The MK -52 Instruction Manual.

Thank Forum "Polygon ghosts" for informational support :)

If you find a typo or somehow make this guide (for example, come up with how to recognize tables), please contact me by email at 648_648@mail.ru mail or ICQ 429825043. The same would be happy if you share schemes calculator and magazines for scanning
By purchasing any magazine, paper instructions for the MC -52, as well as other interesting me an old portable computing.

I. GENERAL INFORMATION

1.1. The calculator "Elektronika MK-52" is available in various designs. Versions differ in the presence of peripheral devices connected to the terminals of the calculator.

1.2. When buying a calculator:

1) Take a completeness check;
2) Require verification of its performance on the control test (Table 1 and 1a). Pre-testing should carefully review the control tests and the notes thereto;
3) Check the instruction manual and warranty card of one of the two ticket stubs for warranty repair.
4) Make sure you have a warranty and a detachable coupon (see Appendices 1-3) shops stamp or signature stamp seller and the date of sale;
5) check that the number on the warranty card number on the basis of the calculator , as well as the safety seal on the body of the calculator and on the power supply .
Remember that if you lose you lose the warranty card Warranty Service calculator.
Tear-off coupons for warranty repair service organization employees are cut only after the operation.

1.3. After storage in a cold room or after transport in winter before inclusion calculator to stand at room temperature for 4 hours

1.4. Before using the calculator, please read this instruction manual.

1.5. The calculator is packed with a protective film on the color filter, which is easily removed.

1.6. If necessary, repair the calculator during the warranty period, enter the coupon number in the calculator and the date of it's release.

Table I

Truncation of TEST OF CONTROL WITHOUT Calculator PERIPHERALS

№ теста	Положение переключателей "ВКЛ"	"Р/ГРД/Г"	"С/З/СЧ"	"Д/П"	Нажимаемые клавиши	Индикация
0	"ВКЛ"					0.
1					1 2 3 4	1 2 3 4.
2					5 6 7 8	1 2 3 4 5 6 7 8.
3					ВП 9 +/-	1 2 3 4 5 6 7 8. - 0 9
4					ВГ	1. 2 3 4 5 6 7 8 - 0 2
5					0 . 9	0. 9
6					X	1. 1 1 1 1 1 1 1 - 0 2
7		"Г"			F sin	1. 9 3 9 2 5 4 5 - 0 4
8		"ГРД"			F cos	1.
9		"Р"			F tg	1. 5 5 7 4 0 7 8
10					X→П 1	1. 5 5 7 4 0 7 8
11					F π	3. 1 4 1 5 9 2 6
12			"С"	"П"	A↑	3. 1 4 1 5 9 2 6
13					↑↓	3. 1 4 1 5 9 2 6
14					F lg	4. 9 7 1 4 9 8 3 - 0 1
15					X→П 2	4. 9 7 1 4 9 8 3 - 0 1
16					F π	3. 1 4 1 5 9 2 6
17			"З"	"Д"	↑↓	3. 1 4 1 5 9 2 6
18			"СЧ"			3. 1 4 1 5 9 2 6
19	"Выкл"					
20	"Вкл"		"СЧ"	"Д"	F π	3. 1 4 1 5 9 2 6
21					A↑	3. 1 4 1 5 9 2 6
22					↑↓	3. 1 4 1 5 9 2 6
						1. 5 5 7 4 0 7 8
23					П→X 1	4. 9 7 1 4 9 8 3 - 0 1
24					П→X 2	0 0
25					F ПРГ	3 6 0 1
26					K max	3 1 3 6 0 2
27					K |x|	4 3 3 1 3 6 0 3
28					X→П 3	2 4 4 3 3 1 0 4
29					F x²	3 8 2 4 4 3 0 5
30					K √	5 - 3 8 2 4 0 6
31					F L3	0 4 5 - . 3 8 0 7
32					0 4	5 0 0 4 5 - 0 8
33					С/П	4. 9 7 1 4 9 8 3 - 0 1
34					F АВТ	4. 9 7 1 4 9 8 3 - 0 1
35					В/О	8. Г Г 7 6 5 7 8
36					С/П	

Notes

1. In Table 1, the key symbols, images of blue and yellow on the keypad, enclosed in parentheses and placed on the keypad above the key, and white - and a key to the right of the key.
2 Tests 12,13,17,21 and 22 are an appeal to the EEPROM, which are indicated (in addition to information) minus signs in all places indicator. While accessing the EEPROM transition to implement other tests are banned.
3. Elapsed time in test 36 is not more than 5 seconds.
4. To re-enable the calculator, turn it off 10 seconds at least.

Table 1a
TEST SEQUENCE FOR CONTROL OF PERIPHERAL DEVICES WITHOUT Calculator

№ теста	Положение переключателей "ВКЛ"	"Р/ГРД/Г"	"С/З/СЧ"	"Д/П"	Нажимаемые клавиши	Индикация
1	2	3	4	5	6	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
0	"ВКЛ"		"С"	"П"		0.
1					6 1	6 I.
2					X→П d	6 I.
3					3 1 5	3 I 5.
4					• 0 7	3 I 5. 0 7
5					F π	3. I 4 I 5 9 2 6
6					A↑	3. I 4 I 5 9 2 6
7					↑↓	3. I 4 I 5 9 2 6
8					ВП 2	3. I 4 I 5 9 2 6 0 2
9					←→	3 I 5. 0 7
10					−	- 9. I 0 7 4 - 0 I
11		"Р"			F |cos|	- 6. I 3 I 6 I 4 - 0 I
12		"ГРД"			F sin⁻¹	4 2. 0 2 0 4 9 9
13		"Г"			/-/	- 4 2. 0 2 0 4 9 9
14					9	9.
15					÷	- 4. 6 6 8 9 4 4 3
16					K X→П 6	- 4. 6 6 8 9 4 4 3
17					F Bx	9.
18					П→X 1	- 4. 6 6 8 9 4 4 3
19					X	- 4 2. 0 2 0 4 9 9
20					F ПРГ	0 0
21					В/О	5 2 0 1
22					F ↻	2 5 5 2 0 2
23					П→X 0	6 0 2 5 5 2 0 3
24					F L2	5 8 6 0 2 5 0 4
25					0 6	0 6 5 8 6 0 0 5
26					2	0 2 0 6 5 8 0 6
27					4	0 4 0 2 0 6 0 7
28					+	1 0 0 4 0 2 0 8
29					K X→П 1	L I I 0 0 4 0 9
30					F LO	5 Г L I I 0 1 0
31					0 1	0 I 5 Г L I I I
32					−	I I 0 I 5 Г I 2
33					F 1/x	2 3 I I 0 I I 3
34					F x≥0	5 9 2 3 I I I 4

I	2	3	4	5	6
35					7 0
36					П→X C
37					+
38					F tg⁻¹
39					F √
40					F ln
4I					F 10ˣ
42					F x<0
43					7 7

I	2	3	4	5	6
44					1
45					3
46					X→П 0
47					X→П 1
48					F ⟲
49					4
50					X→П 2
5I					БП
52					0 1

I	2	3	4	5	6
53					F lg
54					F x²
55					F sin
56					F cos⁻¹
57					F tg
58					П→X d
59					6
60					1
6I					−

I	2	3	4	5	6
62					F x≠0
63					4 5
64					↔
65					СП
66					K V
67					K o→//
68					K |x|
69					−
70					K |x|

I	2	3	4	5	6
7I					K o←
72					П→X 5
73					K ЗН
74					+
75					K o←//
76					F eˣ
77					ВП
78					K o←
79					K max

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
35		7	0		5	9		2	3		I	5
36		6	C		7	0		5	9		I	6
37		I	0		6	C		7	0		I	7
38		I	L		I	0		6	C		I	8
39		2	I		I	L		I	0		I	9
40		I	8		2	I		I	L		2	0
4I		I	5		I	8		2	I		2	I
42		5	C		I	5		I	8		2	2
43		7	7		5	C		I	5		2	3

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
44		0	I		7	7		5	C		2	4
45		0	3		0	I		7	7		2	5
46		4	0		0	3		0	I		2	6
47		4	I		4	0		0	3		2	7
48		2	5		4	I		4	0		2	8
49		0	4		2	5		4	I		2	9
50		4	2		0	4		2	5		3	0
5I		5	I		4	2		0	4		3	I
52		0	I		5	I		4	2		3	2

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
53		I	7		0	I		5	I		3	3
54		2	2		I	7		0	I		3	4
55		I	C		2	2		I	7		3	5
56		I	-		I	C		2	2		3	6
57		I	E		I	-		I	C		3	7
58		6	Г		I	E		I	-		3	8
59		0	6		6	Г		I	E		3	9
60		0	I		0	6		6	Г		4	0
6I		I	I		0	I		0	6		4	I

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
62		5	7		I	I		0	I		4	2
63		4	5		5	7		I	I		4	3
64		I	4		4	5		5	7		4	4
65		5	0		I	4		4	5		4	5
66		3	8		5	0		I	4		4	6
67		2	-		3	8		5	0		4	7
68		3	5		2	-		3	8		4	8
69		I	I		3	5		2	-		4	9
70		3	I		I	I		3	5		5	0

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
7I		2	6		3	I		I	I		5	I
72		6	5		2	6		3	I		5	2
73		3	2		6	5		2	6		5	3
74		I	0		3	2		6	5		5	4
75		3	0		I	0		3	2		5	5
76		I	6		3	0		I	0		5	6
77		0	E		I	6		3	0		5	7
78		3	3		0	E		I	6		5	8
79		3	6		3	3		0	E		5	9

I	2	3	4	5	6
80					К [x]
8I					X
82					К ⊕
83					К ИНВ
84					К Λ
85					К НОП
86					С/П
87					F АВТ
88					БП 7 0

I	2	3	4	5	6
89					F ПРГ
90					К ПП a
9I					↔
92					F ⊙
93					К 1
94					К 2
95					F x²
96					К x=0 7
97					К 2

I	2	3	4	5	6
98					К 1
99					П→X 0
I00					С/П
I0I					7
I02					2
I03					F АВТ
I04					БП 2 4
I05					ШГ
I06					С/П

I	2	3	4	5	6
I07					ШГ
I08					ПП
I09					В/О
II0					С/П
III		"З"	"П"		F π
II2					A↑ ↑↓
II3		"СЧ"	"Д"		↑↓
II4					П→X 9
II5	"ВЫКЛ"				

I	2	3	4	5	6
II6	"ВКЛ"	"Г"	"СЧ"	"П"	
II7			"С"		I000098
II8					A↑ ↑↓
II9					CX I02I064
I20					A↑ ↑↓
I2I					CX I063098
I22					A↑ ↑↓
I23					CX I084098
I24					A↑ ↑↓

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
80		3	4		3	6		3	3	6	0	
8I		I	2		3	4		3	6	6	I	
82		3	9		I	2		3	4	6	2	
83		3	-		3	9		I	2	6	3	
84		3	7		3	-		3	9	6	4	
85		5	4		3	7		3	-	6	5	
86		5	0		5	4		3	7	6	6	
87	-	4	2.	0	2	0	4	9	9			
88	-	4	2.	0	2	0	4	9	9			

Продолжение табл. Ia

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
89		0	0		0	0		0	0	7	0	
90		-	-		0	0		0	0	7	I	
9I		I	4		-	-		0	0	7	2	
92		2	5		I	4		-	-	7	3	
93		5	5		2	5		I	4	7	4	
94		5	6		5	5		2	5	7	5	
95		2	4		5	6		5	5	7	6	
96		E	7		2	4		5	6	7	7	
97		5	6		E	7		2	4	7	8	

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
98		5	5		5	6		E	7	7	9	
99		6	0		5	5		5	6	8	0	
I00		5	0		6	0		5	5	8	I	
I0I		0	7		5	0		6	0	8	2	
I02		0	2		0	7		5	0	8	3	
I03	-	4	2.	0	2	0	4	9	9			
I04	-	4	2.	0	2	0	4	9	9			
I05	-	4	2.	0	2	0	4	9	9			
I06		I.										

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
I07		I.										
I08		2.										
I09		2.										
II0		8.	6	0	0	0	5					
III		3.	I	4	I	5	9	2	6			
II2		3.	I	4	I	5	9	2	6			
II3		3.	I	4	I	5	9	2	6			
II4		0.	0	0	0	5	0	5	4			
II5												

Продолжение табл. Ia

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
II6		0.										
II7		I	0	0	0	0	9	8.				
II8		I	0	0	0	0	9	8.				
II9		I	0	2	I	0	8	4.				
I20		I	0	2	I	0	8	4.				
I2I		I	0	6	3	0	9	8.				
I22		I	0	6	3	0	9	8.				
I23		I	0	8	4	0	9	8.				
I24		I	0	8	4	0	9	8.				

I	2	3	4	5	6
I25					F π
I26			"СЧ"		A↑ ↑↓
I27					CX I000098
I28			"З"		A↑ ↑↓
I29			"СЧ"		↑↓
I30					CX I02I084
I3I			"З"		A↑ ↑↓
I32			"СЧ"		↑↓
I33					CX I063098

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
I25			3.	I	4	I	5	9	2	6		
I26			3.	I	4	I	5	9	2	6		
I27			I	0	0	0	0	9	8.			
I28			I	0	0	0	0	9	8.			
I29			I	0	0	0	0	9	8.			
I30			I	0	2	I	0	8	4.			
I3I			I	0	2	I	0	8	4.			
I32			I	0	2	I	0	8	4.			
I33			I	0	6	3	0	9	8.			

I	2	3	4	5	6
I34			"З"		A↑ ↑↓
I35			"СЧ"		↑↓
I36					CX I084098
I37			"З"		A↑ ↑↓
I38			"СЧ"		↑↓
I39					CX 6 1
I40					X→П d
I4I					5 I-I
I42					X

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
I34			I	0	6	3	0	9	8.			
I35			I	0	6	3	0	9	8.			
I36			I	0	8	4	0	9	8.			
I37			I	0	8	4	0	9	8.			
I38			I	0	8	4	0	9	8.			
I39			6	I.								
I40			6	I.								
I4I	-		5.									
I42	-		3	0	5.							

I	2	3	4	5	6
I43					F Bx
I44					БП 2 3
I45					С/П
I46					2
I47					В/О
I48					С/П

7	8	9	I0	II	I2	I3	I4	I5	I6	I7	I8	I9
I43	-		5.									
I44	-		5.									
I45			I.									
I46			2.									
I47			2.									
I48			8.	0	0	0	0	I				

Notes:

1. In tests with the numbers 6, 7, 112, 113, 118, 120, 122, 124, 126, 128, 129, 131, 132, 134.135, 137, 138 is reference to an EPROM. At the time of treatment to the EEPROM in all digits displayed (in addition to information) minus sign (a sign referring to PROM). While accessing the EEPROM transition to the implementation of follow-up tests is prohibited.
2. The time between switching on and off of the calculator must be at least 10 seconds.
3. While the tests with the numbers 106 and 145 should be no more than 55 s, and with the numbers 110 and 148, no more than 25 seconds.

2. DELIVERY

Name of devices and instruments		Number in execution units, Ind.	
	-	01	02
I. The calculator"ElektronikaMK-52"	1	1	1
2. Operating Manual of the calculator "Elektronika MK 52"	1	1	1
3. Power supply D2-37A	1	1	1
4. The elements of the A-316 "Quantum"	4	4	4
5. Expanded memory unit PDU-2 "Astro-Electronics"	-	-	1
6. Operating Manual of the expansion memory BRP-2	-	-	1
7. Pack	1	1	-
8. Package	2	2	2
9. Lodgment	-	-	1
10. Box	-	-	1
11. Cover	1	1	1

Notes:
I. The calculator in the performance of 01 available on purchase orders.
2. The calculator in the performance of the 02-trading network does not arrive.
3. Allowed to use the elements of the A- 316 "Prima, etc.

3. SAFETY REQUIREMENTS
3.1. The power supply has elements under voltage of 220 V, and the calculator - the elements under the voltage of 27 V, so the repair or open the calculator and the power supply is permitted only to persons eligible for repair calculator.
3.2. At the end of computing work, and in the event of faults turn the calculator off and disconnect the power supply from the network first, and then on the calculator (for running on AC power).
Connect the power adapter to 220 V without a calculator is prohibited.
3.3. In order to avoid the destruction of the battery:
1. Observe polarities.
2. Do not make recharging.

4. SUMMARY
4.1. Appointment
4.1.1. "Elektronika MK-52” is a portable Micro calculator for personal use and is designed for complements you in scientific, engineering, and statistical calculations.
4.2. Technical characteristics
4.2.1. The number system with input and output information - decimal.
4.2.2. The number of digits of the mantissa - eight (see paragraph 6.2).
4.2.3. The number of digits of the order number - two.
4.2.4. The range of computing $1 \cdot 10^{-99} \leq |x| \leq 9{,}9999999 \cdot 1099$.
4.2.5. The presentation of the decimal point:
1) In the range $1 \leq |x| \leq 99999999$ - Natural;
2) In the range of $1 \cdot 10^{99} \leq |x| \leq 1$ and
$99999999 \leq |x| \leq 9{,}9999999 \cdot 10^{99}$ floating.
4.2.6. Number of addressable memory registers - 15.
4.2.7. The volume of non-volatile memory (EEPROM) - 1024 four-digit words or 512 program steps.
4.2.8. Amount of program memory in the calculator= 105 steps, the amount of the read information from the EPROM, or from a block of memory expansion, occasional handling up to 98 steps.
4.2.9. The input and output of a number displayed on the 12- bit fluorescent display (8-bit mantissa, 2 discharge order 2 bits of mantissa digits and order).
4.2.10. The calculator operates in two modes: "Automatic operation " and "Programming”.
4.2.11. The calculator in the "Automatic operation" allows you to:
1) To perform the four arithmetic operations, “+",” -", “x ", "+ “;
2) Calculate the direct trigonometric functions sin x, cos x, tg X. The argument of X can be entered in radians, grads and degrees;
3) Calculate the inverse trigonometric function arcsin X, arcos X, arctg X in radians or degrees and grads;
4) Compute functions x y, ln X, lg X, Ex, 10x,, x2 , 1 / x;
5} Cause constant in the operating register X;
6) The recording of information in the 15 addressable registers;
7) To cause the information in the register X of 15 addressable memory registers;
8) To record information in the stack registers and control its movements;
9) Change the sign of the number in the register X;
10) To carry out the operation of exchange of information between business registers X and Y;
11) The purification of the operational register X;
12) To restore the previous calculation result;
13) To produce chained calculations;
14) Allocate integer and fractional part of a number;
15) To determine the absolute value of the numbers;
16) To determine the sign of the number;
17) Provide the maximum number (of the two);
18) To generate a pseudo-random number between 0 and I;
19) To transfer angular (time) value, expressed in degrees (hours), minutes, seconds and fractions of a second, the values expressed in degrees (hours) and fractions of degrees (hours);
20) To transfer angular (time) value , expressed in degrees (hours), and fractions of a degree (h) , to the values expressed in degrees (hours) , minutes, seconds and fractions of a second;
21) To transfer angular (time) value, expressed in degrees (hours), minutes, and fractions of a minute in the values expressed in degrees (hours) and fractions of degrees (hours);
22) To transfer angular (time) value , expressed in degrees (hours), and fractions of a degree (h) , to the values expressed in degrees (hours) , minutes, and fractions of a minute ;

23) Perform logical operations (multiplication, addition, and exclusive 2nd inversion).
24) To write to the EEPROM program and data stored in the memory addressable software parts of the calculator;
25) To make reading the information from the EPROM in the addressable memory and software components;
26) To produce the selective erasure of information in the EEPROM;
27) To perform calculations for the program.
4.2.12. In the "Program" calculator allows you to:
1) Write a program using the keyboard;
2) To edit and adjust the program;
3) To write to the EEPROM program and data in the addressable memory and software parts of the calculator;
4) To make reading the information from the EPROM in the addressable memory and software components;
5) To selectively erase information in the EEPROM.

4.2.13. The computation time and arithmetic operations 1 / x, $\sqrt{x}$, x^2 to 0.5 sec. Time calculation function x^y no more than 3.5 seconds.
The average time for computing functions ln X, lg X, Ex, 10x, sin x , cos x , tg X, arc-sin X, arcos X, arc-tg X no more than 2 seconds.
4.2.14. In the calculation of trigonometric, logarithmic and exponential functions should be considered valid values and the relative error are listed in Table 2.
4.2.15. To extend the capabilities of programming, and facilities monitoring and debugging programs are provided in the calculator:
1) The command of direct and indirect transitions to the routine and the command return from subroutine;
2) The ability to access the inside of the subroutine subprograms. The depth of such applications is 5 ;
3) The command of direct and indirect unconditional jump;
4) Four types of commands direct and indirect conditional branch (on the conditions X = 0, X ≠ 0, x ≥ 0, X < 0);
5) Useful loop;
6) Command indirect writes the contents of the X register in the memory registers;
7) Command indirect indication of register memory;
8) Command to reset the address zero state;
9) Start and stop the automatic calculation program;
10) Command -step through the program in the “Automatic operation " ;
11), the display code three consecutive steps of the program and the current state of the counter addresses;
12) Buttons to step through the program in the fall or rise of addresses by visual inspection of the program.
4.2.16. Accessing PROM (recording, erasing, reading) unit or a memory expansion should be done with the work of the calculator from the power supply as at the time of treatment to the PROM or to block a substantial power consumption occurs , and if the battery voltage A -316 " Quantum " close to the edge of the discharge may occur incorrect reading (writing , erasing) information from the EPROM or from a block of memory expansion . Accessing the EEPROM is only possible when uncoupled from the block of memory expansion or if you change the unit "ON" in the "on" position.
4.2.17. Programs and data stored in the EEPROM using the keyboard and can be stored in the EEPROM in the " election will PROM " (power cuts, lack of access to the EEPROM) for 5000 hours If PROM is a request, the information stored in the EEPROM is stored for at least 250 hours (total time of treatment, part of 5000h). Any piece of information that is stored in an EPROM, you can call a calculator for processing, and, if necessary, delete, and in its place a new record. The number of writes cycles data is 104.

4.2.18. The information stored in a block of memory expansion BRP- 2 “Astro - Electronics “, its technical characteristics, as well as work with them are described in detail in the manual unit supplied.
4.2.19. The calculator operates in a temperature range from 10 to 35 ° C at a relative humidity of 50 to 90% and an atmospheric pressure of 66 to 106 kPa.
4.2.20. Power supply is provided by the calculator uninterruptible power supply (four elements of A -316 "Quantum”), or from the power supply (D2- 37A) connected to the AC mains 220 V with a tolerance of minus 33 to + 22 V, (50 ± 1) Hz.
4.2.21. To re-enable the calculator is allowed not less than 10 seconds after shutdown.
4.2.22. The power consumed by the calculator batteries A -316 "Quantum”, not more than 0.7 W (without peripherals).
4.2.23. Overall dimensions of the calculator without peripheral devices = 212 x 78 x 42 mm.
4.2.24. Weight of the calculator (without power supply peripherals and decorative cover) is not more than 0.25 kg.
4.2.25. The content of precious metals:
Gold - 0.00932 g,
Silver - 0.07755 g
4.3. General information about the structure of the calculator
4.3.1. The appearance of the calculator is shown in Figure 1, and electrical schematic diagram is shown in Annex 5.
4.3.2. Entering Numbers, operations and commands in the calculator by pressing the appropriate keys. Many of the keys have a double and a triple symbolism. Color symbols depicted above the key matches the color of the keys [F] and [K]. Input function symbol is shown on the keypad as follows: first the push button [F] or [K], then the key on which the symbol of input functions. Key assignment is given in Table 3 and 4.
4.3.3. The control input of numbers and codes of operations as well as reading the results of the calculations are carried out visually with fluorescent indicator.
4.3.4. For the reception, storage and distribution of input data and results of calculations in the calculator are special functional parts registers.
4.3.5. In the calculator, there are two operating registers X and Y.
4.3.6. X is a register for receiving and storing the entered number and the result of computation. Its content is displayed on the LCD.
4.3.7. Register We used to receive information from the register of X, which provides for the necessary input to the register X of the second number. Entry number in the register have going on when you press the [B ↑] (input).

Calculator APPEARANCE

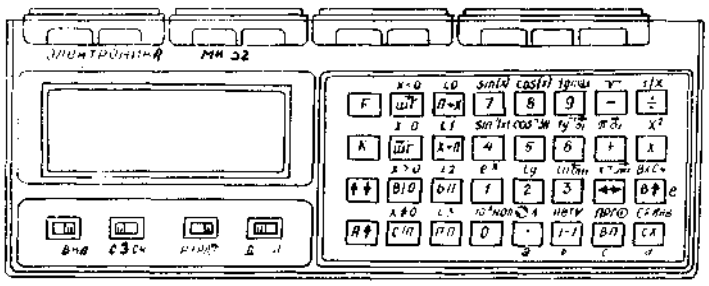


Table 3
Soft keys

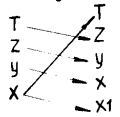
Клавиши	Назначение клавиш
[F]	Переход на вторую символику
[K]	Переход на вторую символику. Косвенный переход и косвенное обращение к адресуемым регистрам
[0] – [9]	Занесение цифр от 0 до 9 в регистр X
[•]	Занесение десятичной запятой
[ВП]	Разделение вводимых чисел и передвижения информации в стеке 

Клавиши	Назначение клавиш
[CX]	Сброс содержимого регистра X
[+]	Сложение содержимого регистра X с содержимым регистра У и передача результата в регистр X
[–]	Вычитание из содержимого регистра У содержимого регистра X и передача результата в регистр X
[÷]	Деление содержимого регистра У на содержимое регистра X и передача результата в регистр X
[×]	Умножение содержимого регистра У на содержимое регистра X и передача результата в ре-

Клавиши	Назначение клавиш
	гистр X
[↔]	Обмен содержимым между регистрами X и У
[/-/]	Смена знака числа и порядка
[ВП]	Подготовка ввода порядка числа
F [0] (10^x)	Вычисление степенной функции 10^X
F [1] (e^x)	Вычисление показательной функции e^X
F [2] (lg)	Вычисление десятичного логарифма

Клавиши	Назначение клавиш
F [3] (ln)	Вычисление натурального логарифма
F [7] (sin)	Вычисление функции синуса
F [8] (cos)	Вычисление функции косинуса
F [9] (tg)	Вычисление функции тангенса
F [4] ($\sin^{-1}$)	Вычисление обратной функции синуса
F [5] ($\cos^{-1}$)	Вычисление обратной функции косинуса

Клавиши	Назначение клавиш
F [6] (tg^{-1})	Вычисление обратной функции тангенса
F [–] ($\sqrt{}$)	Вычисление квадратного корня
F [÷] (1/x)	Вычисление обратной величины X
F [X] (x^2)	Возведение числа X в квадрат
F [↔] (x^y)	Возведение числа X в степень У

Клавиши	Назначение клавиш
F [+] (π)	Вызов константы π = 3,14159265
F [•]	Кольцевые передвижения информации в стеке 
F [ВП] (Bx)	Восстановление предыдущего результата

Клавиши	Назначение клавиш
F [CX] (CF)	Сброс перехода на вторую символику
[X→П] [0]	Запись содержимого регистра X в регистр RG0
[X→П] [1]	То же RG1
[X→П] [2]	" RG2
[X→П] [3]	" RG3
[X→П] [4]	" RG4
[X→П] [5]	" RG5

Клавиши	Назначение клавиш
[X→П] [6]	Запись содержимого регистра X в регистр RG6
[X→П] [7]	То же RG7
[X→П] [8]	" RG8
[X→П] [9]	" RG9
[X→П] [•] (a)	" RGa
[X→П] [/-/] (b)	" RGb
[X→П] [ВП] (c)	" RGc

Клавиши	Назначение клавиш
[X→П] [CX] (d)	Запись содержимого регистра X в регистр RGd
[X→П] [ВП] e	То же RGe
[П→X] [0]	Вызов в регистр X содержимого регистра RG0
[П→X] [1]	То же RG1
[П→X] [2]	" RG2
[П→X] [3]	" RG3
[П→X] [4]	" RG4

Клавиши	Назначение клавиш
[П→X] [5]	Вызов в регистр X содержимого регистра RG5
[П→X] [6]	То же RG6
[П→X] [7]	" RG7
[П→X] [8]	" RG8
[П→X] [9]	" RG9
[П→X] [•] (a)	" RGa
[П→X] [/-/] (b)	" RGb

Клавиши	Назначение клавиш
П→X ВП (c)	Вызов в регистр X содержимого регистра RGc
П→X СХ (d)	То же RGd
П→X В↑ (e)	" RGe
K [x] 7	Выделение целой части числа
K [x} 8	Выделение дробной части числа

Клавиши	Назначение клавиш
	дах и долях секунды, в значения, выраженные в градусах (часах) и долях градуса (часа)
K ° ′ ″ 3	Перевод угловых (временных) величин, выраженных в градусах (часах) и долях градуса (часа), в значения, выраженные в градусах (часах), минутах, секундах и долях секунды
K ° → +	Перевод угловых (временных) величин, выраженных в градусах (часах), минутах и долях

Клавиши	Назначение клавиш
K V I-I	Поразрядное логическое сложение
K ⊕ ВП	Логическая операция "Исключающее ИЛИ"
K ИНВ СХ	Логическая операция "Инверсия"
А↑	Ввод адреса, набранного на клавиатуре, в память интерфейса
↑↓	Запись, стирание и считывание информации по адресу, находящемуся в регистре X

Клавиши	Назначение клавиш
K max 9	Определение максимального значения одного из двух чисел, находящихся в регистрах X и У
K |x| 4	Определение абсолютного значения числа
K ЗН 5	Определение знака числа
K ° → ′ ″	Перевод угловых (временных) величин, выраженных в градусах (часах), минутах, секун-

Клавиши	Назначение клавиш
	минуты, в значения, выраженные в градусах (часах) и долях градуса (часа)
K ° ← 6	Перевод угловых (временных) величин, выраженных в градусах (часах) и долях градуса (часа), в значения, выраженные в градусах (часах), минутах и долях минуты
K СЧ В↑	Генерация псевдослучайного числа от 0 до I
K ∧ •	Поразрядное логическое умножение

Table 4
FUNCTION KEYS USED IN PROGRAMMING

Клавиши	Назначение клавиш
F ПРГ ВП	Переход в режим "Программирование"
F АВТ I-I	Переход в режим "Автоматическая работа"
БП	Безусловный переход
F x<0 ШГ	Прямые переходы по условию (X<0, X = 0, X≥0, X ≠ 0)

Клавиши	Назначение клавиш
F x=0 ШГ	
F x≥0 В/О	
F x≠0 С/П	
ПП	I. Переход на подпрограмму в режиме "Программирование"

Клавиши	Назначение клавиш
	2. Потактовое прохождение программы в режиме "Автоматическая работа"
В/О	I. Возврат из подпрограммы в режиме "Программирование" 2. Переход на нулевой адрес в режиме "Автоматическая работа"
С/П	I. Прекращение прохождения программы в режиме "Программирование" и фиксация содержимого регистра X на индикаторе 2. Начало вычисления по программе в режиме

Клавиши	Назначение клавиш
x≠0 K СП 0 – Вт e	мом регистре, индекс которого входит в команду
x≥0 K В/О 0 – Вт e	
x<0 K Шг 0 – Вт e	
K ПП 0 – Вт e	Косвенный переход к подпрограмме по модифицированному адресу, хранящемуся в адресуемом регистре, индекс которого входит

Клавиши	Назначение клавиш
	в команду
K X→П 0 – Вт e	Косвенная запись содержимого регистра X в регистр по модифицированному коду, хранящемуся в адресуемом регистре, индекс которого входит в команду
K П→X 0 – Вт e	Косвенная индикация вызова в регистр X содержимого адресуемого регистра по модифицированному коду, хранящемуся в адресуемом регистре, индекс которого входит в команду
НОП K 0	Нет операции (при редактировании программы)

Клавиши	Назначение клавиш
	"Автоматическая работа", а также прекращение вычислений в случае зацикливания
L0 F П→X	Организация циклов с регистрами RG0, RG1, RG2, RG3 соответственно
L1 F X→П	
L2 F БП	
L3 F ПП	
K	Переход на вторую символику. Косвенный пере-

Клавиши	Назначение клавиш
	ход и косвенное обращение к адресуемым регистрам
K БП – 0 Вт e	Косвенный безусловный переход по модифицированному адресу, хранящемуся в адресуемом регистре, индекс которого входит в команду
x=0 K Шг 0 – Вт e	Косвенные переходы по условию (X = 0, X≥0, X ≠ 0, X<0), при выполнении которых осуществляется переход по модифицированному адресу, хранящемуся в адресуе-

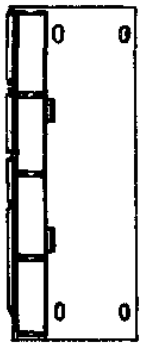
Клавиши	Назначение клавиш
Шг	Потактовое прохождение программы в порядке возрастания адресов в режиме "Программирование"
Шг	Потактовое прохождение программы в порядке уменьшения адресов в режиме "Программирование"

Notes:
1. Function keys used when programming is given in general terms. More detail of the keys will be discussed in the section "Programming".
2. In the following sections of the guide will be listed only the key symbols that carry information about the input operation or command.

4.3.8. In calculating the logarithmic (ln; lg), power (x^2, e^x, 10^x), direct and inverse trigonometric (sin, cos, tg, arcsin, arcos, arctg) functions, as well as the calculation of the square root, finding the inverse of 1 / x is introduced one number. Therefore, the operations of computing these functions are called singles. These operations are performed with the number being in register X. One single operation result stored in the register X, and the contents of the other registers are not changed (see item 6.5).
4.3.9. The calculation of arithmetic functions and a power function X^y two numbers are introduced, so the operation of those calculations are called doubles. These operations are performed with the numbers stored in the registers X and Y. The result of the operation is recorded in the register X.
4.3.10. If the display shows up the results of a previous calculations, the new number keyed automatically moves data from the register X into the register Y. Thus, the result of evaluating the previous operation can participate as a second number to complete subsequent operations. Such calculations are called chained (see p.6.6.4).
4.3.11. To store the raw data and intermediate results in the calculator, memory registers are provided, consisting of 15 addressable registers RG0, RG1 - RG9, RGa, RGb, RGc, RGd, RGe.
4.3.12. Record number of addressable registers in the register X is carried out by pressing the [X → R] and one of the keys [0] - [9], [a], [b]. [c], [d], [e], coinciding with the index addressable register. When the number of transferred in addressable register is stored in register X (see p.6.9).

4.3.13. Calling the number of addressable registers in the register X is carried out after pressing the [П→X] and addressed the key with the index case ([0] - [e]) (see p.6.9) .
4.3.14. Besides addressable registers in the calculator stack memory is composed of four registers: X, Y, Z and T registers X and Y - operating. Work with registers of the stack will be described in more detail in item 6.7.
4.3.15. In the calculator is the previous result register X1, which is intended to record number stored in the X register before the operation (see item 6.8) .
4.3.16. To record a program in the calculator has a special program memory consists of 105 cells (see 7.1), and the return stack, consisting of five categories (see pp.7.1, 7.3).
4.3.17. To store programs and data when the power is off in the calculator has a non-volatile memory (EEPROM), which operates in three modes: “Record”, "Delete” and "Read.”
4.3.18. The main storage device is an EPROM, which is a matrix (64 rows x 64 columns) containing 4,096 memory cells organized in a 1024 four-digit words that can record the program step 512. Each step takes two four words.
4.3.19. Each word in the EEPROM address is determined, starting from zero and ending with 1023.
4.3.20. Appeal to the EEPROM at the address typed on the keyboard by pressing [A ↑] and [↑ ↓],
4.3.21. Processes of writing, reading and erasing manages the interface that when you press [A ↑] remembers the number (address treatment or PROM), located in the X register, and when you press the [↑ ↓] produces consistently address signals to poll the drive EEPROM and in accordance with the addresses of the information coming into the EPROM or a calculator, depending on the mode of the calculator.
4.3.22. At the time of erase,writing, reading) EEPROM information is in the “Selection”, the rest - in the mode of information storage with the power off.
4.3.23. The calculator has the ability to connect peripheral devices (blocks of memory expansion BRP- 2, BRP- 3, etc.).
4.3.24. Memory expansion units are designed to hold special programs. The operation of these units, the types of programs that challenge them in memory of the calculator are described in the manual block of memory expansion.
5. GETTING STARTED calculators
5.1. The work of the calculator from the independent power supply

5.1.1. The calculator comes with the four elements of the A- 316 "Quantum”.
Before turning on the calculator, open the battery cover and insert the batteries in the A- 316 "Quantum" according to the label, and then close the cover (Fig. 2).



5.1.2. Turn on the calculator by setting the power switch to "ON". The display in the high discharge digital image should appear [0] , demonstrating the readiness of the calculator to work. If all the familiarity displayed point, it indicates that the discharge of the battery, which is quite possible, as the batteries discharge over time . Therefore, to continue the work of the batteries, they must be replaced.
Attention! Do not leave dead batteries in the calculator. This leads to leakage of the electrolyte in the compartment contacts oxidation and loss of power efficiency. This calculator is beyond repair.
5.2. The work of the power supply
5.2.1. Connect the power supply to the calculators, and then to an AC voltage of 220 V. The (A-316) "Quantum" batteries while disconnected from the calculator.

5.2.2. Set the switch on the calculator is set to " ON". Display of zero and the point in the high- Bits shows the willingness of the calculator to work.

Figure 2

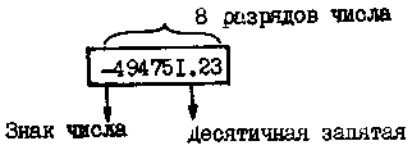
INSTALLING THE BATTERY A-316 "QUANTUM" In the MICROCALCULATOR
1. Remove the cover from the battery compartment. To do this, click on the protruding latch and slide the cover in the direction indicated by the arrow.
2. Install the batteries A-316 according to the label.
3. Close the battery compartment lid. To do this, insert the cover into the slots and press the cover in the direction of the arrow until it clicks.

6. Work in calculator AUTO MODE

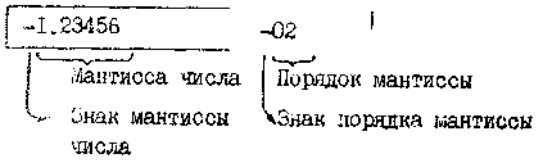
6.1. The calculation mode

6.1.1. Calculations are made on the calculator in the "Automatic operation ". This mode is automatically set after power a calculator or after pressing [F], [ABT] when the calculator is in the "Programming" mode.

6.2. Displays the number on the display
6.2.1. The numbers on the indicator in the range of $1 \leq | X | \leq 99999999$ displayed naturally separated position, and in the range of $1 \cdot 10^{99} \leq | x | \leq 1$ and $99999999 \leq | x | \leq 9{,}9999999 \cdot 10^{99}$ - in the form of floating semicolon.
For example, the number -494,751.23 displayable in a natural form and has the following form:



Since any number can be represented as m x 10^n, where m - the mantissa, and n the order number, the number -0.0123456 can be represented as $-1{,}23456 \cdot 10^{-2}$.
In the display this number will be shown in the form of a floating-point number.



6.3. Entering numbers

6.3.1. The calculator operates with positive and negative decimals.
6.3.2. Input it's produced by pressing the number keys, in the order of the numbers. If you need to enter a fractional number, then enter the first part of the whole, and then press the [•] and enter the fractional part. For example, to enter the number 148.12, press [1], [4], [8], [•] [1] [2].
Check the number on the indicator [148.12].
6.3.3. If you enter a negative number after the last number, press changes the sign [/ - /]. In ka ¬ As an example take the number [148.12], located on the indicator. Press [/ - /] . On display will get [-148.12]
If you need to change the sign of the displayed number, press the [/-/] key. For example, the indicated number of -148.12. Press [/-/]. The display will be shown [148.12].
6.3.4. If you enter the number was a mistake, press the clear register X [CX] and key in the number again.
For example, the display shows the wrong number of under-the-table [148.12]. Push the button [CX], the indicator we have [0].
6.3.5. To enter the order number, first enter the mantissa number, then press the [AM], and enter the numbers of the order. If the order is negative, then after I press the [/-/].

For example, entering the number -148, 12 • 10-15 is as follows:

Нажимаемые клавиши	Индикация
1 4 8 . 1 2	I48.I2
+/-	-I48.I2
ВП	-I48.I2 00

Нажимаемые клавиши	Индикация
1 5	-I48.I2 I5
+/-	-I48.I2 -I5

6.3.6. If the set values of the order of a mistake, then re-enter the value of the order and its sign (if necessary). In addition, each new figure is entered in the junior category of the order and the previous data is moved one position to the left with the loss of senior rank order.
For example, the display illustrated by -148,12 • 10-15, it is necessary that its order is equal to 4. Change the order of operation is as follows:

Нажимаемые клавиши	Индикация
0 4	-148.I2 -04
+/-	-148.I2 04

If [ВП] is pressed at zero mantissa, then the mantissa is 1 and the calculator prepares to receive the values of the order.
6.3.7. Pressing the [В ↑] automatically normalizes the number of which is in the display , and sends a copy of the number stored in register X, the register W.
For example, the indicator have -148,12 • by 104.
After you press [В ↑] will be shown on the display [-1481200].
Note. In the calculator is provided input blocking, if you have already entered the eight digits of the mantissa. In this case, pressing the number keys does not cause any changes in the display.

6.4. Incorrect operation and overflow

6.4.1. By invalid operations are:
Division between "0";
The construction of the power of x to y if $x \leq 0$ and $y \geq \leq 0$;
the square root , if $x < 0$;
Finding the inverse value 1 / x, if $x = 0$;
tgh calculation , if ;
Calculation of the logarithm, if $x \leq 0$;
Calculation of the natural logarithm, if $x \leq 0$;
Computation of inverse trigonometric functions arcsin x, arcos x if the absolute value | X |> 1;
Transfer time (angle) of the quantities, if the minutes or seconds ≥ 60.
6.4.2. An incorrect operation on the indicator lights error signal ЕГГОГ.
A similar signal appears, if the result of these calculations, a number larger than the number of ± 9,9999999 • 1099. If the result of these calculations, a number less than $1 \cdot 10^{99}$, then the X register is reset.

The alarm can be made ЕГГОГ enter numbers and perform calculations. For example, take the square root of minus 4, and then we introduce in the X register the number 25.

Нажимаемые клавиши		Индикация
4	+/-	-4
F	√	ERROR
2	5	25.

6.4.3. When using the results of logical operations as an argument for the operation of another type might escape out of the tolerance range. This leads to incorrect operations and unstable operation of the calculator (giving incorrect results, crashing and creating the loop calculations).

Table 2
Valid values and the error calculation of the function

Функция	Допустимые значения аргумента	Максимальная относительная погрешность
sin x	$10^{-99} \leqslant \lvert X\rvert < 10^{10}$	$3 \cdot 10^{-7}$
cos x	$10^{-99} < \lvert X\rvert < 10^{10}$	$3 \cdot 10^{-7}$
tg x	$10^{-99} < \lvert X\rvert \leqslant 10^{10}$	$3 \cdot 10^{-7}$
arcsin x	$\lvert X\rvert \leqslant 1$	$3 \cdot 10^{-7}$
arccos x	$\lvert X\rvert \leqslant 1$	$3 \cdot 10^{-7}$
arctg x	$\lvert X\rvert \leqslant 9{,}9999999 \cdot 10^{99}$	
	$\lvert X\rvert \geqslant 1$ 10^{-99}	
max	$\lvert y\rvert \neq 0;$ $X \neq 0$	
x^y	$0 < X$	10^{-6}
e^x	$\lvert X\rvert < 100 \ln 10$	$4 \cdot 10^{-7}$
x^2	$\lvert X\rvert < 10^{50}$	10^{-7}
10^x	$\lvert X\rvert \leqslant 99{,}999999$	$4 \cdot 10^{-7}$

1/x	$X \neq 0$	10^{-7}
$\sqrt{x}$	$0 \leqslant X$	10^{-7}
ln X	$0 < X$	$4 \cdot 10^{-7}$
lg X	$0 < X$	$4 \cdot 10^{-7}$
←° ′		10^{-7}
→° ′	$-1 \cdot 10^{-99} \leqslant X < -0{,}06$ $-0{,}06 < X \leqslant 9{,}9999999 \cdot 10^{99}$	10^{-7}
←° ′ ″		10^{-7}
→° ′ ″	$-1 \cdot 10^{-99} \leqslant X < -0{,}06$ $-0{,}0006 < X \leqslant 9{,}9999999 \cdot 10^{99}$	10^{-7}

6.5. Performance of single operations

6.5.1. Putting the argument in the calculation of the direct trigonometric functions and the calculation of an argument for the inverse trigonometric functions can be carried out in radians, grads or degrees depending on the switch position " Р/ГРД/Г " (radian / degree / degree) .

Note. Degrees, radians and grads are in the following relationship: 360 °= 400° = 2 radians.

To calculate the trigonometric and inverse trigonometric functions:

1) Set "Р/ГРД/Г" position for the set or the arguments are evaluated;
2) Dial the number (argument) on the keyboard;
3) Press the [F].
4) Press the calculated function.

Примеры вычислений	Положение переключателя "Р/ГРД/Г"	Нажимаемые клавиши	Индикация
sin 32	"Р"	3 2	32.
		F sin	5.5I42714 -0I
cos I8°	"Г"	1 8	I8.
		F cos	9.5I05655 -0I
tg 48,5°	"Г"	4 8 · 5	48.5
		F tg	I.I302944
arcsin 0,975	"Р"	0 · 9 7 5	0.975
		F $\sin^{-1}$	I.346721
arccos 0,2	"Р"	0 · 2	0.2
		F $\cos^{-1}$	I.3694383

6.5.2. To evaluate the function ln, lg, e^x, 10^x, x^2, extracting the square root of the number, and finding the inverse of a call number order keystrokes same as for calculating trigonometric functions. In this case, the switch "Р/ГРД/Г" can be in any position.

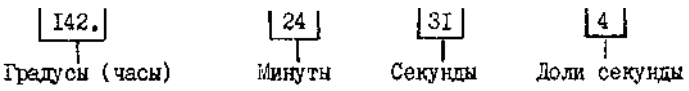
Примеры вычислений	Нажимаемые клавиши	Индикация
ln 412	4 1 2	412.
	F ln	6.0210233
lg 412	4 1 2 F lg	2.6148971
e^{12}	1 2 F e^x	162754.78
$e^{-0,48}$	0 . 4 8 +/- F e^x	6.1878339 -01
$10^{4,75}$	4 . 7 5 F 10^x	56234.129
$10^{-1,48}$	1 . 4 8 +/- F 10^x	3.3113114 -02
$0,745^2$	0 . 7 4 5 F x^2	5.55025 -01
$\frac{1}{589}$	5 8 9 F 1/x	1.6977928 -03
$\sqrt{563}$	5 6 3 F √	23.727621
π	F π	3.1415926

6.5.3. Vesting operations and decimal numbers to determine the absolute value of the number and the definition of the sign can be used in the computation of the program, as well as in solving the normal way.

Примеры вычислений	Нажимаемые клавиши	Индикация
Выделение целой части числа		
[29,374]	2 9 . 3 7 4 K [x]	29.
Выделение дробной части числа		
{29,374}	2 9 . 3 7 4 K [x]	3.74 -01

Примеры вычислений	Нажимаемые клавиши	Индикация
Определение абсолютного значения числа		
|-29,374|	2 9 . 3 7 4 +/- K [x]	29.374
Определение знака числа		
-5	5 +/- K ЗН	-1.
5	5 K ЗН	1.

6.5.4. When transferring time (angular) values the hour (degrees) are separated from the values of minutes, seconds and tenths of a decimal point. For example, if you see the number specified in degrees (hours), minutes, seconds and fractions of a second, then it is added as follows:



If the number refers to degrees (hour, minute), it is administered as follows:

6.5.5. For transfer of angular (time) values, expressed in degrees (hours), minutes, seconds and fractions of a second, the degrees (hours) and a degree (h) type on a keyboard converted values, and press [K], [°′″].

Примеры вычислений	Нажимаемые клавиши	Индикация
20ч 36мин 48с	2 0 . 3 6	20.6I3332
	4 8 K °′″	20,6I3332 ч.

6.5.6. For transfer of angular (time) values, expressed in degrees (hours), and fractions of a degree (an hour) in the degrees (hours), minutes, seconds and fractions of a second type on a keyboard converted values, and press [K], [°′″].

Примеры вычислений	Нажимаемые клавиши	Индикация
20,6I3332 ч	2 0 . 6 1 3	20.364799
	3 3 2 K °′″	20 ч 36 мин 47 с и 0,99 с

6.5.7. For transfer of angular (time) values, expressed in degrees (hours), minutes, and fractions of a minute in the degrees (hours) and a degree (h) type on a keyboard converted values and press [K] [°′].

Примеры вычислений	Нажимаемые клавиши	Индикация	
60° 36′	6 0 . 3 6 K °′	60.6	$60,6^{\circ}$

6.5.8. For transfer of angular (time) values, expressed in degrees (hours), and fractions of a degree (an hour) in the degrees (hours), minutes, and share minutes typing a converted values and press [K] [°′].

Примеры вычислений	Нажимаемые клавиши	Индикация
$60,8^{\circ}$	6 0 . 8 K °′	60.48
		60° 48′

6.5.9. To generate a pseudo-random number between 0 and 1, after the inclusion of the calculator key in a eight-digit number and press [B↑], [K], [СЧ]. The display will show a pseudo-random number.
It should be borne in mind that the value of the pseudo-random number depends on the information in the register Y and office cells calculator. It is determined by the state of registry operations without the prefix and the prefix [F] and [K], and the state of the service cell -only operations with the prefix [K]. Obviously, with the same initial state of the generator will produce the same number. The zero-state memory, that is, immediately after turning the calculator, the generator always gives the number 0.404067.
Some features of using a random number generator in the program are shown in paragraph 9.4.

6.6. Performing double operations

6.6.1. For double operations at least two numbers must be entered in the calculator. Entry numbers in the calculator is a conventional manner. To separate the first number from the second, then press [B↑].

6.6.2. The order of evaluation of arithmetic operations is as follows:

1) Enter the first number.
2) Press the Enter key [B ↑].
3) Enter the second number.
4) Press the following,

Примеры вычислений	Нажимаемые клавиши	Индикация
I2 - 3	1 2 B↑ 3 −	9.
I2 x 3	1 2 B↑ 3 X	36.
I2 ÷ 3	1 2 B↑ 3 ÷	4.

6.6.3. For the construction of x to the power y (x^y):

1) Enter the value of the exponent (the number of y);
2) Press [B ↑];
3) Enter the value of the base level (number of x);
4) Press [F], then [x^y].

Примеры вычислений	Нажимаемые клавиши	Индикация
$21,7^{15,6}$	1 5 · 6	15.6
	B↑	15.6
	2 1 · 7	21.7
	F x^y	7.0594552 20
$4^{-0,2}$	0 · 2 +/−	-2. -01
	B↑	-2. -01
	4	4.

6.6.4. To select a maximum number of two numbers contained in the registers X and Y, press [K], [max].

Примеры вычислений	Нажимаемые клавиши	Индикация
max (6,8; 5,6)	6 · 8 B↑ 5 · 6 K max	6.8

6.6.5. When the chain of operations how to enter numbers and operations with them is similar to that record calculations on paper.
Problem I. In the circuit includes four parallel resistance: R1 = 220 ohms, R2 = 4 ohm R3 = 560 ohms and R4 = 1,2 k-ohms. Need to find the total resistance of the circuit. The resistance is determined by the formula

$$Robщ = \frac{1}{\frac{1}{R1}+\frac{1}{R2}+\frac{1}{R3}+\frac{1}{R4}} = \frac{1}{\frac{1}{220}+\frac{1}{4000}+\frac{1}{560}+\frac{1}{1200}}$$

Using a calculator total resistance of the circuit is calculated as follows:

Нажимаемые клавиши	Индикация
2 2 0 F 1/x	4.5454545 -03
4 0 0 0 F 1/x	2.5 -04
+	4.7954545 -03
5 6 0 F 1/x	I.7857I42 -03
+	6.58II687 -03
1 2 0 0 F 1/x	8.3333333 -04
+	7.4I4502 -03
F 1/x	I34.87082 Результат вычислений,Ом

Task 2. Identify the circuit inductance (Fig. 3), if the circuit reactance XL = 12 ohms, voltage U = 120 V, frequency f = 50 Hz.

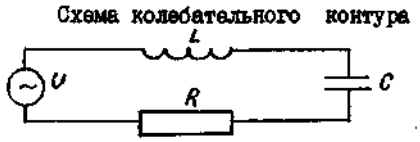


Рис. 3

Inductance of the circuit is defined by the formula

$$L = \frac{XL}{2\pi f} = \frac{12000}{2\pi 50}$$

On the calculator problem is solved as follows:

Нажимаемые клавиши	Индикация
1 2 0 0 0 BП	I2000.
2 ÷	6000.
F π ÷	I909.8593
5 0 ÷	38.I97I86 Результат вычислений,Гн

Task 3. Find the area of the segment (Fig. 4), if the radius of the circle R = 15,7 cm, and the arrow segment h = 4,5 cm.

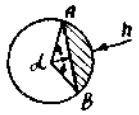


Рис. 4

Area of the segment is given by, where the angle α is expressed in radians. To use this equation, find a central angle α through the cosine of half the central angle

$$\cos\frac{\alpha}{2}=\frac{R-h}{R},$$

whence

$$\alpha=2\arccos\frac{R-h}{R}$$

Thus, the area of the segment is described by

$$S_{сегм}=\frac{1}{2}R^2\left(2\arccos\frac{R-h}{R}-\sin 2\arccos\frac{R-h}{R}\right)=$$
$$=\frac{(15,7)^2}{2}\left(2\arccos\frac{15,7-4,5}{15,7}-\sin 2\arccos\frac{15,7-4,5}{15,7}\right).$$

Calculate segment using a calculator by setting the "Р/ГРД/Г" to "Р":

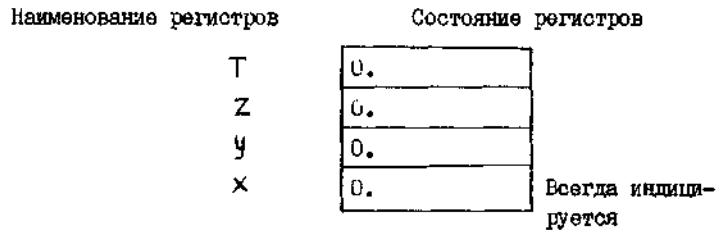
Нажимаемые клавиши	Индикация
1 5 • 7 B↑	15.7
4 • 5 −	11.2
1 5 • 7 ÷	7.1337579 -01
F cos⁻¹	7.764927 -01
2 X	1.5529854
B↑	1.5529854
F sin	9.998414 -01
−	5.53144 -01
1 5 • 7 F x²	246.49
X	136.34446
2 ÷	68.17223

Результат вычислений, $см^2$

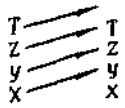
6.7. Use of the stack memory

6.7.1. In the stack memory includes four registers X, Y, Z and T, which are organized on the principle of memory store when consistently recorded information can only be read in the reverse sequence of records (the last recorded number is the first).

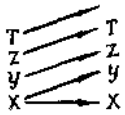
6.7.2. After turning on the calculator stack registers contain zeros:



6.7.3. Entering numbers is always made in the register X. Information in the registers of the stack moves up:

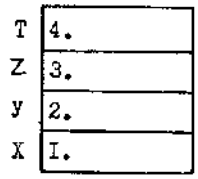


6.7.4. Pressing the [B↑] to back up the number of register X to register Y, as well as the contents of register Y and Z in the register contents of the Z register in the register T. In this case, the contents of the X register are saved and T registers disappears. This movement (lifting) of information can be represented as



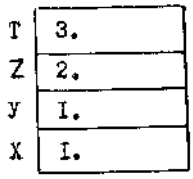
6.7.5. Pressing the [F], [♻], [↔] leads to the next movement of information:

The movement of information in the stack show by example.
Press the following keys in order:
[4], [B↑], [3], [B↑], [2], [B↑], [1].
The information in the registers of the stack as follows:



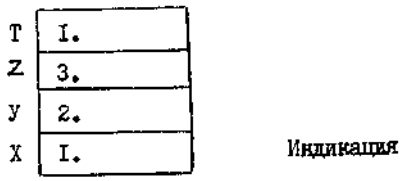
Индикация

Press [B↑]:

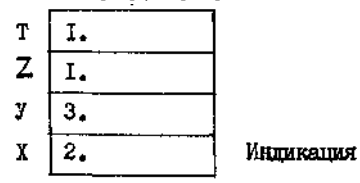


Индикация

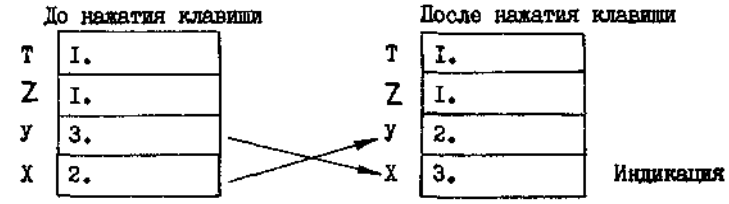
Press [F], [♻]:



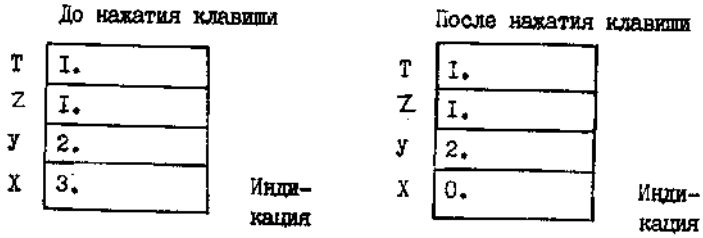
Press [F], [↻]:



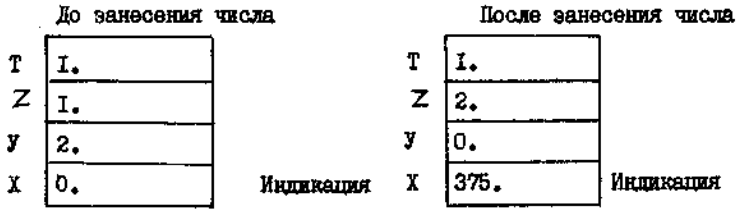
Press the key [↔]:



If the information is entered into the register X is wrong, then, pressing [CX] key, clean the register X. Thus the information in the other registers will not change.

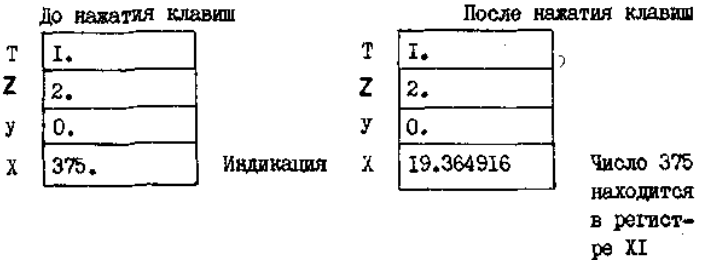


After cleaning, store the X register a new number, i.e. 375.



6.7.6. When performing single operations calculator operates with a number located in register X, the contents of registers Y, Z and T is saved, and the number located prior to the operation in the register X, is transferred to the register of the previous result (register X1). The result is one single operation is transferred to the register X.

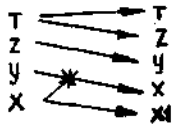
For example, you need to calculate the square root number stored in register X. To do this, press [B↑], [$\sqrt{}$].



6.7.7. Clear all stack registers is performed by pressing [CX], [B↑], [B↑], [B↑].

	До нажатия клавиш		После нажатия клавиш	
T	I.		0.	
Z	2.		0.	
У	0.		0.	
X	I9.364916	Индикация	0.	Индикация

6.7.8. When you do double operations the calculator operates with the numbers stored in the registers X and Y. In this case the information in the registers of the stack moves as follows:



Where * is the result of the operation.
Note. In step X2 moving information in the registers Y, Z, T does not occur.
Overwriting of data on the stack will explain the example of calculating 34 + 12. For greater clarity, first clear all the registers of the stack, then we introduce the numbers and perform addition operation.

Нажимаемые клавиши	Индикация	
CX	0.	
B↑	0.	
B↑	0.	
B↑	0.	
3 4	34.	Число 34 в регистре X
B↑	34.	Число 34 в регистрах X и У
1 2	I2.	Число I2 в регистре X

After entering the numbers 34 and 12 in the stack information registers will be located as follows:

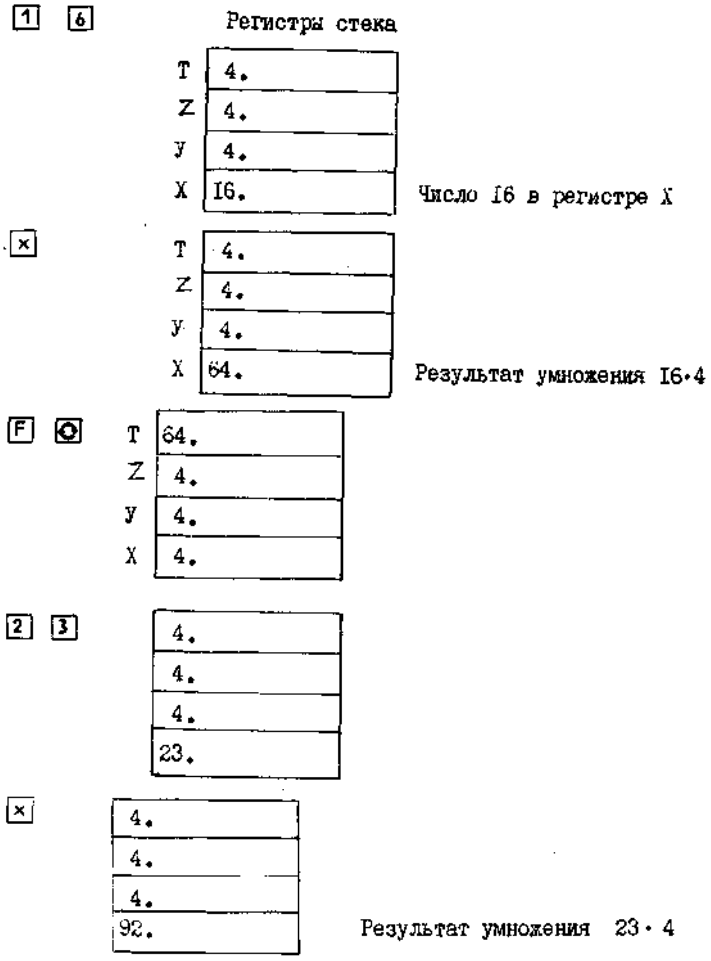
0.
0.
34.
I2.

Нажмите клавишу	Индикация	
+	46.	Результат операции в регистре X, а число I2 в регистре XI

Automatic movement of information in the stack can be used ¬ use when calculating expressions containing a constant, and when you perform a complex sequence of arithmetic operations (usually the calculations with parentheses).

For example, to calculate 16 • 4 =; 23 • 4 =

Make a note of the constant (number 4) in the stack registers by pressing [4], [B ↑], [B ↑], [B ↑], then press:



For example, to calculate the

(12 + 3) x 7 = 3.

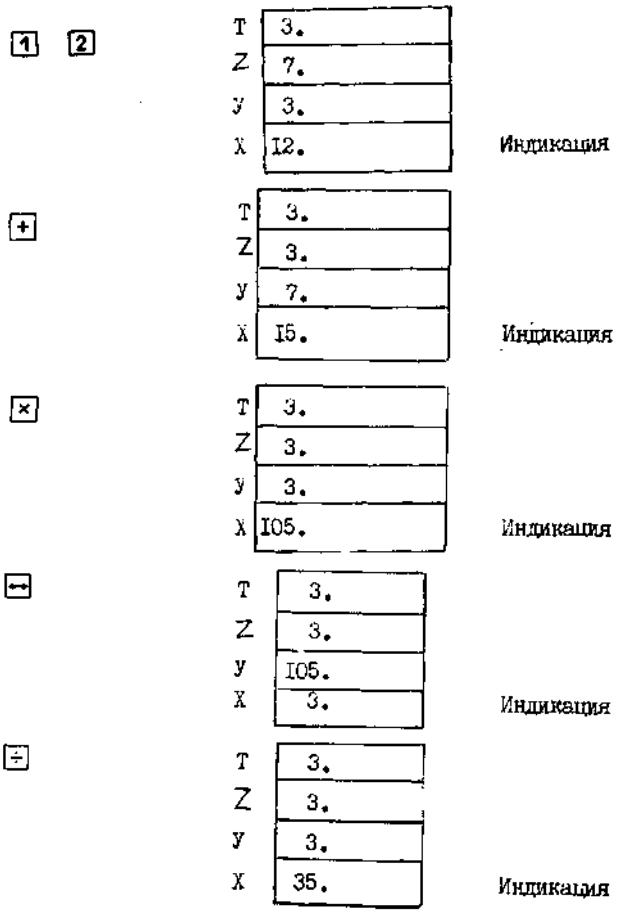
The order of calculations on the paper is as follows:
12 + 3 = 15
15 x 7 = 105
105: 3 = 35

With the help of a calculator, these calculations are performed as follows:

Нажимаемые клавиши	Индикация	
1 2	12.	
B↑	12.	
3	3.	
+	15.	
7	7.	
×	105.	
3	3.	
÷	35.	Результат вычислений

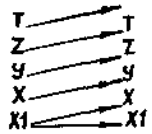
This expression can be calculated in another way: first in the stack registers are administered four
numbers, then lowered them and make action on them.

Нажимаемые клавиши	Регистры стека		
3	T	0.	
	Z	0.	
	y	35.	Предыдущий результат
	X	3.	Число 3 находится в регистре X
B↑	T	0.	
	Z	35.	
	y	3.	
	X	3.	Число 3 находится в регистрах X и Y
7	T	0.	
	Z	35.	
	y	3.	
	X	7.	Число 7 находится в регистре X
B↑	T	35.	
	Z	3.	
	y	7.	
	X	7.	Индикация
3	T	35.	
	Z	3.	
	y	7.	
	X	3.	Индикация
B↑	T	3.	
	Z	7.	
	y	3.	
	X	3.	Индикация

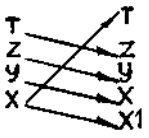


6.8. The use of the register of the previous result

6.8.1. In addition to four stackable registers in micro ¬ calculator, there is another register, called the register of the previous result (X1). This register stores the value of the number, which was in an indicative register before you ¬ X complements the operation. To call the number, press [F] and [Bx]. This will cause the following travel information in the stack:



6.8.2. If the result is obtained to check the number is needed for further calculations, for his recovery, press [F], and []. This will cause the next movement of information in the stack:

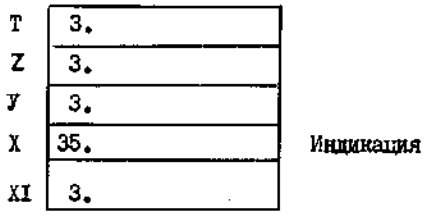


6.8.3. To clean the registry of the previous result is not

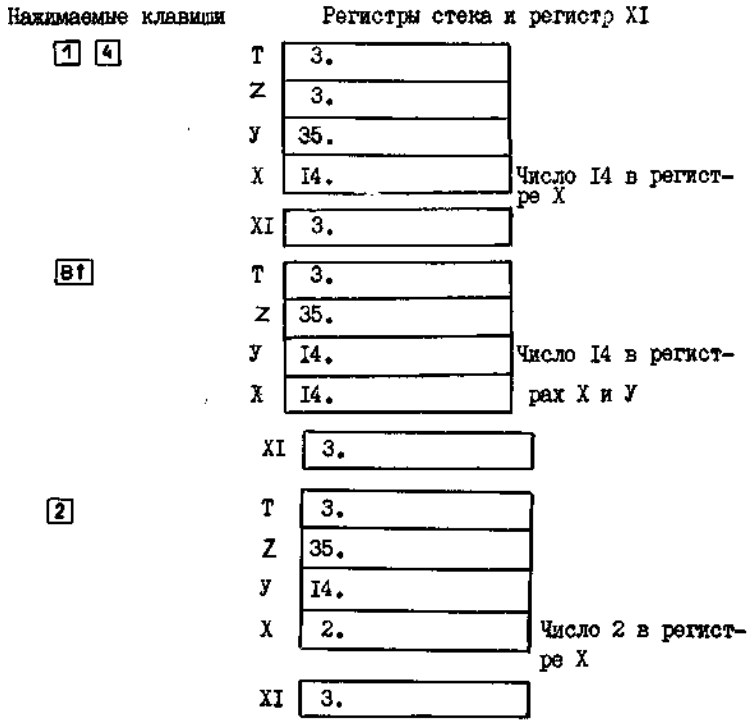
the need to write to him, "0", for this purpose press the [CX] and any action key ([], [-], [x], etc.).

6.8.4. The presence of the stack registers and the register of the previous result facilitates the calculation of complex expressions containing constant. We will show the use of these registers when evaluating the expression [(2 sin 14 °) - 4] 4.

As a result of previous calculation information in the registers in the register stack, and X1 is distributed as follows:

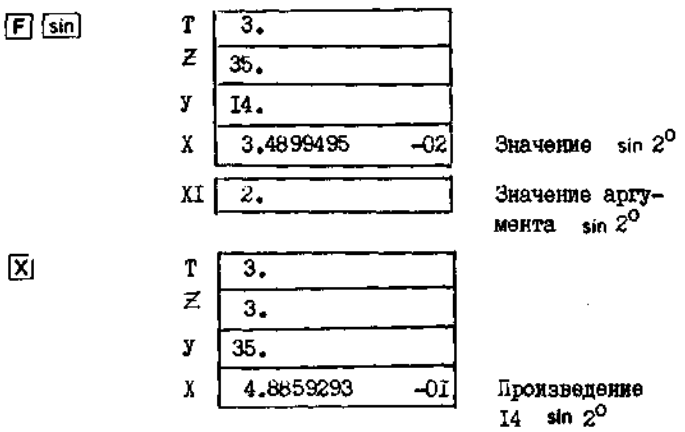


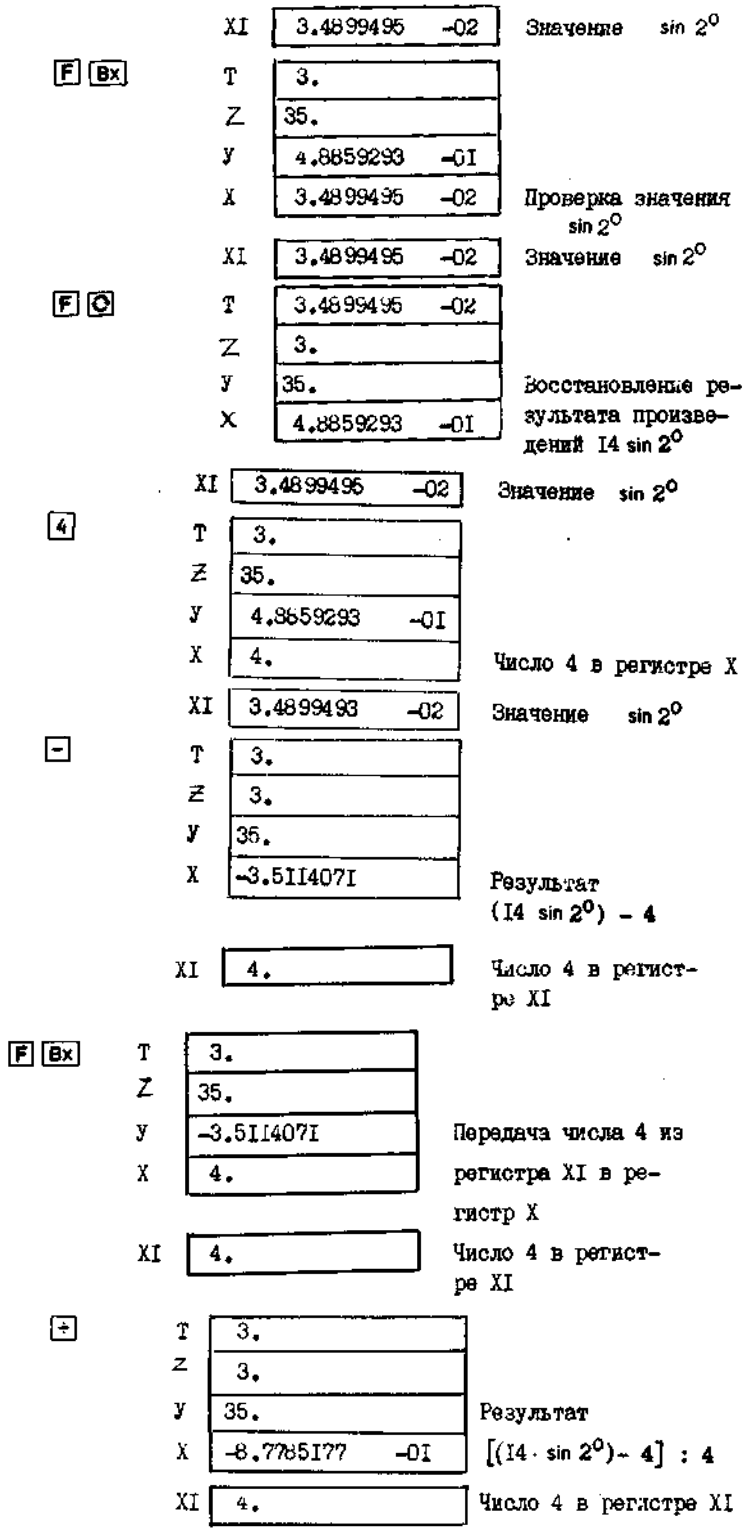
In the solution of this example, depending on the keystrokes are the following distribution of the information in the registers of the stack:



Set the "Р/ГРД/Г" to "Г ".

Press:



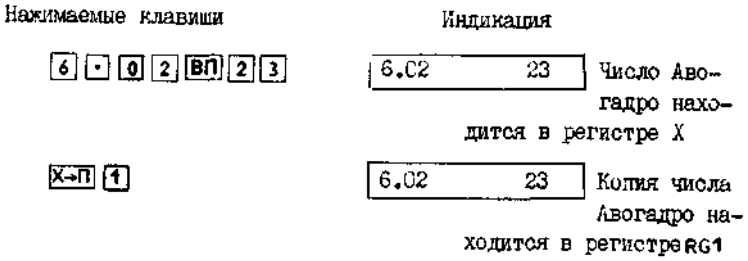


6.9. The use of addressable registers

6.9.1. Passing the number to be stored in addressable registers is carried from the register X.

6.9.2. To transfer a number to the addressed register, press [x→П], and the key corresponding to the number (index) addressable registers ([0], [1] - [9], [a], [b], [c], [d], [e]).

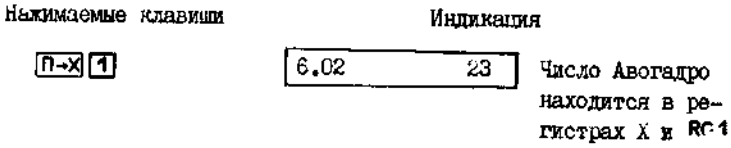
For example, the transfer of Avogadro's number (about 6,02 • 1023) deposited in the register RG1 as follows:



6.9.3. With the number of remaining in the register X, you can make further calculations. For example, the construction of: the Avogadro number in the square below.

6.9.4. To call a number stored in the addressed register, press [П→x] and the key corresponding to the call register ([0], [1] - [9], [a], [b], [c], [d], [e]). In this case, the call number is only in the X register, and does not change the contents of the call register.

For example, you must call the Avogadro number, located in the register RG1.

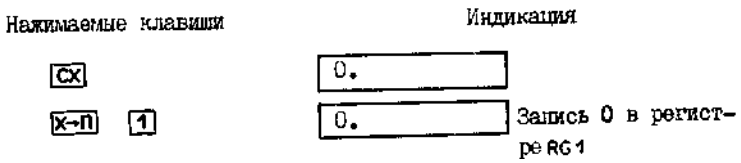


6.9.5. To clean the addressable registers, store the number 0 in the register, which must be cleaned. To do this, follow these steps:

press the [CX];

press the [x→П];

press the key corresponding to the register is to be cleansed ([0], [1] - [9], [a], [b], [c], [d], [e]). For example, you need to clear the register RG1.



6.9.6. Clear all memory registers can be done by turning off the calculator.

6.10. Reset mistakenly pressed key [F]

6.10.1. To clear an erroneously pressed key, press [F] and [CF].

6.11. Execution of logical operations

6.11.1. The numbers in the calculator are presented in sequential code in BCD notation with weights 8, 4, 2, I. Over the numbers in the X and Y registers can produce logical operations: addition, multiplication, addition, modulo 2 (XOR), inversion.

6.11.2. The result of the logic operation is displayed on the display numbers and signs as follows:

0 - нуль, 6 - шесть, [- двенадцать,
I - один, 7 - семь, ⌐ - тринадцать,
2 - два, 8 - восемь, ⊢ - четырнадцать,
3 - три, 9 - девять, пробел - пятнадцать.
4 - четыре, - - десять,
5 - пять, L - одиннадцать,

Due to the automatic suppression of zeros, graduating number, the codes "0" are indicated by spaces and therefore indistinguishable from the code "15".

6.11.3. Implementation of logic (Boolean) function is displayed digit [8.] . In relation to employment for older digital display digit number entered in the registers X and Y to perform logical operations shall include in the senior category of non-significant digit other than zero.

6.11.4. Before you perform logic operations using the calculator, we show the result of the logic operation with the numbers 12 and 43 without a calculator (see Table 5) .

Table 5

Наименование		Информация в регистрах								Результат операции на индикаторе
регистра	выполняемой логической функции	в десятичной системе	в двоично-десятичной системе							
			2-го разряда с весами				I-го разряда с весами			
			8	4	2	I	8	4	2	I
X		I2	0	0	0	I	0	0	I	0
У		43	0	I	0	0	0	0	I	I
		Результат выполнения операции								
X	V		0	I	0	I	0	0	I	I
X	∧		0	0	0	0	0	0	I	0
X	⊕		0	I	0	I	0	0	0	I
X	$\overline{X}$		I	0	I	I	I	I	0	0
			II= L				I2= [			

6.11.5. To perform logical operations (multiplication, addition, modulo-2 addition, inversion) Use [K], [Λ]; [K], [V]; [K], [⊕]; [K], [ИНВ].

6.11.6. Examples. Performing logical operations.

A logical addition of numbers

V 8888888 7770665

Нажимаемые клавиши	Индикация	
1 8 8 8 8 8 8 8	I8888888.	Цифра I введе-
Bt	I8888888.	на для запол-
1 7 7 7 0 6 6 5	I7770665.	нения старшего разряда числа
K V	8. 8EEГ	8. - признак выполнения логических операций

The logical multiplication of numbers

237 Λ 545

Нажимаемые клавиши	Индикация	
4 2 3 7	4237.	Введена цифра 4
В↑	4237.	для заполнения
4 5 4 5	4545.	старшего разряда
К А	8.005	

Exclusive OR numbers
30880 ⊕ 80001

Нажимаемые клавиши	Индикация	
1 3 0 8 8 0	I30880.	Введена цифра I
В↑	I30880.	для заполнения
1 8 0 0 0 1	I80001.	старшего разряда
К ⊕	8.L088I	

The inversion number 112

Нажимаемые клавиши	Индикация	
1 1 1 2	III2.	Введена цифра
К ИНВ	8.EEГ	I для заполнения старшего разряда

7. Calculator in "PROGRAMMING" Mode

7.1. Overview

7.1.1. In the "Programming" the calculator is set after pressing [F] and [ПРГ].

7.1.2. When you press a key in the "Programming" two-digit code operations commands and numbers assigned to the key or combination of keys with [F], [K], [x→П], [П→x] (Table 6), recorded in special memory of the program.

Table 6

The operation codes and commands

Нажимаемые клавиши	Код	Нажимаемые клавиши	Код	Нажимаемые клавиши	Код	Нажимаемые клавиши	Код
0	00	В↑	0E	F tg⁻¹	IL	F LO	5Г
1	0I	·	0-	F sin	IC	F L1	5L
2	02	+/-	0L	F cos	IГ	F L2	58
3	03	ВП	0[	F tg	IE	F L3	5-
4	04	СХ	0Г	F π	20	x→П 0	40
5	05	СП	50	F √	2I	x→П 1	4I
6	06	БП	5I	F x²	22	x→П 2	42
7	07	В/О	52	F 1/x	23	x→П 3	43
8	08	ПП	53	F ↔	24	x→П 4	44
9	09	F 10ˣ	I5	F Cx		x→П 5	45
+	I0	F lg	I7	F Bx	0	x→П 6	46
-	II	F ln	I8	F ○	25	x→П 7	47
×	I2	F eˣ	I6	F x<0	5[	x→П 8	48
÷	I3	F sin⁻¹	I9	F x=0	5E	x→П 9	49
↔	I4	F cos⁻¹	I-	F x≥0	59	x→П a	4-
				F x≠0	57	x→П b	4L

Нажимаемые клавиши	Код
X→П c	4[
X→П d	4Г
X→П e	4E
П→X 0	60
П→X 1	61
П→X 2	62
П→X 3	63
П→X 4	64
П→X 5	65
П→X 6	66
П→X 7	67
П→X 8	68
П→X 9	69
П→X a	6–
П→X b	6L
П→X c	6[

Нажимаемые клавиши	Код
П→X d	6Г
П→X e	6E
К НОП	54
К БП 0	80
К БП 1	81
К БП 2	82
К БП 3	83
К БП 4	84
К БП 5	85
К БП 6	86
К БП 7	87
К БП 8	88
К БП 9	89
К БП a	8–
К БП b	8L
К БП c	8[

Нажимаемые клавиши	Код
К БП d	8Г
К БП e	8E
К ПП 0	–0
К ПП 1	–1
К ПП 2	–2
К ПП 3	–3
К ПП 4	–4
К ПП 5	–5
К ПП 6	–6
К ПП 7	–7
К ПП 8	–8
К ПП 9	–9
К ПП a	--
К ПП b	–L
К ПП c	–[
К ПП d	–Г

Нажимаемые клавиши	Код
К ПП e	–E
К x=0 0	E0
К x=0 1	E1
К x=0 2	E2
К x=0 3	E3
К x=0 4	E4
К x=0 5	E5
К x=0 6	E6
К x=0 7	E7
К x=0 8	E8
К x=0 9	E9
К x=0 a	E–
К x=0 b	EL
К x=0 c	E[
К x=0 d	EГ
К x=0 e	EE

Нажимаемые клавиши	Код
К x<0 0	[0
К x<0 1	[1
К x<0 2	[2
К x<0 3	[3
К x<0 4	[4
К x<0 5	[5
К x<0 6	[6
К x<0 7	[7
К x<0 8	[8
К x<0 9	[9
К x<0 a	[–
К x<0 b	[L
К x<0 c	[[
К x<0 d	[Г
К x<0 e	[E
К x≥0 0	90

Нажимаемые клавиши	Код
К x≥0 1	91
К x≥0 2	92
К x≥0 3	93
К x≥0 4	94
К x≥0 5	95
К x≥0 6	96
К x≥0 7	97
К x≥0 8	98
К x≥0 9	99
К x≥0 a	9–
К x≥0 b	9L
К x≥0 c	9[
К x≥0 d	9Г
К x≥0 e	9E
К x≠0 0	70
К x≠0 1	71

Нажимаемые клавиши	Код
К x≠0 2	72
К x≠0 3	73
К x≠0 4	74
К x≠0 5	75
К x≠0 6	76
К x≠0 7	77
К x≠0 8	78
К x≠0 9	79
К x≠0 a	7–
К x≠0 b	7L
К x≠0 c	7[
К x≠0 d	7Г
К x≠0 e	7E
К X→П 0	L0
К X→П 1	L1
К X→П 2	L2

Нажимаемые клавиши	Код
К X→П 3	L3
К X→П 4	L4
К X→П 5	L5
К X→П 6	L6
К X→П 7	L7
К X→П 8	L8
К X→П 9	L9
К X→П a	L–
К X→П b	LL
К X→П c	L[
К X→П d	LГ
К X→П e	LE
К П→X 0	Г0
К П→X 1	Г1
К П→X 2	Г2
К П→X 3	Г3

Нажимаемые клавиши	Код	Нажимаемые клавиши	Код
К П→Х 4	Г4	К max	36
К П→Х 5	Г5	К ↔	3I
К П→Х 6	Г6	К ЗН	32
К П→Х 7	Г7	К ↻	33
К П→Х 8	Г8	К ↺	26
К П→Х 9	Г9	К ↻/	2–
К П→Х a	Г–	К ↺/	30
К П→Х b	Г[	К СЧ	3[
К П→Х c	Г[	К ∧	37
К П→Х d	ГГ	К ∨	38
К П→Х e	ГЕ	К ⊗	39
К ↔	34	К ИНВ	3–
К ↔	35		

7.1.3. The sequence of input transactions and commands needed to solve the problem, is a program.

7.1.4. Special program memory consists of 105 cells. First cell is assigned number 00 and last one104.

7.1.5. When recording programs to the calculator digit code (step program) in the program memory is a single cell.

7.1.6. Location code defined in the program memory address. To indicate the address from 00 to 99 using the appropriate numbers and addresses for 100 to 104 senior two digits indicate the minus sign (for example, address 100 is denoted as "0").

7.1.7. To control the sequence of recording and for executing commands in the calculator has an address counter. This counter can be set to any initial address (from 00 to 104).

7.1.8. When recording a program introduction to the program memory of commands (operations), the counter increases by 1. Thus, a sequence program instruction corresponding to the keystroke sequence during programming. However, this method is suitable for solutions not only very complex tasks.

7.1.9. In order to perform a sequence of commands different from the recording sequence of commands in the program to repeat parts of the program to change the sequence of the execution took place, depending on the intermediate results of calculations in the calculator are the command with which changes the contents of the address counter. These commands are called the transition command.

7.1.10. Changing the contents of the address counter is at the branch, recorded either in the program memory or in addressable registers, or five-digit return stack - a special area of memory (see section 7.3).

7.1.11. Jump address is recorded in the addressed register, then this is called indirect addressing "Indirect addressing is also used when referring to the addressable registers. In this case, the program instead of directly addressable registers, indicate the number of recorded consequential number, e.g. number of addressable registers in which to store the number that call. While the number of the addressed register is not just stored, but varies in a certain way, (see p.7.3.5).

7.1.12. The " Program" indicator is used to display the codes serial commands from the program memory and the current state of the program counter, i.e. the address to which will be recorded the following command. For example, the display shown

02	0I	0E	06

In this case, the double-digit operations command on the display means:

1) Code 06 - the current state of the address counter;

2) Codes 0E, 01 and 02 - three successive commands respectively located at addresses 03, 04 and 05.

7.2. Stages of computing program

The calculations are made in the program for the following order:

1) The programming of the task;

2) Enter the program into memory and editing program.

3) Debugging programs.

4} Entering input data and program execution.

7.2.1. Programming tasks

7.2.1.1. Programming problems on the calculator "Elektronika MK-52" does not require any special skills, but for the successful programming requires knowledge of its functionality and content commands. When programming tasks cannot be a single program. Any version of the program can be considered valid if it provides the correct result. Programs are possible between different memory usage. The optimality of programming comes with experience.

In this and the following sections of the guide will provide examples of programming and program fragments that explain the content of instruction, but they do not claim to optimality. Features user will be with fewer steps than suggested in the manual.

Before you start writing a program, the user of the calculator should look into the problem, determine its algorithm (sequence of operations) and memory registers for recording raw data and intermediate results of calculations, as well as the location of the program in the program memory of the calculator.

Programming simple tasks consider the example of calculating the area of a circle formula.

$$S=\frac{\pi \times d^2}{4}$$

Where d = diameter of the circle.

To calculate the area of a circle S desirable change procedure, namely: $(d^2 \cdot \pi):4$. Then the value of the diameter d can be recorded in the register X and the calculation of S can be realized pressing the following keys: [F], [x^2], [F], [π], [x], [4], [÷]. This sequence of keystrokes can be done manually. However, if we write it in the "Programming", we get a program that can be run multiple times (see pp.7.2.2, 7.2.4) in the " Automatic operation " without pressing the button above. Any program must be terminated by a stop command [С/П]. If this command is not followed, it may cause an infinite loop of the program.

For the convenience of the program it is usually made in the form of tables, which indicate the address of the instruction in the program memory, the keys to be pressed, the operation code corresponding to the keys and concubines operations.

The program to calculate the area of a circle S is shown in Table 7.

Table 7

Адрес команды	Нажатая клавиша	Код операции	Содержание операции
00	[F] [x^2]	22	Вычисление значения d^2
01	[F] [π]	20	Вызов константы π
02	[×]	12	Вычисление πd^2
03	[4]	04	Занесение числа 4 в регистр X
04	[÷]	13	Вычисление $S=\frac{\pi d^2}{4}$
05	[С/П]	50	Останов для индикации результата

7.2.1.2. For the preparation of branching programs and repeated passage of parts of programs (routines) are used commands transitions (direct and

indirect), an indirect indication of the command and call recording, looping commands. After the jump command (forward) and looping commands in the compiled program must stand the jump address. Jump address for indirect commands contained in the command itself (see section 7.3).

7.2.1.3. For direct and indirect commands branch addresses 00-99 are recorded using the corresponding number keys. Branch addresses 100 - 104 are used only for the direct command and recorded by pressing [•], which corresponds to number 10 and one of the keys [0] - [4] (see section 7.3).

7.2.1.4. The presence of the calculator stack the return establishes sub-programs within programs. The depth is determined by the bit stack routines and is five. Register stack running on the system: the first came in, last out (sm.p.7.3.3, 7.3.4, 7.3.7).

7.2.1.5. To automatically stop and display the calculation result of the program must contain a stop command [С/П].

7.2.2. Entering the program into memory and program editing

7.2.2.1. Program for solving the problem may start with 00 addresses or any arbitrary address.

To enroll in the program to address zero in the "Automatic operation" press the cleaning program counter [В/0] and go to "Program" by pressing [F] and [ПРГ]. The indicator, in this case, is indicated by address counter 00, at which will be introduced the program. Enter the program by pressing the keys that will be stored in memory. The operation entered with the keys controlled by the indicator:

Нажимаемые клавиши	Индикация	
В/О		Содержимое регистра X до нажатия клавиши
F ПРГ	00	Адрес счетчика установлен на 00
П→X 2	62 01	Запись кода вызова информации из регистра RG2 в регистр X по адресу 00
F x²	22 62 02	Запись кода возведения в квадрат числа, находящегося в регистре X, по адресу 01
В↑	0E 22 62 03	Запись кода передачи информации из регистра X в регистр У по адресу 02

To enroll in any program must address in the mode "Automatic operation", press [БП] and then key that will ensure the transition to the desired address. After the transition to a "program" on the address counter, from which the program should be introduced. Entering the program in the program memory by pressing the appropriate keys

Нажимаемые клавиши	Индикация	
[БП] [0] [2]		Содержимое регистра X до нажатия клавиш
[F] [ПРГ]	22 62 02	Счетчик установится на адрес 02, а индикатор покажет информацию, записанную по предыдущим адресам

7.2.2.2. If you make a mistake of the program, then you should go to the correct address at which you wrote the bad command. You can use [ШГ→] or [ШГ←], to find the address that is incorrect, then introduce the right command. Each time you press these keys, the counter instruction addresses respectively increased or decreased by one. Moreover, if a mistake is made in an address transition, then to fix it is necessary to move the information on the two steps and re-enter the command and following it the branch address. When the difference incorrect addresses and the current commands must use the unconditional jump. To do this, go to "Automatic operation", press [БП] and then key the number that will ensure the transition to the desired address. After setting the "Program" mode the incorrect command appears on display address. Correct the error by pressing the desired operation or command.

7.2.2.3. If you want to exclude a command from the program, go to the address of the eliminated commands, and then press [К] and [НОП]. In the program memory can be written command "No operation" on which the calculation is not done nothing.

7.2.3. Testing a program

7.2.3.1. Debugging the program is made in the "Automatic operation" by the analysis of the individual steps of the program. This is implementation by pressing the [ПП] command, in the "Automatic operation".

7.2.3.2. To debug a program, go to "Automatic operation" by pressing [F] or [АВТ], store the raw data for the program, set the start address of the recorded program (p.7.2.2.1), press the [ПП] and analyze the performance of each step program. Fix the detected errors, as indicated in pp.7.2.2.2.

7.2.2.3. If you step through the program should take into account that the implementation of the transition command, and setting the branch address are carried out in one step of the program.

7.2.4. Storing raw data and program execution

7.2.4.1. To run the program in the "Automatic operation" type on the keyboard input data and enter it into the necessary addressable memory register (RG0 - RGe) or in the stack register (X, Y, Z, T). Set the address of the start of the program (see p.7.2.2.1) and start the application on the account by pressing the [ПП] to step through program instructions or the [S / P] to automatically perform a sequence of steps of the program.

7.2.4.2. Pressing [С/П], is followed by blinking display, (which shows program execution). Run time depends on the length and nature of the calculations.

After running the program read the result on the display.

7.2.4.3. In the case of loops, i.e. endless repetition of some part of the program, you must stop it by pressing [С/П], and then check out the program and correct the cause of cycling.

7.2.4.4. To carry out multiple calculations on well-functioning program record in memory of new baseline and repeat the start of the program with the desired address.

WARNING! When power is turned off, all registers of the calculator, including members of the program memory are reset. Therefore, to save the program for a certain time, the power of the calculator cannot be disabled. Otherwise, you must enter the program again. If you want to save the program or data in the addressable registers, then write down the information in the EEPROM.

Below is an example of the program (see Table 7), which is calculated by area of a circle, if the diameter d is equal to 4, 5, 1.8 cm

To do this, follow these steps:

1) Go to "program" on 00 address by pressing [B/0], [F], [ПРГ];

2) Enter the program (see Table 7);

3) Switch to "Automatic operation" by pressing [F], [АВТ];

4) Enter the number in the X register 4 by pressing [4];

5) Start the application on the account with the address 00, press the [B/0], [С/П];

6) Read the result on the [12.56637] cm2.

To calculate the area of a circle of diameter 5 cm and 1.8, do the following:

Нажимаемые клавиши	Индикация	
5 В/О С/П	I9,634963	Площадь круга при d = 5 см
1 · 8 В/О С/П	2.54469	Площадь круга при d = I,8 см

7.3. Jump Commands

7.3.1. Unconditional jump command is realized with the [БП] key. This command interrupts the natural sequence of execution of the program and makes a transition to the execution of the command specified in the address transition (Table 8).

Table 8

Адрес	Нажимаемые клавиши	Код
. . .	. . . . .	. . .
I0	F √	2I
II	БП	5I
I2	4 2	42
. . .	. . . . .	. . .
42	+	I0
. . .	. . . . .	. . .

This code fragment at 11 voice command unconditional jump [БП] . At 12, recorded a jump address. When the program is executed in the "Automatic operation " transition occurs at address 42, ie to carry out the addition operation .

7.3.2. Commands go by ($X \geq 0$, $X < 0$, $X = 0$, $X \neq 0$) implemented key [F] key and the condition ([$X \geq 0$], [$X < 0$], [$X = 0$], [$X \neq 0$]). With these commands, check the contents of the register X ' on the execution of the specified conditions. If the condition is not satisfied, the next program will be performed by a command whose address is explicitly specified for a conditional branch instruction. If the condition is satisfied, the next program commands will be executed in the program, after the jump command address. In this case, the branch address is not perceived (Table 9).

Table 9

Адрес	Нажимаемые клавиши	Код
. . .	. . . . .	. . .
I4	F x^2	22
I5	F x=0	5E
I6	3 8	38
I7	+	I0
. . .	. . . . .	. . .
38	4	04
. . .	. . . . .	. . .

In this fragment at 15 recorded transition command on the condition X = 0. This command checks the contents of the X register for the condition. If the contents of register X = 0, then a transition to the address 17 (adding operation), if not equal , then proceeds to execution of the command , stored in the program at 38.

7.3.3. Jump command to a subroutine implemented by [ПП] key. This command implemented a Jump to a subroutine at the address immediately following the branch instruction and the next instruction address is stored on the stack return (Table 10).

Table 10

Адрес	Нажимаемые клавиши	Код
. . .	. . . . .	. . .
I7	[ПП]	53
I8	[9] [0]	90
I9	[В↑]	0E
. . .	. . . . .	. . .
89	[−]	II
90	[2]	02
9I	[В/О]	52

In this fragment at 17 recorded Jump command to the subroutine. When executing this command, the process moves to the routines stored at address 90, and the address of the main program counter is stored in the stack (19), for return.
7.3.4. The command return from the subroutine is implemented with the [B/0]. With this command, the stack will trigger the return address written on the Jump command to the subroutine [ПП] , and navigates to that address any of the steps of the main program . In the preceding code, this command is recorded at 91. At this command is invoked from the register stack return address and return to the step 19 the program execution, recorded from the same address.

7.3.5. Indirect unconditional jump command is realized by the keys [K], [ВП] and select the addressed register ([0] or [1] - [9], [a], [b], [c], [d], [e]). When executing this command the addresses stored in the registers are modified, the index is included in the command, and the execution jump to the command stored on the new (modified) address. Address modification is based on the number of registers included in the command. If the command contains a number of registers RG0, RG1, RG2, RG3, then with the execution of the command from the contents of the register (target address) 1 is subtracted, if the number of the registers are RG4, RG5, RG6, then to the contents of those registers 1 is added, if the registers RG7, RG8, RG9, RGa, RGb, RGc, RGd, RGe are used, the contents of these registers are not changed.
Next is show modification addresses stored in addressable registers when executing [K], [ВП] , [3]; [K], [ВП] , [4]; [K], [ВП], [a].
Press the [B/0], [F], [ПРГ] and fill the memory of the calculator program given in Table 11.

Table 11

Адрес	Нажимаемые клавиши	Код
00	4	04
01	ВП	0E
02	К БП 3	83
03	F √	21
04	2	02
05	+	I0
06	К БП 4	84
07	+	I0
08	3	03
09	×	I2
I0	К БП а	8-
II	-	II
I2	СП	50

Using the properties of the addressable registers within the indirect unconditional jumps command, you can perform different operations depending on a combination of the numbers stored in addressable registers RG3, RG4, RGa , and the start address of the program. To perform the calculations (4 +2) • 3 to make the jump to the addresses indicated by the arrows in Table 11 , the registers RG3, RG4, RGa , write down the numbers 5 , 7, 12 , respectively, and make a start of program from 00 . To do this, go to “Automatic operation” by pressing [F], [ABT] and perform the following operations:
1) Press:

5 X→П 3 – запись числа 5 в регистр RG3 ;
7 X→П 4 – запись числа 7 в регистр RG4 ;
1 2 X→П а – запись числа I2 в регистр RGa ;
В/О – подготовка счета по программе с адреса 00;

2) Check the contents of the addressable registers RG3, RG4, RGa to the program:

Нажимаемые клавиши	Индикация	
П→X 3	5.	Содержимое регистра RG3
П→X 4	7.	Содержимое регистра RG4
П→X а	I2.	Содержимое регистра RGa

3) Start the application on the account cycle-accurate mode, pressing the [ПП]. One press of the [ПП] corresponds to one embodiment of step program;
4) Check the indicator on the result of each step of the program;

5) If, after execution of the next cycle of the program , check the address to run the command , go to " Program" by pressing [F], [ПРГ] and read the counter following command , and then go to " Automatic operation " by pressing [F], [АВТ] and start the application on the account by pressing the [ПП] (passing in the clock program) or the [С/П] (automatic performance computing program) ;
6) Check the contents of the addressable registers after the execution of the program:

Нажимаемые клавиши	Индикация	
[П→X] [3]	00000004.	Модифицированный адрес в регистре RG3
[П→X] [4]	00000008.	Модифицированный адрес в регистре RG4
[П→X] [a]	000000I2.	Модифицированный адрес в регистре RGa ;

Control over the addressable registers content can be made, and after key in the program, but the sequence of operations is not compromised, restore operations cycle-accurate result is put down in a register X.

7.3.6. Indirect Jumps Commands are realized by the adition of the [K] key to the conditions ([X = 0], [X ≠ 0], [X ≥ 0] or [X < 0]) and the key addressable registers ([0] or [1] - [9], [a], [b], [c], [d], [e]). With this command, is checked the contents of the register X to perform a given condition.
If the condition is not met, the address modification is stored in the addressed register, the index is included in the command (see p.7.3.5) , and proceeds to execute the operation, recorded by the modified address.
If the condition is satisfied, then the program proceeds to the next command. At the same address written in the addressed register is not modified.
Make a program to solve the equation $y=-9x^2+e^{2X}$ for X > 0, and if the result will calculate y>0, then add to its value sinX, if y < 0, then add to its value tgX (Table 12). To implement these conditions in a program administered by a command of indirect Jump condition [K] , [x < 0], [b].
Table 12

Адрес	Нажимаемые клавиши	Код
00	[1]	0I
0I	[9]	09
02	[X→П] [b]	4L
03	[9]	09
04	[П→X] [1]	6I
05	[F] [x²]	22
06	[X]	I2
07	[X→П] [2]	42
08	[П→X] [1]	6I
09	[2]	02
I0	[X]	I2
II	[F] [eˣ]	I6
I2	[П→X] [2]	62
I3	[-]	II
I4	[K] [x<0] [b]	CL
I5	[П→X] [1]	6I
I6	[F] [tg]	IE
I7	[+]	I0
I8	[С/П]	50
I9	[П→X] [1]	6I
20	[F] [sin]	IC
2I	[+]	I0
22	[С/П]	50

Baseline data (value X) is proposed to write to the register RG1 in "Automatic operation". The calculation of $y=-9x^2+e^{2x}$ recorded in the program at the addresses 03 - 13, the branch address , part of the [K] , [x < 0], [b], written at

addresses 00-02 , calculation and tgX sinX written to addresses 15-16 , 19 - 20, respectively.
When executing a program command presence indirect Jump at 14 leads to the fact that the calculation result of the analysis performed $y=-9x^2+e^{2x}$. If the analysis would be that y>0, then a Jump to the address 19 , if y<0 , then the sequence of instructions stored in the program address 15. Program jumps are marked with arrows .
For example, to find the value of y at x = 1, 2 , 3 , 4. To do this, follow these steps:
1) go to " Program" by pressing [B/0], [F], [ПРГ] , and enter the program (see Table 12) ;
2) go to " Automatic operation " by pressing [F], [АВТ];
3) select the " Р/ГРД/Г " to " Р" ;
4) entered in the registers RG1 value of x = 1, by pressing [1], [x→П], [1];
5) set the start address of the account with the program 00 by pressing [В / О];
6) start the application on the account by pressing the [С/П] . The display should be [-5.35365-02] (the value of y when x = 1).
Then, follow these steps:

Нажимаемые клавиши	Индикация	
[2] [X→П] [1] [В/О] [СП]	19.507444	Значение y при x = 2
[3] [X→П] [1] [В/О] [СП]	322.56986	Значение y при x = 3
[4] [X→П] [1] [В/О] [СП]	2836.2007	Значение y при x = 4

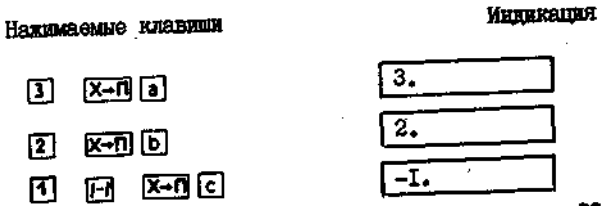
7.3.7. Indirect jump command to a subroutine is implemented using [К] [ПП] and select the addressed register ([0] or [1] - [9], [a], [b], [c], [d], [e]). With this command, address modification is made, stored in the addressed register, the index is included in the command (sm.p.7.3.5), write the following command in the stack and return to the execution of the Jump command, recorded by the modified address.
Table 13

Адрес	Нажимаемые клавиши	Код
00	1	01
01	9	09
02	X→П 7	47
03	К ПП 7	-7
04	+	10
05	П→X a	6-
06	+	13
07	2	02
08	+	13
09	X→П 1	41
10	К ПП 7	-7
11	↔	14
12	-	11
13	П→X a	6-
14	+	13
15	2	02
16	+	13
17	X→П 2	42
18	СП	50
19	П→X a	6-
20	П→X c	6C
21	×	12
22	4	04
23	×	12
24	П→X b	6L
25	F x^2	22
26	↔	14
27	-	11
28	F √	21
29	П→X b	6L
30	/-/	0L
31	В/О	52

Draw up the program (Table 13) solving a quadratic equation with the actual values of the coefficients $ax^2+bx+c=0$, in which the roots of a quadratic equation are given by

$$x_1=\frac{-b+\sqrt{b2-4ac}}{2a}; \qquad x_2=\frac{-b-\sqrt{b^2-4ac}}{2a}.$$

The values of the coefficient "a" is expected to write to the register RGa , "b" - in the register RGb, "c" - in the register RGc in " Automatic operation " and the result of the calculation of the root x1 - the register RG1, the root of x2 - the register in RG2 during the program .
Calculations of the discriminant D = b2-4ac made into a subroutine (address 19 - 27), the reference to which will be carried out by a command [K], [ПП], [7]. The execution of this command results in the fact that the register stack the return address is stored commands (for the first 04 performances and 11 in the second), and the Jump to the 19th page a written computation of the discriminant. Jump address in the program is written to the addresses 00 - 02.
Note. If the value of the discriminant in the solution of the equation is less than 0 , then the roots x1 and x2 are imaginary and the display of the calculator will be displayed ЕГГОГ .
For example, it is necessary to determine the roots of a quadratic equation Zh2 +2 x -1 = 0.
To do this, follow these steps:
1) go to " Program" by pressing [B / O], [F], [PSG] , and enter the program (sm.tabl.13) if the program had not been entered ;
2) go to " Automatic operation " by pressing [F], [ABT];
3) Entered in the register of memory values of the coefficients "a", "b" and "c"



4) set the start address of the account with the program 00 by pressing [B / O]; 5) start the application on the account by pressing the [S / P] , and so ¬ Titus value x2 on the [-1 .] . Press [П→x], [1] and read the value of x1 on the [3.3333333-01] .

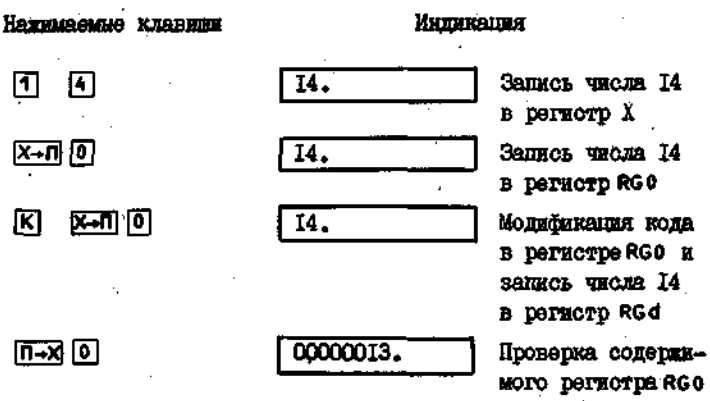
7.3.8 . Command indirect entry in the register is implemented keys [K], [x→П] and select the addressed register ([0] - [e]). With this command, made a modification of content addressable register, the index of which are included in the command (sm.p.7.3.5) , and write the contents of the X register in re ¬ giste corresponding to the obtained modified code.

Table 14

modified code	Register corresponding to the code
00000000.	RG0
00000001.	RG1
00000002.	RG2
00000003.	RG3
00000004.	RG4
00000005.	RG5
00000006.	RG6
00000007.	RG7
00000008.	RG8
00000009.	RG9
00000010.	RGa
00000011.	RGb
00000012.	RGc
00000013.	RGd
00000014.	RGe

Table. 14 shows the modified code that can brush up when the command is an indirect record and register numbers, in which information is recorded on the X register the modified code.

Indirect actions of the command record in the "Automatic operation" can be illustrated by the following examples.



[П→X] [d]	I4.	Проверка содержимого регистра RGd
[5]	5.	Запись числа 5 в регистр X
[K] [X→П] [0]	5.	Модификация кода в регистре RG0 и запись числа 5 в регистр RGc
[П→X] [0]	0000001Z.	Проверка содержимого регистра RG0
[П→X] [c]	5.	Проверка содержимого регистра RGc

7.3.9. The command implemented an indirect indication of the call buttons [K], [П→x] key and the addressable register.
With this command, made a modification of content addressable registers (p.7.3.5) and the call to the register contents of the X register, which corresponds to the modified code (Table 13).

Illustrate the effect of this command by the following:

Нажимаемые клавиши	Индикация	
[4] [X→П] [4]	4.	Запись числа 4 в регистр RG4
[1] [0] [X→П] [5]	I0.	Запись числа I0 в регистр RG5
[2] [0] [X→П] [6]	20.	Запись числа 20 в регистр RG6
[3] [0] [X→П] [7]	30.	Запись числа 30 в регистр RG7
[K] [П→X] [4]	I0.	Модификация числа, находящегося в регистре RG4 (4+I=00000005), и вызов содержимого регистра RG5 в регистр X
[П→X] [4]	00000005.	Вызов модифицированного числа из регистра RG4 в регистр X

[K] [П→X] [4]	20.	Модификация числа, находящегося в регистре RG4 (00000005 + I = = 00000006), и вызов содержимого регистра RG6 в регистр X
[П→X] [4]	00000006.	Вызов модифицированного кода регистра RG4 в регистр X

For example, solutions expression $\sum_{i=1}^{4}\left(2tg\frac{xi}{3}+4\right)$ when Xi = 1, 2, 3, 4 can use the indirect call indication.
In this expression, the number of cycles, and calculating the maximum value of x is equal to 4. To record these values, use the register RG3. Computing cycles arrange with the command [K], [П→x], [3]. At each execution of the command register contents RG3 1 is subtracted, then with ¬ contents of this register is called the register X, where it is using the [F], [x = 0] is checked for zero. If the contents of register x ≠ 0, then proceeds to perform calculations $2tg\frac{xi}{3}+4$ and the accumulation of the results of calculations in the register RG5. If the contents of the X register is zero, execution proceeds to invoke the contents of the register in the register RG5 X and stops the computation.

The program is evaluating the expression $\sum_{i=1}^{4}\left(2tg\frac{xi}{3}+4\right)$ is shown in Table 15.

Table 15

Адрес	Клавиши	Код
00	[X→П] [3]	43
01	[К] [П→X] [3]	I3
02	[П→X] [3]	63
03	[F] [x=0]	5E
04	[0] [7]	07
05	[П→X] [5]	65
06	[СП]	50
07	[3]	03
08	[÷]	I3
09	[F] [tg]	IE

Адрес	Клавиши	Код
I0	[2]	02
II	[X]	I2
I2	[4]	04
I3	[+]	I0
I4	[П→X] [5]	65
I5	[+]	I0
I6	[X→П] [5]	45
I7	[БП]	5I
I8	[0] [1]	0I

The program command [K], [П→x], [3] is a call to the command values Xi so the original data must be entered in the register RG3 as Xi +1. Calculations by the program are shown schematically in Figure 5

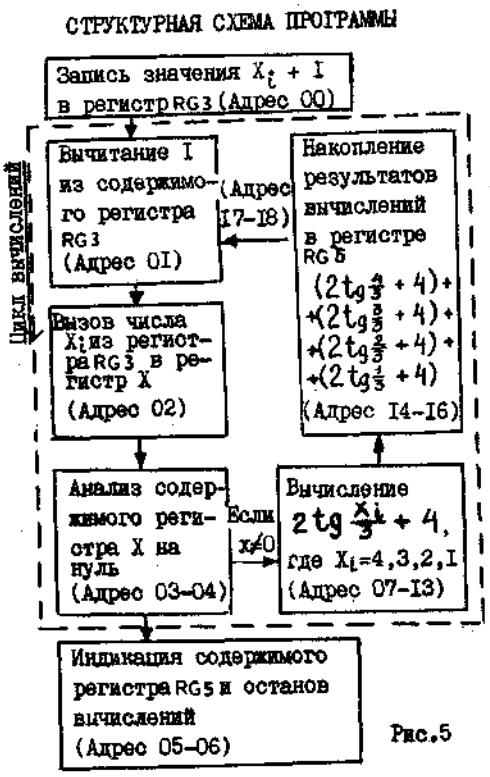


Рис.5

To evaluate an expression $\sum_{i=1}^{4}(2tg\frac{x_i}{3}+4)$, follow these steps :

1) Clean the RG5, pressing [CX], [x→П] , [5] , if register before RG5 used ;
2) go to " Program" by pressing [B / O], [F], [ПРГ] ;
3) enter the program (sm.tabl.15) ;
4) change " Automatic operation " by pressing [F], [АВТ];
5) Prepare the expense of the program address zero by pressing [B/0];
6) Enter the original data by pressing [5 ~ 1 •
7) set the "Р/ГРД/Г " to " Р" ;
8) start the application on the account by pressing the [С/П] . The display must be indicated [29.644467] .

If you need to repeat the bill , clean the register RG5, pressing [CX], [x→П] , [5], enter the original data xi = 5, then press the [B / O], [С/П] .

7.3.10. Useful loop implemented keys [F], [L0] (or [L1], [L2], [L3]). When you press the [L0] ([L1], [L2], [L3]), is addressed to the register RG0 (RG1, RG2, RG3). Whenever you access to a register of the contents of this register is subtracted 1 , and analyze its contents to zero. If the content of the register is not equal to zero, then proceeds to execute the operation, recorded at the Jump command for the next cycle , if zero, the command is executed , the program recorded in the Jump location .

Make a program to solve the example $\sum_{i=1}^{4}(2tg\frac{x_i}{3}+4)$ for xi = 1, 2, 3, 4, using the command cycle [F], [L0]. The initial data (the number of cycles and the maximum number of i xi) can be written in the register RG0. To accumulate the results of the calculations $\sum_{i=1}^{4}(2tg\frac{x_i}{3}+4)$,register RG3 is used. Example calculation program shown in the Table. 16, the calculation diagram is shown in Fig. 6.

Table 16: Block diagram of the program

Адрес	Нажимаемые клавиши	Код
00	[X→П] [0]	40
01	[П→X] [0]	60
02	[3]	03
03	[+]	13
04	[F] [tg]	1E
05	[2]	02
06	[×]	12
07	[4]	04
08	[+]	10
09	[П→X] [5]	65
10	[+]	10
11	[X→П] [5]	45
12	[F] [LO]	5Г
13	[0] [1]	01
14	[СП]	50

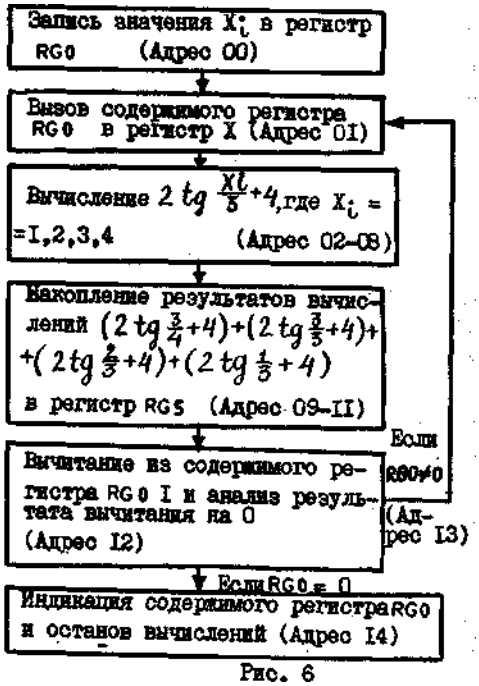


Рис. 6

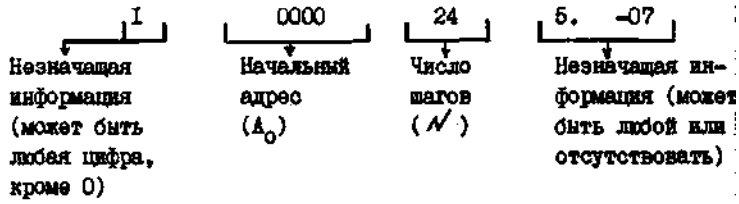
When the last round of calculations, when executing the [F], [L0], of the contents of the register RG0 (figure 1) 1 is subtracted and the result is analyzed by subtracting 0 . As the result of the subtraction 1-1 = 0, then moves to stop execution of the command. The user can check the contents of the register RG0, pressing [П→x], [L0]. The display will be shown [00000001.]

To calculate the example, follow these steps:
1) go to " program" on 00 address by pressing [B / O], [F], [ПРГ] ;
2) enter the program (see Table 15) ;
3) change " Automatic operation " by pressing [F], [АВТ];
4) Clean the RG5, pressing [CX], [x→П] , [5] ;
5) Enter the raw data (number 4) by pressing [4] ;
6) set the "Р/ГРД/Г " to " Р" ;
7) Prepare the expense of program address 00 by pressing [B / O];
8) start the application on the account by pressing the [С/П]
9) read the result on the [29.644467]

8. EEPROM OPERATION

8.1. Overview

8.1.1. Operation with EEPROM is performed setting the switch " С/Э/СЧ " (erase / write / read) to the appropriate position .
8.1.2. Accessing the EEPROM is performed at the address typed on the keyboard. Once the address is typed, press [A ↑] and then [↑ ↓].
8.1.3. The address to the EEPROM must contain at least seven digits and consist of a number diferent from 0, the start address and the number of steps. For example, if the display shows the number 10000245 • 10-7, which will be used as an address,



Start address A_0 determines the starting memory position. The number of steps N determines the number of addressed EEPROM memory cells, equal 2N, and the end memory address interrogated A_0 +2 N-1. The number N should be less than 98. The preceding number 1 is ignored.

8.1.4. Pressing [A ↑], and the arrow keys [↑ ↓] is accompanied by an indication of feature access the EEPROM (the minus sign in all places). During the flashing minus sign, the calculator is accessing the EEPROM, pressing other keys is prohibited.

8.1.5. If X has a register address to access the EEPROM, then press the [A ↑] and [↑ ↓], can be pressed in any mode of operation of the calculator ("Automatic operation" or "Program") .

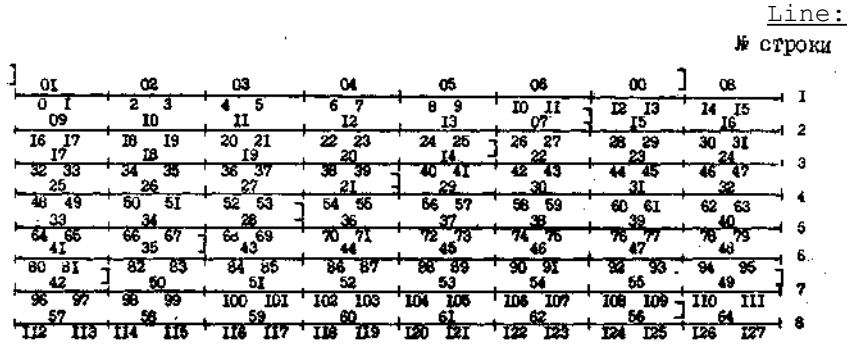
8.1.6. Pressing [A ↑] leads to memorize addresses in the calculator to access EEPROM until a new address is introduced. Therefore, if a Ai is performed, such as deleting information and at the same address, you must write the new information in this case, enter the address of Ai can not be performed, and will be limited by pressing [↑ ↓].

8.1.7. When recording or erasing information in EEPROM pressing [↑ ↓] leads to the fact that information is erased in the program or part of an addressable memory of the calculator , depending on the switch position " Д/П" . If the switch "Д/П" is in the " П" position, then will be erased the software portion of the memory if it's on "Д" , then will be erased part of addressable memory registers. The volume of information to be erased by the number of steps to address appeals to the EEprom. Erase part in the program memory is at address zero in addressable - starting with the register contents on RG0 in increasing order to register RGd inclusive. Erasing or recording information for a single register, requires 7 bytes from the EEPROM.

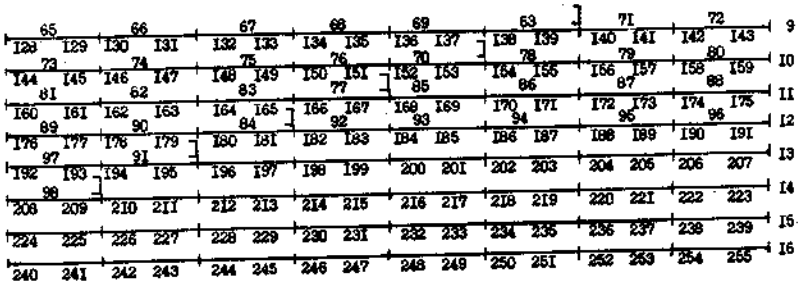
8.1.8 . The survey of EEPROM cells when erasing, writing or reading is done sequentially, step by step, addresses batches consisting of seven address by steps. For convenience in Figure 7 shows the map of EEPROM storage, consisting of 64 rows. Each cell line is used to store four bit words (one digit), has its own address, indicated in Figure 7 below, from 0 to 1023. The order survey for EEPROM cells in Fig. 7 hits for A_0 = 0000 and N = 98. Numbers above the line from 00 to 98, represent targeted steps to address access the EEPROM. Characters] ...] ... packs addresses. Each step of EEPROM address queries two cells, at the addresses specified by the number of step. And the first step in an address pack queries seventh pair of cells, the second - the first pair of cells, and the third - the second pair of cells, etc. In addition, pairs of cells in the survey are sampled the first cell to the right of the step numbers, then to the left.

Figure 7.

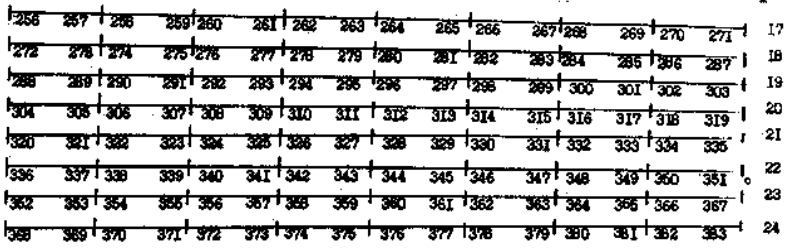
The map of EEPROM storage



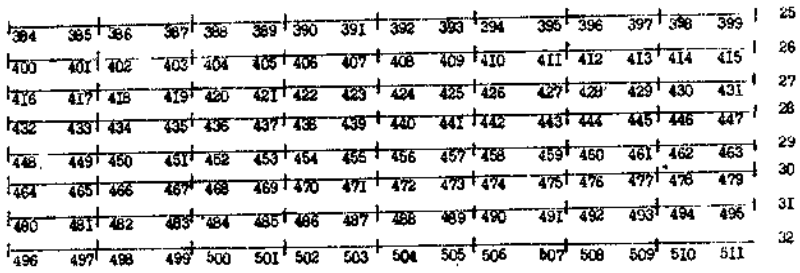
№ строки



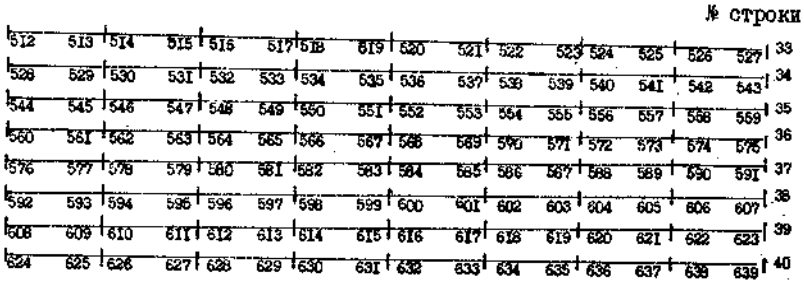
№ строки



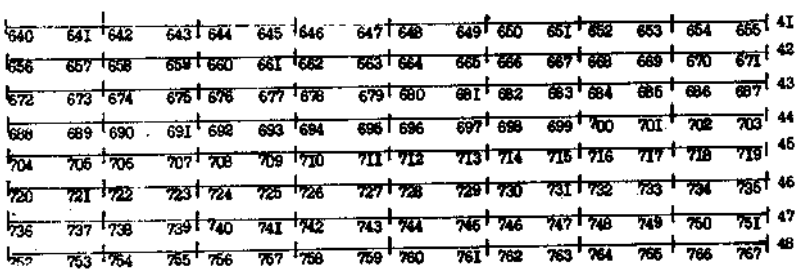
№ строки



№ строки



№ строки



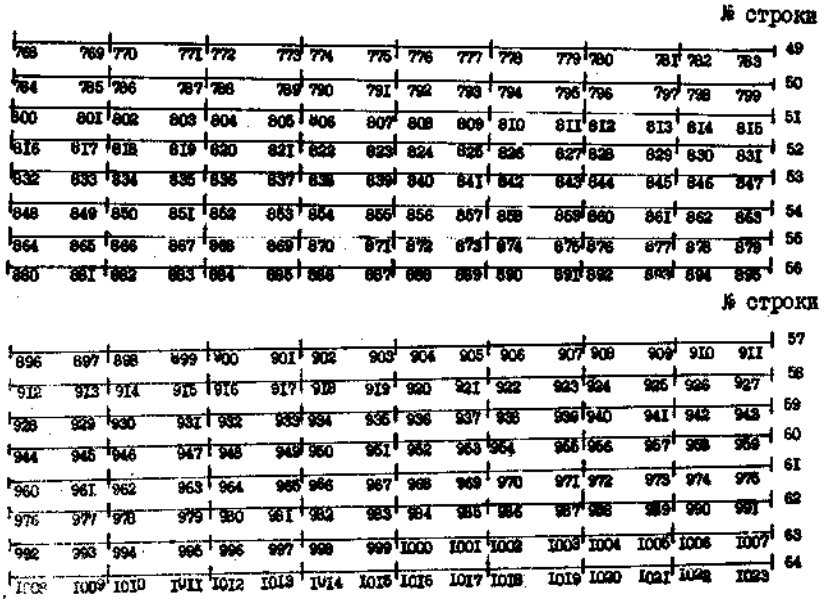


Fig. 7

8.2. Using EEPROM Erase Mode

8.2.1. Erase mode is used when want to put new information on an old location. If this operation is not performed, the new information may merge with the old one, leading to errors.

8.2.2. The information in the EEPROM is erased by line. The beginning and the end of the address of the erased information shall refer to the EEProm. To erase all the information in the string enough to address access to the EEPROM provide at least one four-digit word address, which is located on this line.

8.2.3. In just one step you can wipe the information of lines 1 to 13.

8.2.4. Erase information in the EEPROM :

1) select the " С/Э/СЧ " to " С" (erase) ;

2) select the " Д/П " to " Д " if you want to save the information in the calculator addressable registers , or to the " П " if you want to save the information of the program memory ;

3) type in " Automatic operation " the address to access EEPROM needed to erase some of the information, such as 1000098 (fig.7) ;

4) , press the [A↑], and then , after the termination of the indexing feature to access EEPROM , press [↑ ↓];

After this procedure, the information from 0 to 207th address (lines 1 to 13 on memory map) will be erased.

8.2.5. To clear the entire system EEPROM, (four groups of 208 bytes or 13 lines), you must repeat the operation several times listed in p.8.2.4, with new start address. A new start address is considered one of the addresses on the next “Group”. For example, A_0 = 0208, A_0 = 0416, A_0 = 0624, A_0 = 0832 (fig.7) .

8.3. Using EEPROM in the recording mode

8.3.1. Information is recorded in the EEPROM in those cases where it is necessary to keep the power off or repeatedly used in the computation.

8.3.2. The information in the EEPROM can be recorded from any address. For the convenience of the new PROM information should be recorded from the beginning of the line.

Laying when recording is performed in the EEPROM as shown in Figure 7, except that N corresponds to step addressable program step N- 1. For example, in cell 01 step (sm.rio.1) lies recording information recorded in the program memory at the calculator 00 .

8.3.3. When writing to the EEPROM the number of steps must match the number of

steps of the recorded information in a multiple of seven . If the number of steps of the recorded information is not a multiple of seven , the number of steps to be addressed should be increased to a multiple of seven . If the number of steps is less than the nearest multiple of seven , the information in the record will not be written. (Check the EEPROM Storage map, and the peculiar byte arrangement 1 2 3 4 5 6 0 …, if you choose less than 7 steps the first byte of your program will be loosed)

8.3.4. Write information in the EEPROM :

1) select the " С/Э/СЧ " to " З" (record) ;

2) select the " Д/П " to " Д " , if you want to record the information in the EEPROM addressable registers , or to the " П " if you want to record the information of program memory ;

3) start typing in the " Automatic operation " address to access EEPROM ;

4) press the key on the keyboard [А ↑], then press the [↑ ↓].

8.3.5. Show recording of the program in the EEPROM on the example of calculating the wage net of income tax (Table 17) . The program contains 17 steps . In order to fully record the program in EPROM , the EEPROM address to be access must contain a multiple of seven . Closest multiple of seven to 17 is the number 21. If you record the program (see Table 17) with 00 addresses , the address to access EEPROM is 1000021 . End address in which information can be written in this case is (41 x N)- 1 = (21 x 2)-1. If the EEPROM frome zero to the 41st address is not cleaned, in order to record the program, given in Table 17, it is necessary to clean EEPROM, and then enter the program in the memory of the calculator and write it to the EEPROM.

To clean the memory from zero to 41th address:

1) type in " Automatic operation " address to access EEPROM , ie The number 1000021 ;

2) Set : " С/З/СЧ " - to " С", " Д/П " - to the " П " ;

3) , press the [А ↑], then press the [↑ ↓].

For entering the program, go to address zero by pressing [В/0], [F], [ПРГ] and enter the program by pressing the keys in sequence shown in Table 17

To record a program in the EEPROM :

1) select the " С/З/СЧ " to " З " (record) ;

2) select the " Д/П " to " П " ;

3) change " Automatic operation " by pressing [F], [АВТ] and dial the number 1000021 (address access PROM) ;

4) Press the [А↑], and then press the [↑ ↓].

If data in the EEPROM at the address 1000021 is not erased, then the recording of the program in the EEPROM address 1000021 is not allowed to enter, i.e. You can limit by pressing [↑ ↓].

8.3.6. If the information in the program memory to rewrite the EEPROM program memory is cleared. You can check this by going to “Programming” and press [F], [ПРГ], [ШГ←].

8.3.7. If the information is recorded in the EEPROM, then turn off the calculator should be if you change the "С/Э/СЧ " switch to "СЧ " as accidental key presses can affect the information .

8.4. Using EEPROM in read mode

8.4.1. The information recorded in the EEPROM can be read into the memory of the calculator, for further processing.

8.4.2. Reading information from the EPROM should be done at the same address, on what has been recorded in the EEPROM. And the program stored in the EEPROM should be read only in the programming of the memory of the calculator as well as reading programs in the addressable portion of the memory and checking the contents of the addressable registers can lead to a ban indication. If there was such a procedure, for further work to turn off the calculator and on again.

8.4.3. To read information from the EPROM :

1) select the " С/Э/СЧ” switch to " СЧ " (reading), switch "Д/П" to " Д" if the information should be read in addressable memory registers , or to the " П" if the information must be read in the software portion (program) of the memory of

the calculator ;
2) in the " Automatic operation " start typing address to access EEPROM ;
3) , press the [A↑], then press the [↑ ↓];
4) Check the information read .
8.4.4. We will show the work of the calculator with EPROM in read mode on the example of the reading program recorded in the EEPROM , as described in Section 8.3.5 ;
1) turn on the calculator ;
2) select the " С/Э/СЧ " switch to " СЧ " switch "Д/П" to " П " ;
3) type the address on your keyboard 1000021 ;
4) , press the [A↑], then press the [↑ ↓];
5) Switch to the "Program" by pressing [F], [ПРГ] , and check the read program from that given in Table 17 by pressing [ШГ→].
8.4.5 . Read from the EEPROM program can be used for calculation. To do this, go to " Automatic operation " to address zero by pressing [F], [АВТ], [В / О]. Further calculation process is reduced to typing the value of wages and pressing [С/П]. As a result, calculations will amount to be paid .
For example, type the number 400 , and then press [С/П] , the indicator will be paid an amount equal to 352.8
Table 17
The program is calculating the value of wages net of income tax.

instruction address	keystrokes	operation code
00	[В↑]	0Е
01	[х→П] [2]	42
02	[0]	00
03	[•]	0-
04	[1]	01
05	[3]	03
06	[x]	12
07	[4]	04
08	[•]	0-
09	[8]	08
10	[-]	11
11	[П→x] [2]	62
12	[↔]	14
13	[-]	11
14	[С/П]	50
15	[БП]	51
16	[0] [1]	01

Note. The program is made by the formula
N1 = N-[100 • 8,2% + (N-100) • 13%] = N-[0,13 N-4, 8]
where N - wages;
N1 - wages attributable to the payment.

9. Examples of calculations of the program
9.1. Finding Compound Interest
Need to find one of the four interdependent parameters (n, i, H, k) by using the known three following formulas:

$$n = \frac{\ln(K/H)}{\ln(1+i/100)},$$

$$i = \left[(K/H)^{1/n} - 1\right] \times 100,$$

$$H = K(1+i/100)^{-n},$$

$$K = H(1+i/100)^{n},$$

Where
n - number of time periods;
i - the rate of interest over a period of time;
H - the initial value of accumulation;
k - end value accumulation.
Distribute the original data on the memory registers:
RG2 - n;
RG3 - I;
RG4 - H;
RG5 - k.

Calculation of frequent values (1 + i/100) will issue as a subroutine, which we write to address 47. Program to calculate the parameter n can be written with the address 00.
After calculating the value of the program (1 + i/100) find the natural logarithm of this value and the result is recorded in the register memory RG6, which is used to store intermediate results.
RG5 call from the register value of k, and the register RG4 - the value of H and after calculating ln (k / H) call from the register memory RG6 value of ln (1 + i/100). After dividing these values we obtain the value of the parameter n.
Program to calculate the parameter i write to the addresses 13 - 29 , the parameter N - the addresses 30 - 38, the parameter k - the addresses 39 - 46.
Instruction using the program, refer to Table 18, the program - in Table 19. We consider this problem in a particular case.

Table 18
Manual work with the program

Операции	Нажимаемые клавиши
1. Включите микрокалькулятор	
2. Перейдите в режим "Программирование"	F ПРГ
3. Занесите программу	□ □
4. Перейдите в режим "Автоматическая работа"	F АВТ
5. Занесите исходные данные в регистры памяти:	
n — в RG2	X→П 2
i — в RG3	X→П 3
H — в RG4	X→П 4
K — в RG5	X→П 5
6. По трем параметрам, занесенным в регистры памяти в качестве исходных данных, вычислите четвертый неизвестный:	
n	В/О СП
i	БП 1 3 СП
H	БП 3 0 СП
K	БП 3 9 СП

Table 19
Program

Адрес	Нажимаемые клавиши	Код
00	ПП	53
01	4 7	47
02	F ln	18
03	X→П 6	46
04	П→X 5	65
05	Bt	0E
06	П→X 4	64
07	÷	13
08	F ln	18

Адрес	Нажимаемые клавиши	Код
09	П→X 6	66
10	+	13
11	X→П 2	42
12	С/П	50
13	П→X 5	65
14	Bt	0E
15	П→X 4	64
16	÷	13
17	Bt	0E

Адрес	Нажимаемые клавиши	Код
18	П→X 2	62
19	F 1/x	23
20	↔	14
21	F x^y	24
22	1	01
23	-	11
24	1	01
25	0	00
26	0	00
27	X	12

Адрес	Нажимаемые клавиши	Код
28	X→П 3	43
29	С/П	50
30	ПП	53
31	4 7	47
32	F x^y	24
33	F 1/x	23
34	Bt	0E
35	П→X 5	65
36	X	12
37	X→П 4	44

Адрес	Нажимаемые клавиши	Код
38	С/П	50
39	ПП	53
40	4 7	47
41	F x^y	24
42	Bt	0E
43	П→X 4	64
44	X	12
45	X→П 5	45
46	С/П	50
47	П→X 3	63

Адрес	Нажимаемые клавиши	Код
48	1	01
49	0	00
50	0	00
51	÷	13
52	1	01
53	+	10
54	Bt	0E
55	П→X 2	62
56	↔	14
57	В/О	52

Suppose that in some industries was initially invested 270 million rubles . In this case, 12% of planned annual profits out of which 7.5 % will be levied to expand production.
You want to know what will be equal to the total amount of the contribution to the industry over 6 years.

Here:
n = 6 ;
i = 7,5;
H = 270 ;
k =?
In accordance with the instructions of the program, follow the procedures specified in claims 1 to 4 Table 18. Then, enter the known values of n, i, H, respectively, in memory registers RG2, RG3, RG4.
To enter the address at which to start the calculation of the calculation of the parameter k, perform the operation unconditional jump by pressing [БП] , [3] , [9] and start the application on the account by pressing the [С/П] .
The result on the display read: 416.6914 mln.

9.2. Calculating the sum (S) or the product (P) is the numerical sequence

Calculations are made using the following formulas:

$$S = \sum_{i=1}^{n} i ; \qquad P = \prod_{i=1}^{n} i$$

Instruction using the program, refer to Table 20, the program is in Table 21.

Table 20

Manual work with the program

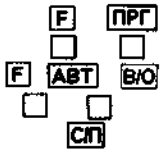
Операция	Нажимаемые клавиши
1. Включите микрокалькулятор 2. Перейдите в режим "Программирование" 3. Занесите программу 4. Очистите программный счетчик 5. Наберите на клавиатуре значение n 6. Вычислите величины S или P 7. Для вычисления суммы с новым значением n выполните операции, указанные в пп. 5,6	

Table 21

Program

Адрес	Нажимаемые клавиши	Код	Адрес	Нажимаемые клавиши	Код
00	X→П 2	42	09	X→П 2	42
01	1	01	10	П→X 3	63
02	-	11	11	БП	51
03	X→П 3	43	12	0 1	01
04	F x≠0	57	13	П→X 2	62
05	↑ 3	13	14	СП	50
06	В↑	0E	15	БП	51
07	П→X 2	62	16	0 0	00
08	+ или X	10/12/	17		

9.3. The calculation of the expectation values of a set of statistical

Calculations are made using the formula

$$\bar{X} = \frac{1}{n} \sum_{i=1}^{n} X_i .$$

Instruction using the program, refer to Table 22, the program - in Table 23.

Table 22

Manual work with the program

Операции	Нажимаемые клавиши
1. Включите микрокалькулятор	
2. Перейдите в режим "Программирование"	F ПРГ
3. Занесите программу	
4. Очистите программный счетчик	F АВТ В/О
5. Наберите число X_i	
6. Вычислите среднее число X	С/П
7. Повторите операции, указанные в пп. 5,6, при работе с очередным членом последовательности	
8. Контроль $\sum_{i=1}^{n} X_i$	П→X 2
9. Контроль n	П→X 3

Table 23

Program

Адрес	Нажимаемые клавиши	Код
00	X→П 2	42
01	1	01
02	X→П 3	43
03	П→X 2	62
04	С/П	50
05	ВП	0E
06	П→X 2	62
07	+	10
08	X→П 2	42
09	П→X 3	63

Адрес	Нажимаемые клавиши	Код
I0	1	01
I1	+	10
I2	X→П 3	43
I3	ВП	0E
I4	П→X 2	62
I5	↔	14
I6	÷	13
I7	С/П	50
I8	БП	51
I9	0 5	05

9.4. Calculations with pseudo-random number generator

Pseudo random number generator can be used to produce a pseudo-random number sequences. The resulting sequence of numbers on the calculator contain non-periodic and periodic parts. The lengths of these parts, composition and distribution of numbers ranging from 0 to 1, the conditions of the state register Y and memory overhead. Naturally, with the same initial conditions will be given the same sequence of numbers.

Program [П→x], [0], [В ↑], [К], [СЧ], [x→П], [0], [С/П], [БП] will display on a pseudo-random sequence of numbers.

By changing the values of the zero memory register, we get a different sequence of numbers. For example, this program is the zero-state of all registers, that is, if it is put in the memory and running immediately after turning the calculator will issue a fixed number sequence containing 89 numbers in a non-periodic part and 145 numbers in the periodic part.

9.5. Calculation examples using PROM

Show the work with PROM on the examples shown in pp.9.1, 9.2 and 9.3. Terms of the program remain the same.

Before writing to the EPROM program shown in Table 19, 21 and 23 to determine the amount of information to be recorded, recording the program in place the drive in accordance with Figure 7 and clear the memory storage device, if necessary.

To record a program Table 19 to 63 addressable step or 126 cells drive to record programs table 21, 23 - to 21 addressable step either 42 cell drive.

Table 19 program written in the EEPROM address zero (0 = 0000, N = 63), the program Table 21 - with A0 = 0128 and N = 21, Table 23 program - with A0 = 0176 and N = 21.

The amount of memory required to record three programs is 14 rows, so cleaning a necessary part of the memory storage can be done in two steps, such as the address A0 = 0000 for N = 98 and A0 = 0208 for N = 07.

To do this:

1) Select the "С/Э/СЧ" to "С";

2) Key in the address of the EEPROM access, equal to 1000098;

3) Select the "Д/П" to " Д ", if there is a program in the calculator and its loss is not desirable

4), press the [А↑], and then press the [↑ ↓];

5) Press [Сх] and start typing the following URL to access EEPROM, equal to 1020807, and then press the [А ↑], then press the [↑ ↓];

To record a program in the EEPROM Table 19:

1) Select the "С/Э/СЧ" to "3";

2) Enter in the "Programming" in memory of the calculator program Table 19 with zero address

3) Select the " Д/П " to " П "

4) Start typing in the "Automatic operation" address of record of the program in the EEPROM, equal to 1000063;

5), press the [А↑], and then press the [↑ ↓]

To record a program in the EEPROM Table 21:

1) Enter in the "Programming" in memory of the calculator program table 21 with zero address

2) Start typing in the "Automatic operation" address entries of the program EEPROM, equal to 1012821;

3), press the [А↑], and then press the [↑ ↓].

To record a program in the EEPROM Table 23:

1) Enter in the "Programming" in memory of the calculator program Table 23 with zero address

2) Start typing in the "Automatic operation" address of record of the program in the EEPROM, equal to 1,017,621;

3), press the [↑], and then press the [↑ ↓].

If you need to perform the calculations for one of the programs stored in the EEPROM, then read the program from the EEPROM in the memory of the calculator at the address at which to write, and follow the steps provided instruction to the program (see Table 18, 20, 22).

We will show the work to programs stored in the EEPROM on the example of the calculation of compound interest.

To read the program from the EEPROM in the memory of the calculator:

1) Select the "С/Э/СЧ" switch to " СЧ "

2) Type in "Automatic operation" address to access EEPROM on which to write the program in Table 19 PROM equal to 1000063 (if need be, clean the register X);

3), press the [А↑], and then press the [↑ ↓]. To perform a calculation on a program called the following operations provided by Table 18:

1), store the original data in the memory registers:

n - the register RG2 ([x→П], [2]);

i - in the register RG3 ([x→П], [3]);

H - to register RG4 ([x→П], [4]);

k - the register RG5 ([x→П], [5]);

2) In the three parameters listed in the memory registers as input, compute the fourth unknown:

n ([В/0], [С/П]);

i ([GC], [1], [3], [С/П]);

H ([GC], [3], [0], [С/П]);

k ([GC], [3], [9], [С/П]).

10.TRANSPORTATION AND STORAGE

10.1.When transporting the calculator must be protected from the weather and mechanical damage.

10.2.To send a calculator repair must be packed and placed in a shipping container. The latter should exclude the possibility of moving it a calculator, to protect it from damage, dust, moisture and climatic influences.

10.3. The calculator must be stored in dry, heated room air in the absence of acid, alkali and other corrosive impurities at a temperature of from 5 to 35 ° C and at a relative humidity not exceeding 85%

11. WARRANTY

11.1. The calculator "Elektronika MK-52" corresponds to the approved sample.

11.2. The manufacturer guarantees that the requirements of the calculator MO.080.334 THAT subject to the owner of the operating rules set forth in the instruction manual.

11.3. The warranty period of the calculator "Elektronika MK-52" 24 months from the date of sale through retail distribution network.

11.4. In the absence of the date of sale and shop stamp on the warranty nor coupon warranty period is calculated from the date of issue of the calculator manufacturer.

11.5. During the warranty period the owner has the right in case of failure of the calculator for a free repair on presentation of guarantee. Thus for the first or second tear repairs cut coupons corresponding to the work performed. Subsequent within the warranty period, repairs are carried out free of charge as an act for the payment of maintenance by the manufacturer.

11.6. Repair of calculators perform maintenance enterprises for which information is available in the appendix of the manual on the calculator and stores selling calculators.

11.7. Without presentation of warranty and ticket stubs and (or) for breach of security seals on the calculator claims to the quality of work will not be accepted and warranty repairs are not made.

11.8. During the warranty period stated on the calculators, repairs are at the owner's expense, if he takes advantage of it in accordance with this instruction manual, or does not comply with the recommendations of the repair facility to ensure the normal operation of the calculator.

11.9. Exchange defective calculators through a trading network on presentation of certificates, repaired and warranty card in accordance with the applicable rules of the exchange of manufactured goods purchased in retail outlets in state and cooperative trade.

11.10. The warranty period for the calculator does not apply to sources of supply.

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