TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

JT9626-AS

LSI FOR LCD WATCHES

This product is a single-chip CMOS LSI for watches with alarm and chronograph functions. It can directly drive a six-digit LCD and offers six functions.

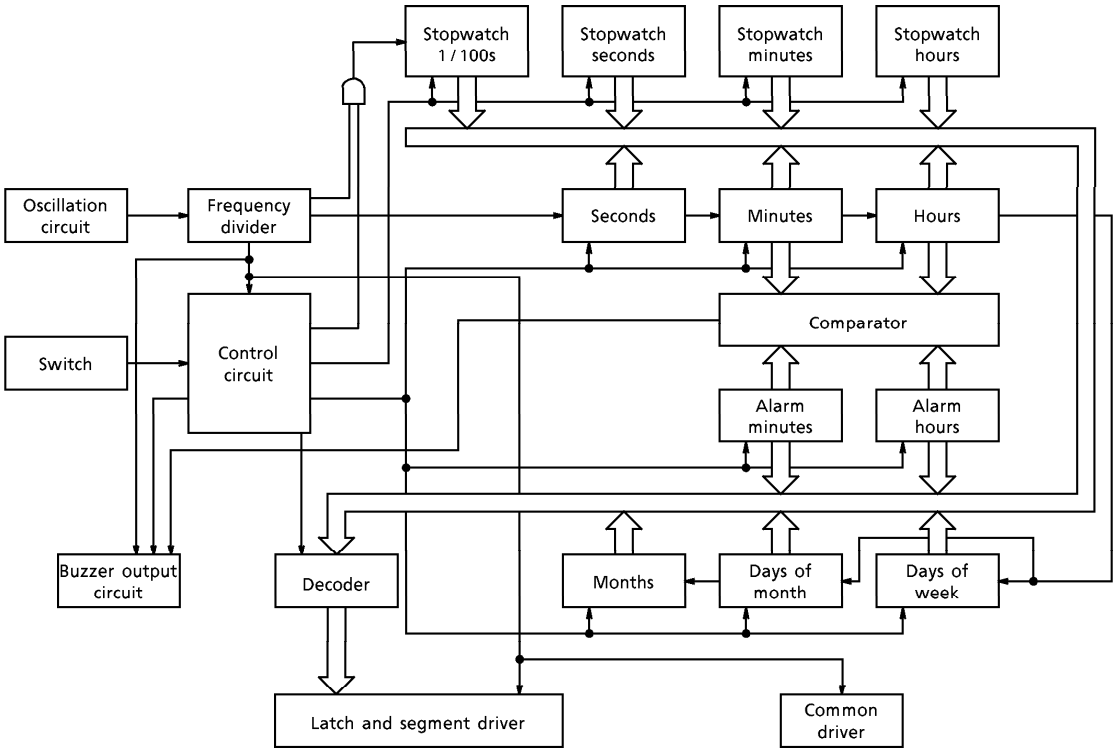
APPLICATIONS

- Watches with alarms and chronographs
- Watches with alarms
- Chronograph watches

FEATURES

- Alarm function with buzzer drive
- Chronograph function with lap recording
- Time signal function
- Display switchable between 12 hour system, or 24 hour system
- Six-digit display, 10 signs, 1/2-duty LCD drive
- Second, minute, hour, day of month, day of week, month recording function. Four-year auto-calendar function
- Chronograph has 1/100 second, second, minute, and hour counter (1/100 second for up to 30 minutes). Counting up to 24 hours with Lap function and Confirmation buzzer sound
- Directly drives buzzer for alarm and time signal (4kHz)
- Low current consumption
- Selectable 1.55V single power supply/3.00V single power supply by bonding
- Three-switch operation
- Built-in voltage doubler/halver circuits
- All display lit function for testing
- Built-in power ON clear function
- Alarm settable in one-minute units (Buzzer sounds for 20 seconds)

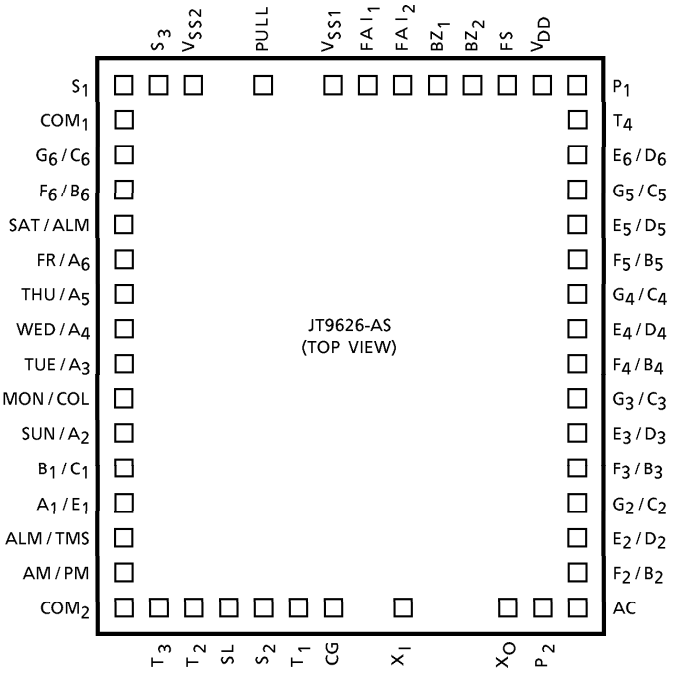
BLOCK DIAGRAM



PIN DESCRIPTIONS (51PINS)

PIN NAME	SYMBOL	No. OF PINS
Power Supply Pins	V_{DD}, V_{SS1}, V_{SS2}, PULL	4
Oscillator Pins	X_I, X_O, C_G	3
Input Pins	$S_{1\sim3}$, SL, P_1, P_2, AC, FS	8
Output Pins	BZ1, BZ2	2
Display Pins	COM_1, COM_2, SEG (26)	28
Test Pins	$T_{1\sim4}$	4
Voltage Doubler / Halver Pins	FAI_1, FAI_2 (256Hz, d.f = 50%)	2

PAD LAYOUT



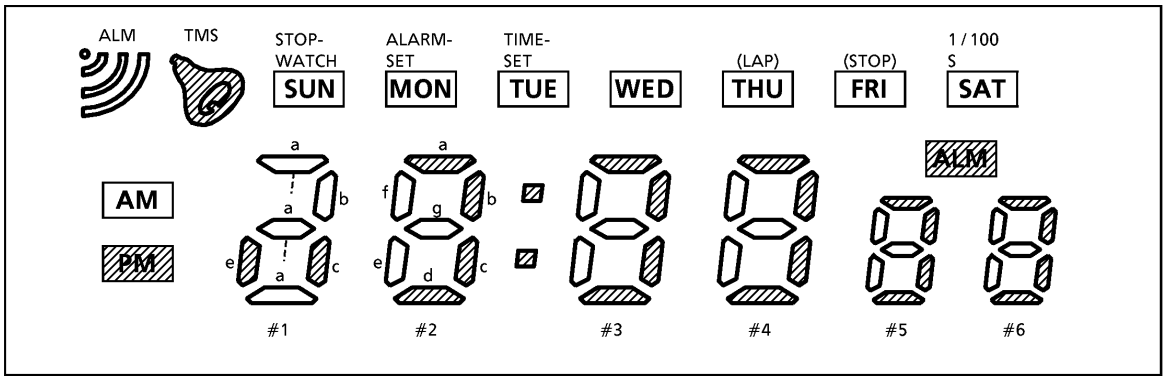
Chip size : 2.70 × 2.75 (mm)
Chip thickness : 300 ± 30 (μm)

PAD LOCATION TABLE

PIN NAME	X POINT	Y POINT	PIN NAME	X POINT	Y POINT
P_1	1211	1232	COM_2	1211	– 1221
T_4	1211	1058	AM / PM	1211	– 1058
E_6 / D_6	1211	895	ALM / TMS	1211	– 895
G_5 / C_5	1211	733	A_1 / E_1	1211	– 733
E_5 / D_5	1211	570	B_1 / C_1	1211	– 570
F_5 / B_5	1211	407	SUN / A_2	1211	– 407
G_4 / C_4	1211	244	MON / COL	1211	– 244
E_4 / D_4	1211	81	TUE / A_3	1211	– 81
F_4 / B_4	1211	– 81	WED / A_4	1211	81
G_3 / C_3	1211	– 244	THD / A_5	1211	244
E_3 / D_3	1211	– 407	FRI / A_6	1211	407
F_3 / B_3	1211	– 570	SAT / ALM	1211	570
G_2 / C_2	1211	– 733	F_6 / B_6	1211	733
E_2 / D_2	1211	– 895	G_6 / C_6	1211	895
F_2 / B_2	1211	– 1058	COM_1	1211	1058
AC	1211	– 1232	S_1	1211	1232
P_2	982	– 1236	S_3	– 982	1236
X_O	819	– 1236	V_{SS2}	– 819	1236
X_I	335	– 1236	PULL	– 445	1236
C_G	– 20	– 1236	V_{SS1}	– 158	1236
T_1	– 183	– 1236	FAI_1	5	1236
S_2	– 420	– 1236	FAI_2	242	1236
SL	– 582	– 1236	BZ_1	405	1236
T_2	– 819	– 1236	BZ_2	642	1236
T_3	– 982	– 1236	FS	804	1236
			V_{DD}	1021	1236

FUNCTION SPECIFICATIONS

1. LCD layout

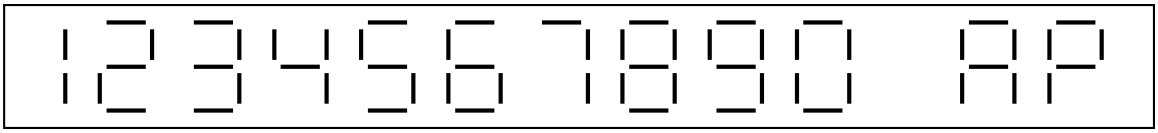


: COM_1
: COM_2

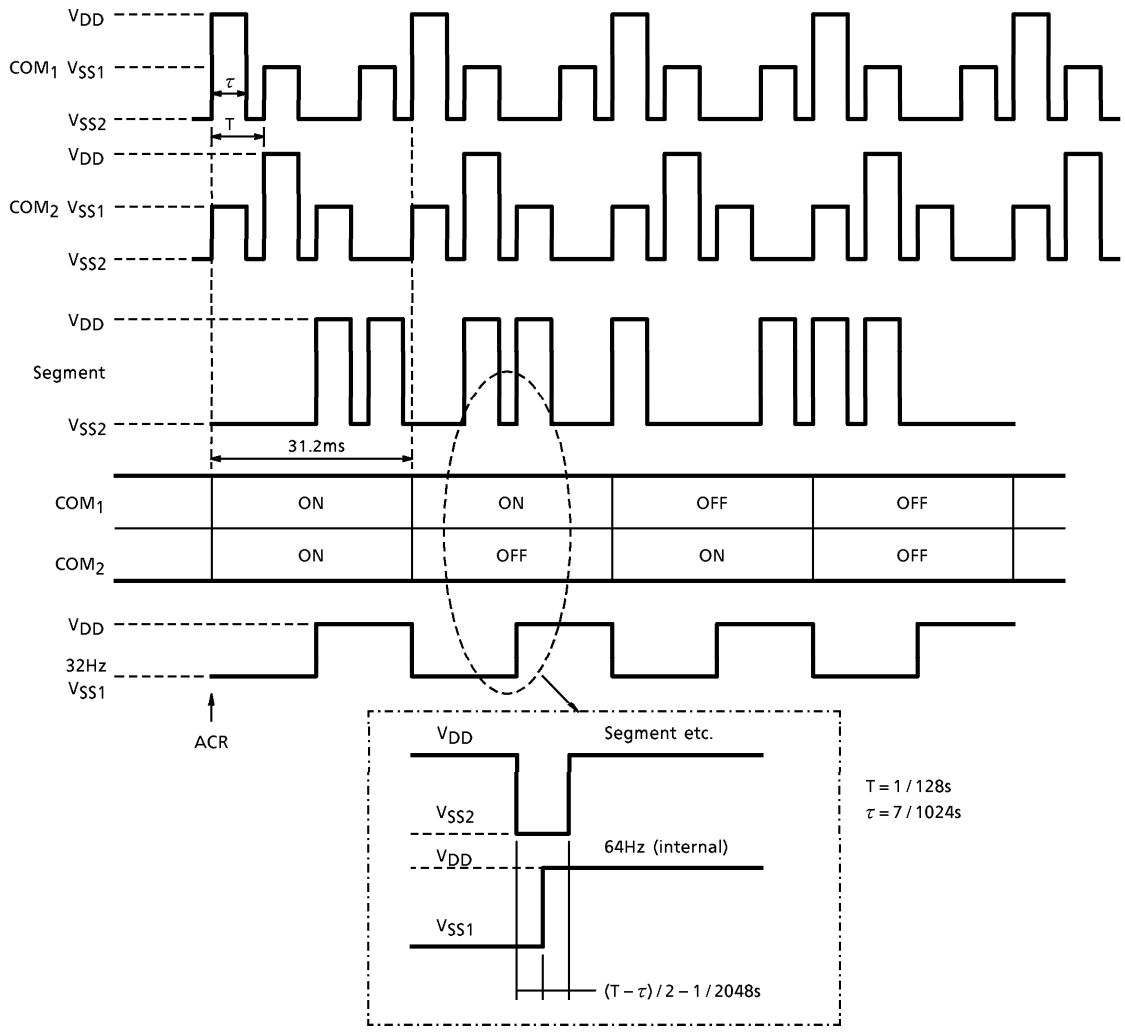
PAD NAME	COM_1	COM_2	PAD NAME	COM_1	COM_2
2F / 2B	2F	2B	AM / PM	AM	PM
2E / 2D	2E	2D	ALM / TMS	ALM	TMS
2G / 2C	2G	2C	1A / 1E	1A	1E
3F / 3B	3F	3B	1B / 1C	1B	1C
3E / 3D	3E	3D	SUN / 2A	SUN	2A
3G / 3C	3G	3C	MON / COL	MON	COL
4F / 4B	4F	4B	TUE / 3A	TUE	3A
4E / 4D	4E	4D	WED / 4A	WED	4A
4G / 4C	4G	4C	THU / 5A	THU	5A
5F / 5B	5F	5B	FRI / 6A	FRI	6A
5E / 5D	5E	5D	SAT / ALM	SAT	ALM
5G / 5C	5G	5C	6F / 6B	6F	6B
6E / 6D	6E	6D	6G / 6C	6G	6C

(Note) This LSI has two pads for alarm sign. Both pads indicate same state. Use the preferred sign. Delete the other sign from the LCD.

2. Display example



3. LCD drive waveform



4. Function selection specifications

The JT9626-AS uses P_1 and P_2 to disable either the chronograph function or the alarm function. Normally, P_1 and P_2 are pulled up to V_{DD} level. Select according to the table below.

P_1	H (OPEN)	With CHRONOGRAPH mode
	L (V_{SS1} or V_{SS2})	No CHRONOGRAPH mode
P_2	H (OPEN)	With ALARM mode
	L (V_{SS1} or V_{SS2})	No ALARM mode

5. Control input specifications

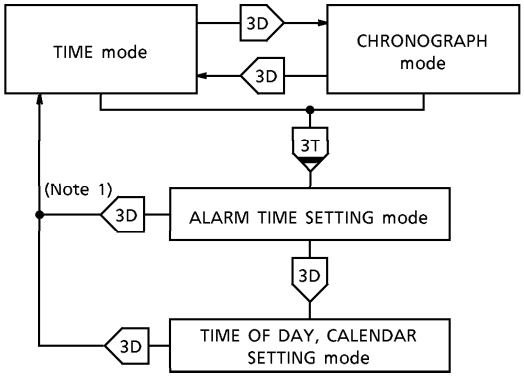
The JT9626-AS is controlled by three switches : S_1, S_2, and S_3.
This control includes both simultaneous pressing, and depressing for two seconds.
The symbols used are shown in the following table.

SYMBOL	OPERATION
1D 2D 3D	S_1, S_2, or S_3 momentary press
1R 2R 3R	S_1, S_2, or S_3 released
1T 2T 3T	S_1, S_2, or S_3 depressed two seconds

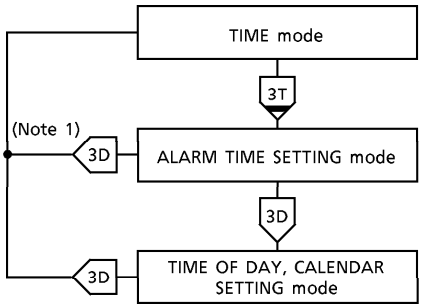
6. Switching Function

Selecting the bonding option

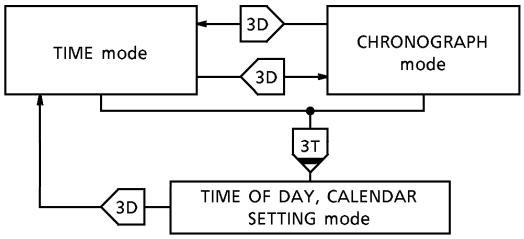
Watch with alarm and chronograph (P_1, P_2 open)



Watch with alarm ($P_1 = V_{SS}$)

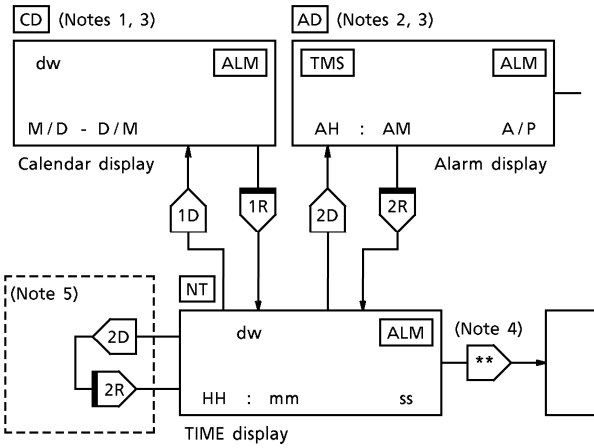


Watch with chronograph ($P_2 = V_{SS}$)



(Note 1) If you press S_3 after using either S_1 or S_2 in alarm time stting mode, the system returns to the time mode.
(Note 2) Most display switching functions can be performed by pressing S_3 momentarily.

Basic switch operation



Alarm / time signal selection by S_1

S_1	ALARM	HOURLY CHIME
1	OFF	OFF
2	OFF	ON
3	ON	ON
4	ON	OFF

(Note 1) In CALENDAR DISPLAY mode (press S_1 and hold in TIME mode), pressing S_2 to switch between month-before-day, or day-before-month display.

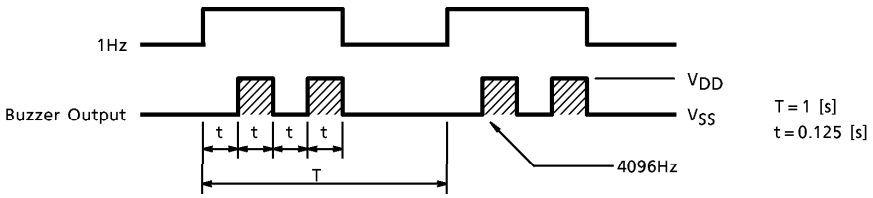
(Note 2) Eath time you press S_1 in alarm display mode, ALARM and TIME signal turn on or off so you can select the desired on / off states as shown in the table above. When ALM sign is lit, the alarm is ON. When the TMS sign is lit, the time signal is ON.

(Note 3) In calender display mode and Alarm display mode, pressing S_3 switches between the 12-hour and 24-hour clock displays.

(Note 4) In TIME mode, pressing S_1 and S_2 at the same time lights all the displays and turns the alarm sound ON. This function is effective for checking modules.

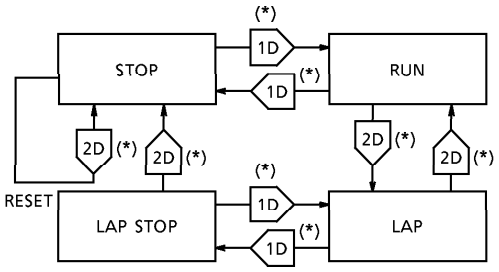
(Note 5) In the chronograph watches (no alarm function), pressing S_2 does not switch to the alarm display.

(Note 6) The alarm sound output waveform is as follows.



7. Chronograph function

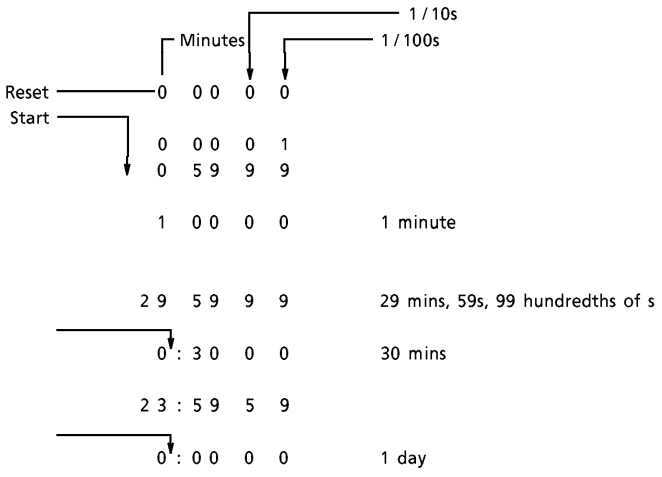
In CHRONOGRAPH mode, pressing S_1 switches between RUN / STOP. Pressing S_2 switches between LAP / LAP RELEASE. In STOP and LAP RELEASE states, pressing S_2 performs a reset. The flow is as follows.



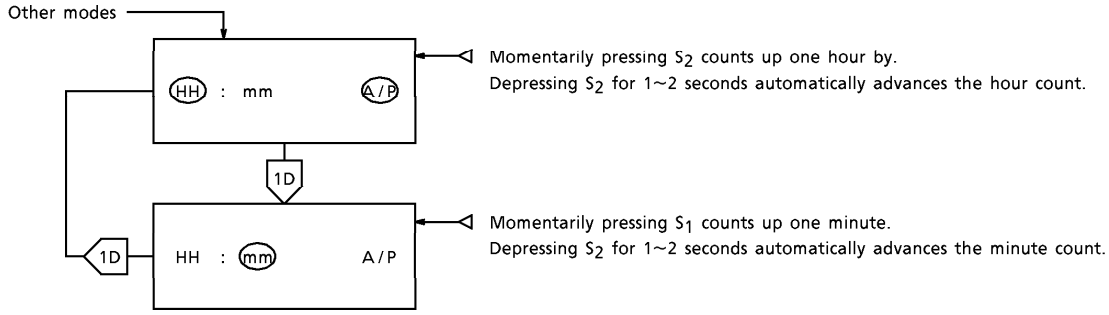
(Note 1) All day of the week marks are lit, with the relevant mark brinking at 2Hz depending on state. When the LAP display or the LAP STOP display are selected, the LAP sign flashes at 2Hz and shows the lap time.
When the STOP display or the LAP STOP display are selected, the STOP sign flashes at 2Hz to show that clocking has stopped.

(Note 2) During 1 / 100 second display, the 1 / 100 second mark continues blinking at 2Hz until the count reaches 30 minutes.

(Note 3) Chronograph display flow



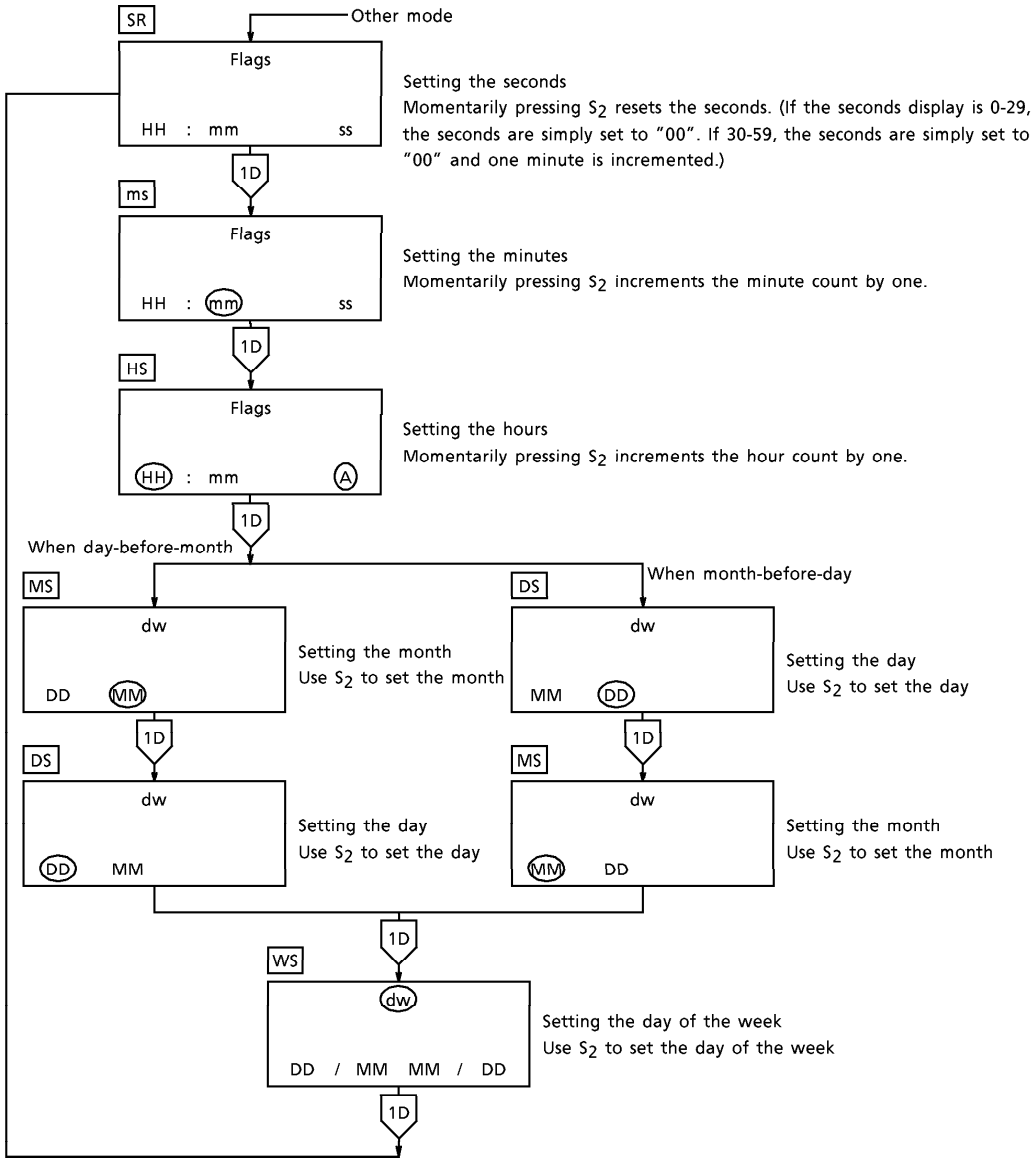
8. Alarm set function



(Note 1) To distinguish between AM and PM, an "A" or a "P" can be displayed in the seconds column. The same is available for the 24-hour SYSTEM.
(Note 2) When the alarm time is set, the alarm is automatically set.
(Note 3) In TIME mode, pressing S_2 while the alarm is sounding stops the alarm.

9. Time / calendar setting function

The following shows the flow when S_1 is momentarily pressed in TIME / CALENDAR SETTING mode.



(Note) In all setting states except for second reset, holding down S_2 automatically advances the count.

10. 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
Power Supply Voltage (1)	V_{SS1}-V_{DD}	−3.0~0.2	V
Power Supply Voltage (2)	V_{SS2}-V_{DD}	−6.0~0.2	V
Operating Temperature	T_{opr}	−10~60	°C
Storage Temperature	T_{stg}	−40~125	°C

ELECTRICAL CHARACTERISTICS

(Unless otherwise stated, V_{DD} = 0V, V_{SS1} = −1.55V, V_{SS2} = −3.0V, Ta = 25°C)

PARAMETER	SYMBOL	TEST CIR-CUIT	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Operating Voltage (1)	V_{SS1}-V_{DD}	1	—		1.25	1.55	2.00	V
Operating Voltage (2)	V_{SS2}-V_{DD}	1	—		2.00	3.00	4.00	V
Output Current (1) (COM)	I_{OH1}	—	V_{SS2} = −3.0V	V_{OH1} = −0.3V	—	—	−70	μA
	I_{OL1}			V_{OL1} = −2.7V	70	—	—	
Output Current (2) (Segment)	I_{OH2}	—	V_{SS2} = −3.0V	V_{OH2} = −0.3V	—	—	−6.0	μA
	I_{OL2}			V_{OL2} = −2.7V	6.0	—	—	
C_D	C_{OUT}	—	—		—	16	—	pF

SILVER OXIDE TYPE (−1.55V)

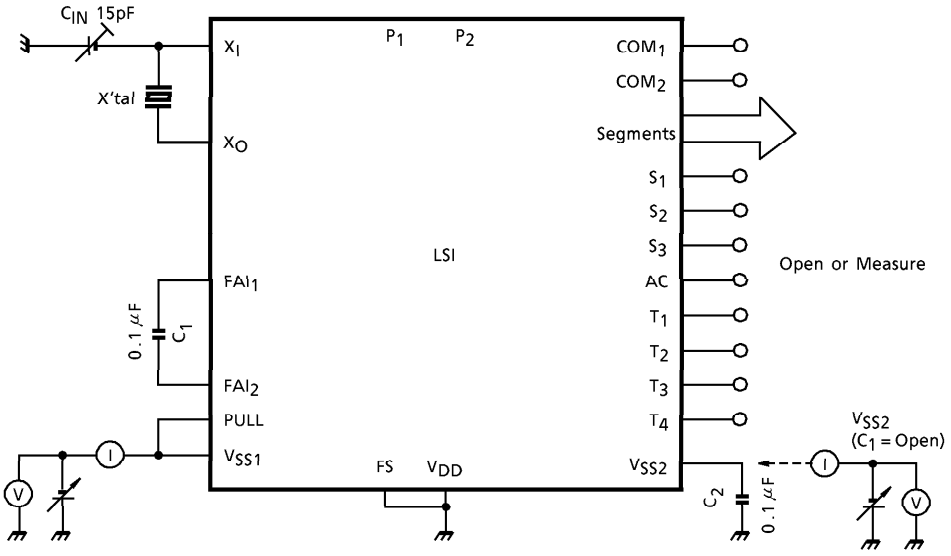
PARAMETER	SYMBOL	TEST CIR-CUIT	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Dissipation Current (1)	$\|I_{sup1}\|$	1	—		—	1.5	2.5	μA
Oscillation Start Voltage (1)	$\|V_{STA1}\|$	1	—		—	—	1.45	V
Output Current (3) (BZ_1, BZ_2)	I_{OH3}	—	V_{SS1} = −1.25V, V_{SS2} = −0.75V	V_{OH3} = −0.5V	—	—	−200	μA
	I_{OL3}			V_{OL3} = −0.75V	200	—	—	
Input Current (1) (S_1~$_3$)	I_{IH1}	—	V_{SS1} = −0.55V	V_{IH1} = 0V	0.3	—	4.4	μA
	I_{IL1}			V_{IL1} = −1.55V	−0.10	—	—	
Input Current (2) (T_1~$_4$)	I_{IH2}	—	V_{IH2} = 0V		—	—	0.1	μA
	I_{IL2}	—	V_{IL2} = −1.55V		−155	—	−10.0	
Input Current (3) (P_1, P_2)	I_{IH3}	—	V_{IH3} = 0V, T_4 = V_{SS1}		—	—	0.1	μA
	I_{IL3}	—	V_{IL3} = −1.55V, T_4 = V_{SS1}		−2.0	—	−0.1	
Input Current (4) (AC)	I_{IH4}	—	V_{IH4} = 0V		10.0	—	155.0	μA
	I_{IL4}	—	V_{IL4} = −1.55V		−0.1	—	—	

LITHIUM TYPE (– 3.0V)

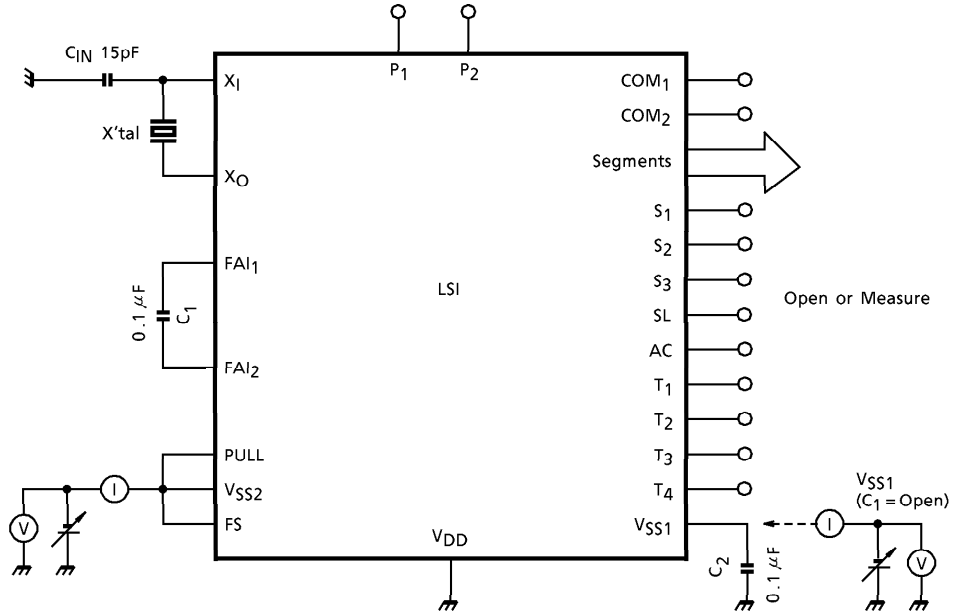
PARAMETER	SYMBOL	TEST CIR-CUIT	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Dissipation Current (2)	$\|I_{sup2}\|$	2	—		—	1.00	1.50	μA
Oscillation Start Voltage (2)	$\|V_{STA2}\|$	2	—		—	—	2.40	V
Output Current (4) (BZ_1, BZ_2)	I_{OH4}	—	V_{SS1} = – 1.25V V_{SS2} = – 2.00V	V_{OH4} = – 0.5V	—	—	– 200	μA
	I_{OL4}			V_{OL4} = – 0.75V	200	—	—	
Input Current (5) ($S_{1\sim3}$, SL)	I_{IH5}	—	V_{IH5} = 0V		5.0	—	18.0	μA
	I_{IL5}	—	V_{IL5} = – 3.00V		– 0.10	—	—	
Input Current (6) ($T_{1\sim4}$)	I_{IH6}	—	V_{IH6} = 0V		—	—	0.1	μA
	I_{IL6}	—	V_{IL6} = – 3.00V		– 300	—	– 7.5	
Input Current (7) (P_1, P_2)	I_{IH7}	—	V_{IH7} = 0V, T_4 = V_{SS2}		—	—	0.1	μA
	I_{IL7}	—	V_{IL7} = – 3.00V, T_4 = V_{SS2}		– 2.0	—	– 0.10	
Input Current (8) (AC)	I_{IH8}	—	V_{IH8} = 0V		7.5	—	300	μA
	I_{IL8}	—	V_{IL8} = – 3.00V		– 0.10	—	—	

TEST CIRCUIT

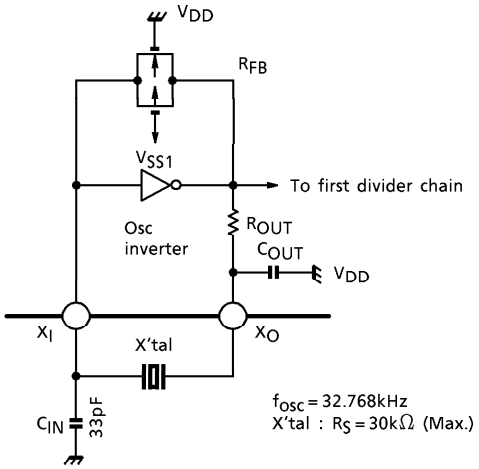
(1) Silver oxide type (– 1.55V)



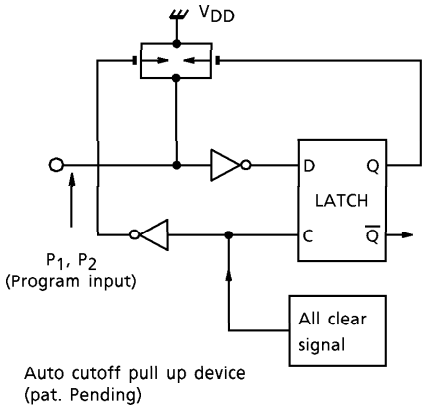
(2) Lithium type (– 3.0V)



(3)

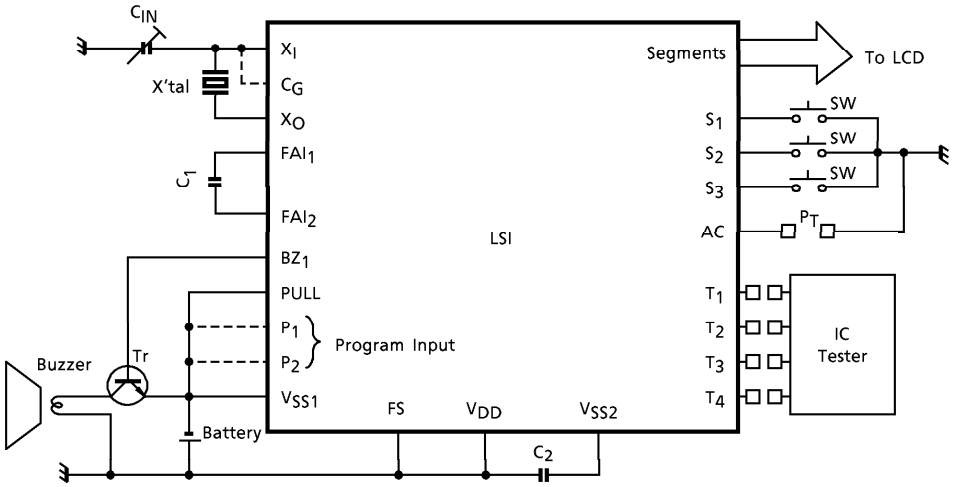


(4)



APPLICATION CIRCUIT EXAMPLE

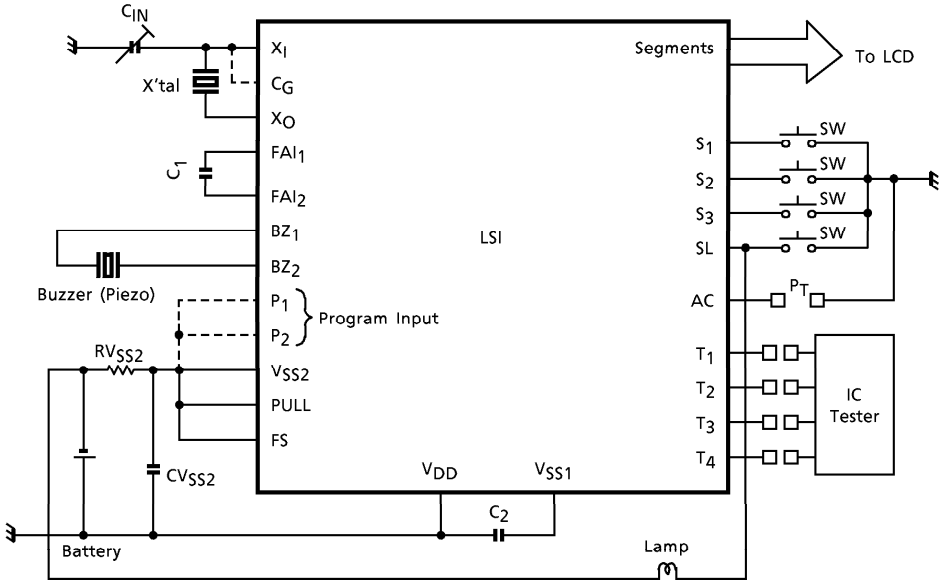
Silver oxide type (– 1.55V)



(Note 1) For specifications featuring an alarm, add a transistor and buzzer.
(Note 2) The FS pin is a bonding option. With silver oxide-type circuits, connect to the V_{DD}.

SYMBOL	SUPPLEMENTARY DESCRIPTION	VALUE	UNIT
C_{IN}	Oscillator stage gate capacitance (Variable)	5 – 33	pF
C_{OUT}	Oscillator stage trend capacitance (Built in)	16 (Typ.)	
C_1	Voltage doubler / halver circuit capacitance	0.1	μF
C_2	Voltage doubler / halver circuit capacitance	0.1	
Battery	Single power supply	1.55 (Typ.)	V
X'tal	f_O = 32.768kHz, R_S = 30kΩ (Max.)	—	—
SW	Push-switch (SPST)	—	—
Tr	Buzzer drive transistor (NPN)	—	—
Buzzer	Magnet buzzer	≒4	kHz
P_T	Manual reset pin	—	—

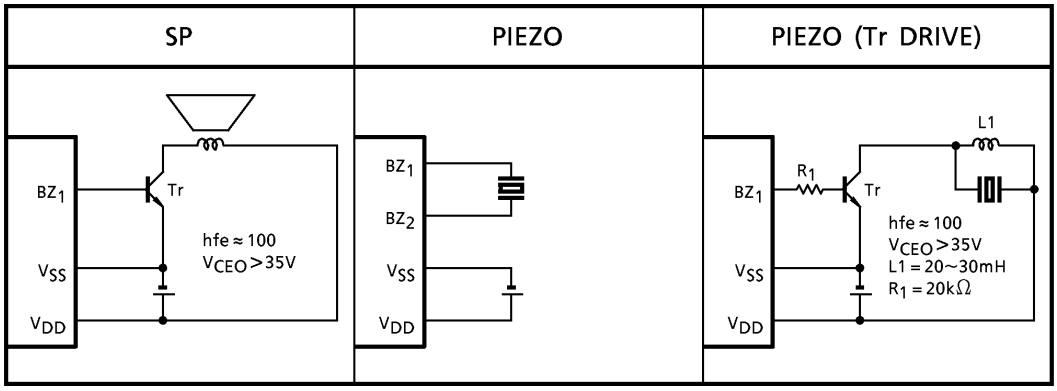
Lithium type (– 3.0V)



(Note 1) For specifications featuring an alarm, add a transistor and buzzer.
(Note 2) The FS pin is a bonding option. With lithium-type circuits, connect to V_{SS2}.
(Note 3) To ensure that the system starts up normally, turn on the SL switch before you actually start up the system after setting the battery in place.

SYMBOL	SUPPLEMENTARY DESCRIPTION	VALUE	UNIT
C_{IN}	Oscillator stage gate capacitance (variable)	5 – 33	pF
C_{OUT}	Oscillator stage trend capacitance (built in)	16 (Typ.)	
C_1	Voltage doubler / halver circuit capacitance	0.1	μF
C_2	Voltage doubler / halver circuit capacitance	0.1	
X'tal	f_O = 32.768kHz, R_S = 30kΩ (Max.)	—	—
SW	Push-switch (SPST)	—	—
Tr	Buzzer drive transistor (NPN)	—	—
P_T	Manual reset pin	—	—
Battery	Internal resistance (– 20°C)	50 (Max.)	Ω
Lamp	Resistance when – 3.0V-drive	500 (Min.)	
RV_{SS2}	Voltage smoothing resistor	1	kΩ
CV_{SS2}	Voltage smoothing capacitance	0.1 (Min.)	μF
Buzzer	Magnet buzzer or piezo buzzer f_O = 4kHz	4	kHz

Buzzer drive application circuit



C_G pin (Bonding option)

If the C_G Pin is bonded instead of the X_I Pin, the built-in capacition (18pF) is connected.