## MM5763 statistical calculator general description

The single-chip MM5763 Statistical 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 MM5763, a keyboard, DS8864 digit driver, NSA1298 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 MM5763, as it typically sources about 8.5 mA of peak current. [Note: The typical duty cycle of each digit is 0.104; average LED segment current is therefore approximately 0.104 (8.5 mA), or 0.9 mA average. Correspondingly the worse-case average segment current is 0.104 (5.0 mA), or 0.52 mA.] The ninth digit (left-most) is used for the negative sign, or the decimal point of a number less than unity.

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 suppresion allows convenient reading of the left justified display, and conserves power. The DS8864 digit driver is capable of sensing a low battery voltage and providing a signal during Digit 9 time that can be used to turn on one of the segments as an indicator. Typical current drain of a complete calculator displaying five "5's" is 30 mA. Automatic display cutoff is included. If no key closure occurs for approximately 25 seconds, all numbers are blanked and all decimal points displayed.

The Ready output signal is used to indicate calculator status. It is useful in providing synchronization information for testing or applications where the MM5763 is used with other logic or integrated circuits; e.g., with the MM5765 Programmer *(Figure 3).*

Thirty-two keys are arranged in a four-by-nine matrix as shown in *Figure 1.* There is an automatic constant feature.

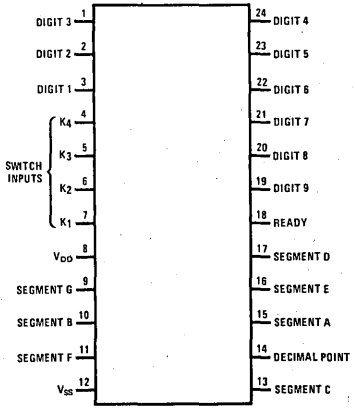
The user has access to eight registers designated X, T, A, C, Y, S, N and M. The X-register is used for keyboard entry and display. The T and A-registers are used in multiply/divide and add/subtract calculations, respectively. C, Y, S and N-registers are used specifically for calculating the statistical functions. M is an accumulating storage memory. Statistical key functions use essentially all registers, including M.

Data is entered into the calculator in floating point business notation. All entries and results are displayed left justified with insignificant zeros to the right of the decimal point suppressed. All intermediate results of a chain calculation are floating point. Terminating keys: equal, percent and "= +" round the display result to two decimal places.

## features

- Complete business and statistical capability
  - Arithmetic functions +, −, x, ÷
  - Per cent: includes markup and discount
  - Statistical functions:
    - ▲ "Σx" key sums X, $X^2$ and N
    - ▲ "Σy" key sums Y, $Y^2$ and X · Y
    - ▲ "REMOVE x" key corrects "Σx" mistake
    - ▲ "REMOVE y" key corrects "Σy" mistake
    - ▲ "FREQ x" key sums grouped data for standard deviation
    - ▲ "$\bar{X}$, SD" key calculates standard deviation and mean
    - ▲ "COR-SLOPE" key performs linear regression giving coefficient of correlation, slope, and intercept
    - ▲ "INT" key calculates y-intercept on line for given x
- Square root
- Accumulating memory
- Auto constant
- Business notation
  - +, − "adding machine" notation
  - x, ÷, = algebraic notation
- Eight full digits
- Power-on clear
- Display cutoff
- Low system cost

## connection diagram (DIP Top View)




**Order Number MM5763N**
**See Package 22**

## absolute maximum ratings

| | |
|---|---|
| Voltage at Any Pin Relative to $V_{SS}$. (All other pins connected to $V_{SS}$) | $V_{SS}+0.3V$ to $V_{SS}-12.0$ |
| 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

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

$V_{SS}$ always defined as 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 | 16.0 | mA |
| Keyboard Scan Input Levels (K1, K2, K3 and K4) | | | | | |
| Logical High Level | $V_{SS}-6.5V \leq V_{DD} \leq V_{SS}-9.5V$ | $V_{SS}-2.5$ | | | V |
| Logical Low Level | $V_{DD} = V_{SS}-6.5V$ | | | $V_{SS}-5.0$ | V |
| | $V_{DD} = V_{SS}-9.5V$ | | | $V_{SS}-6.0$ | V |
| Digit Output Levels | | | | | |
| Logical High Level ($V_{OH}$) | $R_{LOAD} = 3.2\ k\Omega$ to $V_{DD}$ | | | | |
| | $V_{SS}-6.5V \leq V_{DD} \leq V_{SS}-9.5V$ | $V_{SS}-1.5$ | | | V |
| 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 (Sa through Sg and Decimal Point) | $T_A = 25°C$ | | | | |
| | $V_{OUT} = V_{SS}-3.6V$, $V_{DD} = V_{SS}-6.5V$ | −5.0 | −8.5 | | mA |
| | $V_{OUT} = V_{SS}-5V$, $V_{DD} = V_{SS}-8V$ | | −10.0 | | mA |
| | $V_{OUT} = V_{SS}-6.5V$, $V_{DD} = V_{SS}-9.5V$ | | | −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 |
|---|---|---|---|---|---|
| Word Time (*Figure 2*) | | 0.32 | 0.8 | 2.0 | ms |
| Digit Time (*Figure 2*) | | 36 | 89 | 222 | μs |
| Segment Blanking Time (*Figure 2*) | | 2 | 5.5 | 14 | μs |
| Digit Output Transition Times ($t_{RISE}$ and $t_{FALL}$) | $C_{LOAD} = 100$ pF, $R_{LOAD} = 9.6\ k\Omega$ | | 2 | | μs |
| Keyboard Inputs High to Low Transition Time After Key Release | $C_{LOAD} = 100$ pF | | 4 | | μs |
| Ready Output Propagation Time (*Figure 3*) | | | | | |
| 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 | | | | | |
| Key Entry | | 2.8 | 7.2 | 18 | ms |
| Key Release | | 5.1 | 12.8 | 32 | ms |
| Display Cutoff Time (The time after the last valid key closure that all numbers will be blanked and all decimal points displayed.) | | 10 | 25 | 63 | sec |

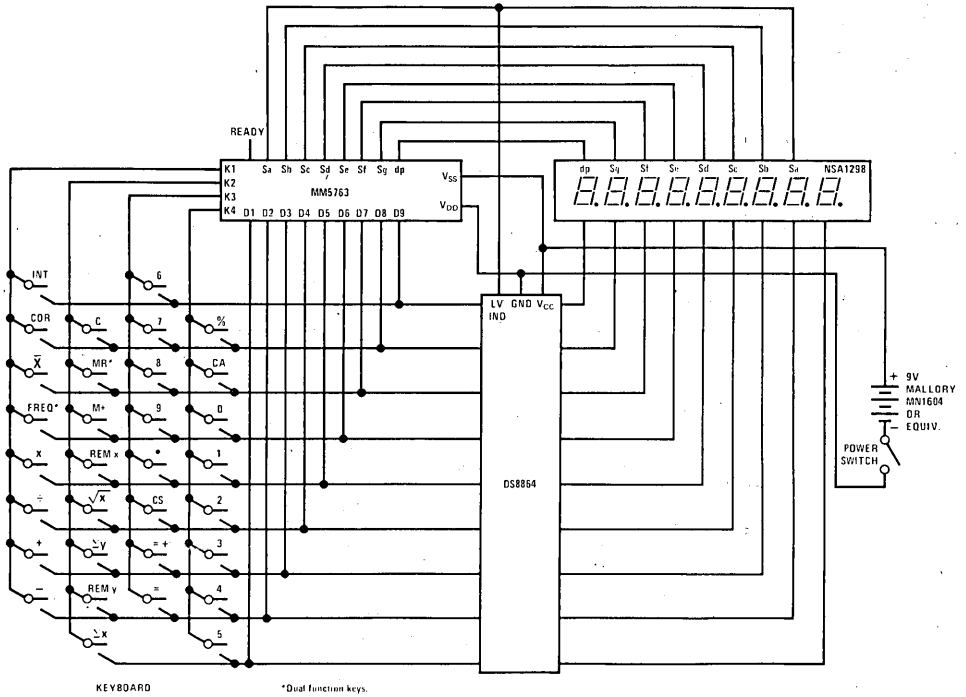



**FIGURE 1. Complete Calculator Schematic**

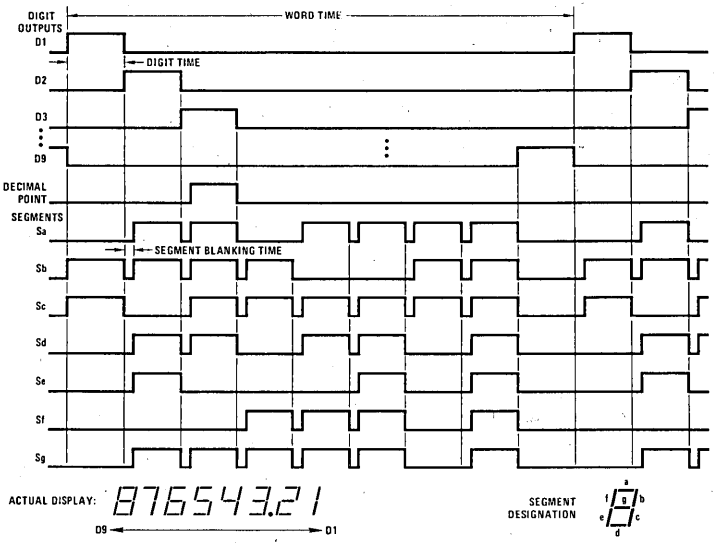



**FIGURE 2. Display Timing Diagram.**

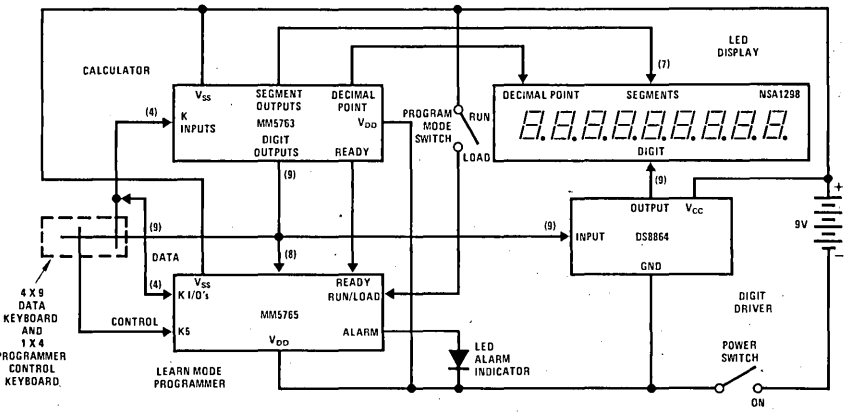



FIGURE 3. Low Cost Handheld Programmable Statistician Computer Using the MM5763 Calculator and MM5765 Programmer.

## KEYBOARD BOUNCE AND NOISE REJECTION

The MM5763 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, K2, 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 MM5763 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 twenty-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 MM5763 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.

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 statistical keys can effect any register they use; "CA" should be depressed if an error occurs.

Overflow as a result of "M+" saves 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 MM5763 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 "=" key, "%" 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 T-register is used to store the constant in the constant mode of operation.

The calculator automatically changes to the chain mode when a "x" or "÷" key occurs in the calculation. In the chain mode, the result of each "x" or "÷" key is stored in both X and T-registers. A new entry replaces X without altering T. At the completion of a calculation, the T-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.

TABLE I. Mode Summary

| MODE | KEYS THAT SET MODE | DESCRIPTION (See Calculation Examples) |
|---|---|---|
| CONSTANT MULTIPLY | "CLEAR" "=" "=+" "%" | Depression of an "=," "= +" or "%" key will multiply the X-register by the T-register and replace X with the product. T 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. T remains unchanged. |
| CONSTANT DIVIDE | "=" "= +" "%" } With calculator previously in chain divide mode. | Depression of an "=," "= +" or "%" key will divide the X-register by the T-register and replace X with the quotient. T is unchanged. |
| CHAIN DIVIDE | "÷," following a terminator or "÷" or "x" operation | Depression of an "=," "= +" or "%" key will divide the T-register by the X-register, transfer X to T, and place the quotient in X. |

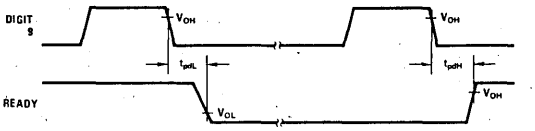



FIGURE 4. Ready Timing.

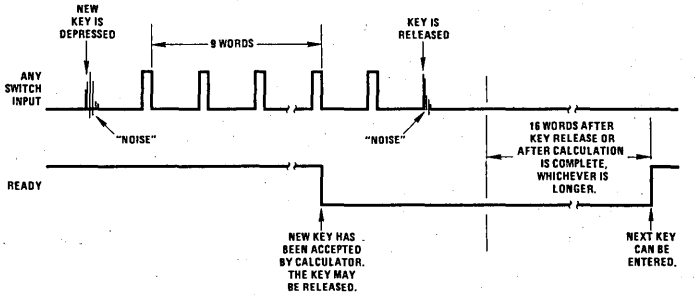



FIGURE 5. Functional Description of Ready Signal and Key Entry.

## KEY OPERATIONS

(Note: Register X is always displayed.)

### Clear Key, "C"

Following a number entry key, it clears the X-register only (clear entry). Following any other key it clears registers X, K, C, S, N and T.

### Clear All Key, "CA"

Clears all registers and sets the calculator to the constant multiply mode.

### 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 "+," "–," 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, "."

As the first depression of a number entry, it clears the X-register and places a point in the left most digit. If the previous key was a number, it enters a decimal point to the right of the last number entered. Following a "+," "–," or "M+" following a "+" or "–," the X-register is transferred to A, cleared and a decimal point entered in the leftmost digit. The last decimal point depression of a number entry is accepted as the valid point.

### Change Sign Key, "CS"

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 T-register and the calculator is set to the chain multiply mode. In a chain calculation in which there has been a "x" key since the last terminator or "÷" key, X is multiplied by T and the resulting product is stored in both X and T; if a "÷" key has occured since the last terminator or "x" key, depression of "x" will divide the T-register by the X-register, with the quotient stored in both X and T.

**Division Key, "÷"**

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 T-register and the calculator is set to the chain divide mode. In a chain calculation if a "x" key has occured since the last terminator or "÷" key, X is multiplied by T and the product is stored in both X and T; if a "÷" key has occured since the last terminator or "x" key, depression of "÷" will divide the T-register by the X-register, with the quotient stored in both X and T.

**Equal Key, "="**

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

The "=" key always rounds the answer stored in X to two places to the right of the decimal point, and clears register A.

**Per Cent Key, "%"**

This key acts exactly like the "=" key except the value of X is divided by 100 and copied in register A before performing the required operation. Register A is not cleared. The result stored in the X-register is rounded to two decimal places.

**Automatic Accumulation Key, "= +"**

It acts just like the "=" key in all modes. After the result is stored in X, the value of X is added to the number in the M-register. The result stored in X and accumulated into M is rounded to two decimal places. Register A is cleared.

**Memory Recall/Memory Clear Key, "MR"**

Following any key except "MR," the value of the M-register is copied in to the X-register. If the preceding key was "+," "–" or "M+" following "+" or "–," the number in the X-register is transferred to the A-register before M is recalled. Following another "MR" key, the M-register is transferred to X, then cleared.

**Memory Plus Key, "M+"**

The number in the X-register is accumulated in 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.

**Square Root Key, "$\sqrt{x}$"**

The absolute value of the number in the X-register is replaced with its square root.

**Sum of X Key, "$\Sigma x$"**

Adds X to the C-register, adds the square of X to the T-register, saves the value of X (to four decimal places) in the Y-register and increments N by one. The operation is completed by copying N into X. The maximum value of N is 99. The register returns to zero on the 100th entry.

**Sum of Y Key, "$\Sigma y$"**

Adds the value of X to the A-register, adds the square of X to the M-register, adds the product of X and Y to the S-register, and recalls N to X.

**Remove X Key, "REM X"**

This is used to delete a data point previously entered by "$\Sigma x$" key. It subtracts X from C, subtracts the square of X from T, saves X to four decimal places in Y, decrements N by one and copies the new value of N in to X.

**Remove Y Key, "REM Y"**

This is used to delete an incorrect data point previously entered by the "$\Sigma y$" key. It subtracts X from A, subtracts the square of X from M, subtracts the product of X and Y from S and copies N to X.

**Frequency of X Key, "FREQ"**

This is used to sum grouped (identical) data entries for mean and standard deviation computations. If the sign of X is positive, "FREQ" performs the "$\Sigma x$" operation $X - 1$ times. When X is negative, "FREQ" performs the "REM X" function $|X| - 1$ times.

**Mean and Standard Deviation Key, "$\bar{X}$, SD"**

Computes both the arithmetic mean and the standard deviation of data points (entered by the "$\Sigma x$" and "FREQ" keys) with a single key depression. The mean is stored in register X (and therefore is the initial result displayed). Standard deviation is stored in registers A and M and is displayed by using the "MR" key. Registers T, C and N are saved so that additional data points may be entered or deleted, and new mean and standard deviation values calculated.

### Correlation Coefficient and Slope Key, "COR SLOPE"

The correlation coefficient and slope of a least squares line fit of accumulated paired data values (that have been entered with the "Σx" and "Σy" keys) are computed with a single key stroke. The correlation coefficient is stored in registers X and S (and therefore is the initial result displayed). Slope is in M and is obtained by using the "MR" key. Registers T and C are lost.

### Y-Intercept Key, "INT"

After the "COR SLOPE" key has been used to compute a least squares line fit on a set of paired data values, any y-coordinate corresponding to a given x-coordinate lying on that line can be computed by entering the x-coordinate in X, and depressing "INT."

**TABLE II. Summary of Statistical Functions**

| KEY | REGISTERS | STATISTICAL EQUATION |
|---|---|---|
| "Σx" | $X \rightarrow Y$<br>$X + c \rightarrow C$, where c = original value of C<br>$X^2 + t \rightarrow T$, where t = original value of T<br>$n + 1 \rightarrow N$, where n = original value of N | $\Sigma x$<br>$\Sigma x^2$<br>Increments n |
| "Σy" | $X + a \rightarrow A$, where a = original value of A<br>$X^2 + m \rightarrow M$, where m = original value of M<br>$(X \cdot Y) + s \rightarrow S$, where s = original value of S | $\Sigma y$<br>$\Sigma y^2$<br>$\Sigma x \cdot y$ |
| "REM x" | $c - X \rightarrow C$<br>$t - X^2 \rightarrow T$<br>$n - 1 \rightarrow N$ | Delete $X_n$<br>Delete $x_n^2$<br>Decrement n |
| "REM y" | $a - X \rightarrow A$<br>$m - X^2 \rightarrow M$<br>$s - (X \cdot Y) \rightarrow S$ | Delete $y_n$<br>Delete $y_n^2$<br>Delete $(x \cdot y)_n$ |
| "$\bar{X}$, SD" | $\frac{C}{N} \rightarrow X$<br>$\sqrt{\frac{T - \frac{C^2}{N}}{N-1}} \rightarrow M$ | $\bar{X} = \frac{\Sigma x}{n}$<br>$SD = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$ |
| "COR SLOPE" | $\frac{S - \frac{C \cdot A}{N}}{\sqrt{\left(T - \frac{C^2}{N}\right)\left(M - \frac{A^2}{N}\right)}} \rightarrow X, S$<br>$\frac{S - \frac{C \cdot A}{N}}{T - \frac{C^2}{N}} \rightarrow M$<br>$\frac{A - M \cdot C}{N} \rightarrow A$ | $r = \frac{\Sigma x \cdot y - \frac{\Sigma x \cdot \Sigma y}{n}}{\sqrt{\left(\Sigma x^2 - \frac{(\Sigma x)^2}{n}\right)\left(\Sigma y^2 - \frac{(\Sigma y)^2}{n}\right)}}$<br>$m = \frac{\Sigma x \cdot y - \frac{\Sigma x \cdot \Sigma y}{n}}{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}$<br>$b = \frac{\Sigma y - m \cdot \Sigma x}{n}$ |
| "INT" | $M \cdot X + A \rightarrow X$ | $y_{INT} = mx + b$ |

### 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 | 1 2 | |
| . | 1 2. | |
| 3 | 1 2.3 | |
| − | −7.1 | |
| C | 0. | |

2. Repeat add or subtract

| KEYS | DISPLAY | COMMENTS |
|---|---|---|
| 3 | 3 | |
| . | 3. | |
| 1 | 3.1 | |
| + | 3.1 | |
| + | 6.2 | |
| + | 9.3 | |
| − | 6.2 | |
| C | 0. | |

3. Chain multiplication or division

| | KEYS | DISPLAY | COMMENTS |
|---|---|---|---|
| a) | 1 | 1 | |
| | × | 1. | |
| | 2 | 2 | |
| | × | 2. | |
| | 3 | 3 | |
| | . | 3. | |
| | 1 | 3.1 | |
| | × | 6.2 | |
| | 4 | 4 | |
| | . | 4. | |
| | 2 | 4.2 | |
| | = | 2 6.0 4 | |
| b) | 1 | 1 | |
| | 0 | 1 0 | |
| | ÷ | 1 0. | |
| | 2 | 2 | |
| | ÷ | 5. | |
| | 1 | 1 | |
| | 0 | 1 0 | |
| | ÷ | .5 | |
| | 2 | 2 | |
| | = | .2 5 | |

## EXAMPLES (Continued)

### 3. (Continued)

| | KEYS | DISPLAY | COMMENTS |
|---|---|---|---|
| c) | 2 | 2 | |
| | 0 | 2 0 | |
| | x | 2 0. | |
| | 4 | 4 | |
| | ÷ | 8 0. | |
| | 8 | 8 | |
| | ÷ | 1 0. | |
| | 7 | 7 | |
| | x | 1.4 2 8 5 7 1 4 | |
| | 4 | 4 | |
| | = | 5.7 1 | Result rounded to two places |

### 4. Constant multiplication or division

| | KEYS | DISPLAY | COMMENTS |
|---|---|---|---|
| a) | 3 | 3 | |
| | x | 3. | |
| | 2 | 2 | |
| | = | 6. | |
| | 4 | 4 | |
| | = | 1 2. | First factor in constant multiply |
| | 5 | 5 | |
| | . | 5. | |
| | 2 | 5.2 | |
| | = | 1 5.6 | |
| | = | 4 6.8 | |
| 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 | |

### 5. To perform products of sum; e.g.,

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

| KEYS | DISPLAY | COMMENTS |
|---|---|---|
| 5 | 5 | |
| + | 5. | |
| 4 | 4 | |
| + | 9. | |
| x | 9. | |
| 3 | 3 | |
| + | 3. | |
| 2 | 2 | |
| + | 5. | |
| ÷ | 4 5. | (5 + 4) x (3 + 2) is executed |
| 6 | 6 | |
| + | 6. | |
| 7 | 7 | |
| + | 1 3. | |
| = | 3.4 6 | 45 ÷ (6 + 7) is executed and rounded to two places |

### 6. Calculate percentage

5% of 300.25

| KEYS | DISPLAY | COMMENTS |
|---|---|---|
| 3 | 3 | |
| 0 | 3 0 | |
| 0 | 3 0 0 | |
| . | 3 0 0. | |
| 2 | 3 0 0.2 | |
| 5 | 3 0 0.2 5 | |
| x | 3 0 0.2 5 | |
| 5 | 5 | |
| % | 1 5.0 1 | "Live %" key executes operation and rounds two places |

### 7. Perform add-on and discount

| | KEYS | DISPLAY | COMMENTS |
|---|---|---|---|
| a) Add-On, 125 + 5% | | | |
| | 1 | 1 | |
| | 2 | 1 2 | |
| | 5 | 1 2 5. | |
| | x | 1 2 5. | |
| | 5 | 5 | |
| | % | 6.2 5 | 5% of 125 is displayed |
| | + | 1 3 1.2 5 | 125 + 5% is displayed |
| b) Discount, 532.1 – 6% | | | |
| | 5 | 5 | |
| | 3 | 5 3 | |
| | 2 | 5 3 2 | |
| | . | 5 3 2. | |
| | 1 | 5 3 2.1 | |
| | x | 5 3 2.1 | |
| | 6 | 6 | |
| | % | 3 1.9 3 | 6% of 532.1 is displayed |
| | – | 5 0 0.1 7 | 532.1 – 6% is displayed |

### 8. Perform change sign

| KEYS | DISPLAY | COMMENTS |
|---|---|---|
| 1 | 1 | |
| 2 | 1 2 | |
| CS | –1 2 | Change sign does not terminate entry. |
| 3 | –1 2 3 | |
| . | –1 2 3. | |
| CS | 1 2 3. | |
| 5 | 1 2 3.5 | |
| CS | –1 2 3.5 | |
| 6 | –1 2 3.5 6 | |
| C | 0. | |

### 9. Accumulate in memory, recall and clear memory

| | KEYS | DISPLAY | COMMENTS |
|---|---|---|---|
| a) | 3 | 3 | |
| | M+ | 3. | Accumulate in memory |
| | 4 | 4 | |
| | M+ | 4. | Accumulate in memory |
| | 5 | 5 | |
| | MR | 7. | Recall memory |
| | MR | 7. | Recall and clear memory |
| | MR | 0. | Recall and clear memory |
| b) | 5 | 5 | |
| | + | 5. | |
| | 6 | 6 | |
| | + | 1 1. | |
| | M+ | 1 1. | Accumulate in memory |
| | 7 | 7 | |
| | + | 1 8. | |
| | M+ | 1 8. | Accumulate in memory |
| | + | 2 5. | Repeat add |
| | 3 | 3 | |
| | 2 | 3 2 | |
| | . | 3 2. | |
| | 2 | 3 2.2 | |
| | CS | –3 2.2 | |
| | M+ | –3 2.2 | |
| | 9 | 9 | |
| | + | 3 4. | |
| | MR | –3.2 | Accumulated value of M is recalled |
| | + | 3 0.8 | |
| | MR | –3.2 | Accumulated value of M is recalled |
| | MR | –3.2 | M is cleared |
| | MR | 0. | |

## EXAMPLES (Continued)

10. Accumulate in memory with the "= +" key

| KEYS | DISPLAY | COMMENTS |
|---|---|---|
| 5 | 5 | |
| x | 5. | |
| 3 | 3 | |
| = + | 1 5. | 5 x 3 = 15 is added to M |
| 4 | 4 | |
| . | 4. | |
| 2 | 4.2 | |
| x | 4.2 | |
| 3 | 3 | |
| = + | 1 2.6 | 4.2 x 3 = 12.6 is added to M |
| 6 | 6 | |
| ÷ | 6. | |
| 7 | 7 | |
| = + | .8 6 | Rounded to 2 decimal places and added to M |
| 9 | 9 | |
| CS | −9 | Note method of multiplying |
| x | −9. | negative number |
| 4 | 4 | |
| = + | −3 6. | −9 x 4 = −36 is added to M |
| MR | −7.5 4 | |

## STATISTICAL FUNCTIONAL EXAMPLES

1. Perform mean and standard deviation

| KEYS | DISPLAY | COMMENTS |
|---|---|---|
| **a) Data: 4.0, 5.1, 4.5** | | |
| CA | 0. | |
| 4 | 4 | |
| Σx | 1. | Display indicates first data point has been entered |
| 5.1 | 5.1 | |
| Σx | 2. | 2nd data point entered |
| 4.5 | 4.5 | |
| Σx | 3. | 3rd data point entered |
| $\bar{X}$, SD | 4.5 3 3 3 3 3 3 | Mean and standard deviation are computed; mean is displayed |
| MR | .5 5 0 7 5 7 6 5 | Standard deviation is recalled from M |
| **b) Data: 3, 3, 3, 3, 4.1, 3.6** | | |
| CA | 0. | Always use "CA" after mean |
| 3 | 3 | and SD calculation |
| Σx | 1. | |
| 4 | 4 | |
| FREQ x | 4. | Grouped data points may |
| 4.1 | 4.1 | be entered conveniently |
| Σx | 5. | using the "FREQ" key |
| 3.9 | 3.9 | |
| Σx | 6. | Wrong data entry |
| 3.9 | 3.9 | |
| REM x | 5. | Wrong data is removed. Five |
| 3.6 | 3.6 | data points are entered. |
| Σx | 6. | |
| $\bar{X}$, SD | 3.2 8 3 3 3 3 3 | Mean and standard deviation are computed: $\bar{X}$ is displayed |
| MR | .4 6 6 5 4 7 7 4 | Standard deviation is recalled from M |
| **c) Correction of group data entered with "FREQ"** **Data: 4, 4, 4, 5, 5, 5, 5** | | |
| CA | 0. | |
| 4 | 4 | |
| Σx | 1. | |
| 3 | 3 | |
| FREQ x | 3. | |
| 5 | 5 | |
| Σx | 4. | |
| 7 | 7 | |
| FREQ x | 10. | 7 is incorrectly entered |
| 5 | 5 | |
| REM x | 9. | |
| 7 | 7 | |
| CS | −7 | |
| FREQ x | 3. | Negative x sets "REMOVE x" function |
| 5 | 5 | |
| Σx | 4. | |
| 4 | 4 | |
| FREQ x | 7. | Corrected data has been entered |
| $\bar{X}$, SD | 4.5 7 1 4 2 8 5 | |
| MR | .5 3 4 5 2 3 1 5 | |

**d) Compute running mean and standard deviations**
**Data: 7, 8, 6, 7, 5**

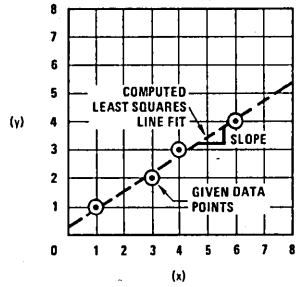
| | | |
|---|---|---|
| CA | 0. | |
| 7 | 7 | |
| Σx | 1. | |
| 8 | 8 | |
| Σx | 2. | n = 2 |
| $\bar{X}$, SD | 7.5 | Mean of first two data entries |
| MR | .7 0 7 1 0 6 7 8 | Standard deviation of first two data entries |
| 6 | 6 | |
| Σx | 3. | n = 3 |
| $\bar{X}$, SD | 7. | Mean of first three entries |
| MR | 1. | Standard deviation of first three entires |
| 7 | 7 | |
| Σx | 4. | n = 4 |
| $\bar{X}$, SD | 7. | Mean of first four entries |
| MR | .8 1 6 4 9 6 5 7 | Standard deviation of first four entries |
| 5 | 5 | |
| Σx | 5. | |
| $\bar{X}$, SD | 6.6 | Mean of all five entires |
| MR | 1.1 4 0 1 7 5 4 | Standard deviation of all five entires |

2. To perform least squares line fit on given data (See plotted data on page 10)

| KEYS | DISPLAY | COMMENTS |
|---|---|---|
| **a) Data: 1, 1** | | |
| **3, 2** | | |
| **4, 3** | | |
| **6, 4** | | |
| CA | 0. | |
| 1 | 1 | |
| Σx | 1. | n = 1 |
| 1 | 1 | |
| Σy | 1. | |
| 3 | 3 | |
| Σx | 2. | n = 2 |
| 2 | 2 | |
| Σy | 2. | |
| 4 | 4 | |
| Σx | 3. | n = 3 |
| 3 | 3 | |
| Σy | 3. | |
| 6 | 6 | |
| Σx | 4. | |
| 4 | 4 | |
| Σy | 4. | |
| COR-SLOPE | .9 9 2 2 7 7 8 8 | Correlation coefficient is displayed (perfect correlation = 1.0) |
| MR | .6 1 5 3 8 4 6 1 | Slope of least squares line fit is recalled from M |
| 0 | 0 | x = 0 |
| INT | .3 4 6 1 5 4 | y-intercept of least squares line at x = 0 is computed |
| 8 | 8 | x = 8 |
| INT | 5. 2 6 9 2 3 0 8 | y-intercept of least squares line at x = 0 is computed |

## STATISTICAL FUNCTION EXAMPLES (Continued)

2. (Continued)




b) Data: 2, 5
1, 4
0, 3

| KEYS | DISPLAY | COMMENTS |
|---|---|---|
| CA | 0. | |
| 2 | 2 | |
| $\Sigma x$ | 1. | $n_x = 1$ |
| 5 | 5 | |
| $\Sigma y$ | 1. | $n_y = 1$ |
| 8 | 8 | Wrong data point is entered |
| $\Sigma x$ | 2. | $n_x = 2$ |
| 9 | 9 | |
| $\Sigma y$ | 2. | $n_y = 2$ |
| 8 | 8. | Wrong data point is removed |
| REM x | 1. | $n_x = 1$ |
| 9 | 9 | |
| REM y | 1. | $n_y = 1$ |
| 1 | 1 | |
| $\Sigma x$ | 2. | $n_x = 2$ |
| 4 | 4 | |
| $\Sigma y$ | 2. | $n_y = 2$ |
| 0 | 0 | |
| $\Sigma x$ | 3. | $n_x = 3$ |
| 3 | 3 | |
| $\Sigma y$ | 3. | $n_y = 3$ |
| COR-SLOPE | 1. | Correlation coefficient is displayed |
| MR | 1. | Slope is displayed |
| 3 | 3 | For x = 3, |
| INT | 6. | the y-intercept is 6 |