SHARP

ELECTRONIC
CALCULATOR
WITH
ALL IC
COMPET-221
MODEL CS-221A

INSTRUCTION MANUAL

CONTENTS

INTRODUCTION

Sharp's amazing CS-221A electronic calculator using MSIs and ICs marks another major advance in modern business methods. Years of pioneering research and resourcefulness in electronic engineering has enabled Sharp to develop an exceptionally remarkable desk calculator.

The CS-221A is thoroughly reliable and carries out complicated calculations with amazing speed and efficiency. This booklet has been prepared to give current users and prospective buyers a detailed understanding of the scope and breadth of the machine's operation.

FEATURES

* **Fully Integrated Circuit (IC)**
Advanced MOS-MSIs (Metal Oxide Semi-conductor Middle Scale Integrations and MOS-ICs (Metal Oxide Semi-conductor Integrated Circuits) enormously reduce the amount of working parts and ensure greater dependability through superior trouble-free performance.

* **Compact and easy to carry**
Space-age all IC design and unique memory device make the CS-221A amazingly compact and light; can be carried anywhere with utmost ease and convenience.

* **Wide range of calculations**
In addition to its four arithmetical operations, multiplication, division by constant, discount calculation and memory calculation can be quickly carried out with maximum efficiency.

* **Ease of operation**
Simplified operations such as AxBxCx . . . =, A÷B÷C . . . = etc. require no special training. The answer to almost any practical mathematical problem appears instantly.

* **Easy to read display panel**
Snap reading with newly developed green numeral indicator. Does not cause eye strain with long use.

* **Automatic decimal positioning**
Tabulation selector specifies the decimal positioning automatically.

* **Minus sign indicator**
Automatically turns on when the result is negative.

* **Overflow error check system**
When the result of calculation exceeds 12 digits, all the decimal points automatically turn on and calculation function stops. No worry about mistake by overflow.

* **Double-setting protection keys**
Numeral keys are so designed that no two keys are set at a time. This eliminates error, speeds up operation . . . . . no worry about double-setting of keys.

* **Sophisticated styling**
Lightweight, noiseless and easy-to-carry the CS-221A enhances office decors, improves working morale, increases efficiency.

HINTS

1. As highly sensitive ICs, and electronic components are used, avoid placing the unit in hot, dusty or humid locations.

2. Be sure to turn off the unit before disconnecting the power cord.

3. Do not jolt or drop the unit.

4. Do not stand it on its side or turn it over.

5. Do not place articles on top of the unit.

6. When cleaning the cabinet, use the enclosed cloth. Do not use a wet cloth or any organic solutions such as kerosene or benzine.

7. When not in use, keep the unit covered.

KEY DESIGNATION

▯ Tabulation selector
Specifies decimal places (0, 1, 2, 3, 4, 6).

⓪~⑨ Numeral keys

· Decimal point key

CE Clear entry key
Clears figures mistakenly set.

C Clear key
Clears all the contents in the calculator.

× Multiplication key
Orders multiplication function.

÷ Division key
Orders division function.

= Equal key
Derives sum, product, and quotient.

■ Red equal key
Derives difference.

Memory function selector

▯ (Σ)   When the Memory function selector is set to "Σ" position, the read-in
numbers are entered by = key(■) into the memory register and accumu-
lated there. Therefore, sum (difference) of products (quotients) can be
calculated. And constant calculation can be performed by entering
a constant with = key(■) into the memory register and by calling it back
to the display (X register).

(N)   For non-memory calculations

(MR)   When the Memory function selector is set to "MR" position, the con-
tents in the memory register are called back to the display (X register).
The contents in the memory register are cleared by depressing CE key
after this selector is set to "MR" position.

⊞ Constant switch

Remembers constant and functions. If the switch is set to "x" position, multiplication function and multiplicand are remembered. If set to "÷" position, division function and divisor are remembered. After setting the switch, constant calculations are carried out by setting variables and ⊟ key only.

If set to "N" position, the remembered functions are cleared.

SPECIFICATIONS

Power source:	AC 120V, 60Hz
Capacity:	12 digits, 6 digit decimals
Addition & Subtraction:	12 digits ± 12 digits = 12 digits
Multiplication:	Total digits of Multiplier and Multiplicand: Up to 12 digits, Product: Up to 12 digits
Division:	11 digits ÷ 11 digits = 12 digits − divisor digit
Decimal point:	Preset decimal point
Negative:	Minus sign indication
Calculation speed:	Addition & subtraction 0.03 sec. Multiplication 0.18 sec. Division 0.19 sec.
MOS MSIs:	2
MOS ICs:	35
Transistors:	48
Diodes:	290
Clock pulse:	50 kHz
Temperature:	0°C − 40°C (32°F − 104°F)
Power consumption:	16W
Dimensions:	255mm wide, 107mm high, 310mm deep (10" wide, 4 1/4" high, 12 1/4" deep)
Weight:	3.7 kg (8.14 lbs.)

OPERATION

1. Connect the power cord to an electric outlet, and turn the unit on.

   Be sure to touch ⊙ key before starting calculations.

2. When not carrying out constant calculation, be sure to set the constant switch to "N" position.

1. Addition and Subtraction

* Sum, Difference: Up to 12 digits (6 digit decimals)

Ex. 1-1   123 + 456 + 789 = 1368

Steps	Operation	Display	Note
1	TAB=0		Tabulation selector
2	123	123	
3	⊟	123	
4	456	456	
5	⊟	579	
6	789	789	
7	⊟	1368	Sum

Ex. 1-2   0.12 + 0.3584 + 0.235 = 0.7134

Steps	Operation	Display	Note
1	TAB=4		Tabulation selector
2	.12	0.12	
3	⊟	0.1200	
4	.3584	0.3584	
5	⊟	0.4784	
6	.235	0.235	
7	⊟	0.7134	Sum

Ex. 1-3   35.62 − 0.53 − 40.15 = −5.06

Steps	Operation	Display	Note
1	TAB=2		Tabulation selector
2	35.62	35.62	
3	⊟	35.62	.
4	.53	0.53	
5	⊟	35.09	
6	40.15	40.15	
7	⊟	5.06−	Difference

Note: Use ⊟ key for addition. Use ⊟ key for subtraction.

2. Multiplication and Successive multiplication

* Total digits of multiplier and multiplicand: Up to 12 digits (6 digit decimals)
* Product: Up to 12 digits (6 digit decimals)

   Note: Set to the Tabulation selector number larger than the required decimal digits.

Ex 2-1 1.1 x 2.2 = 2.42

Steps	Operation	Display	Note
1	TAB=2		Tabulation selector
2	1.1	1.1	
3	⊠	1.1	
4	2.2	2.2	
5	⊟	2.42	Product

Ex. 2-2   2.2 x 3.3 x 4.4 x 5.5 = 175.6920

Steps	Operation	Display	Note
1	TAB=4		Tabulation selector
2	2.2	2.2	
3	⊠	2.2	
4	3.3	3.3	
5	⊠	7.26	
6	4.4	4.4	
7	⊠	31.944	
8	5.5	5.5	
9	⊟	175.6920	Product

Note: 1) When the decimal digits of the product are smaller than the specified Tabulation selector number, the decimal point is automatically positioned. When the decimal digits of the product are larger than the specified Tabulation selector number, the selector specifies the decimal digits.

2) For further continued Successive Multiplication, touch the ⊠ key repeatedly and proceed with the calculations.

3. Division and Successive division
   * Dividend: Up to 11 digits (6 digit decimals)
   * Divisor: Up to 11 digits (6 digit decimals)
   * Quotient: Up to 11 digits (6 digit decimals)
   Note: Set to the Tabulation dial number larger than the required decimal digits.

Ex. 3-1   436.524 ÷ 2 = 218.262

Steps	Operation	Display	Note
1	TAB=3		Tabulation selector
2	436.524	436.524	
3	⊟	436.524	
4	2	2	
5	⊟	218.262	Quotient

Ex. 3-2   256 ÷ 12 ÷ 0.56 = 38.095237

Steps	Operation	Display	Note
1	TAB=6		Tabulation selector
2	256	256	
3	÷	256	
4	12	12	
5	÷	21.333333	
6	. 56	0.56	
7	=	38.095237	Quotient

Note: 1) For further continued Successive Division, touch ÷ key repeatedly to proceed with the cal-culations.

4. Sum (Difference) of products and Individual products

* Capacity: Same as for multiplication

Ex. 4 - 1   (123 x 0.55) + (43 x 0.76) = 100.33

Steps	Operation	Display	Note
1	■ᴵ		Memory function selector
2	TAB=2		Tabulation selector
3	123	123	
4	×	123	
5	.55	0.55	
6	=	67.65	(product), ᴵ lamp on
7	43	43	
8	×	43	
9	.76	0.76	
10	=	32.68	(product)
11	■	100.33	Sum of products

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Ex. 4 - 2 (12.3 x 9.8) − (2.3 x 4.32) = 110.6040

Steps	Operation	Display	Note
1	▮ Σ		Memory function selector
2	TAB=4		Tabulation selector
3	12.3	12.3	
4	⊠	12.3	
5	9.8	9.8	
6	⊟	120.5400	(product), ▫lamp on
7	2.3	2.3	
8	⊠	2.3	
9	4.32	4.32	
10	▤	9.9360 −	(product)
11	▮MR	110.6040	Difference of products

Ex. 4 - 3 (46.9 x 3.51) + (83.4 x 7.2) − (65.3 x 4.73) = 456.2300

Steps	Operation	Display	Note
1	▮ Σ		Memory function selector
2	TAB=4		Tabulation selector
3	46.9	46.9	
4	⊠	46.9	
5	3.51	3.51	
6	⊟	164.6190	(product), ▫ lamp on
7	83.4	83.4	
8	⊠	83.4	
9	7.2	7.2	
10	⊟	600.4800	(product)
11	65.3	65.3	
12	⊠	65.3	
13	4.73	4.73	
14	▤	308.8690 −	(product)
15	▮	456.2300	Ans.

5. Sum (Difference) of Quotients and individual quotients

* Capacity: Same as for Division

Ex. 5 - 1 (1288 ÷ 23) + (0.86 ÷ 4) = 56.2150

Steps	Operation	Display	Note
1	▯Σ		Memory function selector
2	TAB=4		Tabulation selector
3	1288	1288	
4	÷	1288	
5	23	23	
6	⊟	56.0000	(quotient), ɪ lamp on
7	.86	0.86	
8	÷	0.86	
9	4	4	
10	⊟	0.2150	(quotient)
11	▮мʀ	56.2150	Sum of quotients

Ex. 5 - 2 (11.502 ÷ 2.7) − (0.96 ÷ 5) = 4.0680

Steps	Operation	Display	Note
1	▯ᵡ		Memory function selector
2	TAB=4		Tabulation selector
3	11.502	11.502	
4	÷	11.502	
5	2.7	2.7	
6	=	4.2600	(quotient), ᵮ lamp on
7	.96	0.96	
8	÷	0.96	
9	5	5	
10	▅	0.1920 −	(quotient)
11	▯ᴹᶠ	4.0680	Difference of quotients

Ex. 5 - 3 (568 ÷ 4) + (0.586 ÷ 2) − (35.8 ÷ 9.308) = 138.4469

Steps	Operation	Display	Note
1	▯ᵡ		Memory function selector
2	TAB=4		Tabulation selector
3	568	568	
4	÷	568	
5	4	4	
6	=	142.0000	(quotient), ᵮ lamp on
7	.586	0.586	
8	÷	0.586	
9	2	2	
10	=	0.2930	(quotient)
11	35.8	35.8	
12	÷	35.8	
13	9.308	9.308	
14	▅	3.8461 −	(quotient)
15	▯ᴹᶠ	138.4469	Ans.

6. Product (Quotient) of Sums (Differences) and individual Sums (Differences)

* Capacity: Same as for Multiplication or Division.

Ex. 6 - 1 (35 + 186) x (8 + 47) = 12155

Steps	Operation	Display	Note
1	▯Σ		Memory function selector
2	TAB=0		Tabulation selector
3	35	35	
4	⊟	35	Ⓘ lamp on
5	186	186	
6	⊟	186	
7	ⓒ	0	
8	▮ʷ 8	8	Memory function selector
9	⊟	8	
10	47	47	
11	⊟	55	
12	⊠	55	
13	▯ᴹᴿ	221	
14	⊟	12155	(product of sums)

Ex. 6 - 2 (286 − 35) x (86 − 55) = 7781

Steps	Operation	Display	Note
1	▯Σ		Memory function selector
2	TAB=0		Tabulation selector
3	286	286	
4	⊟	286	Ⓘ lamp on
5	35	35	
6	⊖	35	
7	ⓒ	0	
8	▮ʷ 86	86	Memory function selector
9	⊟	86	
10	55	55	
11	⊖	31	
12	⊠	31	
13	▯ᴹᴿ	251	
14	⊟	7781	(product of differences)

7. Discount calculation

* Capacity: Same as for Multiplication

Ex. 7   1234 − 1234 × 0.07 = 1147.62 (7% discount)

Steps	Operation	Display	Note
1	TAB=2		Tabulation selector
2	1234	1234	
3	⊠	1234	
4	.07	0.07	
5	⊟	86.38	
6	⊟	1147.62	

8. Multiplication and Division by Constant

A)   When using the constant switch

* Capacity: Same as for Multiplication or Division
* Constant: Multiplicand or Divisor

Ex. 8 - 1   1)   99.99 × 11.11 = 1110.8889
     2)   99.99 × 33.33 = 3332.6667
     3)   99.99 × 44.44 = 4443.5556

Steps	Operation	Display	Note
1	⊡		Constant switch
2	TAB=4		Tabulation selector
3	99.99	99.99	
4	⊠	99.99	
5	11.11	11.11	
6	⊟	1110.8889	Product
7	33.33	33.33	
8	⊟	3332.6667	Product
9	44.44	44.44	
10	⊟	4443.5556	Product

Note: When the constant switch is set to "X" position, multiplication function and multiplicand are remembered.

Ex. 8 - 2 1)   11.11 ÷ 77.77 = 0.142857
        2)   33.33 ÷ 77.77 = 0.428571
        3)   44.44 ÷ 77.77 = 0.571428

Steps	Operation	Display	Note
1	▣		Constant switch
2	TAB=6		Tabulation selector
3	11.11	11.11	
4	÷	11.11	
5	77.77	77.77	
6	=	0.142857	Quotient
7	33.33	33.33	
8	=	0.428571	Quotient
9	44.44	44.44	
10	=	0.571428	Quotient

Note: When the constant switch is set to "÷" position, division function and divisor are remembered.

B)   When using the memory bank

Ex. 8 - 3 $14.14 \times 26 \times 163 = 59925.32$
$14.14 \times 74 \times 237 = 247987.32$
$14.14 \times 36 \times 502 = 255538.08$

Steps	Operation	Display	Note
1	▯Σ		Memory function selector
2	TAB=2		Tabulation selector
3	14.14	14.14	constant
4	⊟	14.14	
5	▮ᴺ ⊠	14.14	
6	26	26	
7	⊠	367.64	
8	163	163	
9	⊟	59925.32	Ans.
10	74	74	
11	⊠	74	
12	237	237	
13	⊠	17538	
14	▮	14.14	
15	⊟	247987.32	Ans.
16	36	36	
17	⊠	36	
18	502	502	
19	⊠	18072	
20	▮	14.14	
21	⊟	255538.08	Ans.

9. Mixed calculation

* Capacity: Same as for Addition, Subtraction, Multiplication and Division.

Ex. 9 $\dfrac{(5+12) \times 0.2 + 48 - 16}{4} = 8.85$

Steps	Operation	Display	Note
1	TAB=2		Tabulation selector
2	5	5	
3	⊟	5.00	
4	12	12	
5	⊟	17.00	
6	⊠	17.00	
7	.2	0.2	
8	⊟	3.40	
9	48	48	
10	⊟	51.40	
11	16	16	
12	⊟	35.40	
13	⊟	35.40	
14	4	4	
15	⊟	8.85	Ans.

10. Square root extraction

Express the approximate expression of $\sqrt{R}$ as follows:

$$\sqrt{R} \fallingdotseq (N + R) \times S$$

Steps: (See attached table on page 20.)

1. Take 3 digits from the figures counting from the left.
   Determine N, which is the nearest value in the square root table.

2. Divide R into groups of two digits each from the decimal point.
   When the highest group consists of one digit, determine S from row IN in the table.
   When it consists of two digits, determine S from row 10 N of the table.

3. Calculate $(N + R) \times S$.

Ex. 10 . $\sqrt{53987}$

   1. Determine N = 542=54200 (to equalize the digits)
   2. Then determine that S = 214768 from the row IN.
   3. Calculate (54200 + 53987) × 214768.

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Steps	Operation	Display	Note
1	TAB=0		Tabulation selector
2	54200	54200	
3	⊟	54200	
4	53987	53987	
5	⊟	108187	
6	☒	108187	
7	214768	214768	
8	⊟	23235105616	Ans.

Note: Five digits from the top are available.

The position of the decimal point is decided by dividing R into groups of two digits each counting from the decimal point.

Taking $\sqrt{53987}$, for example, 53987 is divided into three* groups (5:39:87) counting from the decimal point. The decimal point of the answer, therefore, must be placed between the third* and the fourth digit counting from the left. The answer is 232.35.

11. Correcting mistakes

A) Numeral correction

Ex. 11-1   123 x <u>556</u> (mistake)   <u>456</u>

Steps	Operation	Display	Note
1	TAB=0		Tabulation selector
2	123	123	
3	☒	123	
4	556	556	
5	ℂ	0	
6	456	456	
7	⊟	56088	

B) Function key correction (⨸,☒ keys)

Function key correction is possible in multiplication and division as follows:

A☒⨸B⊟....... A ÷ B will be performed instead of A x B.

A⨸☒B⊟....... A x B will be performed instead of A ÷ B.

SQUARE ROOT TABLE

N	S 1 N	S 10 N	N	S 1 N	S 10 N	N	S 1 N	S 10 N	N	S 1 N	S 10 N
1.00	500000	158114	1.76	376889	119183	3.00	288675	0912871	5.00	223607	0707107
1.02	495074	156556	1.79	373718	118180	3.04	286770	0906845	5.07	222058	0702208
1.04	490290	155043				3.08	284901	0900937	5.14	220541	0697410
1.06	485643	153574	1.82	370625	117202	3.12	283069	0895144	5.21	219054	0692710
1.08	481125	152145	1.84	367606	116248	3.16	231272	0889460	5.28	217597	0688102
1.10	476731	150756	1.88	364662	115316	3.20	279508	0883883	5.35	216169	0683586
1.12	472456	149404	1.91	361787	114407	3.25	277350	0877058	5.42	214768	0679157
1.14	468293	148087	1.94	358979	113519	3.30	275241	0870388			
1.16	464238	146805	1.97	356235	112651	3.35	273179	0863868	5.50	213201	0674200
1.18	460287	145556				3.40	271163	0857493	5.58	211667	0669349
			2.00	353553	111803	3.45	269191	0851257	5.66	210166	0664602
1.20	456435	144338	2.03	350931	110974				5.74	208696	0659955
1.22	452679	143150	2.06	348367	110163	3.50	267261	0845154	5.82	207257	0655403
1.24	449013	141990	2.09	345857	109370	3.55	265372	0839181	5.90	205847	0650945
1.26	445435	140859	2.12	343401	108593	3.60	263523	0833333	5.98	204465	0646576
1.28	441942	139754	2.15	340997	107833	3.65	261712	0827606			
1.30	438529	138675	2.18	338643	107088	3.70	269938	0821995	6.06	203111	0642294
1.32	435194	137620	2.21	336336	106359	3.75	258199	0816497	6.14	201784	0638096
1.34	431934	136590	2.24	334077	105644	3.80	256495	0811107	6.22	200482	0633979
1.36	428746	135582	2.27	331862	104944	3.86	254493	0804778	6.31	199047	0629441
1.38	425628	134595	2.30	329690	104257	3.92	252538	0798596	6.40	197642	0625000
			2.33	327561	103584	3.98	250627	0792553	6.49	196267	0620651
1.40	422577	133631	2.36	325472	102923				6.58	194920	0616392
1.42	419591	132686	2.40	322749	102062	4.04	248759	0786646	6.67	193601	0612219
1.44	416667	131762	2.44	320092	101222	4.10	246932	0780869	6.76	192308	0608130
1.46	413803	130856	2.48	317500	100402	4.16	245145	0775217	6.85	191040	0604122
1.48	410997	129969				4.22	243396	0769686	6.94	189798	0600192
1.50	408248	129099	2.52	314970	0996024	4.28	241684	0764272			
1.52	405554	128247	2.56	312500	0988212	4.34	240008	0758971	7.03	188579	0596338
1.54	402911	127412	2.60	310087	0980581	4.40	238366	0753778	7.12	187383	0592557
1.56	400320	126592	2.64	307729	0973124	4.46	236757	0748691	7.21	186210	0588847
1.58	397779	125789	2.68	305424	0965834				7.30	185058	0585206
			2.72	303170	0958706	4.52	235180	0743705	7.40	183804	0581238
1.60	395285	125000				4.58	233635	0738818	7.50	182574	0577350
1.62	392837	124226	2.76	300965	0951734	4.65	231869	0733236	7.60	181369	0573539
1.64	390434	123466	2.80	298807	0944911	4.72	230144	0727778	7.70	180187	0569803
1.66	388075	122720	2.84	296695	0938233	4.79	228456	0722441	7.80	179029	0566139
1.68	385758	121988	2.88	294628	0931695	4.86	226805	0717219	7.90	177892	0562544
1.70	383482	121268	2.92	292603	0925292	4.93	225189	0712109			
1.73	380143	120212	2.96	290619	0919018				8.00	176777	0559017

N	S		N	S		N	S		N	S	
	1 N	10 N		1 N	10 N		1 N	10 N		1 N	10 N
8.11	175574	0555213	8.66	169907	0537293	9.12	165567	0523567	9.74	160210	0506630
8.22	174395	0551486	8.77	168838	0533913	9.24	164488	0520156	9.84	159152	0503282
8.33	173240	0547832	8.88	167789	0530595	9.36	163430	0516811			
8.44	172107	0544250				9.48	162392	0513530			
8.55	170996	0540738	9.00	166667	0527046	9.61	161290	0510045	10.00	158114	0500000

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