TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

JT6P24-AS

LCD Display 5-Digit Counter LSI

This product is a single-chip CMOS LSI for counters capable of directly driving a 5-digit LCD.

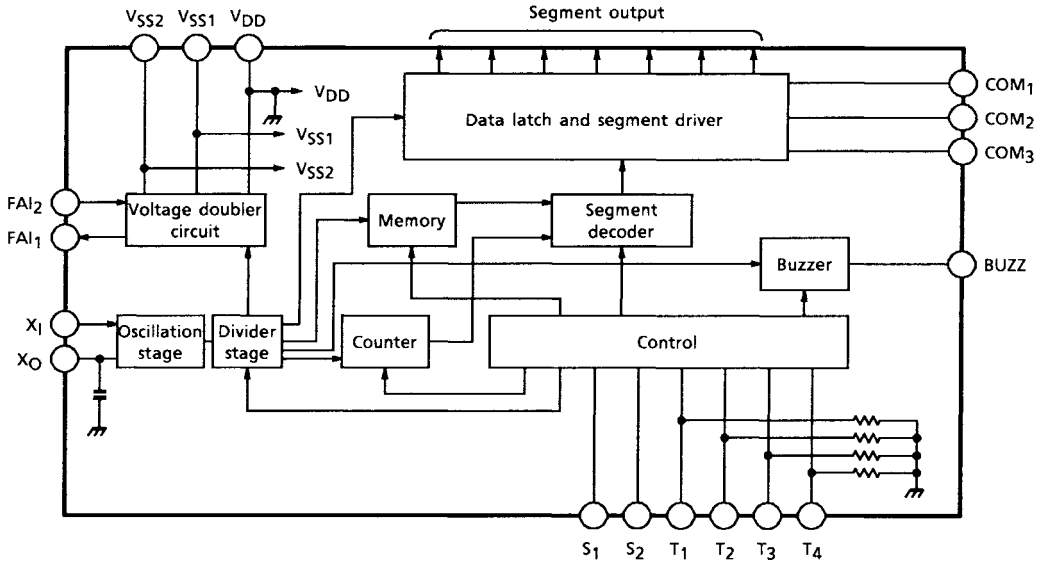
Applications

- Pedometers
- Counters

Features

- 32.768 kHz crystal oscillator
- Counts up to 99999
- 1/3 duty LCD drive, 5-digit display
- Low current consumption (I_{sup} = 3.0 µA max)
- Voltage doubler circuit (two 0.1 µF-external capacitors)

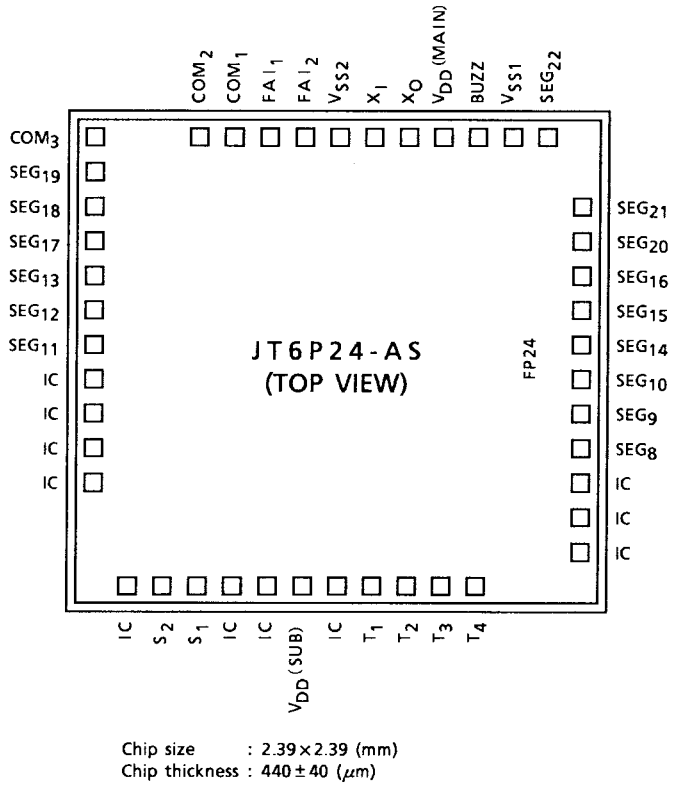
Block Diagram



Pin Descriptions (44 pins)

Pin Name	Symbol	No. of Pins
Power Supply Pins	V_{DD} (2), V_{SS1}, V_{SS2}	4
Oscillator Pins	X_I, X_O	2
Input Pins	S_1, S_2	2
Output Pin	BUZZ	1
Display Pins	$COM_{1\sim3}$, SEG (15)	18
Test Pins	$T_{1\sim4}$	4
Voltage Doubler Pins	FAI_1, FAI_2	2
IC (do not use)	—	11

Pad Layout



Chip size : 2.39 × 2.39 (mm)
Chip thickness : 440 ± 40 (μm)

Note 1: Be sure to connect the V_{DD} (MAIN).

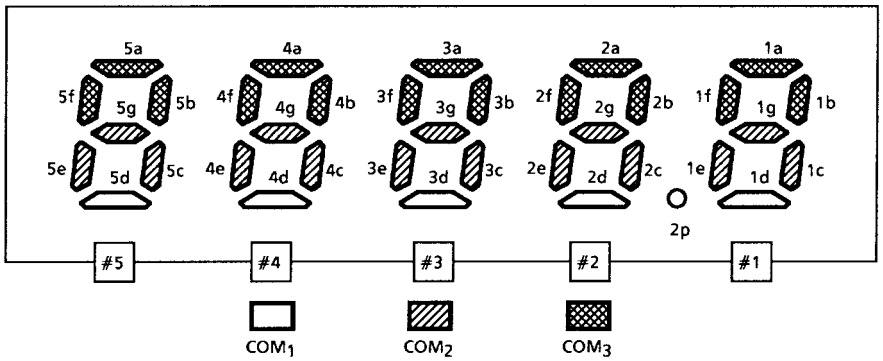
Pad Location Table

(μm)

Pin Name	X Point	Y Point	Pin Name	X Point	Y Point
IC	−1067	−618	SEG_{21}	1067	618
IC	−1067	−455	SEG_{20}	1067	455
IC	−1067	−292	SEG_{16}	1067	292
IC	−1067	−129	SEG_{15}	1067	130
SEG_{11}	−1067	33	SEG_{14}	1067	−33
SEG_{12}	−1067	196	SEG_{10}	1067	−196
SEG_{13}	−1067	359	SEG_9	1067	−359
SEG_{17}	−1067	522	SEG_8	1067	−522
SEG_{18}	−1067	684	IC	1067	−684
SEG_{19}	−1067	847	IC	1067	−847
COM_3	−1067	1010	IC	1067	−1010
COM_2	−618	1067	T_4	618	−1067
COM_1	−455	1067	T_3	455	−1067
FAI_1	−292	1067	T_2	292	−1067
FAI_2	−129	1067	T_1	130	−1067
V_{SS2}	33	1067	IC	−33	−1067
X_I	196	1067	V_{DD} (SUB)	−196	−1067
X_O	359	1067	IC	−359	−1067
V_{DD} (MAIN)	522	1067	IC	−522	−1067
BUZZ	684	1067	S_1	−684	−1067
V_{SS1}	847	1067	S_2	−847	−1067
SEG_{22}	1010	1067	IC	−1010	−1067

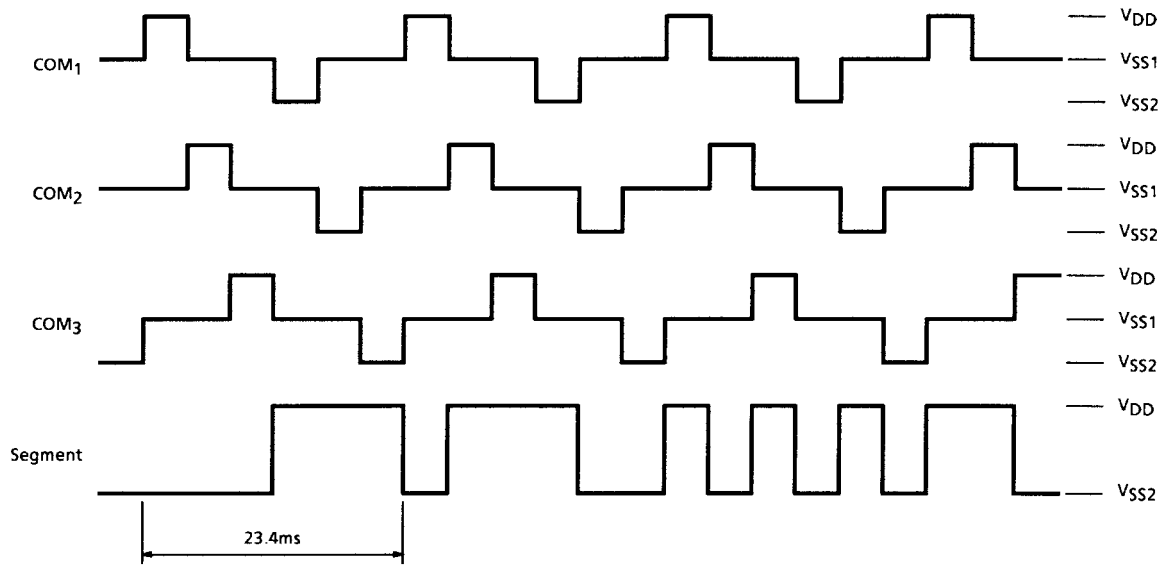
Function Specifications

1. LCD Segment Pattern



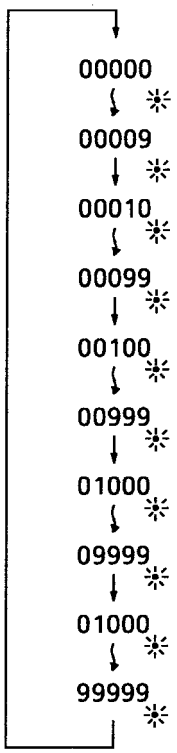
	COM_1	COM_2	COM_3		COM_1	COM_2	COM_3
SEG_8	—	5e	5f	SEG_{16}	—	3c	3b
SEG_9	5d	5g	5a	SEG_{17}	—	2e	2f
SEG_{10}	—	5c	5b	SEG_{18}	2d	2g	2a
SEG_{11}	—	4e	4f	SEG_{19}	2p	2c	2b
SEG_{12}	4d	4g	4a	SEG_{20}	—	1e	1f
SEG_{13}	—	4c	4b	SEG_{21}	1d	1g	1a
SEG_{14}	—	3e	3f	SEG_{22}	—	1c	1b
SEG_{15}	3d	3g	3a				

2. LCD Drive Waveform



3. Display Modes and Display Sequences

Counter display mode



☼: Counter mode sign flashes at 1Hz.

4. Input Setting

S_1, S_2: Normally, pulled down to the V_{SS1} level by external resistance. S_1 and S_2 perform their specified functions when connected to the V_{DD} by an external switch.

5. Input Functions

Counter display	S_1: +1/S_1	Pressing S_1 or S_2 outputs an operating confirmation
	S_2: Count reset	sound from BUZZ. (around 30~60 ms)
		The drive frequency is 4 kHz.

6. 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 (if no temperature stipulations, Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Power supply voltage (1)	V_{SS1}-V_{DD}	−3.0~0.2	V
Power supply voltage (2)	V_{SS2}-V_{DD}	−4.5~0.2	V
Input voltage (1)	V_{IN1}	V_{SS1} − 0.2~V_{DD} + 0.2	V
Input voltage (2)	V_{IN2}	V_{SS2} − 0.2~V_{DD} + 0.2	V
Output voltage (1)	V_{OUT1}	V_{SS1} − 0.2~V_{DD} + 0.2	V
Output voltage (2)	V_{OUT2}	V_{SS2} − 0.2~V_{DD} + 0.2	V
Operating temperature	T_{opr}	−10~60	°C
Storage temperature	T_{stg}	−40~125	°C

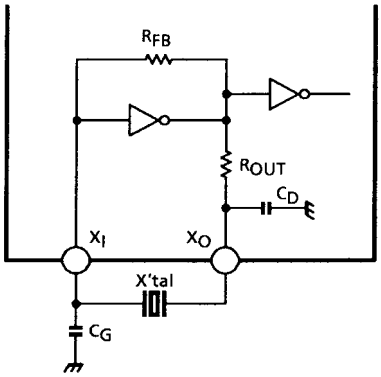
Electrical Characteristics

(unless otherwise stated, V_{DD} = 0.00 V, V_{SS1} = –1.55 V, V_{SS2} = –3.00 V, C_G = 20 pF, C_D = built-in (10 pF), C_{IMAX} = 21 kΩ, F_o = 32768 Hz)

Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Operating voltage	$\|V_{SS1}-V_{DD}\|$	3	—		1.25	1.55	1.80	V
Operating current consumption	$\|I_{sup}\|$	2	No LCD load		—	—	3.0	μA
Oscillation start voltage	$\|V_{STA}\|$	3	t_{STA} 10 s		—	—	1.40	V
Output current (1) Segment	I_{OH1}	4	V_{OH1} = −0.2 V		—	—	−0.5	μA
	I_{OL1}	4	V_{OL1} = −2.8 V		0.5	—	—	
Output current (2) Common	I_{OH2}	4	V_{OH2} = −0.2 V		—	—	−4.0	μA
	I_{OL2}	4	V_{OL2} = −2.8 V		4.0	—	—	
Output current (3) Buzzer	I_{OH3}	4	V_{SS1} = −1.25 V	V_{OH3} = −0.5 V	—	—	−100	μA
	I_{OL3}	4	V_{SS2} = −2.8 V	V_{OL3} = −0.75 V	100	—	—	
Input current (2) T_1, T_3, T_4	I_{IH2}	4	V_{IH2} = 0 V		—	—	0.1	μA
	I_{IL2}	4	V_{IL2} = −1.55 V		—	−50	—	
Input current (3) T_2	I_{IH3}	4	V_{IH3} = 0 V		—	—	0.1	μA
	I_{IL3}	4	V_{IL3} = −1.55 V		−15.5	—	—	
Input current (4) S_1, S_2	I_{IH4}	4	V_{IH4} = 0 V		—	—	0.1	μA
	I_{IL4}	4	V_{IL4} = −1.55 V		−0.1	—	—	
Voltage doubler output	$\|V_{uco}\|$	2	C_1 = C_2 = 0.1 μF, R_L = 3 MΩ		3.0	—	—	V

Test Circuit

1. Oscillation Circuit



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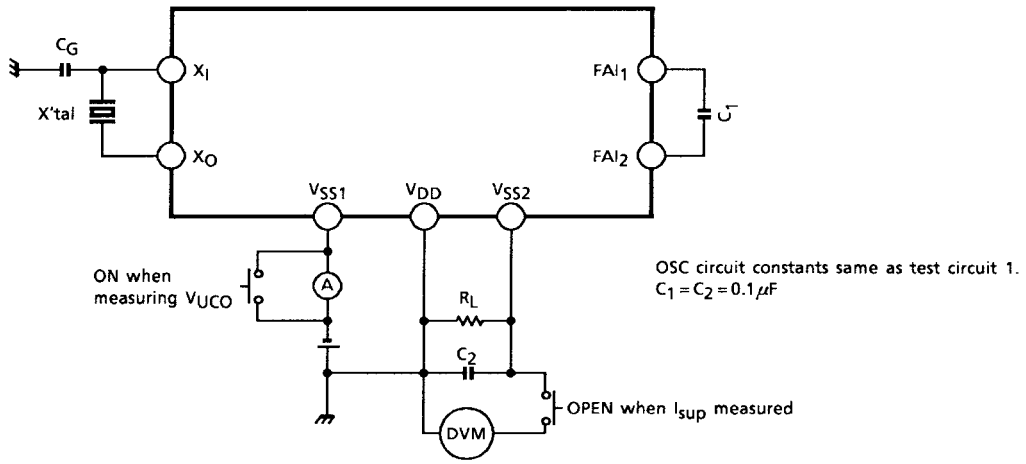
R_S = 21 kΩ

F_0 = 32.768 kHz

C_G = 20 pF

C_D = 10 pF built in

2. Measuring I_{sup} and V_{UCO}



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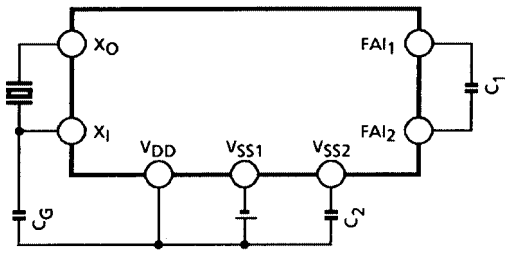

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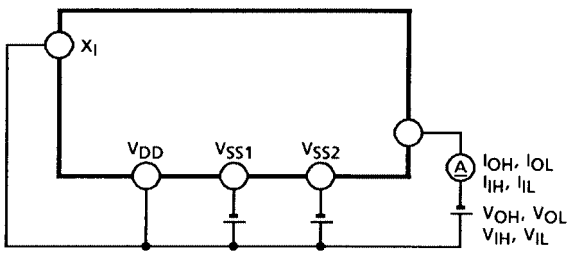
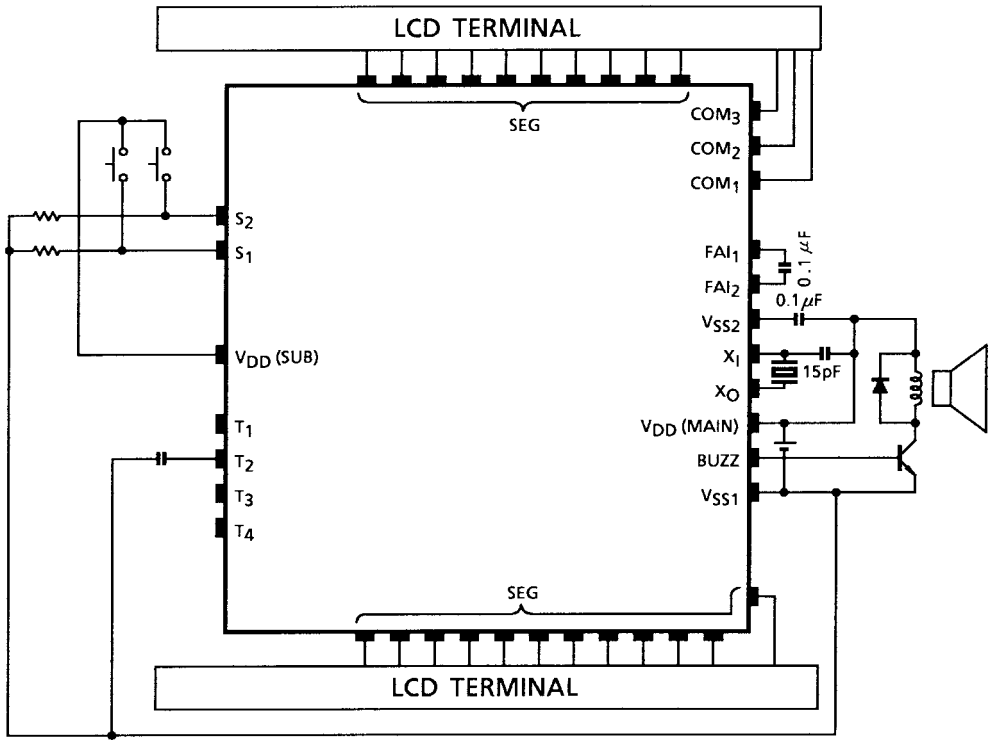


Application Circuit Example



Note 2: Be sure to connect the V_{DD} (MAIN).

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