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GENERAL DESCRIPTION

The EMPCD100 is a single-chip LS1 CMOS calculator for 3 sets store memory (10-digits or 12-digits). Besides, the EMPCD100 is an arithmetic four standard types of general function (+, –, ×, ÷), TAX function, Euro & 5 sets currency exchange, percentage calculation functions, leading zero and trailing zero suppression, chain calculations, Mark up/down (MU/MD) & Delta percent (Δ%) calculation, Grand Total (GT) calculation, Auto Power OFF available, 10/12-digit selectable LCD display. Dual power supply operation, wide operating voltage, and lower power consumption make it suitable for 1.5 solar battery operated calculator.

FEATURES

- Number of display — 10 /12 digits of data, (including punctuation in each digit) 1-digit of floating minus sign, memory I (M) & memory II (MII) load symbol, error symbol, 3-digits of commas for thousands, TAX symbol, currency exchange (Local, Euro, C1~C5) symbol, GT and sing symbol, etc.
- Operation methods — By algebraic operation.
- Basic operations — Four function, 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

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- Error detect display
  1. Key entry exceeding the number of display digits is invalid, but dies 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”, ”→” 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
  6 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 AC key pressed.

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PIN DESCRIPTIONS

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 ~ A15	O	LCD Segment signal output.
B4 ~ B15	O	LCD Segment signal output.
C4 ~ C15	O	LCD Segment signal output.
VDD,VSS	---	Positive and negative power supply pin.
VA,VB	---	Voltage double for LCD connects a capacitor (0.1uF) between both pins.
VEE	---	LCD voltage from voltage double connects a capacitor (0.1uF) to pin VDD.
TS1	I	Test pin input, 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.

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Function Descriptions

A). Operation Characteristics

- Constant Operation
  The EMPCD100 has implied constant mode on +, -, ×, ÷ 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.
- Number Entry
  Numerical can be entered up to 12 digit.
- Memory Protection
  In any error detection, the memory contents present before the error detection are protected.
- Memory Indication
  If the memory contents are a number other than zero, "M" is indicated in the sign-digit position.

B). Keyboard Description

- Off key (OFF)
  Turn off the power.
- Resume key (RESUME)
  A push will power on the calculation. Keep calculate state before power off.
- Clear key (C)
  During the digit entry, the first depression will clear all except memory contents.
- Clear Entry key (CE)
  During the digit entry will clear the entry register and display number "0".
- Clear & Clear Entry key (C/CE)
  i). During the digit entry will clear the entry register and display number "0".
  ii). Other will clear all except memory contents.
- Number, Decimal key (“000”, “00”, “0 – 9”, “•”)
  The first number key in a sequence will clear the display and enter the digit in the display. Successive entries will shift the display left and enters the data in display register. The first decimal point entered is effective. An attempted entry of more than 13 digits or 11decimal places will be ignored.
- Change Sign key (+/-)
  Pushing the "+/-" key twice in succession causes the corresponding sign to appear and disappear. During digit entry, this function changes the sign of the entered factor.
- Reverse (RV)
  Reverse dividend.

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- Shift Key (→)
  i). Delete the rightist digit and others will shift to right.
  ii). Rate setting mode, to recall and select pre-registered exchange rate value(s).
- Multiplication Key (×)
  i). Enters multiplicand.
  ii). Performs previous operation and displays result.
- Division Key (÷)
  i). Enters dividend.
  ii). Performs previous operation and displays result.
- Addition Key (+)
  i). Conditions machine for an addition.
  ii). Performs previous operation and displays result.
- Subtraction Key (-)
  i). Conditions machine for a subtraction.
  ii). Performs previous operation and displays result.
- Equal Key (=)
  i). Performs Keyed-in operation and maintains that operation for possible use.
  ii). 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. Depression of the percent key yields the amount to add on, such as tax or interest. Depression of the "=" key adds this amount to the principal.
- Square Root Key ($\sqrt{}$)
  Extract the square root of a positive numeric displayed in the entry register.
- Memory I & II Plus Key (M+ & MII+)
  i). Adds the current display to the contents of memory.
  ii). It will terminate a number entry.
- Memory I & II Minus Key (M- & MII-)
  i). Subtracts the current display from the contents of memory
  ii). It will terminate a number entry.
- Clear memory I & II key (CM & CMII)
  i). Recall and clear the contents of memory.
  ii). The recalled number is displayed and printed without rounding.
- Recall memory I & II key (RM & RMII)
  i). Recall the contents of memory and memory is kept.
  ii). The recalled number is displayed and printed without rounding or zero suppress.

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- Recall & Clear memory I & II key (RCM & RCMII)
  i). First pressed as RM key, transfers the contents of the memory register into the display register.
  ii). Second pressed as CM key, clear the memory.
- GT memory Recall and Clear key (RC GT)
  i). First pressed as RGT key, transfers the contents of the GT memory register into the display register.
  ii). Second pressed as CGT key, clear the GT memory.
- Grand Total (GT+)
  Add the current display to the content of grand total memory.
- Grand Total (GT-)
  Substrate the current display from the content of grand total memory, GT- will terminate a number entry.
- Mark-up/down & Delta percent key (MU/MD&Δ%)
  i). First press (MU) key, execute Mark-up calculation by A (×) B (MU).
  ii). First press (MD) key, execute Mark-down calculation by A (÷) B (MU [MD]).
  iii). Second press (MU/MD) key, to calculate the mark-up/down percent value.
  iv). Execute Delta-percent calculation by A (+ or -) B (MU [Δ%]).
- Delta Percent key (Δ% key)
  i). Execute Increase ratio calculation by A (×) B (Δ%).
  ii). Execute Decrease ratio calculation by A (÷) B (Δ%).
- Rate key (RATE)
  To start inputting the TAX rate, the Euro exchange rate or the Currency (C1~C5) exchange rate.
- TAX-including key (TAX+)
  i). When immediately after [RATE] key, store displayed number in TAX memory.
  ii). Execute TAX-including calculation of displayed number, TAX rate is in TAX memory.
  iii). In the halfway of four rules of arithmetic, TAX-including calculation don't break the intermediate result, so TAX-including is used in expression.
  iv). When pressed just after the TAX-including calculation to calculate the TAX value when pressed just after the first press.
- TAX-excluding key (TAX-)
  i). When immediately after [RATE] key, recall displayed number in TAX memory.
  ii). Execute TAX-excluding calculation of displayed number, TAX rate is in TAX memory.
  iii). In the halfway of four rules of arithmetic, TAX-excluding calculation don't break the intermediate result, so TAX-excluding is used in expression.
  iv). When pressed just after the TAX-excluding calculation to calculate the TAX value when pressed just after the first press.

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

Selection Mode Switch Functions

12-digit / 10-digit modes depend on 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 entered numbers and calculation results follow to floating decimal point system.
- DP i = 0, 1, 2, 3, 4, 5, 6 mode
  The calculation results follow to fixed decimal point system and i +1 decimal place is counted by "UP", "CUT" and "5/4".
- ADD mode
  When "+" and "-" operation are performed after a number except decimal point is entered. The calculation is executed as 1/100 value of 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".

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- GT off mode
  Grand Total disable.
- GT on mode
  Grand Total enable.
- Rate set mode
  To start inputting 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,

Error Conditions

(a) Error Detection

System errors occur when:

i) The division by zero.

ii) The integral part of any memory calculation results exceeds 12 (10) digits.

iii) Rough estimate calculation error.

iv) The integral part of any calculation-four standard function, %, or power calculation result exceeds 12 digits (10 digits)

(b) Error Indication

i) System error:
System error:

ii) Rough estimate calculation error

iii) The high-order 12 digits (10 digits) of any calculation result is indicated with “E” sign and the decimal point is displayed at the position corresponding to 10^{-12} (10^{-10}) of the calculation result also on zero shift is performed.

(c) Error Release

System error:

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

Overflow Condition

(1) When the integer part of result exceed 12 digits (or 10 digits), the display will show 12 most significant digits of result divide by "10^{+12}" ("10^{+10}") and "E".

(2) When an overflow occurs on the way of add-on/discount calculation, display will show a zero and ”E”.

(3) When the integer part of result exceeds 12 digits (or 10 digits), display will show a zero and “E”.

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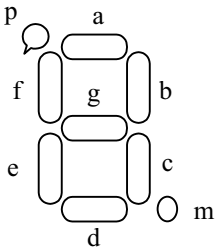
(4) When division by zero is attempted, an overflow condition will result, and error symbol ”E” and a zero are displayed.

(5) When the integer part of result in memory register exceeds 12 digits (or 10 digits) at memory calculation, display will show a zero and “E”, and previous data will be kept in memory register.

(6) In overflow condition, any operation or numeral entry will be inhibited.

LCD Panel Description

The EMPCD100 can directly voltage 3V and drive 12-digit 1/3 duty and 1/2 bias LCD panel. The following tables exhibit the relationship between the LCD segment, and common pins and corresponding pattern on the display.

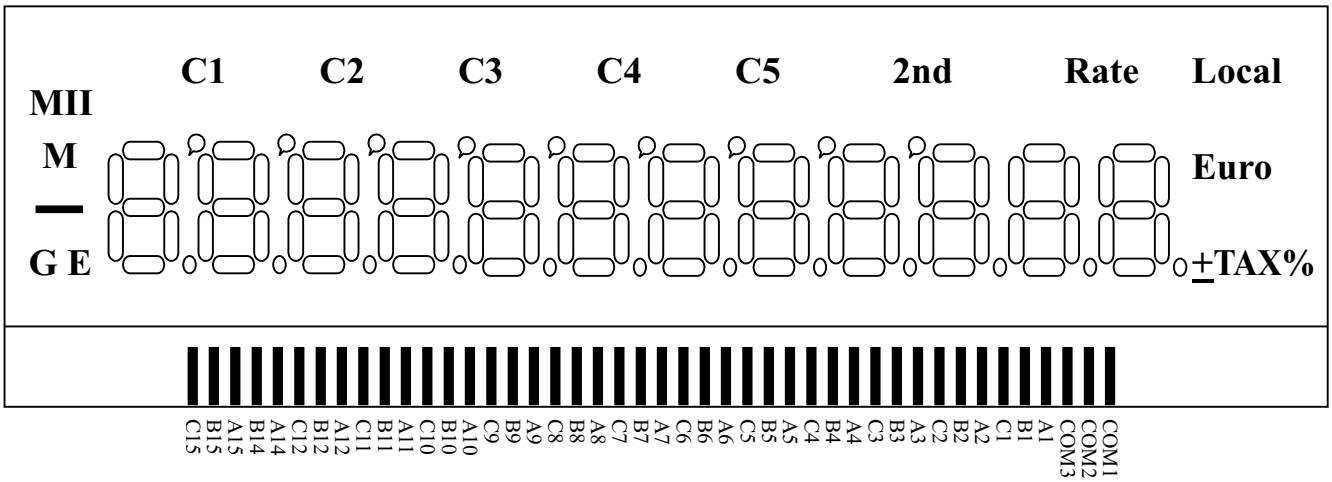


Segment		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
COM1	An	M	2nd	X	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1
	Bn	TAX	C3	X	a12	a11	a10	a9	a8	a7	a6	a5	a4	a3	a2	a1
	Cn	TAX–	X	X	f12	f11	f10	f9	f8	f7	f6	f5	f4	f3	f2	f1
COM2	An	–	C1	X	c12	c11	c10	c9	c8	c7	c6	c5	c4	c3	c2	c1
	Bn	GT	C4	X	g12	g11	g10	g9	g8	g7	g6	g5	g4	g3	g2	g1
	Cn	TAX+	X	X	e12	e11	e10	e9	e8	e7	e6	e5	e4	e3	e2	e1
COM3	An	E	C2	X	m12	m11	m10	m9	m8	m7	m6	m5	m4	m3	m2	m1
	Bn	TAX%	C5	X	d12	d11	d10	d9	d8	d7	d6	d5	d4	d3	d2	d1
	Cn	RATE	X	X	MII	p11	p10	p9	p8	p7	p6	p5	p4	P3	LOCAL	EURO

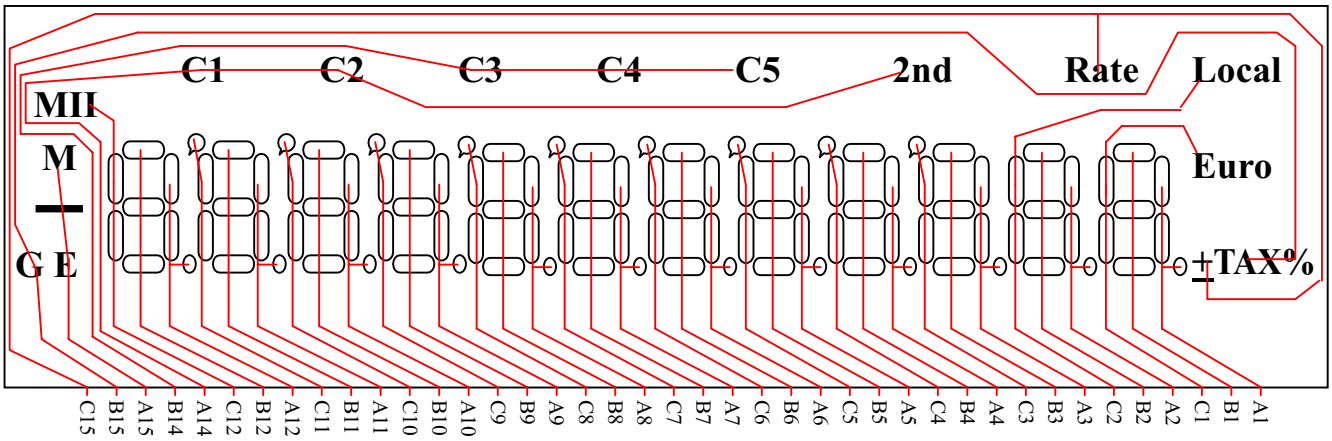
Note : 10 digit function “MII” symbol change to “p10” symbol location.

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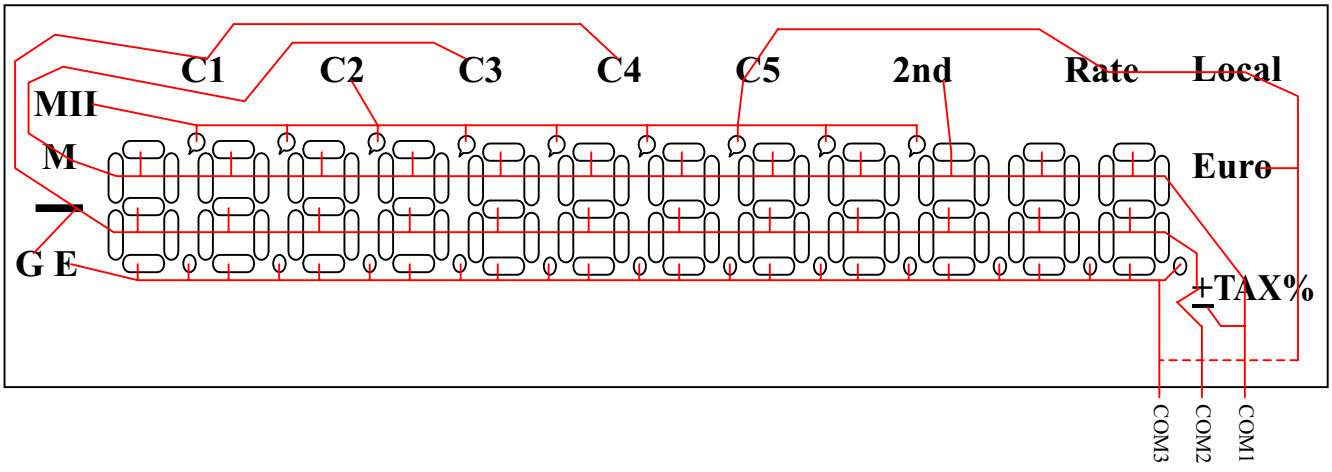
- LCD Panel outlines drawing



- LCD Segment



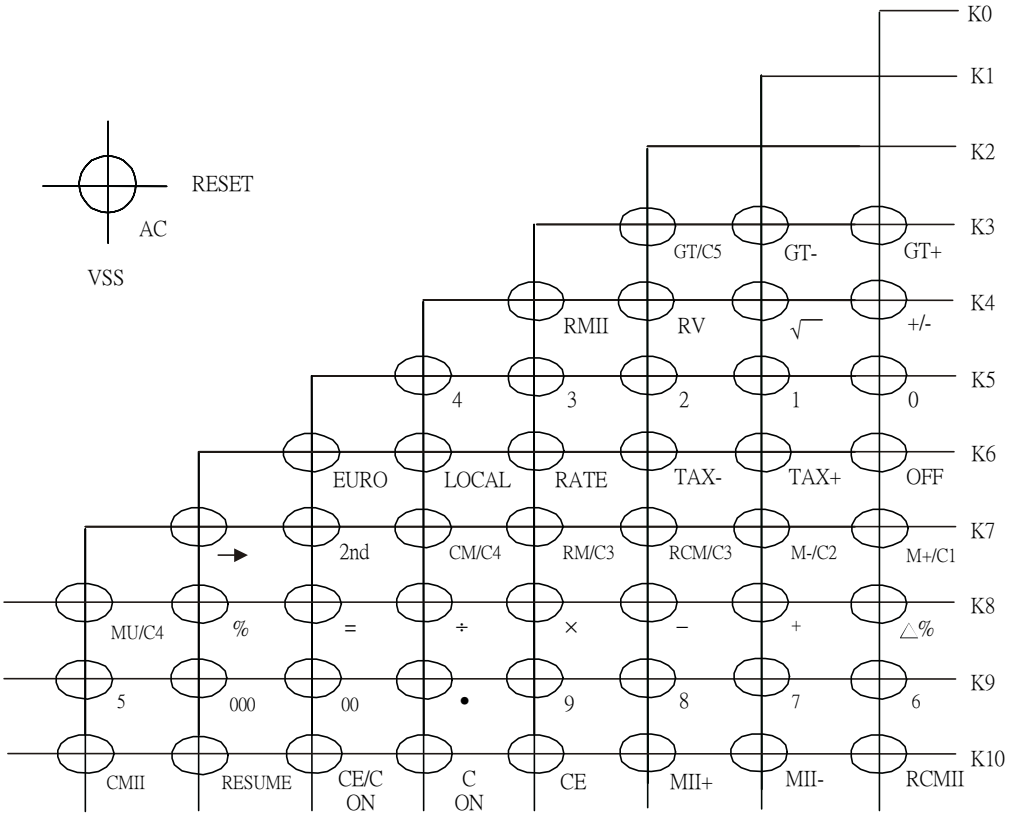
- LCD Common



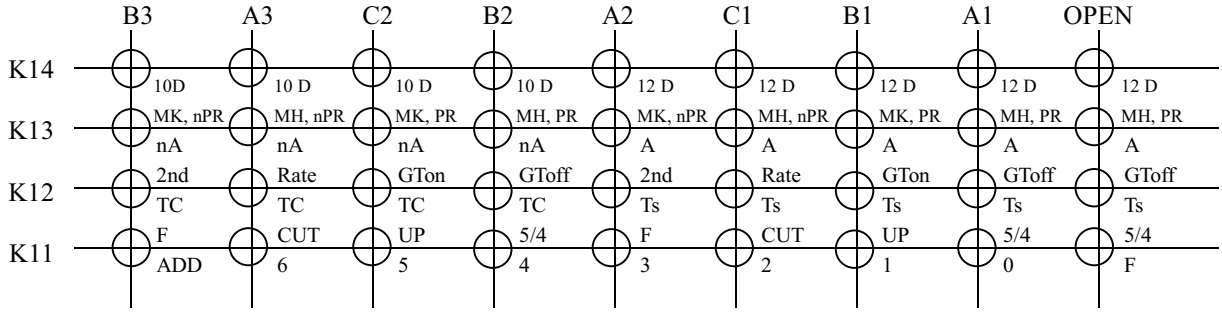
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CONNECTION OF KEYBOARD

- Keyboard arrangement



- Connection of switch



K14: Select with Calculated Digits (12 digit or 10 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).

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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).

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PRE-RATE VALUE SELECTION

Pre-rate values are exchange rates of the current Euro membership 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 membership 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)

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OPERATION EXAMPLES

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

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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		
	$25^{1/2}$ = 5	C 25 √ =	0. 25. 5. 5.00
	10 x $(9^{1/2})$ ÷ 2 =15	C 10 x 9 √ ÷ 2 =	0. 10. 3. 30. 15.00
Clear Entry (CE)	TAB SW: 2, GT SW: Off, Round SW: 5/4		
		C 123 x 756 CE 456 =	0. 123. 756. 0. 56,088.00

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ADD mode	TAB SW: ADD, GT SW : Off, Round SW: 5/4			
1. In the case of addition and subtraction.	1. 12.55 + 15.75 + 4.20 + 100.00 – 10.45 – 5.30 = 116.75	C 1255 + 1575 + 420 + 100. – 1045 – 530 =		0. 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. 12 x 20 = 240 200 ÷ 3 = 66.67	C 12 x 20 = 200 ÷ 3 =		0. 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 1000 M+ 100000000000 M- 100 x 3 M+ 1500 ÷ 2 M- RM CM	M M M M M M M	0. 1,000.000 100,000,000,000. 100. 300.000 1,500. 750.000 –99,999,999,999,450.0 –99,999,999,999,450.0
	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	0. 100,000,000,000. 100,000,000,000. 400. 800.000 300. 60.000 –740.000 –740.000
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 243 x 12 MII+ 576 x 25 MII+ RMII CMII 456 x 32 MII- RCMII RCMII	 MII MII MII MII MII MII	0. 243. 2,916.000 576. 14,400.000 17,316.000 17,316.000 456. 14,592.000 –14,592.000 –14,592.000
GT calculation	TAB SW: 3, GT SW: On, Round SW: CUT			
	10 + 20 = 30 2 x 3 = 6 200 x 20% = 40 100 + 200 = 300	C GT SW: On 10 + 20 = 2 x 3 = 200 x 20 % GT SW: Off 100 + 200 =	 G G G G G G G	0. 10. 30.000 2. 6.000 200. 40.000 100. 300.000

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		GT SW: On		
	–200,000,000,000	200000000000 +/–	G	–200,000,000,000.
	= –200,000,000,000	=	G	–199,999,999,800.
	960 + 4	960 +	G	960.
	=964	4 =	G	964.000
	GT	GT	G	–199,999,998,760.
	= –199,999,998,460	GT		–199,999,998,760.
Store GT memory calculation	TAB SW: 3, GT SW: Off, Round SW: CUT			
		C		0.
	1 ÷ 3 GT+	Round SW: CUT		
	100 ÷ 6 GT+	1 ÷		1.
	1,000 ÷ 3 GT-	3 GT+	G	0.333
	GT =			
		100 ÷	G	100.
		6 GT+	G	16.666
		Round SW: UP		
		1000 ÷	G	1,000.
		3 GT-	G	333.334
		GT	G	–316.335
		GT		–316.335
		GT		–316.335
Mark up calculation	TAB SW: 2, GT SW: Off, Round SW: 5/4			
	Cost: 9,000	C		0.
	Profit rate: 20%	9000 x		9,000.
	Selling price	20 MU		11,250.00
	= 9,000 ÷ (1 – 20 ÷ 100)	MU		2,250.00
	=11,250			
Mark down calculation	Selling price: 2,400	C		0.
	Profit rate: 20%	2400 ÷		2,400.
	Cost	20 MU		2,000.00
	= 2,400 ÷ (1+ 20 ÷ 100)	MU		400.00
	=2,000			
Delta percent calculation	TAB SW: 2, GT SW: Off, Round SW: 5/4			
	Original value: 15,000	C		0.
	New value: 18,000	1.		
	Increment rate	18000 ÷		18,000.
	= (18,000 – 15,000) ÷ 15,000 x 100	15000 Δ%		20.00
	= 20 %	2.		
		18000 –		18,000.
		15000 MU		20.00
Constant calculation	TAB SW: 1, GT SW: Off, Round SW: 5/4			
1. Multiplication		C		0.
		TAB SW: 6		
	2 x 3 = 6	2 x		2.
	2 x 10 = 20	3 =		6.000000
	2 x 20 = 40	10 =		20.000000
		20 =		40.000000
2. Division		TAB SW: 5		
	36 ÷ 3 = 12	36 ÷		36.
	24 ÷ 3 = 8	3 =		12.00000
	6 ÷ 3 = 2	24 =		8.00000
		6 =		2.00000

Preliminary

3. Percent	 1,500 x 15 % = 225 1,500 x 30 % = 450 1,500 x 3 % = 45 200 ÷ 3 % = 6,666.7 1,500 ÷ 3 % = 50,000.0 300 ÷ 3 %= 10,000.0	TAB SW: 4 1500 x 15 % 30 % 3 % TAB SW: 1 200 ÷ 3 % 1500 % 300 %	 1,500. 225.0000 450.0000 45.0000 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.
5. Mark down	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
Overflow	TAB SW: 2, GT SW: Off, Round SW: CUT		
1. Addition and Subtraction calculation	 – 600,000,000,000 – 600,000,000,000 = – 1,200,000,000,000 E 400,000,000,000 + 400,000,000,000 – 400,000,000,000 – 400,000,000,000 + 400,000,000,000 + 400,000,000,000 = 1,200,000,000,000 E	C 600000000000 +/- – 600000000000 = C/CE C/CE 400000000000 + 400000000000 – 400000000000 – 400000000000 + 400000000000 + 400000000000 + 400000000000 = CE	0. –600,000,000,000. –600,000,000,000. E –1.20000000000 –1.20000000000 0. 400,000,000,000. 800,000,000,000. 400,000,000,000. 0. 400,000,000,000. 800,000,000,000. E 1.20000000000 1.20000000000
2. Multiplication and Division calculation	 100,000,000,000 x 200 = 20,000,000,000,000 E 123,000,000,000 ÷ 0.001 = 123,000,000,000,000 E	C 100000000000 x 200 = C 123000000000 ÷ 0.001 = C	0. 100,000,000,000. E 20.0000000000 0. 123,000,000,000. 123.000000000 E 0.
3. Division by zero	 1 ÷ 0 = 0. E	C 1 ÷ 0 =	0. 1. E 0.

Preliminary

4. Store (M, MII & GT) memory calculation	800,000,000,000 M+ M+ E M = 800,000,000,000	C 800000000000 M+ M+ C RM CM		M ME M M	0. 800,000.000.000. 1.60000000000 0. 800,000,000,000. 800,000,000,000.
5. GT memory calculation	900,000,000,000 = 900,000,000,000 = E	GT SW: On 900000000000 = 900000000000 = C GT GT		G GE G G	900,000,000,000. 1.80000000000 0. 900,000,000,000. 900,000,000,000.
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+ C 5 Rate TAX+		Rate Rate Rate Rate	0. 0. TAX% 5. 0. 5. TAX% 5.
	2. Switch mode.	C 5 TAX+		Rate	0. TAX% 5.
2. TAX rate recall	1. Key mode.	C Rate TAX–		Rate	0. 0. TAX% 5.
	2. Switch mode.	C TAX–			0. TAX% 5.
3. TAX+ calculation	TAX rate: 5%	C 800 TAX+ TAX+ TAX+		TAX+ TAX TAX+	0. 800. 840.00 40.00 840.00
4. TAX– calculation	TAX rate: 5%	C 840 TAX– TAX– TAX–		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+ =		TAX+ TAX+ TAX	0. 100. 1,200.00 1,300. 2,400.00 400.00 1,700.00
6. Calculation including TAX– values	TAX rate: 20%	C 100 + 2400 TAX– + 3600 TAX– TAX– =		TAX– TAX– TAX	0. 100. 2,000.00 2,100. 3,000.00 600.00 2,700.00

Preliminary

Exchange rate setting to Euro and currency (C1~C5)	Option: PreRate				
	1. Key mode	C			0.
		5 Rate	Rate		5.
		Euro	Rate	Euro	5.
		C			
		Rate	Rate	Euro	0.
		→ → →	Rate		0.
		Euro	Rate		1.95583
		C			1.95583
		Rate	Rate	2nd	0.
		→	Rate	C1	0.
		2nd	Rate		13.7603
		C1	Rate	2nd	13.7603
		C		2nd	13.7603
		2nd		2nd	0.
		Rate	Rate	C2	0.
		10	Rate		0.
		C2	Rate		10.
		C			10.
		20		2nd	0.
		Rate	Rate	C3	20.
		2nd	Rate		20.
		C3	Rate		20.
					20.
	2. Switch mode: Rate	C			0.
		→	Rate		13.7603
		Euro	Rate	Euro	13.7603
		C			0.
		20			20.
		→ → →	Rate		1.95583
		2nd	Rate	2nd	1.95583
		C1	Rate	C1	1.95583
		C			0.
		2nd		2nd	0.
		30		2nd	30.
		C4	Rate	C4	30.
	3. Switch mode: 2nd	C			0.
		Rate	Rate		0.
		2	Rate		2.
		Euro	Rate	Euro	2.
		C			0.
		Rate	Rate		0.
		→ → →	Rate		1.95583
		5	Rate		5.
		C1	Rate	C1	5.
		C			0.
		Rate	Rate		0.
		40	Rate		40.
		C5	Rate	C5	40.
Exchange rate recall	1. Key mode	C			0.
		Rate	Rate		0.
		Local	Rate	Euro	2.
		Rate	Rate		0.
		C1	Rate	C1	5.
		C			0.
		100			100.
		Rate	Rate		100.
		C2	Rate	C2	10.

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	2. Switch mode: Rate	C			0.
		123			123.
		Local	Rate	Euro	2.
		C			0.
		C3	Rate	C3	20.
		C			0.
		→	Rate		13.7603
		C4	Rate	C4	30.
		C			0.
		C5	Rate	C5	40.
Euro → Local conversion	TAB SW: 2, GT SW: Off, Round SW: CUT				
	Euro Rate: 1.23456	C			0.
		1000			1,000.
		Local		Local	1,234.56
		Local		Local	1,234.56
		Euro		Euro	1,000.
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
	2. Switch mode: 2nd	C			0.
	Round SW:UP	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

Preliminary

Calculation	TAB SW: 2, GT SW: Off, Round SW: 5/4			
including values	Switch SW: 2nd	C		0.
conversion	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

Preliminary

ABOLUTE MAXIMUM RATINGS

Items	Sym.	Min.	Max.	Unit
Supply Voltage	VDD-VSS	-0.3	2.0	V
Input Voltage	V_{IN}	-0.3	VDD+0.3	V
Operating Temperature	T_{OP}	0	50	^{O}C
Storage Temperature	T_{STG}	-55	+125	^{O}C

DC ELECTRICAL CHARACTERISTICS

(VDD=1.5V±0.3V, VSS=0V, TA=25 ^{o}C, VEE=3.0±0.4V)

Parameter	Pin Name	Sym.	Min.	Typ.	Max.	Unit	Condition
Operating Voltage	-	V_{DD}	1.2	1.5	1.8	V	
"1" Input Voltage	K3~K10	$V_{IH}(1)$	V_{DD}-0.4	-	V_{DD}	V	
"1" Input Voltage	K11~K14	$V_{IH}(2)$	V_{EE}-0.4	-	V_{EE}	V	
"0" Input Voltage	K3~K14	$V_{IL}(1)$	0	-	0.4	V	
"1" Input Voltage	RESET	$V_{IH}(3)$	0.6 V_{DD}	-	V_{DD}	V	VDD=1.5V
"0" Input Voltage	RESET	$V_{IL}(2)$	0	-	0.4 V_{DD}	V	VDD=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	
"1" Output Resistance	SEGMENT COM1~3	R_{OH}	-	-	70	KΩ	V_{OUT}= V_{EE}-0.5V
"0" Output Resistance	SEGMENT COM1~3	R_{OL}	-	-	70	KΩ	V_{OUT}= 0.5V

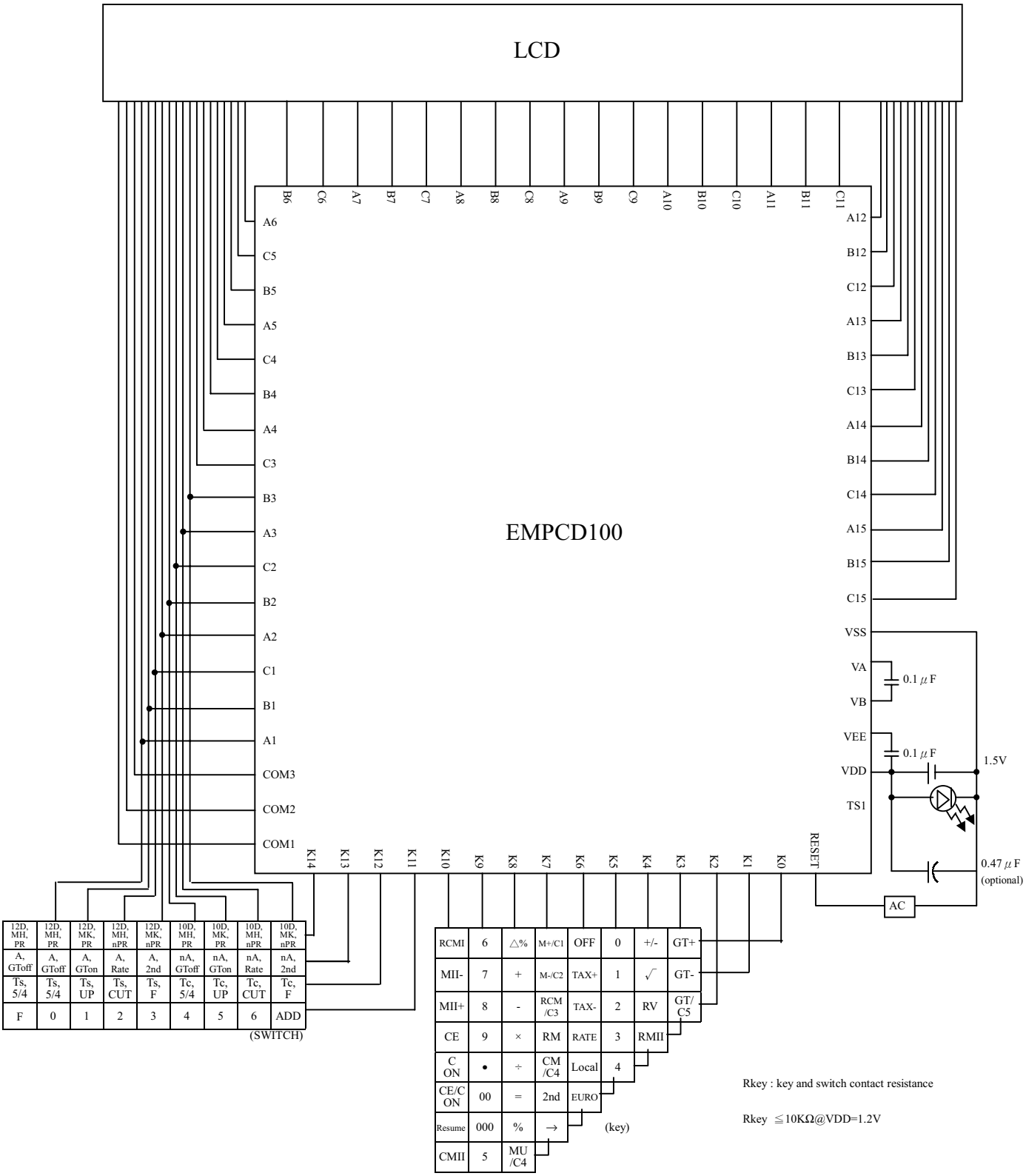
Preliminary

Parameter	Name	Sym.	Min.	Typ.	Max.	Unit	Condition
Key Pull Down Resistance	K0~K10	$R_{KEYL}(1)$	240	-	650	KΩ	$V_{OUT}= V_{DD}$
Key Pull Up Resistance	K0~K7	$R_{KEYH}(1)$	-	-	10	KΩ	$V_{OUT}= 0.5V$
	RESET	$R_{KEYH}(2)$	50	-	370	KΩ	$V_{OUT}= 0.5V$
Switch Pull Down Resistance	K11~K14	$R_{SW}(1)$	240	400	800	KΩ	$V_{OUT}= V_{EE}$
Oscillating Frequency	(Wait) TS1	$F0_{WAIT}$	15.7	22.5	29.3	KHz	
	(Operate) TS1	$F0_{OP}$	100	195	290	KHz	
Frame Frequency	SEGMENT COM1~3	f_F	70	117	164	Hz	
Supply Current	1 (WAIT)	I_{DDWAIT}	-	3.0	4.5	μA	$V_{DD}= 1.5V$
	2 (OPERATE)	I_{DDOP}	-	22	35	μA	$V_{DD}= 1.5V$
	3 (OFF)	I_{DDOFF}	-	-	1.0	μA	$V_{DD}= 1.5V$

Preliminary

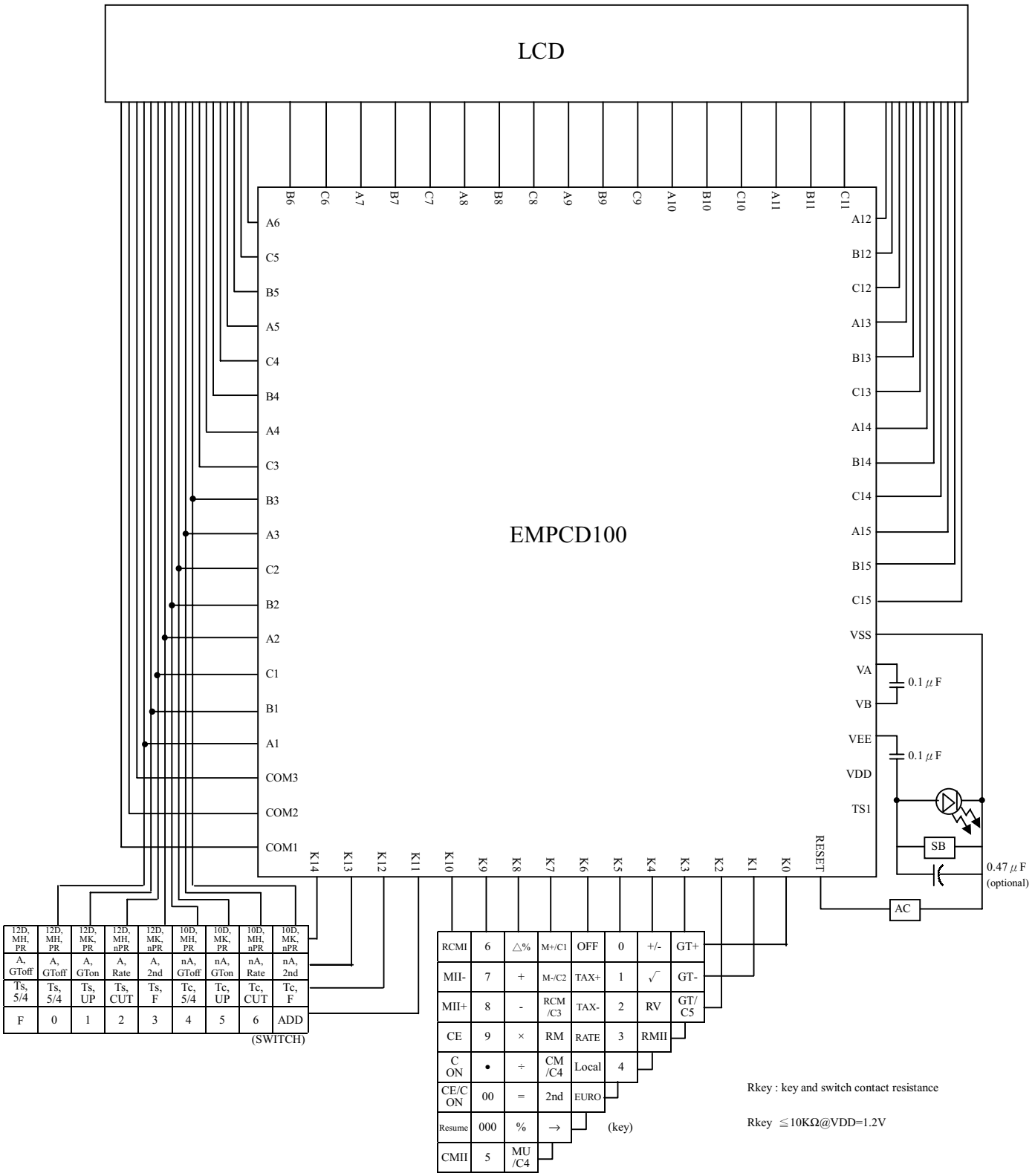
APPLICATION BLOCK DIAGRAM

- Battery Type



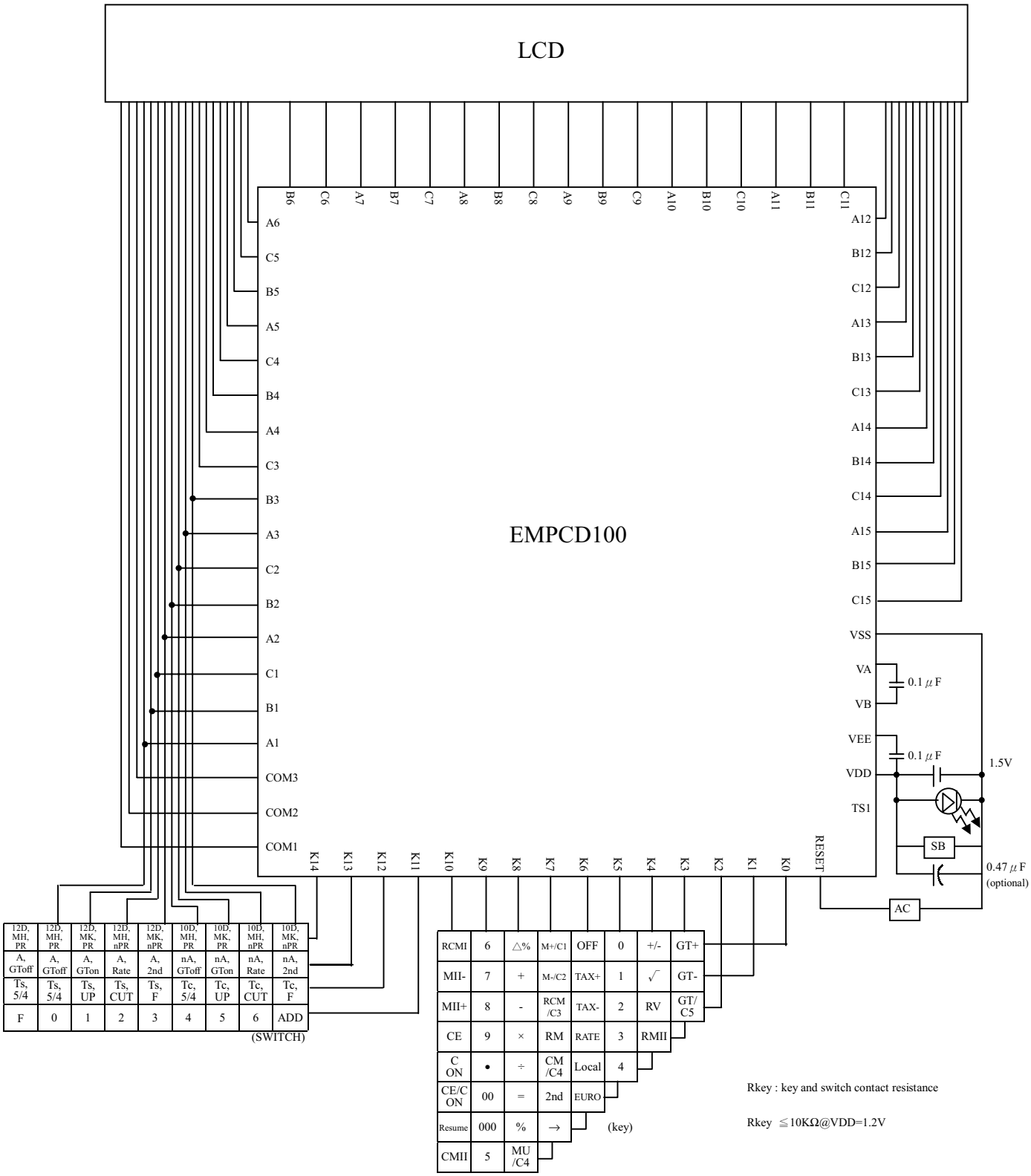
Preliminary

- Solar Type



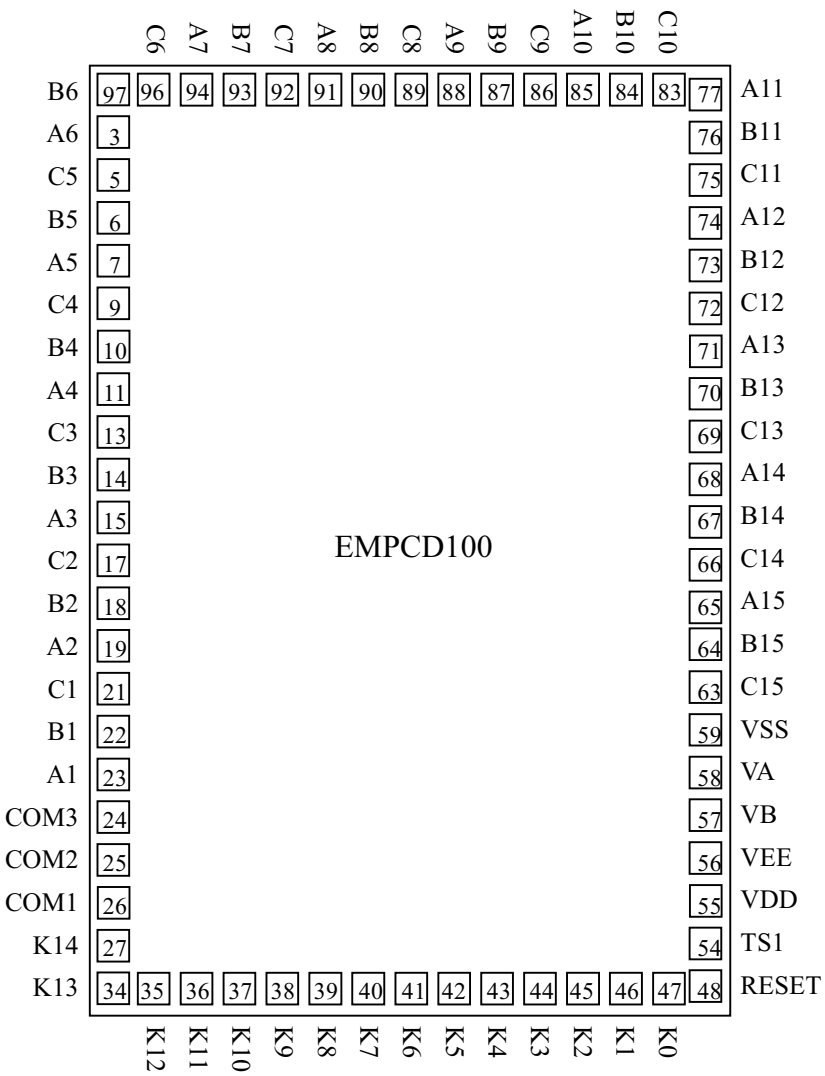
Preliminary

- Dual Type



Preliminary

PAD DIAGRAM



Preliminary

Pad No.	Symbol	X	Y
1	NC		
2	NC		
3	A6	-770.0	1035.0
4	NC		
5	C5	-770.0	920.0
6	B5	-770.0	805.0
7	A5	-770.0	695.0
8	NC		
9	C4	-770.0	585.0
10	B4	-770.0	475.0
11	A4	-770.0	367.5
12	NC		
13	C3	-770.0	262.5
14	B3	-770.0	157.5
15	A3	-770.0	52.5
16	NC		
17	C2	-770.0	-52.5
18	B2	-770.0	-157.5
19	A2	-770.0	-262.5
20	NC		
21	C1	-770.0	-367.5
22	B1	-770.0	-475.0
23	A1	-770.0	-585.0
24	COM3	-770.0	-695.0
25	COM2	-770.0	-805.0
26	COM1	-770.0	-920.0
27	K14	-770.0	-1035.0
28	NC		
29	NC		
30	NC		
31	NC		
32	NC		
33	NC		
34	K13	-770.0	-1160.0
35	K12	-645.0	-1160.0
36	K11	-535.0	-1160.0
37	K10	-425.0	-1160.0
38	K9	-317.5	-1160.0
39	K8	-210.0	-1160.0
40	K7	-105.0	-1160.0

Preliminary

Pad No.	Symbol	X	Y
41	K6	0.0	-1160.0
42	K5	105.0	-1160.0
43	K4	210.0	-1160.0
44	K3	317.5	-1160.0
45	K2	425.0	-1160.0
46	K1	535.0	-1160.0
47	K0	645.0	-1160.0
48	RESET	770.0	-1160.0
49	NC		
50	NC		
51	NC		
52	NC		
53	NC		
54	TS1	770.0	-1035.0
55	VDD	770.0	-920.0
56	VEE	770.0	-805.0
57	VB	770.0	-695.0
58	VA	770.0	-585.0
59	VSS	770.0	-475.0
60	NC		
61	NC		
62	NC		
63	C15	770.0	-367.5
64	B15	770.0	-262.5
65	A15	770.0	-157.5
66	C14	770.0	-52.5
67	B14	770.0	52.5
68	A14	770.0	157.5
69	C13	770.0	262.5
70	B13	770.0	367.5
71	A13	770.0	475.0
72	C12	770.0	585.0
73	B12	770.0	695.0
74	A12	770.0	805.0
75	C11	770.0	920.0
76	B11	770.0	1035.0
77	A11	770.0	1160.0
78	NC		
79	NC		
80	NC		

Preliminary

Pad No.	Symbol	X	Y
81	NC		
82	NC		
83	C10	645.0	1160.0
84	B10	535.0	1160.0
85	A10	425.0	1160.0
86	C9	317.5	1160.0
87	B9	210.0	1160.0
88	A9	105.0	1160.0
89	C8	0.0	1160.0
90	B8	-105.0	1160.0
91	A8	-210.0	1160.0
92	C7	-317.5	1160.0
93	B7	-425.0	1160.0
94	A7	-535.0	1160.0
95	NC		
96	C6	-645.0	1160.0
97	B6	-770.0	1160.0
98	NC		
99	NC		
100	NC		

Chip size:1800 x 2580 um

Note : For PCB layout, IC substrate must be connected to VSS.