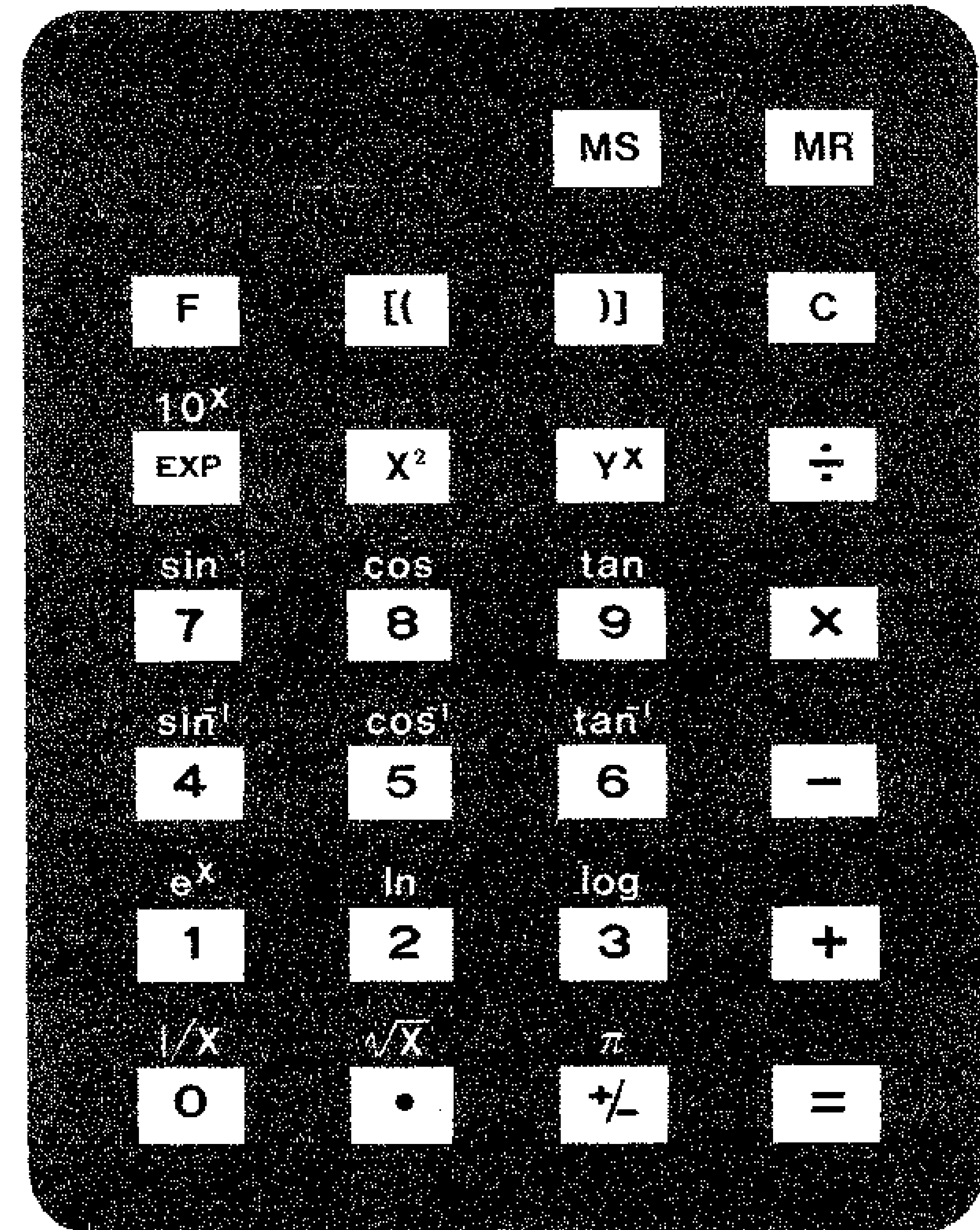


QUALITRON

2450

Scientific Electronic Calculator



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SPECIFICATION

Display:
9-digit green tube display

Keyboard:
26-key with dome keyboard

Capacity:
8-digit mantissa with sign and 2-digit exponent with sign for data entry and internal storage; 5-digit mantissa with sign and 2-digit exponent with sign displayed; or 8-digit floating decimal with sign for data entry or results.

Decimal point:
Automatic selection of correct notation for result display (scientific or floating decimal)

Switches:
► ON: Power ON/OFF switch
RD-DG : Radian/Degree mode switch for trigonometric function.

Negative Indicators:
"-" symbol in the extreme left digit position indicates negative mantissa.
"-" symbol in the 3rd digit from the right indicates negative exponents

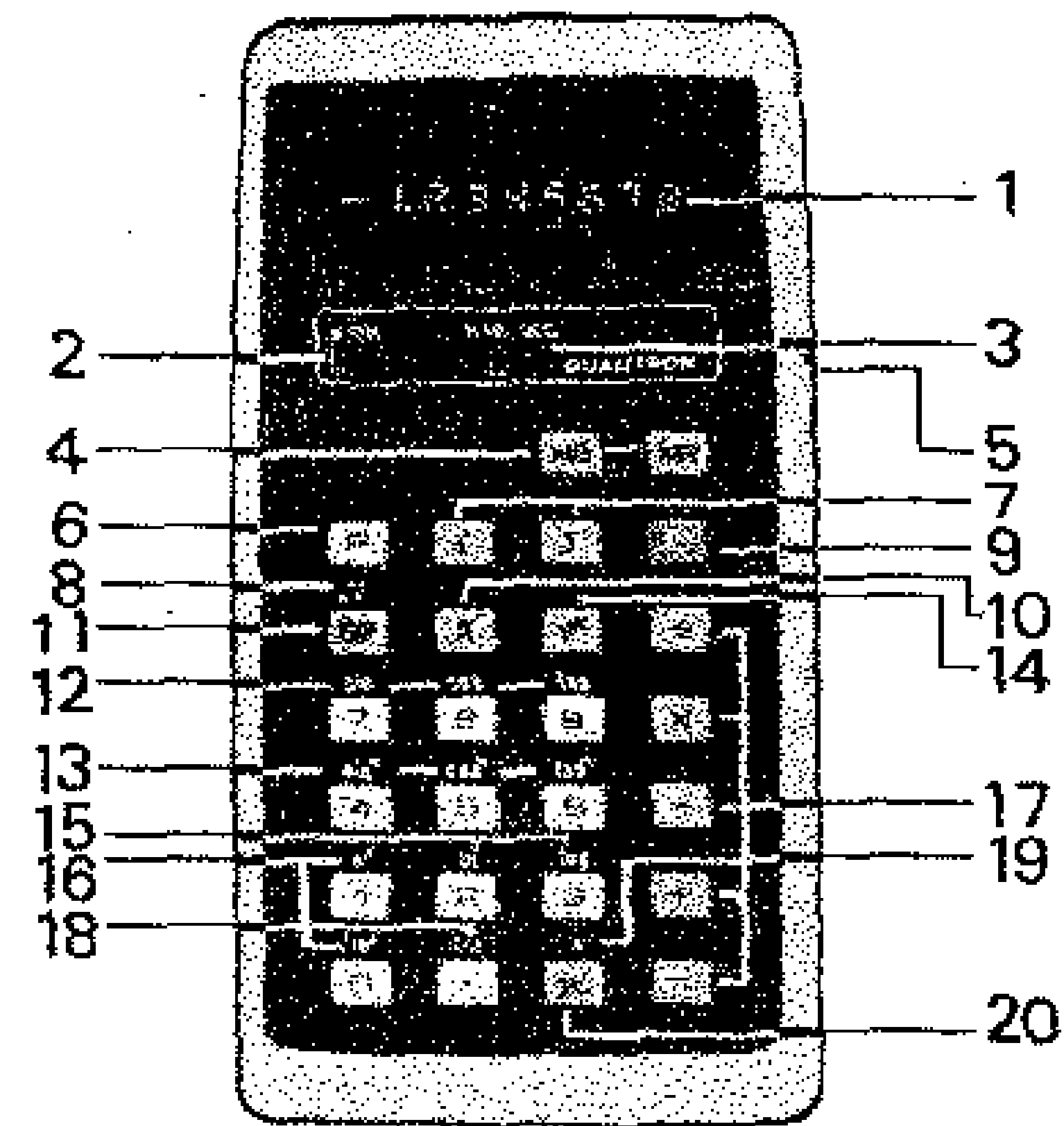
Overflow and Error Indicators:
All nine decimal points and zeros lit indicates overflow or error conditions.

OPERATION:

- * Basic arithmetic functions (+, -, \times , \div)
- * Algebraic operation for arithmetic functions
- * Automatic constant operations for arithmetic functions.
- * Trigonometric functions (sin, cos, tan)
- * Inverse trigonometric functions (\sin^{-1} , \cos^{-1} , \tan^{-1})
- * Logarithms (ln, log)
- * Anti-logarithms (e^x , 10^x)
- * Power function (y^x)
- * π constant
- * Square (x^2)

- * Square root (\sqrt{x})
- * Reciprocal ($1/x$)
- * Change sign (+/-)
- * Memory recall & memory store(MR, MS)
- * Two nested parenthesis levels ([()])
- * Single key for "clear entry" or "clear all" function (C)

KEYBOARD LAYOUT



1. Display
 2. ON/OFF Switch
 3. Radian-Degree Switch
 4. Memory Operation Keys
 5. AC Socket
 6. Inverse Trig Function Command Key
 7. Parenthetic Function Command Keys
 8. Square Root Function Key
 9. Clear Function Key
 10. π Constant
 11. Exponent Command Key
 12. Trigonometric Function Keys
 13. Anti-Trigonometric Function Keys
 14. Power Function Operation
 15. Logarithmic Function Keys
 16. Anti-Logarithmic Function keys
 17. Basic Airthmetic Function keys
 18. Reciprocal Function Key
 19. Square Function Key
 20. Change Sign Key
- 0~9 . Numerical Keys

OPERATING POWER

- * This calculator is operated on 4 built in Ni-Cad rechargeable batteries.
- * A dim display indicates the batteries are discharged & recharging is necessary.
- * Degradation of the batteries may occur if charging is continued for more than 72 hours.

AC ADAPTOR

- * With the calculator off, allow approximately 10 hours for batteries to be fully charged.
- * You can operate the calculator while charging the batteries, but the time required for the batteries to become fully charged will increase.
- * The AC ADAPTOR used must provide a DC 6V 100 mA output for the calculator.

CAUTION

- * To avoid possible damage to your calculator, use only the charge supplied with it.
- * Do not operate your calculator without the charger until you have charged the batteries for five hours. Failure to do so may damage the batteries.

OPERATION GUIDE

Notes on Display

There are two display formats on this calculator:

1. Normal notation (up to 8 digits)
2. Scientific notation (5-digit mantissa with 2-digit exponent displayed, accuracy up to 8-digit mantissa with 2-digit exponent internally)

Result of any non-data key will be displayed as follows:

1. $1 \leq |x| \leq 10^8 - 1$ in floating point notation.
2. Values outside the range stated above will be displayed in scientific notation.

- * All results are left-adjusted with trailing zero suppression. The exponent is suppressed when not in scientific notation.

- * A result larger than $\pm 9.9999999 \times 10^{99}$ will cause overflow and the error condition will be displayed. The lowest figure that can be displayed is $\pm 1 \times 10^{-99}$. Any result lower than this in magnitude but not equal to zero will cause underflow to zero.

A. BASIC FUNCTIONS

A.1 Chain Operation

Example 1) $1.23 + 4.567 - 8.9 + 10 = 6.897$

Operation	Display	Remark
\boxed{C}	0.	
1.23	1.23	
$\boxed{+}$	1.23	
4.567	4.567	
$\boxed{-}$	5.797	
8.9	8.9	
$\boxed{+}$	-3.103	
10	10.	
$\boxed{=}$	6.897	

Example 2) $9.87 \times 6.543 \div 2.1 \div 0.9 = 34.169$

Operation	Display	Remark
\boxed{C}	0.	
9.87	9.87	
$\boxed{\times}$	9.87	
6.543	6.543	
$\boxed{\div}$	64.57941	
2.1	2.1	
$\boxed{\div}$	30.7521	
0.9	0.9	
$\boxed{=}$	34.169	

A.2 Intermixed Operation

Example 1) $[(1+2) \times 3 - 4] \div 5 = 1$

Operation	Display	Remark
\boxed{C}	0.	
1	1.	
$\boxed{+}$	1.	
2	2.	
$\boxed{\times}$	3.	1+2
3	3.	
$\boxed{-}$	9.	3X3
4	4.	
$\boxed{\div}$	5.	9-4
5	5.	
$\boxed{=}$	1.	

Example 2) $[(10+9-8) \div 7 \div 6 + 5] \div 4 = 1.3154761$

Operation	Display	Remark
\boxed{C}	0.	
10	10.	
$\boxed{+}$	10.	
9	9.	
$\boxed{-}$	19.	
8	8.	
$\boxed{\div}$	11.	

Operation	Display	Remark
7	7.	
\div	1.5714285	
6	6.	
$+$	2.6190-01	
5	5.	
\div	5.2619047	
4	4.	
$=$	1.3154761	

A. 3 Repeated Operation

Example 1) $1.1 + 1.1 + 1.1 + 1.1 + 1.1 = 5.5$

Operation	display	Remark
C	0.	
1.1	1.1	
$+$	1.1	
$=$	2.2	
$=$	3.3	
$=$	4.4	
$=$	5.5	

Example 2) $4.4 - 1.1 - 1.1 - 1.1 - 1.1 = 0$

Operation	Display	Remark
C	0.	
4.4	4.4	

Operation	Display	Remark
$=$	4.4	
1.1	1.1	
$=$	3.3	
$=$	2.2	
$=$	1.1	
$=$	0.	

Example 3) $1.1 \times 3 \times 3 \times 3 = 29.7$

Operation	Display	Remark
C	0.	
1.1	1.1	
\times	1.1	
3	3.	
$=$	3.3	
$=$	9.9	
$=$	29.7	

A.4 Constant Operation

Example 1) $1 + 2 = 3$ $4 + 2 = 6$
 $5 + 2 = 7$

Operation	Display	Remark
C	0. 0.	
1	1. 1.	
$+$	1. 1.	
2	2. 2.	

Operation	Display	Remark
$\boxed{=}$	3.	1+2
4	4.	
$\boxed{=}$	6.	4+2
5	5.	
$\boxed{=}$	7.	5+2

Example 2) $10 - 2 = 5$ $15 - 5 = 10$
 $20 - 5 = 15$

Operation	Display	Remark
\boxed{C}	0.	
10	10.	
$\boxed{-}$	10.	
5	5.	
$\boxed{=}$	5.	10-5
15	15.	
$\boxed{=}$	10.	15-5
20	20.	
$\boxed{=}$	15.	20-5

Example 3) $3 \times 2 = 6$ $4 \times 2 = 8$
 $5 \times 2 = 10$

Operation	Display	Remark
\boxed{C}	0.	
3	3.	
$\boxed{\times}$	3.	
2	2.	

Operation	Display	Remark
$\boxed{=}$	6.	3x2
4	4.	
$\boxed{=}$	8.	4x2
5	5.	
$\boxed{=}$	10.	5x2

Example 4) $8 \div 2 = 4$ $16 \div 2 = 8$
 $40 \div 2 = 20$

Operation	Display	Remark
\boxed{C}	0.	
8	8.	
$\boxed{\div}$	8.	
2	2.	
$\boxed{=}$	4.	8÷2
16	16.	
$\boxed{=}$	8.	16÷2
40	40.	
$\boxed{=}$	20.	40÷2

A.5 Operation with Exponent

Example 1) $(2.3 \times 10^7) \times (5.86 \times 10^{-3})$
 $= 13.478 \times 10^4$
 $= 134780$

Operation	Display	Remark
\boxed{C}	0. 0.	
2.3	2.3.3	

Operation	Display	Remark
EXP	2.3 00	
7	2.3 07	
X	23000000.	
5.86	5.86	
EXP	5.86 00	
3	5.86 03	
+/-	5.86 -03	
=	134780	

Example 2) $10^2 \div 3.2 = 31.25$

Operation	Display	Remark
C	0.	
EXP	1. 00	
2	1. 02	
÷	100.	
3.2	3.2	
=	31.25	

A.6 Change Sign +/-

Example 1) $(-6) \times 3 = -18$

Operation	Display	Remark
C	0.	
6	6.	
+/-	-6.	

Operation	Display	Remark
X	-6.	
3	3.	
=	-18.	

Example 2) $[6 \times (-7)] \div (-21) = 2$

Operation	Display	Remark
C	0.	
6	6.	
X	6.	
7	7.	
+/-	-7.	
÷	-42.	
21	21.	
+/-	-21.	
=	2.	

A.7 π Constant

Example 1) $\pi + 2 = 5.1415926$

Operation	Display	Remark
C	0.	
F π	3.1415926	
+	3.1415926	
2	2.	
=	5.1415926	

Example 2) Find the circumference of a circle (Radius = 5)

$$2\pi \times 5 = 31.415926$$

Operation	Display	Remark
\boxed{C}	0.	
5	5.	
\boxed{X}	5.	
$\boxed{F} \boxed{\pi}$	3.1415926	
\boxed{X}	15.707963	
2	2.	
$\boxed{=}$	31.415926	

A.8 Parentheses

* The $\boxed{[($ and $\boxed{)]}$ keys are used to implement two levels of parentheses using the parentheses registers.

* All arithmetic functions and scientific functions may be nested in parentheses.

Example 1) $2 + [3X(16+2)] = 56$

Operation	Display	Remark
\boxed{C}	0.	
2	2.	
$\boxed{+}$	2.	
$\boxed{[($	2.	
3	3.	
\boxed{X}	3.	

Operation	Display	Remark
$\boxed{[($	3.	
16	16.	
$\boxed{+}$	16.	
2	2.	
$\boxed{)]}$	18.	
$\boxed{)]}$	54.	
$\boxed{=}$	56.	

Example 2) $5X[3+(2X9)]+4 = 109$

Operation	Display	Remark
\boxed{C}	0.	
5	5.	
\boxed{X}	5.	
$\boxed{[($	5.	
3	3.	
$\boxed{+}$	3.	
$\boxed{[($	3.	
2	2.	
\boxed{X}	2.	
9	9.	
$\boxed{)]}$	18.	
$\boxed{)]}$	21.	
$\boxed{+}$	105.	

Operation	Display	Remark
4	4.	
=	109.	

B. MEMORY OPERATIONS

Example 1) $(1+2+3) \div (4+5+6) = 0.4$

Operation	Display	Remark
C	0.	
4	4.	
+	4.	
5	5.	
+	9.	
6	6.	
=	15.	
MS	15.	
1	1.	
+	1.	
2	2.	
+	3.	
3	3.	
÷	6.	
MR	15.	
=	4. -01	

$$\text{Example 2) } \frac{(3 \times 6) - 5}{(3 \times 6) + 5} - \frac{(4 \times 3) + 5}{(4 \times 3) - 5}$$

$$= -1.8633541$$

Operation	Display	Remark
C	0.	
3	3.	
X	3.	
6	6.	
-	18.	
MS	18.	
5	5.	
÷	13.	
[(13.	(3X6) - 5*A
MR	18.	
+	18.	
5	5.	
])	23.	(3X6) + 5*B
-	5.6521-01	A ÷ B
[(5.6521-01	
4	4.	
X	4.	
3	3.	
+	12.	
MS	12.	

Operation	Display	Remark
5	5.	
$\frac{\square}{\square}$	17.	(4X3)+5 *C
[(17.	
MR	12.	
-	12.	
5	5.	
)]	7.	(4X3)-5 *D
)]	2.4285714	c÷D
=	-1.8633541	A/B - C/D

C. SCIENTIFIC FUNCTIONS

C.1 Trigonometric Functions

* For the argument limits of the trigonometric functions, please refer to Appendix.

C.1.1 Argument in Degree

(Set RD/DG Switch at DG Position)

Example 1) $\sin 60^\circ$

Operation	Display	Remark
C	0.	
60	60.	
F sin	8.6602-01	

Example 2) $\cos 30^\circ$

Operation	Display	Remark
C	0.	

Operation	Display	Remark
30	30.	
F cos	8.6602-01	

Example 3) $\tan 45^\circ$

Operation	Display	Remark
C	0.	
45	45.	
F tan	1.	

C.1.2 Argument in Radian

(Set RD/DG Switch at RD Position)

Example 1) $\sin \pi$

Operation	Display	Remark
C	0.	
F π	3.1415926	
F sin	0.	

Example 2) $\cos 2/3 \pi$

Operation	Display	Remark
C	0.	
2	2.	
X	2.	
F π	3.1415926	
$\frac{\square}{\square}$	6.2831852	
3	3.	
=	2.094395	

Operation	Display	Remark
\boxed{F} $\boxed{\cos}$	-5. -01	

Example 3) $\tan^{-1} \pi/4$

Operation	Display	Remark
\boxed{C}	0.	
\boxed{F} $\boxed{\pi}$	3.1415926	
$\boxed{\div}$	3.1415926	
4	4.	
$\boxed{=}$	7.8539-01	
$\boxed{+/-}$	-7.8539-01	
\boxed{F} $\boxed{\tan}$	-1.	

C.2 Inverse Trigonometric Functions

C.2.1 Argument in Degree

(Set RD/DG Switch at DG Position)

Example 1) $\sin^{-1} 0.5$

Operation	Display	Remark
\boxed{C}	0.	
0.5	0.5	
\boxed{F} $\boxed{\sin^{-1}}$	30.	

Example 2) $\cos^{-1} (-0.5)$

Operation	Display	Remark
\boxed{C}	0.	
0.5	0.5	

Operation	Display	Remark
$\boxed{+/-}$	-0.5	
\boxed{F} $\boxed{\cos^{-1}}$	120.	

Example 3) $\tan^{-1}(-1)$

Operation	Display	Remark
\boxed{C}	0.	
1	1.	
$\boxed{+/-}$	-1.	
\boxed{F} $\boxed{\tan^{-1}}$	-45.	

C.2.2 Argument in Radian

(Set RD/DG Switch at RD Position)

Example 1) $\sin^{-1} 0.5$

Operation	Display	Remark
\boxed{C}	0.	
0.5	0.5	
\boxed{F} $\boxed{\sin^{-1}}$	5.2359-01	

Example 2) $\cos^{-1} 0.3$

Operation	Display	Remark
\boxed{C}	0.	
0.3	0.3	
\boxed{F} $\boxed{\cos^{-1}}$	1.2661	

Example 3) $\tan^{-1} 23$

Operation	Display	Remark
\boxed{C}	0.	

Operation	Display	Remark
23	23.	
\boxed{F} $\boxed{\tan^{-1}}$	1.52735	

C. Logarithm (Ln, Log)

Example 1) Ln 5

Operation	Display	Remark
\boxed{C}	0.	
5	5.	
\boxed{F} $\boxed{\ln}$	1.60944	

Example 2) Log 0.03

Operation	Display	Remark
\boxed{C}	0.	
0.03	0.03	
\boxed{F} $\boxed{\text{Log}}$	-1.52288	

C.4 Anti-Logarithm (e^x , 10^x)

Example 1) $e^{2.3}$

Operation	Display	Remark
\boxed{C}	0.	
2.3	2.3	
\boxed{F} $\boxed{e^x}$	9.97418	

Example 2) $10^{2.3}$

Operation	Display	Remark
\boxed{C}	0.	
2.3	2.3	

Operation	Display	Remark
\boxed{F} $\boxed{10^x}$	199.526	

C.5 Power Function y^x

Example 1) 3^4

Operation	Display	Remark
\boxed{C}	0.	
3	3.	
$\boxed{y^x}$	3.	
4	4.	
$\boxed{=}$	81.	

Example 2) $(2 \times 10^3)^4 = 1.6 \times 10^{13}$

Operation	Display	Remark
\boxed{C}	0.	
2	2.	
$\boxed{\text{EXP}}$	2. 00	
3	3. 03	
$\boxed{y^x}$	2000.	
4	4.	
$\boxed{=}$	1.6 13	

C.6 Square Root \sqrt{x}

Example 1) $\sqrt{8}$

Operation	Display	Remark
\boxed{C}	0.	

Operation	Display	Remark
8	8.	
$\boxed{F} \boxed{\sqrt{x}}$	2.8284271	

Example: 2) $100^{1/4}$

Operation	Display	Remark
\boxed{C}	0.	
100	100.	
$\boxed{F} \boxed{\sqrt{x}}$	10.	
$\boxed{F} \boxed{\sqrt{x}}$	3.1622776	

C.7 Square x^2

Example 1) 6^2

Operation	Display	Remark
\boxed{C}	0.	
6	6.	
$\boxed{x^2}$	36.	

Example 2) Find the area of a circle
of radius 5
 $5^2 \times 3.1415926$

Operation	Display	Remark
\boxed{C}	0.	
5	5.	
$\boxed{x^2}$	25.	
$\boxed{\times}$	25.	
$\boxed{F} \boxed{\pi}$	3.1415926	

Operation	Display	Remark
$\boxed{=}$	78.539815	

C.8 Reciprocal $1/X$

Example 1) $1/8$

Operation	Display	Remark
\boxed{C}	0.	
8	8.	
$\boxed{F} \boxed{1/X}$	1.25 -01	

Example 2) $\frac{1}{(3-1/2)} = 0.4$

Operation	Display	Remark
\boxed{C}	0.	
3	3.	
$\boxed{-}$	3.	
2	2.	
$\boxed{F} \boxed{1/X}$	5. -01	$1/2=0.5$
$\boxed{=}$	2.5	
$\boxed{F} \boxed{1/X}$	4 -01	$1/2.5=0.4$

D. OVERFLOW, UNDERFLOW OR ERROR OPERATIONS

Example: $\sin^{-1} 2 = \text{error}$

Operation	Display	Remark
\boxed{C}	0.	
2	2.	
$\boxed{F} \boxed{\sin}$	0.0.0.0.0.0.0.0.	error

Example: $(8 \times 10^{50}) \times (5 \times 10^{55})$
 $= 4 \times 10^{106}$

Operation	Display	Remark
\boxed{C}	0.	
8	8.	
\boxed{EXP}	8. 00	
50	8	
\boxed{Y}	8. 50	
5	5.	
\boxed{EXP}	5. 00	
55	5. 55	
$\boxed{=}$	0.0.0.0.0.0.0.0.0.	overflow

APPENDIX

I. ARGUMENT LIMITS

sin, cos, tan: $|X| \leq 180$ degrees or
 $|X| \leq 3.1415927$ radians

\sin^{-1} , \cos^{-1} : $|X| \leq 1$

\tan^{-1} : $|X| < 5 \times 10^{99}$

e^X : $X < 230.25851$

10^X : $X < 100$

X^2 : $|X| < 10^{50}$

\sqrt{X} : $0 \leq X \leq 9.9999999 \times 10^{99}$

y^X : $Y \geq 10^{-99}$ and
 $X \ln Y < 230.25851$

$1/X$: $X \neq 0$

*The arguments outside the above ranges will cause the error condition to be set.

II. OPERATION ACCURACY

a. +, -, \times , \div , $1/X$, X^2 and π : 8 digits
 $(\pm 1$ in the eighth digit)

\sqrt{X} : 8 digits (± 5 in the eighth digit)

sin, cos, tan, \sin^{-1} , \cos^{-1} , \tan^{-1} ,

e^X , 10^X , Ln and Log: 6 digits

(± 3 in the sixth digit) except as noted below.

b. Ranges where above accuracy may not hold:

1.1 $\ln X$, $\log X$
 $1 > X > .9999999$

1.2 y^X
 $1 > Y > .9999999$

1.3 $\sin^{-1} X$
 $1 > |X| > .9999999$

1.4 $\cos^{-1} X$
 $-1 < X < -.9999999$, $.99 < X < 1$

* Following is for X in radians only

2.1 $\cos X$, $\tan X$
 $1.581 > |X| > 1.56$

2.2 $\sin X$, $\tan X$
 $3.1415927 \geq |X| > 3.131$