# IZ12291M

# 10-DIGITS CALCULATOR

The IZ12291M is a single chip CMOS LSI with 10-digit arithmetic operation, single memory, extraction-of-square-root, percentage calculation, auto power off and punctuation , designed for FEM LCD operation with a 1.5V power supply.

## FUNCTIONS

- Four standard functions ( +, -, ×, ÷ )
- Square and reciprocal calculations
- Extraction of square root
- Auto constant calculations (constant: multiplicand, divisor,
  addend and subtrahend)
- Mark-up and mark-down calculations
- Percentage calculations
- Chain multiplication and division
- Power calculations
- Rough estimate calculations
- Punctuation comma and touch tone mark display
- Clear key: ON/C, CE

## FEATURES

- Single chip CMOS construction
- Floating decimal point
- LCD direct drive
- Overflow indication: "E"
- On chip oscillator components
- Auto Power off
- Accumulating memory: M+, M-, MR, MC, MRC
- Bare chip is available
  Mirror type

## LCD CONNECTION



H1 a1 b1 c1 a2 b2 c2 a3 b3 c3 a4 b4 c4 a5 b5 c5 a6 b6 c6 a7 b7 c7 a8 b8 c8 a9 b9 c9 a10 b10 c10 a11 H3 H2
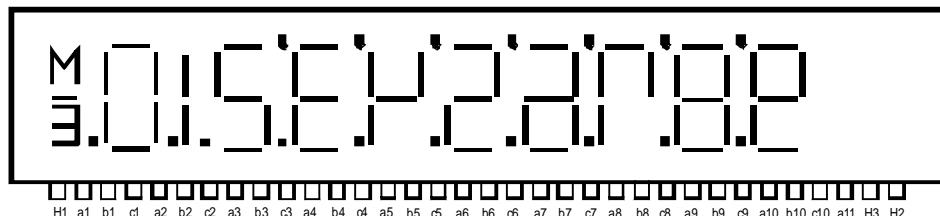
## ABSOLUTE MAXIMUM RATINGS ( $T_a$ = 25$^o$C )

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Terminal Voltage | $V_{CC}$ | - 0.3 ~ + 2.1 | V |
|  | $V_{IN}$ | - 0.3 ~ $V_{CC}$ + 0.3 | V |
| Operating Temperature | $T_a$ | 0 ~ + 50 | $^o$C |
| Storage Temperature | $T_{stg}$ | - 55 ~ + 125 | $^o$C |

## ELECTRICAL CHARACTERISTICS ($T_a$ = 25$^o$C, $V_{CC}$ = 1.5V, unless otherwise specified)

| Characteristic | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{OP}$ |  | 1.1 | 1.5 | 1.8 | V |
| Input Voltage (pins FDISB, EXT) | $V_{IH}$ |  | $V_{CC}$ - 0.4 |  |  | V |
|  | $V_{IL}$ |  |  |  | 0.4 |  |
| Input Current 1 (pins FDISB, EXT) | $I_{IH1}$ | $V_{IN}$ = $V_{CC}$ |  |  | 1 | μA |
|  | $I_{IL1}$ | $V_{IN}$ = 0V | 1.5 | 2.5 | 3 |  |
| Input Current 2 | $I_{IH2}$ | $V_{IN}$ = $V_{CC}$; APODISB = 0V |  |  | 1 | μA |

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| Characteristic | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| (pins K4 ÷ K6) | $I_{IL2}$ | $V_{IN} = 0V$;   FDISB = 0V | 3 | 5.5 | 7.5 | |
| Output Voltage | $V_{OA}$ | Without load | 2.80 | 2.95 | | |
| (pins a1÷a11, b1÷b10, | $V_{OB}$ | Without load | 1.30 | 1.50 | 1.70 | V |
| c1÷c10, H1÷H3) | $V_{OC}$ | Without load | | 0 | 0.20 | |
| Display Frequency | $F_d$ | $V_{CC} = 1.3V$, Display is on | 55 | 75 | | Hz |
| Supply Current | $I_{OFF}$ | Display is off | | | 1 | µA |
| | $I_{DIS}$ | $V_{CC} = 1.3V$, Ddisplay is on | | 6 | 10 | |

## FUNCTIONAL  DESCRIPTION
### Decimal  point  system
Complete floating decimal point system.

### Integral  number
10 digits leading zero suppression. Zero shift.

**Symbols**        **-**  : negative number display

**E** : error display

**,**  : punctuation comma

## Error  detections
• **System errors occur when:**
 1) The division by zero.
 2) The extraction of square root of a negative number.
 3) The integral part of any memory calculation result exceeds 10 digits.
• **Rough  estimate  calculation error occur when**

The integral part of any calculation – any standard functions, percentage, square root, reciprocal or power calculations result exceeds 10 digits.

## Error  indication
• **System error**

"0" is indicated in the 1-digit position and "E" in the sign-digit position.
• **Rough  estimate  calculation  error**

The high-order 10-digit calculation result is indicated together with "E".

The decimal point is indicated if the position corresponding to a calculation result of time $10^{-10}$, and no zero shift is performed

## Error  release
• **System error**

A system error can be release by the ON/C key.
• **Rough  estimate  calculation error**

ON/C key can release a rough estimate-calculation error and clear calculation result at once. CE key can release only a rough estimate calculation error ("E" flag).

## Number  entry
Numericals can be entered up to 10 digits. Numerical entries equal to 11 digits or more are ignored.

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

## Memory indication
If the memory content is not zero, "M" is indicated in the sign-digit position.

## Key bounce protection
**Front edge**
Minimum 3 words
**Trailing edge**
Minimum 16 words
1 word is 3.3ms when display frequency is $F_d$ = 100Hz.

## Auto power OFF
Power automatically turns off after 7 - 8 minutes pass from the last key pressure. By connecting the APODISB pin to GND or $V_{CC}$, the auto power off function is disabled or enabled, respectively.



b1a1   b2a2  c1  b3a3  c2   b4a4  c3   b5a5  c4   b6a6  c5   b7a7  c6   b8a8  c7   b9a9  c8   c9b10a10  c10
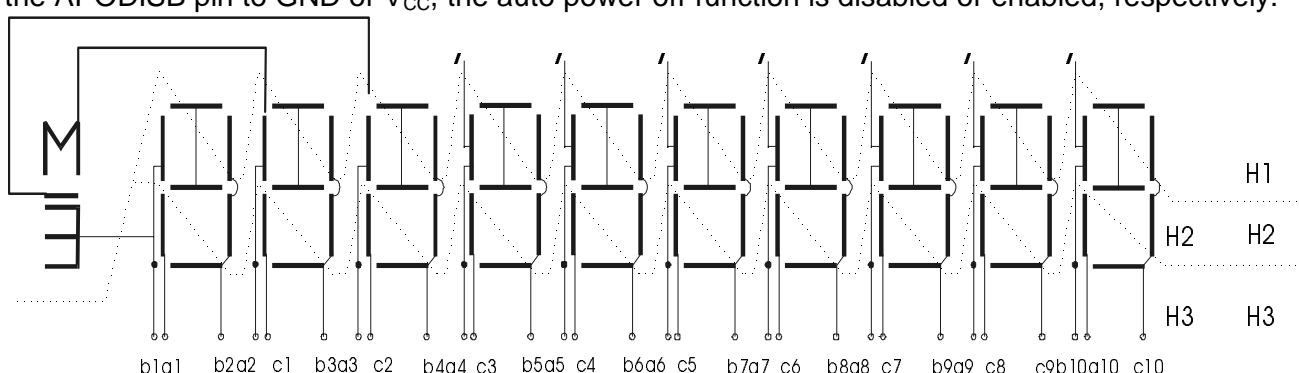
**Mirror LCD with IZ12291M**

## *CLEAR KEY DESCRIPTION*

### ON/C key
• Power-on function.
• All operations are cleared by the ON/C key (except memory contents).

### CE key
• CE key can edit the last operand or operator.

## *MARK-UP AND MARK-DOWN CALCULATION*

| ENTRY | | DISPLAY | |
|---|---|---|---|
| A | A | A | A |
| +/- | × | A | A |
| B | B | B | B |
| % | % | A $\pm$ AM/100 | AM/100 |
| | + OR - | | AM/100 |
| | = | | A + AM/100 OR A − AM/100 |

Note:   AM: AMOUNT

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## APPLICATION CIRCUIT (mirror LCD)
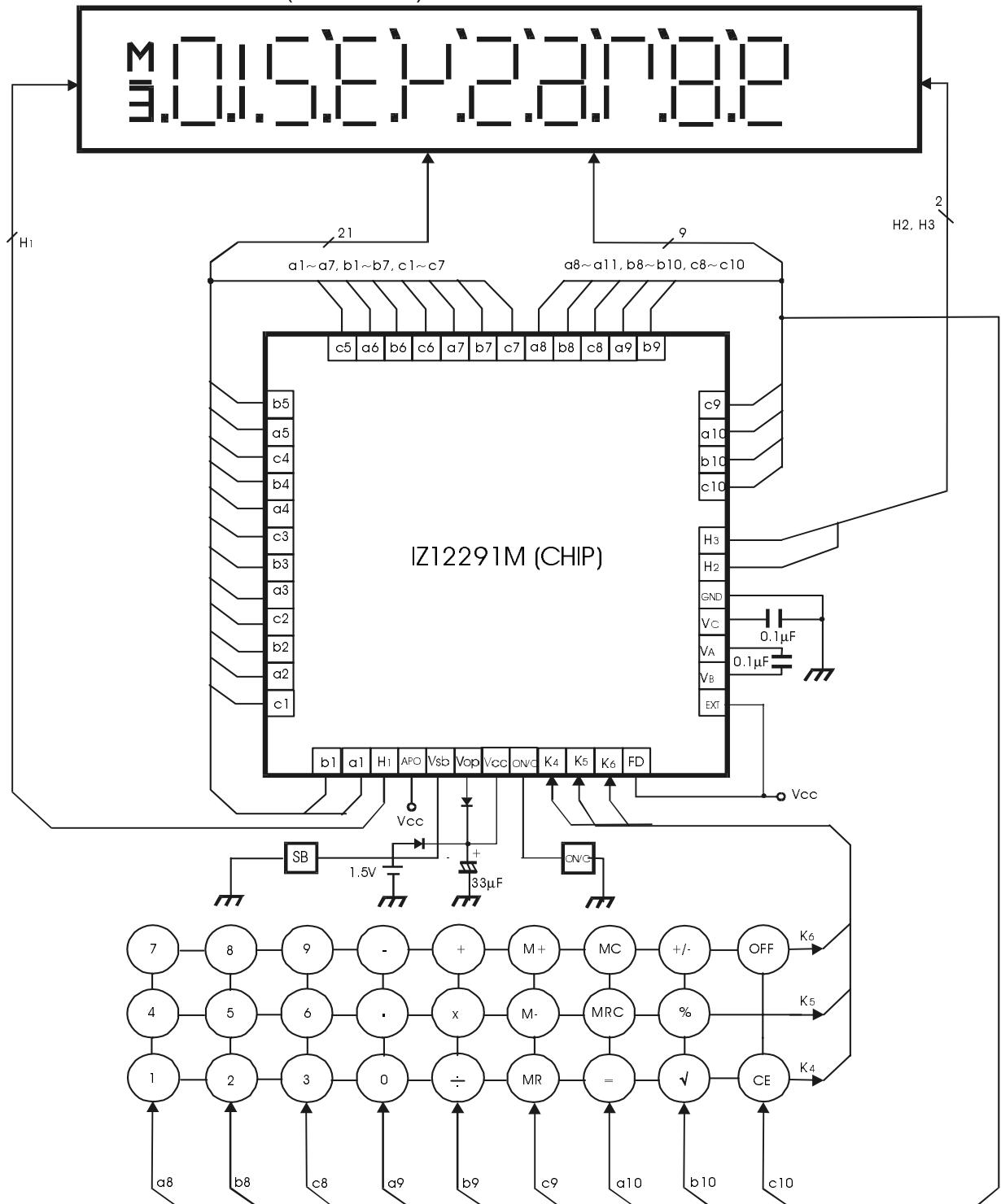


NOTE1:

SB: Solar Battery

AUTO POWER OFF CONDITION

| APODISB | $V_{CC}$ | GND |
|---|---|---|
| APO STATE | ENABLE | DISABLE |

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## PAD DIAGRAM
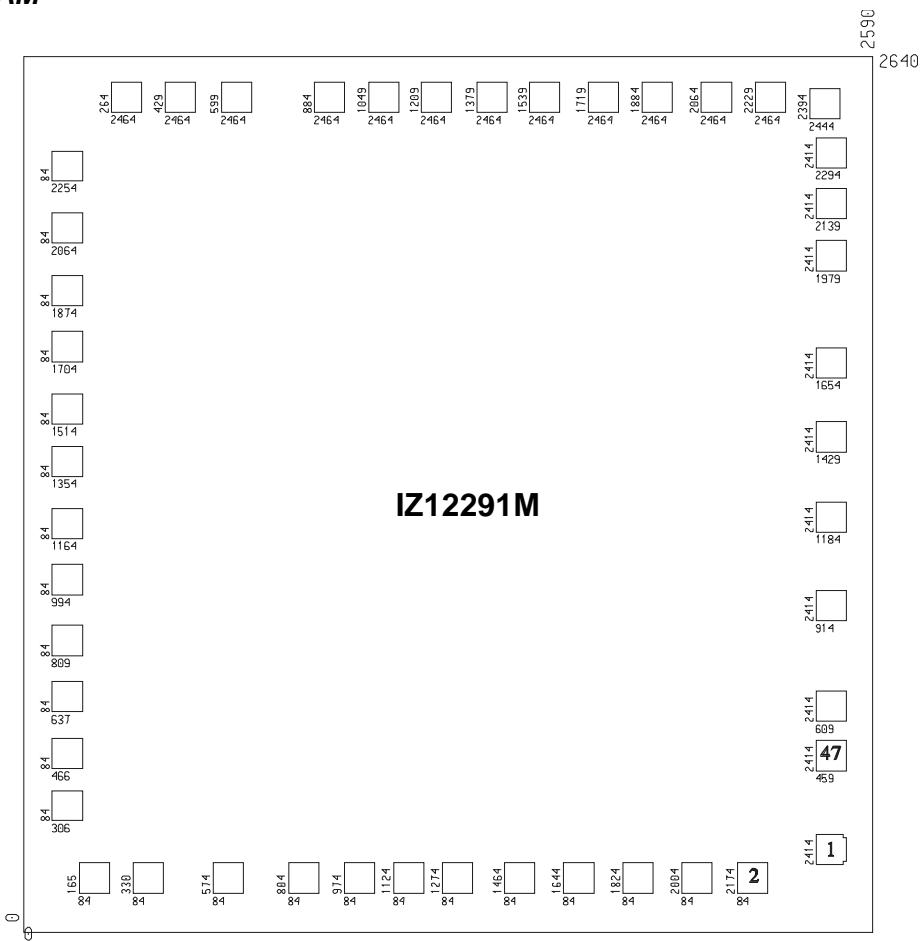


## PAD LOCATION

| Pad No. | Pad Name | Description | Pad No. | Pad Name | Description | Pad No. | Pad Name | Description |
|---|---|---|---|---|---|---|---|---|
| 1 | EXT | External Clock | 17 | c2 | Display output | 33 | a8 | Display output |
| 2 | FD | $F_{OSC}$ Disable | 18 | a3 | Display output | 34 | b8 | Display output |
| 3 | K6 | Key input | 19 | b3 | Display output | 35 | c8 | Display output |
| 4 | K5 | Key input | 20 | c3 | Display output | 36 | a9 | Display output |
| 5 | K4 | Key input | 21 | a4 | Display output | 37 | b9 | Display output |
| 6 | ON/C | Key Input | 22 | b4 | Display output | 38 | c9 | Display output |
| 7 | $V_{CC}$ | Power Supply | 23 | c4 | Display output | 39 | a10 | Display output |
| 8 | $V_{OP}$ | Solar battery | 24 | a5 | Display output | 40 | b10 | Display output |
| 9 | $V_{SB}$ | Option Pin | 25 | b5 | Display output | 41 | c10 | Display output |
| 10 | APO | APO Disable | 26 | c5 | Display output | 42 | H3 | COM3 |
| 11 | H1 | COM1 | 27 | a6 | Display output | 43 | H2 | COM2 |
| 12 | a1 | Display output | 28 | b6 | Display output | 44 | GND | Ground |
| 13 | b1 | Display output | 29 | c6 | Display output | 45 | $V_C$ | Capacitor terminal |
| 14 | c1 | Display output | 30 | a7 | Display output | 46 | $V_A$ | Capacitor terminal |
| 15 | a2 | Display output | 31 | b7 | Display output | 47 | $V_B$ | Capacitor terminal |
| 16 | b2 | Display output | 32 | c7 | Display output | | | |

APO: Output Power OFF

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