TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT   SILICON MONOLITHIC

JT9634-AS

CALCULATOR ALARM CHRONOGRAPH DUAL TIME FUNCTION WRIST WATCH

APPLICATION
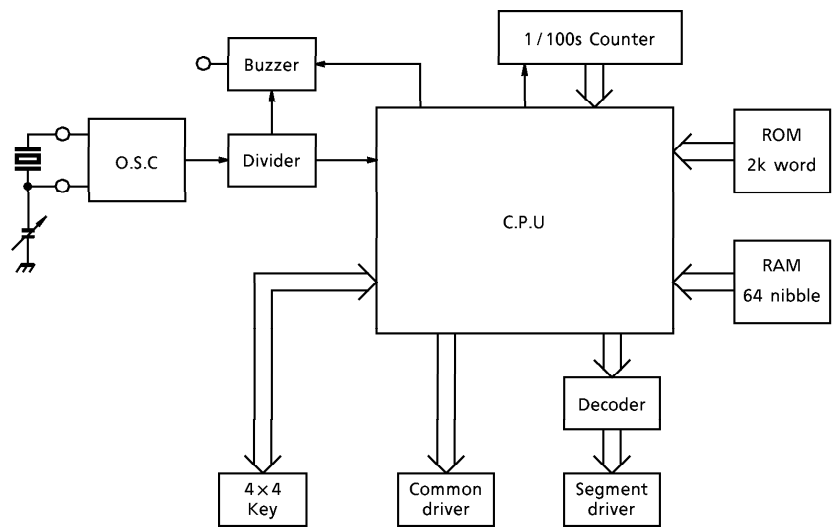
- Calculator Watch

FEATURES

- Calculator function with 4 standard function by 8 digits.

- Alarm function with buzzer direct drive.

- Chime function to beep the buzzer at every hour.

- Chronograph function with lap operation.
  (Stopwatch) (Max. count times : 9 : 59^M 59^S $99^{1/100S}$)

- Dual Time function ; Hour, Minutes, Year, Month, Day of the Month and Day of the week.

- 12 hour / 24 hour cycle are selectable by wearer with switch.

- Month-Day-Year / Day-Month-Year display are selectable by the switch operation.

- Direct interface to 1 / 3-duty L.C.D : 8 digits, 8 points and 12 flags.

- 7 watch function : Hour, Minute, Second, Year, Month, Day of the Month and Day of the week.

- Day of the month and day of week can be calculated from year and month.

- 16 keys for calculator function with 4 or 5 keys for Watch function.

- Buzzer beep shot for anouncing sure calculator operation.

- Single 1.55V power supply.

- Voltage doubler. (Two external capacitor)

- Alarm Time ; 20 seconds.

- 3~4 minutes snooze function.

BLOCK DIAGRAM

PIN DESCRIPTION (58 pins)

PIN NAME	SYMBOL	No. OF PINS
Power Supply Pins	V_{DD} (MAIN, SUB), V_{SS1}, V_{SS2}, V_{SSC}, PULL	6
Oscillator Pins	X_{IN}, X_{OUT}	2
Input Pins	$K_{IN1\sim4}$, $DK_{IN1\sim4}$, SNZ, FS, $P_{1\sim4}$ (Don't use)	14
Output Pins	$K_{OUT1\sim4}$, DK_{OUT1}, BUZZ, $\overline{BUZZ}$, LAMP	8
Display Pins	$S_1\sim S_{30}$, $COM_{1\sim3}$	33
Test Pins	TE_1, $TS_{1\sim5}$ (Don't use)	6
DOUBLER / HALVER	FAI_1, FAI_2	2

PAD LAYOUT

Top pads (left to right): S_{21}, S_{20}, S_{19}, S_{18}, S_{17}, S_{16}, S_{15}, S_{14}, S_{13}, S_{12}, S_{11}, S_{10}, S_9, S_8, S_7, S_6, S_5, S_4

Left pads (top to bottom): COM_2, TE_1, X_{OUT}, X_{IN}, DK_{IN2}, V_{DD} (SUB), P_1, P_2, P_3, P_4, TS_1, TS_5, $\phi 1$, $\phi 2$, SNZ, DK_{IN3}, K_{OUT1}

Right pads (top to bottom): S_3, S_2, S_1, COM_1, DK_{IN1}, TS_2, TS_3, TS_4, V_{SSC}, LAMP, BUZZ, $\overline{BUZZ}$, V_{DD} (MAIN), FS, V_{SS2}, PULL, V_{SS1}, DK_{IN4}

Center: JT9634-AS (TOP VIEW)

Bottom pads (left to right): K_{OUT4}, K_{OUT3}, K_{OUT2}, K_{IN1}, K_{IN2}, K_{IN3}, K_{IN4}, S_{22}, S_{23}, S_{24}, S_{25}, S_{26}, S_{27}, S_{28}, S_{29}, S_{30}, COM_3, DK_{OUT1}

Chip size : 3.87×3.91 (mm)

PAD LOCATION TABLE   (μm)

PIN NAME	X POINT	Y POINT	PIN NAME	X POINT	Y POINT
K_{OUT1}	− 1800	− 1789	S_2	1800	1421
D_{KIN3}	− 1800	− 1421	S_1	1800	1243
SNZ	− 1800	− 1243	COM_1	1800	1066
$\phi 2$	− 1800	− 1066	DK_{IN1}	1800	888
$\phi 1$	− 1800	− 888	TS_2	1800	710
TS_5	− 1800	− 710	TS_3	1800	533
TS_1	− 1800	− 533	TS_4	1800	355
P_4	− 1800	− 355	V_{SSC}	1800	178
P_3	− 1800	− 178	LAMP	1800	0
P_2	− 1800	0	BUZZ	1800	− 178
P_1	− 1800	178	$\overline{BUZZ}$	1800	− 355
V_{DD} (SUB)	− 1800	355	V_{DD} (MAIN)	1800	− 533
DK_{IN2}	− 1800	533	FS	1800	− 710
X_{IN}	− 1800	710	V_{SS2}	1800	− 888
X_{OUT}	− 1800	888	PULL	1800	− 1066
TE_1	− 1800	1066	V_{SS1}	1800	− 1243
COM_2	− 1800	1291	DK_{IN4}	1800	− 1606
S_{21}	− 1800	1789	DK_{OUT1}	1800	− 1789
S_{20}	− 1432	1789	COM_3	1432	− 1789
S_{19}	− 1254	1789	S_{30}	1254	− 1789
S_{18}	− 1077	1789	S_{29}	1077	− 1789
S_{17}	− 899	1789	S_{28}	899	− 1789
S_{16}	− 721	1789	S_{27}	722	− 1789
S_{15}	− 544	1789	S_{26}	544	− 1789
S_{14}	− 366	1789	S_{25}	366	− 1789
S_{13}	− 189	1789	S_{24}	189	− 1789
S_{12}	− 11	1789	S_{23}	11	− 1789
S_{11}	167	1789	S_{22}	− 166	− 1789
S_{10}	344	1789	K_{IN4}	− 344	− 1789
S_9	522	1789	K_{IN3}	− 522	− 1789
S_8	699	1789	K_{IN2}	− 699	− 1789
S_7	877	1789	K_{IN1}	− 877	− 1789
S_6	1055	1789	K_{OUT2}	− 1054	− 1789
S_5	1232	1789	K_{OUT3}	− 1232	− 1789
S_4	1617	1789	K_{OUT4}	− 1617	− 1789
S_3	1800	1789			

(Note) Each coordinate shows the center of each pad.

FUNCTION SPECIFICATIONS

1. Display configulation

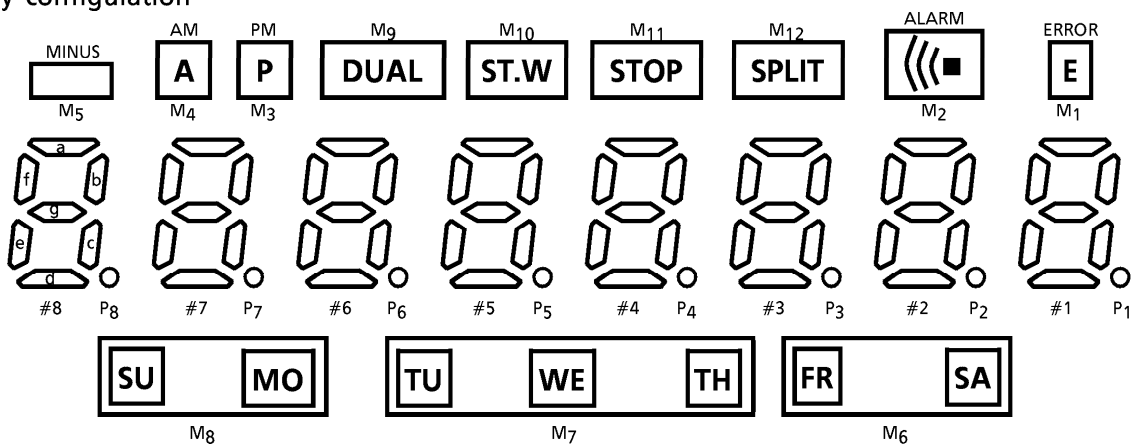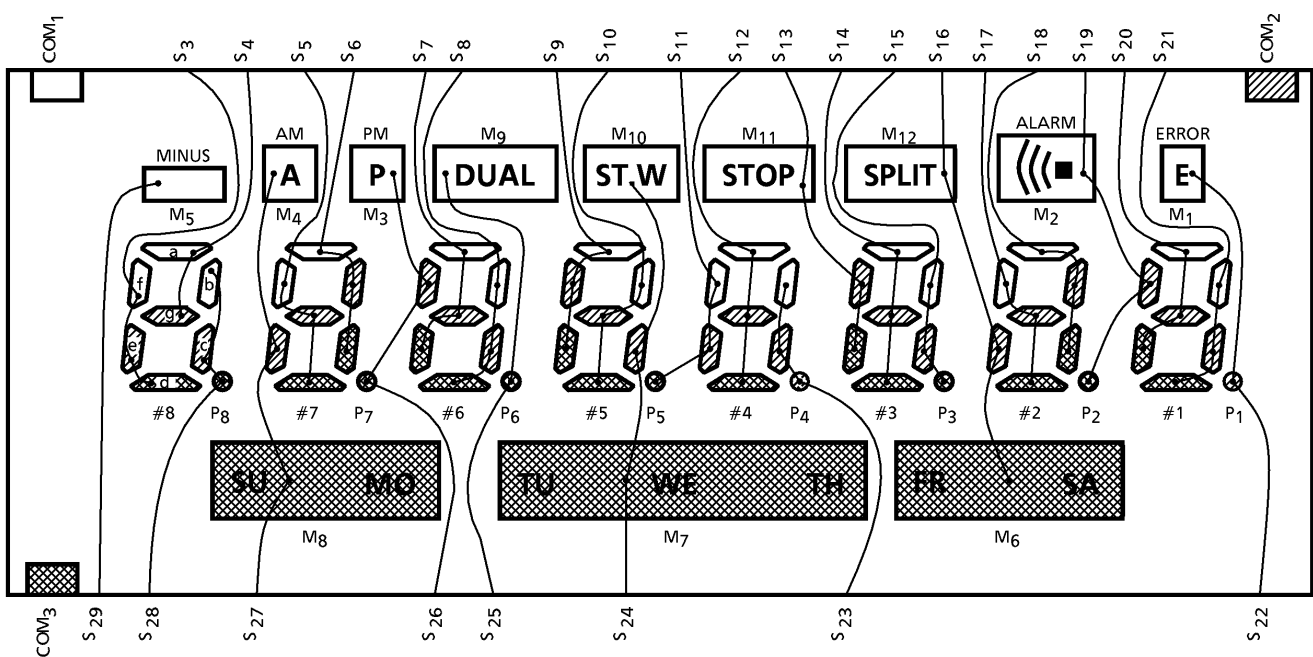Fig.1 Recommended L.C.D., layout
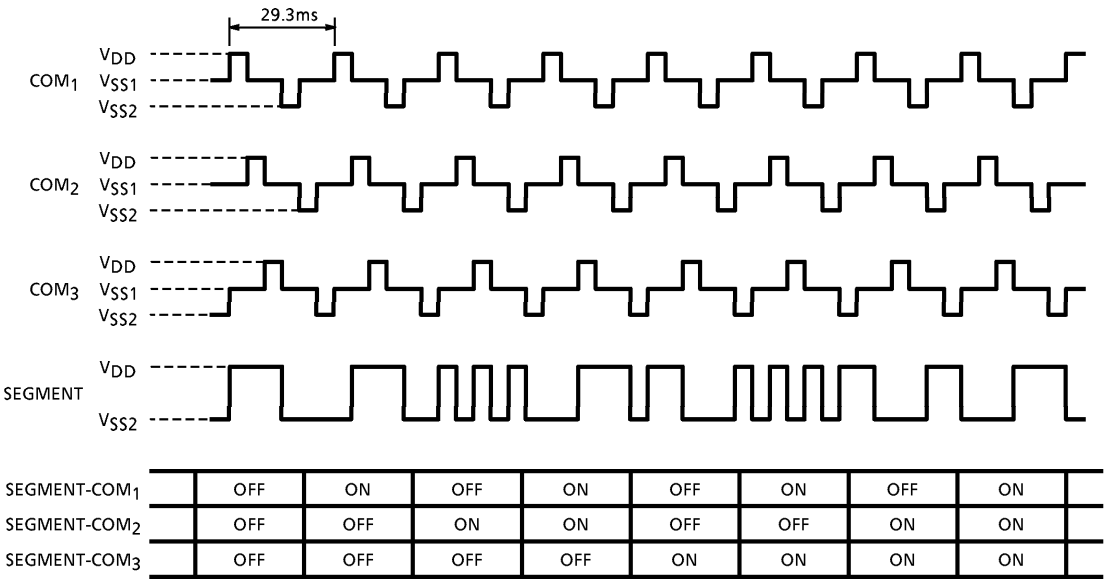

Fig.2 Recommended L.C.D., pattern (Segments, common)

Fig.3 The font of alphanumerics

2. Assignment of L.C.D
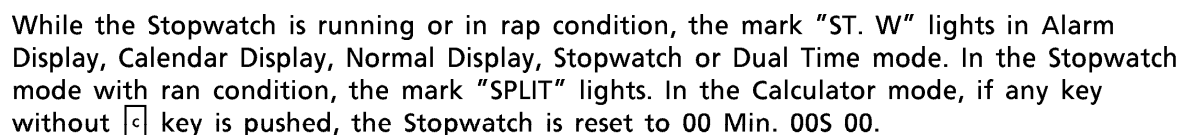
	COM_1	COM_2	COM_3
S_3	8f	8e	8d
S_4	8a	8g	8i
S_5	7f	7g	7d
S_6	7a	7b	7c
S_7	6a	6g	6e
S_8	6b	6c	6d
S_9	5a	5f	5e
S_{10}	5b	5g	5d
S_{11}	4f	4e	P_5
S_{12}	4a	4g	4d
S_{13}	M_{11}	3f	3e
S_{14}	3a	3g	3d
S_{15}	3b	3c	P_3
S_{16}	M_{12}	2e	M_6
S_{17}	2f	2g	2d
S_{18}	2a	2b	2c
S_{19}	M_2	1f	P_2
S_{20}	1a	1g	1e
S_{21}	1b	1c	1d
S_{22}	M_1	P_1	M_{13}
S_{23}	4b	4c	P_4
S_{24}	M_{10}	5c	M_7
S_{25}	M_9	COL	P_6
S_{26}	M_3	6f	P_7
S_{27}	M_4	7e	M_8
S_{28}	8b	8c	P_8
S_{29}	M_5	P_9	M_{14}

3. Timing chart for 1/3 duty LCD driving

SEGMENT-COM$_1$	OFF	ON	OFF	ON	OFF	ON	OFF	ON
SEGMENT-COM$_2$	OFF	OFF	ON	ON	OFF	OFF	ON	ON
SEGMENT-COM$_3$	OFF	OFF	OFF	OFF	ON	ON	ON	ON

FUNCTION DESCRIPTION

1. Mode flow and switch operation

	Alarm	Hourly Chime
1.	OFF	OFF
2.	ON	OFF
3.	ON	ON

Sound Demonstration

Alarm Display

HH - MM   AL

Alarm Display

HH - MM   AL

S_4H lamp ON

Normal Disply

HH - MM   AL

W

Calender Disply

MONO - DD - YY

W

Caluculator

0.

16 key mode with SW operating sound

Stop Watch

S_1, S_2 : with SW operating sound

Dual Time

HH - MM   SS

W

S_4H Lamp ON

Alarm Set

(HH)- MM   AL

Normal Set

HH - MM (SS)

W

Dual Set

HH -(MM) SS

W

Full Display

S_1H and S_2H over 1~2s

S_1, S_2, S_3 or S_4

S_3	S_2	S_1	S_4
c	−	×	÷
7	8	9	0
4	5	6	.
1	2	3	+=

Switches

S_1 : Figure selection

S_2 : Set

While the Stopwatch is running or in rap condition, the mark "ST. W" lights in Alarm Display, Calendar Display, Normal Display, Stopwatch or Dual Time mode. In the Stopwatch mode with ran condition, the mark "SPLIT" lights. In the Calculator mode, if any key without c key is pushed, the Stopwatch is reset to 00 Min. 00S 00.

Symbol of switch operation

SYMBOL	SWITCH OPERATION
S_1, S_2, S_3	Momentary depression
S_3*	Momentary depression after S_1 or S_2
S_1L, S_2L	Holding switch to V_{SS} level
S_1H, S_2H, S_4H	Holding switch to V_{DD} level
S_2T, S_3T	Depressing switch for more than 1 to 2 seconds
NT	None of switches are depressed for 1 to 2 minutes. (Auto Return)
NT*	None of switches are depressed for 10 to 20 minutes. (Auto Return)

2. Alarm set
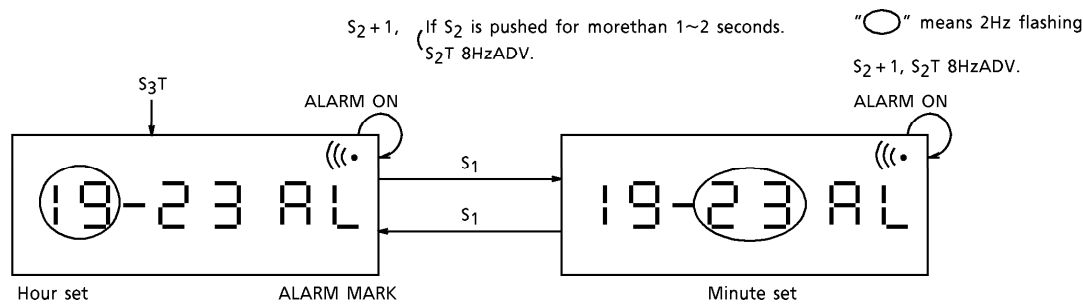
If Alarm time is set by S_2, the mark " $(((\bullet$ " appears.
If Alarm time is set by 8Hz-advance, the figure being set is not flashing.

3. Normal set
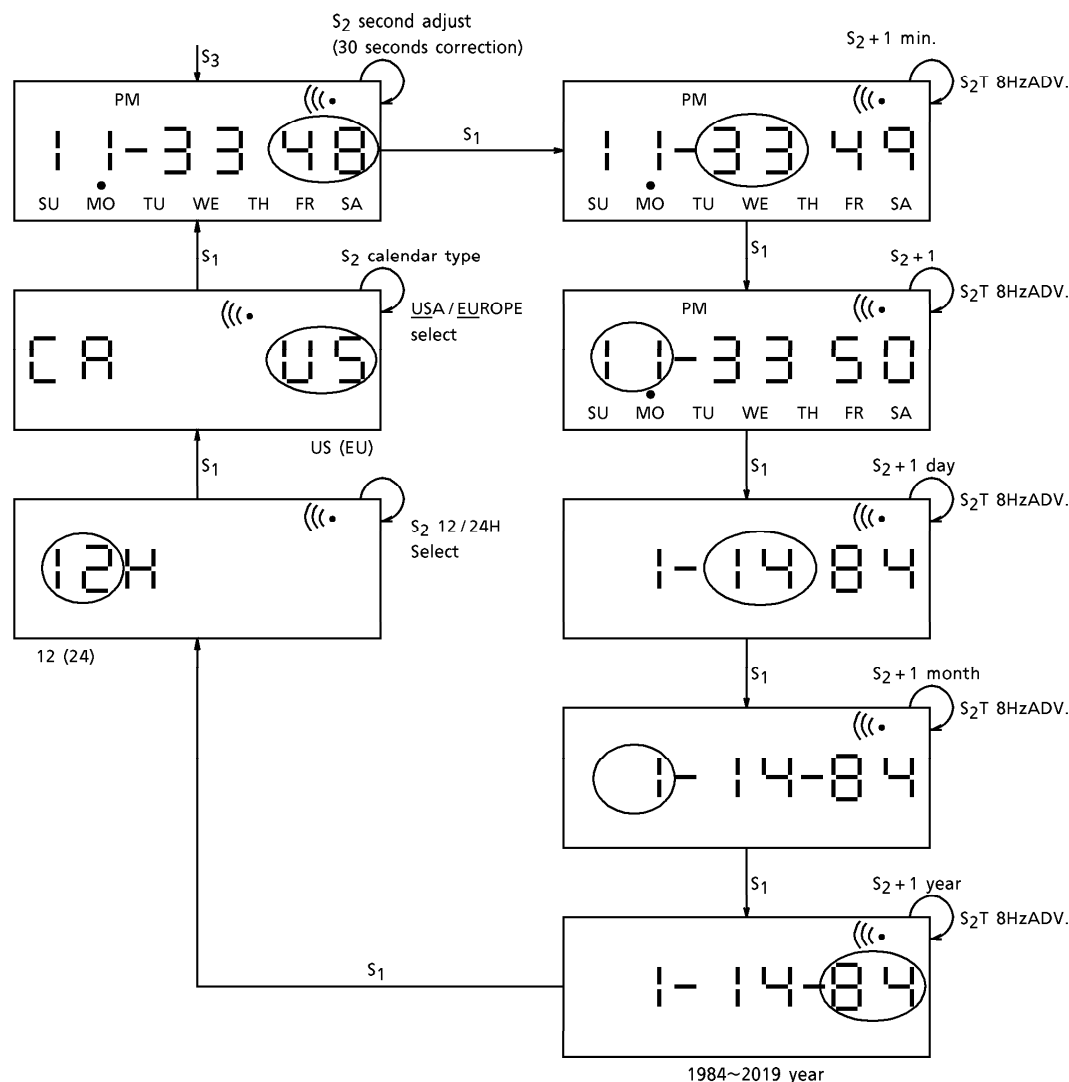
The week of Day is set automatically, by setting Day, Month or Year.

4. Dual time set

The second of Dual Time is the same as the Second of Normal Time.

5. Stopwatch

"*" means SW operating sound.
"ST. W" means 1Hz flashing.

"ST. W" mark appears in Normal mode.

"ST. W" mark appears in Normal mode.

Stopwatch counting is as follows

	minute	second	1/10, 1/100 second
Reset	00 —	00 —	00
Start	00 —	00 —	01
		⟩	
	59 —	59 —	99
		↓	
	hour	minute	second
	1 —	00 —	00
		⟩	
	9 —	59 —	59

6. Display format in each mode

① Normal Display (24H)
ex. PM. 1 : 53 46", Sunday

```
((( •
13-53/46
• SU  MO  TU  WE / TH  FR  SA
```

Alarm ON, Hourly Chime OFF

② Alarm Display (12H)
ex. AM 5 : 30

```
AM ST. W
5-30 AL
```
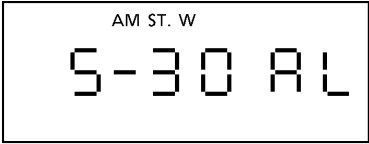
Alarm OFF, Hourly Chime OFF
Stopwatch : run or split

③ Calendar Display (U.S.A. type)
ex. 1984, Dec. 3, Monday

```
ST. W            ((( •
12-  3-84        2Hz
SU  MO  TU  WE  TH  FR  SA   flashing
```
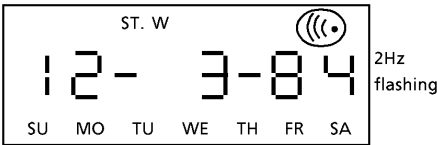
Alarm ON, Hourly Chime ON
Stopwatch : run or split

④ Calendar Display (Europe type)
ex. 1984, Dec. 3, Monday

```
((( •
3- 12-84
SU  MO  TU  WE  TH  FR  SA
```
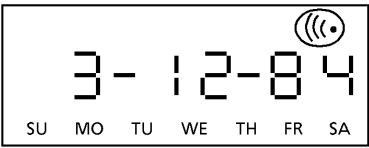
Alarm ON, Hourly Chime ON
Stopwatch : run or split

⑤ Calculator (1)
ex. 12345678

```
((( •
12345678
```
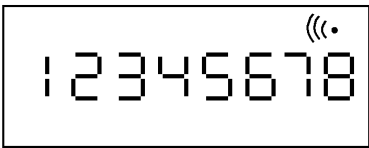
Alarm ON, Hourly Chime OFF

⑥ Calculator (2)
ex. − 25

```
−
              25
```
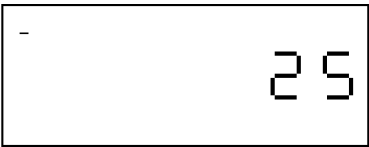
⑦ Calculator (3)
Error

```
              E
              0
```

⑧ Calculator (4)
Error

```
−            ((( • E
12.345678
```
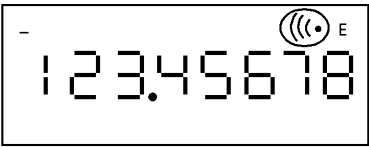
Alarm ON, Hourly Chime ON

⑨ Calculator (5)
Error

```
              E
12.345678
```

⑩ Full Display

```
− AP DUAL ST. W STOP SPLIT ((( • E
8.8.8.8.8.8.8.8.
SU  MO  TU  WE  TH  FR  SA
```
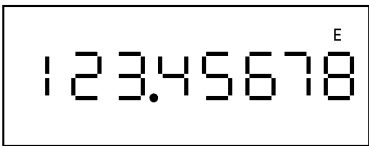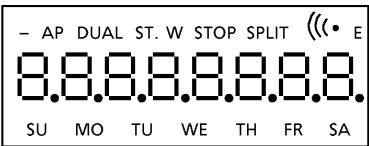
⑪ Dual Time Display (12H)
ex. AM 7 : 23 56", Tuesday

AM	DUAL	ST. W	(((•

7-23 56

SU   MO   TU   WE   TH   FR   SA
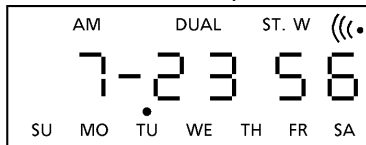
Alarm ON, Hourly Chime ON
Stopwatch : run or split

⑫ Stopwatch Display
ex. 5 hours 23 minutes 27 seconds

ST. W   (((•

5-23 27
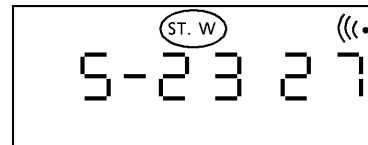
Alarm ON, Hourly Chime ON
Stopwatch : run

"AL" is displayed at the 1st and 2nd digits in the Alarm Display mode or Alarm Set mode.

7. Calendar display function

(1) While S_1 is depressed in the Normal Display mode, it becomes Calendar Display mode.

By releasing S_1 in the Calendar Display mode, the Normal Display mode can be selected again.

(2) The Calendar Display has U.S.A. type and Europe type. The displays are in order to Month-Day - Year by U.S.A. type, and Day-Month-Year by Europe type.
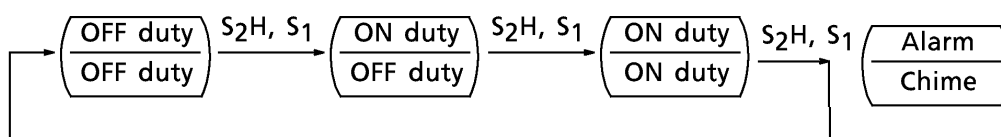
(3) The sequence of the year count is as follows.

$$\hookrightarrow 1984\sim1999 \rightarrow 2000 \rightarrow 2001\sim2019 \dashv$$
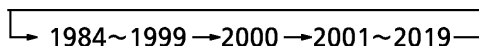
Display : $84\sim99 \rightarrow 00 \rightarrow 01\sim19$

8. Alarm function and chime function

(1) The selection of alarm and chime function

By every momentary depression of the switch S_1 with depressing the switch S_2 in the Alarm Display mode, one of three states shown below is selected sequentialy.

| $\dfrac{\text{OFF duty}}{\text{OFF duty}}$ | $\xrightarrow{S_2H, S_1}$ | $\dfrac{\text{ON duty}}{\text{OFF duty}}$ | $\xrightarrow{S_2H, S_1}$ | $\dfrac{\text{ON duty}}{\text{ON duty}}$ | $\xrightarrow{S_2H, S_1}$ | $\dfrac{\text{Alarm}}{\text{Chime}}$ |

(2) Display of the alarm function and chime function

In every mode the state of the selection of the Alarm function and the Chime function is displayed by the mark " (((• ".

① Alarm OFF, Hourly Chime OFF ——— " (((• " OFF

② Alarm ON, Hourly Chime OFF ——— " (((• " ON

③ Alarm ON, Hourly Chime ON ——— " (((• " 2Hz flashing

(3) If the alarm time is adjusted by S_2, the alarm function is ON. If the sound condition is Alarm-OFF / Hourly Chime-OFF, before the alarm time is adjusted, the condition becomes Alarm-ON / Hourly Chime-OFF by adjusting.

If the condition before adjusting is Alarm-ON / Hourly Chime-OFF or Alarm-ON / Hourly Chime-ON, the sound condition of Alarm and Hourly Chime is not changed.

(4) Alarm sound demonstration

The Alarm Demo Sound is activated by depressing the switch S_1 during the S_2 depressed in the Alarm Display mode.

(5) Alarm function

On condition that the Alarm function is on duty and the Normal time coincides with the Alarm Time, the Alarm sound signal is activated for 20 seconds in any mode. The timing chart of the Alarm sound signal is as follows.
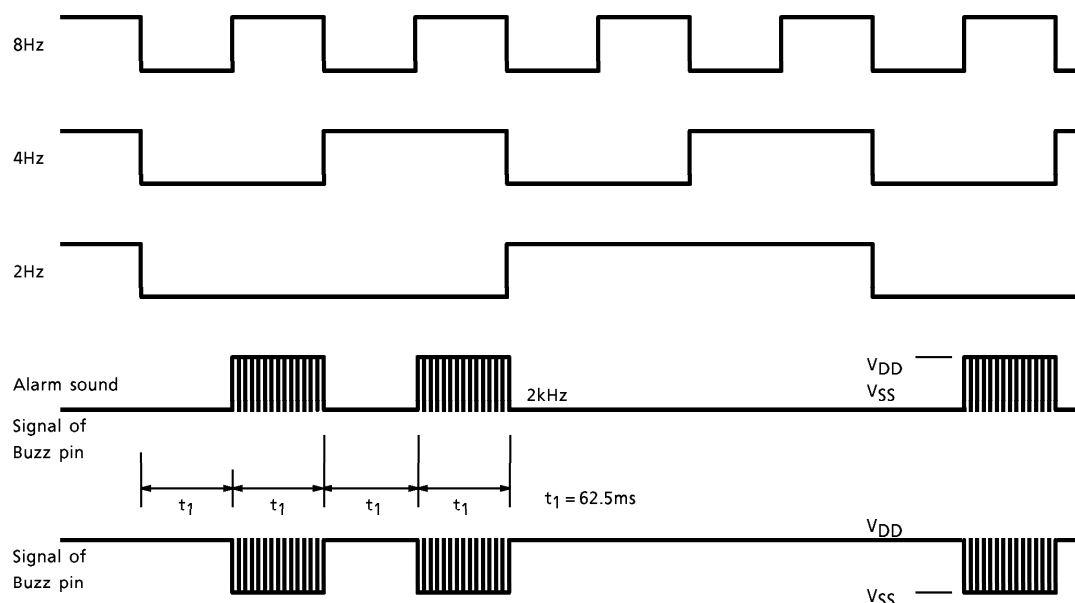

(6) How to stop the alarm beeping

While the Alarm is beeping in the mode without calculator, the Alarm stops by pushing A_1~S_4. In calculator mode the Alarm stops by pushing any key in 16 keys. Then the sound condition as Alarm / Hourly Chime is not changed. When the Alarm is stopped by switches, the function of switches are only to stop the Alarm without stopwatch mode. Then the function of adjusting and changing mode is invalid. In the stopwatch mode, the function of switches is to stop Alarm sound and to control the stopwatch at the same time. The explanation of the Snooze function is shown the item of Snooze function.

(7) Hourly chime function

On condition that the chime function is on duty the chime sound signal is activated every hour in any mode. The timing chart of the chime sound signal is as follows.

Hour

Hourly Chime V_{DD} V_{SS} 2kHz

Buzz pin

(Sound signal) $t_2 = 62.5ms$

t_2

$\overline{Buzz}$ pin V_{DD} V_{SS}
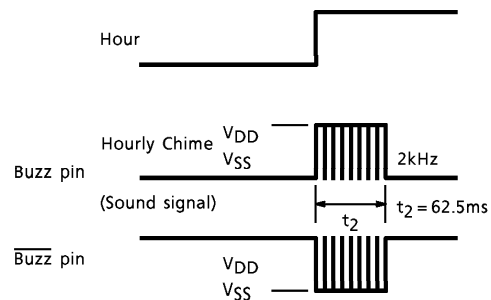
9 Switch operating sound

Switch operating sound is activated by the key operation in the calculator mode and in the stopwatch mode. It is the same signal as the chime sound signal.
When the mode changes from the calculator mode or from the stopwatch mode to the other mode, this sound is not activated.

10. Lamp control

The output level of the pin LAMP becomes V_{DD} V (0V) by depressing the switch S_4 ($\div$) except in the calculator mode. This output level is 0V while S_4 is depressed and returns to V_{SS} V (Low Level) by the release of S_4. The output level of the pin LAMP is as follows.

Lamp signal V_{DD} V_{SS}

$S_4 = OFF$ $S_4 = ON$ $S_4 = OFF$
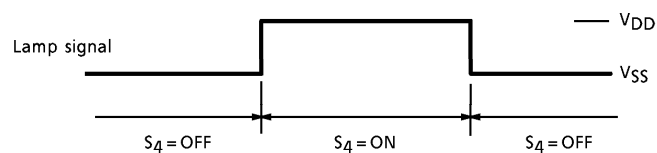
11. Notes on the watch function

(1) The Day of the month is calculated automatically by the year including a leap year and the month.

(2) The nonexistent date is able to be set in the Normal Set mode. If the nonexistent date is set in the Normal Set mode, the day of the month is reset to the 1st of the next month by returning to the Normal Display mode.

(3) The timing of the 2Hz flashing is as follows.
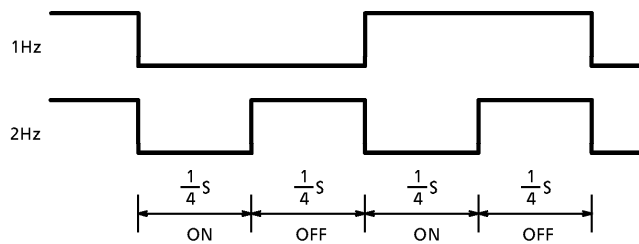
(4) When the mode is Alarm Set, Normal Set or Dual Set, pushing both S_1 and S_2, over 1 to 2 seconds, makes the Full Display mode be selected. In the Full Display mode, by depressing S_1, S_2, S_3 or S_4, the mode returns to Alarm Set, Normal Set or Dual Set before.

12. Snooze function

If the SNZ switch is pushed while the Alarm sounds the sound of the alarm stops and the sound, as the alarm, sounds 3~4 minutes after over again. It's the Snooze function. The Snooze function while the Alarm sounding is activated over and over again.
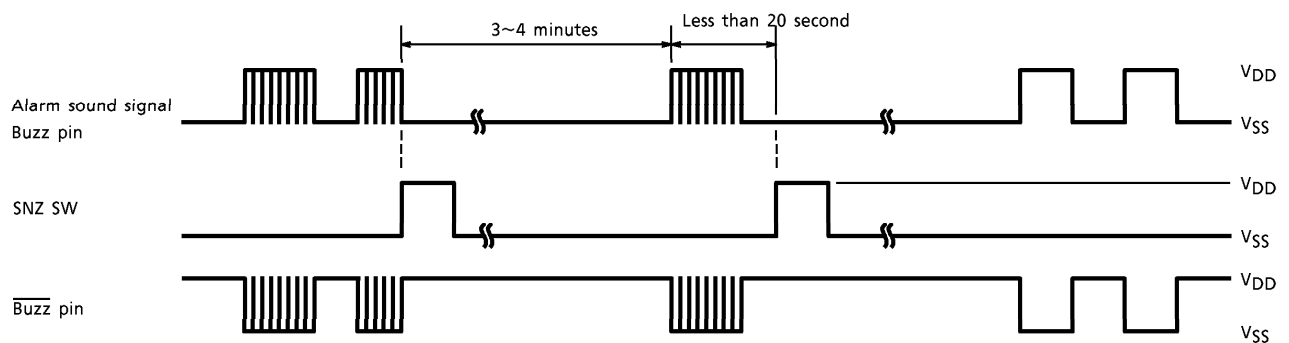
If the Snooze function is not needed, SNZ SW is not needed.

13. ALL Clear function

When all of switch inputs S_1, S_2, S_3 and S_4 are ON at the same time in the Normal Display mode, displays become Normal time = AM 12 : 00 00, 1984 January 1st Sunday, Alarm time = AM 12 : 00, 12 / 24H = 12H cycle, Calendar type = U.S.A. type and Alarm / Hourly chime = OFF / OFF.

SPECIFICATION OF CALCULATOR

1. Operational features

    (1) Eight digits of data

    (2) Algebraic mode

    (3) Full floating point

    (4) Standard four functions +, −, ×, ÷

    (5) Constant calculation ×, ÷ (Automatic constant)

    (6) Chain calculation

    (7) Leading zero suppression

    (8) The key operation with the beep sound to confirm the sure operation.

2. Capacity of calculation

    (1) Numeral entry

        8 digits. The numeral entry over 8 digits not executed.

    (2) When the result is positive and the integer part of it does not exceed 8 digits it is displayed as the result of the normal operation. (See the description on the error condition.)

    (3) When the result is negative and the integer part of it does not exceed 8 digits, the minus symbol ″−″ and it are displayed as the result of the normal operation.
    (See the description on the error condition.)

(Note 1)

KEY OPERATION	DISPLAY
1	1.
2	1 2.
3	1 2 3.
4	1 2 3 4.
5	1 2 3 4 5.
6	1 2 3 4 5 6.
7	1 2 3 4 5 6 7.
8	1 2 3 4 5 6 7 8.
9	1 2 3 4 5 6 7 8.

(Note 2)
8267 × 3594

2	9	7	1	1	5	9	8

(Note 3)
61438976 − 49276312

1	2	1	6	2	6	6	4

3. Error condition

(1) When the division by zero is attempted the error symbol "E" and a zero are displayed.

(2) When the result is positive and the integer part of it exceeds 8 digits the error symbol "E" and the upper 8 digits of the value obtained by the division of it by 10^8 are displayed.

(3) When the result is negative and integer part of it exceeds 8 digits the error symbol "E", the minus symbol "–" and the upper 8 digits of the value obtained by the division of it by 10^8 are displayed.

(Note 1)

| 5. | ÷ | 0. | E 0. |

(Note 2)

| 9 8 7 6 5 4 3 2. | × | 2. | E 1. 9 7 5 3 0 8 6. |
(197530864)

| 4 0 0 0 0 0 0 0. | × | 3 0 0 0 0 0 0 0. | E 1 2 0 0 0 0 0 0. |
(1.2 × 10^{15})

(Note 3)

– | 1 2 3 4 5 6 7 8. | × | 9 9. | – E 1 2. 2 2 2 2 2 1 |
(1.222222122 × 10^9)

– | 4 0 0 0 0 0 0 0. | × | 3 0 0 0 0 0 0 0. | – E 1 2 0 0 0 0 0 0. |

(4) Clearing the error condition

While the error occurs the numeral entry and the operation are inhibited. The error condition can be cleared by depressing |C| twice. In this case by the first depression the mark "E" is disappeared. By the second depression "0" is displayed as follows.

(Note 1)

E | 1 2 0 0 0 0 0 0. | | 1 2 0 0 0 0 0 0. | | 0. |
|C| 1 |C| 2

4. keys for calculator

  ① Data keys

    The data keys consist of the numeral keys $\boxed{0}$ through $\boxed{9}$.

  ② point key

    (i) $\boxed{\cdot}$ is a decimal point key.

    (ii)   When the key $\boxed{\cdot}$ pushed in the midst of the numeral entry, the display is not changed. The point and figures are taken up one place by the next numeral entry.

    (iii)   If the key $\boxed{\cdot}$ is pushed after the arithmatic operation key is pushed, the display becomes "0". It means the data "0" is memorized. Then the point and figures are taken up one place at the same time by the next numeral entry.

    (iv)   The first pushing about $\boxed{\cdot}$ key proceeds.

  ③ Arithmetic operation keys

    They consist of $\boxed{-}$, $\boxed{\times}$, $\boxed{\div}$ and $\boxed{^+_=}$.

    $\boxed{-}$, $\boxed{\times}$, $\boxed{\div}$

      (i) By depressing one of these keys after the numeral entry the operation instruction memorized just before is executed and the new operation instruction by these keys is memorized.

      (ii) By depressing one of these keys after the depression o f $\boxed{-}$, $\boxed{\times}$, $\boxed{\div}$ or $\boxed{^+_=}$ the operation instruction is not executed and the new operation instruction by these keys.

      (iii) By depressing one of these keys in the constant calculation mode this mode is canceled and the operation instruction by these keys is memorized.

    $\boxed{^+_=}$

      (i) By depressing this key after the first numeral entry the addition instruction is memorized.

      (ii) By depressing this key after the second numeral entry the operation instruction memorized just before is executed.
In case that the operation instruction executed is the addition or the subtraction instruction, the addition instruction is memorized. In case that the operation instruction executed is the multiplication or the division instruction, the constant calculation mode is selected.

Command function key

[C]

(i) By depressing this key without any other key after the calculator mode is selected, the Stopwatch mode is selected. Then the alarm set mode is selected after this key is pushed for over 1~2 seconds.

(ii) If the calculator is not error condition, by depressing this key after depressing [±], [−], [×], [÷], all registers for the calculator are cleared. (All clear)

(iii) By depressing this key after the data keys the calculator returns to the state that is one state previous to the state where these data keys are depressed. In this case "0" is displayed. (Clear Enter).

(iv) By depressing [±], [−], [×] or [÷] just after All Clear or Clear Enter state, the state turns to the same state as [±], [−], [×] or [÷] is depressed after 0. So "0" is displayed and the operation instruction correspond to [±], [−], [×] or [÷] is memorized.

(v) By depressing [C] in the All Clear state the Normal Display mode is selected. Then the Alarm Set mode is selected after this key is pushed for over 1~2 seconds.

④ Constant calculation

(i) When multiplication or division is excuted, the mode becomes constant calculation.

(ii) The first numerical value is constant value about Division.
The second numerical value is constant value about multiplication.

(iii) When [−], [×], [÷] or [±] keys are pushed, the display is not changed and the constant calculation is released.

(Note 1) Clear Enter

KEY OPERATION	DISPLAY	KEY OPERATION	DISPLAY	KEY OPERATION	DISPLAY	KEY OPERATION	DISPLAY
a	a	a	a	a	a	a	a
×	a	÷	a	±	a	−	a
b	b	b	b	b	b	b	b
c	0	c	0	c	0	c	0
d	d	d	d	d	d	d	d
±	a×d	±	a÷d	±	a+d	±	a−d

(Note 2) Clear

KEY OPERATION	DISPLAY	KEY OPERATION	DISPLAY	KEY OPERATION	DISPLAY	KEY OPERATION	DISPLAY
a	a	a	a	a	a	a	a
×(÷,+=,−)	a	×(÷,+=,−)	a	×(÷,+=,−)	a	×(÷,+=,−)	a
b	b	b	b	b	b	b	b
c	0	c	0	c	0	c	0
×	0	÷	0	+=	0	−	0
d	d	d	d	d	d	d	d
+=	a×0×d	+=	a×0÷d	+=	a×0+d	+=	a×0−d
	(a÷0×d (Error 0), (a+0)×d, (a−0)×d)		(a÷0÷d (Error 0), (a+0)÷d, (a−0)÷d)		(a÷0+d (Error 0), a+0+d, a−0+d)		(a÷0−d (Error 0), a+0−d, a−0−d)

Arithmetic Operation

(Note 3)

(1) Entry

	KEY OPERATION	DISPLAY
(1)	1	1.
	2	1 2.
	3	1 2 3.
	4	1 2 3 4.
	5	1 2 3 4 5.
	6	1 2 3 4 5 6.
	7	1 2 3 4 5 6 7.
	8	1 2 3 4 5 6 7 8.

	KEY OPERATION	DISPLAY
(2)	1	1.
	2	1 2.
	.	1 2.
	3	1 2. 3
	4	1 2. 3 4

(2) Four fundamental arithmetic calculation

	KEY OPERATION	DISPLAY
(1)	a	a
	+=	a
	b	b
	+=	a + b
(2)	a	a
	−	a
	b	b
	+=	a − b

	KEY OPERATION	DISPLAY
(3)	a	a
	×	a
	b	b
	+=	a·b
(4)	a	a
	÷	a
	b	b
	+=	a / b

(3) Constant calculation (K = constant value)

(1)	KEY OPERATION	DISPLAY
	K	K
	[×]	K
	b	b
	[+][=]	K·b
	C	C
	[+][=]	K·C

(2)	KEY OPERATION	DISPLAY
	a	a
	[÷]	a
	K	K
	[+][=]	a / K
	C	C
	[+][=]	C / K

(4) Power calculation

(1)	KEY OPERATION	DISPLAY
	a	a
	[×]	a
	[+][=]	a^2
	[×]	a^2
	[+][=]	a^4

(2)	KEY OPERATION	DISPLAY
	a	a
	[÷]	a
	[+][=]	a^{-1}

(5) Mixed calculation

(1)	KEY OPERATION	DISPLAY
	a	a
	[+][=]	a
	b	a + b
	[×]	a + b
	c	c
	[÷]	(a + b)·c
	c	d
	[−]	(a + b)·c / d
	d	e
	[+][=]	(a + b)·c / d − e
(2)	a	a
	[×]	a
	b	b
	[+][=]	a·b
	[+][=]	a·b
	c	c
	[+][=]	a·b + c

(3)	KEY OPERATION	DISPLAY
	a	a
	[÷]	a
	b	b
	[+][=]	a / b
	[+][=]	a / b
	c	c
	[+][=]	a / b + c

11. All clear function

When power is applied or when the supply of power is interrupted (e.g. if the battery is changed), the internal state of the IC may become unstable, even though it appears to be operating normally. For this reason it is vital to verify that the crystal oscillation circuit is oscillating normally ant stably (at 32 kHz) and then to use the system reset pin to initialize the IC (i.e. clear it) before use.

Note that a clear operation using the built-in power-on clear circuit should not be used in this case.

MAXIMUM RATINGS

| PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage (1)	V_{SS1}-V_{DD}	$-3.0\sim0.2$	V
Supply Voltage (2)	V_{SS2}-V_{DD}	$-4.0\sim0.2$	V
Operating Temperature	T_{opr}	$-10\sim60$	°C
Storage Temperature	T_{stg}	$-40\sim125$	°C

ELECTRICAL CHARACTERISTICS

($V_{DD}=0V$, $V_{SS1}=-1.55V$, $V_{SS2}=-3.00V$, Ta$=25°C$, unless otherwise noticed)

| PARAMETER	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Operating Voltage (1)	$|V_{SS1}|$	1	$C_G=15pF$		1.25	1.55	1.80	V
Operating Voltage (2)	$|V_{SS2}|$	2	$C_G=15pF$		2.30	3.00	3.60	V
Current Consumption	$|I_{SUP1}|$	1	$C_G=15pF$		—	—	3.00	μA
OSC Starting Voltage	$|V_{STA}|$	1	$C_G=20pF$		—	—	1.45	V
Output Voltage of Up Converter	$|V_{UCO}|$	1	$C_1=C_2=0.068pF$		2.95	—	—	V
Output Current (1) (Segment COM) V_{SS1}	I_{OH1}	3	$V_{OH1}=-0.30V$		—	—	-140	μA
	I_{OL1}		$V_{OL1}=-2.70V$		140	—	—	
Output Current (2) (Segment COM) V_{SS2}	I_{OH2}	3	$V_{OH2}=-1.75V$		—	—	-70	μA
	I_{OL2}		$V_{OL2}=-1.35V$		70	—	—	
Output Current (3) (Segment)	I_{OH3}	3	$V_{OH3}=-0.30V$		—	—	-6.0	μA
	I_{OL3}		$V_{OL3}=-2.70V$		6.0	—	—	
Output Current (4) (BUZZ, $\overline{BUZZ}$, Lamp)	I_{OH4}	3	$V_{OH4}=-0.5V$		—	—	-300	μA
	I_{OL4}		—		—	—	—	
Output Current (5) (DK$_{OUT1}$, K$_{OUT1\sim4}$)	I_{OH5}	3	PULL$=V_{SS1}$	$V_{OH5}=-0.2V$	—	—	-30	μA
	I_{OL5}			—	—	—	—	
Input Current (1) (DK$_{IN1\sim4}$, K$_{IN1\sim4}$, SNZ)	I_{IH1}	3	PULL$=V_{SS1}$	$V_{IH1}=0.00V$	0.3	—	4.4	μA
	I_{IL1}			$V_{IL1}=-1.55V$	-0.1	—	—	
Input Current (2) (Test Input)	I_{IH2}	3	PULL$=V_{SS1}$	$V_{IH2}=0.00V$	8	—	120	μA
	I_{IL2}			$V_{IL2}=-1.55V$	-0.1	—	—	

TEST CIRCUIT

1.
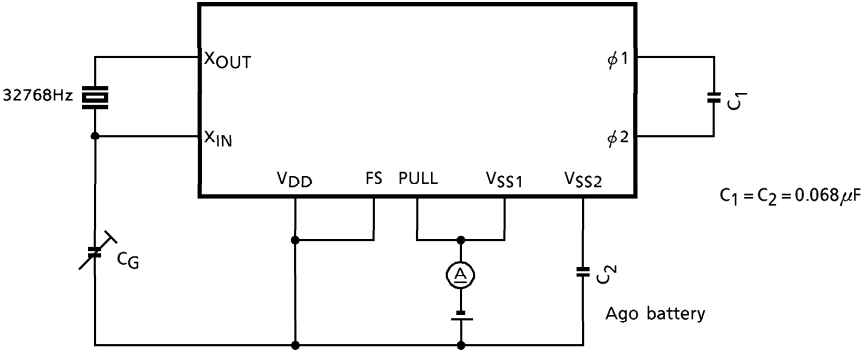
2.
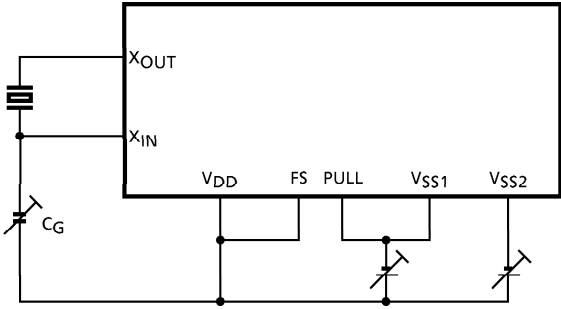
3.
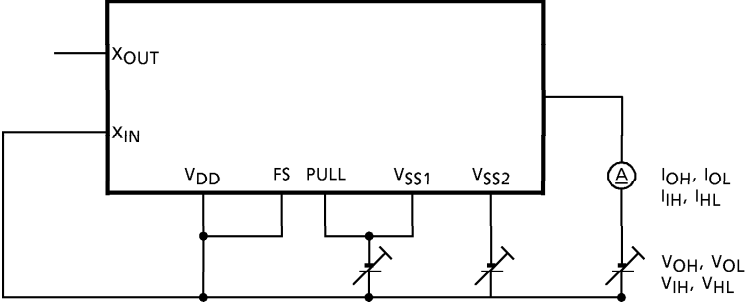
APPLICATION CIRCUIT

The case of ago battery (1.55V) type
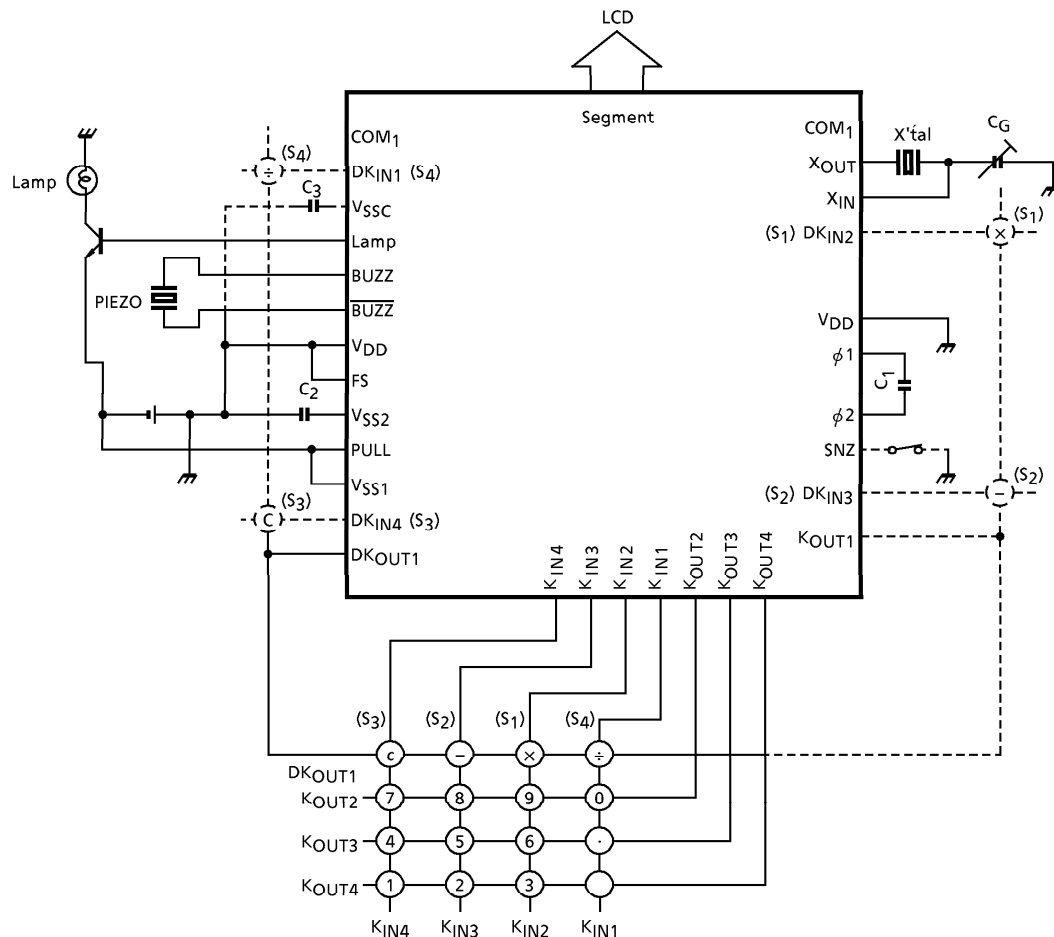
(Note 1) $C_1 \sim C_3 = 0.068 \mu F$

(Note 2) $C_G = 5 \sim 30pF$

(Note 3) The pad V_{SSC} had better to be connected the capacitor C_3 with V_{DD} for preventing the voltage V_{SS1} from the voltage noise.

(Note 5) Switch $S_1 \sim S_4$ ($\otimes$, $\ominus$, $\copyright$, $\oplus$) are to be connected $K_{IN1 \sim 4}$ or $DK_{IN1 \sim 4}$ with DK_{OUT1} or K_{OUT1} like APPLICATION CIRCUIT.

(Note 6) When SNOOZE function is needed, SNZ switch had better to be connected with V_{DD}.

2. Buzzer drive application

SP	PIEZO	PIEZO (Tr Drive)
BUZZ V_{SS} V_{DD} TR $h_{fe} \approx 100$ $V_{CEO} > 35V$	BUZZ $\overline{BUZZ}$ V_{SS} V_{DD}	BUZZ R_1 V_{SS} V_{DD} L_1 TR $h_{fe} \approx 100$ $V_{CEO} > 35V$ $L_1 = 20 \sim 30mH$ $R_1 = 20k\Omega$

Buzzer signal ──────── BUZZ

Buzzer signal ──────── $\overline{BUZZ}$

Buzzer signal

BUZZ — V_{DD} / V_{SS}

$\overline{BUZZ}$ — V_{DD} / V_{SS}