



TC8490D 10/12 DIGIT CALCULATOR

General Description :

TC8490D is a CMOS calculator. It can drive the 12-digits or 10-digits liquid crystal display (LCD) with single power supply. At the single power supply operation that is wide operating voltage and lower power consumption for 1.5V solar battery operated calculator.

Feature :

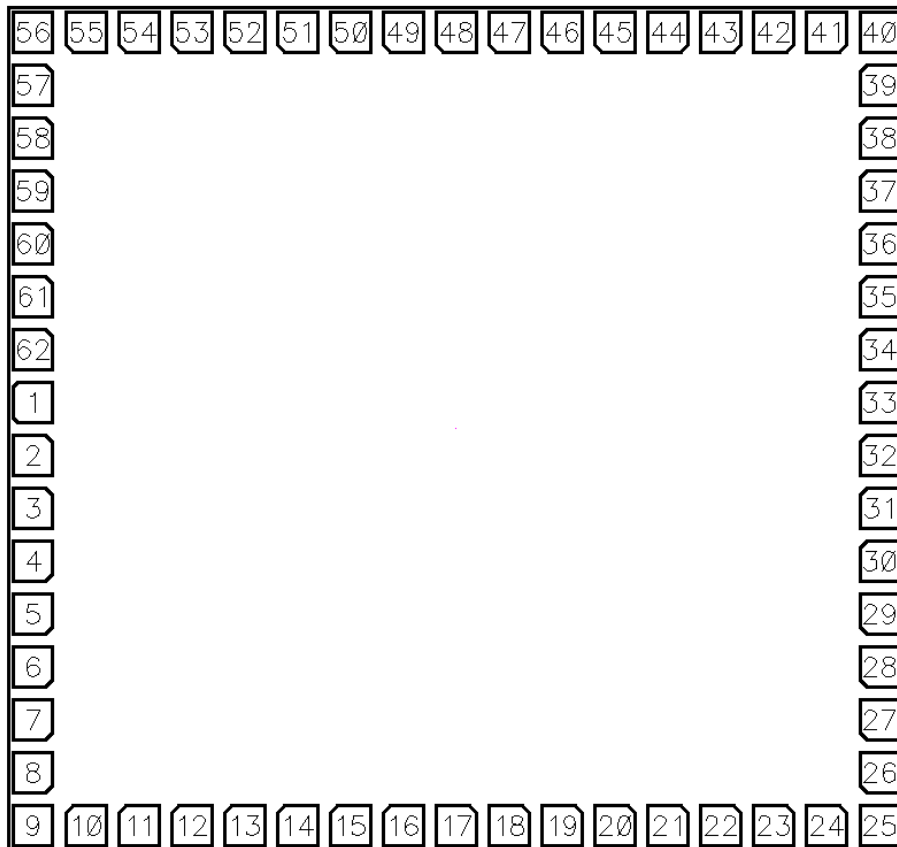
- ◆ Four standard function addition, subtraction, multiplication, division .
- ◆ Square root, Change sign, Chain calculation, Constant calculation.
- ◆ Memory and Grand total calculation.
- ◆ Delta percentage, mark-up and mark-down operations.
- ◆ Percentage operation with add-on discount.
- ◆ GT memory register with count up or count down item counter.
- ◆ Floating calculation selected with a switch.
- ◆ Fixed point 0,1,2,3,4,6 selected with a switch.
- ◆ Adding point selected with a switch.
- ◆ Delta rounding up,down,5/4 selected with a switch.
- ◆ Input overflow will show error.
- ◆ During calculation overflow will show error.
- ◆ Memory overflow will show error.
- ◆ Voltage 1.1V ~ 1.8V.
- ◆ Oscillator off $I_{DD}=1\mu A$ (MAX.)
- ◆ Low power $I_{DD}=2.6\mu A$ (TYP.) when oscillator at waiting mode.

PIN Description :

| NO. | PIN NAME | I/O | PH/PL | FUNCTION DESCRIPTION |
|------------|-----------------|------------|--------------|--|
| 1 | SIG1 | O | | Control LCD signal |
| 2 | C12 | O | | Control LCD signal |
| 3 | B12 | O | | Control LCD signal |
| 4 | A12 | O | | Control LCD signal |
| 5 | C11 | O | | Control LCD signal |
| 6 | B11 | O | | Control LCD signal |
| 7 | A11 | O | | Control LCD signal |
| 8 | C10 | O | | Control LCD signal |
| 9 | B10 | O | | Control LCD signal |
| 10 | A10 | O | | Control LCD signal |
| 11 | C9 | O | | Control LCD signal |
| 12 | B9 | O | | Control LCD signal |
| 13 | A9 | O | | Control LCD signal |
| 14 | C8 | O | | Control LCD signal |
| 15 | B8 | O | | Control LCD signal |
| 16 | A8 | O | | Control LCD signal |
| 17 | C7 | O | | Control LCD signal |
| 18 | B7 | O | | Control LCD signal |
| 19 | A7 | O | | Control LCD signal |
| 20 | C6 | O | | Control LCD signal |
| 21 | B6 | O | | Control LCD signal |
| 22 | A6 | O | | Control LCD signal |
| 23 | C5 | O | | Control LCD signal |
| 24 | B5 | O | | Control LCD signal |
| 25 | A5 | O | | Control LCD signal |
| 26 | C4 | O | | Control LCD signal |
| 27 | B4 | O | | Control LCD signal |
| 28 | A4 | O | | Control LCD signal |
| 29 | C3 | O | | Control LCD signal |
| 30 | B3 | O | | Control LCD signal and function key input |
| 31 | A3 | O | | Control LCD signal and function key input |
| 32 | C2 | O | | Control LCD signal and function key input |
| 33 | B2 | O | | Control LCD signal and function key input |
| 34 | A2 | O | | Control LCD signal and function key input |
| 35 | C1 | O | | Control LCD signal and function key input |
| 36 | B1 | O | | Control LCD signal and function key input |
| 37 | A1 | O | | Control LCD signal and function key input |
| 38 | COM3 | O | | Common 3 to LCD |
| 39 | COM2 | O | | Common 2 to LCD |
| 40 | COM1 | O | | Common 1 to LCD |
| 41 | OP3 | I | | Select calculated digits and MH,MK,GTH,GTK |
| 42 | OP2 | I | | Select Auto Power Off or Manual Power Off and show Grand Total or don't show Grand Total |
| 43 | OP1 | I | | Select rounding Down,Up,5/4 |
| 44 | OP0 | I | | Select Fixed point or Floating mode |
| 45 | KIN10 | I | PL | Input key |
| 46 | KIN9 | I | PL | Input key |
| 47 | KIO8 | I/O | | Clock out and lock key data |

| | | | | |
|----|-------|-----|----|-----------------------------|
| 48 | KIO7 | I/O | | Clock out and lock key data |
| 49 | KIO6 | I/O | | Clock out and lock key data |
| 50 | KIO5 | I/O | | Clock out and lock key data |
| 51 | KIO4 | I/O | | Clock out and lock key data |
| 52 | KIO3 | I/O | | Clock out and lock key data |
| 53 | KO2 | O | | Clock out |
| 54 | KO1 | O | | Clock out |
| 55 | RESET | I | PH | IC RESET |
| 56 | TEST | O | | TEST PIN |
| 57 | VDD | P+ | | Positive power |
| 58 | VEE | O | | Connect to capacitor |
| 59 | CUP2 | O | | Connect to capacitor |
| 60 | CUP1 | O | | Connect to capacitor |
| 61 | VSS | P- | | Negative power |
| 62 | NC | O | | Test pin |

PAD DIAGRAM :



- (A).CHPI SIZE =1940*1830UM^2
- (B).Substrate don't connect to VDD or VSS.
- (C) PAD SIZE=85*82.6um^2
- (D) PAD Pitch Min.=110um

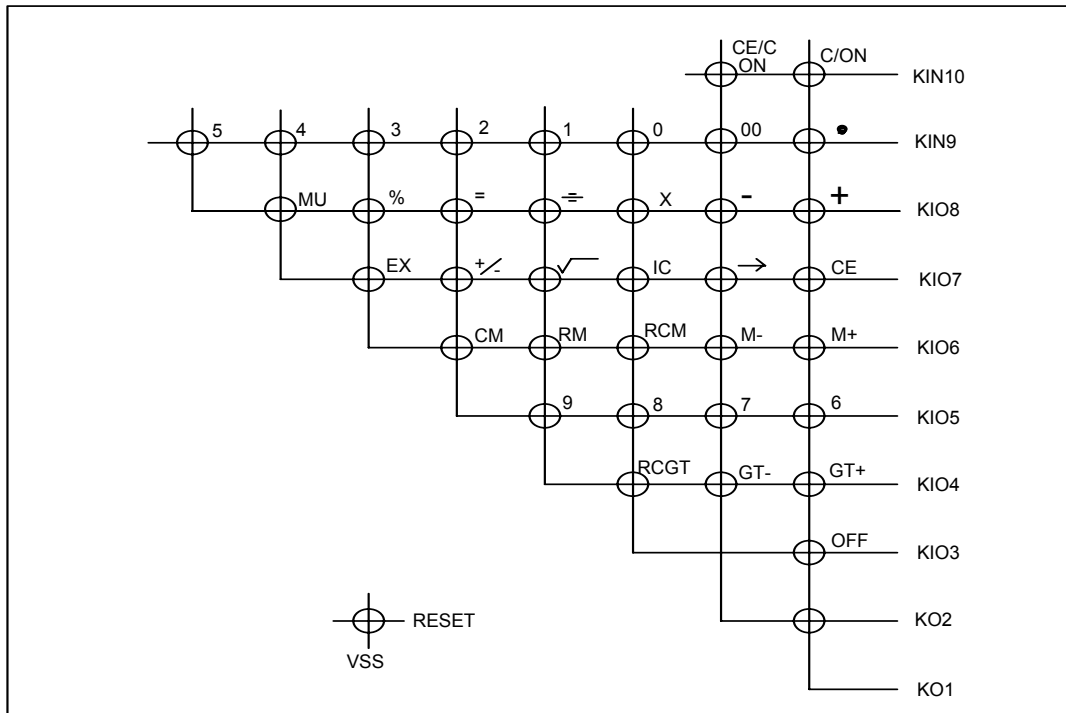
CHPI SIZE =1940*1830UM^2

| PAD NO. | PAD NAME | X | Y | PAD NO. | PAD NAME | X | Y |
|---------|----------|----------|----------|---------|----------|----------|---------|
| 1 | SIG1 | -878.700 | 54.900 | 32 | C2 | 878.700 | -54.900 |
| 2 | C12 | -878.700 | -54.900 | 33 | B2 | 878.700 | 54.900 |
| 3 | B12 | -878.700 | -164.700 | 34 | A2 | 878.700 | 164.700 |
| 4 | A12 | -878.700 | -274.500 | 35 | C1 | 878.700 | 274.500 |
| 5 | C11 | -878.700 | -384.300 | 36 | B1 | 878.700 | 384.300 |
| 6 | B11 | -878.700 | -494.100 | 37 | A1 | 878.700 | 494.100 |
| 7 | A11 | -878.700 | -603.900 | 38 | COM3 | 878.700 | 603.900 |
| 8 | C10 | -878.700 | -713.700 | 39 | COM2 | 878.700 | 713.700 |
| 9 | B10 | -878.700 | -823.700 | 40 | COM1 | 878.700 | 823.700 |
| 10 | A10 | -768.600 | -823.700 | 41 | OP3 | 768.600 | 823.700 |
| 11 | C9 | -658.800 | -823.700 | 42 | OP2 | 658.800 | 823.700 |
| 12 | B9 | -549.000 | -823.700 | 43 | OP1 | 549.000 | 823.700 |
| 13 | A9 | -439.200 | -823.700 | 44 | OP0 | 439.200 | 823.700 |
| 14 | C8 | -329.400 | -823.700 | 45 | KIN10 | 329.400 | 823.700 |
| 15 | B8 | -219.600 | -823.700 | 46 | KIN9 | 219.600 | 823.700 |
| 16 | A8 | -109.800 | -823.700 | 47 | KIO8 | 109.800 | 823.700 |
| 17 | C7 | 0.000 | -823.700 | 48 | KIO7 | 0.000 | 823.700 |
| 18 | B7 | 109.800 | -823.700 | 49 | KIO6 | -109.800 | 823.700 |
| 19 | A7 | 219.600 | -823.700 | 50 | KIO5 | -219.600 | 823.700 |
| 20 | C6 | 329.400 | -823.700 | 51 | KIO4 | -329.400 | 823.700 |
| 21 | B6 | 439.200 | -823.700 | 52 | KIO3 | -439.200 | 823.700 |
| 22 | A6 | 549.000 | -823.700 | 53 | KO2 | -549.000 | 823.700 |
| 23 | C5 | 658.800 | -823.700 | 54 | KO1 | -658.800 | 823.700 |
| 24 | B5 | 768.600 | -823.700 | 55 | RESET | -768.600 | 823.700 |
| 25 | A5 | 878.700 | -823.700 | 56 | TEST | -878.700 | 823.700 |
| 26 | C4 | 878.700 | -713.700 | 57 | VDD | -878.700 | 713.700 |
| 27 | B4 | 878.700 | -603.900 | 58 | VEE | -878.700 | 603.900 |
| 28 | A4 | 878.700 | -494.100 | 59 | CUP2 | -878.700 | 494.100 |
| 29 | C3 | 878.700 | -384.300 | 60 | CUP1 | -878.700 | 384.300 |
| 30 | B3 | 878.700 | -274.500 | 61 | VSS | -878.700 | 274.500 |
| 31 | A3 | 878.700 | -164.700 | 62 | NC | -878.700 | 164.700 |

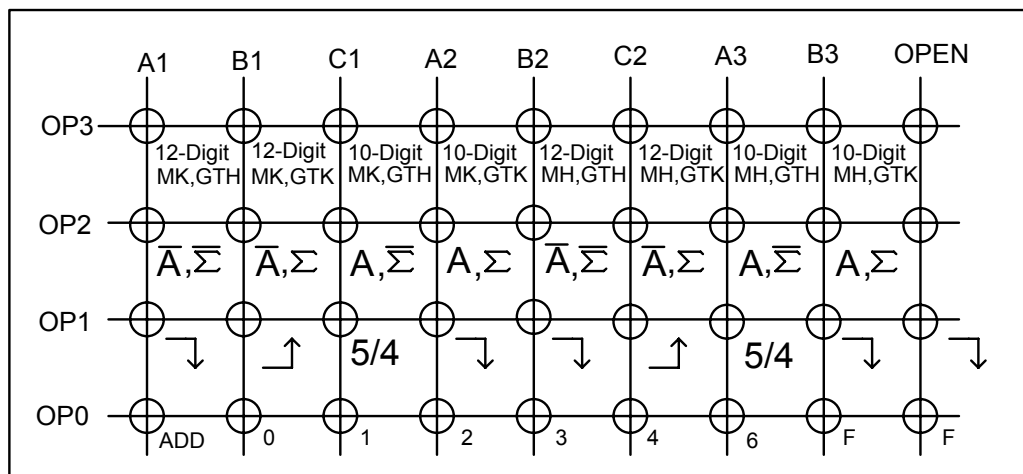
Function Description :

1. Constant Operation : +, -, x, ÷, % .
2. Number key : 0,00,1,2,3,4,5,6,7,8,9.
3. Function key : OFF,GT+,GT-,RCGT,M+,M-,RCM,RM,CM,EX,±,√,IC,
→,CE,MU,C/ON,CE/C/ON
4. Memory Indication : when memory contents are not zero, “MEMORY” is indicated in the sign-digit position.
5. Auto power off : The IC will turn off when no key is depressed for a specific of time, that is 570 sec .
6. Error Conditions :
 - a. The result exceeds 12 digits.
 - b. Memory operation result exceeds 12 digits.
 - c. The mark-up and mark-down calculation result exceeds 12 digits.
 - d. Any number divides a zero.
 - e. The square root of a negative number.
7. Error Release : depress AC key, ON/C key, or RIGHT key.

Key matrix :

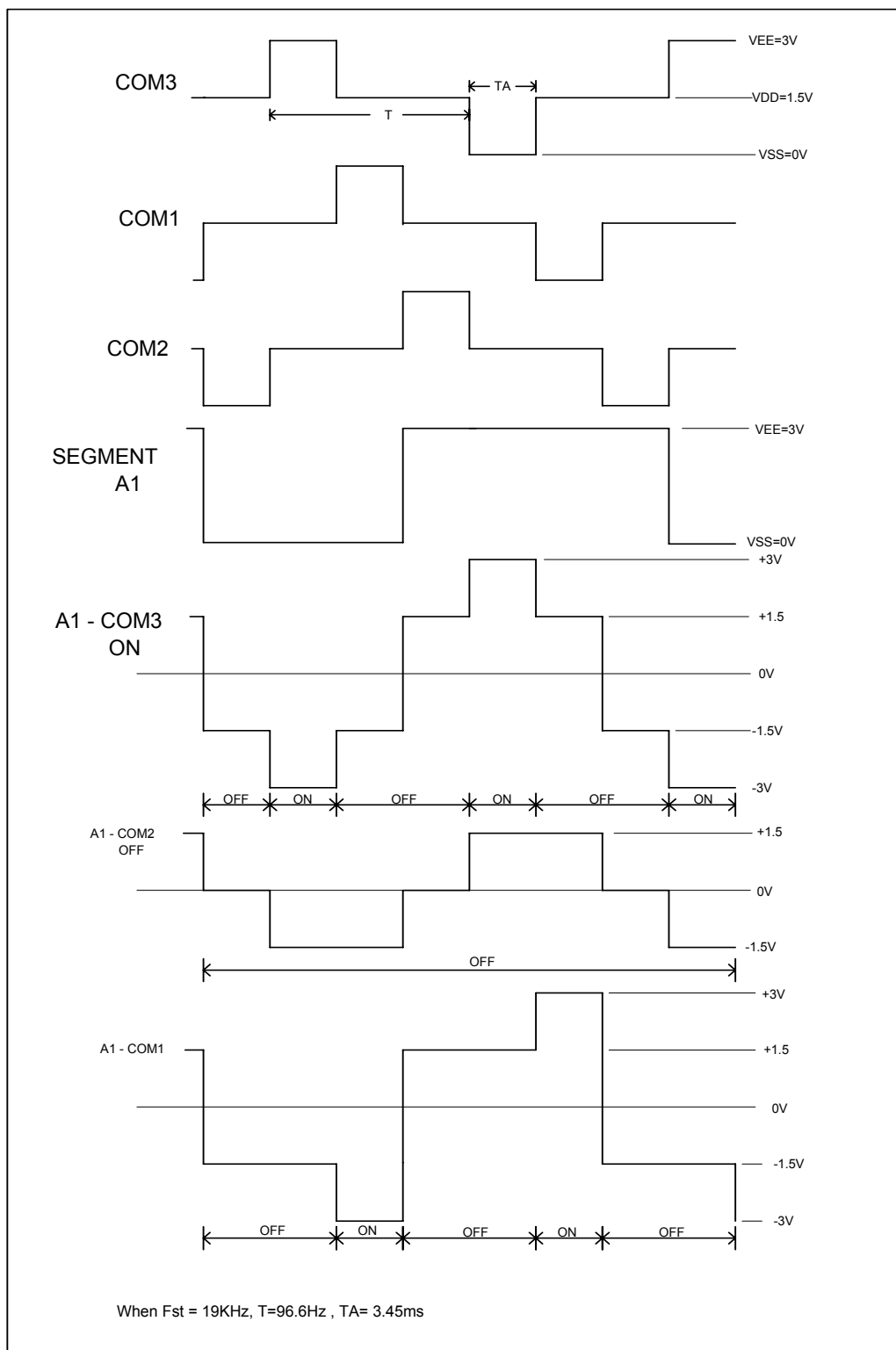


Option Key matrix :



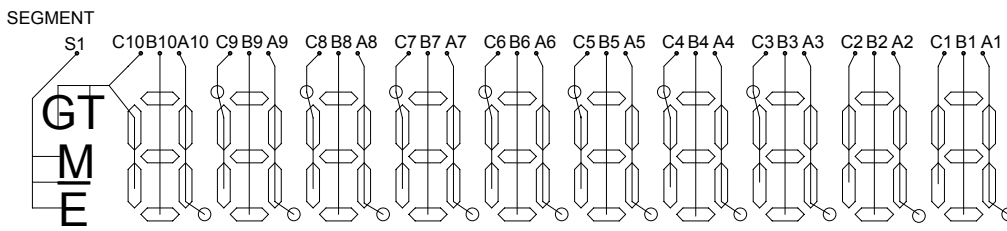
Note : " A " : Auto Power Off
 " Ā " : Don't Auto Power Off
 " Σ " : Show GT
 " Σ̄ " : Don't Show GT

LCD waveforms :

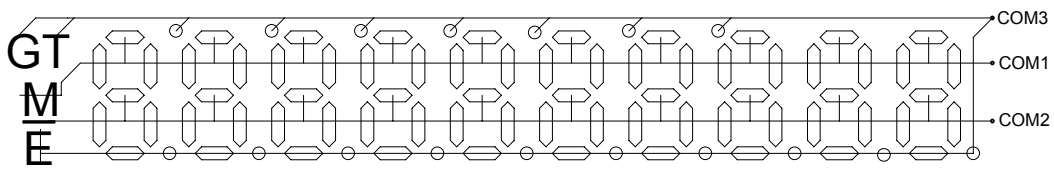


LCD Display

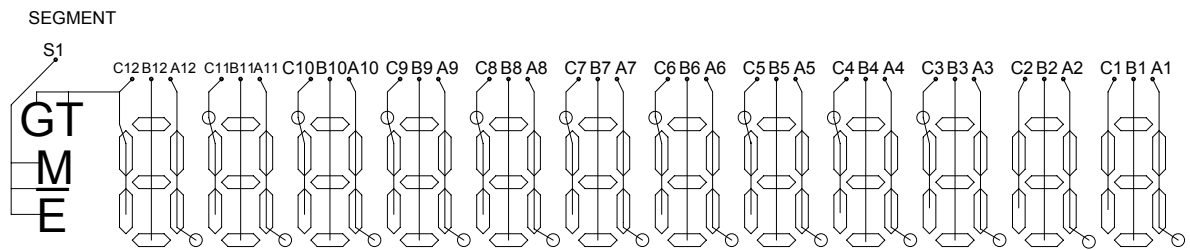
a. 10-digits for LCD



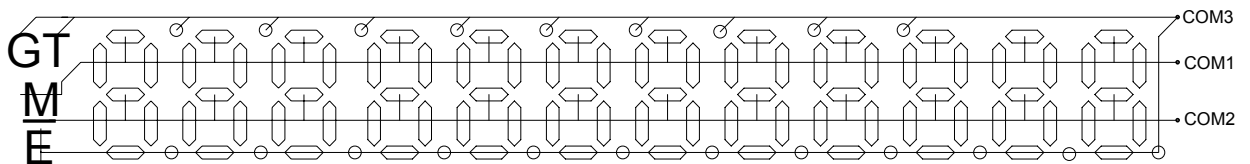
COMMON



b. 12-digits for LCD



COMMON



Option keys are shown in an explanation as following:

| | | | | | |
|----------|----------|----------|----------|----------|------------|
| F | 0 | 2 | 3 | 4 | ADD |
| | | √ | | | |

| | CALCULATION | OPERATION | DISPLAY |
|----------------------|------------------------------|--------------------------|--|
| + | 4-5=-1 | 4 - 5 = | 4. -1.00 |
| | (-3)X2=-6 | - C 3 X 2 = | 0. 3. -3. -6.00 |
| - | (-365)÷7=-52.14 | - C 365 ÷ 7 = | 0. 365. -365. -52.14 |
| | 400X3,345=1,338,000 | C 400 X 3345 = | 0. 400. 1'338'000.00 |
| ÷ | 400X56=22,400 | 56 = | 22'400.00 |
| | 32,560÷300=108.53 | 32560 ÷ 300 = | 32'560. 108.53 |
| | 12,345÷300=41.15 | 12345 = | 41.15 |
| n X | ³ 5 =125 | 5 x = = | 5. 25.00 125.00 |
| 1/X | 1/5=0.2 | 5 ÷ = | 5. 0.20 |
| CE | 23x789=18,147 | 23 x 489 CE 789 = | 23. 789. 18'147.00 |
| % | 1,234x(15/100)=185.10 | 1234 x 15 % | 1'234. 185.10 |
| | (456/789)x100=57.79 | 456 ÷ 789 % | 456. 57.79 |
| % | 2000+(2000x12/100) =2,240 | 2000 x 12 % + = | 2'000. 240.00 240.00 2'240.00 |
| | 2000-(2000x12/100) =1,760 | 2000 x 12 % - = | 2'000. 240.00 240.00 1'760.00 |

| | CALCULATION | OPERATION | DISPLAY |
|------------|---------------------------|------------------|----------------|
| M+ | 123x12=1,476 | (CM) 123 x | 123. |
| | +)456x25=11,400 | 12 M+ | M 1'476.00 |
| M+ | 12,876 | 456 x | M 456. |
| | -)456x16=7296 | 25 M+ | M 11'400.00 |
| RM | 5580 | RM | M 12'876 |
| | | 456 x | M 456. |
| M- | | 16 M- | M 7'290.00 |
| RCM | | RCM | M 5580 |
| | | RCM | 5580. |
| MU | 45÷(1-10/100)=50 | 45 ÷ | 45. |
| | | 10 MU | 50.00 |
| | | MU | 5.00 |
| √ | √16 =4 | 16 | 16. |
| | | √ | 4. |
| | | = | 4.00 |
| | 20 x √9 ÷ 2 =30 | 20 x | 20. |
| | | 9 √ | 3. |
| | | ÷ | 60. |
| | | 2 = | 30.00 |
| EX | $\frac{3}{1+2+3+4} = 0.3$ | 1 + | 1. |
| | | 2 + | 3. |
| | | 3 + | 6. |
| | | 4 + | 10. |
| | | ÷ | 10. |
| | | 3 | 3. |
| | EX | 10. | |
| | = | 0.30 | |
| GT | 100+200+300=600 | 100 + | 100. |
| | +) 300+400+500=1200 | 200 + | 300. |
| | +) 500-600+700=600 | 300 + | 600. |
| | | = | GT 600.00 |
| | Grand Total = 2400 | 300 + | GT 300. |
| | | 400 + | GT 400. |
| | | 500 + | GT 500. |
| | | = | GT 1'200.00 |
| | | 500 - | GT 500. |
| | | 600 + | GT -100. |
| | | 700 + | GT 600. |
| | | = | GT 600.00 |
| | GT | GT 2'400. | |
| | GT | 2'400. | |

Absolute ratings :

| ITEM | DESCRIPTION | SYMBOL | RATINGS | UNIT |
|-----------------------|-------------|---------|-----------|------|
| Supply Voltage | | VDD-VSS | 1.1 ~ 1.8 | V |
| Operating temperature | | Topr | 0 ~ 50 | °C |
| Storage temperature | | Tstg | -55 ~ 125 | °C |

Electronic characteristics :

(VDD=1.5±0.2V, GND(VSS)=0V, TA=25°C, VEE=3.0 ±0.4V)

| ITEM | SYMBOL | CONDITION | MIN | TYPE | MAX | UNIT |
|---|--------|--------------------------|----------|-------|----------|------|
| Supply voltage | VDD | | 1.1 | 1.5 | 1.8 | V |
| Input_high voltage KIO3 ~ KIN10 | VIH | | 0.7VDD | - | VDD | V |
| Input_low voltage KIO3 ~ KIN10,Reset | VIL | | 0 | - | 0.3VDD | V |
| Input_high voltage OP0 ~ OP3 | VIH | | 0.7VDD | - | VEE | V |
| Input_low voltage OP0 ~ OP3 | VIL | | 0 | - | 0.3VEE | V |
| OP0 ~ OP3 Pull_low Resistance | R_PL | VDD=1.5V | 22K | 35K | | Ω |
| LCD Voltage | VEE | VDD=1.5V | 2VDD-0.2 | - | 2VDD+0.2 | V |
| Output voltage "H" SEGMENT and COM1,2,3 | VOH | VDD=1.5V Without load | VEE-0.2 | - | VEE+0.2 | V |
| Output voltage "L" SEGMENT and COM1,2,3 | VOL | VDD=1.5V Without load | 0 | - | 0.2 | V |
| Output voltage "M" COM1,2,3 | VOM | VDD=1.5V Without load | VDD-0.2 | - | VDD+0.2 | V |
| KO1 ~ KIO8 output Low Impedence | Rol | VDD=1.5V | 293K | 625K | 940K | Ω |
| KO1 ~ KIO8 Output High Impedence | Roh | VDD=1.5V | 1.6K | 3.3K | 5K | Ω |
| KIN9 ~ KIN10 Pull_low Resistance | R_PL | VDD=1.5V | 250K | 500K | 750K | Ω |
| Reset Pull_high Resistance | R_PH | VDD=1.5V | 120K | 240K | 360K | Ω |
| Key Resistance | K_RS | VDD=1.5V | - | - | 120K | Ω |
| Output "H" Resistance SEGMENT and COM1,2,3 | ROH | VDD=1.5V | | - | 10K | Ω |
| Output "L" Resistance SEGMENT and COM1,2,3 | ROL | VDD=1.5V | | - | 10K | Ω |
| Sinking current SEGMENT, | IOL | VEE=3.0V Vo=0.5V | - | 1.5 | - | mA |
| DRIVING SEGMENT, | IOH | VEE=3.0V Vo=2.5V | - | 0.7 | - | mA |
| Sinking current COM1,2,3 | IOL | VEE=3.0V Vo=0.5V | - | 0.56 | - | mA |
| DRIVING COM1,2,3 | IOH | VEE=3.0V Vo=2.5V | - | 0.56 | - | mA |
| Oscillator_stand by | Fst | VDD=1.5V | 11.4K | 19.0K | 26.6K | Hz |
| Oscillator_operate | Fop | VDD=1.5V | 84K | 166K | 196K | Hz |
| Frame Frequency SEGMENT,COM | | | 58.0 | 96.6 | 135.2 | Hz |
| IDD_stand by | Idd_st | Oscillator ON | - | 2.6 | 3.4 | uA |
| IDD_operate | Idd_op | Oscillator ON | - | 7.0 | 11.0 | uA |
| IDD | Idd | Oscillator OFF | - | - | 1.0 | uA |
| Auto-Power OFF | T-off | VDD=1.5V | 407 | 600 | 1000 | sec |

Applicatin :

