CST816S Datasheet

High performance self-capacitance touch chip

Rev： V1.4

1. Overview

CST816S self-capacitance touch chip, using high-speed MCU core and embedded DSP circuit, combined with its own fast self-capacitance sensing technology, support a variety of self-capacitance patterns including triangles, and realize single-point and real two-point gestures on it. It features extremely high sensitivity while very low standby power consumption.

2. Chip Characteristics

- **Built-in fast self-capacitance detection circuit and high-performance DSP module**
  - Support online programming;
  - Built-in watchdog;
  - Multiple buttons support;
  - Support standby gesture wake-up function.

- **Capacitive screen support**
  - Support up to 14 sensing channels;
  - Support channel floating/pull-down design;
  - Module parameters are automatically adjusted.

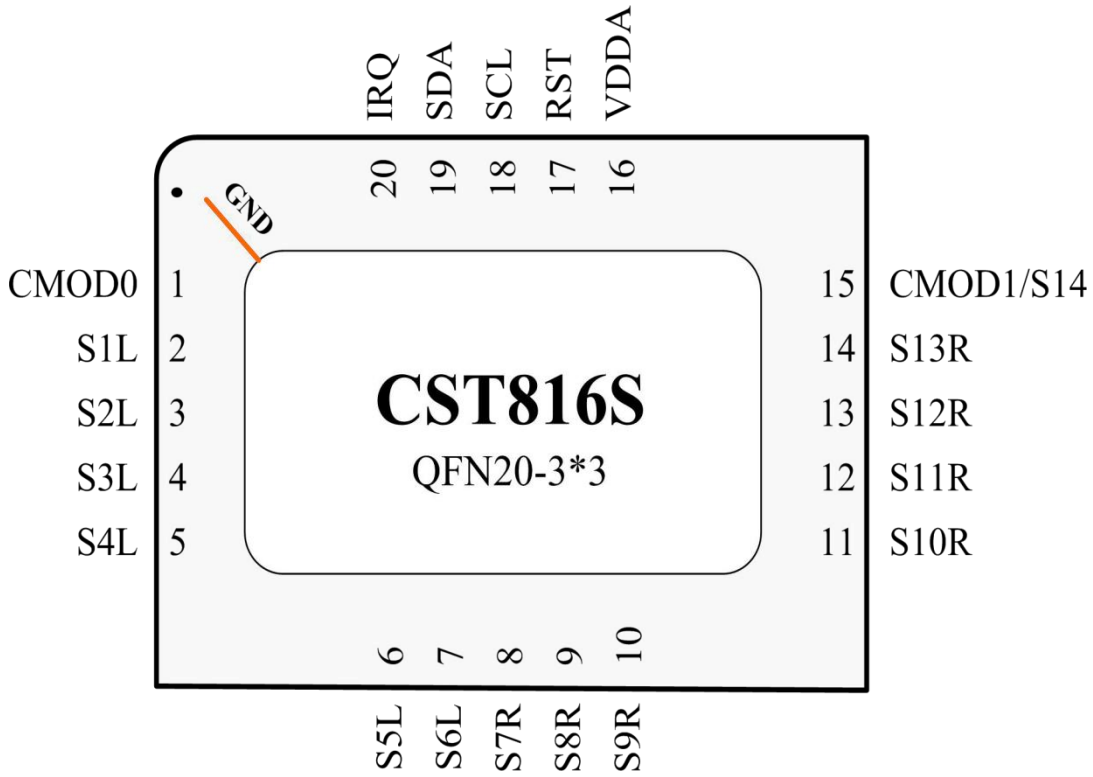
- **Performance**
  - Refresh rate >100Hz;
  - Single point gesture and real two-point operation;
  - Typical power consumption in dynamic mode < 1.6mA;
  - Typical power consumption in standby mode <6.0uA;
  - Typical power consumption in sleep mode <1.0uA.

- **Communication interface**
  - I2C master/slave communicating interface, configurable rate range 10Khz~400Khz;
  - Compatible with 1.8V/3.3V interface levels.

- **Power supply**
  - Single power supply range 2.7V~3.6V, power supply ripple <=50mv

- **Package type**: QFN20 3mm*3mm*0.55mm (pitch 0.4mm)

3. Pinout/Description



Name	Description	Remarks
S1~S13	Sensing channels	
VDDA	Power supply	2.7V~3.6V, connect 2.2uF~10uF capacitor
CMOD0	Stabilizing capacitor	Connect 1nF~5.6nF stabilizing capacitor
CMOD1/S14	Stabilizing capacitor/Multiplexed sensing channels	Connect 1nF~5.6nF stabilizing capacitor, or can be multiplexed sensing channels
IRQ	Interrupt output	Up/Down edge optional
SCL/SDA	I2C	Optional internal pull-up/open drain mode
RST	Reset input	Low active

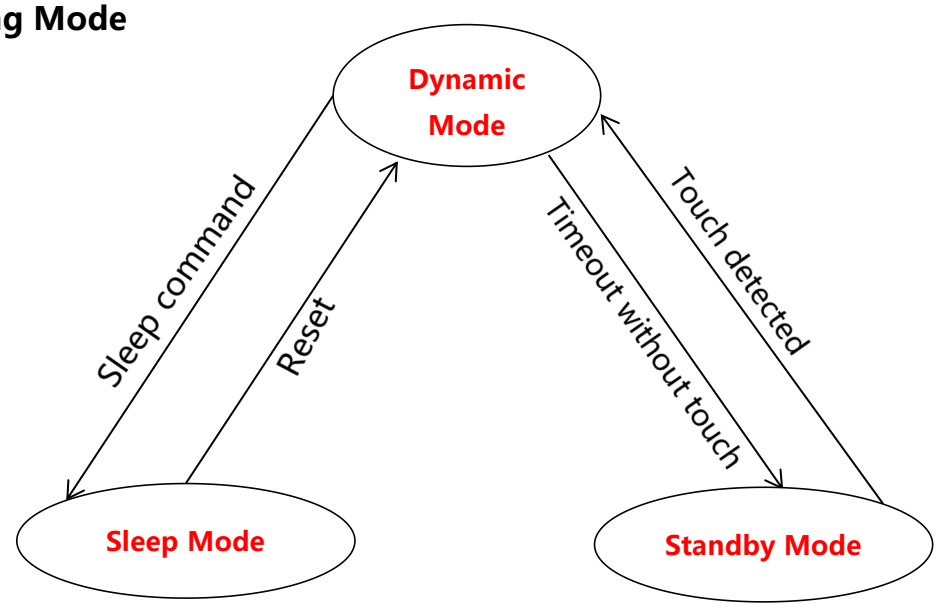
Remarks:

1. CMOD0 must be connected to a stabilizing capacitor, and the size is 1nF ~ 5.6nF;
2. When Pin15 is used as CMOD1, it must be connected to a 1nF ~ 5.6nF stabilizing capacitor.

4. Functional Description

CST816S self-capacitance touch chip, through its built-in fast self-capacitance sensor module, can realize single-point and real two-point gestures on triangles and other patterns without any external devices (except circuit bypass capacitor); the chip has excellent anti-noise, waterproof and low-power performance while achieving rapid response.

4.1 Operating Mode



- Dynamic mode

  When there is frequent touch operation, it is in this mode. In this mode, the touch chip quickly performs self-capacitance scanning on the touch screen, to detect the touch and report it to the host.

  After not touching 2S, automatically enter standby mode. The function of automatically entering standby mode can be controlled by register.

- Standby mode

  In this mode, the touch chip scans the touch screen at a lower frequency, and enters the dynamic mode after detecting the finger. At the same time, the touch chip wakes up the host through the IRQ pin or switches to dynamic mode through the reset pin.

- Sleep mode

  After receiving the sleep command, the chip is in this mode. In this mode, the touch chip is in a deep sleep state to maximize power consumption and can be switched to the dynamic mode by the reset pin.

4.2 Channels/Nodes Configuration

As the CST816S self-capacitance touch chip supports up to 13 sensing channels, each channel can support self-capacitance scanning without any external devices.

Self-capacitance range supported by each channel: 1pF ~ 400pF.

4.3 Power on/Reset

The built-in power-on reset module will keep the chip in reset until the voltage is normal. When the voltage is lower than a certain threshold, the chip will also be reset. When the external reset pin RST*n* is low, the whole chip will be reset. This pin has a built-in pull-up resistor and RC filter, and the built-in watchdog ensures the chip can return to normal operation within the specified time when an abnormal situation occurs.

4.4 Low-power Mode

CST816S touch chip supports the following low-power modes:

- Sleep mode: After the host sends a sleep command to the chip, the chip will immediately enter deep sleep state so as to achieve the lowest power consumption. After resetting, the chip will wake up and enter dynamic mode.
- Standby mode: In this mode, the chip is always at a lower frequency for minimal scanning to match predefined wake gestures.

4.5 II2C Communication

The chip supports the standard I2C communication protocol, which can achieve the 10KHz~400KHz compatible communication rate.

Two I2C pins, SCL and SDA, support both open drain mode and internal pull-up mode for flexible selection.

4.6 Interrupt Mode

The touch chip only informs the host to read valid data through the IRQ pin when it detects a valid touch and needs to report it to the host, so as to improve the efficiency and reduce CPU load.

The interrupt edge can be configured as a rising edge or a falling edge as needed.

The IRQ pin is also used to wake up the host when matching predefined gestures in standby mode.

4.7 IIC Interface Description

The chip itself supports IIC operation, and can also use IIC pins to implement simple IO operations. Specific functions can be customized by the software according to specific projects.

a. Device IIC address

The 7-bit device address of the chip is generally 0x15, that is, the device write address is 0x2A, and the read address is 0x2B.

The device address of some projects may be different, please consult the corresponding projects and engineering personnel.

b. IIC communication rate

For reliable communication, it is recommended to use a maximum communication rate of 400Kbps.

c. Write a single byte

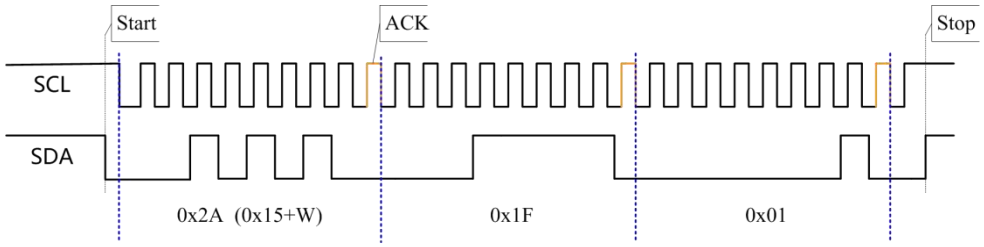


Figure 6. *Write 0x01 to the 0x1F register*

d.Write multiple bytes consecutively

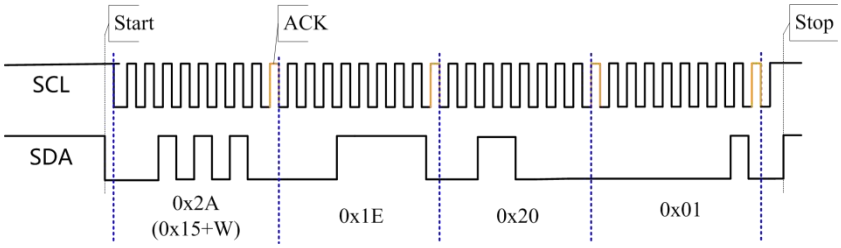


Figure 7. *Write 0x20, 0x01 to 0x1E, 0x1F respectively*

e. Read a single byte

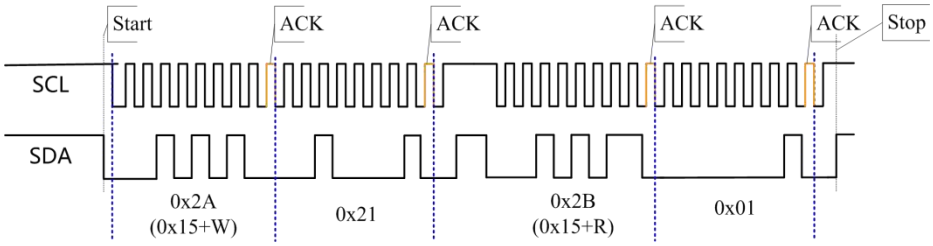


Figure 8. *Read a single byte from 0x21*

f. Read multiple bytes consecutively

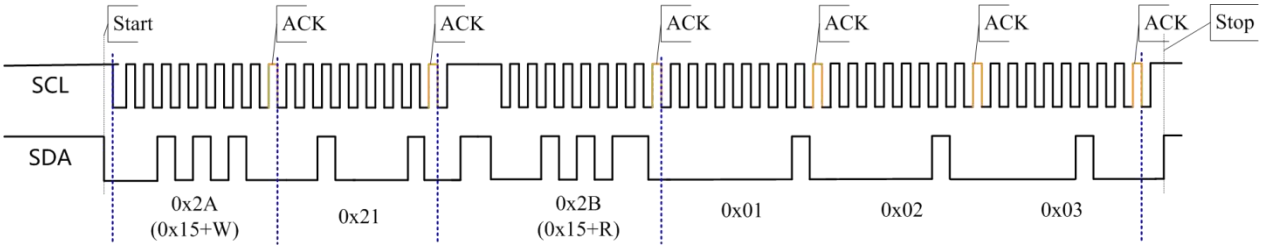


Figure 9. *Read 3 bytes from 0x21, 0x22, 0x23*

5. Application Design Specification

5.1 Power Supply Decoupling Capacitor

Generally, a 0.1uF and 10uF ceramic capacitor are connected in parallel at the VDD and VSS terminals of the chip to perform the function of decoupling and bypassing. The untwisting capacitor should be placed as close as possible to the chip to minimize the current loop area.

5.2 COMD Filter Capacitor

The filter capacitor uses an NPO/COG material capacitor with at least 10% accuracy. The capacitance value can be selected from 1nF to 5.6nF, and 1nF is generally selected. The specific optimum value is related to the corresponding body capacitance. The COMD filter capacitor must be placed close to the corresponding pin of the chip, and the trace between the chip and the chip should be as short as possible.

5.3 Waterproof Precautions

Do not have a large solid ground around the Sensor and its traces. For large areas of ground, it must be broken.

5.4 ESD Consideration

The design of the FPC will directly affect the effect of the ESD. At the time of design, the following must be noted:

- The FPC uses magnetic film as much as possible for full shielding, and the magnetic film must be grounded.
- The position where the FPC and Sensor are attached is as far as possible from the gap of the assembled mechanism to reduce the impact of ESD.
- Power access can be considered to increase TVS pipe to the ground to enhance ESD immunity.

5.5 Electromagnetic Interference Precautions

Sensor traces must be isolated from lines that may cause interference, such as power traces, audio lines, LCD drive lines, Bluetooth antennas, RF antennas, and more. In particular, when the TP adopts the full-fit design, it may be interfered by the LCD. In this case, the parameters of the TP need special debugging.

5.6 Ground Wire

The high-precision detection lines inside the touch chip are sensitive to the ground line. If possible, the user should use star ground to isolate the noise of other chips. At the same time, magnetic beads are inserted in the ground as much as possible to enhance the anti-interference ability.

If the star grounding is difficult to implement, the user should also try to separate the ground of the high current device from the trace of the touch chip.

6. Electrical Characteristics

Ambient temperature 25 ˚C，VDDA=3.3V.

Parameter	Min. value	Typical value	Max. value	Unit
Operating voltage	2.7	3.3	3.6	V
Operating temperature	-40	+25	+85	˚C
Storage temperature	-60	-	+150	˚C
Operating humidity	-	-	95	%
Power ripple	-	-	50	mV
Operating current (dynamic mode)	-	1.6	-	mA
Operating current (standby mode)	-	6.0	-	uA
Operating current (sleep mode)	-	1.0	-	uA

7. Product Packaging

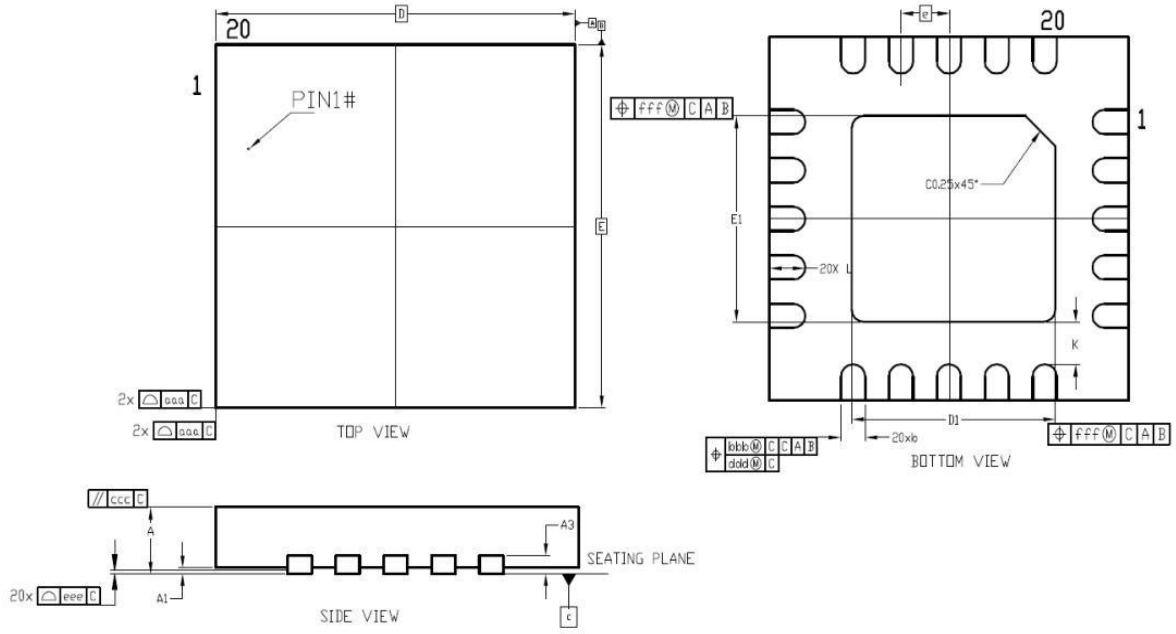
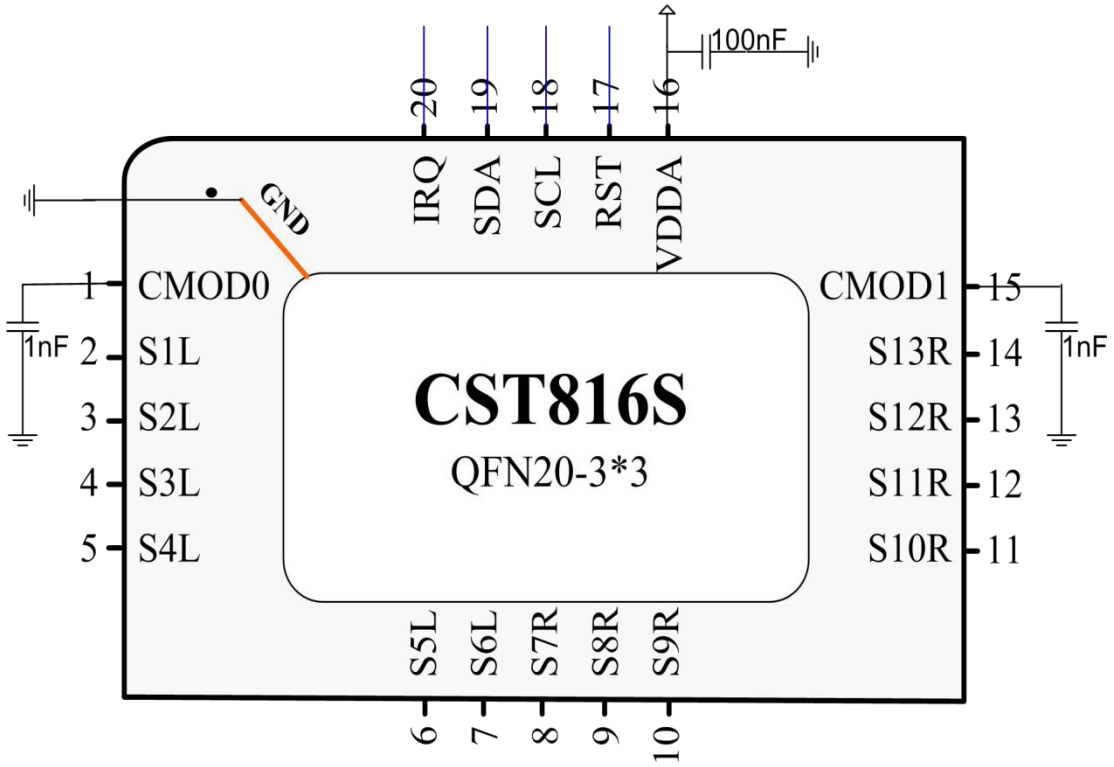


Figure 10 *QFN20 Outline Drawing*

DIM / SYMBOL	MIN.	NOM.	MAX.
A	0.50	0.55	0.60
A1	0	0.02	0.05
A3	–	0.152 REF	–
b	0.15	0.20	0.25
D		3.00BSC	
E		3.00BSC	
D2	1.60	1.70	1.80
E2	1.60	1.70	1.80
e		0.40BSC	
L	0.25	0.30	0.35
K	0.20	–	–
aaa		0.10	
bbb		0.07	
ccc		0.10	
ddd		0.05	
eee		0.08	
fff		0.10	

Figure 11 *QFN20 Outline Dimensions*

8. Reference Circuit



Revision History

Version	Revision history
V1.4	Modify Pin15 description
V1.3	Modify power consumption
V1.2	Add reference circuit
V1.1	Add electrical characteristics
V1.0	Initial version