1		38		For F(x)		63			
14	74	x		39				64			
15	95	=		40		Followed by		65			
16	35	$\sqrt{x}$		41	51	M		66			
17	85	–		42	81	1		67			
18	52	MR		43				68			
19	63	9		44		Then Enter		69			
20	95	=		45		Key Steps		70			
21	51	M		46		For $F^1(x)$		71			
22	62	8		47							
23	52	MR		48		Followed					
24	81	1		49		By					

Registers	
0	Initial x
1	F(x)
2	$F^1(x)$
3	
4	
5	
6	
7	
8	Temporary
9	Σ

Notes
Heration programme
$X_{n+1} = x_n - \frac{F(x_n)}{F^1(x_n)}$

NUMERICAL SOLUTION OF P(x)=0 BY NEWTON RAPHSON METHOD   USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Set Display FP/Sci/Eng.		F	FP/SCi Eng	n		
3	Mode Switch to LOAD						
4	Enter program as overleaf.						
	in LOCS 00 to 34						
	LOCS 36 to 71 are for user to enter						
4(a)	F (x) followed by N.B. use as many steps as necessary to enter F (x) provided total		M	1			
	program does not exceed 72 – then.						
4(b)	F^1 (x) followed by		M	2			
			GTO	0	6		
5	Mode Switch to RUN						
6	Enter initial value of x in MO	xo	M	0			
	Enter accuracy figure in M9						
	eg. if answer is required to 4d.p	0.0001	M	9			
7	Press R/S		R/S				xo
8	Press R/S		R/S				x1
	Repeat step 8 until display						
	ceases to change or Pi is displayed						Pi
	Press MR O to recall result		MR	0			Result
	NB if initial value of x is not sufficiently near to root the program may diverge.						
	To solve another equation insert new formulae for F(x) and F^1(x) in steps 4a & 4b						

INVERSION OF 2 x 2 MATRIX — PROGRAM LISTING

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	64	(		25	55	x ↔ m		50			
01	52	MR		26	72	5		51			
02	61	7		27	21	F		52			
03	74	x		28	55	x ↔ m		53			
04	52	MR		29	61	7		54			
05	72	5		30	81	1		55			
06	65	)		31	94	+/−		56			
07	85	−		32	21	F		57			
08	64	(		33	74	Mx		58			
09	52	MR		34	62	8		59			
10	71	4		35	21	F		60			
11	74	x		36	74	Mx		61			
12	52	MR		37	71	4		62			
13	62	8		38	13	R/S		63			
14	95	=		39	14	GOTO		64			
15	51	M		40	91	O		65			
16	91	O		41	91	O		66			
17	21	F		42				67			
18	75	M÷		43				68			
19	21	F		44				69			
20	95	9 M		45				70			
21	21	F		46				71			
22	55	x ↔ m		47							
23	61	7		48							
24	21	F		49							

Registers	
0	Used for det.
1	
2	
3	
4	c
5	d
6	
7	a
8	b
9	

Notes

Matrix is
(a b)
(c d)
stored in
(M7 M8)
(M4 M5)

INVERSION 2 x 2 MATRIX — USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Fix display FP/Sci/Eng						
3	Mode switch to LOAD						
4	Key in program						
5	Mode switch to RUN, press R/S once to begin program.		R/S				
6	Enter data a b M7 M8	a	M	7			
	c d M4 M5	b	M	8			
		c	M	4			
		d	M	5			
7	Press R/S to execute		R/S				−1.00
	Check		MR	0			0.00
	Inverted matrix stored in original memories						
	recalled by pressing		MR	7			d / △
			MR	8			-b / △
			MR	4			-c / △
			MR	5			a / △
							where △ is value of
	Return to step 7 for new data entries.						det. (M)

PRODUCT OF TWO MATRIXES

PROGRAM LIST

Loc	Code	Key	Comments
00	64	(	
01	52	MR	
02	62	8	
03	74	x	
04	52	MR	
05	81	1	
06	65	)	
07	84	+	
08	64	(	
09	52	MR	
10	63	9	
11	74	x	
12	52	MR	
13	91	O	
14	95	=	
15	51	M	
16	61	7	
17	64	(	
18	52	MR	
19	62	8	
20	74	x	
21	52	MR	
22	82	2	
23	65	)	
24	84	+	
25	64	(	
26	52	MR	
27	63	9	
28	74	x	
29	52	MR	
30	83	3	
31	95	=	
32	51	M	
33	8		
34	64	(	
35	52	MR	
36	72	5	
37	74	x	
38	52	MR	
39	81	1	
40	65	)	
41	84	+	
42	64	(	
43	52	MR	
44	73	6	
45	74	x	
46	52	MR	
47	91	O	
48	95	=	
49	61	M	
50	71	4	
51	64	(	
52	53	MR	
53	72	5	
54	74	x	
55	52	MR	
56	82	2	
57	65	)	
58	84	+	
59	64	(	
60	52	MR	
61	73	6	
62	74	x	
63	52	MR	
64	83	3	
65	65	)	
66	95	=	
67	51	M	
68	72	5	
69	13	R/S	
70			
71			

Registers	
0	c_2
1	a_2
2	b_2
3	d_2
4	
5	c_1
6	d_1
7	
8	a_1
9	b_1

Notes

$M_1 = a_1\ b_1$
$c_1\ d_1$

$M_2 = a_2\ b_2$
$c_2\ d_2$

PRODUCT OF TWO MATRIXES

USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Set display FP/Sci/Eng						
3	Mode Switch to LOAD						
4	Key in Program						
5	Mode switch to RUN, press R/S once to begin program		R/S				
6	Enter data Matrix 1 $(a_1\ b_1)$ Stored in M8, M9	a_1	M	8			
	$(c_1\ d_1)$ M5, M6	b_1	M	9			
		c_1	M	5			
		d_1	M	6			
	Matix 2 $(a_2\ b_2)$ Stored in M1, M2.	a_2	M	1			
	$(c_2\ d_2)$ MO, M3.	b_2	M	2			
		c_2	M	0			
		d_2	M	3			
7	Press R/S to execute		R/S				
8	Result stored in M7 M8 $(a_3\ b_3)$	recall via	MR	7			
	M4 M5 $(c_3\ d_3)$		MR	8			
			MR	4			
			MR	5			

EVALUATION OF DETERMINANT OF A 3 x 3 MATRIX. PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	52	MR		25	64	(		50	52	MR	
01	61	7		26	52	MR		51	82	2	
02	74	x		27	71	4		52	65	)	
03	64	(		28	74	x		53	85	–	
04	64	(		29	52	MR		54	64	(	
05	52	MR		30	83	3		55	52	MR	
06	72	5		31	65	)		56	81	1	
07	74	x		32	85	–		57	74	x	
08	52	MR		33	64	(		58	52	MR	
09	83	3		34	52	MR		59	72	5	
10	65	)		35	81	1		60	95	=	
11	85	–		36	74	x		61	51	M	
12	64	(		37	52	MR		62	91	O	
13	52	MR		38	73	6		63	13	R/S	
14	82	2		39	95	=		64	14	GTO	
15	74	x		40	84	+		65	91	O	
16	52	MR		41	64	(		66	91	O	
17	73	6		42	52	MR		67			
18	95	=		43	63	9		68			
19	85	–		44	74	x		69			
20	64	(		45	64	(		70			
21	52	MR		46	64	(		71			
22	62	8		47	52	MR					
23	74	x		48	71	4					
24	64	(		49	74	x					

Registers	
0	→ Det A
1	a_3
2	b_3
3	c_3
4	a_2
5	b_2
6	c_2
7	a_1
8	b_1
9	c1

Notes

EVALUATION OF DETERMINANT OF A 3 x 3 MATRIX USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Set Display FP/Sci/Eng		F	FPetc	n		
3	Mode Switch to LOAD						
4	Key in program						
5	Mode Switch to RUN, press once to begin program.		R/S				
6	Enter matrix data on keys 1-9 as a mapping of the matrix						
	a_1 b_1 c_1 M_7 M_8 M_9						
	a_2 b_2 c_2 → M_4 M_5 M_6						
	a_3 b_3 b_3 M_1 M_2 M_3						
7	Check data entered correctly by pressing MR1 thro' 9 in the order 7,8,9,4,5,6,1,2,3.						
8	Press R/S to run		R/S				Det (A)
	(Value of Det A Also stored in MO)						

RANDOM NUMBER GENERATOR (A) PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	84	+		25				50			
01	45	Pi		26				51			
02	95	=		27				52			
03	34	y^x		28				53			
04	72	5		29				54			
05	95	=		30				55			
06	21	F		31				56			
07	51	FRAC	Program	32				57			
08	51	M	Uses	33				58			
09	91	0	$FRAC(x+\pi)^5$	34				59			
10	13	R/S		35				60			
11	14	GOTO		36				61			
12	0	0		37				62			
13	0	0		38				63			
14				39				64			
15				40				65			
16				41				66			
17				42				67			
18				43				68			
19				44				69			
20				45				70			
21				46				71			
22				47							
23				48							
24				49							

Registers	
0	Random Number
1	
2	
3	
4	
5	
6	
7	
8	
9	

Notes

RANDOM NUMBER (A) USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			
2	Set length of number to n figures		F	FP	n		
3	Mode switch to LOAD						
4	Key in program						
5	Mode Switch to RUN, press R/S once		R/S				
6	Enter any starting number into display such as log (date) or sin (your age).						
7	Press R/S to execute Program stops with Random Number on display		R/S				Random Number
8	Press R/S to generate next random number		R/S				
	For check on randomness of process see next programme.						
	The numbers are generated as a decimal between 0 and 1 and their length is present before programme is run.						

RANDOM NUMBER GENERATOR (B) WITH COUNT PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	84	+		25	71	4	•	50	81	1	
01	45	π		26	95	=		51	21	F	
02	95	=		27	15	SKIP		52	84	M+	
03	34	y^x		28	14	GOTO		53	71	4	
04	72	5		29	83	3	—	54	81	1	
05	95	=		30	62	8		55	21	F	
06	21	F		31	81	1		56	84	M+	
07	51	FRAC		32	21	F		57	63	9	
08	51	M		33	84	M+		58	52	MR	
09	91	0	Pause to	34	82	2		59	63	9	
10	13	R/S	display	35	14	GOTO		60	15	SKP	
11	85	–	R. No.	36	72	5		61	13	R/S	
12	52	MR		37	71	4	•	62	52	MR	
13	72	5		38	95	=		63	91	0	
14	95	=		39	15	SKP		64	14	GOTO	
15	15	SKIP		40	14	GOTO		65	91	0	
16	14	GOTO		41	72	5		66	91	0	
17	82	2	IF –	42	91	0		67	91	0	
18	73	6		43	81	1		68			
19	81	1		44	21	F		69			
20	21	F		45	84	M+		70			
21	84	M+		46	83	3		71			
22	81	1		47	14	GOTO					
23	14	GOTO		48	72	5					
24	72	5		49	71	4	•				

Registers	
0	Random Number
1	Quartile Count 1
2	Quartile Count 2
3	Quartile Count 3
4	Quartile Count 4
5	0.25
6	
7	
8	
9	– N
	N is the number of of random nos. required to be generated.

RANDOM NUMBER GENERATOR (B) WITH COUNT

SR-56 USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
	This program generates random numbers from 1 to 6 digits between						
	0 and 1, and counts the numbers into the 4 quartiles as a partial						
	Check on their randomness.						
1	Clear all registers		F	CA			
2	Set length (n decimal places) on random number required		F	FP	n		
3	Mode switch to LOAD						
4	Key in program						
5	Mode switch to RUN						
6	Press R/S once to begin program		R/S				
7	Enter 0.25 in M5	0.25	M	5			
8	Enter No. of random numbers required (with sign reversed)	+	+/–	M	9		
9	Enter starting number 1 e.g. Log (Date)						
10	Press R/S to execute program		R/S				
11	Program stops to display 1st random number						Random number
12	Press R/S to continue		R/S				
13	When n random numbers have been generated display shows						00
14	Quartile counts can then be recalled 0 –0.25 M1		MR	1			1st Quartile
	0.25–0.5 M2		MR	2			2nd Quartile
	0.5 –0.75 M3		MR	3			3rd Quartile
	0.75–1 M4		MR	4			4th Quartile
N.B.	If quartile count only is required, without displaying the random numbers.						
	Replace step 5 by						
	Mode switch to run						
	GOTO 10, Modeswitch to Clear,) This replaces program						
	Press "Step" once, mode switch to Run) Step 10 by "99 NULL"						
	Then continues as before						

CALCULATION OF CHI SQUARED X² — PROGRAM LIST

Loc	Code	Key	Comments	Loc	Code	Key	Comments	Loc	Code	Key	Comments
00	13	R/S		25	84	+		50			
01	51	M		26	52	MR		51			
02	81	1		27	81	1		52			
03	21	F		28	95	=		53			
04	84	M+		29	21	F		54			
05	62	8		30	84	M+		55			
06	13	R/S		31	91	O		56			
07	51	M		32	52	MR		57			
08	82	2		33	91	O		58			
09	21	F		34	14	GTO		59			
10	84	M+		35	91	O		60			
11	63	9		36	91	O		61			
12	81	1		37				62			
13	21	F		38				63			
14	84	M+		39				64			
15	61	7		40				65			
16	64	(		41				66			
17	52	MR		42				67			
18	81	1		43				68			
19	85	–		44				69			
20	52	MR		45				70			
21	82	2		46				71			
22	65	)		47							
23	74	x		48							
24	95	=		49							

Registers	
0	x^2 (CHI²)
1	
2	
3	
4	
5	
6	
7	
8	Sum of expected Σ ne Frequences
9	Sum of observed frequencies ΣN_O

Notes

CALCULATION OF CHI SQUARED X² — USER INSTRUCTIONS

Step	Procedure	Enter	Press				Display
1	Clear All		F	CA			00
2	Set display eg FP2		F	FP	2		00.00
3	Mode switch to LOAD						
4	Key in Program						
5	Mode switch to RUN, press R/S twice		R/S	R/S			
6	Enter expected frequency in 1st class	eg 50					50
	Press R/S		R/S				50.00
7	Enter observed frequency in 1st class	eg 41					41
	Press		R/S				1.62
8	Repeat steps 6 and 7 for each class						
	Final display						CHi²
9	CHECKS		MR	7			No. of classes
			MR	8			Sum of expected frequencies.
			MR	9			Sum of observed frequencies.
			MR	0			CHi²

POWER SUPPLY

Rechargeable Battery

AC Operation

Connect the charger to any standard electrical outlet and plug the jack into the Calculator. After the above connections have been made, the power switch may be turned "ON". (While connected to AC, the batteries are automatically charging whether the power switch is "ON" or "OFF").

Battery Operation

Disconnect the charger cord and push the power switch, "ON"

With normal use a full battery charge can be expected to supply about 2 to 3 hours of working time.

When the battery is low, figures on display will dim. Do not continue battery operation, this indicates the need for a battery charge. Use of the calculator can be continued during the charge cycle.

Battery Charging

Simply follow the same procedure as in AC operation. The calculator may be used during the charge period. However, doing so increases the time required to reach full charge. If a power cell has completely discharged, the calculator should not be operated on battery power until it has been recharged for at least 3 hours, unless otherwise instructed by a notice accompanying your machine. Batteries will reach full efficiency after 2 or 3 charge cycles.

Use proper Commodore/CBM adapter-recharger for AC operation and recharging.

Adapter 640 or 707 North America

Adapter 708 England

Adapter 709 West Germany

NOTES

NOTES

SALES AND SERVICE CENTERS

Commodore Business Machines, Inc.
901 California Avenue
Palo Alto, California 94304

Commodore Business Machines,
(Canada) Ltd.
946 Warden Avenue
Scarborough, Ontario

CBM Business Machines Limited
Eaglescliffe Industrial Estate
Stockton on Tees
Cleveland County
TS16 OPN
England

Commodore Buromaschinen GmbH
6072 Dreieich 1
Robert-Bosch-Str. 12A
West Germany

Commodore Japan Ltd.
Taisei-Denshi Bldg.
8-14, Ikue 1-Chome
Asahi-Ku, Osaka 535

Commodore France S.A.
Zone Industrielle
Departmentale M 14
06510 Carros, France.

Commodore Switzerland S.A.
Bahhnofstrasse 74
CH-5000 AARAU, Switzerlaud