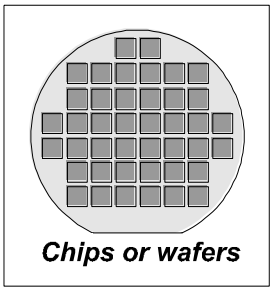
# 5-FUNCTIONS 6-DIGITS WATCH CIRCUIT FOR TRIPLEXED LCD.




The An8112 is a CMOS LSI which contains all the logic necessary to implement a five-function six-digit liquid crystal display watch. The circuit contains an oscillator amplifier with an internal feedback resistor for the use of 32,768Hz quartz crystals. The circuit operates from a single 1.5-volt battery and contains an internal voltage doublet. Only 2 switches are required to control all functions. These switch inputs have a pull down resistor and can debunked by internal circuitry.

## FUNCTIONS

- 5-functions: Month, Date, Hour, Minute and Second
- 12-hour format.
- Selectable display for hour, minute, second/month, date.
- One-touch correction of time error within ±30 seconds.
- 2-switch sequential operation.
- 4-year calendar.
- LCD test

## FEATURES

- One-chip CMOS construction.
- Drives 6-digit triplexes LCD.
- Colon and PM display.
- Low power consumption.
- 32,768Hz crystal oscillator.
- Single 1.5V battery operation.
- Built-in voltage doublet circuit.
- Built-in crystal oscillator input capacitor.
- Trimmer capacitor included
- Reset on power–on.

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## ABSOLUTE MAXIMUM RATINGS (Ta = 25'C)

| Characteristics | Symbol | Value | Unit |
|---|---|---|---|
| Supply Voltage ($V_{DD}$ – $V_{SS}$) | $V_{DS1}$ | – 0.3 ~ + 2.0 | V |
| Supply Voltage ($V_{DD2}$ – $V_{SS}$) | $V_{DS2}$ | -0.3 ~ + 4.0 | V |
| Operating Temperature | $T_{OPR}$ | – 20 ~ + 75 | °C |
| Storage Temperature | $T_{STG}$ | -55 ~ +125 | °C |

*Voltage greater than above may damage the circuit.

## ELECTRICAL CHARACTERISTICS

(Ta =25°C, $V_{DD}$=1.5V, $V_{SS}$=0V; unless otherwise specified)

| Characteristic | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{DD}$ | | 1.2 | 1.5 | 1.8 | V |
| | $V_{DD2}$ | | 2.4 | 3.0 | 3.6 | V |
| Supply Current | $I_{DD}$ | Without Load | | 0.8 | 2.0 | µA |
| Input High Voltage | $V_{IH}$ | | $V_{DD}$ – 0.3 | | $V_{DD}$ | V |
| Input Low Voltage | $V_{IL}$ | | $V_{SS}$ | | $V_{SS}$ + 0.3 | V |
| Switch Activation Current | $I_{SW}$ | $V_{IN}$ = $V_{DD}$ | 0.1 | 0.5 | 3 | µA |
| Oscillator Start Voltage | $V_{OSC}$ | Within 5 sec | | | 1.45 | V |
| Oscillator Stop Voltage | $V_{OSP}$ | | | | 1.15 | V |
| Oscillator Frequency | $F_{OSC}$ | | | 32.768 | | Hz |
| DC-DC Conversion Frequency | $F_{CON}$ | C1 = C2 = 0.1µF | | 1.024 | | Hz |
| LCD Frequency | Fd | | | 43 | | Hz |
| Oscillator Capacitor | $C_{IN}$ | | | 20 | | pF |
| | $C_{OUT}$ | | | 20 | | pF |
| Switch Debouncing Time | $T_{DEB}$ | | | | 31.25 | msec |

- $V_{DD}$ - Supply voltage is connected to VCC.
- $V_{DD2}$ - Voltage of voltage doubler at VOCC2.
- $V_{SS}$ - Voltage supplied to Ground OV.

# FUNCTIQNAL DESCRIPTION

Two switch's (D and S) are required to control all displays and function.

## A) Display Control

Hours, minutes and seconds are displayed and colon remains stationary in normal mode.
Month and date are displayed by depressing the D-switch.
If the D-switch is not depressed continuously, the display will return to normal mode (hours, minutes and seconds) after 2 seconds.

## B) Setting Control

See Operational Diagram.

**1. Second**

Depressing the S-switch in normal mode will cause second correction mode. Second display will flash at a 2Hz rate in this mode. The D-switch is used to correct second within ±30 seconds. After second's correction, the display will return to normal mode (hours, minutes and seconds).

**2. Hour**

Depressing the S-switch in second correction mode will cause "hour set" mode and hour display will flash at a 2Hz rate. D-switch is used to advance contents of selected state. If the D-switch is depressed continuously, contents will be advanced at a 4Hz rate.

**3. Minute**

The next depressing of the S-switch will select "minute set" mode and minute display will flash at a 2Hz rate, Minute setting can be advanced as above.

**4. Month**

The next depressing of the S-switch will select "month set" mode and month display will flash at a 2Hz rate.

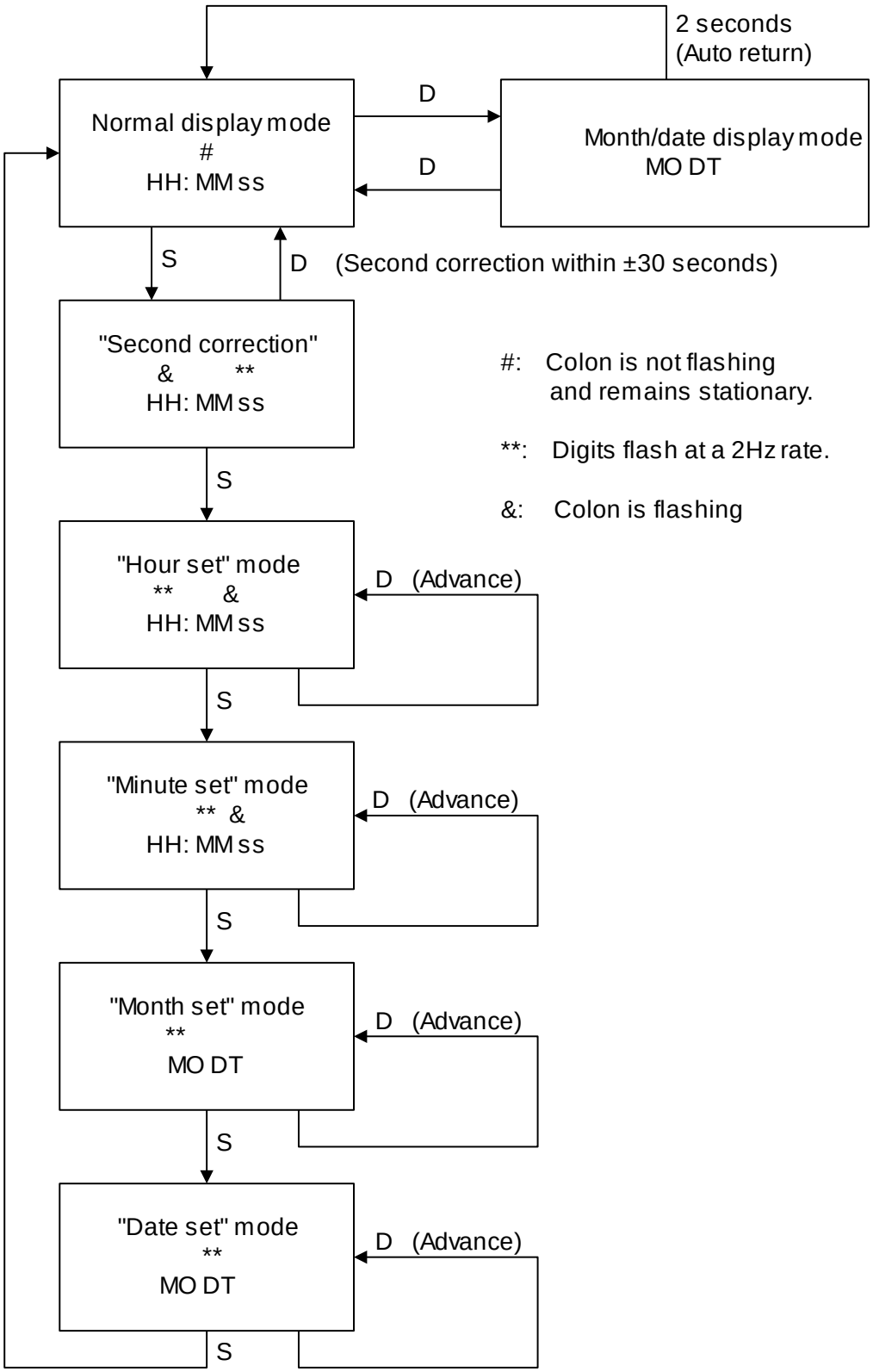
**5. Date**

The next depressing of the S-switch will select "date set" mode and date display will flash at a 2Hz rate.

**6. Return**

The next depressing of the S-switch will return to normal display mode.

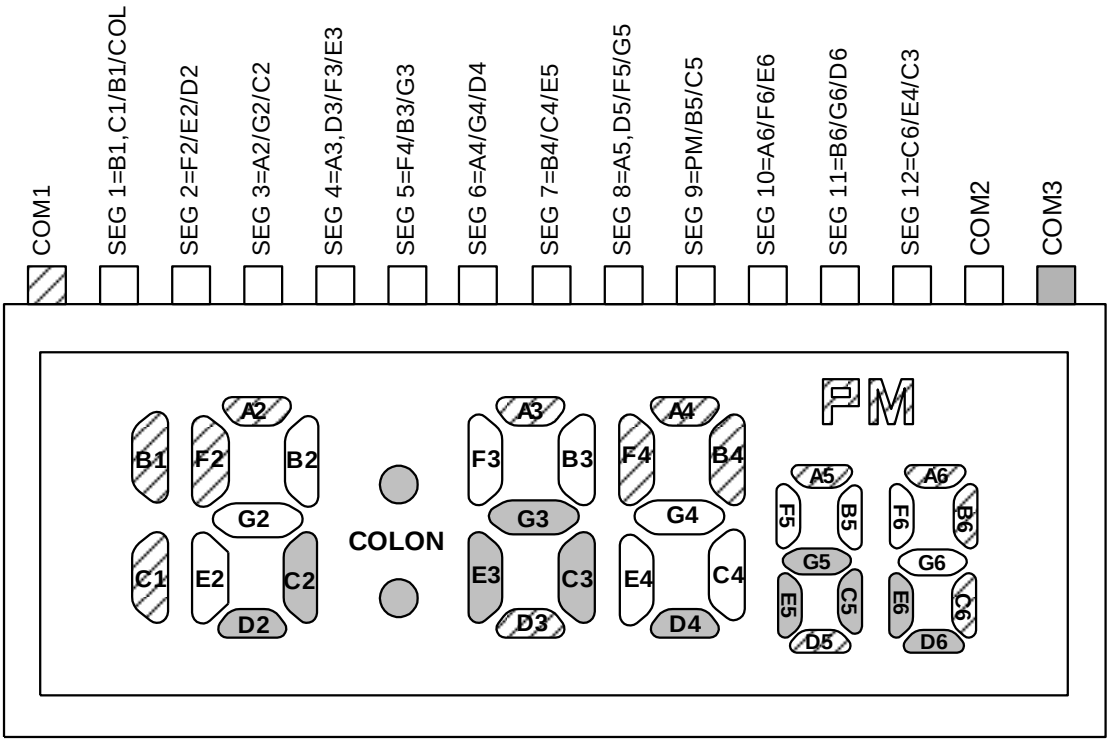
## OPERATIONAL DIAGRAM



## TESTING

- T1, T2 and T3 PADs are provided for testing. In normal operation they should be kept open.
- Three test inputs and two switches are pulled down by internal resistors.

## LCD FORMAT

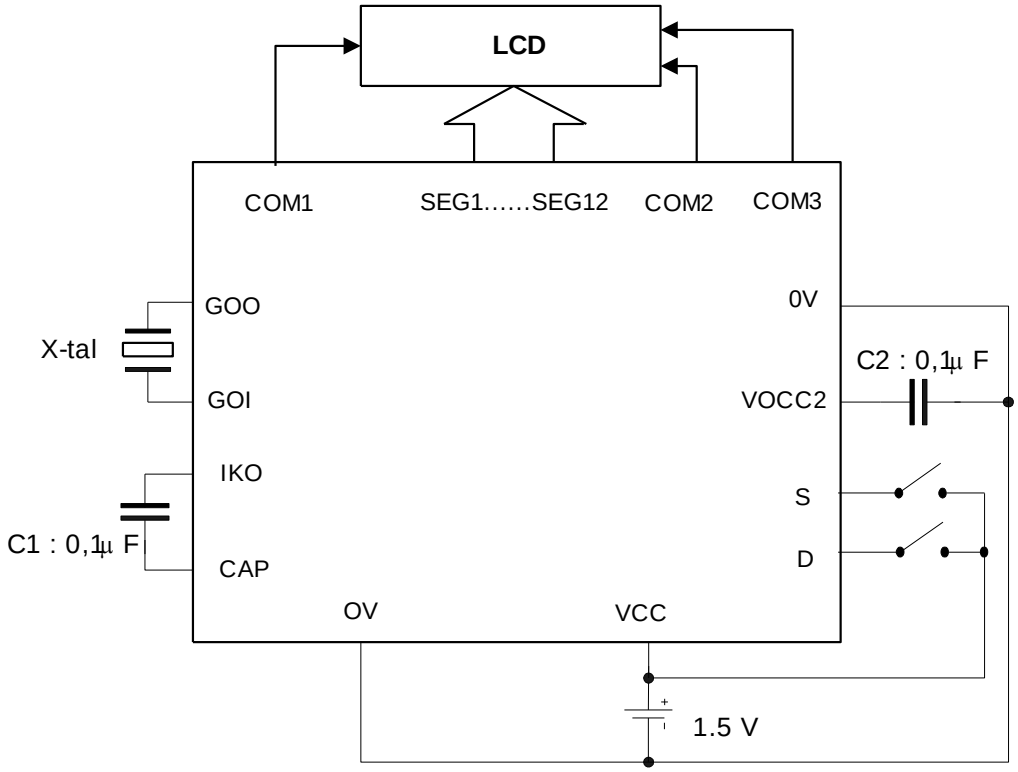



## APPLICATION

See Application Circuit

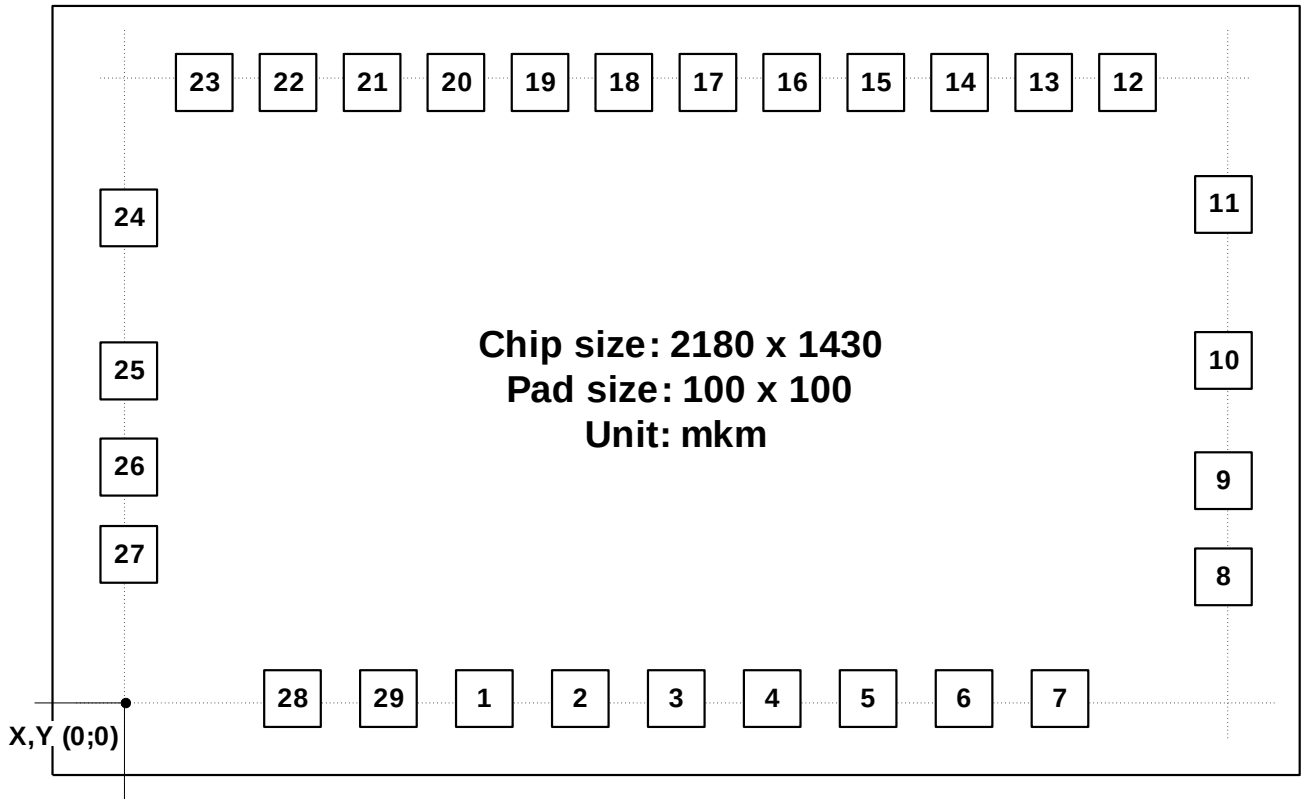
- The voltage doubler circuit is formed by connecting 0.05μF to 0.1μF capacitor from 'CAP' PAD to 'IKO' PAD and from 'VOCC2' PAD to 'OV' PAD.
- The oscillator circuit is formed by connecting crystal from 'GOI' PAD to 'GOO' PAD.
- The circuit substrate is electrically connected to $V_{SS}$, the most negative voltage. The preferred assembly method is to connect die area to $V_{SS}$ using a conductive die attach.
- The watch can operate with a 1.5V silver oxide battery and the user should connect 'VCC' PAD to 1.5V, OV to OV.

## APPLICATION CIRCUIT




* Quartz Crystal Parameter
Fp = 32,768Hz
CL = 10pF
C1 = 4pF
Co = 2.5pF
Rs = 35KQ
Q = 35,000

## PAD DIAGRAM




## PAD LOCATION

| Pad number | Pad name | X | Y | Pad number | Pad name | X | Y |
|---|---|---|---|---|---|---|---|
| 1 | OV | 647 | 0 | 16 | SEG8 | 1179 | 1158 |
| 2 | T1 | 825 | 0 | 17 | SEG7 | 1039 | 1158 |
| 3 | T2 | 981 | 0 | 18 | SEG6 | 899 | 1158 |
| 4 | T3 | 1137 | 0 | 19 | SEG5 | 759 | 1158 |
| 5 | VCC | 1296 | 0 | 20 | SEG4 | 619 | 1158 |
| 6 | D | 1457 | 0 | 21 | SEG3 | 479 | 1158 |
| 7 | S | 1613 | 0 | 22 | SEG2 | 339 | 1158 |
| 8 | VOCC2 | 1908 | 195 | 23 | SEG1 | 199 | 1158 |
| 9 | OV | 1908 | 355 | 24 | COM1 | 0 | 888 |
| 10 | COM3 | 1908 | 582 | 25 | GOOT | 0 | 569 |
| 11 | COM2 | 1908 | 848 | 26 | GOO | 0 | 413 |
| 12 | SEG12 | 1739 | 1158 | 27 | GOI | 0 | 257 |
| 13 | SEG11 | 1599 | 1158 | 28 | IKO | 264 | 0 |
| 14 | SEG10 | 1459 | 1158 | 29 | CAP | 443 | 0 |
| 15 | SEG9 | 1319 | 1158 | | | | |