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12- channel self-correcting capacitive touch sensor chip Specifications

1. Overview

XW12C is a 12-button capacitive touch sensor chip, which can replace mechanical touch buttons to achieve an integrated sealing beauty View the appearance. Two-wire serial output; AO button analog voltage output for customers to choose and apply flexibly. Key effective indication and The buzzer output of 2.7KHz simplifies the peripheral circuit. XW12C chip has SOP24 and SSOP_24 (0.635) two kinds of seals Installation specifications.

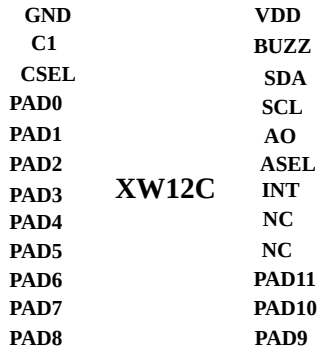
1.1 Application

◆ Used in TVs, stereos, monitors, toys and other home appliances and entertainment equipment and industrial control equipment

1.2 Features

- Extremely high sensitivity, can penetrate 13mm glass and sense the touch of a finger
- Super anti-interference and ESD ability, can pass the human body 8000v test without adding any components
- The peripheral circuit is simple, at least a 4.7nf capacitor is required, and the chip can work normally
- Automatic correction of peripheral parasitic capacitance
- Multi-channel common sensitivity capacitor
- Operating voltage range: 2.5 ~ 5.5V
- SOP24 environmental protection package

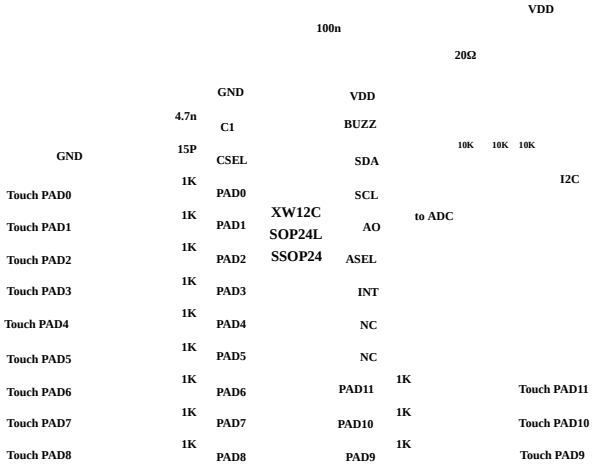
1.3 Package



1.4 Pin definition

NO.	PADNAME	Descrption	NO.	PADNAME	Descrption
1	GND	Power ground	**twenty four**	VDD	Positive power
2	C1	Internal balance capacitor interface	**twenty three**	BUZZ	Buzzer drive output, drive frequency Rate 2.7 KHz
3	CSEL	Sensitivity adjustment capacitor interface	**twenty two**	SDA	I2C data input and output
4	PAD0		**twenty one**	SCL	I2C clock input
5	PAD1		**20**	AO	Analog voltage output, when there is no button Output VDD
6	PAD2		**19**	ASEL	I2C address selection
7	PAD3	Touch button (no Time dangling)	**18**	INT	Key output (Open drain OD output)
8	PAD4		**17**	NC	Internal test pin (floating)
9	PAD5		**16**	NC	Internal test pin (floating)
10	PAD6		**15**	PAD11	
11	PAD7		**14**	PAD10	Touch button (hanging when not in use)
12	PAD8		**13**	PAD9	

1.5 Typical application



1. C1 is the internal balance capacitor, the value range is 1nf~10nf. It is recommended to use 4.7nf.

2. CSEL is the sensitivity setting capacitor, the minimum value is 15pf, and the maximum value is 100pF. The selection of the capacitor is based on the application environment. The size of the touch sensitive disk is considered a compromise.

2. Absolute maximum

parameter	Scope	unit
VDD voltage	-0.3~6.0	V
Input and output voltage	-0.3~6.0	V

range of working temperature	-40~85	℃
Storage temperature range	-55~150	℃
ESD, HUM	≥8000	V

3. Electrical parameter characteristics **(** no special instructions, **Ta=25** ℃, VDD=5V **)**

symbol	Parameter Description	condition	Minimum	Typical Value	Maximum	Unit
VDD	Operating Voltage		2.5		5.5	V
I _sleep	Sleep mode operating current			90		uA
I_vdd	Working current	VDD=3.0V		0.8		mA
		VDD=5.0V		1.6		mA
T_init	Power-on initialization time			400		mS
CSEL	Sensitivity capacitance		0		100	pF
C_in	Chip sensing capacitance range		0.2		200	pF
F_br	I2C maximum baud rate			400		KBit/S
F_buzz	Buzzer drive frequency			2.7		KHz
I_source	Buzzer drive source current	VDD=5.0V		30		mA
I_sink	Buzzer drive current sink	VDD=5.0V	30	40		mA
Z_AO	Analog voltage output internal resistance		20	25	30	kΩ

4. Function description

4.1 Initialization

After the chip is powered on and reset, it only takes about 400mS to calculate the environmental parameters and automatically calibrate the button trace length.
The detection function starts to work.

4.2 Automatic correction function

The chip has a built-in automatic correction function. The chip can automatically adjust the size of the capacitor according to the changes in the external environment.
When the key is pressed, the automatic calibration stops and enters the key judgment process. From the detection of the key, after about 30~60 seconds, the chip
Re-entering the auto-calibration state means that the effective time of detecting the button is 30~60 seconds, and the button time exceeds this time.
The button is invalid, and the sensing capacitance is included in the external environment capacitance.

4.3 Key valid indication

The INT pin of the chip is a valid indication of the button. The internal structure is NMOS open-drain output, and the output is low power when any button is pressed
Flat, high resistance when no button is pressed.

4.4 Analog voltage output

The chip integrates an analog voltage output circuit. When using the analog voltage output, a single key is used for effective output. When multiple keys are pressed at the same time

When pressed, the AO port will respond to the highest-level keys with decreasing priority from PAD0 to PAD11.
The corresponding relationship between buttons and voltage is shown in the table:

button	Analog voltage value
No buttons	VDD
PAD0	2/16*VDD
PAD1	3/16*VDD
PAD2	4/16*VDD
PAD3	5/16*VDD
PAD4	6/16*VDD
PAD5	7/16*VDD
PAD6	8/16*VDD
PAD7	9/16*VDD

PAD8	10/16*VDD
PAD9	11/16*VDD
PAD10	12/16*VDD
PAD11	13/16*VDD

4.5 Buzzer drive circuit

The chip integrates a buzzer drive circuit, which outputs a square wave with a fixed switching frequency of 50ms, which can directly drive the buzzer.
Save the external square wave signal generating circuit and buzzer drive circuit, reduce the application cost of the system, simplify the system design, according to
The system needs to be able to connect an external drive circuit to increase the drive capacity and adapt to a buzzer with higher power.

4.6 I2C interface

XW12C supports I ₂ C bus transfer protocol. I ₂ C is a two-way, two-wire communication interface, which is the serial data line SDA
And the serial clock line SCL. Both wires must be connected to power through a pull-up resistor. XW12C only supports read operations.

The device that sends data on the bus is called a transmitter, and the device that receives data is called a receiver. Control information exchange
The device is called the master device, and the device controlled by the master device is called the slave device. The master device generates the serial clock SCL to control
Bus access status, START and STOP conditions are generated. The XW12C chip works as a slave device in the bus.

Only when the bus is in an idle state can data transmission be started. Each data transfer starts with the START condition,
It ends with a STOP condition. The information is transmitted in bytes (8 bits), and the receiver generates a response at the 9th bit.

4.6.1 Start and stop conditions

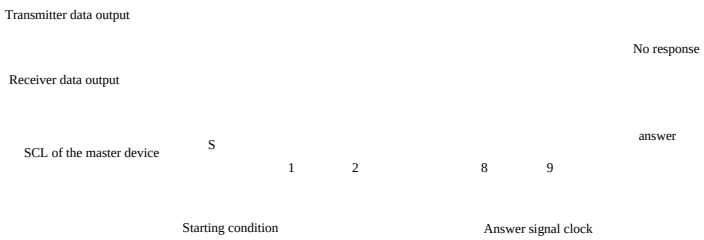
If the data and clock lines are both high, it is said that the bus is in an idle state. When SCL is high, the falling edge of SDA (high to low)
It is called the start condition (START, abbreviated as S), and the rising edge (low to high) of SDA is called the stop condition (STOP, abbreviated as S).
Written as P).

4.6.2 Bit transmission

Each clock pulse transmits one bit of data. SDA must remain stable when SCL is high, because the change of SDA is recognized at this time
It is a control signal. Bit transfer see figure

4.6.3 Response

The receiver on the bus generates a response every time it receives a byte, and the master device must generate a corresponding additional Clock pulse, see



The receiver pulls down the SDA line to indicate a response, and maintains a stable low level during the response pulse. When the master device is receiving It must signal the end of data transmission to the transmitter, that is, it will not be during the response pulse after the last byte.
A response signal will be generated (do not pull down SDA). In this case, the transmitter must release the SDA line high so that the master device can generate Stop condition.

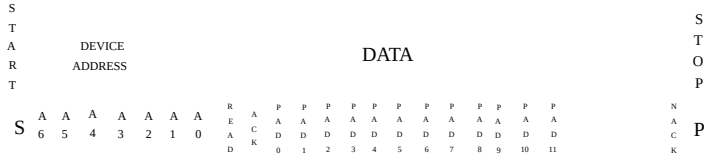
4.6.4 Device addressing

After the chip read and write operations are enabled by the initial condition, the master device requires 8-bit device address information, which is added by the 7-bit chip address.
The 1bit READ command is composed, and the specific values are shown in the table below. The address of XW12C is determined by the voltage of ASEL, and the specific values are sho

ASEL voltage	High level	Low level	Hang in the air
Chip address A[6:0]	44H	42H	40H
Read command A[6:0]+R/W	89H	85H	81H

4.6.5 Complete communication process

The following figure shows the communication process of XW12C for a complete reading of data. The master device sends a start signal first, and then sends Send 8-bit device address (7-bit chip address + 1 bit read command); when the slave device gives 1 bit "0" as the response signal, the master device Start to read 16bit button data {button data (PAD0~PAD11) button data, +4bit "1111"}, then the master device Send 1 bit "1" for no response signal and immediately send a stop signal to end the communication process. When the button is pressed, the corresponding The data of PAD is 0. For example, if PAD7 is pressed, the data read by PAD7 in the figure is low level, otherwise it is high level.



4.7 Sleep mode

In order to reduce the standby power consumption of the chip, SDA is high and no buttons are detected within 90S, the chip enters sleep mode. Electric mode. The sampling interval time of the button becomes longer, the VDD current is reduced, and the power consumption of the chip is reduced. In sleep mode, once detected When the button is pressed, the chip immediately exits the sleep mode and enters the normal working mode.

If you need to cancel the sleep mode and keep the chip in a working state for a long time, you only need to switch on the SDA pin every 20s. Within the interval, pour a low-level signal into the SDA pin of the chip.

5 Peripheral circuits and precautions

The peripheral circuit of XW12C is very simple, only a few capacitance and resistance components are needed. 1.5 is the typical application circuit of XW12C.

5.1 Internal balance capacitor and sensitivity adjustment capacitor

The C1 capacitor and CSEL capacitor are recommended to use NPO capacitors with an accuracy of 10%. When laying out the PCB board, please use the C1 capacitor Place the CESL capacitor as close to the IC as possible.

5.2 Sensitivity capacitance and button detection **PAD** size and dielectric material and thickness selection

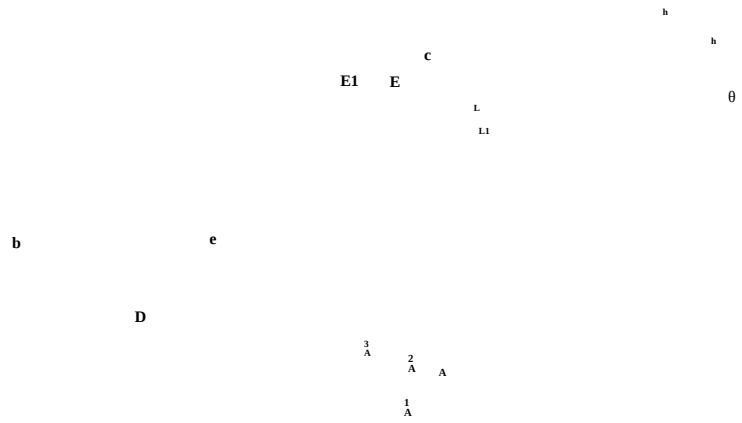
Commonly used media include glass, acrylic, plastic, ceramics, etc., users can choose according to their actual usage Appropriate material and thickness, according to different materials and PCB layout to determine the size of the button PAD and capacitance CSEL value. The thicker the isolation medium, the smaller the CSEL capacitance required (increase the sensitivity of detection), and at the same time it is required to increase appropriately Press the key to detect the area of the PAD. On the contrary, the thinner the isolation medium is, the CSEL capacitance should be appropriately increased to increase the anti-interference at It is generally recommended to choose a suitable capacitor between 0 and 100pF from small to large.

Under normal circumstances, the area of the key detection PAD can be between 3mm*3mm~30mm*30mm. The area remains the same to ensure the same sensitivity. The capacitance sensor can be any shape of conductor, it is recommended to use a diameter larger than A 10mm round metal sheet or a square metal sheet with a side length of 10mm. Commonly used induction disks are copper foil, flat Top cylindrical spring, metal sheet and conductive rubber, etc.

5.3 Precautions for **VDD** supply voltage

XW12C measures small changes in capacitance. The ripple and noise of the power supply are required to be small, and attention should be paid to avoid the intrusion of the power supply. Strong external interference. Especially when used in a high-noise environment, it must be able to effectively isolate external interference and voltage mutations, requiring power It has a high degree of stability and should be as far away as possible from the device area with high voltage and high current or shielded. If the amplitude of the power wave is large, It is recommended to do special treatment to the power supply, such as adding filtering or using a voltage stabilized circuit composed of 78L05. In some specific applications In occasions, keep the touch circuit as far away as possible from certain functional circuits, such as radio, RF, etc.

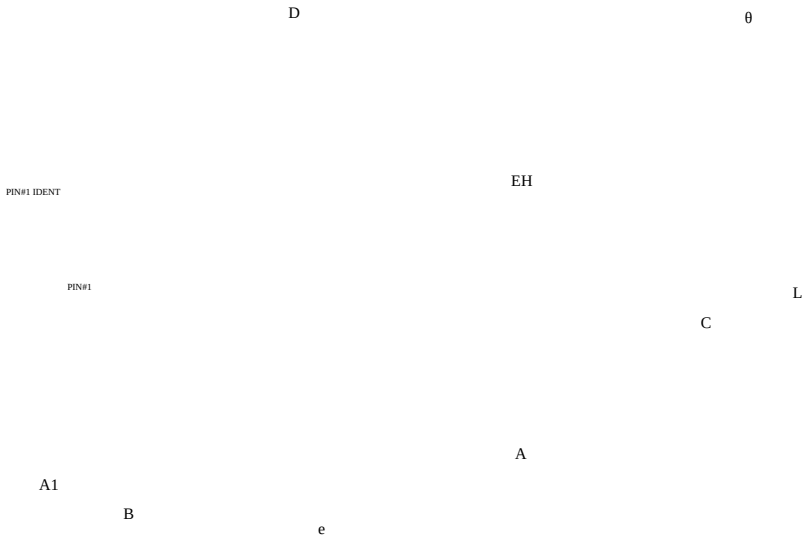
6. Package size information **(SOP24L)**



Symbol	Dimensions In Millimeters		
	MIN	TYP	MAX
A	2.36	2.54	2.64
A1	0.1	0.2	0.3
A2	2.26	2.3	2.35
A3	0.97	1.02	1.07
b	0.39	---	0.48
b1	0.38	0.41	0.43
c	0.25	---	0.31
c1	0.24	0.25	0.26
D	15.2	15.4	15.6
E	10.1	10.3	10.5
E1	7.4	7.5	7.6
e		1.27BSC	
L	0.7	---	1
L1		1.40BSC	
h	0.25	---	0.75
θ	0	---	8 °

Note : BSC: Basic Spacing between Centers, the width between IC pins.

Package Dimensions (SSOP-24) (0.635)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.25	1.55	0.049	0.061
A1	0.05	0.25	0.002	0.010
B	0.194	0.314	0.008	0.012
C	0.15	0.25	0.006	0.010
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.015	0.157
e	0.635		0.025	
H	5.70	6.30	0.224	0.248
L	0.30	0.90	0.012	0.035
θ	0°	7°	0°	7°