MM57123 business/financial calculator circuit

general description

The single-chip MM57123 Business and Financial Calculator was developed using a metal-gate, P-channel enhancement and depletion-mode MOS/LSI technology with low end-product cost as a primary objective. A complete calculator as shown in *Figure 1* requires only the MM57123, a keyboard, digit driver, LED display, 9V battery and appropriate hardware.

Keyboard decoding and key debounce circuitry; all clock and timing generation and 7-segment output display encoding are included on-chip and require no external components. Segments can usually be driven directly from the MM57123, as it typically sources about 8.5 mA of peak current.

An internal power-on clear circuit is included that clears all registers, including the memory, when V_{DD} and V_{SS} are initially applied to the chip.

Trailing zero suppression allows convenient reading of the left justified display, and conserves power; typical current drain of a complete calculator displaying five "5's" is 30 mA. Automatic display cutoff is also included: if no key closure occurs for approximately 35 seconds, all numbers are blanked and all decimal points are displayed.

The Ready output signal is used to indicate calculator status. It is useful in providing synchronization information for testing or applications where the MM57123 is used with other logic or integrated circuits; e.g., with the MM5765 Programmer *(Figure 3).*

Twenty-two dual-function keys are arranged in a three-by-nine matrix as shown in *Figure 1.* There are the standard four-function keys (+, −, x, ÷), Change Sign, Exchange X and Y, Percent, $\sqrt{x}$, Power, four accumulating memory control keys, plus 12 unique business or financially oriented computation keys; an automatic constant feature is also included.

The MM57123 is physically and electrically compatible with the MM5767 slide-rule calculator IC so that two different models can be produced using the exact same components, even the keyboard; only the keyboard overlay need be changed to show respective keystroke functions.

The user has access to six registers designated X, Y, A, I, N and M. The X-register is used for keyboard entry and display. The Y and A-registers are used in multiply/divide and add/subtract calculations, respectively. Interest values are held in the I-register and the N-register stores the number of time periods in financial calculations. M is an accumulating storage memory and is completely independent of the others.

Data is entered into the calculator in floating point business notation. All entries and results are displayed as floating point, left justified with insignificant zeros to the right of the decimal point suppressed.

features

- Complete business and financial capability
  - Arithmetic functions: +, −, x, ÷
  - Power function: Y^X (power)
  - Live percent
  - Sum-of-digits capability for computing depreciation or "Rule of 78's" loan costs
  - Financial functions:
    - "N" keys enter number of periods
    - "I" keys enter interest rate per period
    - "AMT" key enters given amount
    - "INT" keys compute PV or FV (compound interest)
    - "SAV" keys compute deposit or sinking fund amounts
    - "LOAN" keys compute payment or loan amounts
- Accumulating memory
- Automatic constant
- Convenient business (adding machine) entry notation
- Eight full digits
- Power-on clear
- Automatic display cutoff

keyboard outline
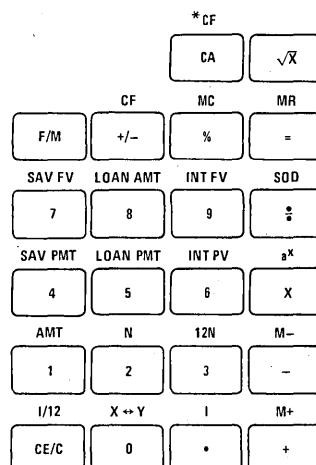
*Optional

absolute maximum ratings

Voltage at Any Pin Relative to V_{SS}	$V_{SS} + 0.3V$ to $V_{SS} - 12V$
(All other pins connected to V_{SS}).	
Ambient Operating Temperature	$0°C$ to $+70°C$
Ambient Storage Temperature	$-55°C$ to $+150°C$
Lead Temperature (Soldering, 10 seconds)	$300°C$

operating voltage range

$6.5V \leq V_{SS} - V_{DD} \leq 9.5V$

V_{SS} is always defined as the most positive supply voltage

dc electrical characteristics

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Supply Current (I_{DD})	$V_{DD} = V_{SS} - 9.5V$, $T_A = 25°C$		8.0		mA
Keyboard Scan Input Levels					
(K1, K2, and K4)	$V_{SS} - 6.5V \leq V_{DD} \leq V_{SS} - 9.5V$	$V_{SS}-2.5$			
Logical High Level	$V_{DD} = V_{SS} - 6.5V$			$V_{SS}-5.0$	V
Logical Low Level	$V_{DD} = V_{SS} - 9.5V$			$V_{SS}-6.0$	V
Digit Output Levels					
Logical High Level (V_{OH})	$R_{LOAD} = 3.2 k\Omega$ to V_{DD}				
	$V_{SS} - 6.5V \leq V_{DD} \leq V_{SS} - 9.5V$	$V_{SS}-1.5$			
Logical Low Level (V_{OL})	$V_{DD} = V_{SS} - 6.5V$			$V_{SS}-6.0$	V
	$V_{DD} = V_{SS} - 9.5V$			$V_{SS}-7.0$	V
Segment Output Current	$T_A = 25°C$				
(Sa through Sg and Decimal Point)	$V_{OUT} - V_{SS} - 3.6V$, $V_{DD} = -6.5V$	-5.0	-8.5		mA
	$V_{OUT} = V_{SS} - 5V$, $V_{DD} - 8V$		-10.0		mA
	$V_{OUT} = V_{SS} - 6.5V$, $V_{DD} - 9.5V$			-15.0	mA
Ready Output Levels					
Logical High Level (V_{OH})	$I_{OUT} = -0.4 mA$	$V_{SS}-1.0$			V
Logical Low Level (V_{OL})	$I_{OUT} = 10 \mu A$			$V_{DD}-1.0$	V

ac electrical characteristics

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
World Time	(Figure 2)	0.32	0.75	2.0	ms
Digit Time	(Figure 2)	.36	83	220	μs
Segment Blanking Time	(Figure 2)	2	4.5	14	μs
Digit Output Transition Time	$C_{LOAD} = 100 pF$				
(t_{RISE} and t_{FALL})	$R_{LOAD} = 9.6 k\Omega$		2		μs
Keyboard Inputs High to Low	$C_{LOAD} = 100 pF$		4		μs
Transition Time after Key Release					
Ready Output Propagation Time	(Figure 4)				
Low to High Level (t_{PDH})	$C_{LOAD} = 100 pF$	10		50	μs
High to Low Level (t_{PDL})	$C_{LOAD} = 100 pF$			1	ms
Key Input Time-out	(Figure 5)				
Key Entry		2.8	7.0	18	ms
Key Release		5.1	12	32	ms
Display Cutoff Time		15	35	92	sec
(The time after the last valid key closure that all numbers will be blanked and all decimal points displayed).					
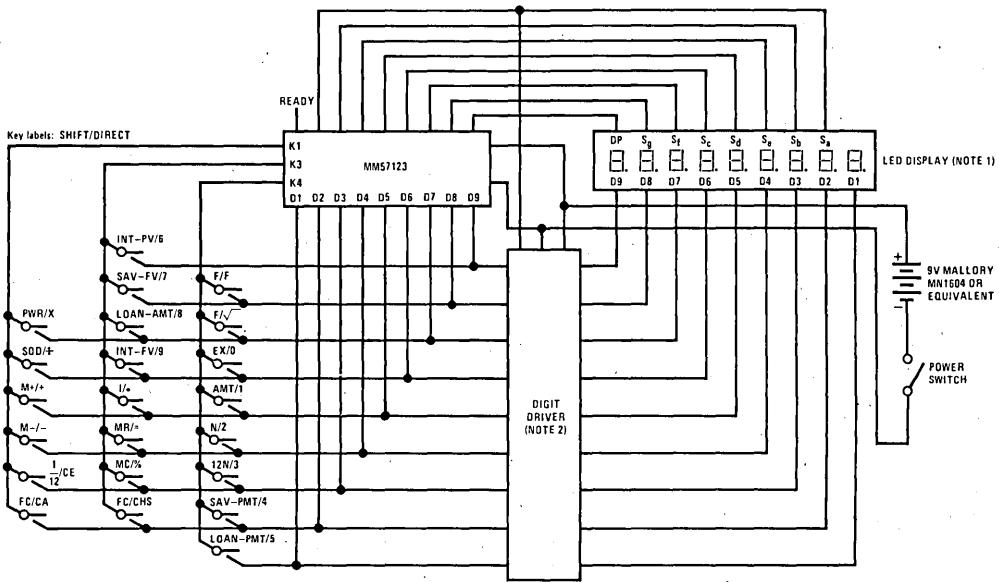
Note 1: Display: Use NSA1198, NSA1298 or NSA0098.
Note 2: Driver: Use DS8864 or DS8873 (with low-battery indicator), or DS8855 or DS8872 (without low-battery indicator).

FIGURE 1. Complete Calculator Schematic
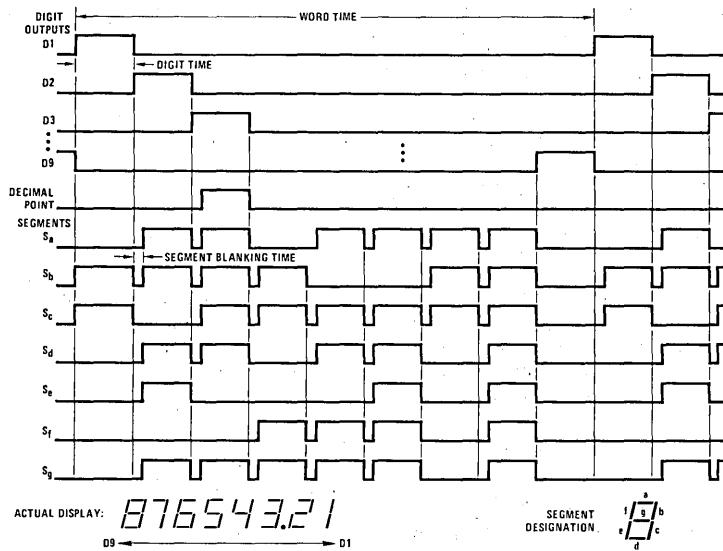


FIGURE 2. Display Timing Diagram

8
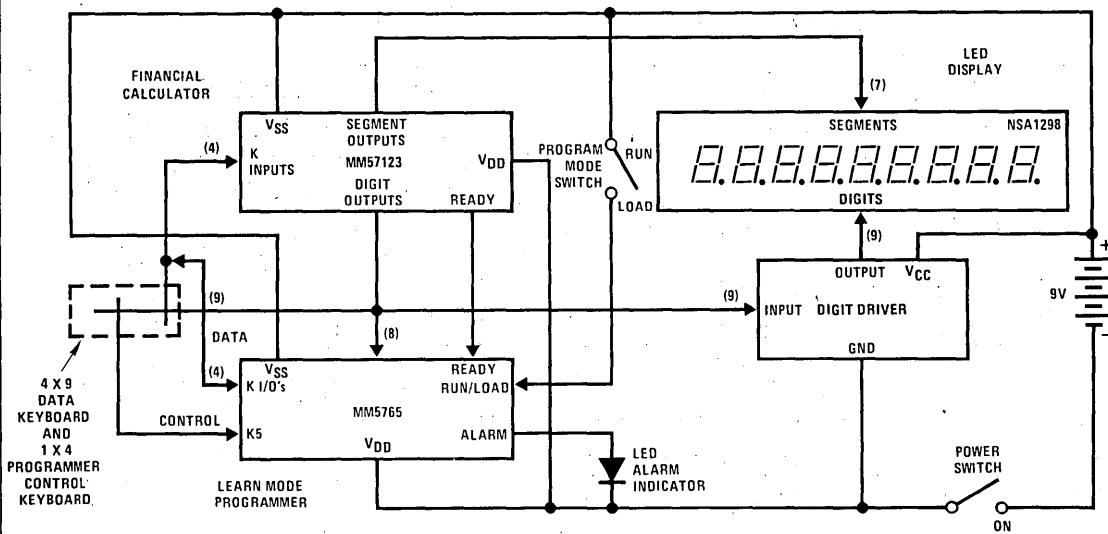
FIGURE 3. Low Cost Hand-Held Programmable Financial Computer
Using the MM57123 Calculator and MM5765 Programmer

KEYBOARD BOUNCE AND NOISE REJECTION

The MM57123 is designed to interface with most low cost keyboards, which are often the least desirable from a false or multiple entry standpoint.

A key closure is sensed by the calculator chip when one of the key inputs, K1, K3 or K4 are forced more positive than the Logical High Level specified in the electrical specifications. An internal counter is started as a result of the closure. The key operation begins after nine word times if the key input is still at a Logical High Level. As long as the key is held down (and the key input remains high) no further entry is allowed. When the key input changes to a Logical Low Level, the internal counter starts a sixteen word time-out for key release. During both entry and release time-outs the key inputs are sampled approximately every other word time for valid levels. If they are found invalid, the counter is reset and the calculator assumes the last valid key input state.

One of the popular types of low-cost keyboards available, the elastomeric conductor type, has a key pressure versus contact resistance characteristic that can generate continuous noise during "teasing" or low pressure key depressions. The MM57123 defines a series contact resistance up to 50 kΩ as a valid key closure, assuring a reliable interface for that type of keyboard.

AUTOMATIC DISPLAY CUTOFF

If no key is depressed for approximately thirty-five seconds, an internal automatic display cutoff circuit will blank all segments and display nine decimal points. Any key depression will restore the display; to restore the display without modifying the status of the calculator, use two Change Sign "+/−" key depressions.

READY SIGNAL OPERATION

The Ready signal indicates calculator status. When the calculator is in an "idle" state, the output is at a Logical High Level (near V_{SS}). When a key is closed, the internal key entry timer is started. Ready remains high until the time-out is completed and the key entry is accepted as valid, then goes low as indicated in *Figures 4 and 5.* It remains at a Logical Low Level until the function initiated by the key is completed and the key is released. The low to high transition indicates the calculator has returned to an idle state and a new key can be entered.

ERROR INDICATION

In the event of an operating error, the MM57123 will display all zeros and all decimal points. The error indication occurs if division by zero is attempted or either a result or intermediate value exceeds 99999999.
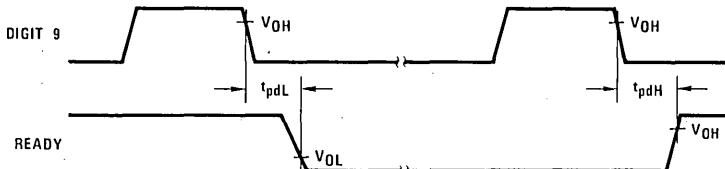
FIGURE 4. Ready Timing
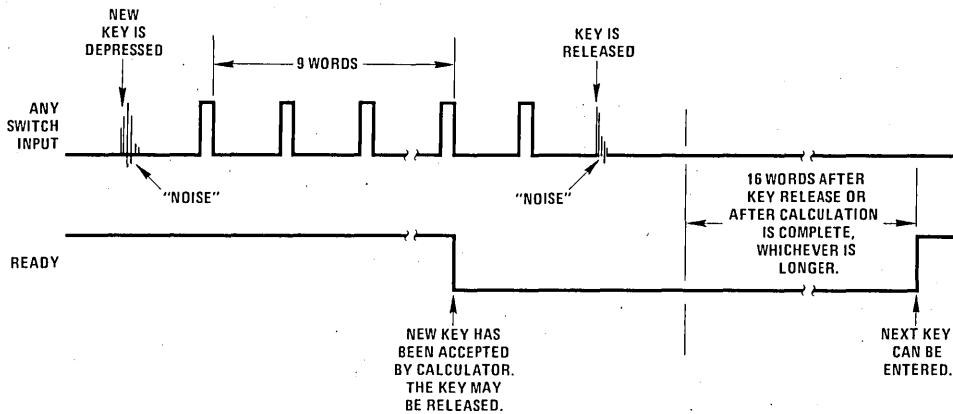
FIGURE 5. Functional Description of Ready Signal and Key Entry.

The indication is cleared by depressing any key.

If an error results from a "+" or "−" key, the X-register is cleared and the last entry is saved in the A-register; all other registers are not effected. An error condition during "x" or "÷" operations clears X without changing any of the other registers.

Overflow as a result of the "POWER," "INT," "SAV" or "LOAN" keys clears the X-register and destroys the values in N, I and A. Y is not changed.

An attempt to raise a negative number to a power will cause the error indication to appear, the X-register will be cleared and the exponent will be stored in Y. The other registers are not changed.

Overflow as a result of "M+" destroys the value stored in M, clears X and displays the error indication. Calculations are immediately stopped and other registers are not cleared.

AUTOMATIC CONSTANT

The MM57123 retains as a constant the first factor of a multiplication calculation or the second factor of a division calculation, when that calculation is terminated by an "=" key or "%" key. Subsequent calculations using the stored constant are made by entering a number and operating upon it with the appropriate terminator ("=," or "%" key). The Y-register is used to store the constant in the constant mode of operation.

The calculator automatically changes to the chain mode when an "x" or "÷" key occurs in the calculation. In the chain mode, the result of each "x" or "÷" key is stored in both X and Y-registers. A new entry replaces X without altering Y. At the completion of a chain calculation, the Y-register will contain the value used as first factor of the last multiply, or the latest entry if the last operation was a divide.

Table I summarizes the four modes.

KEY OPERATIONS

(Note: Register X is always displayed.)

Clear Entry Key, "CE"

Following a number entry or an "MR" key, it clears the X-register only (clear entry). Following any other key it clears registers X, Y and A.

Clear All Key, "CA"

Pressing "CA" once clears all registers including M (memory).

Number Entries

The first entry clears the X-register and enters the number into the LSD of X. Second through eighth entries (excluding a decimal point) are entered one digit to the right of the last number. The ninth, and subsequent entries are ignored. First entry after a "+", "−", "M+" or "M−" following a "+" or "−" key causes the number in the X-register to be transferred to the A-register before clearing and placing the new entry in X.

Decimal Point, "."

At the first depression of a number entry, it clears the X-register and places a point in the leftmost digit. If the previous key was a number, it enters a decimal point to the right of the last number entered. Following a "+", "−" or those keys preceding a "M+" or "M−" key, the X-register is transferred to A, cleared and a decimal point entered in the leftmost digit. The last decimal point depression in a single number entry is accepted as the valid point.

Change Sign Key, "+/−"

Changes sign of register X.

Addition Key, "+"

If the previous key was not a "+" or "−" key, the number in the A-register is added to the X-register, X is transferred to A, and the sum is stored in X. When the last key was a "+" or "−" key, the number in A is added to the number in X without destroying the value of A. The sum is stored in X.

Subtraction Key, "−"

If the previous key was not a "+" or "−" key, the number in the X-register is subtracted from the number in the A-register, X is transferred to A, and the difference is stored in X. When the last key was a "+" or "−" key, the number in A is subtracted from X without destroying the value of A. The result is stored in X.

Multiplication Key, "x"

If there has not been a "x" or "÷" key since the last terminator key ("=" or "%"), the value of the X-register is copied into the Y-register and the calculator is set to the chain multiply mode. In a chain calculation in which there has been an "x" key since the last terminator c "÷" key, X is multiplied by Y and the resulting product is stored in both X and Y; if a "÷" key has occurred since the last terminator or "x" key, depression of "x" will divide the Y-register by the X-register, with the quotient stored in both X and Y.

Division Key, "÷"

If there has not been an "x" or "÷" key since the last terminator key ("=", or "%"), the value of the X-register is copied into the Y-register and the calculator is set to the chain divide mode. In a chain calculation, if an "x" key has occurred since the last terminator or "÷" key, X is multiplied by Y and the product is stored in both X and Y; if a "÷" key has occurred since the last terminator or "x" key, depression of "÷" will divide the Y-register by the X-register, with the quotient stored in both X and Y.

TABLE I. Mode Summary

MODE	KEYS THAT SET MODE	DESCRIPTION (See Calculation Examples)
CONSTANT MULTIPLY	CE = } With calculator previously % } in chain multiply PWR SOD INT SAV LOAN	Depression of an "=" or "%" key will multiply the X-register by the Y-register and replace X with the product. Y remains unchanged.
CHAIN MULTIPLY	X Following a terminator or "÷" or "x" operation	Depression of an "=" or "%" key will multiply the X-register by the Y-register and place the product in X. Y remains unchanged.
CONSTANT DIVIDE	= } With calculator previously % } in chain multiply	Depression of an "=" or "%" key will divide the X-register by the Y-register and replace X with the quotient. Y is unchanged.
CHAIN DIVIDE	÷ Following a terminator or "÷" or "x" operation	Depression of an "=" or "%" key will divide the Y-register by the X-register, transfer X to Y, and place the quotient in X.

Equal Key, "="

In the chain multiply mode, the value in the X-register is multiplied by the Y-register with the product stored in X. Register Y remains unchanged. In the chain divide mode, depression of "=" will divide Y by X, transfer X to Y, and place the quotient in X. If the calculator is in constant multiply, "=" will multiply X by Y, place the product in X and retain Y. For constant divide, the X-register is divided by Y, the quotient is stored in X; Y is unchanged.

Percent Key, "%"

This key acts exactly like the "=" key except the value of X is copied into A, then divided by 100 before performing the required operation.

Square-root Key, "√"

Depression of this key will compute the square-root of the number contained within the X-register; no other registers are affected. The same results can be achieved by using the power "PWR" key (requires extra key-strokes) as shown in example 12; this allows producing a 20-key calculator (leaving off "CA" and "√") with no sacrifice in performance.

Function Key, "F"

Depression of this key shifts the entry scheme from a direct or "primary" function mode to the secondary function or "shift key" mode.

Memory Plus Key, "M+" (shift mode)

The number in the X-register is accumulated into the M-register. Registers X and A are not changed, so the repeat addition or subtraction conditions that existed before accumulation to memory are still valid.

Memory Recall Key, "MR" (shift mode)

Following "MR", the value of the M-register is copied into the X-register.

Power Key, "PWR" (shift mode)

When the calculator is in either the chain or constant multiply modes, depression of "PWR" raises the number in the Y-register to the power of the X-register and replaces X with the result. Thus, to raise two to the fifth power use the sequence: "2, X, 5, F, PWR." If the calculator is in the constant or chain divide modes, the value of Y is raised to the inverse of X power; i.e., the key sequence "5, ÷, 2, F, PWR" results in the calculation of 5 raised to the 1/2 power. The original value of X is retained in Y and register A is cleared. The calculator is set to the constant multiply mode. Results computed with the "PWR" key are rounded to five places.

Exchange Key, "EX" (shift mode)

The X and Y-registers are exchanged. No other registers are effected.

Interest Entry Keys "I" and "I/12" (shift mode)

"I" divides the number by 100 and stores the quotient in X and the I-register. "I/12" divides by 1200 and stores the quotient in both X and I; i.e., the interest will be compounded monthly.

Number of Periods Entry Keys, "N" and "12N" (shift mode)

The "N" key copies X directly into register N. The "12N" key multiplies X by 12; the product is stored in register N and displayed in X.

Amount Entry Key, "AMT" (shift mode)

The value of the X-register is copied into the Y-register. No other registers are effected.

"INT" (compound interest) Keys, "FV" and "PV" (shift mode)

The "INT-FV" key will compute future value: the sum of money available at the end of n periods from the present date (N-register) that is equivalent to the present amount (Y-register) with interest i (I-register). The "INT-PV" key will compute present value: the sum of money necessary today to accumulate the future amount contained in Y over n periods stored in N at the interest rate per interest period that is stored in I. Thus, to compute future value, simply enter i, n, and amount in any order and press "INT-FV". For present value, press "INT-PV". Registers Y, N and I are not altered; X is replaced by the computed value and register A is cleared. The calculator is set to the constant multiply mode.

Savings Deposit Keys, "SAV-PMT" and "SAV-FV" (shift mode)

The "SAV-PMT" key will compute the amount to be deposited at the end of each period in a *sinking fund* for the number of periods, n, contained in register N, at an interest rate, i, contained in register I, compounded each time period, to accumulate the desired amount, contained in register Y. The "SAV-FV" key will compute the amount in a *sinking fund*. The number in Y is deposited at the end of n time periods (N-register) at an interest rate per time period i (I-register), compounded each time period. Thus, to compute the required *sinking fund deposit* to accumulate a desired amount over a given period of time, enter i, n and the amount in any order using the "I," "N" and "AMT" keys, then "SAV-PMT". To find the amount in the *sinking fund,* simply enter i, n and the periodic amount of deposit and press "SAV-FV". Registers N, I or Y are not altered by the calculation, register A is cleared and register X contains the computed value. The calculator is set to the constant multiply mode.

Loan Installment Keys, "LOAN-PMT" and "LOAN-AMT" (shift mode)

The "LOAN-PMT" key will compute the end-of-period payment or receipt required over the number of time periods contained in the N-register at an interest rate per time period equal to the value in the I-register to support a loan equal to the amount stored in the Y-register. "LOAN-AMT" computes the amount that can be loaned for a given end-of-period payment stored in Y over the number of time periods contained in N at the interest rate per time period of I, compounded each time period. Thus, to compute the required installment on a given loan, enter the amount of the loan using the "AMT" key, the interest rate using "I" and the number of periods with "N", then press "LOAN-PMT". To compute how much can be borrowed given a fixed payment, enter the payment amount, number of periods and interest rate, then "LOAN-AMT". "AMT", "I", or "N" can always be entered in any order. Registers N, I or Y are not altered by the calculation; register A is cleared and register X will contain the computed value. The calculator is set to the constant multiply mode.

NOTE: in the above explanations, only "I" and "N" have been referenced for simplicity; these relate to interest per period ("I") and number of periods ("N"). In business sense, a period can be either one-month (i.e., interest compounded monthly) or one year (interest rate is compounded yearly, use the "I" key, if monthly, use the I/12 key. Correspondingly, the "N" key (for number of periods) should be used whenever "I" is used and 12N whenever I/12 is used. The only exception would be if the interest were given as monthly for a period of less than one year; in this case, use "I" and "N".

Sum-of-Digits Key, "SOD" (shift mode)

Following a "+" or "−" key, it transfers the number in register X to register A and computes a *first sum-of-digits* depreciation on that number by multiplying it by the ratio of the number in the N-register to the sum-of-digits of N. The result is stored in X; the difference between the initial and final values of X, the *depreciable value,* is stored in registers Y and A. N is decremented by one. (Therefore, to find depreciable value, simply use the "EX" key.) Subsequent depressions of the "SOD" key will compute successive depreciation and depreciable value amounts using the original value of N and present values stored in N and A. N is decremented by one after each computation. The number to be depreciated (or the loan amount in a "Rule of 78's" interest calculation) is always entered with a "+" or "−" key and the number of periods with the "N" key, without regard to key order. If the key preceding "SOD" is not "+" or "−," the sum-of-digits computation is performed on the number in the A-register without the number in X first being transferred to A. Calculator mode is set to constant multiply.

examples

1. Addition or Subtraction

		2.0
		3.2
		−12.3

KEYS	DISPLAY	COMMENTS
2	2	
+	2.	
3	3	
.	3.	
2	3.2	
+	5.2	
1	1	
2	12	
.	12.	
3	12.3	
−	−7.1	Note adding machine notation

2. Repeat Add or Subtract

KEYS	DISPLAY	COMMENTS
3	3	
.	3.	
1	3.1	
+	3.1	
+	6.2	
+	9.3	
−	6.2	

3. Chain Multiplication or Division

	KEYS	DISPLAY	COMMENTS
a)	1	1	
	x	1.	
	2	2	
	x	2.	
	3	3	
	.	3.	
	1	3.1	
	x	6.2	
	4	4	
	.	4.	
	2	4.2	
	=	26.04	
b)	1	1	
	0	10	
	÷	10.	
	2	2	
	÷	5.	
	1	1	
	0	10	
	÷	.5	
	2	2	
	=	.25	
c)	2	2	
	0	20	
	x	20.	
	4	4 ·	
	÷	80.	

examples (Continued)

8	8
÷	10.
7	7
×	1.4285714
4	4
=	5.7142856

4. Constant Multiplication or Division

KEYS	DISPLAY	COMMENTS
a) 3	3	
×	3.	
2	2	
=	6	
4	4	
=	12.	First factor in constant multiply
5	5	
.	5.	
2	5.2	
=	15.6	
=	46.8	15.6 is re-entered and multiplied by constant
b) 5	5	
÷	5.	
2	2	
=	2.5	
4	4	
=	2.	Second factor in constant divide
5	5	
.	5.	
2	5.2	
=	2.6	
=	1.3	2.6 is re-entered and divided by constant

5. To Perform Products of Sums

$(5+4) \times (3+2)/(6+7) = ?$

KEYS	DISPLAY	COMMENTS
5	5	
+	5.	
4	4	
+	9.	
×	9.	Chain multiply mode is set
3	3	
+	3.	
2	2.	
+	5.	
÷	45.	(5+4)x(3+2) is executed
6	6	
+	6.	
7	7	
+	13.	
=	3.4615384	45÷(6+7) is executed

6. Calculate Percentage

KEYS	DISPLAY	COMMENTS
3	3	
0	30	
0	300	
.	300.	
2	300.2	
5	300.25	
×	300.25	
5	5	
%	15.0125	"Live %" key

7. Perform Add On and Discount

KEYS	DISPLAY	COMMENTS
a) Add-On: $125 plus 5%		
1	1	
2	12.	
5	125.	
×	125.	
5	5	
%	6.25	5% of 125 is displayed
+	131.25	125+5% is displayed
b) Discount: $532.10 by 6%		
5	5	
3	53	
2	532	
.	532.	
1	532.1	
×	532.1	
6	6	
%	31.96	6% of 532.1 is displayed
−	500.174	532.1 − 6% is displayed

8. Perform Change Sign

KEYS	DISPLAY	COMMENTS
1	1	
2	12	Change sign does not terminate entry.
+/−	−12	
3	−123.	
.	−123.	
+/−	123.	
5	123.5	
+/−	−123.5	
6	−123.56	

9. Perform Exchange Registers (X←→Y)

KEYS	DISPLAY	COMMENTS
a) 5	5	
×	5.	
3	3	
=	15.	5 is initially constant multiplier
4	4	
F, EX	5.	4 is now constant multiplier
=	20	

examples (Continued)

b)
KEYS	DISPLAY	COMMENTS
6	6	
÷	6.	
3	3	
F, EX	6.	Numerator and denom-inator are exchanged.
=	.5	

10. Accumulate in Memory, Recall and Clear Memory

KEYS	DISPLAY	COMMENTS
a) 3	3	
F, M+	3	Accumulate in memory
4	4	
F, M+	4	Accumulate in memory
F, MR	7	Recall memory
F, MC	7	Clear memory
F, MR	0	Recall memory
b) 5	5	
+	5	
6	6	
+	11	
F, M+	11	Accumulate in memory
7	7	
+	18	
F, M+	18	11+18 is accumulated in M
+	25	Repeat add
3	3	
2	32	
.	32.	
2	32.2	
+/−	−32.2	
F, M+	−32.2	29−32.2 is accumulated in M
9	9	
+	34	
F, MR	−3.2	Accumulated value of M is recalled
+	30.8	
F, MC	30.8	M is cleared
F, MR	0	M = 0

11. Raising a Number to a Power

KEYS	DISPLAY	COMMENTS
a) $2^5 = 32$		
2	2	
x	2	
5	5	
F, PWR	32	
b) $5^{1.5} = 11.18$		
5	5	
x	5	
1	1	
.	1.	
5	1.5	
F, PWR	11.18	Rounded to 5 digits; trailing zero is sup-pressed

c) $3^{-5} = 0.00412$
KEYS	DISPLAY	COMMENTS
3	3	
x	3	
5	5	
+/−	−5	Change sign
F, PWR	.00412	Rounded to five digits

12. Calculating Roots

KEYS	DISPLAY	COMMENTS
a) $2\sqrt{5} = 2.2361$		
5	5	
÷	5	
2	2	
F, PWR	2.2361	Rounded to five digits
b) $3\sqrt{6} = 1.8171$		
6	6	
÷	6	
3	3	
F, PWR	1.8171	Rounded to five digits

financial examples

1. Future Value Compound Interest Computations

To find the accumulated amount in a savings account at the end of 9 years when a) $2,500 is deposited at 5.25% interest compounded monthly, b) $3,000, c) $3,000 at 5% interest, d) $3,000 at 5% interest for 10 years.

KEYS	DISPLAY	COMMENTS
a) 9	9	Number of years
F, 12N	108	Compounded monthly, stored in N
5.25	5.25	
F, I/12	.004375	Compounded monthly, stored in I
2500	2500	Original deposit
F, AMT	2500	Stored in Y
F, INT-FV	4005.8665	Future value
b) 3000	3000	New deposit amount
F, AMT	3000	New deposit stored in Y
F, INT-FV	4807.0398	Future value
c) 5	5	New interest rate
F, I/12	.00416666	New interest rate stored in I
F, INT-FV	4700.5347	Future value
d) 10	10	New number of years
F, 12N	120	Compounded monthly, stored in N
F, INT-FV	4941.0234	Future value

2. Present Value Compound Interest Computations

To find the amount to be deposited to accumulate a) $5,000 in 7 years at 4.5% interest compounded monthly b) $10,000, c) $10,000 in 7.5 years.

financial examples (Continued)

KEYS	DISPLAY	COMMENTS
a) 7	7	Number of years
F, 12N	84	Compounded monthly, stored in N
4.5	4.5	Interest
F, I/12N	.00375	Compounded monthly, stored in I
5000	5000	Future value
F, AMT	5000	Future value stored in Y
F, INT-PV	3651.0957	Present value required
b) 10000	10000	New future value
F, AMT	10000	Futue value stored in Y
F, INT-PV	7302.1914	Present value required
c) 7.5	7.5	New number of years
F, 12N	90	Compounded monthly, stored in N
F, INT-PV	7140.0271	Present value required

3. Savings Computations – Period Payments

To find the amount that a) must be deposited monthly in a savings account at an interest rate of 5.5% compounded monthly for 5 years to accumulate $15,000, b) compounded, and deposited quarterly.

KEYS	DISPLAY	COMMENTS
a) 5.5	5.5	Interest
F, I/12	.00458333	Compounded monthly, stored in I
5	5	Number of years
F, 12N	60	Compounded monthly, stored in N
15000	15000	Future value
F, AMT	15000	Future value stored in Y
F, SAV-PMT	217.7676	Monthly deposit required
b) 5.5	5.5	Interest
÷	5.5	
4	4	Compound quarterly
=	1.375	
F, I	.01375	Quarterly interest stored in I
5	5	Number of years
x	5	
4	4	Compound quarterly
=	20	
F, N	20	Quarter periods, stored in N
15000	15000	Re-enter future value
F, AMT	15000	Future value stored in Y
F, SAV-PMT	656.7085	Quarterly deposit required

4. Savings Computations – Accumulated Value

To find the amount accumulated a) if $100 is deposited at the end of each month for 6 years in a savings account at an interest rate of 4.75%, compounded monthly, b) 7.5%, c) at 4.75% for 9 years.

KEYS	DISPLAY	COMMENTS
a) 4.75	4.75	Interest
F, I/12	.00395833	Compounded monthly, stored in I
6	6	Number of years
F, 12N	72	Compounded monthly, stored in N
100	100	Monthly payment
F, AMT	100	Monthly payment stored in Y
F, SAV-FV	8311.9301	Accumulated sinking fund
b) 7.5	7.5	New interest rate
F, I/12	.00625	Compounded monthly, stored in I
F, SAV-FV	9057.8807	Accumulated sinking fund
c) 4.75	4.75	New interest rate
F, I/12	.00395833	Compounded monthly, stored in I
9	9	New number of years
F, 12N	108	Compounded monthly, stored in N
F, SAV-FV	13443.173	Accumulated sinking fund

5. Loan Computations – Monthly Payment

To find the monthly payments of a loan of $5,000 paid over 5 years at an annual percentage rate of a) 18%, b) 12%, c) 7.5% for 10 years.

KEYS	DISPLAY	COMMENTS
a) 18	18	Interest rate
F, I/12	.015	Compounded monthly, stored in I
5	5	Number of years
F, 12N	60	Compounded monthly, stored in N
5000	5000	Loan amount
F, AMT	5000	Loan amount stored in Y
F, LOAN-PMT	126.9671	Monthly installment
b) 12	12	New interest rate
F, I/12	.01	Compounded monthly, stored in I
F, LOAN-PMT	111.22225	New monthly installment
c) 7.5	7.5	New interest rate
F, I/12	.00625	Compounded monthly, stored in I
10	10	New number of years
F, 12N	120	Compounded monthly, stored in N
F, LOAN-PMT	59.35085	New monthly installment

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financial examples (Continued)

6. Loan Computations — Loan Amount

To find the amount of a loan with monthly payments of $125, and an interest rate of 9% for 3 years, b) 4 years, c) $120 for 4 years.

	KEYS	DISPLAY	COMMENTS
a)	9	9	Interest rate
	F, I/12	.0075	Compounded monthly, stored in I
	3	3	Number of years
	F, 12N	36	Compounded monthly, stored in N
	125	125	Payment amount
	F, AMT	125	Payment amount stored in Y
	F, LOAN-AMT	3930.8485	Computed loan amount
b)	4	4	New number of years
	F, 12N	48	Compounded monthly, stored in N
	F, LOAN-AMT	5023.0982	Computed loan amount
c)	120	120	New payment amount
	F, AMT	120	New payment stored in Y
	F, LOAN-AMT	4822.1742	Computed loan amount

7. Performing a Sum-of-Digits Depreciation

Find the depreciation and depreciable value for each year, on an item with an initial cost of $3,500.00 and a salvage value at the end of 8 years of $675.00.

KEYS	DISPLAY	COMMENTS
3500	3500	
+	3500	Enter initial value
675	675	Enter salvage value
−	2825.	Calculate change
8	8	
F, N	8.	Enter period in N
F, SOD	627.77777	1st year depreciation
F, EX	2197.2223	Depreciable value
F, SOD	549.30557	2nd year depreciation
F, EX	1647.9168	Depreciable value
F, SOD	470.83396	3rd year depreciation
F, EX	1177.0835	Depreciable value
F, SOD	392.36116	4th year depreciation
F, EX	784.7224	Depreciable value
F, SOD	313.88896	5th year depreciation
F, EX	470.83344	Depreciable value
F, SOD	235.41672	6th year depreciation
F, EX	235.41672	Depreciable value
F, SOD	156.94447	7th year depreciation
F, EX	78.47225	Depreciable value
F, SOD	78.47225	8th year depreciation
F, EX	0.	Depreciable value

connection diagram

Dual-In-Line Package

DIGIT 3 — 1
DIGIT 2 — 2
DIGIT 1 — 3
SWITCH INPUTS { K4 — 4
K3 — 5
NC — 6
K1 — 7
V_{DD} — 8
S_g — 9
S_b — 10
S_f — 11
V_{SS} — 12

24 — DIGIT 4
23 — DIGIT 5
22 — DIGIT 6
21 — DIGIT 7
20 — DIGIT 8
19 — DIGIT 9
18 — READY
17 — S_d
16 — S_e
15 — S_a
14 — DP
13 — S_c

TOP VIEW
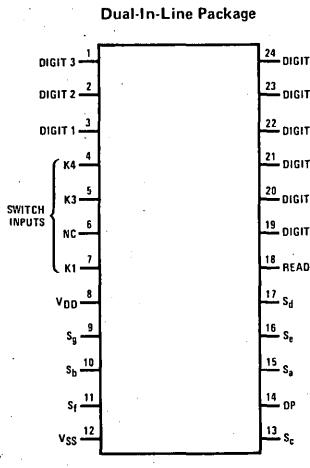
Order Number MM57123N
See Package 22