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**EMPCD200**

**14/16-Digit Calculator**

**Product  
Specification**

**DOC. VERSION 1.0**

**ELAN MICROELECTRONICS CORP.**

April 2010

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### Specification Revision History

Doc. Version	Revision Description	Date
0.1	Initial version	2002/01/22
0.3	<ul style="list-style-type: none"><li>a. Modified VIH and VIL of K3~K14.</li><li>b. Modified VIH and VIL of RESET.</li><li>c. Added VEE specification.</li><li>d. Modified ROH and ROL (max.) of the LCD pins.</li><li>e. Modified the pull-down resistor of K0~K10.</li><li>f. Modified the pull-up resistor of K0~K7 and RESET.</li><li>g. Modified the pull-down resistor of K11~K14.</li><li>h. Removed the 'Preliminary' watermark on the background.</li></ul>	2002/09/11
0.4	Modified the Pad Diagram	2009/10/15
1.0	<a href="#">Upgraded to version 1.0</a>	<a href="#">2010/04/02</a>

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## 1 General Description

The EMPCD200 is a single-chip LS1 CMOS calculator with 3 sets of storage memory (14-digit or 16-digit). Besides, the EMPCD200 is an arithmetic four standard type of general function (+, −, ×, ÷), TAX function, Euro and 5 sets of currency exchange, percentage calculation functions, leading zero and trailing zero suppression, chain calculations, Mark up/down (MU/MD) and Delta percent ( $\Delta\%$ ) calculation, Grand Total (GT) calculation, Auto Power OFF available, 14/16-digit selectable LCD display. Dual power supply operation, wide operating voltage, and lower power consumption. All these features combine to make it suitable for 1.5 solar battery operated calculator.

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## 2 Features

- Number of display 14 /16 digits of data (including punctuation in each digit) 1 digit of floating minus sign, Memory I (M) and Memory II (MII) load symbol, error symbol, 3 digits of commas for thousands, TAX symbol, currency exchange (Local, Euro, C1~C5) symbol, GT and sign symbol, etc.
- Operation methods By algebraic operation
- Basic operations Four functions, repeat multiplication and division, mixed calculation, square calculation, percentage calculation, percent discount and add-on / discount calculation, memory calculation, delta percent calculation, add-mode calculation, mark-up / down calculation, Grand total calculation, constant calculation, TAX calculation, EURO exchange, currency exchange and square root calculation.
- Decimal point method Decimal set lock key controls output format. Fixed decimal setting ("0", "1", "2", "3", "4", "5", "6"), full floating decimal, and ADD mode (selectable with a switch).
- Contents of operation
  1. Floating point mode during operation and key entry that specified only Addition and Subtraction.
  2. Specified decimal point mode is valid only for operation results.
  3. Round-off when most significant digits have higher priority or at auto shift of rough estimation.



- Key rollover method Two-key rollover
- Error detect display
  1. Key entry exceeding the number of display digit is invalid, but does not cause an error.
  2. If the integer part of an operation result exceeds the number of display digits, a rough estimate is displayed.
  3. In the overflow condition, all key except “C”, “C/CE”, “CE”, “→” keys are inoperative.
- Protection
  1. In the overflow condition, all key except “C”, “C/CE”, “CE”, and “→” keys are inoperative.
  2. Key chatter protection
  3. Auto-clear at power on

Auto-clear functions by connecting a capacitor to the RESET pin.
- Auto power off function: 5 minutes
- Clock source Oscillator / clock generator internal to chip.
- Others
  1. Keyboard encoding internal to chip.
  2. Wide supply voltage range (1.2 to 1.8V).
  3. Very low power consumption
  4. Battery/solar power supply
  5. Symbol blinking available
  6. Rate will be kept after the AC key is pressed.

### 3 Pin Description

Symbol	I/O	Function
COM1~3	O	LCD Common signal output
A1	O	LCD Segment signal output and strobe output for switch status
B1	O	LCD Segment signal output and strobe output for switch status
C1	O	LCD Segment signal output and strobe output for switch status
A2	O	LCD Segment signal output and strobe output for switch status
B2	O	LCD Segment signal output and strobe output for switch status
C2	O	LCD Segment signal output and strobe output for switch status
A3	O	LCD Segment signal output and strobe output for switch status
B3	O	LCD Segment signal output and strobe output for switch status
C3	O	LCD Segment signal output
A4 ~ A16	O	LCD Segment signal output
B4 ~ B16	O	LCD Segment signal output
C4 ~ C16	O	LCD Segment signal output
D1 ~ D6	O	LCD Segment signal output (for symbols or icons display)
VDD, VSS	–	Positive and negative power supply pin
VA, VB	–	Voltage doubler for LCD. Connect a 0.1 $\mu$ F capacitor between both pins.
VEE	–	LCD voltage. From voltage doubler, connect a 0.1 $\mu$ F capacitor to the VDD pin.
TS1	I	Test pin input, should be opened.
RESET	I	System reset / AC key input (built-in Schmitt trigger for debouncing)
K0 ~ K2	O	Keyboard polling signal output pins
K3 ~ K7	I/O	Keyboard polling signal output and strobe input pins
K8 ~ K10	I	Keyboard strobe input pins
K11~K14	I	Switch status strobe input pins

## 4 Functional Description

### 4.1 Operational Characteristics

#### 4.1.1 Constant Operation

The EMPCD200 has implied constant mode on +, -, x, ÷ and % operations. The constant is performed automatically by the "=" key, "%=" key, or "%\*" key without a constant for addition and division while the first operand is the constant for multiplication.

#### 4.1.2 Number Entry

Numerals can be entered up to 16 digits.

#### 4.1.3 Memory Protection

In any error detection, the memory contents present before the error detection are protected.

#### 4.1.4 Memory Indication

If the memory contents are numbers other than zero, "M" is indicated in the sign-digit position.

### 4.2 Keyboard Description

- Off key (OFF)  
Pressing this key will turn off the power.
- Resume key (RESUME)  
Pressing this key will resume the calculation. Keep on in this calculation state before power off.
- Clear key (C)  
During a digital entry, pressing this key the first time will clear all, except the memory contents.
- Clear Entry key (CE)  
During a digital entry, pressing this key will clear the entry register and displays the number "0".
- Clear and Clear Entry key (C/CE)
  - During a digital entry, pressing this key will clear the entry register and display the number "0".
  - Pressing this key will clear all the other entries except the memory contents.

- Number, Decimal key (“000”, “00”, “0 – 9”, “.”)
  - The first number keyed in a sequence will clear the display and the pressed digit will be entered in the display. Successive entries will shift the display left and the keyed in data will be entered in the display register. The first decimal point entered is effective. An attempted entry of more than 15 digits or 17 decimal places will be ignored.
- Change Sign key (+/-)

Pressing the "+/-" key twice in succession causes the corresponding sign to appear and disappear. During a digital entry, this function changes the sign of the entered factor.
- Reverse (RV)

Reverse dividend
- Shift Key (→)
  - Deletes the right most digit and the other digits will shift to the right.
  - Rate setting mode, to recall and select the pre-registered exchange rate value(s).
- Multiplication Key (x)
  - Pressing this key enters the multiplicand.
  - Performs the previous operation and displays the result.
- Division Key (÷)
  - Pressing this key enters the dividend
  - Performs the previous operation and displays the result.
- Addition Key (+)
  - Pressing this key conditions the calculating machine for an addition.
  - Performs the previous operation and displays the result.
- Subtraction Key (-)
  - Pressing this key conditions the calculating machine for a subtraction.
  - Performs the previous operation and displays the result.
- Equal Key (=)
  - Performs the keyed in operation and maintains that operation for possible use.
  - Establishes power/reciprocation calculation.

■ Percent key (%)

The purpose of the percent key is to allow for calculation of add-on and discount. Determination of add-on requires the principal amount to be the first entry followed by the "+" or "-" key, with the percentage being the second entry. Pressing the percent key yields the amount to add on, such as tax or interest. Pressing the "=" key adds this amount to the principal.

■ Square Root Key ( $\sqrt{\quad}$ )

Extracts the square root of a positive number displayed in the entry register.

■ Memory I & II Plus Key (M+ & MII+)

- Adds the current display to the memory contents.
- It will terminate a number entry.

■ Memory I & II Minus Key (M- & MII-)

- Subtracts the current display from the memory contents.
- It will terminate a number entry.

■ Clear memory I & II Key (CM & CMII)

- Recalls and clears the memory contents.
- The recalled number is displayed and printed without rounding.

■ Recall Memory I & II Key (RM & RMII)

- Recalls the memory contents, and the memory is kept.
- The recalled number is displayed and printed without rounding or zero suppress.

■ Recall & Clear Memory I & II Key (RCM & RCMII)

- First pressed as RM key, transfers the contents of the memory register into the display register.
- Second pressed as CM key, clears the memory contents.

■ GT memory Recall and Clear Key (RC GT)

- First pressed as RGT key, transfers the contents of the GT memory register into the display register.
- Pressing the CGT key the second time, clears the GT memory.

■ Grand Total (GT+) Key

Add the current display to the contents of the grand total memory.

■ Grand Total (GT-) Key

Subtract the current display from the contents of the grand total memory. GT- will terminate a number entry.

- Mark-up/down and Delta percent key (MU/MD &  $\Delta\%$ )
  - First press the (MU) key to execute Mark-up calculation by A ( $\times$ ) B (MU).
  - First press the (MD) key to execute Mark-down calculation by A ( $\div$ ) B (MU [MD]).
  - Second press the (MU/MD) key, to calculate the mark-up/down percent value.
  - Execute Delta-percent calculation by A (+ or -) B (MU [ $\Delta\%$ ]).
- Delta Percent key ( $\Delta\%$  key)
  - Execute Increase ratio calculation by A ( $\times$ ) B ( $\Delta\%$ ).
  - Execute Decrease ratio calculation by A ( $\div$ ) B ( $\Delta\%$ ).
- Rate key (RATE)

Start to input the TAX rate, the Euro exchange rate or the Currency (C1~C5) exchange rate.
- TAX-including key (TAX+)
  - When pressed immediately after pressing the [RATE] key, stores the displayed number in the TAX memory.
  - Execute TAX-including calculation of the displayed number. The TAX rate is in the TAX memory.
  - Halfway through the four rules of arithmetic, TAX-including calculation doesn't break the intermediate result, so TAX-including is used in expression.
  - When pressed just after the TAX-including calculation to calculate the TAX value, press again just after pressing the first-time.
- TAX-excluding key (TAX-)
  - When pressed immediately after pressing the [RATE] key, recalls the displayed number in the TAX memory.
  - Execute TAX-excluding calculation of the displayed number. TAX rate is in the TAX memory.
  - Halfway through the four rules of arithmetic, TAX-excluding calculation doesn't break the intermediate result, so TAX-excluding is used in expression.
  - When pressed just after the TAX-excluding calculation to calculate the TAX value, press again just after pressing the first-time.

- EURO-conversion key (EURO)
  - Execute EURO-conversion of the displayed number. Conversion rate is in the EURO memory.
  - Halfway through the four rules of arithmetic, EURO-conversion doesn't break the intermediate result, so EURO-conversion is used in expression.
  - When pressed immediately after pressing the [RATE] key, stores the displayed number in the EURO memory.
- Local-conversion key (LOCAL)
  - Execute Local-conversion of the displayed number. Conversion rate is in the EURO memory.
  - Halfway through the four rules of arithmetic, Local-conversion doesn't break the intermediate result, so Local-conversion is used in expression.
  - When pressed immediately after pressing the [RATE] key, recalls the displayed number in the EURO memory.
- 2nd key (2nd)
  - Toggle enable/disable 2nd mode.
  - Indicates that the (2nd) key has been pressed. Pressing another (C1~C5) key in succession, to which the currency exchange function is assigned, performs the function.

### 4.3 Selection Mode Switch Functions

Either 14-digit / 16-digit mode depends on pressing the selectable switch. Fixed / floating decimal point mode and ADD mode are selected by rounding switch. The rounding switch should be so composed that either one of 6, 5, 4, 3, 2, 1, 0, ADD is selected.

- Fixed "F" mode

When TAB "F" is selected, both the entered numbers and the calculation results follow the floating decimal point system.

- DP i = 0, 1, 2, 3, 4, 5, 6 mode

The calculation results follow the fixed decimal point system and i +1 decimal place is counted by "UP", "CUT" and "5/4".

- ADD mode

When "+" and "-" operations are performed after a number, except decimal point, is entered, the calculation is executed as 1/100 value of the number being entered.

- Fixed "UP" mode  
The number of  $i + 1$  decimal position is counted as round up away.
- Fixed "CUT" mode  
The number of  $i + 1$  decimal position is counted as cutting away.
- Fix "5/4" mode  
When a number of  $i + 1$  decimal position is more than 0.5, the number of  $i$  decimal position is counted as added to "1".
- GT off mode  
Grand Total disable
- GT on mode  
Grand Total enable
- Rate set mode  
Start to input the TAX rate, the Euro exchange rate or the Currency (C1~C5) exchange rate.
- 2nd mode  
Pressing another (C1~C5) key in succession, to which the currency exchange function is assigned, performs the function.

## 4.4 Error Conditions

### 4.4.1 Error Detection

A system error occur when:

- Performing division by zero.
- The integral part of any memory calculation result exceeds 14 (16) digits.
- There's rough estimate calculation error.
- The integral part of any calculation-four standard function, %, or power calculation result exceeds 14 digits (16 digits)

### 4.4.2 Error Indication

- System error:  
System error:
- Rough estimate calculation error
- The high-order 14 digits (16 digits) of any calculation result is indicated with an "E" sign and the decimal point is displayed at the position corresponding to 10-14 (10-16) of the calculation result also on zero shift is performed.

### 4.4.3 Error Release

#### System error:

A system error can be released by pressing the ON/AC key or CE/C key. However, the calculation result is not cleared by CE/C key but is retained.

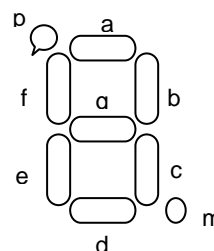
## 4.5 Overflow Condition

- (1) When the integer part of the result exceeds 14 digits (or 16 digits), the display will show the 14 most significant digits of the result divided by "10+14" ("10+16") and "E".
- (2) When an overflow occurs on the way of add-on/discount calculation, the display will show a zero and "E".
- (3) When the integer part of the result exceeds 14 digits (or 16 digits), the display will show a zero and "E".
- (4) When division by zero is attempted, an overflow condition will result, and the error symbol "E" and a zero are displayed.
- (5) When the integer part of the result in the memory register exceeds 14 digits (or 16 digits) during memory calculation, the display will show a zero and "E", and the previous data will be kept in the memory register.
- (6) In overflow condition, any operation or numeral entry will be inhibited.

## 4.6 Panel Description

The EMPCD200 can be directly operated using a 3V voltage and drive 16-digit, 1/3 duty and 1/2 bias LCD panel.

The following tables exhibit the relationship between the LCD segment, and common pins and the corresponding pattern on the display.



## 4.7 Table

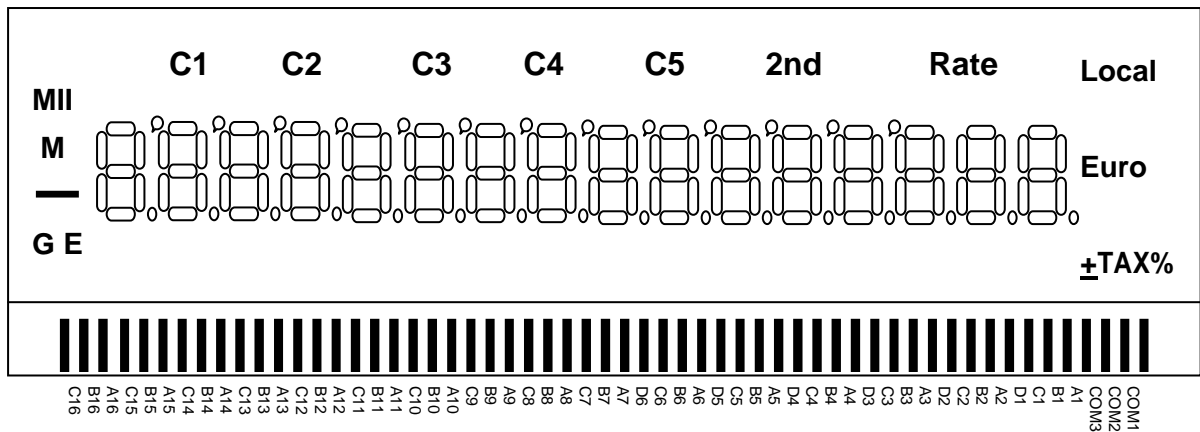
SEG			A1	B1	C1	D1	A2	B2	C2	D2	A3	B3	C3	D3
COM1	COM1		b1	a1	f1	C1	b2	a2	f2	C5	b3	a3	f3	RATE
COM2		COM2	c1	g1	e1	C2	c2	g2	e2	Euro	c3	g3	e3	% "T"
COM3		COM3	m1	d1	2nd	C3	m2	d2	C4	Local	m3	d3	p3	X

SEG	A4	B4	C4	D4	A5	B5	C5	D5	A6	B6	C6	D6	A7	B7	C7
COM1	b4	a4	f4	TAX	b5	a5	f5	M	b6	a6	f6	G	b7	a7	f7
COM2	c4	g4	e4	+ "T"	c5	g5	e5	-	c6	g6	e6	MI	c7	g7	e7
COM3	m4	d4	p4	- "T"	m5	d5	p5	E	m6	d6	p6	X	m7	d7	p7

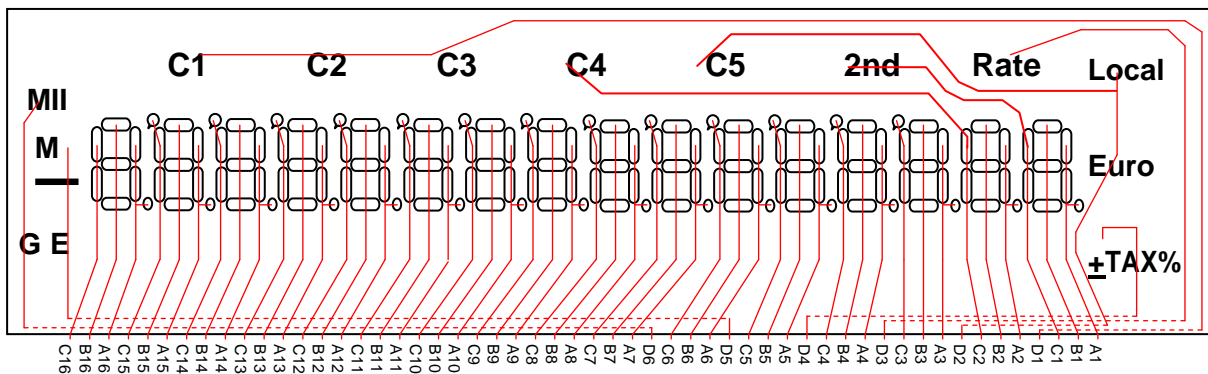
SEG	A8	B8	C8	A9	B9	C9	A10	B10	C10	A11	B11	C11	A12	B12	C12
COM1	b8	a8	f8	b9	a9	f9	b10	a10	f10	b11	a11	f11	b12	a12	f12
COM2	c8	g8	e8	c9	g9	e9	c10	g10	e10	c11	g11	e11	c12	g12	e12
COM3	m8	d8	p8	m9	d9	p9	m10	d10	p10	m11	d11	p11	m12	d12	p12

SEG	A13	B13	C13	A14	B14	C14	A15	B15	C15	A16	B16	C16
COM1	b13	a13	f13	b14	a14	f14	b15	a15	f15	b16	a16	f16
COM2	c13	g13	e13	c14	g14	e14	c15	g15	e15	c16	g16	e16
COM3	m13	d13	p13	m14	d14	p14	m15	d15	p15	m16	d16	X

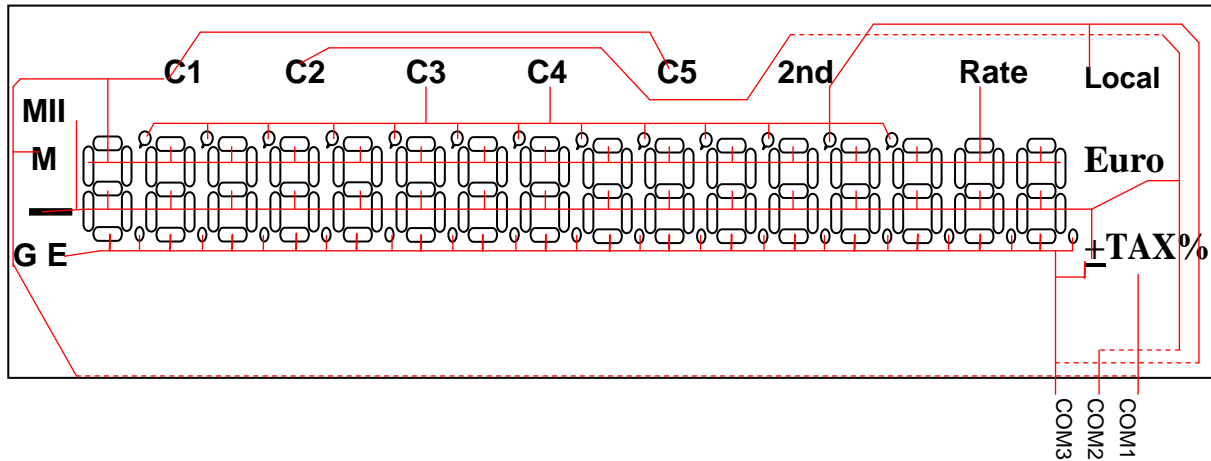
■ LCD Panel Outline Drawing



■ LCD Segment

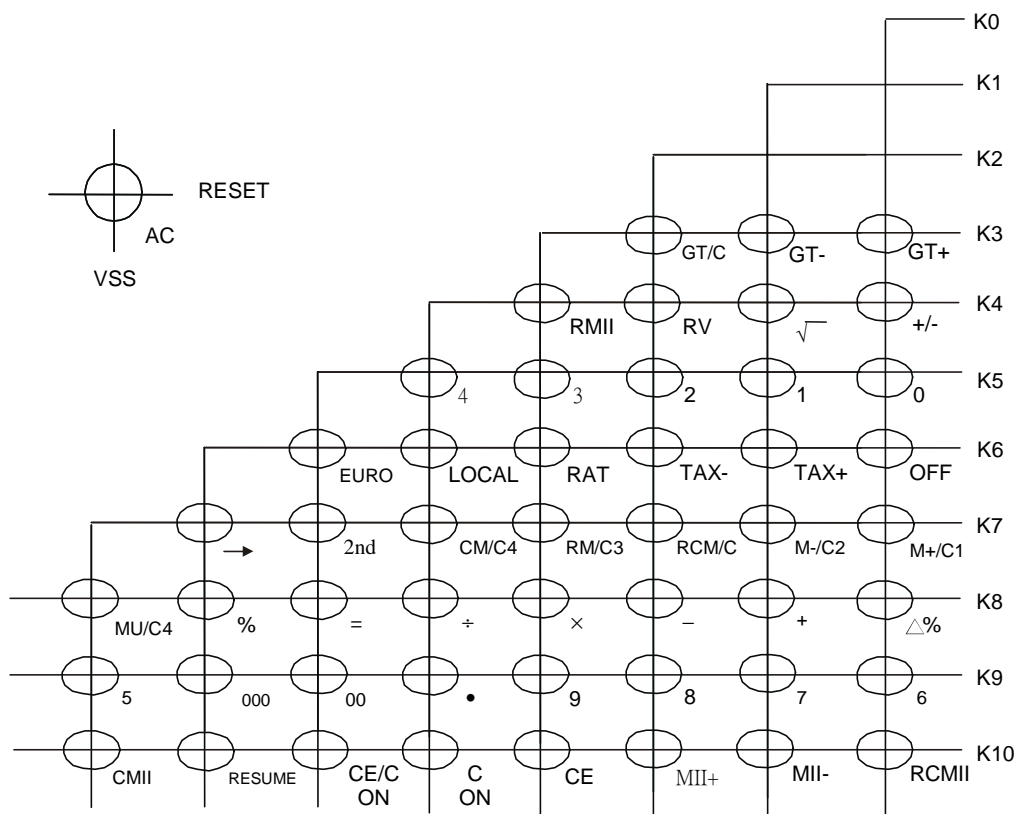


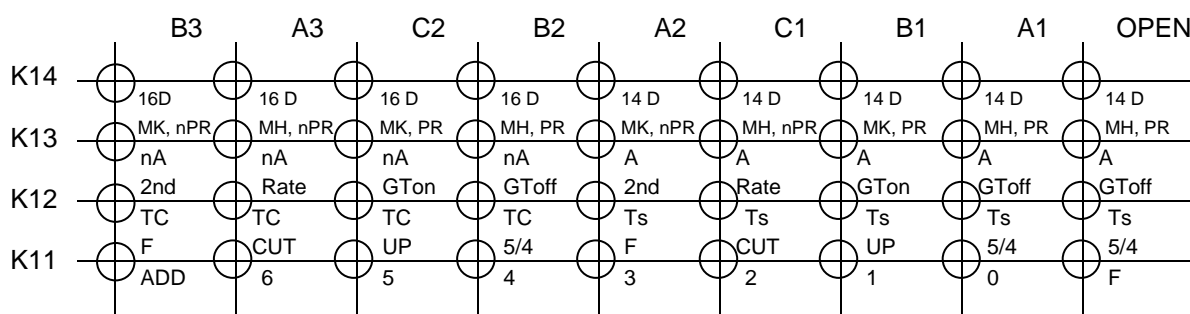
■ LCD Common



## 5 Keyboard Connection

■ Keyboard Arrangement



**■ Switch Connection**


K14: Select with Calculated Digits (14-digit or 16-digit) and Memory Hold Status, MH (Memory Hold), MK (Memory Kill) at Auto Power OFF or OFF key and Pre-Rate value selection nPR (Pre-Rate disable), PR (Pre-Rate enable).

K13: Select with Auto Power OFF mode and Grand total on/off, Rate or 2nd switch.

K12: Select with TAX symbol option and Rounding switches or floating mode (F, CUT, UP, 5/4).

TC: TAX("TAX"), TAX+("TAX" and "+"), TAX-("TAX" and "-"), TAX%("TAX" and "%");

Ts: TAX("TAX"), TAX+("+"), TAX-("-"), TAX%("%")

K11: Select with Fixed point or floating mode (ADD, 6, 5, 4, 3, 2, 1, 0, F).

## 6 Pre-rate Value Selection

Pre-rate values are exchange rates of the current Euro member states (the way of selecting one from pre-rate 11 values).

When pressing "→" key for the first time, the rate No.1 is always chosen. As "→"key is pressed repeatedly after the first press, the rate selected is changed in the sequence of 2, 3, 4, ... 11, 1, 2, ...

The pre-rate values are the exchange rate between the 11 Euro member states and Euro as shown in the list below.

No.	Pre-rate Value	Corresponding Currency Unit
1	13.7603	Austrian schilling (ATS)
2	40.3399	Belgian franc (BEF)
3	1.95583	Deutsche mark (DEM)
4	166.386	Spanish peseta (ESP)
5	5.94573	Finnish markka (FIM)
6	6.55957	French franc (FRF)
7	0.787564	Irish pound (IEP)
8	1936.27	Italian lira (ITL)
9	40.3399	Luxembourg franc (LUF)
10	2.20371	Dutch guilder (NLG)
11	200.482	Portuguese escudo (PTE)



## 7 Operation Examples

Type of Calculation	Operation	Key-in	Display
Addition and Subtraction calculation	TAB SW: 2, GT SW: Off, Round SW: 5/4		
	100 + 200 = 300	C 100 + 200 =	0. 100. 300.00
	3 - 5 = -2	C 3 - 5 =	0. 3. -2.00
	10 + 20 - 50 = -20	C 10 + 20 - 50 =	0. 10. 30. -20.00
Multiplication and Division calculation	TAB SW: 2, GT SW: Off, Round SW: 5/4		
	(-2) x 3 = -6.	1. C 2 +/- x 3 =	0. -2. -6.00
		2. - 2 x 3 =	- -2. -6.00
	(-365) ÷ 7 = -52.14	1. C 365 +/- ÷ 7 =	0. -365. -52.14
		2. - 365 ÷ 7 =	- -365. -52.14
	300 x 2,145 = 643,500	C 300 x 2145 =	0. 300. 643,500.00
300 x 4,950.6 = 1,485,180	C 4950.6 =	1,485,180.00	
31,750 ÷ 500 = 63.50	C 31750 ÷ 500 =	0. 31,750. 63.50	
54,236 ÷ 500 = 108.47	C 54236 =	108.47	
Square and Cube calculation	TAB SW: 2, GT SW: Off, Round SW: 5/4		
	32 = 9	C 3 x =	0. 3. 9.00
	53 = 125	C 5 x = =	0. 5. 25.00 125.00
Reciprocal calculation	TAB SW: 2, GT SW: Off, Round SW: 5/4		
	1 ÷ 4 = 0.25	1. C 1 ÷ 4 =	0. 1. 0.25
2. 4 ÷ =		4. 0.25	

( continuation )

Type of Calculation	Operation	Key-in	Display
Percentage calculation	TAB SW: 2, GT SW: Off, Round SW: 5/4		
	2,350 x 17 % = 399.50	C 2350 x 17 %	0. 2,350. 399.50
	456 ÷ 789 % = 57.79	C 456 ÷ 789 %	0. 456. 57.79
	2,000 + (2,000 x 12 %) = 2,240	C 2000 x 12 % + =	0. 2,000. 240.00 240.00 2,240.00
2,000 – (2,000 x 12 %) = 1,760	C 2000 x 12 % – =	0. 2,000. 240.00 240.00 1,760.00	
“→” key	TAB SW: 2, GT SW: Off, Round SW: 5/4		
		C 122.5 → 3 → → → 345 + 0.678 = → x 10 % →	0. 122.5 122. 122.3 122. 12. 12,345. 12,345.68 12,345.6 12,345.6 1,234.56 1,234.5
Reverse (RV)	TAB SW: 2, GT SW: Off, Round SW: 5/4		
	3 ÷ (1 + 2 + 3 + 4) = 0.3	C 1 + 2 + 3 + 4 + ÷ 3 RV =	0. 1. 3. 6. 10. 10. 3. 10. 0.30
Square root calculation	TAB SW: 2, GT SW: Off, Round SW: 5/4		
	25 <sup>1/2</sup> = 5	C 25 √ =	0. 25. 5. 5.00
	10 x (9 <sup>1/2</sup> ) ÷ 2 =15	C 10 x 9 √ ÷ 2 =	0. 10. 3. 30. 15.00



( continuation )

Type of Calculation	Operation	Key-in	Display	
Clear Entry (CE)	TAB SW: 2, GT SW: Off, Round SW: 5/4			
		C	0.	
		123 x 756 CE	123. 756. 0.	
		456 =	56,088.00	
ADD mode	TAB SW: ADD, GT SW : Off, Round SW: 5/4			
	1. In the case of addition and subtraction.	1. C	0.	
		12.55 + 15.75 + 4.20 + 100.00 – 10.45 – 5.30 = 116.75	1255 + 1575 + 420 + 100. – 1045 – 530 =	12.55 28.3 32.5 132.5 122.05 116.75
		2. In the case of calculations that are not addition or subtraction.	2. C	0.
	12 x 20 = 240 200 ÷ 3 = 66.67	12 x 20 = 200 ÷ 3 =	12. 240.00 200 66.67	
Store memory calculation	TAB SW: 3, GT SW: Off, Round SW: CUT			
	1,000 M+ 100,000,000,000 M- 100 x 3 M+ 1500 ÷ 2 M- M = –99,999,999,999,450	C	0.	
		1000 M+ 100000000000 M- 100 x 3 M+ 1500 ÷ 2 M- RM CM	M M M M M M M M	1,000.000 100,000,000,000.00 100. 300.000 1,500. 750.000 –99,999,999,450.000 –99,999,999,450.000
		100,000,000,000 M- 100,000,000,000 M+ 400 x 2 M- 300 ÷ 5 M+ M = –740	C 100000000000 M- 100000000000 M+ 400 x 2 M- 300 ÷ 5 M+ RCM RCM	M M M M M M M
Store memory II calculation	TAB SW: 3, GT SW: Off, Round SW: CUT			
	243 x 12 MII+ 576 x 25 MII+ 456 x 32 MII- MII = 14,592	C	0.	
		243 x 12 MII+ 576 x 25 MII+ RMII CMII 456 x 32 MII- RCMII RCMII	MII MII MII MII MII MII	243. 2,916.000 576. 14,400.000 17,316.000 17,316.000 456. 14,592.000 –14,592.000 –14,592.000

( continuation )

Type of Calculation	Operation	Key-in	Display
GT calculation	TAB SW: 3, GT SW: On,	Round SW: CUT	
		C	0.
	10 + 20 = 30	GT SW: On 10 + 20 =	G 10. 30.000
	2 x 3 = 6	2 x 3 =	G 2. G 6.000
	200 x 20% = 40	200 x 20 %	G 200. G 40.000
	GT SW: Off		
	100 + 200 = 300	100 + 200 =	G 100. G 300.000
	-200,000,000,000 = -200,000,000,000	GT SW: On 20000000000000 +/- =	G -20,000,000,000,000. G -19,999,999,999,800.00
	960 + 4 =964	960 + 4 =	G 960. G 964.000
	GT = -199,999,998,460	GT GT	G -19,999,999,998,760. -19,999,999,998,760.
	TAB SW: 3, GT SW: Off,	Round SW: CUT	
		C	0.
Store memory calculation	GT 1 ÷ 3 GT+ 100 ÷ 6 GT+ 1,000 ÷ 3 GT- GT =	Round SW: CUT	
		1 ÷ 3 GT+	G 1. 0.333
		100 ÷ 6 GT+	G 100. G 16.666
		Round SW: UP 1000 ÷ 3 GT-	G 1,000. G 333.334
		GT GT GT	G -316.335 G -316.335 G -316.335
Mark up calculation	TAB SW: 2, GT SW: Off,	Round SW: 5/4	
	Cost: 9,000 Profit rate: 20% Selling price = 9,000 ÷ (1 - 20 ÷ 100) =11,250	C 9000 x 20 MU MU	0. 9,000. 11,250.00 2,250.00
Mark down calculation	Selling price: 2,400 Profit rate: 20% Cost = 2,400 ÷ (1+ 20 ÷ 100) =2,000	C 2400 ÷ 20 MU MU	0. 2,400. 2,000.00 400.00



( continuation )

Type of Calculation	Operation	Key-in	Display
Delta percent calculation	TAB SW: 2, GT SW: Off, Original value: 15,000 New value: 18,000 Increment rate = (18,000 – 15,000) ÷ 15,000 x 100 = 20 %	Round SW: 5/4  C 1. 18000 ÷ 15000 Δ%  2. 18000 – 15000 MU	0.  18,000. 20.00  18,000. 20.00
	Constant calculation	TAB SW: 1, GT SW: Off, Round SW: 5/4	
1. Multiplication	2 x 3 = 6 2 x 10 = 20 2 x 20 = 40	TAB SW: 6 C 2 x 3 = 10 = 20 =	0.  2. 6.000000 20.000000 40.000000
	2. Division	TAB SW: 5 36 ÷ 3 = 24 = 6 =	36. 12.00000 8.00000 2.00000
3. Percent	1,500 x 15 % = 225 1,500 x 30 % = 450 1,500 x 3 % = 45	TAB SW: 4 1500 x 15 % 30 % 3 %	1,500. 225.0000 450.0000 45.0000
	200 ÷ 3 % = 6,666.7 1,500 ÷ 3 % = 50,000.0 300 ÷ 3 % = 10,000.0	TAB SW: 1 200 ÷ 3 % 1500 % 300 %	200. 6,666.7 50,000.0 10,000.0
4. Mark up	Cost: 9,000 Profit rate: 20% Selling price = 9,000 ÷ (1 – 20 %) = 11,250 Profit rate: 40% Selling price = 9,000 ÷ (1 – 40 %) = 15,000	TAB SW: F 9000 x 20 MU MU  40 MU MU	9,000. 11,250. 2,250.  15,000. 6,000.
	Selling price: 2,400 Profit rate: 20% Cost = 2,400 ÷ (1 + 20 %) = 2,000 Profit rate: 40% Cost = 2,400 ÷ (1 + 40 %) = 1,714.29	TAB SW: 2 2400 ÷ 20 MU MU  40 MU MU	2,400. 2,000.00 400.00  1,714.29 685.71



( continuation )

Type of Calculation	Operation	Key-in	Display		
Overflow	TAB SW: 2, GT SW: Off,	Round SW: CUT			
1. Addition and Subtraction calculation	- 60,000,000,000,000 - 60,000,000,000,000 =	C6000000000000 +/- - 60000000000000 =	-60,000,000,000,000. -60,000,000,000,000. -1.2000000000000 E -1.2000000000000 0.		
	- 120,000,000,000,000 E	C/CE C/CE	0.		
	40,000,000,000,000 + 40,000,000,000,000 - 40,000,000,000,000 - 40,000,000,000,000 + 40,000,000,000,000 + 40,000,000,000,000 + 40,000,000,000,000 = 120,000,000,000,000 E	40000000000000 + 40000000000000 - 40000000000000 - 40000000000000 + 40000000000000 + 40000000000000 + 40000000000000 + 40000000000000 = CE	+ - - + + + + = E	40,000,000,000,000. 80,000,000,000,000. 40,000,000,000,000. 0. 40,000,000,000,000. 80,000,000,000,000. 1.2000000000000 E 1.2000000000000	
	2. Multiplication and Division calculation	10,000,000,000,000 x 200 =2,000,000,000,000,000 E	10000000000000 x 200 = C 12300000000000 ÷ 0.001 = C	C 0. E 10,000,000,000,000. E 20.000000000000 0. E 12,300,000,000,000. E 123.00000000000 0.	
		12,300,000,000,000 ÷ 0.001 = 12,300,000,000,000,000 E	C 1 ÷ 0 =	0. 1. E 0.	
		3. Division by zero	1 ÷ 0 = 0. E	C 1 ÷ 0 =	0. 1. E 0.
			4. Store (M, MII & GT) memory calculation	80,000,000,000,000 M+ M+ E M = 80,000,000,000,000	80000000000000 M+ M+ C RM CM
	5. GT memory calculation			90,000,000,000,000 = 90,000,000,000,000 = E	GT SW: On 9000000000000000 = 9000000000000000 = C GT GT
		TAX calculation		TAB SW: 2, GT SW: Off,	Round SW: UP
	1. TAX rate setting	TAX rate: 5% 1. Key mode.	C Rate 5 TAX+	0. 0. Rate TAX% 5.	
2. Switch mode.		C 5 Rate TAX+	0. Rate 5. Rate TAX% 5.		
		C 5 TAX+	0. Rate TAX% 5.		



( continuation )

Type of Calculation	Operation	Key-in	Display
2. TAX rate recall	1. Key mode.	C Rate TAX-	0. Rate TAX% 5.
	2. Switch mode.	C TAX-	0. TAX% 5.
3. TAX+ calculation	TAX rate: 5%	C 800 TAX+ TAX+ TAX+	0. 800. 840.00 40.00 840.00
	TAX rate: 5%	C 840 TAX- TAX- TAX-	0. 840. 800.00 40.00 800.00
5. Calculation including TAX+ values	TAX rate: 20%	C 100 + 1000 TAX+ + 2000 TAX+ TAX+ =	0. 100. 1,200.00 1,300. 2,400.00 400.00 1,700.00
	TAX rate: 20%	C 100 + 2400 TAX- + 3600 TAX- TAX- =	0. 100. 2,000.00 2,100. 3,000.00 600.00 2,700.00
Exchange rate	Option: PreRate		
	Key mode	C 5 Rate Euro C Rate → → → Euro C Rate → 2nd C1 C 2nd Rate 10 C2 C 20 Rate 2nd C3	0. 5. Rate Euro 5. 0. Rate 1.95583 Rate Euro 1.95583 0. Rate 0. Rate 13.7603 Rate 2nd 13.7603 Rate C1 13.7603 0. 2nd Rate 0. Rate 2nd 10. Rate C2 10. 0. 20. Rate 20. Rate 2nd 20. Rate C3 20.
Set to Euro currency (C1~C5)			

( continuation )

Type of Calculation	Operation	Key-in	Display
	2. Switch mode: Rate	C → Euro C 20 → → → 2nd C1 C 2nd 30 C4	0. 13.7603 Rate Euro 13.7603 0. 20. Rate 1.95583 Rate 2nd 1.95583 Rate C1 1.95583 0. 0. 2nd 30. Rate C4 30.
	3. Switch mode: 2nd	C Rate 2 Euro C Rate → → → 5 C1 C Rate 40 C5	0. 0. Rate 2. Rate Euro 2. 0. Rate 0. Rate 1.95583 Rate 5. Rate C1 5. 0. Rate 0. Rate 40. Rate C5 40.
Exchange rate recall	1. Key mode	C Rate Local C Rate C1 C 100 Rate C2	0. 0. Rate Euro 2. 0. Rate 0. Rate C1 5. 0. 100. Rate 100. Rate C2 10.
	2. Switch mode: Rate	C 123 Local C C3 C → C4 C C5	0. 123. Rate Euro 2. 0. Rate C3 20. 0. Rate 13.7603 Rate C4 30. 0. Rate C5 40.
Euro → Local	TAB SW: 2, GT SW: Off, Round SW: CUT		
Conversion	Euro Rate: 1.23456	C 1000 Local Local Euro	0. 1,000. Local 1,234.56 Local 1,234.56 Euro 1,000.

( continuation )

Type of Calculation	Operation	Key-in	Display	
Local → Euro Conversion	TAB SW: 1, GT SW: Off, Round SW: CUT			
	Euro Rate: 1.23456	C	0.	
		1000	1,000.	
		Euro	Euro 810.0	
		Euro	Euro 810.0	
		Local	Local 1,000	
Currency exchange	TAB SW: 2, GT SW: Off, Round SW: CUT			
	1. Key mode	C	0.	
	C1 Rate: 5	1000	1,000.	
	C2 Rate: 10	2nd	2nd 1,000.	
	C3 Rate: 20	C1	C1 200.00	
	C4 Rate: 30	2nd	2nd 200.00	
	C5 Rate: 40	C2	C2 100.00	
	Euro Rate: 2	2nd	2nd 100.00	
		C3	C3 50.00	
		2nd	2nd 50.00	
		C4	C4 33.33	
		2nd	2nd 33.33	
		C5	C5 25.00	
		Euro	Euro 500.00	
		Local	Local 1,000	
	Switch mode: 2nd	TAB SW: 2, GT SW: Off, Round SW: UP		
		Switch mode: 2nd	C	0.
		2000	2,000.	
		C1	C1 400.00	
		C2	C2 200.00	
		C3	C3 100.00	
		C4	C4 66.67	
		C5	C5 50.00	
		Euro	Euro 1,000.00	
		Local	Local 2,000	
Calculation including values conversion		TAB SW: 2, GT SW: Off, Round SW: 5/4		
	Switch SW: 2nd	C	0.	
	C1 Rate: 5	250.11 +	250.11	
	C2 Rate: 10	123 Euro	Euro 62.89	
	C3 Rate: 20	+	313.	
	C4 Rate: 30	100 +	413.	
	C5 Rate: 40	350 Euro	Euro 178.95	
	Euro Rate: 1.95583	+	591.95	
		1234 C1	C1 246.80	
		+	838.75	
		1234 C2	C2 123.40	
		+	962.15	
		1234 C3	C3 61.70	
		+	1023.85	
	1234 C4	C4 41.13		
	+	1064.98		
	1234 C5	C5 30.85		
	=	1095.83		

## 8 Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit
Supply Voltage	$V_{DD}-V_{SS}$	-0.3	2.0	V
Input Voltage	$V_{IN}$	-0.3	$V_{DD}+0.3$	V
Operating Temperature	$T_{OP}$	0	50	°C
Storage Temperature	$T_{STG}$	-55	+125	°C

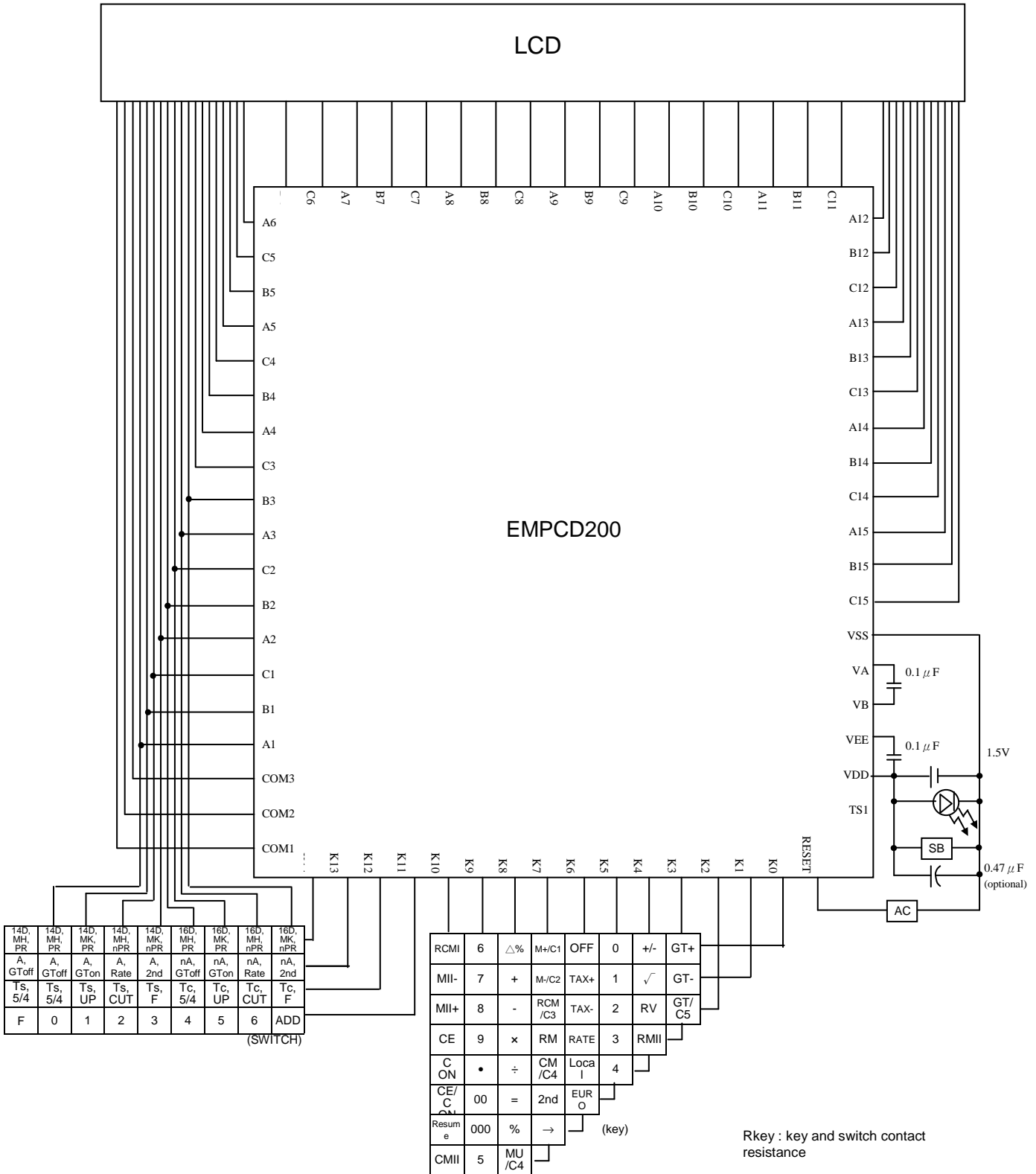
## 9 DC Electrical Characteristics

$V_{DD}=1.5V\pm 0.3V$ ,  $V_{SS}=0V$ ,  $T_A=25^{\circ}C$ ,  $V_{EE} = 3.0 \pm 0.4V$

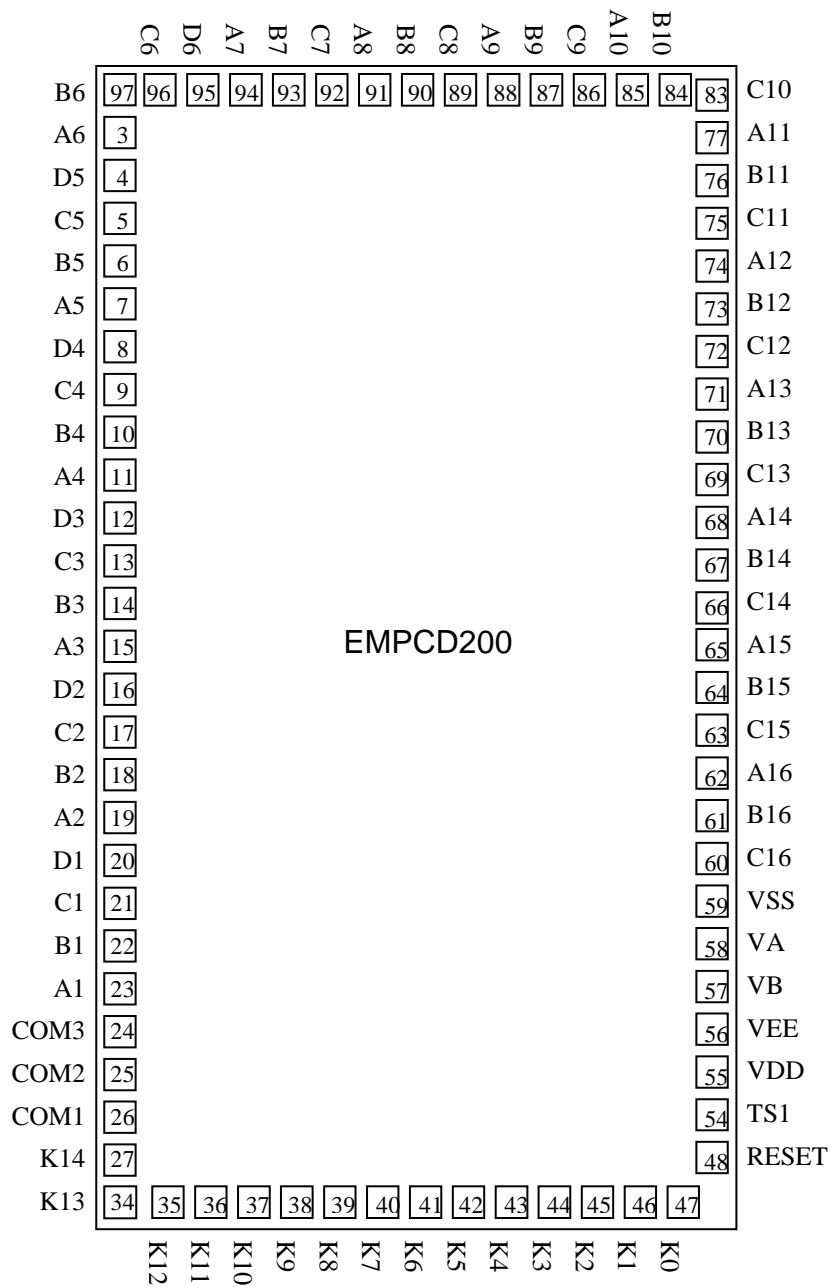
Parameter	Pin Name	Symbol	Min.	Typ.	Max.	Unit	Condition
Operating Voltage	-	$V_{DD}$	1.2	1.5	1.8	V	-
"1" Input Voltage	K3~K14	$V_{IH}(1)$	$V_{DD}-0.3$	-	$V_{DD}$	V	-
"0" Input Voltage	K3~K14	$V_{IL}(1)$	0	-	0.3	V	-
"1" Input Voltage	RESET	$V_{IH}(2)$	$0.7 V_{DD}$	-	$V_{DD}$	V	$V_{DD} = 1.5V$
"0" Input Voltage	RESET	$V_{IL}(2)$	0	-	$0.2 V_{DD}$	V	$V_{DD} = 1.5V$
"1" Output Voltage	SEGMENT COM1~3	$V_{OH}(1)$	$V_{EE}-0.2$	-	$V_{EE}$	V	-
"0" Output Voltage	SEGMENT COM1~3	$V_{OL}(1)$	0	-	0.2	V	-
"M" Output Voltage	COM1~3	$V_{OM}$	$V_{DD}-0.2$	-	$V_{DD}+0.2$	V	-
"1" Output Voltage	K0~K7	$V_{OH}(2)$	$V_{DD}-0.2$	-	$V_{DD}$	V	-
"0" Output Voltage	K0~K7	$V_{OL}(2)$	0	-	0.2	V	-
LCD voltage	VEE	$V_{EE}$	$2V_{DD}-0.2$	-	$2V_{DD} +0.2$	V	$V_{DD} = 1.2V\sim 1.8V$
"1" Output Resistance	SEGMENT COM1~3	$R_{OH}$	-	-	10	K	$V_{OUT} = V_{EE}-0.5V$
"0" Output Resistance	SEGMENT COM1~3	$R_{OL}$	-	-	10	K	$V_{OUT} = 0.5V$
Key Pull-down Resistance	K0~K10	$R_{KEYL}(1)$	180	350	900	K	$V_{OUT}= V_{DD}= 1.2V\sim 1.8V$
Key Pull-up Resistance	K0~K7	$R_{KEYH}(1)$	-	5	10	K	$V_{OUT}= 0.5V$
	RESET	$R_{KEYH}(2)$	50	100	370	K	
Switch Pull Down Resistance	K11~K14	$R_{SW}(1)$	180	350	900	K	$V_{OUT}= V_{DD}= 1.2V\sim 1.8V$
Oscillating Frequency	(Wait) TS1	$F_{WAIT}$	19.6	28	36.4	kHz	$V_{DD}= 1.2V\sim 1.8V$
	(Operate) TS1	$F_{OP}$	117	195	273	kHz	
Frame Frequency	SEGMENT COM1~3	$f_F$	130	146	162	Hz	-
Supply Current	1 (WAIT)	$I_{DDWAIT}$	-	4.0	5.5	-	$V_{DD}= 1.5V$
	2 (OPERATE)	$I_{DDOP}$	-	22	35	-	-
	3 (OFF)	$I_{DDOFF}$	-	-	1.0	-	-

# 10 Application Block Diagram

■ Dual Type



## 11 Pad Diagram





Pad No.	Symbol	Chapter 2 X	Chapter 3 Y
1	NC	-	-
2	NC	-	-
3	A6	-770.0	1310.0
4	D5	-770.0	1190.0
5	C5	-770.0	1075.0
6	B5	-770.0	965.0
7	A5	-770.0	855.0
8	D4	-770.0	745.0
9	C4	-770.0	635.0
10	B4	-770.0	527.5
11	A4	-770.0	420.0
12	D3	-770.0	315.0
13	C3	-770.0	210.0
14	B3	-770.0	105.0
15	A3	-770.0	0.0
16	D2	-770.0	-105.0
17	C2	-770.0	-210.0
18	B2	-770.0	-315.0
19	A2	-770.0	-420.0
20	D1	-770.0	-527.5
21	C1	-770.0	-635.0
22	B1	-770.0	-745.0
23	A1	-770.0	-855.0
24	COM3	-770.0	-965.0
25	COM2	-770.0	-1075.0
26	COM1	-770.0	-1190.0
27	K14	-770.0	-1310.0
28	NC	-	-
29	NC	-	-
30	NC	-	-
31	NC	-	-
32	NC	-	-
33	NC	-	-
34	K13	-770.0	-1435.0
35	K12	-645.0	-1435.0
36	K11	-535.0	-1435.0
37	K10	-425.0	-1435.0
38	K9	-317.5	-1435.0
39	K8	-210.0	-1435.0
40	K7	-105.0	-1435.0

( continuation )

Pad No.	Symbol	Chapter 4 X	Chapter 5 Y
41	K6	0.0	-1435.0
42	K5	105.0	-1435.0
43	K4	210.0	-1435.0
44	K3	317.5	-1435.0
45	K2	425.0	-1435.0
46	K1	535.0	-1435.0
47	K0	645.0	-1435.0
48	RESET	770.0	-1435.0
49	NC	-	-
50	NC	-	-
51	NC	-	-
52	NC	-	-
53	NC	-	-
54	TS1	770.0	-1310.0
55	VDD	770.0	-1190.0
56	VEE	770.0	-1070.0
57	VB	770.0	-950.0
58	VA	770.0	-835.0
59	VSS	770.0	-720.0
60	C16	770.0	-605.0
61	B16	770.0	-495.0
62	A16	770.0	-385.0
63	C15	770.0	-275.0
64	B15	770.0	-165.0
65	A15	770.0	-55.0
66	C14	770.0	55.0
67	B14	770.0	165.0
68	A14	770.0	275.0
69	C13	770.0	385.0
70	B13	770.0	495.0
71	A13	770.0	605.0
72	C12	770.0	720.0
73	B12	770.0	835.0
74	A12	770.0	950.0
75	C11	770.0	1070.0
76	B11	770.0	1190.0
77	A11	770.0	1310.0
78	NC	-	-
79	NC	-	-
80	NC	-	-

( continuation )

Pad No.	Symbol	Chapter 6 X	Chapter 7 Y
81	NC	-	-
82	NC	-	-
83	C10	770.0	1435.0
84	B10	645.0	1435.0
85	A10	535.0	1435.0
86	C9	425.0	1435.0
87	B9	317.5	1435.0
88	A9	210.0	1435.0
89	C8	105.0	1435.0
90	B8	0.0	1435.0
91	A8	-105.0	1435.0
92	C7	-210.0	1435.0
93	B7	-317.5	1435.0
94	A7	-425.0	1435.0
95	D6	-535.0	1435.0
96	C6	-645.0	1435.0
97	B6	-770.0	1435.0
98	NC	-	-
99	NC	-	-
100	NC	-	-

Chip size: 1800 x 3130  $\mu\text{m}$

**NOTE**

*For PCB layout, the IC substrate must be connected to VSS.*